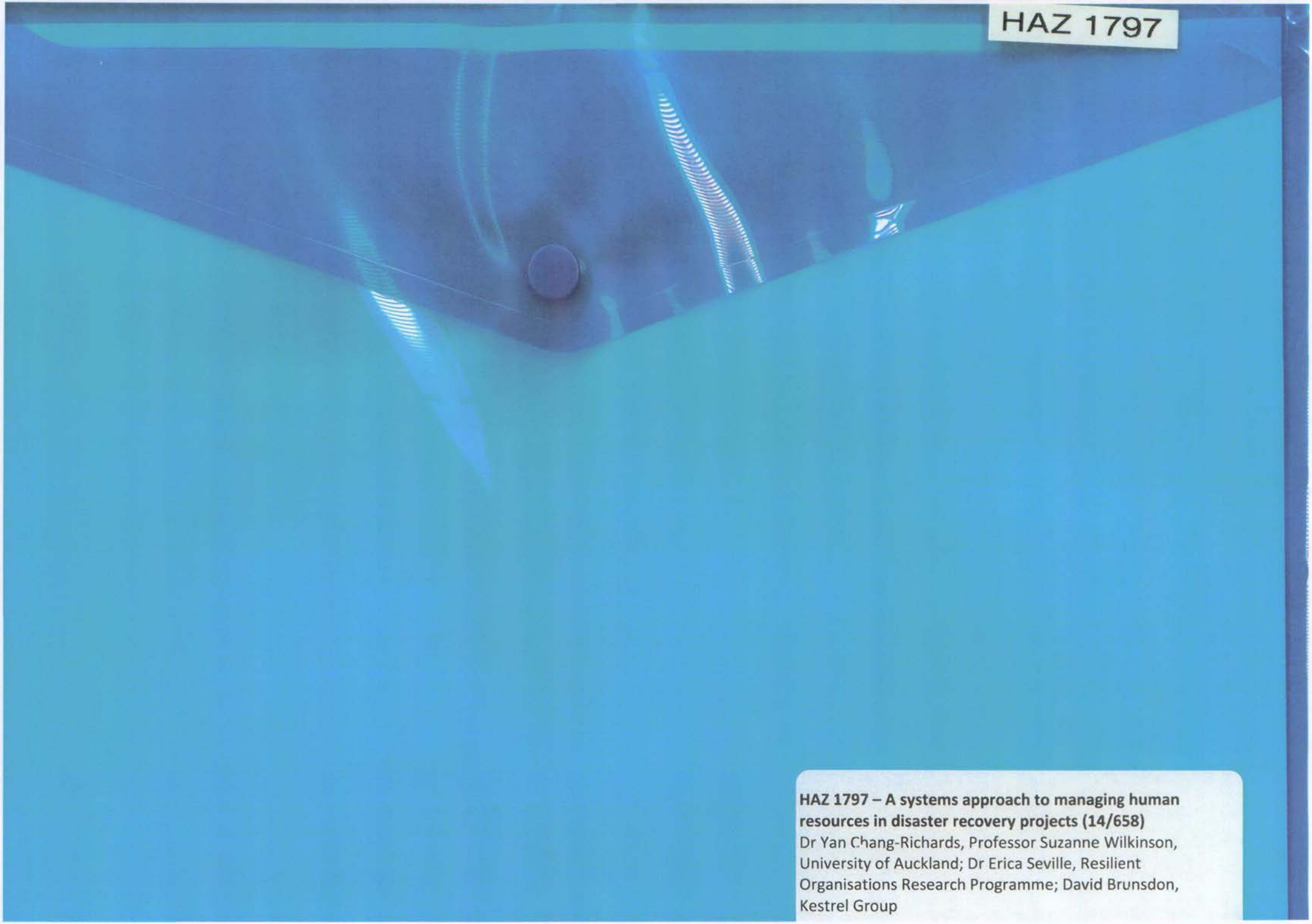

HAZ 1797 – A systems approach to managing human resources in disaster recovery projects (14/658)

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A systems approach to managing human resources in disaster recovery projects

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Abstract

Lack of construction resources and capacity has always presented difficult challenges to the construction industry following a major disaster. In the case of the Canterbury earthquakes that took place in 2010 and 2011 in Christchurch, New Zealand, a number of factors combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. Research findings show that the limited technical capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies. The study suggests that the design of policy instruments in managing human resources in Christchurch should be informed by a detailed understanding of the dynamics that mediate between policy objectives and outcomes over time. A systems approach should be applied to increase the efficiencies in resource management in the continued reconstruction.

Keywords: Systems dynamics, Human resources, Disaster reconstruction, Construction firms, Christchurch

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1. Introduction

The gradual shift in modern concept of 'building resilience' that has occurred over the past decade is having far-reaching implications for the construction industry who plays a pivotal role in disaster risk reduction and carrying out the post-disaster reconstruction tasks. In many countries, disaster recovery projects are given equal or even more priority over other development projects. Compared to conventional construction projects, disaster recovery construction projects are seen as requiring different management and delivery systems [1, 2]. In particular, disaster recovery construction projects following a large disaster tend to have resource challenges [3, 4] and capability issues [5].

When the Darfield earthquake struck Christchurch in 2010, the New Zealand construction industry was going through a recessional period of low activity caused by the 2008 global financial crisis. Many construction businesses had managed to come from the bust of economic cycle and aiming for a reviving opportunity in post-earthquake reconstruction [6]. Nevertheless, the shortage of skills is a recurrent problem in the New Zealand construction industry [7, 8]. And there was a limited pool of professionals in the country who had the experience of seismic assessment and design. The Canterbury region subsequently suffered a sequence of aftershocks. The earthquake of magnitude 6.3 on 22 February 2011 was the most severe, taking the lives of 185 people and causing buildings to collapse, further damage to infrastructure and widespread liquefaction [9]. High pressures of skills needs in undertaking the reconstruction following the earthquake events raised questions concerning how these skills needs can be met given the limited resource pool in New Zealand construction sector [10].

A number of factors such as the change of the building standards [11], insurance pay-out [12] and the decisions made by the Immigration New Zealand on Canterbury Skills Shortage List[1], combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study aims to identify the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. The study was undertaken longitudinally with 15 construction organizations over an extended period. Research findings from this study is hoped to provide insights into future disaster response with respect to addressing the problem of rebuilding capability.

[1] The Canterbury Skills Shortage List (CSSL) highlights occupations in shortage that are needed during the rebuild in Canterbury region (area of South Island), and facilitates the grant of temporary work visas for those occupations. For more information, see http://www.dol.govt.nz/immigration/knowledgebase/item/4551

2. The construction industry skills shortage

Having a skilled, well-trained and productive workforce has always been central to the construction sector's growth and success [13-15]. The literature reveals a number of factors which have impinged upon the construction skills problem (See Table 1).

Table 1: Contributing factors that shape the skills problem in the construction industry

Category	Contributing factors
1) Contextual factors	• Workforce aging and demographic downturn • Reduced numbers of young people entering the construction sector • Technological changes • A lack of investment in skills development
2) Structural factors	• Absence of human resource management strategies at a project level • A lack of partnership between sector employers and training bodies • Low levels of training • Increased casual self-employment and sub-contracting • Rigidity of skills divisions
3) Inherent factors in the construction industry	• Poor image of the industry • Poor perception of pay and workplace conditions • Working practices • Cyclical labour demand • Fragmented, transient and heterogeneous workforce structure • Fragmentation between training provision and employment

Context-specific factors included such as workforce aging and demographic downturn [13, 16], reduced numbers of young people entering the construction sector [17, 18], technological changes [19, 20] and a lack of investment in skills development [21]. Structural factors causing construction skills shortfall included the absence of human resource management strategies at a project level [22], a lack of partnership between sector employers and training bodies [23, 24], low levels of training [7, 25], increased casual self-employment and sub-contracting [26, 27] and the rigidity of skills divisions [28].

Adding to the list are factors in relation to the very nature of construction industry, including the poor image of the industry [29, 30], especially regarding the pay and workplace conditions [31]; working practices [32]; cyclical labour demand [33, 34] and often fragmented, transient

and heterogeneous workforce structure [35, 36]. Above all, Dainty et al. found that fragmentation that flows from the structure of training provision and employment is likely to narrow the industry's skills base and reduce innovation within the sector [17].

By comparing construction industry concerns 50 years apart, O'Donnell et al. concluded that how to attract and develop apprentices and graduates remained to be a major industry concern [37]. Chan and Dainty [14] suggested that genuine skills improvement requires a sustained effort to understand the practical realities of skills provision at a project level. Lobo and Wilkinson [7] advocated a focus on examining the efficiency of skill level in the existing workforce, rather than quantity of skills. In practice, there has been a shift of emphasis from top-down labour market policy measures towards demand-led skills development systems [35, Dainty et al., 38]. This shift, however, calls for employers and employees to play a more proactive role in formalising the industry's training and employment practices if improved performance and productivity is be achieved [39, 40].

There is a growing awareness of the importance of skills development among construction organisations as a means of improving productivity [35, 41, 42]. Research points towards a direct correlation between skills, productivity and employment. Enhancing labour productivity was proposed by Chan and Dainty [14] as one of the solutions to alleviating the problem of skilled labour shortages in construction. This view, however, emphasised the efficacy of skills utilisation and development, rather than increasing their supply. Other solutions to addressing skills crises have been used in the past, primarily in such areas as training [25, 31], multi-skilling [43], industry promotion [13, 14], employing migrant workers or outsourcing [28], and the development of new technologies and construction techniques [44]. However, as Dainty et al, suggested such measures are difficult to sustain unless backed by a bespoke regional labour market approach [17, 45].

3. Resource issues faced by construction organisations post-earthquake in Christchurch

Past disaster events have shown that in the aftermath of a major disaster where the operational environment is often uncertain, complex and dynamic, the "business as usual" way of managing resources may not be fully applicable [46, 47]. In a post-disaster environment, there is strong pressure to act quickly to get back to normal [48]. Under the pressure of limited time, the need to replace lost housing, building and infrastructure facilities often generates a demand surge for labour [49, 50].

According to Dainty et al. [51], workforce planning models need to take account of a wide range of factors determining both labour supply and demand. However, the complexity of the post-earthquake situation has rendered accurate forecasting of skills needs extremely difficult. Variations in the size, speed and scope of reconstruction had a marked effect on the employment practice which further influenced skills demand [52]. In the case of New Zealand,

despite a relatively brief hiatus created by the global financial crisis, significant skills shortages have re-emerged from the earthquakes. The construction sector has moved from bust to boom and the employment situation in construction has dramatically changed [53].

Construction organisations, largely being labour-intensive, are more influenced by human resource effects. Following the 2010/11 earthquakes, construction organisations in Christchurch experienced major resource shortages for both post-quake damage emergency response and reconstruction stages [54]. Ongoing aftershocks caused structural and land inspection professionals to be constantly diverted from existing jobs to new damage [55, 56]. A questionnaire survey commissioned by the Resilient Organisations between October 2011 and January 2012 revealed that resource pressures experienced by the construction organisations in Canterbury region were primarily from human resources associated with structural, architectural and land issues. And the three most frequently reported 'problematic' human resources were: structural engineers, geotechnical engineers, and draughtsperson [54].

A follow-up survey in 2013 showed that as the reconstruction progressed, many construction organisations started encountering difficulty in finding suitable project management expertise such as site engineers, project managers and quantity surveyors [57]. Some engineering consultancies have reported ongoing issues with sourcing workers of high skill levels [53]. Since the September 2010 earthquake, young engineers and mature project management skills from Europe continue to be the largest inbound demographic group involved with the rebuild in Christchurch [56, 58]. At the same time, there has been an inflationary impact which flows through to higher property rents, and makes attracting tradespeople from other parts of New Zealand harder [59].

Against this backdrop, this research attempts to investigate the dynamic factors that influence the resourcing behaviours of construction organisations operating on post-earthquake projects in Christchurch. By capturing perspectives from construction organisations, this study provides an understanding of how companies are responding to a looming skills and labour shortage for the Canterbury rebuild and how their resourcing approaches might affect the environment where they operate. The research methods used, the findings from this research along with a discussion are presented in the remaining sections. This paper concludes by reflecting on the implications of research findings for future studies.

4. Research Methods

4.1 Case study method

A case study method was adopted for this research due to its theory-building nature [60, 61]. As proposed by Yin [62], the case study design develops an empirical approach to research of a contemporary phenomenon within its own context. Longitudinal case studies of construction

organisations can provide insights into how hiring strategies across the construction industry and their strategies for workforce development will change as the landscape of Christchurch changes. The selection of case study organizations was based on criteria such as: the type of organization, size2, business characteristics, and involvement in the earthquake recovery process.

The key strategy used for selecting the sample was that all organisations would come from a spectrum of areas of the New Zealand construction industry. The case study sample was selected from the New Zealand Construction Industry Council (NZCIC) membership database. Sample organisations were all based and operated in Christchurch and registered with regional industry bodies under the umbrella of NZCIC. In December 2012, 15 case study organisations were selected to participate in the research. The chosen case studies collectively provided a reasonable overview of current experience with regard to the resourcing of skills for building activities [57].

In April 2014, the researchers conducted a second series of case studies with previously selected organisations. The focus of the second case studies was to examine the dynamics that influence their experiences of resourcing in Canterbury and changed business strategies since. Of 15 organisations, 10 participated in the second case studies. The reasons for the other 5 organisations not being able to participate included unavailability at the time of the case studies and absence from Christchurch operations. 3 additional organisations took part in the case studies. A total of 16 interviews were undertaken across 13 organisations in Christchurch in April 2014 (See Table 2).

Table 2: Description of organisations used for case study data collection

Types of construction organisations	Characteristics
2 Engineering consultancies	1 large size and 1 medium size (E1 and E2)
7 Contractors/builders	3 large civil contractors, 2 subcontractors, 1 home builder, 1 large construction company (C1-C7)
2 Building supplies companies	2 large concrete product manufacturers (M1 and M2)
2 Project Management Offices	Horizontal infrastructure rebuild & EQC's residential repairs (P1 and P2)

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520). The interview records within case studies were recorded, transcribed, coded, and further analysed using NVivo 9 qualitative data analysis software. NVivo 9 coding comparison of queries allowed for

[2] The size of the organization was pre-defined in the survey in terms of the number of employees. A large organization has more than 100 employees; a medium sized organization has more than 50 but less than 100 employees; a small organization has 50 or fewer employees; and a micro-sized organization has less than 10 employees.

similar comments and suggestions being synthesised under common themes. A case study report that relates to individual organisations was sent back to interviewees for data validation.

4.2 Qualitative systems dynamics

System dynamics is a method to enhance learning in complex systems [63, p4]. Based on the findings from the interviews, further analysis was conducted by using causal loop diagrams to describe the dynamics and how they have influenced the behaviours of case study construction organisations in resourcing for disaster recovery. This paper only reports the qualitative system dynamics, often referred to as system thinking. The quantitative system dynamics which is based on quantified simulation will be reported in future published works.

The System Dynamic modelling approach was first introduced by Jay Forrest [64]. It offers a rigorous method for the description, exploration and analysis of complex organisational system comprised of organisational elements and the environmental influence. In the security world, systems thinking is a powerful tool for analysing and interpreting risks, and for developing control or intervention options [65]. While systems methods are not yet widely used in disaster management, experience in related disciplines, such as earthquake mitigation decision making [66] and planning for disaster recovery [67], indicates that they will be an increasingly useful tool for addressing complex issues in the aftermath of a large disaster.

We approached the analysis with the intent of exploring the critical dynamics of organisational resourcing process following the Canterbury earthquakes. By aggregating the findings from the case studies, the issues and processes that were relevant across a range of case study organisations can be identified. Those dynamics and how they have influenced the resourcing behaviours of case study organisations are presented in the causal loop by using Vensim modelling technique. In the following section, the generalised thematic findings will be presented and discussed, with illustration of dynamics identified in case studies.

5. Results and Discussion

5.1 Changed business operational model

Case studies in April 2014 show that there is a general trend for the workforce that were involved in the Canterbury earthquake reconstruction to move away from disaster recovery projects, as shown in Figure 1. In particular, the medium to large-sized infrastructure contractors were experiencing some human resourcing pressure as they have lost expertise to the new subdivision sectors. Case study organisations reported a renewed interest in moving

back to their business-as-usual market, driven by the development of new subdivisions in Canterbury and New Zealand Government's housing and transport commitments.

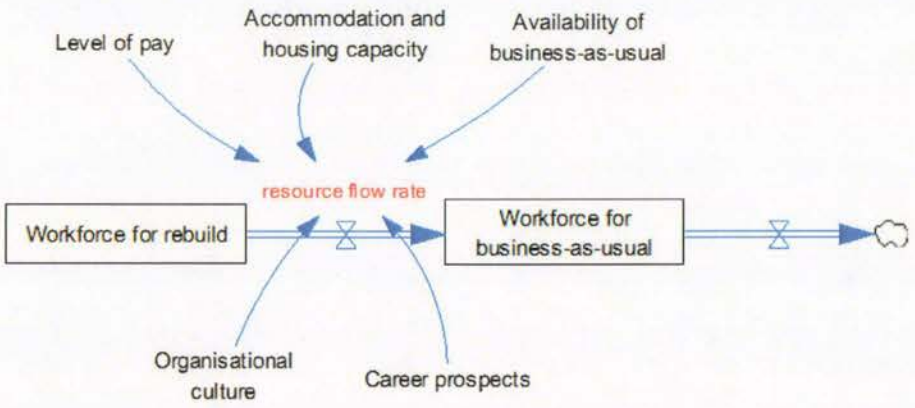

Figure 1: Dynamic factors that influence workforce flows between sectors

Lifestyle and cost factors are the dominant determinants of workforce migration patterns [68]. Such labour demographic-related factors play a major role in a workforce's decision-making and changing directions of resource flows [35, 36]. Case study organisations reported that the phenomenon of moving away from reconstruction to other sectors was most prominent among those who entered the reconstruction sector following the earthquakes, including overseas immigrants and those entrant people from outside Canterbury. Anecdotally, it appears that some new entrants tended to pursue better career opportunities in other places with their Christchurch reconstruction experience. This tendency, however, will likely be moderated somewhat by rebuild-related organisations providing needed support with organisational culture and certainty of career development playing a central role [59].

Small-to-medium sized businesses have seen work levels in non-reconstruction sectors rise over 2013 and were optimistic about development prospects in buildings and infrastructure industry. Large engineering and construction companies, however, remained to be focused on the reconstruction projects, in the meantime, dealing with high rate of staff turnover and the challenge of staff retention. As reported by interviewee C6,

> *'This year (2014), we start seeing a significant resource pinch on our external subcontractors. For instance, we sent 100 invitations for tender, only a third got back to us as those subcontractors are busy and their resources got tied up. It will be difficult for us to find compliant tenders and keep us competitive.'*

General changes in the demand landscape for different sectors of reconstruction and new developments were also affecting business operational behaviours. For example, as shown in Figure 1, the change in demand and higher rates in other places meant that those who established local operations in Christchurch and secured reconstruction projects following the earthquakes had now moved back to housing and building markets in Auckland or Wellington. As one interviewee E2 put it,

> '*As the Auckland market picks up whereas the Christchurch market raised but not super busy, some of those companies had pulled out their presence from Christchurch as they can survive now in other markets.*'

This finding bears resemblance to the situation following the 2009 Victorian 'Black Saturday' bushfires [69] and the situation in Queensland' flood-affected areas in Australia [70]. Comerio [71] stressed that with prospects of economic development and growth pressures in other areas, the impact of their competing demands for construction skills should not be underestimated. Some case study organisations were concerned that escalating accommodation costs may discourage some construction workers from outside Christchurch. Case study organisations highlighted the importance of Government's investment in temporary housing for additional out-of-town workers as a strategy to retain these resources for the reconstruction projects.

5.2 Shifted focus from recruitment to retention and up-skilling

The skills issue in terms of resource quality is one of the most reported problems – so to a certain extent was viewed by small-to-medium-sized organisations as their top concern. This is not surprising as Mahamid [72] argued that a lack of labour experience is among the top-five factors negatively affecting construction business performance. A range of terms, such as 'lack of competency', 'lack of experience', 'low level of skill', 'absence of work ethics' and 'incorrect work attitude', were used by studied employers as a reason, in part, to explain their reluctance to recruit young workforce which does not seem to have a sufficient skills set for work elements of the reconstruction. A continuing low unemployment rate (3.2 per cent for the December quarter of 2013) in Christchurch will make sourcing appropriate labour more difficult [73]. This is an issue that may become more prominent once more construction works get underway.

Prolonged lead time from planning for forward work programmes to their eventualisation was another key resourcing barrier identified by case study organisations. This is also intertwined with an inconsistent work flow issue. For construction businesses, there is added instability and uncertainty in planning, particularly human resources which causes waste and increased costs [74]. According to Hua [75], firms are more likely to invest in physical assets if they expect demand to remain high and long-term economic conditions to be good. If the economic prospects are unfavourable, they tend to be conservative about their investment due to potential fiscal risks.

Some interviewees noted that slow reconstruction of commercial buildings was capping the rate of the cash flow and the rate and number of people coming in. This is in line with the findings of Ng et al. [76] which emphasised that private construction investment is more sensitive to general economic conditions, creating uncertainty in the future levels of construction workloads. Contractors and suppliers also reported some of their spare capacity was a result of the inconsistent workflows, affecting their workforce demand. One contractor C2 in the infrastructure rebuild sector shared its particular concern:

> *'In 2014, we are particularly concerned that the new subdivisions as a result of the earthquakes and the vertical rebuild will be sucking a lot of our subcontractors. What's gonna happen next might be they are going to suck our own staff, our engineers and project managers.'*

Case studies opened up a discussion about a focus in 2014 for skills retention and up-skilling. Strategies already implemented included changing from annual to quarterly reviews, touching base on a regular basis, increasing the focus on staff development and staying competitive in the market in terms of pay rates. It appears that the high turnover rate among newly recruited workforce undermines the skills retention and in-house up-skilling strategies adopted by case study organisations. As one interviewee (C4) highlighted:

> *'Finding the right people who are willing, able and motivated has been problematic. The more frustrating is you take on new people and spend a lot of time and money training them up. Once they have gained that experience, they move to another company. This is certainly not good for apprenticeship with fewer companies willing to invest in youth training.'*

This is not supervising given that the New Zealand construction industry has a labour turnover rate of over 20 per cent on average [77]. It in turn increases recruitment and training costs. With the higher turnover rate, construction business owners will need to secure key people who maintain the core competency of the business [26, 27]. The need to effectively 'self-insure' for human resource loss, and escalating competing demand from the business-as-usual sectors, will potentially lead some businesses to rethink their resourcing strategies.

5.3 Changing dynamics and relative nature of hiring

Some construction businesses of small-to-medium size indicated that it may be uneconomic to hire wage workers, partly due to quick turnover and some of the work ethics issues of their recruits. This is similar to the findings in the European construction sectors, which lead to the increased sub-contracting [24]. One studied organisation C5 reported that they had to re-assessed their business development strategies and opted to re-structure the company by using sub-contractors to reduce operational costs. The interviewee acknowledged that this change of staffing approach had increased its revenue in terms of improved productivity and work efficiency.

As mentioned above, the change in business resourcing behaviour brought about by staffing experience through a rapid growth cycle post-earthquake will in turn affect the in-take of new staff and buy-in of industry training programmes. If a growing number of construction businesses choose to cancel or reduce the pipeline of their recruitment, it is less likely that a skilled workforce will be delivered to Christchurch in the long term. Figure 2 shows that three critical dynamics – staff turnover rate, competency of hired workforce and business operational capacity – play out together to have an impact on company's ability to work efficiently. The more difficulties a company finds in achieving work efficiency, the lower the productivity [78, 79]. This will in turn make hiring less desirable and less affordable, causing more businesses not to hire.

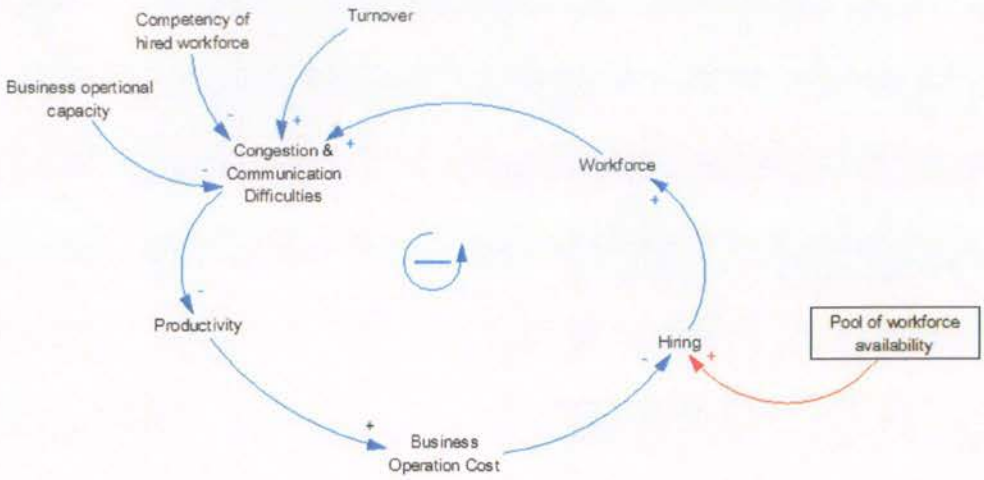

Figure 2: Changing business dynamics and relative nature of hiring

As mentioned earlier, the issues of rapid turnover and lack of competency are particularly found among the youth workforce. The implications from the dynamic model in Figure 2 are that the trend of recruitment is now moving to more temporary contracts on short-to-medium terms. However, there are economic and social consequences of the industry labour market in not delivering the supply of workforce at a rate to meet the required demand by employers [23, 80, 81]. In the meantime, construction organisations were understandably concerned about the risks of overcapacity in Christchurch. In particular, the risk of influx of a less experienced labour force and questions over the training buy-in from the industry were of concern.

6. Conclusion

The nature of reconstruction following a large disaster is often fraught with uncertainties, leading to pronounced fluctuations in its demand [50]. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in

relation to the employment demand and supply in the Canterbury recovery from 2010/11 earthquakes. In particular, the limited engineering and project management capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies.

It is difficult to separate pre-existing contributing factors that influence construction skills problems from those of the effects of reconstruction demands. Comerio suggested that disasters do not completely change pre-disaster economic conditions; instead they simply magnify trends or conditions in place before disaster strikes [82]. As shown in this research, the Canterbury earthquakes and the reconstruction demand had brought about fluctuations in the economic cycle. However, the pre-event issues such as the high staff turnover rate, competency of hired workforce, organisational culture and company retention ability still played a dominant role impinging upon the practice of human resource management of construction organisations in disaster recovery projects.

The dynamic models developed in this research provide visual directions for decision makers and construction organisations to implement supporting measures for improved capacity and capability for ongoing reconstruction. The study offers an improved understanding of disaster effects on the construction skills needs and of changes in the skills requirements post-event, enabling better future industry preparedness for a similar event. It is suggested that the design of policy instruments in managing human resources in Christchurch should be informed by a continued investigation of the dynamics that mediate between policy objectives and outcomes over time.

More than that, the study makes the case for a new approach to looking at resourcing problems following a major disaster. Those methods that are based on neoclassical economics and deal mostly with the larger economy tend to consider resource availability as a consequential result of market processes. The systems approach used in this research demonstrates that for enhancing the reconstruction capability in complex post-disaster settings, an organisational perspective should be considered in the decision making, which explains both internal resourcing dynamics and the linkages between construction organisations and the wider recovery environment.

7. Acknowledgement

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A systems approach to managing human resources in disaster recovery projects

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Abstract

Lack of construction resources and capacity has always presented difficult challenges to the construction industry following a major disaster. In the case of the Canterbury earthquakes that took place in 2010 and 2011 in Christchurch, New Zealand, a number of factors combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. Research findings show that the limited technical capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies. The study suggests that the design of policy instruments in managing human resources in Christchurch should be informed by a detailed understanding of the dynamics that mediate between policy objectives and outcomes over time. A systems approach should be applied to increase the efficiencies in resource management in the continued reconstruction.

Keywords: Systems dynamics, Human resources, Disaster reconstruction, Construction firms, Christchurch

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1. Introduction

The gradual shift in modern concept of 'building resilience' that has occurred over the past decade is having far-reaching implications for the construction industry who plays a pivotal role in disaster risk reduction and carrying out the post-disaster reconstruction tasks. In many countries, disaster recovery projects are given equal or even more priority over other development projects. Compared to conventional construction projects, disaster recovery construction projects are seen as requiring different management and delivery systems [1, 2]. In particular, disaster recovery construction projects following a large disaster tend to have resource challenges [3, 4] and capability issues [5].

When the Darfield earthquake struck Christchurch in 2010, the New Zealand construction industry was going through a recessional period of low activity caused by the 2008 global financial crisis. Many construction businesses had managed to come from the bust of economic cycle and aiming for a reviving opportunity in post-earthquake reconstruction [6]. Nevertheless, the shortage of skills is a recurrent problem in the New Zealand construction industry [7, 8]. And there was a limited pool of professionals in the country who had the experience of seismic assessment and design. The Canterbury region subsequently suffered a sequence of aftershocks. The earthquake of magnitude 6.3 on 22 February 2011 was the most severe, taking the lives of 185 people and causing buildings to collapse, further damage to infrastructure and widespread liquefaction [9]. High pressures of skills needs in undertaking the reconstruction following the earthquake events raised questions concerning how these skills needs can be met given the limited resource pool in New Zealand construction sector [10].

A number of factors such as the change of the building standards [11], insurance pay-out [12] and the decisions made by the Immigration New Zealand on Canterbury Skills Shortage List[1], combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study aims to identify the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. The study was undertaken longitudinally with 15 construction organizations over an extended period. Research findings from this study is hoped to provide insights into future disaster response with respect to addressing the problem of rebuilding capability.

[1] The Canterbury Skills Shortage List (CSSL) highlights occupations in shortage that are needed during the rebuild in Canterbury region (area of South Island), and facilitates the grant of temporary work visas for those occupations. For more information, see http://www.dol.govt.nz/immigration/knowledgebase/item/4551

2. The construction industry skills shortage

Having a skilled, well-trained and productive workforce has always been central to the construction sector's growth and success [13-15]. The literature reveals a number of factors which have impinged upon the construction skills problem (See Table 1).

Table 1: Contributing factors that shape the skills problem in the construction industry

Category	Contributing factors
1) Contextual factors	• Workforce aging and demographic downturn • Reduced numbers of young people entering the construction sector • Technological changes • A lack of investment in skills development
2) Structural factors	• Absence of human resource management strategies at a project level • A lack of partnership between sector employers and training bodies • Low levels of training • Increased casual self-employment and sub-contracting • Rigidity of skills divisions
3) Inherent factors in the construction industry	• Poor image of the industry • Poor perception of pay and workplace conditions • Working practices • Cyclical labour demand • Fragmented, transient and heterogeneous workforce structure • Fragmentation between training provision and employment

Context-specific factors included such as workforce aging and demographic downturn [13, 16], reduced numbers of young people entering the construction sector [17, 18], technological changes [19, 20] and a lack of investment in skills development [21]. Structural factors causing construction skills shortfall included the absence of human resource management strategies at a project level [22], a lack of partnership between sector employers and training bodies [23, 24], low levels of training [7, 25], increased casual self-employment and sub-contracting [26, 27] and the rigidity of skills divisions [28].

Adding to the list are factors in relation to the very nature of construction industry, including the poor image of the industry [29, 30], especially regarding the pay and workplace conditions [31]; working practices [32]; cyclical labour demand [33, 34] and often fragmented, transient

and heterogeneous workforce structure [35, 36]. Above all, Dainty et al. found that fragmentation that flows from the structure of training provision and employment is likely to narrow the industry's skills base and reduce innovation within the sector [17].

By comparing construction industry concerns 50 years apart, O'Donnell et al. concluded that how to attract and develop apprentices and graduates remained to be a major industry concern [37]. Chan and Dainty [14] suggested that genuine skills improvement requires a sustained effort to understand the practical realities of skills provision at a project level. Lobo and Wilkinson [7] advocated a focus on examining the efficiency of skill level in the existing workforce, rather than quantity of skills. In practice, there has been a shift of emphasis from top-down labour market policy measures towards demand-led skills development systems [35, Dainty et al., 38]. This shift, however, calls for employers and employees to play a more proactive role in formalising the industry's training and employment practices if improved performance and productivity is be achieved [39, 40].

There is a growing awareness of the importance of skills development among construction organisations as a means of improving productivity [35, 41, 42]. Research points towards a direct correlation between skills, productivity and employment. Enhancing labour productivity was proposed by Chan and Dainty [14] as one of the solutions to alleviating the problem of skilled labour shortages in construction. This view, however, emphasised the efficacy of skills utilisation and development, rather than increasing their supply. Other solutions to addressing skills crises have been used in the past, primarily in such areas as training [25, 31], multi-skilling [43], industry promotion [13, 14], employing migrant workers or outsourcing [28], and the development of new technologies and construction techniques [44]. However, as Dainty et al, suggested such measures are difficult to sustain unless backed by a bespoke regional labour market approach [17, 45].

3. Resource issues faced by construction organisations post-earthquake in Christchurch

Past disaster events have shown that in the aftermath of a major disaster where the operational environment is often uncertain, complex and dynamic, the "business as usual" way of managing resources may not be fully applicable [46, 47]. In a post-disaster environment, there is strong pressure to act quickly to get back to normal [48]. Under the pressure of limited time, the need to replace lost housing, building and infrastructure facilities often generates a demand surge for labour [49, 50].

According to Dainty et al. [51], workforce planning models need to take account of a wide range of factors determining both labour supply and demand. However, the complexity of the post-earthquake situation has rendered accurate forecasting of skills needs extremely difficult. Variations in the size, speed and scope of reconstruction had a marked effect on the employment practice which further influenced skills demand [52]. In the case of New Zealand,

despite a relatively brief hiatus created by the global financial crisis, significant skills shortages have re-emerged from the earthquakes. The construction sector has moved from bust to boom and the employment situation in construction has dramatically changed [53].

Construction organisations, largely being labour-intensive, are more influenced by human resource effects. Following the 2010/11 earthquakes, construction organisations in Christchurch experienced major resource shortages for both post-quake damage emergency response and reconstruction stages [54]. Ongoing aftershocks caused structural and land inspection professionals to be constantly diverted from existing jobs to new damage [55, 56]. A questionnaire survey commissioned by the Resilient Organisations between October 2011 and January 2012 revealed that resource pressures experienced by the construction organisations in Canterbury region were primarily from human resources associated with structural, architectural and land issues. And the three most frequently reported 'problematic' human resources were: structural engineers, geotechnical engineers, and draughtsperson [54].

A follow-up survey in 2013 showed that as the reconstruction progressed, many construction organisations started encountering difficulty in finding suitable project management expertise such as site engineers, project managers and quantity surveyors [57]. Some engineering consultancies have reported ongoing issues with sourcing workers of high skill levels [53]. Since the September 2010 earthquake, young engineers and mature project management skills from Europe continue to be the largest inbound demographic group involved with the rebuild in Christchurch [56, 58]. At the same time, there has been an inflationary impact which flows through to higher property rents, and makes attracting tradespeople from other parts of New Zealand harder [59].

Against this backdrop, this research attempts to investigate the dynamic factors that influence the resourcing behaviours of construction organisations operating on post-earthquake projects in Christchurch. By capturing perspectives from construction organisations, this study provides an understanding of how companies are responding to a looming skills and labour shortage for the Canterbury rebuild and how their resourcing approaches might affect the environment where they operate. The research methods used, the findings from this research along with a discussion are presented in the remaining sections. This paper concludes by reflecting on the implications of research findings for future studies.

4. Research Methods

4.1 Case study method

A case study method was adopted for this research due to its theory-building nature [60, 61]. As proposed by Yin [62], the case study design develops an empirical approach to research of a contemporary phenomenon within its own context. Longitudinal case studies of construction

organisations can provide insights into how hiring strategies across the construction industry and their strategies for workforce development will change as the landscape of Christchurch changes. The selection of case study organizations was based on criteria such as: the type of organization, size2, business characteristics, and involvement in the earthquake recovery process.

The key strategy used for selecting the sample was that all organisations would come from a spectrum of areas of the New Zealand construction industry. The case study sample was selected from the New Zealand Construction Industry Council (NZCIC) membership database. Sample organisations were all based and operated in Christchurch and registered with regional industry bodies under the umbrella of NZCIC. In December 2012, 15 case study organisations were selected to participate in the research. The chosen case studies collectively provided a reasonable overview of current experience with regard to the resourcing of skills for building activities [57].

In April 2014, the researchers conducted a second series of case studies with previously selected organisations. The focus of the second case studies was to examine the dynamics that influence their experiences of resourcing in Canterbury and changed business strategies since. Of 15 organisations, 10 participated in the second case studies. The reasons for the other 5 organisations not being able to participate included unavailability at the time of the case studies and absence from Christchurch operations. 3 additional organisations took part in the case studies. A total of 16 interviews were undertaken across 13 organisations in Christchurch in April 2014 (See Table 2).

Table 2: Description of organisations used for case study data collection

Types of construction organisations	Characteristics
2 Engineering consultancies	1 large size and 1 medium size (E1 and E2)
7 Contractors/builders	3 large civil contractors, 2 subcontractors, 1 home builder, 1 large construction company (C1-C7)
2 Building supplies companies	2 large concrete product manufacturers (M1 and M2)
2 Project Management Offices	Horizontal infrastructure rebuild & EQC's residential repairs (P1 and P2)

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520). The interview records within case studies were recorded, transcribed, coded, and further analysed using NVivo 9 qualitative data analysis software. NVivo 9 coding comparison of queries allowed for

[2] The size of the organization was pre-defined in the survey in terms of the number of employees. A large organization has more than 100 employees; a medium sized organization has more than 50 but less than 100 employees; a small organization has 50 or fewer employees; and a micro-sized organization has less than 10 employees.

similar comments and suggestions being synthesised under common themes. A case study report that relates to individual organisations was sent back to interviewees for data validation.

4.2 Qualitative systems dynamics

System dynamics is a method to enhance learning in complex systems [63, p4]. Based on the findings from the interviews, further analysis was conducted by using causal loop diagrams to describe the dynamics and how they have influenced the behaviours of case study construction organisations in resourcing for disaster recovery. This paper only reports the qualitative system dynamics, often referred to as system thinking. The quantitative system dynamics which is based on quantified simulation will be reported in future published works.

The System Dynamic modelling approach was first introduced by Jay Forrest [64]. It offers a rigorous method for the description, exploration and analysis of complex organisational system comprised of organisational elements and the environmental influence. In the security world, systems thinking is a powerful tool for analysing and interpreting risks, and for developing control or intervention options [65]. While systems methods are not yet widely used in disaster management, experience in related disciplines, such as earthquake mitigation decision making [66] and planning for disaster recovery [67], indicates that they will be an increasingly useful tool for addressing complex issues in the aftermath of a large disaster.

We approached the analysis with the intent of exploring the critical dynamics of organisational resourcing process following the Canterbury earthquakes. By aggregating the findings from the case studies, the issues and processes that were relevant across a range of case study organisations can be identified. Those dynamics and how they have influenced the resourcing behaviours of case study organisations are presented in the causal loop by using Vensim modelling technique. In the following section, the generalised thematic findings will be presented and discussed, with illustration of dynamics identified in case studies.

5. Results and Discussion

5.1 Changed business operational model

Case studies in April 2014 show that there is a general trend for the workforce that were involved in the Canterbury earthquake reconstruction to move away from disaster recovery projects, as shown in Figure 1. In particular, the medium to large-sized infrastructure contractors were experiencing some human resourcing pressure as they have lost expertise to the new subdivision sectors. Case study organisations reported a renewed interest in moving

back to their business-as-usual market, driven by the development of new subdivisions in Canterbury and New Zealand Government's housing and transport commitments.

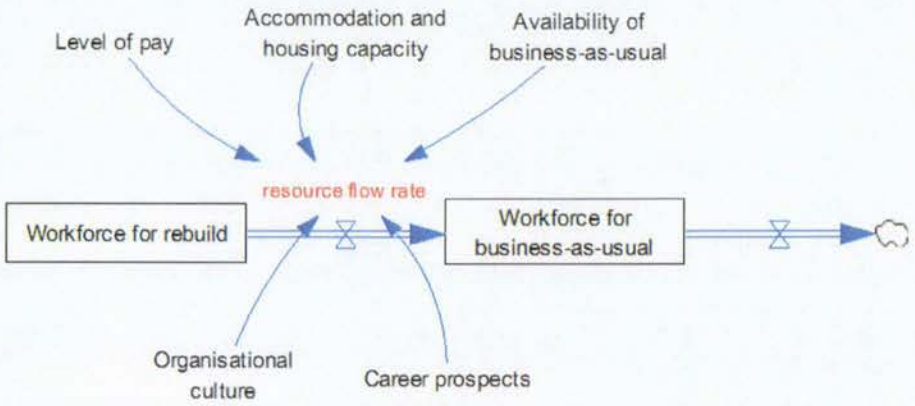

Figure 1: Dynamic factors that influence workforce flows between sectors

Lifestyle and cost factors are the dominant determinants of workforce migration patterns [68]. Such labour demographic-related factors play a major role in a workforce's decision-making and changing directions of resource flows [35, 36]. Case study organisations reported that the phenomenon of moving away from reconstruction to other sectors was most prominent among those who entered the reconstruction sector following the earthquakes, including overseas immigrants and those entrant people from outside Canterbury. Anecdotally, it appears that some new entrants tended to pursue better career opportunities in other places with their Christchurch reconstruction experience. This tendency, however, will likely be moderated somewhat by rebuild-related organisations providing needed support with organisational culture and certainty of career development playing a central role [59].

Small-to-medium sized businesses have seen work levels in non-reconstruction sectors rise over 2013 and were optimistic about development prospects in buildings and infrastructure industry. Large engineering and construction companies, however, remained to be focused on the reconstruction projects, in the meantime, dealing with high rate of staff turnover and the challenge of staff retention. As reported by interviewee C6,

> *'This year (2014), we start seeing a significant resource pinch on our external subcontractors. For instance, we sent 100 invitations for tender, only a third got back to us as those subcontractors are busy and their resources got tied up. It will be difficult for us to find compliant tenders and keep us competitive.'*

General changes in the demand landscape for different sectors of reconstruction and new developments were also affecting business operational behaviours. For example, as shown in Figure 1, the change in demand and higher rates in other places meant that those who established local operations in Christchurch and secured reconstruction projects following the earthquakes had now moved back to housing and building markets in Auckland or Wellington. As one interviewee E2 put it,

> '*As the Auckland market picks up whereas the Christchurch market raised but not super busy, some of those companies had pulled out their presence from Christchurch as they can survive now in other markets.*'

This finding bears resemblance to the situation following the 2009 Victorian 'Black Saturday' bushfires [69] and the situation in Queensland' flood-affected areas in Australia [70]. Comerio [71] stressed that with prospects of economic development and growth pressures in other areas, the impact of their competing demands for construction skills should not be underestimated. Some case study organisations were concerned that escalating accommodation costs may discourage some construction workers from outside Christchurch. Case study organisations highlighted the importance of Government's investment in temporary housing for additional out-of-town workers as a strategy to retain these resources for the reconstruction projects.

5.2 Shifted focus from recruitment to retention and up-skilling

The skills issue in terms of resource quality is one of the most reported problems – so to a certain extent was viewed by small-to-medium-sized organisations as their top concern. This is not surprising as Mahamid [72] argued that a lack of labour experience is among the top-five factors negatively affecting construction business performance. A range of terms, such as 'lack of competency', 'lack of experience', 'low level of skill', 'absence of work ethics' and 'incorrect work attitude', were used by studied employers as a reason, in part, to explain their reluctance to recruit young workforce which does not seem to have a sufficient skills set for work elements of the reconstruction. A continuing low unemployment rate (3.2 per cent for the December quarter of 2013) in Christchurch will make sourcing appropriate labour more difficult [73]. This is an issue that may become more prominent once more construction works get underway.

Prolonged lead time from planning for forward work programmes to their eventualisation was another key resourcing barrier identified by case study organisations. This is also intertwined with an inconsistent work flow issue. For construction businesses, there is added instability and uncertainty in planning, particularly human resources which causes waste and increased costs [74]. According to Hua [75], firms are more likely to invest in physical assets if they expect demand to remain high and long-term economic conditions to be good. If the economic prospects are unfavourable, they tend to be conservative about their investment due to potential fiscal risks.

Some interviewees noted that slow reconstruction of commercial buildings was capping the rate of the cash flow and the rate and number of people coming in. This is in line with the findings of Ng et al. [76] which emphasised that private construction investment is more sensitive to general economic conditions, creating uncertainty in the future levels of construction workloads. Contractors and suppliers also reported some of their spare capacity was a result of the inconsistent workflows, affecting their workforce demand. One contractor C2 in the infrastructure rebuild sector shared its particular concern:

> *'In 2014, we are particularly concerned that the new subdivisions as a result of the earthquakes and the vertical rebuild will be sucking a lot of our subcontractors. What's gonna happen next might be they are going to suck our own staff, our engineers and project managers.'*

Case studies opened up a discussion about a focus in 2014 for skills retention and up-skilling. Strategies already implemented included changing from annual to quarterly reviews, touching base on a regular basis, increasing the focus on staff development and staying competitive in the market in terms of pay rates. It appears that the high turnover rate among newly recruited workforce undermines the skills retention and in-house up-skilling strategies adopted by case study organisations. As one interviewee (C4) highlighted:

> *'Finding the right people who are willing, able and motivated has been problematic. The more frustrating is you take on new people and spend a lot of time and money training them up. Once they have gained that experience, they move to another company. This is certainly not good for apprenticeship with fewer companies willing to invest in youth training.'*

This is not supervising given that the New Zealand construction industry has a labour turnover rate of over 20 per cent on average [77]. It in turn increases recruitment and training costs. With the higher turnover rate, construction business owners will need to secure key people who maintain the core competency of the business [26, 27]. The need to effectively 'self-insure' for human resource loss, and escalating competing demand from the business-as-usual sectors, will potentially lead some businesses to rethink their resourcing strategies.

5.3 Changing dynamics and relative nature of hiring

Some construction businesses of small-to-medium size indicated that it may be uneconomic to hire wage workers, partly due to quick turnover and some of the work ethics issues of their recruits. This is similar to the findings in the European construction sectors, which lead to the increased sub-contracting [24]. One studied organisation C5 reported that they had to re-assessed their business development strategies and opted to re-structure the company by using sub-contractors to reduce operational costs. The interviewee acknowledged that this change of staffing approach had increased its revenue in terms of improved productivity and work efficiency.

As mentioned above, the change in business resourcing behaviour brought about by staffing experience through a rapid growth cycle post-earthquake will in turn affect the in-take of new staff and buy-in of industry training programmes. If a growing number of construction businesses choose to cancel or reduce the pipeline of their recruitment, it is less likely that a skilled workforce will be delivered to Christchurch in the long term. Figure 2 shows that three critical dynamics – staff turnover rate, competency of hired workforce and business operational capacity – play out together to have an impact on company's ability to work efficiently. The more difficulties a company finds in achieving work efficiency, the lower the productivity [78, 79]. This will in turn make hiring less desirable and less affordable, causing more businesses not to hire.

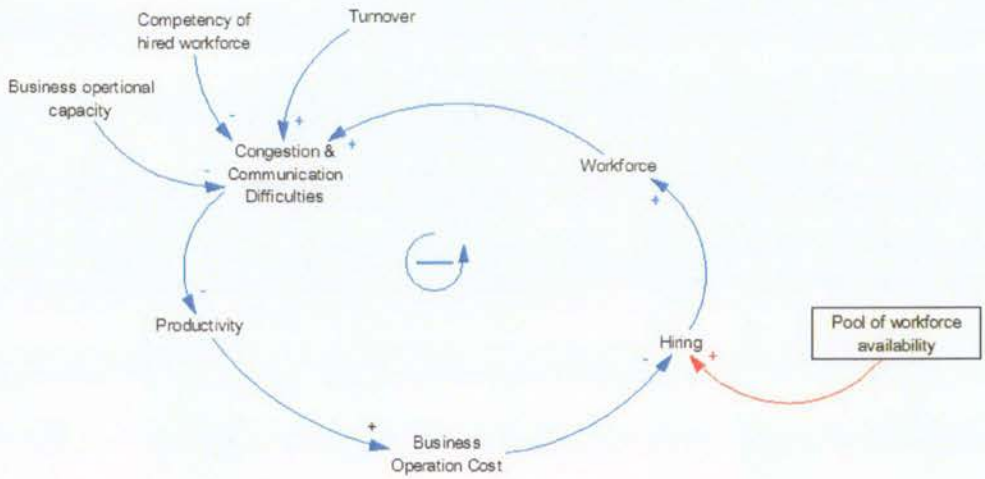

Figure 2: Changing business dynamics and relative nature of hiring

As mentioned earlier, the issues of rapid turnover and lack of competency are particularly found among the youth workforce. The implications from the dynamic model in Figure 2 are that the trend of recruitment is now moving to more temporary contracts on short-to-medium terms. However, there are economic and social consequences of the industry labour market in not delivering the supply of workforce at a rate to meet the required demand by employers [23, 80, 81]. In the meantime, construction organisations were understandably concerned about the risks of overcapacity in Christchurch. In particular, the risk of influx of a less experienced labour force and questions over the training buy-in from the industry were of concern.

6. Conclusion

The nature of reconstruction following a large disaster is often fraught with uncertainties, leading to pronounced fluctuations in its demand [50]. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in

relation to the employment demand and supply in the Canterbury recovery from 2010/11 earthquakes. In particular, the limited engineering and project management capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies.

It is difficult to separate pre-existing contributing factors that influence construction skills problems from those of the effects of reconstruction demands. Comerio suggested that disasters do not completely change pre-disaster economic conditions; instead they simply magnify trends or conditions in place before disaster strikes [82]. As shown in this research, the Canterbury earthquakes and the reconstruction demand had brought about fluctuations in the economic cycle. However, the pre-event issues such as the high staff turnover rate, competency of hired workforce, organisational culture and company retention ability still played a dominant role impinging upon the practice of human resource management of construction organisations in disaster recovery projects.

The dynamic models developed in this research provide visual directions for decision makers and construction organisations to implement supporting measures for improved capacity and capability for ongoing reconstruction. The study offers an improved understanding of disaster effects on the construction skills needs and of changes in the skills requirements post-event, enabling better future industry preparedness for a similar event. It is suggested that the design of policy instruments in managing human resources in Christchurch should be informed by a continued investigation of the dynamics that mediate between policy objectives and outcomes over time.

More than that, the study makes the case for a new approach to looking at resourcing problems following a major disaster. Those methods that are based on neoclassical economics and deal mostly with the larger economy tend to consider resource availability as a consequential result of market processes. The systems approach used in this research demonstrates that for enhancing the reconstruction capability in complex post-disaster settings, an organisational perspective should be considered in the decision making, which explains both internal resourcing dynamics and the linkages between construction organisations and the wider recovery environment.

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Housing the workforce following the Canterbury earthquakes in New Zealand

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ABSTRACT

Temporary housing following a large-scale disaster has a positive effect on household welfare and community recovery. Following the 2010 and 2011 Canterbury earthquakes, a shortage of temporary accommodation has also created barriers for outside construction workforce to engaging in repairs and rebuild in Christchurch. This study investigates the impacts of housing shortages for the overall recovery and the strategies adopted by both households and workforce in the building industry. Findings suggest that the interplay among the industry strategies and household strategies for securing housing determines the magnitude and scope of economy-wide inflation. One unfortunately consequence of these industry strategies is that the pressures of resource shortages are likely to transit from the construction sector to quake-affected households. These findings have implications on the nature and design of pre- and post-disaster planning programs in order to reduce the impacts of housing issues on household welfare and at the same time to the meet the needs of construction sector if the scheduled rebuild works are to be achieved.

1. INTRODUCTION

Temporary housing plays a critical role in the aftermath of a major disaster as it offers victims a safe transition to normal life (Felix et al., 2013; Johnson, 2007b; Peacock et al., 2007). For countries or regions where there is a limited resource pool and external resources need to be brought in to undertake large-scale disaster reconstruction, temporary housing for outside workers is a key component of the construction industry's capability. According to Comerio (1997), a housing crisis will result when there is a lack of housing stocks available for disaster victims. This crisis is likely to be compounded by construction workers who compete with locals for limited housing stock and putting lower-income people at risk of displacement (Plyer et al., 2009).

In rebuilding after a devastating disaster, affected people need to relocate to temporary places while their houses are under repairs or rebuild. To meet these demands, governments in every country after a major disaster tend to establish disparate temporary housing assistance programmes (Iwasa et al., 2012). Commonly designed to serve a variety of demographic and socio-economic settings, these temporary houses provide a range of substantive functions as the affected population recovers from disasters. They differ depending on the construction type and scale of capacity (Felix et al., 2013; Johnson, 2007a; Ritchie & Tierney, 2011); financial mechanisms, especially regarding the sources and flow of funds for both erection and maintenance (Abt Associates Inc., 2009; Maly & Kondo, 2013); organizational design (Johnson, 2007b); and the characteristics of the population they serve (Harasawa et al., 2012; Iwasa et al., 2012; Rafieian & Asgary, 2013).

The provision of temporary housing for disaster-affected populations, however, only provides a one-dimensional view of how disaster recovery can be affected as a result of this solution. In a more developed country, it is often the case that a decrease in housing stock will lead households to look for what accommodation is available. On the other hand, large-scale reconstruction may induce the outside workforce to come to the disaster-affected areas during the period of rebuild or even longer (Chang et al., 2011). Those workers may pursue affordable accommodation with reasonable living conditions and drive the housing demand. In such a situation, the local capacity for housing may become a critical factor attracting needed personnel from outside the disaster zone and affecting the speed and cost of reconstruction in the region (Chang-Richards et al., 2013).

The large-scale rebuilding effort in New Orleans, for instance, increased demands for construction workers which were already in short supply because of strong home-building activity around the rest of the country (NAHB, 2005). In a survey of construction workers rebuilding New Orleans,

Fletcher et al. (2007) found that 70 per cent of surveyed workers were U.S. citizens, and most of them came from other states such as Texas and Florida. The remainder were from other countries including Mexico, Honduras, and El Salvador; most were Latino. To a varied degree, high demand of rental properties for the reconstruction workforce had contributed to local rent escalation, with many displaced households and low-income renters being priced out of the market (Plyer et al., 2009).

The problems and issues regarding temporary housing for reconstruction workers also surfaced in Christchurch after the 2010 and 2011 earthquake events. Based on a study in Christchurch, this paper considers the impacts of housing shortages for the overall recovery and the strategies adopted by both households and workforce in the building industry. Specifically, market-level investigation is focused on understanding the effects of 1) workforce immigration patterns, 2) nature and availability of housing, 3) existence and impact of post-earthquake policies, and 4) interplay between the industry strategies and household strategies for securing available housing units.

This is work is significant for three reasons. First, it seeks recovery lessons for future catastrophic earthquakes by studying insurance-led earthquake recovery in New Zealand. Second, it focuses on a spectrum of housing needs post-disaster which is beyond the household-level investigations existing in most literature. Third, it complements previous studies on temporary housing by examining the impact of housing shortages on the overall recovery and reconstruction. This research presents evidence from both construction organisations and accommodation suppliers, in order to gain insights into the complexity of housing needs and how they interact and respond in a post-large disaster situation.

2. HOUSING NEEDS FOLLOWING THE 2010/11 EARTHQUAKES IN CHRISTCHURCH

A sequence of large earthquakes struck the Canterbury region of New Zealand in late 2010 and 2011. The two major ones were a 7.1 magnitude earthquake that hit west of Christchurch on September 4, 2010 and the deadly 6.3 magnitude earthquake on 22 February 2011. The second quake took a toll of 185 lives and caused substantial destruction of buildings, widespread land damage and rock falls. Over 150,000 homes which is about **three quarters of Christchurch's housing stock** sustained some damage from the earthquakes. Some areas of Christchurch have been declared not suitable for rebuilding, affecting more than 7,800 residential properties. The total number of individual building, land and contents claims received exceeds 600,000 (Earthquake Commission, 2011).

The biggest challenge faced by Christchurch as a result of the earthquakes is the changed residential land and the requirement for substantial land use reviews and zoning across the city. The Government announced on 23 June 2011 that all land in greater Christchurch and in the Waimakariri District had been zoned into four residential zones – red (no rebuilding allowed), orange and white (further assessment needed), and green (rebuilding allowed) based on geotechnical assessment. More than 7,800 property owners in the residential red zone were offered a buy-out package by the Government to leave their uninhabitable houses. Houses in green zone were also subdivided into three technical categories - TC1 (grey), TC2 (yellow) and TC3 (blue). In these subzones, more than 10,000 homes were assessed as in TC3 and require substantial foundation work before the houses may be considered safe for living.

Given the large-scale housing damage and in the context of other residential demand, there is a need for a range of affordable housing options:

- Non-red zone residents selling existing homes to red zone residents;
- Non-red zone residents opting to build elsewhere because of constraints on rebuilding on their existing properties;
- Accommodation for recovery workers; and
- Short-term accommodation needs of existing residents during the repair or rebuild of their homes;

Recognising these housing challenges, the Government established three Temporary Villages and developed about 40 permanent units to fill the gap of unmet housing needs for displaced residents. Housing New Zealand has initiated a progressive approach to rebuilding quake-damaged social housing properties in the eastern suburbs. Christchurch City Council has fast tracked the repairs of its State Housing for lower-income residents. Despite these efforts, the rental market still failed to meet the needs of other groups of people who seek affordable accommodation. The increase in the average weekly private rent in several Christchurch suburbs was 20 per cent or more for the three months ending January 2013, compared to the same period the previous year (MBIE, 2013b). **Some areas such as "Inner North" and "North West"** recorded above-average rent increases of 39 per cent and 32 per cent respectively (MBIE, 2013a).

The temporary accommodation issue has become prominent as competing demands emerge between the reconstruction workforce, who are from outside Christchurch, and displaced residents, including red-zone residents and those whose houses are subject to repairs. Demand for housing from construction workers, however, is likely to compound the shortage of houses available to residents displaced by the

earthquakes. Against this backdrop, this paper aims to investigate the housing needs posed by construction workforce involved in post-earthquake reconstruction in order to improve the understanding of housing issues post disaster.

3. RESEARCH METHODS

Empirically, this research is based on the case study of post-disaster recovery and reconstruction in Christchurch following the 2010 and 2011 earthquakes. According to Leedy and Ormrod (2010), a case study is especially suitable for learning more about a little known or poorly understood situation. The case study method in this research can therefore help add the understanding of this topic. Methods for data collection included participatory observations, a questionnaire survey, interviews and document studies (Table 1).

Table 1. Summary of research data collection methods

Objectives	Participants
1.To understand the patterns of labor influx post-earthquake	May 2012, November and December 2012 ***33 interview participants from:*** 3 design organizations 5 structural engineering consultancies 1 large geotechnical engineering company 5 construction contractors and builders 5 Project Management Offices (PMOs) 1 Building Industry Association 2 Government departments (Building and Housing Group & Labour Group in MBIE)
2.To capture the housing needs of those out-of-town workers for earthquake repairs and rebuild	April and May 2013 ***Online questionnaire survey of 38 participants:*** 26 motel owners/operators 6 operators of motor camps and holiday parks 6 property managers
	May 2013 ***Semi-structured interviews with 29 selected survey participants:*** 3 holiday parks owners/operators 2 Bed & Breakfast owners 1 Hotel operator 19 Motel owners/operators 2 rental property managers 2 home-stay managers

To understand the patterns of labor influx post-earthquake, primary data was collected through field observations and in-depth, semi-structured interviews with 33 participants from 22 construction organizations and 2 recovery agencies. The interviews and field observations were conducted in Christchurch in May 2012, followed by a second round of interviews between November and December 2012.

To capture the housing needs and options of those out-of-town workers, an online questionnaire survey of Christchurch Motel Association and property managers was initiated between April and May 2013. Of a sample of 128 accommodation owners/operators and property managers, 38 responded to the survey with a response rate of approximately 30 per cent. Detailed interviews with 29 selected accommodation owners/operators followed in May to supplement questionnaire findings. Desktop studies were also undertaken including reviewing the recovery strategy and plans of Christchurch, local newspapers (The Press) and publications of the recovery agencies.

4. RESEARCH RESULTS

A shortage of temporary accommodation has become a real concern for many construction organisations engaged in repairs and rebuild in Christchurch. This study provides an initial estimate of accommodation needs of the construction sector. The housing needs posed by out-of-town workers were reported by interviewed organisations and can be summarised into three groups. First are the workers who were temporarily relocated from other offices across New Zealand. These workers tended to stay in commercial beds. It includes short-to-medium term apartments, townhouses, motels, hotels and Bed Breakfasts.

Second category includes workers who were on longer-term relocation with more than six months. According to most interviewed companies, these workers aim for places with cooking facilities and access to workplace and community services. However, these accommodation needs were met by private rental market and company purchased houses. The third category includes construction workers who were considered as permanent migrants. Many of workers recruited from overseas and some of those who relocated from other parts of New Zealand had an expectation to live in Christchurch on a potential permanent basis. As reported by the construction organisations that the needs of these people are generally more complex. A short period of temporary solutions was often provided by companies till workers find their own housing. Therefore, securing an accommodation for these people takes longer before integration into the community is possible.

Some engineering consultancies reported ongoing issues sourcing people with high skill levels. Young engineers and mature project management skills from Europe continue to be the largest inbound demographic group involved with the rebuild (Table 2). Some construction organizations faced difficulties with immigration issues and housing their incoming workforces. At the same time, the inflationary impact which flowed through to higher property rents made attracting tradespeople from other parts of New Zealand more difficult.

Table 2. Demographic features of migrant workers for rebuild in Christchurch

Characteristic	Engineers	Building control professionals
Origin	Earthquake-prone countries – the U.S. Italy, Spain, Chile	Europe, Australia, the U.S.
Age cohort	25-35	30-50
Work experience	New graduates or more than 2 years' experience	At least 5-10 years plus experience

From surveying the commercial accommodation providers, Figure 1 below presents a snapshot of commercial accommodation capacity taken by construction workers who are involved with the Canterbury rebuild, homeowners, tourists, and others in 2011, 2012, and 2013.

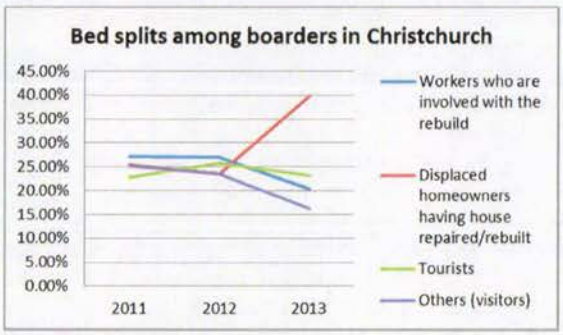

Figure 1. Commercial accommodation capacity among boarders in Christchurch

The survey shows that following the September 2010 earthquake, construction workers along with displaced home owners who were having emergency repairs or permanent repairs and rebuilds became a large force of guests taking up half of capacity in motels. The most significant increase in the number of displaced homeowners staying in motels since 2012 could reflect a combination of a decrease of rental supply, increasing demand from residents leaving the red zone and increased insurance residential repairs in the same period.

Interviews with accommodation providers also identified a number of trends that are likely to drive demand for low-cost accommodation in the construction sector. The shortages of accommodation were most pronounced at the operative level of construction companies. Affordability and accessible space for parking work vehicles were reported by construction workers, particularly most builders and tradespeople, as top two priorities when they looked for accommodation. As a result, construction workers have a strong preference for holiday parks, motor camps and backpacker lodges as most allow for parking flexibility and the rates are relatively cheaper comparing with other commercial beds options.

5. DISCUSSION AND IMPLICATIONS

Christchurch city lacked a comprehensive approach to addressing housing needs across a spectrum of population following the earthquakes. It appeared that the Government agencies and housing authorities gave highest priority to rapid repairs of public housing. Existing housing assistance did not match the damage needs of earthquake events. The actual impacts of housing damage and the spill-over effects to other sectors will take time to discover and quantify (Hallegatte & Ghil, 2008). Lower-income people were targeted for special attention after the disaster, but there was also a substantial need for coordinated assistance for construction workers to support the post-disaster recovery and reconstruction. As housing issue is economy-wide, it is therefore vital that any housing strategy enables all agencies and accommodation providers to work together to address housing-related issues.

In major disasters, low-cost rental housing constitutes a substantial portion of the affected housing stock (Comerio, 1997; Edgington, 2010; Tafti & Tomlinson, 2013). This has been the case in Christchurch following the earthquakes. Both temporary and permanent rental properties were mostly sought by both earthquake-displaced home owners and out-of-town workers. Additionally, this study shows that there is also a lack of large private low-cost accommodation providers in Christchurch which are most needed by builders and construction tradespeople. There is a need for a systematic review of the learnings from overseas experience on the model of temporary accommodation provision for construction workers and how it was integrated into, and balanced with assistance for disaster-displaced residents.

Research findings also suggest that there is a strong tendency for commercial accommodation providers, such as motels, hotels, and lodging type facilities, to absorb the workforce with capacities that were originally intended for tourists and visitors. There is also a strong tendency for recovery agencies and insurance companies to perceive the displacement as being an issue for households to solve, given that technical and financial assistance provided. However, a strong case can be made that it is such matters as lack of pre-impact housing inventories (Comerio, 1993; Peacock et al., 2007), failure to recognize the correlation between disaster and housing (Brezar, 2005), inadequate co-operation among insurance companies (Chang-Richards et al., 2013), and other organizational and community-level factors (Levine et al., 2007) which contribute to the

problem of housing shortages across a spectrum of the needy.

A lack of transitional accommodation for construction workers had forced workers to rent any houses available on the private market, consequently reducing availability for Christchurch residents. However, trade worker's ability to pay above-market rent to secure rental accommodation exacerbated inflation in the housing market. In line with price responsiveness of the housing market (Whitehead, 1999) and natural disaster economies (Hallegatte & Ghil, 2008; Hallegatte & Przyluski, 2010), the research shows that the impact of construction workers monopolising available accommodation has a negative impact on the entire housing market and tourism industry. The provision of accommodation for both workers and displaced residents should be considered as being equally important. This study suggests that the Government, together with local council, work with the existing operators to facilitate an expansion of their facilities to meet demand from both displaced residents and workers required for repairs.

6. CONCLUSIONS

An important lesson from a large-scale disaster is that the significant level of damage to residential housing, the acute labour demand to undertake repairs, the general lack of temporary accommodation, and the forecasted higher demand for skills for rebuilding could, if managed poorly, could lead to adverse social and economic consequences for local industry and communities. By examining the workforce accommodation issues following the Christchurch earthquakes, this paper raises the importance of the often overlooked yet critical issue after large disasters, relating to the processes of disaster recovery as well as its outcomes.

The study shows that provision of temporary accommodation for construction workers involved in repairs and rebuilds has a crucial role to play for recovery, particularly if housing assistance is integrated into the economic response. For a region which needs to rely on massive labor influx for the rebuild, temporary housing is critical to the construction industry capability. Future detailed case studies of construction organizations are needed to provide insights into how hiring strategies across the construction industry and their strategies for housing the workforce will change the landscape of housing needs in Christchurch.

According to official projections, there will be an additional 17,000 workers needed to meet demand at the height of the rebuilding activity in late 2014. Flowing on from the rebuild, another 15,000 workers will be needed in supporting roles and sectors, including administration, law, accounting, retail, accommodation and services (MBIE, 2013a). Additional government and industry effort in supporting interim housing solutions is needed if the projected increase in rebuild works in 2014 and 2015 is to be achieved. Also to reduce the impact of housing shortages on the speed and cost of reconstruction, recovery agencies need to integrate housing needs of out-of-town workers with those of displaced households as part of the longer-term housing recovery and economic development strategy.

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Resilient ORGANISATIONS
A collaboration between research & industry

Resourcing the Canterbury rebuild

Emerging issues facing subcontracting businesses

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Resilient Organisations Research Report 2015/03

May 2015

1. Introduction

This study reports key emerging issues facing subcontracting businesses in late 2014. Following previous resourcing case studies of construction organisations in Christchurch (Chang-Richards et al., 2014)[1], this study concentrates on the subcontracting sector. This report is part of the Resilient Organisations' resourcing study of subcontracting businesses in Christchurch following the 2010/11 earthquakes. The research findings with regard to the resourcing strategies adopted by Canterbury rebuild subcontractors were reported in Resilient Organisations Research Report 2015/02 (Chang-Richards et al., 2015)[2]. The case studies, which include interviews from a range of subcontracting businesses, also provide insight into emerging issues facing subcontracting sector, which are presented in this report. The summary of case studies is provided in the Appendix.

2. Emerging issues during the rebuild and future expectations

Looking forward, case study subcontractors identified the following emerging issues concerning their businesses in the 2015/2016 period.

2.1 Increased mobility of workforce

Workers in the construction industry are generally mobile, responding to major developments and infrastructure projects across the country. In the medium term, several case study subcontractors expected increased competition for construction employees from infrastructure investment and housing developments. Subcontractors reported that the mobility of the workforce is an issue as the turnover rate is increased by increased competition. Several subcontractors reported that labour mobility in the construction industry is rising.

[1] Chang-Richards, Y., Wilkinson, S., Seville, E., & Brunsdon, D. (2014). Workforce behaviour and business responses: Case studies of construction organisations. Resilient Organisations Research Report 2014/03.
[2] Chang-Richards, Y., Wilkinson, S., Seville, E., & Brunsdon, D. (2015). Resourcing the Canterbury Rebuild: Case studies of construction subcontractors - recruitment and retention strategies, April 2015. Resilient Organisations Research Report 2015/02

2.2 Potential shortages of materials

Feedback from case study subcontractors has continued to identify potential issues in the supply of labour and materials for the reconstruction efforts in Canterbury. In the Canterbury region, where the demand for roading materials is increasing as the Government's infrastructure commitment increases, several case study subcontractors reported that they anticipate critical shortages for materials like bitumen and asphalt.

2.3 Potential shortages of workers

Subcontractors identified the vertical rebuild in the central Christchurch facing the most workforce challenges as subcontracting businesses losing resources to business as usual sectors. In particular, repair-related jobs were perceived as having a low margin and more demanding, whereas working on new developments in Canterbury and other parts of New Zealand were seen more attractive.

There are still hot spots for skill shortages (e.g. project managers and general labourers as identified in this study), particularly in Christchurch where unemployment is low and infrastructure and housing developments are progressing. Subcontractors reported that heightened competition for human resources is currently being experienced and is likely to increase.

2.4 Uncertain workflows

Several subcontractors reported that there could be construction jobs created in the anchor projects. However, they were concerned that any change in project timeframe would result in change to the peak levels of projected labour demand. Previous case studies identified potential short-term skills challenges as anchor projects commence, with a likely shortfall in capacity and skills needed to either support construction in the CBD and/or maintain the progress of existing projects managed by SCIRT and the residual projects undertaken by Fletcher EQR (Chang-Richards, Wilkinson, Seville, & Brunsdon, 2014). Case study subcontractors in this report noted

that the size of the shortfall is dependent on the ability of government, project clients and contractors to successfully import and re-deploy new workers (new entrants, apprenticeships, and workers from outside) into Christchurch.

2.5 Required social infrastructure

Significant other challenges reported by subcontractors include the need to provide the necessary structural and social infrastructure, including temporary accommodation and/or housing facilitation, to support the workforces coming from outside Canterbury region. Otherwise, there is a likelihood of increased mobility to work outside the Canterbury region compounding problems.

2.6 Aging workforce

The demanding physical requirement of the majority of jobs in the construction industry means the career span is typically shorter, leading to early retirement and a loss of valuable knowledge and skills from industry. Subcontractors were worried about their aging workforce and retirements. Expertise and knowledge of senior workers are gradually lost as they retire from the industry. Several subcontractors suggested that much of skills, knowledge and experience which workers gained from being working on the infrastructure repairs and rebuild could also be potentially lost as there seemed to be no mechanism in the industry to capture knowledge.

2.7 Skills development and training

Across the case studies, there is a perception the subcontracting sector lacks a long term career focus. This deters candidates from considering the industry as a potential career choice. Subcontractors grapple with the requirements to train staff on limited budgets and mostly use informal training mechanisms rather than externally offered courses.

2.8 Poaching of staff

Several subcontractors raised the issue that efforts made to train up a worker put them at greater risk of having their employees poached by other companies who seek workers with higher levels of skills. There are some concerns among case study subcontractors about the problem of retraining workers from horizontal to vertical reconstruction.

Acknowledgement

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Annex: Profiles of studied subcontractors

Company code	Year established	Ownership structure	No. of Emp	Products/services	Market	BAU Vs. EQ-related	Pinch resources	Resourcing strategies	Business strategies
S1	1999	Family business	7	Commerical machine laid kerb and channel for roading Subdivisions and car parks	Canterbury	80%:20%	• Excavator operator • Kerb & channel machine operator	• Ensuring job security • Recruitment on a permanent basis • Investment in training and offering promotion to identified 'loyal' staff •Good conditions of work	• Strong client oritentation • Expanding client network • Quality improvement of workmanship
S2	1968	Family business	10	Drain laying and maintenance Manhole installation Trench shield work and excavation	Canterbury	100%:0%	Drain layer	• Investment in recruiting and training local young people • Empowering workers to take initiatives • Good benefits	• Strong brand/reputation • Improving company-wide communications
S3	1985	Incoproated	45 (30 in Chch)	Drainage/pipe laying Sheet piling/trench shields Pump stations and manholes Dewatering Pipe bursting and thrusting	Hamilton Christchurch	10%:90%in Christchurch	• Excavator operator • Truck drivers • Civil pipe-layer/drain layer	• Retaining mature staff aged between 30 and 50 • Encouraging knowledge transfers among staff	• Service diversity • Market expansion
S4	1950	Incoporated family	190	Construction, surfacing, bitumen products, transport, quarrying, contract management services	South Island	80%:20%	• Excavator operator • Drain layer • Project manager	• Reduced recruitment and increased retention and skills development • Improved career path • Good conditions of work	• Forming long-term relationship with other subcontractors • Product and service diversifaction • Regular review of business plan
S5	1983	Limited company Family	16	Construction of driveways, vehicle crossings, car parks and small subdivisions Asphalt Laying and excavations	Canterbury	30%:70%	• Drain layer • Excavator operator	• Retaining family-committed staff aged between 25 and 40 • Strong preference for recruiting local people in Christchurch • Fast track of career path • Good pay at the market rate and other benefits	• Maintain the current size of the company • Maximise business stability • Build good reputation • Employee multi-tasking
S6	1984	Limited company Family	50	Drainage, subdivision, traffic management, project management, quantity surveying, road infrastructure and bridge construction	Canterbury	15%:85%	• Truck driver • Excavator operator • Drain layer	• Recruit staff in other newly established services (e.g. electrical services, dairy effluent disposal design and resource consenting application) • Investment in recruiting by using Big Splash and Hayes & Stellar recruitment agency • 2 weeks probationary period	• Reduce rebuild-related work from 85% to 15% by end of 2015 • Expand client base • Diversity services • Instil corporate structure with family values • A possible partnership by joint venture

								• An information sharing policy for knowledge transfer	
S7	1985	Family business	4	Drainage	Canterbury	10%:90%	Drain layer	• Recruting through recrtuiment agencies and 'buy out' good recruits from them • Direct in-house training provided by directors • Prefer to recruit workers aged between 30 and 50	• Joint venture with a local main contractor and be in charge of the drainlaying jobs • Adding Health and Safety into training schemes
S8	1954	Limited company Family – a subsidiary of Fletcher	31 in Chch	River and marine works Engery pipelines, civil structure and foundation work	Auckland Hamilton Wellington Canterbury	55%:45%	• Plant/machine operator	• Having a mentoring and knowledge transfer scheme for new staff • 250 hours of on-job-training before employees are permitted to undertake unsupervised work • Using recruitiment agencies for recruirting temporary staff	• Gradually reducing the rebuild-related work and increase the BAU road contracts from NZTA • Having access to all benefits provided by Fletcher
S9	1998	Incoproated	40	Ground remediation, excavation and other earthworks Driveways and footpaths Foundations, retaining walls Civil construction Truck and excavator hire	Canterbury	70%:30%	• Truck driver • Plant operator • Civil engineer	• Using recruitiment agencies to find skilled engineers and machine/plant operators • Recruitment from Ireland • Encoruaging workers to achieve higher qualifications and participate in Health and Safety training	• Improving relationships and form partnership with other companies • Exploring the potential of recruiting secondary school students
S10	1955	Incoporated family	57 (9 based in chch)	Civil construction in roading, subdivisions, drainage, water reticulation, site works, traffic management, aggregate supply, transporting, landscape supplies	Whanganui Canterbury	0%:100% in Christchurch	• Truck driver • Plant operator	• Relocating staff from Whanganui office • Recruiting people from other cities of NZ and from overseas • Strong perference for employees aged between 25 and 40	• Building presence and reputation in Canterbury • Diversifying client base
S11	1999	Family business	11	Construction, surfacing and maintenance, bridge maintenance and construction, civil construction and commercial works	Canterbury	25%:75%	• Machine operator • Labourer	• Strong perference for recruting locally through 'Word of Mouth' • 'Equal productivity' policy to increase staff morale and reduce animosity • Rapid growth of staff • Relationship building activities between managers and staff	• Expanding client base by including major consturction companies • Strong barnd/reputation • Quality improvement of workmanship
S12	1979	Incoporated family	90 (50 based in chch)	Subdivisions, road works, site clearance, house foundations, drainlaying, landscaping, and forestry work	Canterbury (Timaru and Christchurch)	85%:15%	• Excavator operator • Site worker • Truck driver	• Intensive in-house training other workers to become skilled excavator operators • Strong preference for local recruits • Using recruitiment agencies for recruiting temporary staff	• Christchurch office established after the earthquakes • Relationships formed with large contractors in the SCIRT Alliance team

									• Increase the workloads from new subdivisions in Christchurch
S13	2008	Incoproated	20	Pipe and drainage	Auckland Christchurch	0%:100%	Drain layer	• 90 day trial for new recruits • Strong preference for candidates with interpersonal skills • Increasing organisational capacity to attract local people	• Semi-alliances with Christchurch subcontractors • Investment in building company capacity (premises, facilities) • Increasing the subdivision work by end of 2014

Note: BAU denotes business as usual; EQ denotes earthquake; Emp denotes employment

About the case studies

The cases were selected in consultation with Christchurch employers organisations such as the Canterbury chapters of the Specialist Trade Contractors Federation and the New Zealand Building Subcontractors' Federation. A sample of 30 subcontracting businesses was drawn. The initial list was then reduced, based primarily on whether the company is involved in civil works for the infrastructure rebuild in Christchurch and the company's willingness to be interviewed in depth. However, other considerations such as the diversity of companies in terms of size, type of business, years in business and form of labour were also taken into account. In total, 13 subcontracting business were studied (Table 1).

Table 1: Basic profile of case study subcontractors

Case study subcontractors	Number	Organisational coding
Business ownership category		
Family business	4	S1, S2, S7, S11
Incorporated	3	S3, S9, S13
Incorporated family	3	S4, S10, S12
Limited company family	3	S5, S6, S8
Organisational size		
Micro-sized (Ep≤10)	3	S1, S2, S7
Small-sized (Ep≤50)	7	S3, S5, S6, S8, S9, S11, S13
Medium-sized (50 <Ep≤100)	2	S10, S12
Large-sized (Ep>100)	1	S4
Years in business		
Less than 10 years	1	S13
10-20 years	3	S1, S9, S11
21-30years	3	S3, S6, S7
31-40 years	2	S5, S12
More than 40 years	4	S2, S4, S8, S10

Note: Emp denotes the number of employees

The companies are all located in the construction subcontracting sector. Companies who were engaged in civil works for the infrastructure rebuild were chosen. Organisations with between 1 and 200 employees were selected, with most case study organisations having less than 50 employees. Face-to-face interviews with 13 subcontractors were conducted in Christchurch. Respondents were asked to describe any emerging issues they felt they were facing.

About the Resilient Organisations Research Programme

"Building more resilient organisations, able to survive and thrive in a world of uncertainty, through research and practice"

We live in an increasingly complex world dealing with a broad spectrum of crises arising from both natural and man-made causes. Resilient organisations are those that are able to survive and thrive in this world of uncertainty.

Who we are:

The Resilient Organisations Research Group (ResOrgs) is a multi-disciplinary team of over thirty researchers and practitioners that is New Zealand based and with global reach. A collaboration between top New Zealand research Universities and key industry players, including the University of Canterbury and the University of Auckland, ResOrgs is funded by the Ministry of Business, Innovation and Employment through the Natural Hazards Research Platform and supported by a diverse group of industry partners and advisors. The research group represents a synthesis of engineering disciplines and business leadership aimed at transforming organisations into those that both survive major events and thrive in the aftermath.

We are committed to making organisations more resilient in the face of major hazards in the natural, built and economic environments. Resilient organisations are able to rebound from disaster and find opportunity in times of distress. They are better employers, contribute to community resilience and foster a culture of self-reliance and effective collaboration.

What we do:

The ResOrgs programme of public good research is aimed at effective capability building through research activities with significant impacts on policy and practice. Activities and outputs of the group, in existence since 2004, include informing and focusing debate in areas such as Civil Defence Emergency Management, post-disaster recovery, and the resilience of critical infrastructure sectors, in addition to core activities in relation to organisational resilience capability building and benchmarking. We have produced practical frameworks and guides and helped organisations to develop and implement practical resilience strategies suitable to their environment.

Why we do it:

In an increasingly volatile and uncertain world, one of the greatest assets an organisation can have is the agility to survive unexpected crisis and to find opportunity to thrive in the face of potentially terminal events. We believe such resilience makes the most of the human capital that characterises the modern organisation and offers one of the greatest prospects for differentiating the successful organisation on the world stage. This resilience is typified by 20/20 situation awareness, effective vulnerability management, agile adaptive capacity and world class organisational culture and leadership. More resilient organisations lead to more resilient communities and provide the honed human capital to address some of our most intractable societal challenges.

For more information see our website: www.resorgs.org.nz

A systems approach to managing human resources in disaster recovery projects

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Abstract

Lack of construction resources and capacity has always presented difficult challenges to the construction industry following a major disaster. In the case of the Canterbury earthquakes that took place in 2010 and 2011 in Christchurch, New Zealand, a number of factors combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. Research findings show that the limited technical capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies. The study suggests that the design of policy instruments in managing human resources in Christchurch should be informed by a detailed understanding of the dynamics that mediate between policy objectives and outcomes over time. A systems approach should be applied to increase the efficiencies in resource management in the continued reconstruction.

Keywords: Systems dynamics, Human resources, Disaster reconstruction, Construction firms, Christchurch

The paper is accepted and to be presented at the 5th Annual International Conference on Building Resilience, Newcastle, Australia, 15-17 July 2015

1. Introduction

The gradual shift in modern concept of 'building resilience' that has occurred over the past decade is having far-reaching implications for the construction industry who plays a pivotal role in disaster risk reduction and carrying out the post-disaster reconstruction tasks. In many countries, disaster recovery projects are given equal or even more priority over other development projects. Compared to conventional construction projects, disaster recovery construction projects are seen as requiring different management and delivery systems [1, 2]. In particular, disaster recovery construction projects following a large disaster tend to have resource challenges [3, 4] and capability issues [5].

When the Darfield earthquake struck Christchurch in 2010, the New Zealand construction industry was going through a recessional period of low activity caused by the 2008 global financial crisis. Many construction businesses had managed to come from the bust of economic cycle and aiming for a reviving opportunity in post-earthquake reconstruction [6]. Nevertheless, the shortage of skills is a recurrent problem in the New Zealand construction industry [7, 8]. And there was a limited pool of professionals in the country who had the experience of seismic assessment and design. The Canterbury region subsequently suffered a sequence of aftershocks. The earthquake of magnitude 6.3 on 22 February 2011 was the most severe, taking the lives of 185 people and causing buildings to collapse, further damage to infrastructure and widespread liquefaction [9]. High pressures of skills needs in undertaking the reconstruction following the earthquake events raised questions concerning how these skills needs can be met given the limited resource pool in New Zealand construction sector [10].

A number of factors such as the change of the building standards [11], insurance pay-out [12] and the decisions made by the Immigration New Zealand on Canterbury Skills Shortage List[1], combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study aims to identify the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. The study was undertaken longitudinally with 15 construction organizations over an extended period. Research findings from this study is hoped to provide insights into future disaster response with respect to addressing the problem of rebuilding capability.

[1] The Canterbury Skills Shortage List (CSSL) highlights occupations in shortage that are needed during the rebuild in Canterbury region (area of South Island), and facilitates the grant of temporary work visas for those occupations. For more information, see http://www.dol.govt.nz/immigration/knowledgebase/item/4551

2. The construction industry skills shortage

Having a skilled, well-trained and productive workforce has always been central to the construction sector's growth and success [13-15]. The literature reveals a number of factors which have impinged upon the construction skills problem (See Table 1).

Table 1: Contributing factors that shape the skills problem in the construction industry

Category	Contributing factors
1) Contextual factors	• Workforce aging and demographic downturn • Reduced numbers of young people entering the construction sector • Technological changes • A lack of investment in skills development
2) Structural factors	• Absence of human resource management strategies at a project level • A lack of partnership between sector employers and training bodies • Low levels of training • Increased casual self-employment and sub-contracting • Rigidity of skills divisions
3) Inherent factors in the construction industry	• Poor image of the industry • Poor perception of pay and workplace conditions • Working practices • Cyclical labour demand • Fragmented, transient and heterogeneous workforce structure • Fragmentation between training provision and employment

Context-specific factors included such as workforce aging and demographic downturn [13, 16], reduced numbers of young people entering the construction sector [17, 18], technological changes [19, 20] and a lack of investment in skills development [21]. Structural factors causing construction skills shortfall included the absence of human resource management strategies at a project level [22], a lack of partnership between sector employers and training bodies [23, 24], low levels of training [7, 25], increased casual self-employment and sub-contracting [26, 27] and the rigidity of skills divisions [28].

Adding to the list are factors in relation to the very nature of construction industry, including the poor image of the industry [29, 30], especially regarding the pay and workplace conditions [31]; working practices [32]; cyclical labour demand [33, 34] and often fragmented, transient

and heterogeneous workforce structure [35, 36]. Above all, Dainty et al. found that fragmentation that flows from the structure of training provision and employment is likely to narrow the industry's skills base and reduce innovation within the sector [17].

By comparing construction industry concerns 50 years apart, O'Donnell et al. concluded that how to attract and develop apprentices and graduates remained to be a major industry concern [37]. Chan and Dainty [14] suggested that genuine skills improvement requires a sustained effort to understand the practical realities of skills provision at a project level. Lobo and Wilkinson [7] advocated a focus on examining the efficiency of skill level in the existing workforce, rather than quantity of skills. In practice, there has been a shift of emphasis from top-down labour market policy measures towards demand-led skills development systems [35, Dainty et al., 38]. This shift, however, calls for employers and employees to play a more proactive role in formalising the industry's training and employment practices if improved performance and productivity is be achieved [39, 40].

There is a growing awareness of the importance of skills development among construction organisations as a means of improving productivity [35, 41, 42]. Research points towards a direct correlation between skills, productivity and employment. Enhancing labour productivity was proposed by Chan and Dainty [14] as one of the solutions to alleviating the problem of skilled labour shortages in construction. This view, however, emphasised the efficacy of skills utilisation and development, rather than increasing their supply. Other solutions to addressing skills crises have been used in the past, primarily in such areas as training [25, 31], multi-skilling [43], industry promotion [13, 14], employing migrant workers or outsourcing [28], and the development of new technologies and construction techniques [44]. However, as Dainty et al, suggested such measures are difficult to sustain unless backed by a bespoke regional labour market approach [17, 45].

3. Resource issues faced by construction organisations post-earthquake in Christchurch

Past disaster events have shown that in the aftermath of a major disaster where the operational environment is often uncertain, complex and dynamic, the "business as usual" way of managing resources may not be fully applicable [46, 47]. In a post-disaster environment, there is strong pressure to act quickly to get back to normal [48]. Under the pressure of limited time, the need to replace lost housing, building and infrastructure facilities often generates a demand surge for labour [49, 50].

According to Dainty et al. [51], workforce planning models need to take account of a wide range of factors determining both labour supply and demand. However, the complexity of the post-earthquake situation has rendered accurate forecasting of skills needs extremely difficult. Variations in the size, speed and scope of reconstruction had a marked effect on the employment practice which further influenced skills demand [52]. In the case of New Zealand,

despite a relatively brief hiatus created by the global financial crisis, significant skills shortages have re-emerged from the earthquakes. The construction sector has moved from bust to boom and the employment situation in construction has dramatically changed [53].

Construction organisations, largely being labour-intensive, are more influenced by human resource effects. Following the 2010/11 earthquakes, construction organisations in Christchurch experienced major resource shortages for both post-quake damage emergency response and reconstruction stages [54]. Ongoing aftershocks caused structural and land inspection professionals to be constantly diverted from existing jobs to new damage [55, 56]. A questionnaire survey commissioned by the Resilient Organisations between October 2011 and January 2012 revealed that resource pressures experienced by the construction organisations in Canterbury region were primarily from human resources associated with structural, architectural and land issues. And the three most frequently reported 'problematic' human resources were: structural engineers, geotechnical engineers, and draughtsperson [54].

A follow-up survey in 2013 showed that as the reconstruction progressed, many construction organisations started encountering difficulty in finding suitable project management expertise such as site engineers, project managers and quantity surveyors [57]. Some engineering consultancies have reported ongoing issues with sourcing workers of high skill levels [53]. Since the September 2010 earthquake, young engineers and mature project management skills from Europe continue to be the largest inbound demographic group involved with the rebuild in Christchurch [56, 58]. At the same time, there has been an inflationary impact which flows through to higher property rents, and makes attracting tradespeople from other parts of New Zealand harder [59].

Against this backdrop, this research attempts to investigate the dynamic factors that influence the resourcing behaviours of construction organisations operating on post-earthquake projects in Christchurch. By capturing perspectives from construction organisations, this study provides an understanding of how companies are responding to a looming skills and labour shortage for the Canterbury rebuild and how their resourcing approaches might affect the environment where they operate. The research methods used, the findings from this research along with a discussion are presented in the remaining sections. This paper concludes by reflecting on the implications of research findings for future studies.

4. Research Methods

4.1 Case study method

A case study method was adopted for this research due to its theory-building nature [60, 61]. As proposed by Yin [62], the case study design develops an empirical approach to research of a contemporary phenomenon within its own context. Longitudinal case studies of construction

organisations can provide insights into how hiring strategies across the construction industry and their strategies for workforce development will change as the landscape of Christchurch changes. The selection of case study organizations was based on criteria such as: the type of organization, size2, business characteristics, and involvement in the earthquake recovery process.

The key strategy used for selecting the sample was that all organisations would come from a spectrum of areas of the New Zealand construction industry. The case study sample was selected from the New Zealand Construction Industry Council (NZCIC) membership database. Sample organisations were all based and operated in Christchurch and registered with regional industry bodies under the umbrella of NZCIC. In December 2012, 15 case study organisations were selected to participate in the research. The chosen case studies collectively provided a reasonable overview of current experience with regard to the resourcing of skills for building activities [57].

In April 2014, the researchers conducted a second series of case studies with previously selected organisations. The focus of the second case studies was to examine the dynamics that influence their experiences of resourcing in Canterbury and changed business strategies since. Of 15 organisations, 10 participated in the second case studies. The reasons for the other 5 organisations not being able to participate included unavailability at the time of the case studies and absence from Christchurch operations. 3 additional organisations took part in the case studies. A total of 16 interviews were undertaken across 13 organisations in Christchurch in April 2014 (See Table 2).

Table 2: Description of organisations used for case study data collection

Types of construction organisations	Characteristics
2 Engineering consultancies	1 large size and 1 medium size (E1 and E2)
7 Contractors/builders	3 large civil contractors, 2 subcontractors, 1 home builder, 1 large construction company (C1-C7)
2 Building supplies companies	2 large concrete product manufacturers (M1 and M2)
2 Project Management Offices	Horizontal infrastructure rebuild & EQC's residential repairs (P1 and P2)

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520). The interview records within case studies were recorded, transcribed, coded, and further analysed using NVivo 9 qualitative data analysis software. NVivo 9 coding comparison of queries allowed for

[2] The size of the organization was pre-defined in the survey in terms of the number of employees. A large organization has more than 100 employees; a medium sized organization has more than 50 but less than 100 employees; a small organization has 50 or fewer employees; and a micro-sized organization has less than 10 employees.

similar comments and suggestions being synthesised under common themes. A case study report that relates to individual organisations was sent back to interviewees for data validation.

4.2 Qualitative systems dynamics

System dynamics is a method to enhance learning in complex systems [63, p4]. Based on the findings from the interviews, further analysis was conducted by using causal loop diagrams to describe the dynamics and how they have influenced the behaviours of case study construction organisations in resourcing for disaster recovery. This paper only reports the qualitative system dynamics, often referred to as system thinking. The quantitative system dynamics which is based on quantified simulation will be reported in future published works.

The System Dynamic modelling approach was first introduced by Jay Forrest [64]. It offers a rigorous method for the description, exploration and analysis of complex organisational system comprised of organisational elements and the environmental influence. In the security world, systems thinking is a powerful tool for analysing and interpreting risks, and for developing control or intervention options [65]. While systems methods are not yet widely used in disaster management, experience in related disciplines, such as earthquake mitigation decision making [66] and planning for disaster recovery [67], indicates that they will be an increasingly useful tool for addressing complex issues in the aftermath of a large disaster.

We approached the analysis with the intent of exploring the critical dynamics of organisational resourcing process following the Canterbury earthquakes. By aggregating the findings from the case studies, the issues and processes that were relevant across a range of case study organisations can be identified. Those dynamics and how they have influenced the resourcing behaviours of case study organisations are presented in the causal loop by using Vensim modelling technique. In the following section, the generalised thematic findings will be presented and discussed, with illustration of dynamics identified in case studies.

5. Results and Discussion

5.1 Changed business operational model

Case studies in April 2014 show that there is a general trend for the workforce that were involved in the Canterbury earthquake reconstruction to move away from disaster recovery projects, as shown in Figure 1. In particular, the medium to large-sized infrastructure contractors were experiencing some human resourcing pressure as they have lost expertise to the new subdivision sectors. Case study organisations reported a renewed interest in moving

back to their business-as-usual market, driven by the development of new subdivisions in Canterbury and New Zealand Government's housing and transport commitments.

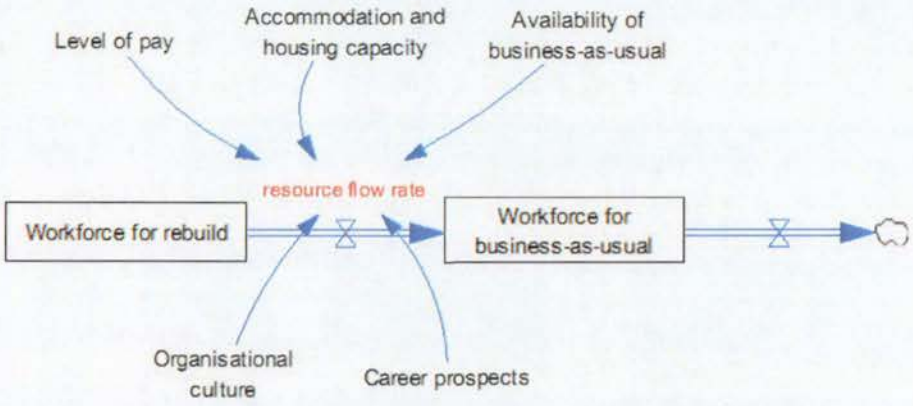

Figure 1: Dynamic factors that influence workforce flows between sectors

Lifestyle and cost factors are the dominant determinants of workforce migration patterns [68]. Such labour demographic-related factors play a major role in a workforce's decision-making and changing directions of resource flows [35, 36]. Case study organisations reported that the phenomenon of moving away from reconstruction to other sectors was most prominent among those who entered the reconstruction sector following the earthquakes, including overseas immigrants and those entrant people from outside Canterbury. Anecdotally, it appears that some new entrants tended to pursue better career opportunities in other places with their Christchurch reconstruction experience. This tendency, however, will likely be moderated somewhat by rebuild-related organisations providing needed support with organisational culture and certainty of career development playing a central role [59].

Small-to-medium sized businesses have seen work levels in non-reconstruction sectors rise over 2013 and were optimistic about development prospects in buildings and infrastructure industry. Large engineering and construction companies, however, remained to be focused on the reconstruction projects, in the meantime, dealing with high rate of staff turnover and the challenge of staff retention. As reported by interviewee C6,

> *'This year (2014), we start seeing a significant resource pinch on our external subcontractors. For instance, we sent 100 invitations for tender, only a third got back to us as those subcontractors are busy and their resources got tied up. It will be difficult for us to find compliant tenders and keep us competitive.'*

General changes in the demand landscape for different sectors of reconstruction and new developments were also affecting business operational behaviours. For example, as shown in Figure 1, the change in demand and higher rates in other places meant that those who established local operations in Christchurch and secured reconstruction projects following the earthquakes had now moved back to housing and building markets in Auckland or Wellington. As one interviewee E2 put it,

> '*As the Auckland market picks up whereas the Christchurch market raised but not super busy, some of those companies had pulled out their presence from Christchurch as they can survive now in other markets.*'

This finding bears resemblance to the situation following the 2009 Victorian 'Black Saturday' bushfires [69] and the situation in Queensland' flood-affected areas in Australia [70]. Comerio [71] stressed that with prospects of economic development and growth pressures in other areas, the impact of their competing demands for construction skills should not be underestimated. Some case study organisations were concerned that escalating accommodation costs may discourage some construction workers from outside Christchurch. Case study organisations highlighted the importance of Government's investment in temporary housing for additional out-of-town workers as a strategy to retain these resources for the reconstruction projects.

5.2 Shifted focus from recruitment to retention and up-skilling

The skills issue in terms of resource quality is one of the most reported problems – so to a certain extent was viewed by small-to-medium-sized organisations as their top concern. This is not surprising as Mahamid [72] argued that a lack of labour experience is among the top-five factors negatively affecting construction business performance. A range of terms, such as 'lack of competency', 'lack of experience', 'low level of skill', 'absence of work ethics' and 'incorrect work attitude', were used by studied employers as a reason, in part, to explain their reluctance to recruit young workforce which does not seem to have a sufficient skills set for work elements of the reconstruction. A continuing low unemployment rate (3.2 per cent for the December quarter of 2013) in Christchurch will make sourcing appropriate labour more difficult [73]. This is an issue that may become more prominent once more construction works get underway.

Prolonged lead time from planning for forward work programmes to their eventualisation was another key resourcing barrier identified by case study organisations. This is also intertwined with an inconsistent work flow issue. For construction businesses, there is added instability and uncertainty in planning, particularly human resources which causes waste and increased costs [74]. According to Hua [75], firms are more likely to invest in physical assets if they expect demand to remain high and long-term economic conditions to be good. If the economic prospects are unfavourable, they tend to be conservative about their investment due to potential fiscal risks.

Some interviewees noted that slow reconstruction of commercial buildings was capping the rate of the cash flow and the rate and number of people coming in. This is in line with the findings of Ng et al. [76] which emphasised that private construction investment is more sensitive to general economic conditions, creating uncertainty in the future levels of construction workloads. Contractors and suppliers also reported some of their spare capacity was a result of the inconsistent workflows, affecting their workforce demand. One contractor C2 in the infrastructure rebuild sector shared its particular concern:

> *'In 2014, we are particularly concerned that the new subdivisions as a result of the earthquakes and the vertical rebuild will be sucking a lot of our subcontractors. What's gonna happen next might be they are going to suck our own staff, our engineers and project managers.'*

Case studies opened up a discussion about a focus in 2014 for skills retention and up-skilling. Strategies already implemented included changing from annual to quarterly reviews, touching base on a regular basis, increasing the focus on staff development and staying competitive in the market in terms of pay rates. It appears that the high turnover rate among newly recruited workforce undermines the skills retention and in-house up-skilling strategies adopted by case study organisations. As one interviewee (C4) highlighted:

> *'Finding the right people who are willing, able and motivated has been problematic. The more frustrating is you take on new people and spend a lot of time and money training them up. Once they have gained that experience, they move to another company. This is certainly not good for apprenticeship with fewer companies willing to invest in youth training.'*

This is not supervising given that the New Zealand construction industry has a labour turnover rate of over 20 per cent on average [77]. It in turn increases recruitment and training costs. With the higher turnover rate, construction business owners will need to secure key people who maintain the core competency of the business [26, 27]. The need to effectively 'self-insure' for human resource loss, and escalating competing demand from the business-as-usual sectors, will potentially lead some businesses to rethink their resourcing strategies.

5.3 Changing dynamics and relative nature of hiring

Some construction businesses of small-to-medium size indicated that it may be uneconomic to hire wage workers, partly due to quick turnover and some of the work ethics issues of their recruits. This is similar to the findings in the European construction sectors, which lead to the increased sub-contracting [24]. One studied organisation C5 reported that they had to re-assessed their business development strategies and opted to re-structure the company by using sub-contractors to reduce operational costs. The interviewee acknowledged that this change of staffing approach had increased its revenue in terms of improved productivity and work efficiency.

As mentioned above, the change in business resourcing behaviour brought about by staffing experience through a rapid growth cycle post-earthquake will in turn affect the in-take of new staff and buy-in of industry training programmes. If a growing number of construction businesses choose to cancel or reduce the pipeline of their recruitment, it is less likely that a skilled workforce will be delivered to Christchurch in the long term. Figure 2 shows that three critical dynamics – staff turnover rate, competency of hired workforce and business operational capacity – play out together to have an impact on company's ability to work efficiently. The more difficulties a company finds in achieving work efficiency, the lower the productivity [78, 79]. This will in turn make hiring less desirable and less affordable, causing more businesses not to hire.

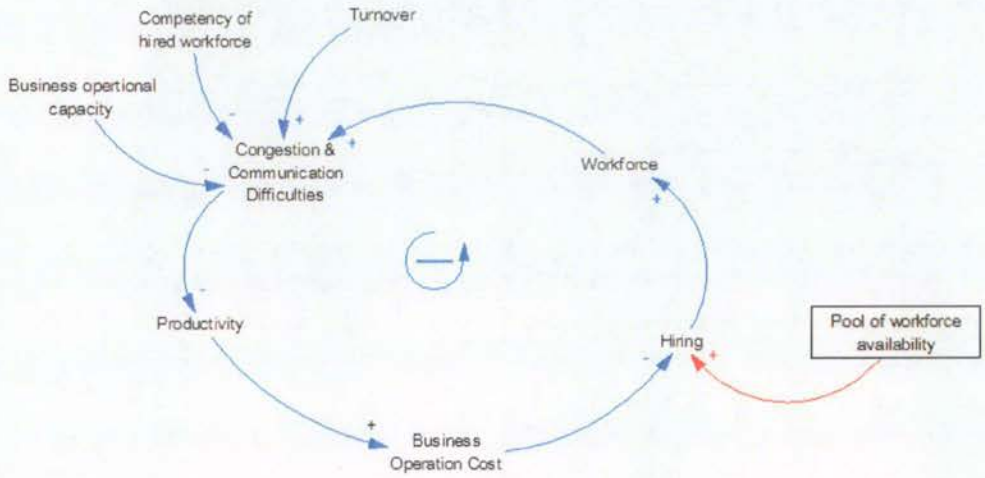

Figure 2: Changing business dynamics and relative nature of hiring

As mentioned earlier, the issues of rapid turnover and lack of competency are particularly found among the youth workforce. The implications from the dynamic model in Figure 2 are that the trend of recruitment is now moving to more temporary contracts on short-to-medium terms. However, there are economic and social consequences of the industry labour market in not delivering the supply of workforce at a rate to meet the required demand by employers [23, 80, 81]. In the meantime, construction organisations were understandably concerned about the risks of overcapacity in Christchurch. In particular, the risk of influx of a less experienced labour force and questions over the training buy-in from the industry were of concern.

6. Conclusion

The nature of reconstruction following a large disaster is often fraught with uncertainties, leading to pronounced fluctuations in its demand [50]. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in

relation to the employment demand and supply in the Canterbury recovery from 2010/11 earthquakes. In particular, the limited engineering and project management capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies.

It is difficult to separate pre-existing contributing factors that influence construction skills problems from those of the effects of reconstruction demands. Comerio suggested that disasters do not completely change pre-disaster economic conditions; instead they simply magnify trends or conditions in place before disaster strikes [82]. As shown in this research, the Canterbury earthquakes and the reconstruction demand had brought about fluctuations in the economic cycle. However, the pre-event issues such as the high staff turnover rate, competency of hired workforce, organisational culture and company retention ability still played a dominant role impinging upon the practice of human resource management of construction organisations in disaster recovery projects.

The dynamic models developed in this research provide visual directions for decision makers and construction organisations to implement supporting measures for improved capacity and capability for ongoing reconstruction. The study offers an improved understanding of disaster effects on the construction skills needs and of changes in the skills requirements post-event, enabling better future industry preparedness for a similar event. It is suggested that the design of policy instruments in managing human resources in Christchurch should be informed by a continued investigation of the dynamics that mediate between policy objectives and outcomes over time.

More than that, the study makes the case for a new approach to looking at resourcing problems following a major disaster. Those methods that are based on neoclassical economics and deal mostly with the larger economy tend to consider resource availability as a consequential result of market processes. The systems approach used in this research demonstrates that for enhancing the reconstruction capability in complex post-disaster settings, an organisational perspective should be considered in the decision making, which explains both internal resourcing dynamics and the linkages between construction organisations and the wider recovery environment.

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Resilient ORGANISATIONS

A collaboration between research & industry

Resourcing the Canterbury Rebuild

Case studies of construction subcontractors recruitment and retention strategies

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Resilient Organisations Research Report 2015/02

April 2015

About the Resilient Organisations Research Programme

"Building more resilient organisations, able to survive and thrive in a world of uncertainty, through research and practice"

We live in an increasingly complex world dealing with a broad spectrum of crises arising from both natural and man-made causes. Resilient organisations are those that are able to survive and thrive in this world of uncertainty.

Who we are:

The Resilient Organisations Research Group (ResOrgs) is a multi-disciplinary team of over thirty researchers and practitioners that is New Zealand based and with global reach. A collaboration between top New Zealand research Universities and key industry players, including the University of Canterbury and the University of Auckland, ResOrgs is funded by the Ministry of Business, Innovation and Employment through the Natural Hazards Research Platform and supported by a diverse group of industry partners and advisors. The research group represents a synthesis of engineering disciplines and business leadership aimed at transforming organisations into those that both survive major events and thrive in the aftermath.

We are committed to making organisations more resilient in the face of major hazards in the natural, built and economic environments. Resilient organisations are able to rebound from disaster and find opportunity in times of distress. They are better employers, contribute to community resilience and foster a culture of self-reliance and effective collaboration.

What we do:

The ResOrgs programme of public good research is aimed at effective capability building through research activities with significant impacts on policy and practice. Activities and outputs of the group, in existence since 2004, include informing and focusing debate in areas such as Civil Defence Emergency Management, post-disaster recovery, and the resilience of critical infrastructure sectors, in addition to core activities in relation to organisational resilience capability building and benchmarking. We have produced practical frameworks and guides and helped organisations to develop and implement practical resilience strategies suitable to their environment.

Why we do it:

In an increasingly volatile and uncertain world, one of the greatest assets an organisation can have is the agility to survive unexpected crisis and to find opportunity to thrive in the face of potentially terminal events. We believe such resilience makes the most of the human capital that characterises the modern organisation and offers one of the greatest prospects for differentiating the successful organisation on the world stage. This resilience is typified by 20/20 situation awareness, effective vulnerability management, agile adaptive capacity and world class organisational culture and leadership. More resilient organisations lead to more resilient communities and provide the honed human capital to address some of our most intractable societal challenges.

For more information see our website: www.resorgs.org.nz

Executive summary

This report focusses on how employers' behaviours have changed in response to employment demand and supply for the Canterbury rebuild and recovery. The study in this report looks at the ways in which construction subcontracting businesses develop their resource capability, and the recruitment and retention strategies being adopted by Canterbury rebuild subcontractors. The challenges subcontractors are facing during the rebuild and their resourcing policies and practice are also examined.

Through case studies of 13 subcontractors, this study shows the extent to which subcontracting businesses account for workforce development in the construction industry in Canterbury.

The main findings are:

- Subcontractors tend to have a limited financial resource base and limited internal knowledge base. Their size of business operations and capacity is relatively small compared to larger contractors. Subcontractors are particularly vulnerable to market forces and fluctuating workflows, but they tend to have close links with the local communities.

- The scale of reconstruction tasks and increased workloads from new subdivisions has created skill shortages, particularly for drainlayers, excavator operators, plant/machine operators and truck drivers. Project management and general labouring are also in short supply within the subcontracting sector.

- Lead times needed to train a drainlayer to be qualified, coupled with the labour market test required for overseas drainlayers to work in New Zealand, are cited as reasons for the shortage of this resource. In contrast, plant operators and truck drivers are in undersupply largely due to the high turnover of new recruits, particularly among the younger workforce.

- There have been significant changes in subcontractor resourcing practices that have emerged following the Canterbury earthquakes. These include:

    - newly stated visions and/or commitments to providing job security for employees;

- a shift from casual employment to more permanent employment;
- mechanisms for staff retention;
- improved human resource management systems; and
- investment in workers' skills and capacity development.

- On-going issues related to the construction industry's structure, such as an aging workforce, long lead times for training, high turnover (30% on average), and a lack of integrated workforce planning across the sector are all particular challenges that make workforce planning for subcontractors more difficult and increase their costs of recruitment and training.

- Some subcontractors are fully involved in infrastructure-rebuild related works, while others have reduced their rebuild commitments to focus on more business as usual projects. Overall there has been a shift in focus from 2013 to 2014 away from the horizontal rebuild towards work on new subdivisions in the Canterbury region.

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1. Introduction

This study examines:

- Characteristics of the construction subcontractor businesses in Canterbury;
- The key resource challenges that subcontractors are encountering;
- Solutions adopted by subcontracting businesses to overcome these challenges

Following previous resourcing case studies of construction organisations in Christchurch (Chang-Richards et al., 2014), this study concentrates on the subcontracting sector. The case studies, which include interviews from a range of subcontracting businesses, provide a better understanding of the reality that construction employers and workers face in the subcontracting sector. The research findings with regard to key emerging issues facing subcontracting businesses were reported in Resilient Organisations Research Report 2015/03 (Chang-Richards et al., 2015). This report presents the resourcing strategies adopted by Canterbury rebuild subcontractors.

2. About the case studies

The case studies were selected in consultation with Christchurch employers organisations such as the Canterbury chapters of the Specialist Trade Contractors Federation and the New Zealand Building Subcontractors' Federation. A sample of 30 subcontracting businesses was drawn. The initial list was then reduced, based primarily on whether the company is involved in civil works for the infrastructure rebuild in Christchurch and the company's willingness to be interviewed in depth. However, other considerations such as the diversity of companies in terms of size, type of business, years in business and form of labour were also taken into account. In total, 13 subcontracting business were studied (Table 1).

The companies are all located in the construction subcontracting sector. Companies who were engaged in civil works for the infrastructure rebuild were chosen. Organisations with between 1 and 200 employees were selected, with most case studies having less than 50 employees.

Table 1: Basic profile of case study subcontractors

Case study subcontractors	Number	Organisational coding
Business ownership category		
Family business	4	S1, S2, S7, S11
Incorporated	3	S3, S9, S13
Incorporated family	3	S4, S10, S12
Limited company family	3	S5, S6, S8
Organisational size		
Micro-sized (Emp≤10)	3	S1, S2, S7
Small-sized (Emp≤50)	7	S3, S5, S6, S8, S9, S11, S13
Medium-sized (50 <Emp≤100)	2	S10, S12
Large-sized (Emp>100)	1	S4
Years in business		
Less than 10 years	1	S13
10-20 years	3	S1, S9, S11
21-30years	3	S3, S6, S7
31-40 years	2	S5, S12
More than 40 years	4	S2, S4, S8, S10

Note: Emp denotes the number of employees

Face-to-face interviews with 13 subcontractors were conducted in Christchurch between May and June 2014. Respondents were asked to describe:

- The characteristics of the construction subcontractor businesses in Canterbury;
- The key resource challenges that subcontractors are encountering;
- Solutions adopted by subcontracting businesses to overcome these challenges.

3. Subcontractors resourcing challenges and response strategies

3.1 Critical skills that are in short supply

Case study subcontractors reported that the scale of the reconstruction tasks and their increased workloads from the new subdivisions imposed skills shortages such as for drainlayers, excavator operators, other plant/machine operators and truck drivers. Case study organisations noted that although drainlayers were added to the revised Canterbury Skill Shortage List (CSSL), many of the overseas trained drainlayers are not readily employed and required a full labour market test process (i.e. an employer advertising to demonstrate that there are no New Zealand citizens or

residents available or trainable for the position on offer) to be able to take up opportunities locally.

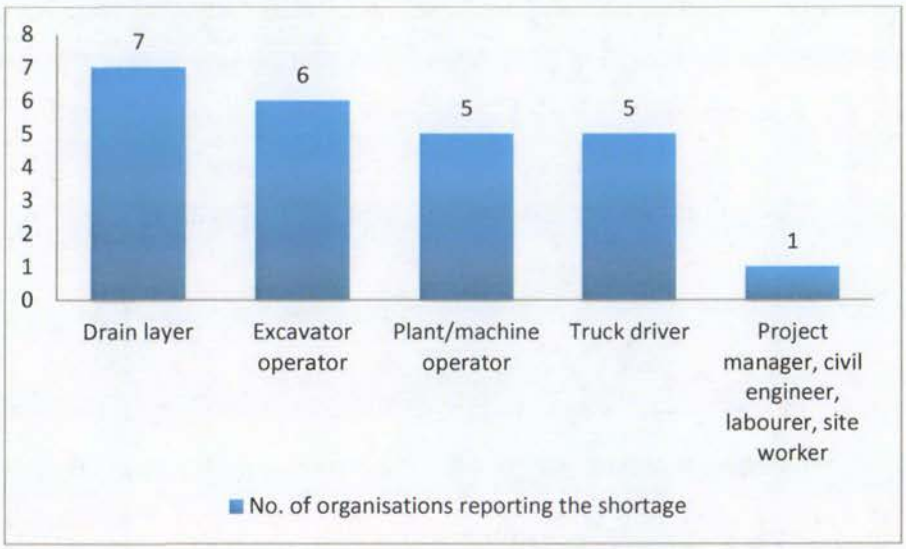

Figure 1: Reported human resources that are in short supply by case study subcontractors

Results show that a shortage of qualified labour to operate machinery was a prominent issue. Our previous case studies found that plant operators in general, and excavator operators in particular, along with truck drivers, are in short supply largely due to the high turnover of new recruits, particularly among younger workforce (Chang-Richards et al., 2014). The subcontractors reinforced this point, and S3 explained that

> '*The job of operating a machine or driving a truck is repetitive. The new trainees soon find that this is not the type of job which is exciting and rewarding. They often have to work non-regular hours, which is a disruption to their life styles.*' (Subcontractor S3)

Among those who reported the shortages of machine operators (S1, S3-S6, S8-S12) and truck drivers (S3, S6, S9-10, S12), four subcontractors (S3, S9, S10, S12) emphasised that the market has become more competitive where workers are able to bargain for higher pay. Poaching and turnover have occurred more frequently as companies are desperate to acquire these skills.

The shortage of project managers (S4), civil engineers (S9), labourers (S11) and site workers (S12) were also reported.

In terms of increasing their skills base, subcontractors S4, S9 and S12 had plans for expansion either through market penetration or by diversifying their service range. For instance, subcontractor S4 made a decision in 2012 to increase its skills base to support their strategy to diversify their business into other domains (civil construction, conservation and environment). Having successfully expanded, the company found that the management skills, especially project management expertise, became an increasingly important required skill. Project managers with at least 3 years' experience were added onto their resource requirement in 2014.

3.2 Resourcing response strategies used by case study subcontractors

Case study organisations were also asked how they solved their skills shortages. Typical responses included; steps taken to recruit or buy-in ready-trained staff from the labour market (either domestic or overseas); training and developing existing staff; or, in most cases, a combination of both. Subcontractors also improved their business practices.

Table 2 shows details of the resourcing response strategies applied by case study subcontractors according to the following criteria:

- Commitment to providing job security for employees
- Casual employment replaced by more permanent employment
- Established mechanisms for staff retention
- Established human resource management systems
- Investment in workers' skills and capacity development

Table 2: Examples of resourcing measures to improve capability of case study subcontractors

Resourcing response strategies	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
Commitment to providing job security for employees	√				√								
Casual employment is replaced by more permanent employment													
Reduced number of casual and/or temporary employment	√					√	√			√			
Increased permanent employment	√	√			√	√	√			√	√		√
Investment in recruiting	√	√			√	√	√	√	√	√		√	
More structured and organised contracting process for new employees	√	√			√	√	√	√	√	√	√		√
Buy-out recruits from recruitment agencies							√						
Established mechanisms for staff retention													
Increased communication in order to be tuned to workers needs and concerns			√					√			√		
Increased internal promotion	√		√										
Offering market rates of pay			√	√	√								
Offering other welfare/wellbeing related benefits		√	√	√	√								
Good conditions/environment of work	√			√									
Delegating and empowering staff		√		√				√		√			
Established human resource management system													
More regular and standardised performance review					√						√		
Designing clear career path for employees					√								
One-on-one mentoring schemes								√					
Multi-skilling and skill diversification schemes				√		√							
Regular team building											√		
Investment in workers' skills and capacity development, particularly investment in:													
In-house skills training of existing staff and new recruits	√	√		√			√	√	√			√	√
IT facilities and expanded premises										√			√
Knowledge transfer between senior staff and younger or less-experienced staff			√			√		√					
Providing internship or apprenticeship for secondary school students or school leavers					√								
Providing access to ITOs/BCITOs training courses				√					√				

3.2.1 Casual employment replaced by more permanent employment

Although a certain level of informality still exists in their approaches to sourcing needed workers, most of case study subcontractors reported a shift in recruitment strategies. Rather than being work-focused to win contracts, most of them now had a people-focused vision; a vision to focus on clients and employees in order to sustain business. Creating a stable workforce was a key goal. As subcontractor S1 highlighted:

> "*It's a big learning curve from the depression to such a boom. Coming out fresh from perhaps the most depressing time we have ever had in 2009; we had a better understanding of the internal and external factors that influence the survival of our business. We are conscious of the fact that a good, well-organised company attracts people and also attracts clients. Only by maintaining good relations with our clients and providing security for our people, can we gain the competitive advantage over others. This advantage can endure the test of time.*" (Subcontractor S1)

Before they started to take on any jobs related to the rebuild, a formal or informal skills audit was undertaken within some organisations. Sources of information for such a process included consultation with existing staff, job descriptions for the essential experience needed for a post, identifying deficiencies in skills that cause problems for the business, and the company's business plan for growth.

3.2.2 Changing patterns of subcontractors' use of different forms of labour

Many construction employers have historically used temporary workers as a relatively cheap and flexible form of labour (Forde & MacKenzie, 2007; Lobo & Wilkinson, 2008; MacKenzie, Kilpatrick, & Akintoye, 2000). There is still evidence of interest in using non-permanent labour. Those who used temporary labour reported that the prominent reasons for employing temporary workers were oriented around flexibility, such as providing short-term cover, fulfilling one-off tasks, easy adjustment of staffing levels and reducing the risk of high cost caused by high turnover.

However, some companies reported a retreat from temporary contract forms following the earthquakes. Indeed, 8 out of 13 subcontractors had a tendency to provide more permanent

employment to fill existing vacancies or to meet employment needs in the foreseeable future. However, four subcontractors reported making a conscious move towards the recruitment of temporary workers in meeting peaks of demand. Problems in recruiting suitably skilled direct labour were cited by these four subcontractors as a reason for employing temporary workers whom they usually source from recruitment agencies.

The subcontractors suggested that the majority of those undergoing the change from non-permanent labour forms of employment towards direct employment had put in place a more structured and organised contracting process for new employees. The most commonly cited reason for increased permanent recruitment was maintaining control over the quality of work. Some subcontractors (e.g. S1, S6, S7 and S10) found casual labour required more supervision and produced poor quality work which required costly rework. When found to be competent, temporary workers were offered permanent contracts. Subcontractor S7 offered a 'buy out' package to the recruitment agency for a temporary worker whom they found 'extremely competent and reliable' and the company went on to offer the worker a permanent position.

3.2.3 Established mechanisms for staff retention

Most subcontractors found that keeping specialised skills within the company was fundamental to the survival of their business. More than half of subcontractors focused on a three-dimensional retention strategy:

- Offering competitive pay
- Welfare- or wellbeing-related initiatives to improve job satisfaction
- Ensuring safe and pleasant workplace conditions

For instance, festivals, BBQs and other social events which include the entire staff, create opportunities for further interaction and loyalty-building between the company and workers.

Additional retention strategies included setting up effective forms of in-house communication between the management and workers (S3, S8 and S11). S8 has a policy whereby *ad hoc* discussions can be initiated by either workers or managers; and management has instituted

regular talks between the director of the company and every worker, where workers can raise any issue. S3 and S11 have instituted meetings at different levels. For instance, as S11:

> "*There is value in gathering together on a regular basis, regardless of whether a specific issue needs to be addressed. We found that workers are more open to us in terms of their interests, their needs and concerns. We are now instituting some channels of communication; we used to have periodic meetings between supervisors and workers which only address work-related issue; now we have periodic management-staff meetings to allow inputs of common concerns and to share ideas.*"

S1 and S3 felt it was particularly important to retain skilled workers through internal promotion and development. Several advantages were recognised by the interviewees, frequently in terms of the loyalty generated from staff appreciating the promotion and/or development opportunities. Subcontractor S1 and S3 considered internal promotion, along with internal development, as an important aspect towards staff. In particular, S3 highlighted that:

> '*Disaster recovery projects are often executed more quickly than most professionals are used to. The time needed to recruit externally can be problematic especially when local staff are hard to find, or cost above-average rates, or have to be transported from further afield. This is where internal development scores much higher than external recruitment. By providing a clear career path, along with an action plan for our existing staff, they see a clearer picture of where they can go in the future.*"

In several of the subcontractors studied (S2, S4, S8 and S10), workers are regularly informed of what is happening within the company. The objective of this, according to the subcontractor S10, is to get staff to be involved in strategic initiatives and take ownership of the changes brought about by certain initiatives. Subcontractor S8 also emphasised that they have changed their focus of attention from what the business wants to achieve, to how to get employees to help the business. Delegation and empowerment were cited as key aspects of this culture shift.

For instance, management at subcontractor S4 made effective delegation a priority, with positive results. Interviewee S4 expressed confidence in workers being involved in operational decision-making, including allowing some workers to decide how much overtime they would like to work and letting them to deal with issues with clients the way they think appropriate. Subcontractor S4

reported that the company has benefited from a high number of worker referrals of new recruits and the relatively low turnover rate; these have reduced recruitment and retention costs for the company. Similarly, other firms allowing delegation and empowerment of staff also benefited from lower staff turnover. Subcontractor S4:

> '*We used to follow a very paternalistic approach to managing our people, providing sufficient welfare as the basis of building trust in the company. We kept losing good people... But now we provide delegation, promoting the prospects of secure employment and development opportunities that we can offer by valuing their potential and input in every decision we make.*' (Subcontractor S4)

3.2.4 Established human resource management system

Among the 10 small-sized subcontractors (See Table 1), 8 have what could be referred to as a formal human resources policy. There are differences in detail and degree of formalisation, depending on the size of the workforce, the business environment and the management style. Subcontractors S5 and S11 reported to be in the process of transition to adopting a formal human resources policy. The most common evidence of more formal human resources management policies, as cited by the subcontractors studied, was the introduction of employee trial periods and the introduction of some form of employee induction guidelines which provides guidance to new workers on terms of reference and the rights and obligations of both employer and employee. Their key objective was to clarify expectations on both sides and provide new workers with a good orientation of the organisation and business undertaken.

There were 6 subcontractors using a probationary period to ensure that the candidate is suitable. For most of them, the choice to remain relatively flexible by having a three month trial is due in part to an unstable business environment, high turnover of workers and concerns about high operational costs if an unsuitable worker is employed. For instance, subcontractor S9 had experienced high turnover of truck drivers in 2013 as a result of heightened market demand at the time and consequently has been reluctant to accept candidates who only look reliable on the CV. On the other hand, subcontractor S12 is contemplating a more formal system which would

include a recruitment policy and a career development plan to enable the firm to retain committed truck drivers and to develop rules for the disengagement of non-performing workers.

When asked what additional systems were put in place or what changes had been introduced since the Canterbury earthquakes to better manage people, subcontractors gave the following examples:

- Performance appraisal and the reward system (S5, S11)
- New workers support system (S5, S8)
- Skills development system (S4, S6, S11)

The smaller subcontractors studied generally commented positively on the outcome of good performance and reward in terms of motivating workers. Subcontractors S5 and S8 amended their appraisal system by introducing more clearly defined procedures. The learnings they had before became inputs into their new systems, as subcontractor S8 commented:

> '*Our previous system only involved managers who conducted semi-formal individual appraisals based on criteria like employee performance, discipline, attendance and other attributes. It seemed to create low motivation and competition among staff, rather than collaboration. Now our system is more formal, transparent and inclusive. We introduced a three-step performance appraisal process: first workers appraise themselves; then supervisors appraise workers and lastly workers and supervisors meet to discuss and agree on the appraisal. It works pretty well, and avoids discord among staff.*'

Two subcontractors studied had added support systems for new employees. For instance, management at S8 have introduced a one-on-one mentoring scheme for new workers to build up the skills by pairing each with one senior member. An action plan was provided which lists the critical skills and knowledge that the new worker should acquire and the expected completion dates.

The majority of subcontractors had undertaken work for the Stronger Christchurch Infrastructure Rebuild Team (SCIRT), and relied on the alliance for organising the allocation of work. However, a number of companies recognised the need to prepare for future markets when the alliance terminates. Several businesses (e.g. S4, S6 and S11) have begun to diversify the range of

services. Multi-skilling or the diversification of expertise was added to their skills development for existing staff. In particular, subcontractor S11 tried to instil a life-long learning culture in its skills development programme. As S11 commented:

> '*Both the company and our people have learned from the past volatile situations that as individuals, you've got to help yourself, build up your skills, and diversify your expertise. It can open up more opportunities for you and the company when times become bad.*'

10 out of 13 studied subcontractors indicated that one of the learnings from the global financial crisis is good selection and staff development strategies as essential prerequisites for efficient business performance. This was thought of as ineffective unless backed up by carefully designed reward system to suit employees' needs. As subcontractor S8 indicated:

> "*This was where we went wrong ... cutting corners by offering minimal wages or very basic other benefits, then experiencing enormous levels of staff turnover, which blew our operating costs through to the roof.*"

Most studied organisations realise that fair rates of pay and good working conditions must be sufficient to attract staff, to retain them and to motivate them to willingly contribute to achieving the goals of the organisation. Following the Canterbury earthquakes, nearly half of case study organisations had invested in their internal systems. Some examples included:

- Job-based pay with regular reviews to encourage loyalty and stability in the workforce
- Keeping an eye on local wage rates so that rates of pay can be aligned with the market level
- Upgrading the payroll systems
- Offering other benefits such as medical and health insurance, uniforms, pensions, annual leave, cover for sickness etc.

3.2.5 Investment in workers' skills and capacity development

In most of the subcontractors studied, skills development was done by in-house training. Where training policies exist, most of them are designed to provide the company with the minimum requirements needed to retain a productive workforce. Budget constraint was the most

commonly cited reason for subcontractors not being able to provide employees with the access to external training courses (course offered at Christchurch Polytechnic Institute of Technology (CPIT) and/or other Building and Construction Industry Training Organisations (BCITO)). The two subcontractors S4 and S9 who were able to do so were more well-established companies in Canterbury region. Subcontractors (S3, S5, S6, S11) reported that some of the training programmes from which their employees could benefit were offered by SCIRT, as the alliance team has a strong orientation for skills development.

Although facing budget constraints, more than half of the studied subcontractors reported that they have increased investment in training-focused skills development since the earthquakes. Subcontractors S3, S6 and S8 particularly emphasised the importance of internal knowledge transfer from older generation to younger ones through internally organised training or mentoring programmes. The subcontractors studied had expressed their concern about the potential knowledge gap that exists between the senior workers of near-retirement age and young workers in their 20s and early 30s. Subcontractor S4 commented that:

> '*Over the past decade in particular we have seen a larger skills vacuum in the industry where more and more senior people have retired and not many young workers have caught up in skills. Aging problems become more prominent. This knowledge gap has become wider as the earthquake rebuild requires more specialised expertise which cannot be simply fast tracked.* '

It was found that a lack of knowledge transfer at the firm level largely derives from the need to minimise disruption to the senior staff member's work. Previous case studies of construction organisations in Canterbury show that companies were generally concerned that knowledge transfer which takes the form of on-the-job training can affect the productivity performance of core personnel who offer training (Chang-Richards, Wilkinson, Seville, & Brunsdon, 2013; 2014). Subcontractors are now becoming more selective in offering one-on-one skills training to those who show longer-term commitment to the company.

There is a growing recognition of the importance of operational capacity development to business expansion. Subcontractors S10 reported that a doubling of their workforce since the earthquakes has created a proportionate increase in the administration system, to ensure that

payslips go to employees on time and that tax is paid promptly. Subcontractor 13 commented that:

> '*At the beginning of the rebuild, we were excited about the opportunities ahead of us to revive the business from recession. We were too much focused on the human side of resourcing, while forgetting the other management systems to organise and co-ordinate this. It is not simply employing an extra administrative assistant, but also the need to upgrade the computerised accounting systems and training staff to operate it. Getting an assistant might take a few days but getting the systems right can take weeks or months to become fully functional.*'

Subcontractors S10 and S13 reported that they have upgraded of their IT facilities and relocated to a new office premise to accommodate expanded workforce.

8 out of 13 subcontractors raised the need to engage prospective school leavers in secondary school to join the construction workforce. However, only 1 subcontractor, S5, had an internship programme in place. Such internship is offered to secondary school students who might want to consider work in the construction field in the future. However, recruitment was carried out informally through employees, families and friends. The biggest barrier to implementing such a programme widely in Christchurch, according to subcontractor S5, was that internship may involve issues beyond construction, such as safety and health of interns, costs and closer supervision.

4. Conclusion

This report has collated information about the resource challenges faced by the studied subcontractors in Christchurch. The cases indicate that the majority of subcontractors made conscious efforts to put in place policies and practices that create a competent workforce and motivate workers to contribute to business performance.

The resourcing strategies adopted by subcontractors (e.g. investment in skills development, skills diversification, using causal or permanent workers) are shaped by their own characteristics and a range of internal and external factors. Overall, business strategy and a vision to achieve a sustainable business appear to be driving forces for investment in employment and skills development. Having been through the challenges of the Canterbury earthquakes, most subcontractors realised that having a productive and competent workforce is the key to creating quality work and a sustained client base in a small company. Some of the issues identified in this report, such as high turnover, youth employment, lack of knowledge transfer, and lack of investment in training and skills development, need to be addressed in a more systematic way.

Annex: Profiles of studied subcontractors

Company code	Year established	Ownership structure	No. of Emp	Products/services	Market	BAU Vs. EQ-related	Pinch resources	Resourcing strategies	Business strategies
S1	1999	Family business	7	Commerical machine laid kerb and channel for roading Subdivisions and car parks	Canterbury	80%:20%	• Excavator operator • Kerb & channel machine operator	• Ensuring job security • Recruitment on a permanent basis • Investment in training and offering promotion to identified 'loyal' staff •Good conditions of work	• Strong client oritentation • Expanding client network • Quality improvement of workmanship
S2	1968	Family business	10	Drain laying and maintenance Manhole installation Trench shield work and excavation	Canterbury	100%:0%	Drain layer	• Investment in recruiting and training local young people • Empowering workers to take initiatives • Good benefits	• Strong brand/reputation • Improving company-wide communications
S3	1985	Incoproated	45 (30 in Chch)	Drainage/pipe laying Sheet piling/trench shields Pump stations and manholes Dewatering Pipe bursting and thrusting	Hamilton Christchurch	10%:90%in Christchurch	• Excavator operator • Truck drivers • Civil pipe-layer/drain layer	• Retaining mature staff aged between 30 and 50 • Encouraging knowledge transfers among staff	• Service diversity • Market expansion
S4	1950	Incoporated family	190	Construction, surfacing, bitumen products, transport, quarrying, contract management services	South Island	80%:20%	• Excavator operator • Drain layer • Project manager	• Reduced recruitment and increased retention and skills development • Improved career path • Good conditions of work	• Forming long-term relationship with other subcontractors • Product and service diversifaction • Regular review of business plan
S5	1983	Limited company Family	16	Construction of driveways, vehicle crossings, car parks and small subdivisions Asphalt Laying and excavations	Canterbury	30%:70%	• Drain layer • Excavator operator	• Retaining family-committed staff aged between 25 and 40 • Strong preference for recruiting local people in Christchurch • Fast track of career path • Good pay at the market rate and other benefits	• Maintain the current size of the company • Maximise business stability • Build good reputation • Employee multi-tasking
S6	1984	Limited company Family	50	Drainage, subdivision, traffic management, project management, quantity surveying, road infrastructure and bridge construction	Canterbury	15%:85%	• Truck driver • Excavator operator • Drain layer	• Recruit staff in other newly established services (e.g. electrical services, dairy effluent disposal design and resource consenting application) • Investment in recruiting by using Big Splash and Hayes & Stellar recruitment agency • 2 weeks probationary period	• Reduce rebuild-related work from 85% to 15% by end of 2015 • Expand client base • Diversity services • Instil corporate structure with family values • A possible partnership by joint venture

								• An information sharing policy for knowledge transfer	
S7	1985	Family business	4	Drainage	Canterbury	10%:90%	Drain layer	• Recruting through recrtuiment agencies and 'buy out' good recruits from them • Direct in-house training provided by directors • Prefer to recruit workers aged between 30 and 50	• Joint venture with a local main contractor and be in charge of the drainlaying jobs • Adding Health and Safety into training schemes
S8	1954	Limited company Family – a subsidiary of Fletcher	31 in Chch	River and marine works Engery pipelines, civil structure and foundation work	Auckland Hamilton Wellington Canterbury	55%:45%	• Plant/machine operator	• Having a mentoring and knowledge transfer scheme for new staff • 250 hours of on-job-training before employees are permitted to undertake unsupervised work • Using recruitiment agencies for recruirting temporary staff	• Gradually reducing the rebuild-related work and increase the BAU road contracts from NZTA • Having access to all benefits provided by Fletcher
S9	1998	Incoproated	40	Ground remediation, excavation and other earthworks Driveways and footpaths Foundations, retaining walls Civil construction Truck and excavator hire	Canterbury	70%:30%	• Truck driver • Plant operator • Civil engineer	• Using recruitiment agencies to find skilled engineers and machine/plant operators • Recruitment from Ireland • Encoruaging workers to achieve higher qualifications and participate in Health and Safety training	• Improving relationships and form partnership with other companies • Exploring the potential of recruiting secondary school students
S10	1955	Incoporated family	57 (9 based in chch)	Civil construction in roading, subdivisions, drainage, water reticulation, site works, traffic management, aggregate supply, transporting, landscape supplies	Whanganui Canterbury	0%:100% in Christchurch	• Truck driver • Plant operator	• Relocating staff from Whanganui office • Recruiting people from other cities of NZ and from overseas • Strong perference for employees aged between 25 and 40	• Building presence and reputation in Canterbury • Diversifying client base
S11	1999	Family business	11	Construction, surfacing and maintenance, bridge maintenance and construction, civil construction and commercial works	Canterbury	25%:75%	• Machine operator • Labourer	• Strong perference for recruting locally through 'Word of Mouth' • 'Equal productivity' policy to increase staff morale and reduce animosity • Rapid growth of staff • Relationship building activities between managers and staff	• Expanding client base by including major consturction companies • Strong barnd/reputation • Quality improvement of workmanship
S12	1979	Incoporated family	90 (50 based in chch)	Subdivisions, road works, site clearance, house foundations, drainlaying, landscaping, and forestry work	Canterbury (Timaru and Christchurch)	85%:15%	• Excavator operator • Site worker • Truck driver	• Intensive in-house training other workers to become skilled excavator operators • Strong preference for local recruits • Using recruitiment agencies for recruiting temporary staff	• Christchurch office established after the earthquakes • Relationships formed with large contractors in the SCIRT Alliance team

									• Increase the workloads from new subdivisions in Christchurch
S13	2008	Incoproated	20	Pipe and drainage	Auckland Christchurch	0%:100%	Drain layer	• 90 day trial for new recruits • Strong preference for candidates with interpersonal skills • Increasing organisational capacity to attract local people	• Semi-alliances with Christchurch subcontractors • Investment in building company capacity (premises, facilities) • Increasing the subdivision work by end of 2014

Note: BAU denotes business as usual; EQ denotes earthquake; Emp denotes employment

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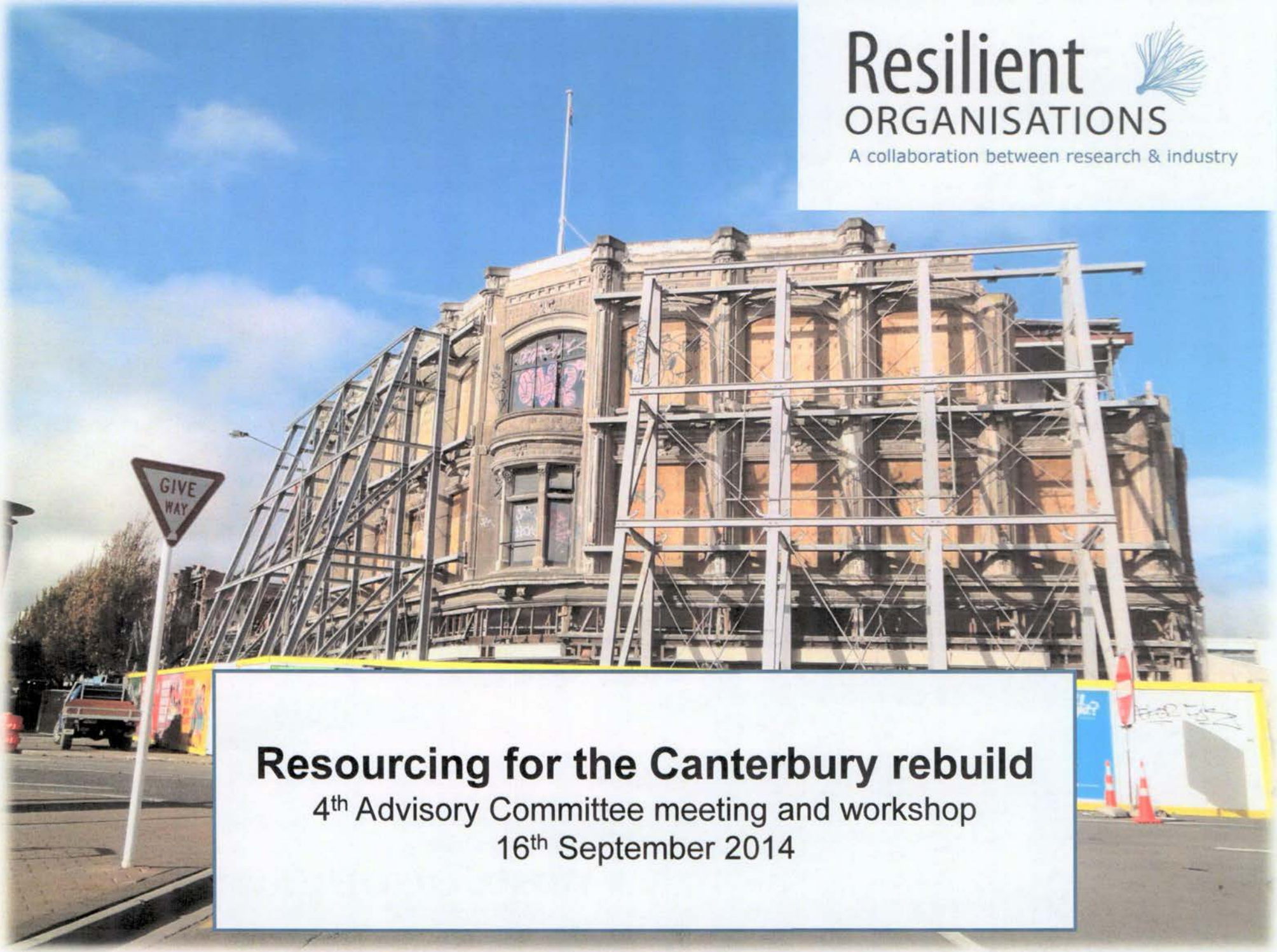

Resourcing for the Canterbury rebuild

4th Advisory Committee meeting and workshop

16th September 2014

Acknowledgement

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- Project sponsor:

BRANZ

EQC

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

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Fletcher EQR

Greg Slaughter
Stronger Christchurch Infrastructure Rebuild Team (SCIRT)

Former:

Robert Haig (MBIE), David Wood (Fletcher EQR), Sean Walsh (SCIRT)

Agenda

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This Advisory Committee meeting and workshop seeks to provide findings from Resilient Organisations' ongoing "Resourcing the Canterbury rebuild" research project and provide lessons from overseas disaster recovery efforts. The aim is to inform the current recovery process in Christchurch by providing up-to-date knowledge, as well as gaining the feedback from the project Advisory Committee.

- **Welcome and introductions** (Suzanne Wilkinson)
- **Update on the progress made and next steps** (Suzanne Wilkinson and Alice Chang-Richards)
- **Presentations on emerging issues: learnings from international experience** (Suzanne Wilkinson and Alice Chang-Richards)
- **Findings from the case studies of Christchurch construction organisations** (Alice Chang-Richards)
- **Feedback session from workshop participants: top resourcing challenges and emerging issues** (Erica Seville)
- **Guest presentation** (Amy McNaughton, Canterbury Development Corporation)
- **Other key events/outputs of Resilient Organisations** (Suzanne Wilkinson, David Brunsdon, Alice Chang-Richards, Erica Seville)

What did we aim to achieve for 2014?

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- ***Directions*** set at the 3rd Advisory committee meeting and workshop, 23rd July 2013

  - The Advisory Group will continue to lend support for this research project
  - Secure co-funding from MBIE and EQC
  - Continue case studies
  - Investigate emerging issues
  - Continue to feed information to key agencies CERA, MBIE, PMOs
  - Provide inputs into a collaborative effort of the building and construction industry with CERA and MBIE

What have we actually achieved in 2014?

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- ***Project to date***

  - Co-funding from MBIE (2 years) and EQC (1.5 years) starting from January 2014
  - Updated case study of construction organisations (15 existing relationships, 3 more)
  - Increased focus on emerging issues that are likely to affect the needs of rebuild (housing the workforce & cash-out rebuilds)
  - Inputs into the *Construction Sector Workforce Plan for Great Christchurch*
  - Re-sampling of case study organisations
    - engineering firms (8 firms)
    - subcontractors for civil construction projects (13 firms)
    - subcontractors for anchor projects (sample under development)

Deliverables 2014 summary

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- ***Report 1***: Assisting Self-Managing Rebuilding Owners in New Zealand to Rebuild their Homes
- ***Report 2***: Provision of temporary accommodation for construction workers: Learnings from Queensland post Cyclone Larry
- ***Report 3***: Case studies –workforce behaviour and business responses
- ***Conference paper*** based on the learnings from Christchurch with respect to workers accommodation was prepared for the 10th International Conference of the International Institute for Infrastructure Resilience and Reconstruction (IIIRR) - May 2014 at Purdue University, USA.
- ***Research paper 1*** regarding the issues of temporary housing in Christchurch was completed and submitted to Disasters journal for peer-review.
- ***Research paper 2*** regarding the case study learnings of construction organisations in terms of resourcing was prepared and will be submitted to a peer-reviewed journal soon.
- ***BRANZ Build article 1*** on skills issues has been published (Build 141).
- ***BRANZ Build article 2*** on self-managing rebuilding owners for house rebuild in Christchurch is being published (published Build).
- ***Project briefings*** in MCDEM e-bulletin July and August

Work in progress for 2014

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- In-depth case studies of organisations in one sector
  - **Case studies of subcontractors for civil construction projects** (reporting end of September 2014 – *data from 14 companies currently being analysed*)
  - **Case studies of engineering firms** (reporting end of November 2014 - *data from 8 companies currently being analysed*)
  - **Case studies of subcontractors for anchor projects** (a focus for 2014/15 – Imelda PhD; data collection will be undertaken in November 2014 -)

- Report on "Exit Strategy", Bush fire update in October 2014 (reporting in November 2014)

Plans for 2015

- Synthesis of research findings over the past 3 years.
- A report and a conference paper based on reviewing patterns of resource availability and recovery (Imelda, early 2015)
- Framework of resourcing strategies
- Continued case studies of construction organisations
- Investigation in emerging issues
- Stock-taking at 5th advisory Committee meeting in 2015

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Assisting Self-Managing Rebuilding Owners in New Zealand to Rebuild their Homes

Lessons for New Zealand from the 2009 Victoria Bush Fire Recovery

Self-managing rebuild

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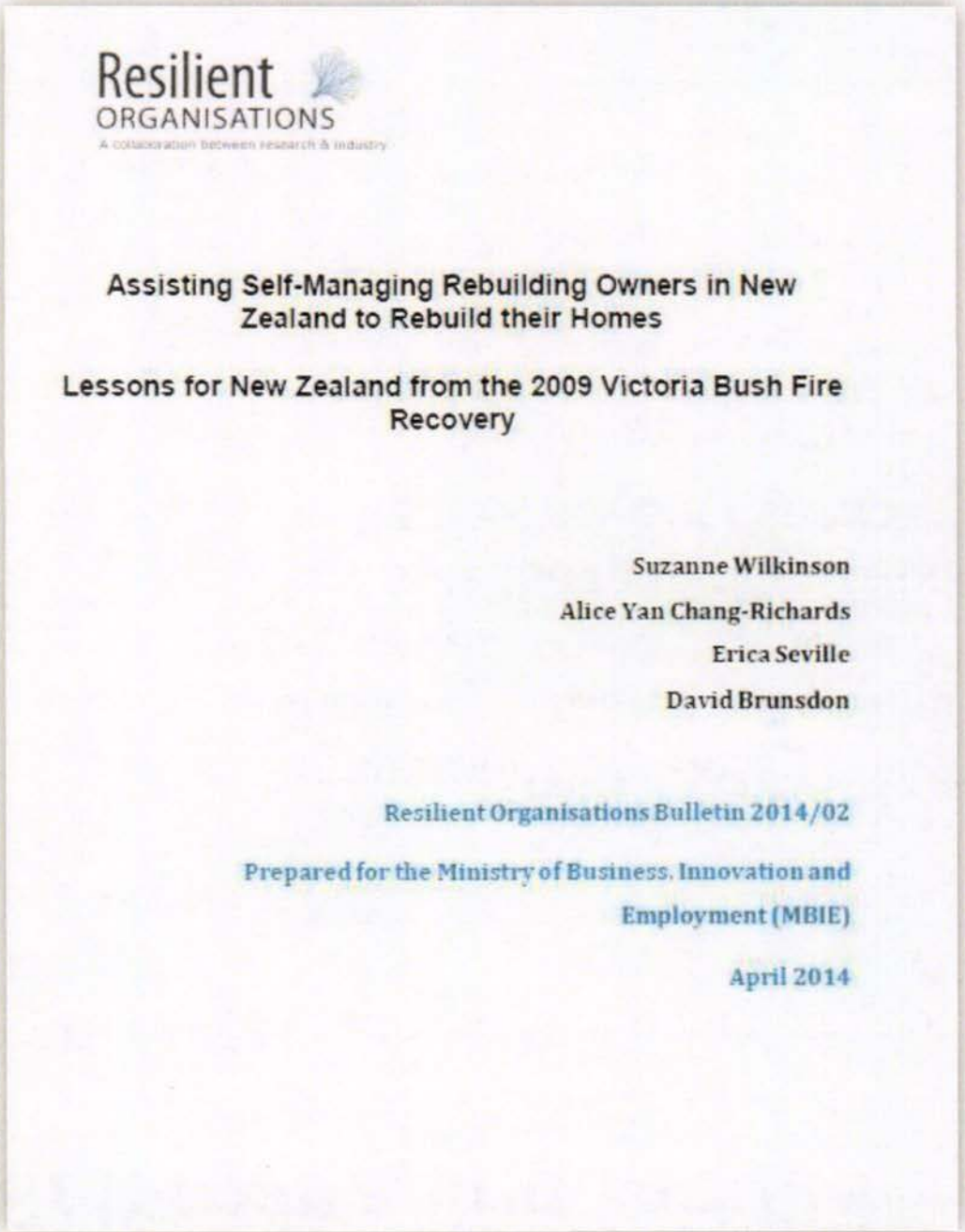
November 2013

- 5th field trip + research tour to Victoria, Australia
- learn from the longer-term recovery following the 2009 'Black Saturday' bushfires
- Interviews with Victorian Government & Murridindi Council
- Issues around self-managing rebuild owners
  - Increase stress
  - funding issue
  - quality and delay

Self-managing rebuild

- Relevance with Christchurch cash-out rebuilds
- Recommendations
    - An appropriately skilled advisory service to home owners who are interested in self-managing the rebuilding of their properties
        * take the form of an expanded RAS,
        * a new advisory service
    - A register of competent and accredited professional



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This report looks at the implications of learnings from bushfire recovery for Christchurch. Recommendations for better management of cashout rebuilds in Christchurch are suggested in the report.

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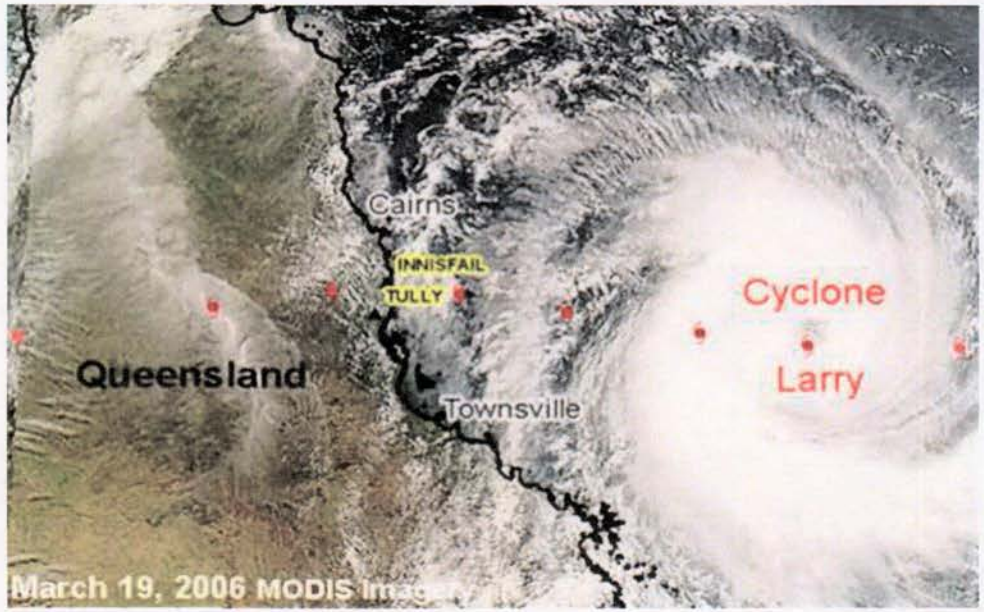
Provision of temporary accommodation for construction workers

Learnings from Queensland post Cyclone Larry

Relevance of Larry to Canterbury recovery?



- Severity of housing damage
  - **75%** of housing stock damaged in Chch
  - **15%-70%** of housing damaged in Qld
- Large demand for construction workers
- Effects of lack of "tradie" accommodation
  - inflation
  - displacement of low-income group
  - compounding skills shortage
  - time and cost implications for recovery

Location	Damage
Mareeba / Eacham / Millaa Millaa	93 damaged properties
Babinda	80% of buildings damaged
Flying Fish Point	15% of homes damaged
Innisfail	**50% of homes damaged** **35% of private industry damaged** **25% of Government buildings damaged (schools etc)**
Etty Bay	40% of homes suffered roof damage
East Palmerston	**70% of homes damaged**
Silkwood	worst affected location 99% of homes lost roofs or suffered structural damage
Kurrimine Beach	30% of homes damaged 15% of private industry damaged
El Arish	30% of homes damaged 50% of private industry damaged
Bingil Bay	30% of homes damaged
Mission Beach	30% of homes damaged 20% of private industry damaged 45% of caravan park damaged
South Mission Beach	20% of homes damaged 20% of private industry damaged
Jappoonvale	Possible tornado damage

PPP model for medium to long term housing assistance

A Public Private Partnership to provide accommodation for workers; integrated into assistance for cyclone-displaced residents

Queensland Govt (Dept of Housing and Public Works (DHPW))	• Lead role in the initiative • Source re-locatable temporary units • Obtain relevant approvals • Engage local councils
Local authority	• Identify the public and private lands • Provide and maintain services and facilities • Control tenancies by collating a register of needs for tradespeople and local residents
Private accommodation provider	• Provide land for placing temporary units • Tenancy management

Larry lessons

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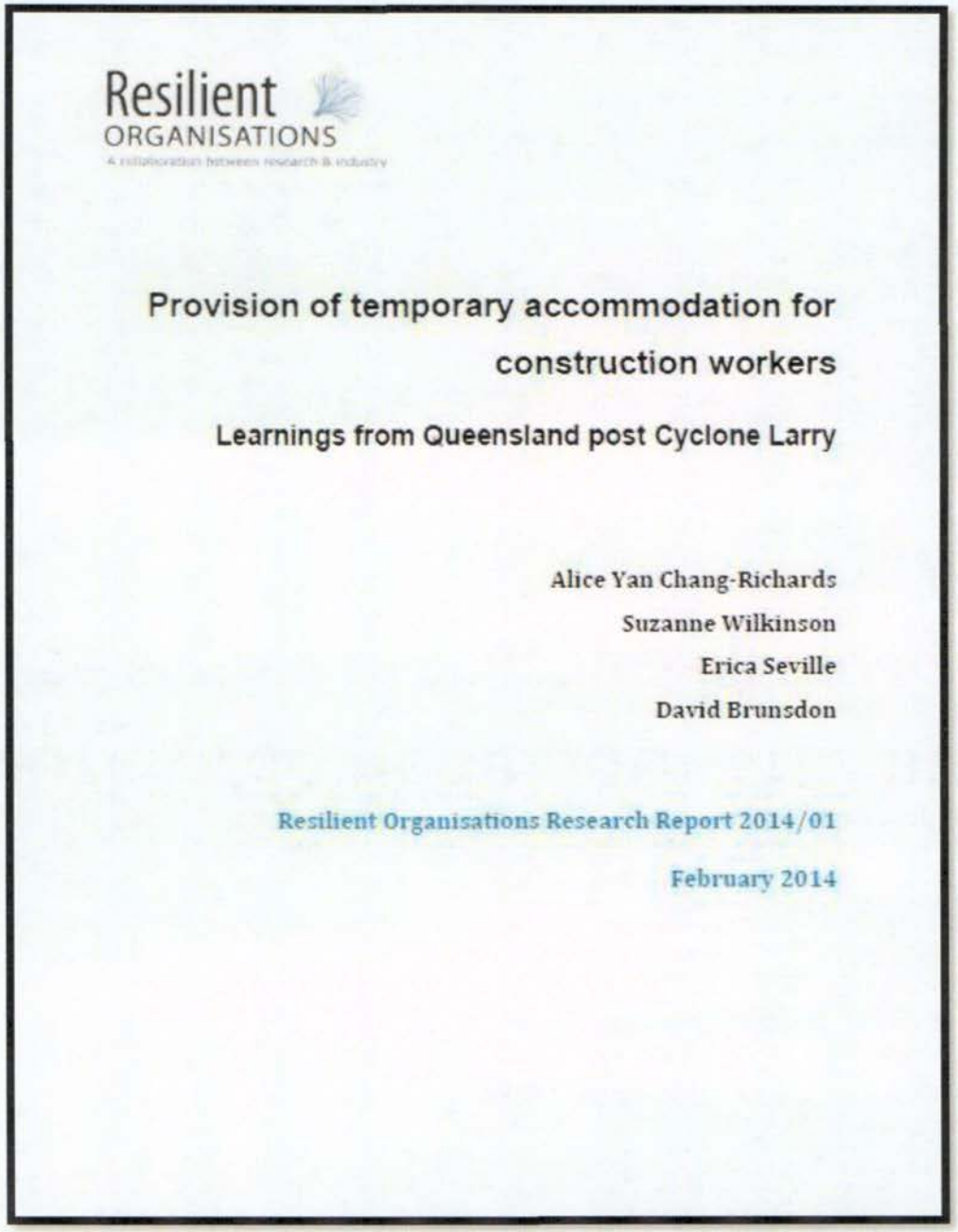
- Use existing units
- Working with existing accommodation providers to expand their capacity rather than embarking on greenfield developments
- Coverage of accommodation assistance to suit varied needs
- Local authority: a key stakeholder
- Close tenancy management by private accommodation operators



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This report presents salient points associated with each component of workers' accommodation and makes recommendations for Christchurch.

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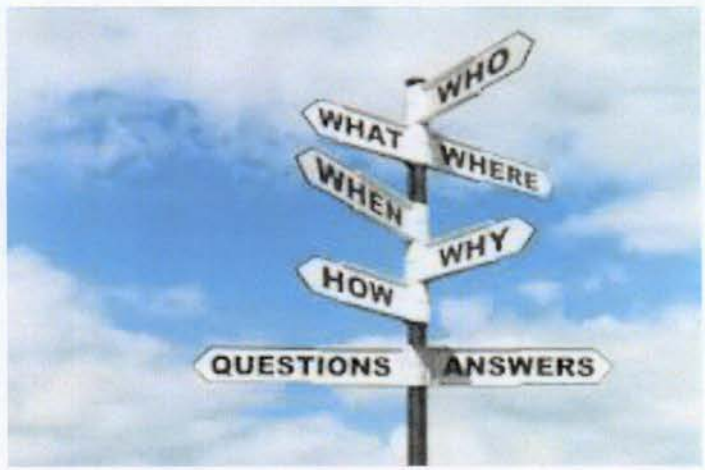
Workforce behaviour and business responses

Case studies of construction organisations, May 2014



Framework of resourcing case studies

Problematic resources
- Human resources
- Materials
- Plant

Emerging issues
- Workers accommodation
- Cost escalation
- Immigration
- Cash-out rebuilds
- Exit Strategies

... as rebuild evolves

Resourcing pinch points
- Barriers
- Effects on businesses and recovery

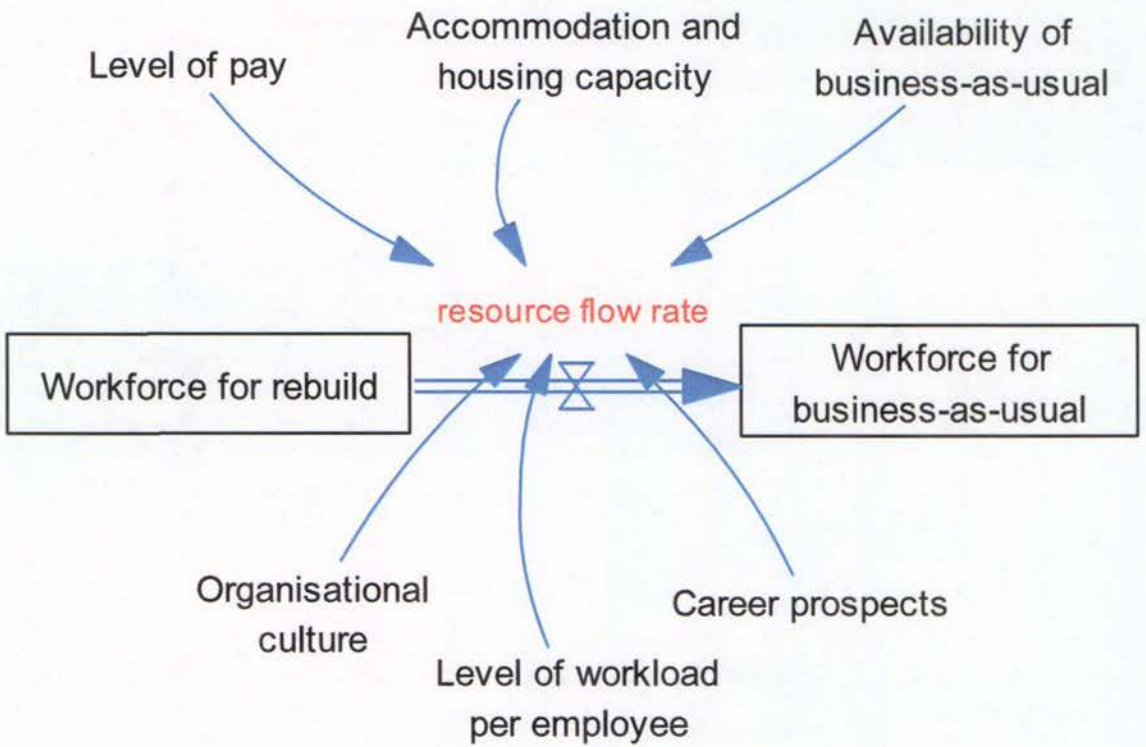
Construction employers response
- Measures in place
- Initiatives
- Anticipated efforts of other agencies

Findings of cases studies: Problematic resources

Resource category	December 2012	May 2014
Engineering	• **Structural engineers** – intermediate and senior level • Geotechnical engineers - intermediate and senior level	• **Civil engineers** in infrastructure sector
Building professionals	Junior or senior construction professionals **- project managers** **- site engineers** **- supervisors** - quantity surveyors	Junior and senior construction professionals in infrastructure sector **- project managers** **- quality control people**
Trades	Specialised trades - **drain layers (infras)** - plasters (housing) - painters (housing)	Specialised trades - **drain layers (infras)** - welders (infras) - machine operators (infras) - tilers (housing) - asbestos removal specialists (housing) - roofers (housing) -brick and block layers (housing)
Building supplies	**Truck drivers**	**Truck drivers**

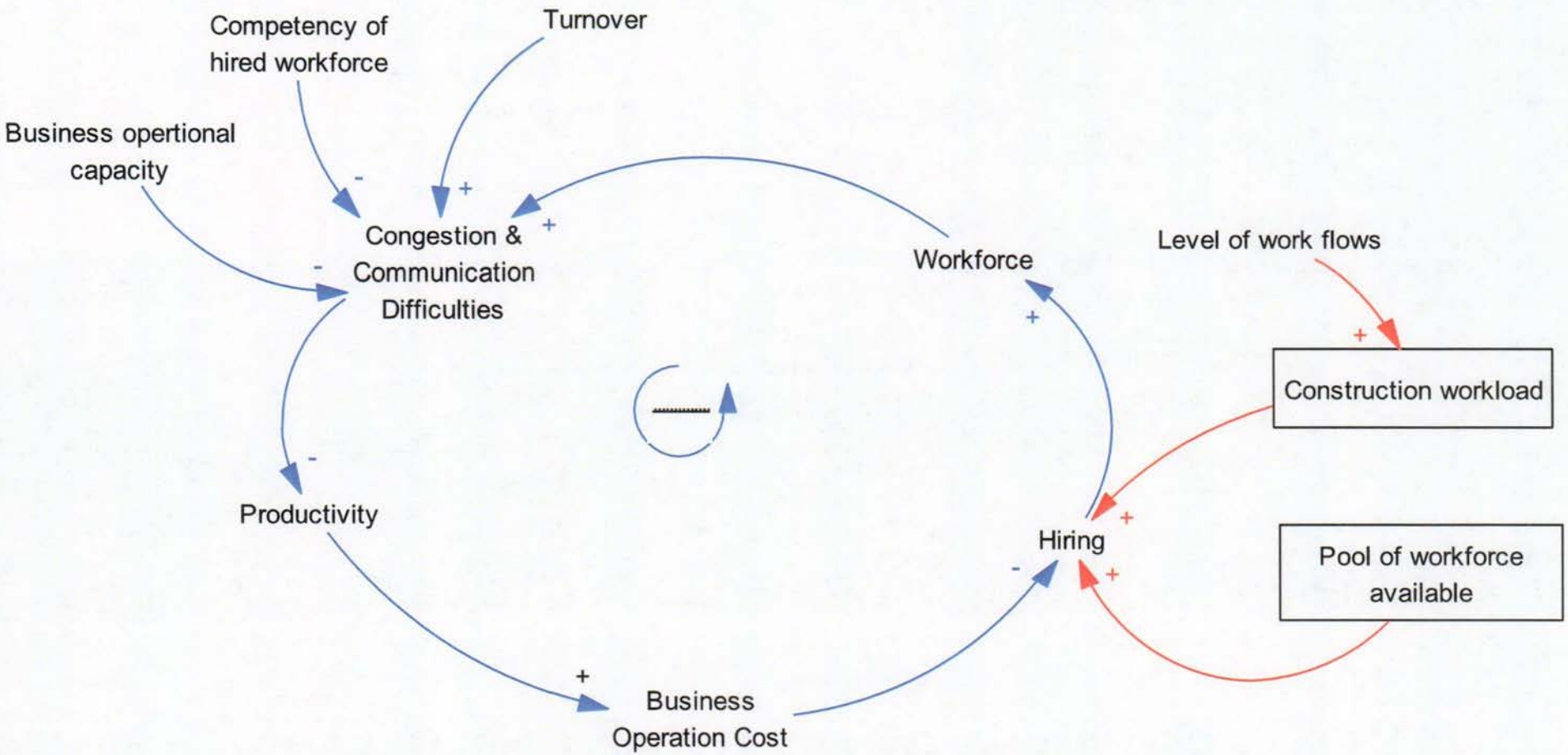
Findings of case studies

- Dynamic factors that influence workforce flows between sectors



Findings of case studies

- Construction employer response model



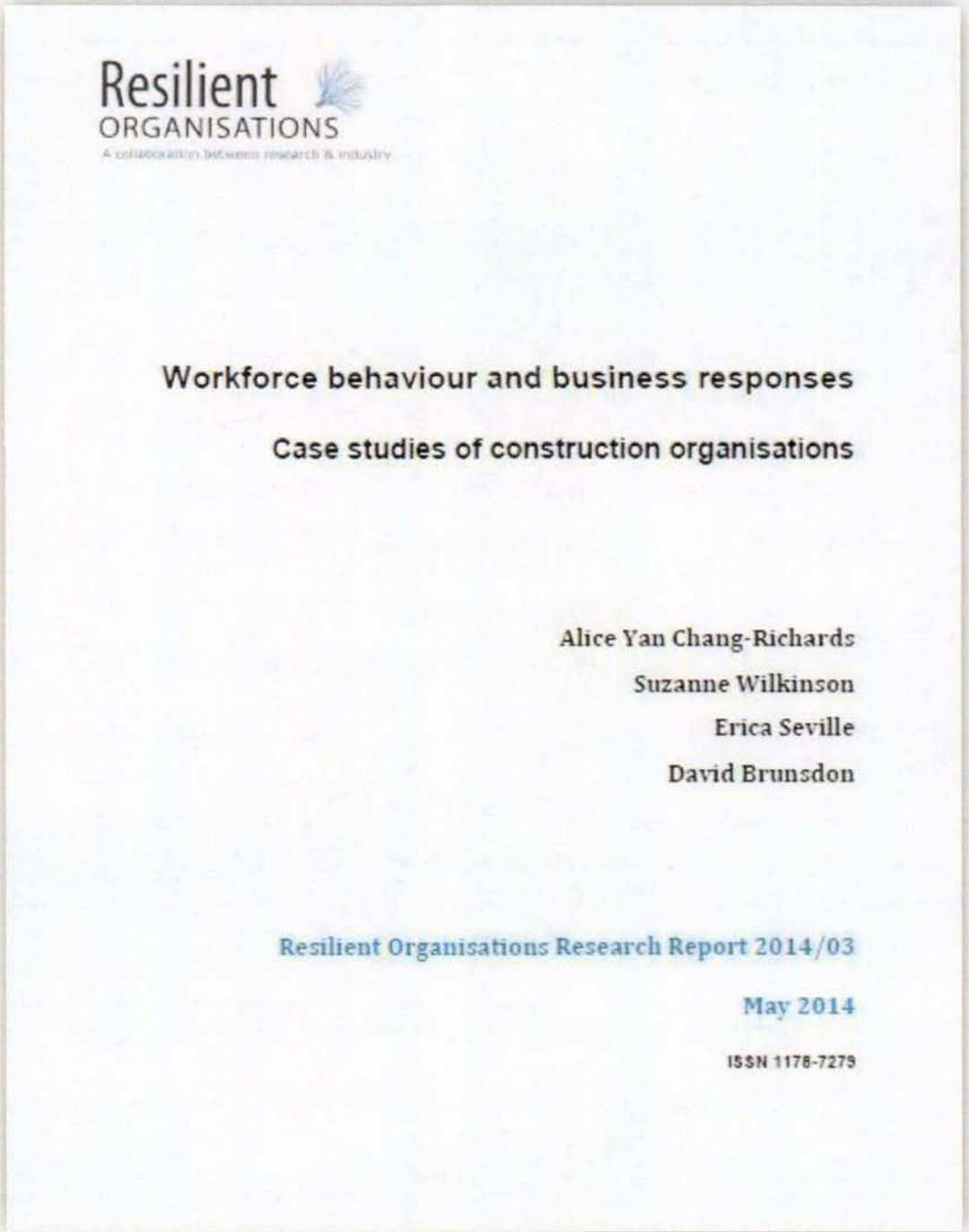
Findings of case studies

- Emerging issues

- Temporary accommodation for migrant workers
- Wage rise
- Increased competition for resources among PMOs
- Increased competition between rebuilds and BAUs
- Competition from vertical rebuild
- Lack of office premises
- Economic conditions in Europe

- House repair and rebuild for cash settled home owners
- A mismatch of labour and skills, prominent among younger workers
- Loss of good staff due to burnout and other well-being issues
- Exit strategy of companies and agencies

December 2012 May 2014



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As well as identifying resource challenges for construction employers, investigations were also focused on the good employment practice, business dynamics, and emerging issues that are likely to affect the needs of the construction sector in the near future.

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Key events/outputs

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- SCIRT Learning Legacy Project (Suzanne Wilkinson)
- Buildings Resilience (Dave Brunsdon)
- APEC Natural Disasters Workforce Project (Alice Chang-Richards)
- Resilience Opportunities Workshops (Erica Seville)

SCIRT

Learning Legacy

Search

Project in collaboration with:

UC QUAKE CENTRE

Resilient ORGANISATIONS

UCT CEISMIC

Please note that the Learning Legacy website is currently being developed and will be available later in 2014.

The Lessons from SCIRT

Background

The spate of earthquakes that occurred in Christchurch and wider Canterbury during 2010 and 2011 resulted in very significant damage and disruption to the Christchurch horizontal infrastructure networks.
In response, Stronger Christchurch Infrastructure Rebuild Team (SCIRT) was formed and has the responsibility for repairing and replacing Christchurch's three waters, roading and bridge networks as well as some retaining walls and stopbanks.

SCIRT is an alliance between Christchurch City Council, Canterbury Earthquake Recovery Authority (CERA), New Zealand Transport Agency (NZTA), City Care, Downer, Fletcher Construction, Fulton Hogan, and McConnell Dowell.

A recent indication of SCIRT's achievement was its winning of the Institution of Civil Engineers (ICE) prestigious Brunel Medal, awarded in recognition of excellence in civil engineering.

Example resources

Understanding Your Building's Resilience

Much more than just robust construction.....

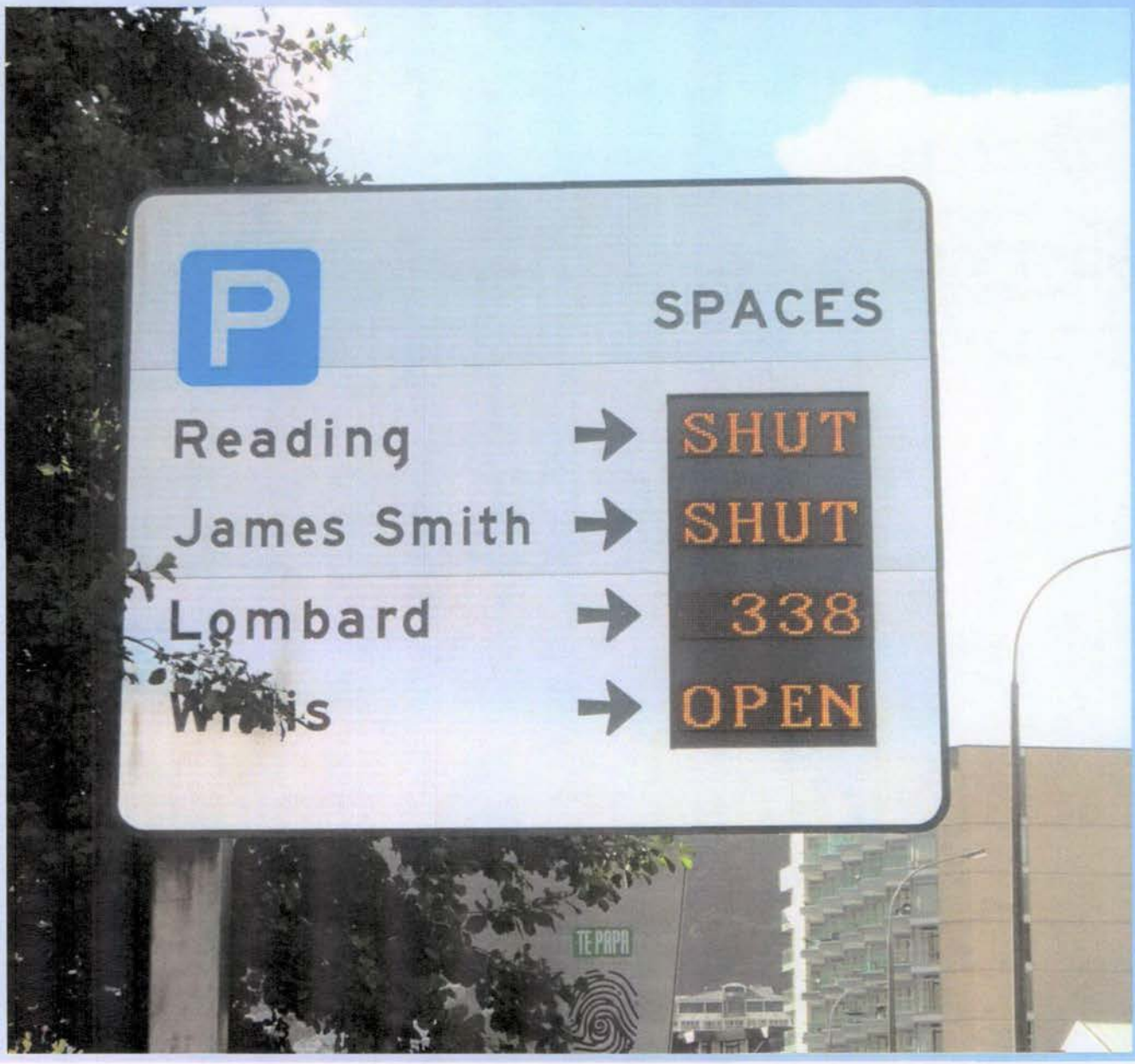
Reference: Article in BRANZ Build 141 April/ May 2014

By Erica Seville, Dave Brunsdon and John Hare

Timber Framed Buildings

More resilient than you might think

Wellington City – One Year On



Buildings and Organisational Resilience

More than just robust construction……

- **Neighbourhood awareness – what is the vulnerability of the surrounding environment to hazards?**
- **Clarity in operational planning by organisations – how important really is access to their building?**
- **Clarity in briefing organisational advisers – the interface between business continuity advisers and engineering advisers is important**

Resilience and Importance Level 4 Buildings

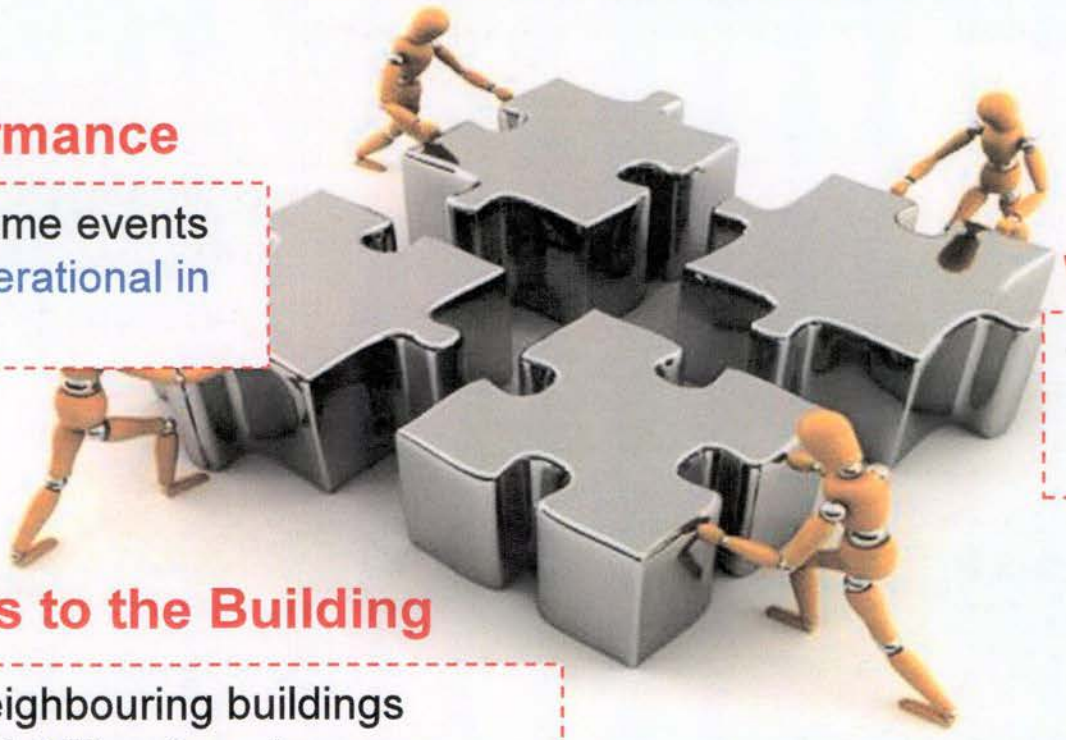
- Seismic capacity is only part of the story….

Emergency Power

- extent of coverage

Structural Performance

- Life safety in extreme events
- Continue to be operational in major events



Water Storage

- potable water and wastewater holding

Access to the Building

- neighbouring buildings
- reliability of road access

Asia-Pacific
Economic Cooperation

Building Natural Disaster Response Capacity – Sound Workforce Strategies for Recovery and Reconstruction

Final Report

APEC Human Resources Development Working Group

December 2013

Resilient ORGANISATIONS
A collaboration between research & industry

Project Number: HRD 01/2012A
APEC# 214-HR-01.1
ISBN: 978-981-07-9342-5

by Resilient Organisations:
Alice Yan Chang-Richards,
Erica Seville,
Suzanne Wilkinson,
Bernard Walker

www.resorgs.org.nz

Case studies

- the June 2013 Southern Alberta floods in Canada
- the 2010 and 2011 Queensland floods in Australia
- **the 2010 and 2011 Canterbury earthquakes in New Zealand**
- the 2011 Great East Japan Earthquake and Tsunami in Japan
- the 2008 Wenchuan earthquake in China

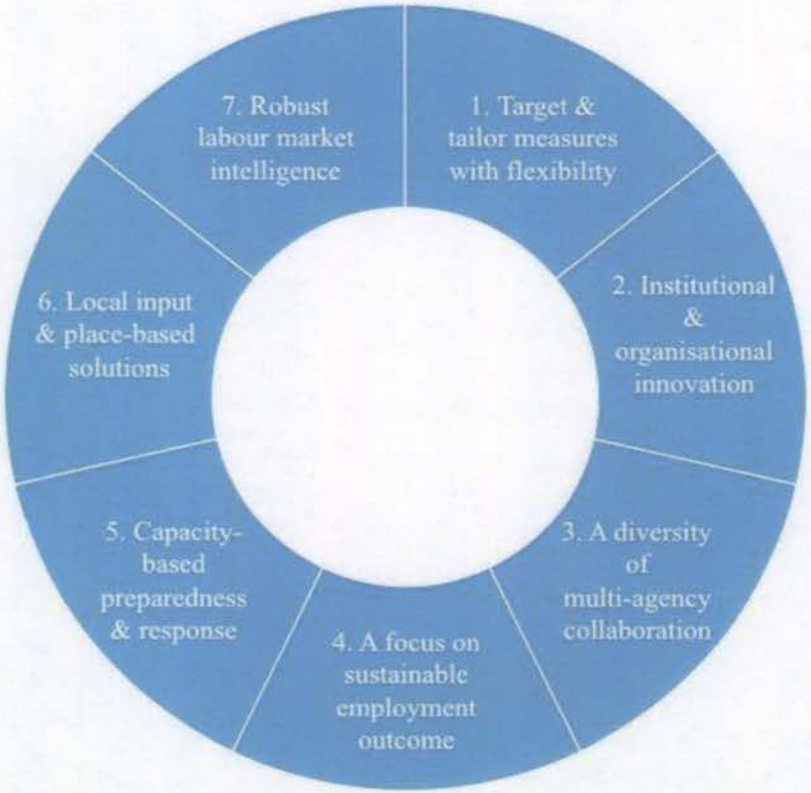
Comparative analysis across case studies

- Comparing conditions and labour market outcomes
  - Pre-disaster conditions
  - Disaster impacts
  - How did the labour market fare
- Comparing labour market policy responses
  - Measures to support the unemployed and social protection
  - Measures to retain and create employment
  - Active labour market programmes (ALMPs)

Menu of workforce strategies post disaster

Category	Measures	Description
Social protection	Income support	Unemployment benefits or short-time work benefits
	Livelihood support housing support	Assistance provided to households or individual workers
	Public works	Workfare programs to provide employment relief on emergency projects
Employment retention and creation	Business assistance	Support to disaster-affected businesses
	Sector-based assistance	Targeted support to most affected industries and other economic opportunities emerge from disaster recovery to adjust the structural change in local economy and maximise the job opportunities
	Macro stimulus policies	Prioritising infrastructure repairs and rebuild as well as other development projects in disaster-affected areas to stimulate the aggregate labour demand
Active labour market programmes (ALMP)	Training and education	Support to both training organisations and trainees
	Public employment services	To assist people in accessing job opportunities and dealing with employment churn and unemployment in terms of job matching, re-employment and job placement services
	Hiring subsidies	Subsidising the recruitment of newly hired and disadvantaged jobseekers

Principles for sound workforce strategies following natural disasters



Principle 1: Target and tailor measures with flexibility

Principle 2: Institutional and organisational innovation

Principle 3: A diversity of multi-agency collaboration

Principle 4: A focus on sustainable employment outcome

Principle 5: Capacity-based preparedness and response

Principle 6: Local input and place-based solutions

Principle 7: Robust labour market intelligence

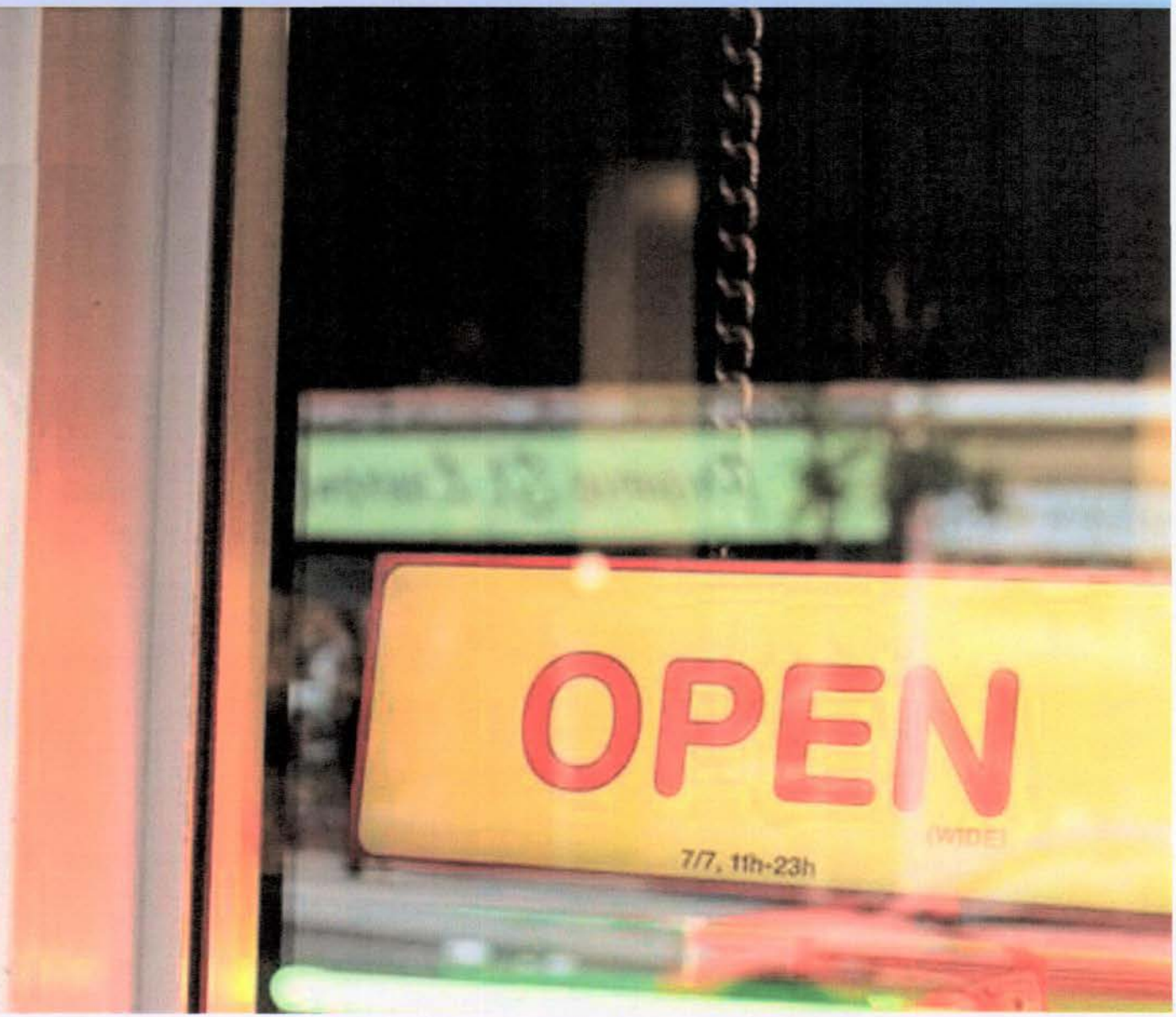
Links with emergency preparedness

Dimension of labour market preparedness

- Know-how and information
- Public sector/government agency preparedness
- Multi-agency partnership
- Supportive resources
- Social protection
- Business resilience and preparedness
- Workforce and skills development

Celebrating 10 Years of Research

A series of events around NZ to discuss, showcase and propagate resilience ideas and opportunities.



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Provision of temporary accommodation for construction workers

Learnings from Queensland post Cyclone Larry

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Resilient Organisations Research Report 2014/01

February 2014

Executive summary

The Queensland Government in Australia provided temporary accommodation for construction workers following Cyclone Larry, which struck the Innisfail region in March 2006. This initiative aimed to address workers' medium- to long-term accommodation needs to facilitate recovery and repairs in the affected areas. The Department of Housing and Public Works took a lead role for facilitation of this initiative. This report provides a summary of the temporary accommodation model used after Cyclone Larry.

In total, the Department of Housing and Public Works facilitated approximately 400 beds for temporary accommodation and over 30 community facilities across Queensland. A major component in the success of this initiative was that it worked with existing operators to facilitate an expansion of their facilities to meet accommodation demand. This improved occupancy rates for operators, increased revenue and allowed those with available land to finance expansion plans to meet demand as the workforce increases over time.

The provision of accommodation for both workers and displaced residents was considered by the Queensland Government as being equally important. A core rationale for providing medium-term accommodation following disasters is that provision should be in response to a lack of capacity in the community. The Queensland Government concluded that assistance with workers' accommodation was necessary on the following basis:

- A lack of transitional accommodation for trade workers often forces tradespeople to rent any houses available on the private market, consequently reducing availability for residents.
- Trade worker's ability to pay above-market rent to secure rental accommodation exacerbates inflation in the housing market.
- The impact of tradespeople monopolising available accommodation has a negative impact on tourism and primary production (in this case sugar cane and bananas) that relies on itinerant labour.
- The need to minimise the impact of accommodation demands from construction workers required for repairs on the overall labour and housing markets.

The strategy used was a collaboration between the Queensland Government and the local authorities involved. Funding was made available across all partnering agencies. While the Department of Housing and Public Works facilitated and coordinated the temporary accommodation initiative, local authorities acted as a key stakeholder in providing and maintaining services and facilities, as well as identifying sites for facilities, transportable accommodation and infrastructure. Private accommodation operators played a role in tenancy maintenance.

Interviewed officials within the Queensland Government regarded the temporary housing initiative as a successful example of 'public and private partnership' (PPP). Partnering with local councils and private sector was seen as desirable for recovery, because building future resilience and preparedness were considered as being important components of the post-disaster recovery operation. Provision of temporary accommodation for construction workers provided the added benefit of facilitating economic recovery by enabling seasonal/temporary workers for the local horticultural and tourism industries to secure affordable accommodation.

The accommodation issues that are faced by Christchurch following the 2010/11 earthquakes bear resemblance to that of the Queensland cyclone events in 2006 and 2011. Drawing on Queensland's experience, this report presents some key issues in Christchurch that could inform the direction and magnitude of housing assistance from government agencies. Recommendations are suggested to address the workers' accommodation needs, including for a model of governance between the Government Department (Building and Housing Group within MBIE) and local council to address the housing needs in Christchurch. It is also suggested to develop a Register of Accommodation Need to monitor accommodation demand from construction workers, and to run regular information sessions to facilitate sharing of information between key stakeholder groups in the housing issue. Other recommendations include for accommodation needs to be incorporated into recovery models, for existing operators to be identified for capacity expansion, and for innovative building techniques and processes to be used.

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Acknowledgements

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1. Introduction

This report summarises the findings of a research trip to Queensland in November 2013. The objective of this trip was to learn from the Queensland Government's response to workers' accommodation needs in a large disaster event. As well as identifying good practice for the provision of workers' temporary accommodation, consideration was given to:

- the range of demands from the construction sector
- accommodation assistance options and associated issues
- how the key stakeholders could work together to address the construction workers' accommodation needs

This study focuses on learnings from communities affected by Cyclone Larry in March 2006 in the Innisfail region, specifically focusing on temporary accommodation initiatives specific to Cyclone Larry. This report explores the types of workers' accommodation established by the Queensland Government in order to facilitate post-cyclone repairs and rebuild. Lessons from Cyclone Larry have proved valuable in responding to the 2010/11 flooding events in Queensland, despite the events being significantly different. The responses to two cyclone events overlapped to some extent and the stakeholders were the same. The team was also maintained over the period in between events.

This report provides a summary of the approach to temporary accommodation for construction workers used by the Queensland Government after Cyclone Larry. It shows what works, and why. Information in relation to 2011 Cyclone Yasi will also be included. This report is relevant to the provision of housing for workers in Christchurch. The comments and observations in this report primarily reflect the experiences and perceptions on workers' accommodation since Cyclone Larry. This report presents salient points associated with each component of workers' accommodation, outlines the options where appropriate for Christchurch.

This study is part of the project 'Resourcing the Canterbury Rebuild' under Resilient Organisations Research Programme. The project is funded by the Building Research Association of New Zealand (BRANZ), the Ministry of Business, Innovation and Employment (MBIE) and Earthquake Commission (EQC).

2. Background

Following the 2006 Cyclone Larry, Queensland required a multi-faceted approach to provide immediate and longer term accommodation to support the post-disaster recovery and reconstruction. To ensure success, it was vital any housing strategy enabled all agencies and private accommodation providers to work together to address housing-related issues. There was an immediate need for short-term emergency accommodation after the cyclone. This requirement was met through Emergency Services responses and mainly used existing intact infrastructure, augmented by quickly deployed temporary units such as tent camps and portable buildings.

In the medium to longer-term, it was recognised that cyclone-affected residents needed accommodation while repairs or rebuilds were taking place. It was recognised that other people, such as reconstruction workers, seasonal agricultural employees and tourists (particularly in certain regions) would find it difficult to secure housing without additional support from government and the community. General accommodation, recovery assistance buildings (e.g. public ablutions and laundries, recovery centres, support services accommodation), and workers accommodation were all required at the time the area moved into recovery and reconstruction. There was awareness that the significant level of damage to residential housing across North Queensland, the acute labour demand to undertake repairs, the general lack of temporary accommodation, and the forecasted higher demand for skills for rebuilding could, if managed poorly, lead to adverse social and economic consequences for local industry and communities.

The Queensland Government had significant experience in responding to the effects of natural disasters. Their experience has shown that provision of temporary accommodation for construction workers involved in repairs and rebuilds has a crucial role to play for recovery, particularly if housing assistance is integrated into the economic response.

3. Accommodation after Cyclone Larry

Following Cyclone Larry, the cost and supply of private rental accommodation was identified as an issue impacting community recovery. The Queensland Government identified the following problems that would need to be addressed as part of the longer term recovery process:

- Significant scope of works required to repair cyclone damaged properties across North Queensland;
- The lack of workforce to undertake remedial work;
- The general lack of temporary accommodation for displaced people as well as for subsequent workforce

Temporary accommodation was required for hundreds of people who lost homes or whose homes were being rebuilt, as well as for trades people needed to help in the process. A Housing Taskforce was established by the Department of Housing and Public Works to ensure a coordinated approach between all agencies that had responsibility for housing-related strategies to support the medium and long-term community recovery.

3.1 Sources of accommodation units

The Department of Housing and Public Works facilitated approximately 400 beds for temporary accommodation across Queensland. A focus of accommodation strategy was on maximising the availability of accommodation in situations where services were available. Extra accommodation units were provided by negotiation dependent on the availability and capacity of existing facilities. The Department of Housing and Public Works, together with local council, worked with the existing operators to facilitate an expansion of their facilities to meet demand from both displaced residents and workers required for repairs. A variety of re-locatable temporary units were sourced (Figure 1), such as:

- surplus government multi-room transportable accommodation
- mining industry demountable houses
- re-locatable accommodation units from other caravan parks with overcapacity
- manufactured modular houses

Example 1: 150 Munro St, Babinda 3 x 2 bedroom self-contained accommodation

Example 2: 10 Water St, Innisfail, 4 x 2 bedroom self-contained accommodation

Figure 1 Examples of re-locatable temporary units post-cyclone Larry

The Department was responsible for providing 122 bedrooms of accommodation for Cyclone Larry. For instance, surplus government multi-room transportable accommodation was sourced, upgraded, relocated and established in hotel and caravan park grounds in Innisfail, Flying Fish Point, Mena Creek, South Johnstone, Fishery Falls and Mourilyan. More than 120 rooms for accommodation were provided for use by local residents and tradespeople involved in the rebuilding effort.

These dwellings were managed locally by the proprietors. However, Council had control of the tenancies. Council collated a register of need for trades people and people requiring assistance with accommodation. Council worked closely with the Department ensuring that the register was current and contained accurate information. The structured process worked well due to the relationships fostered between all parties with the proprietors. This ensured that those in need and wanting to work on the rebuild could be assisted.

In the event of Cyclone Yasi, the Department was responsible for providing 145 bedrooms of accommodation. In addition from sourcing transportable accommodation units, the Department and Cassowary Coast Regional Council were donated the utilization of a Santos mining camp consisting of 40 bedrooms of accommodation. The camp was transported to Tully on a convoy of

trucks and constructed at the show grounds. This camp was perceived ideal for housing trades people. The camp previously used for workers at mines was fully self-contained with its own sewerage treatment plant, water system, generated power and commercial kitchen (Figure 2).

Figure 2: Fully self-sufficient mining workers' camp used for trades people after Cyclone Yasi

3.2 Placement of transportable accommodation

When accommodation was sourced, placement was important as it needed to be provided in as normal a setting as possible so that tenants (displaced residents, seasonal workers, construction tradespeople and recovery workers) would not be socially isolated. For instance, suitable private caravan parks, hotels, and Council and Departmental owned sites in the area were identified by the Department and local council as sites for facilities, transportable accommodation and infrastructure required by communities in the Cassowary Coast Region. The most preferred placement sites were caravan parks with existing infrastructure (Figure 3).

Example: Dongas – transportable accommodation on River Drive Caravan Park, 20 rooms

Figure 3 Placement of re-locatable accommodation units on caravan parks

In total, 3 out of 7 private caravan parks were used for placing Government-provided accommodation after Cyclone Larry, and 4 out of 9 were used post Cyclone Yasi. The management of the tenants was carried out privately by caravan park owners. Tenancy arrangements for these facilities were negotiated and formalized, often through local authorities, with input and agreement from the Department. Additionally, a number of re-locatable temporary units were upgraded and shifted to hotels with available lands (Figure 4).

Example 1: Goondi Hill Hotel, 20 rooms

Example 2: River Lodge Bed & Breakfast, 7 rooms

Example 3: South Johnstone Hotel, 8 rooms

Example 4: Mourilyan Hotel, 5 rooms

Figure 4 Placement of re-locatable accommodation units on hotel lots

The post-cyclone relief and recovery effort saw the Queensland Government implement creative accommodation solutions, including the use of the former Babinda Nurses' Quarters for single people (Figure 5). The property was managed through the Community Housing Program. It gave a much needed boost to the supply of single persons' accommodation in the region.

Note: These quarters contained 22 single rooms however only 12 of these were being used by Department of Health when the Cyclone Larry struck

Figure 5 Babinda Nurses Quarters used for single persons' accommodation

A range of factors influenced the placement of temporary accommodation including: 1) safety and security; 2) property ownership; 3) nearby amenities; 4) management arrangements; 5) costs; 6) infrastructure availability and requirements. In terms of building requirements, the Department of Housing and Public Works sought advice from the regional office, disaster management agencies and local authorities. Buildings were configured on the basis of required outcome, amenity and available existing infrastructure and management. Site layout was designed to be sensitive to a range of requirements including the type of buildings; tenant type; separation of precincts for workers and families; and disability access.

Other efforts by the Department of Housing and Public Works included obtaining relevant approvals and local authority engagement to provide appropriate infrastructure (water, sewer and electricity) to required specifications. Previous experience in Australia indicated that response to accommodation needs often end up being kept permanently or for extended durations. Therefore, the initial conceptual design of temporary accommodation initiative post-cyclone Larry included response matching the requirements and that long-term deployment is both manageable and socially appropriate.

3.3 Tenancy management

Previous disaster experience suggested that most people would prefer to stay in their own environment supported by neighbours, albeit in adverse conditions, than move to temporary accommodation. Alternatively, they would prefer to rent in the private market and maintain a sense of normality for their family. Temporary Villages tend to be the last resort for those who have no other options.

However, for seasonal workers and construction workers working on repairs, there is a preference for private accommodation with modest furnishing, enabling a degree of comfort. The temporary emergency housing provided a range of accommodation options for:

- Emergency workers (e.g. Police Emergency Services, Department of Health, Red Cross, etc.);
- Cyclone victims requiring short term accommodation during construction and repair of their houses;

- Recovery workers unable to source the limited private accommodation available, including Department of Communities, volunteer organisations and other agencies;
- Trades people undertaking repair and rebuilding of cyclone damaged houses

The utilisation of this accommodation across the affected area was very strong and its availability underpinned the recovery operation by allowing transitional options for householders. It also enabled the availability of tradespeople to undertake reconstruction work. Table 1 below shows that the finance of accommodation and duration of their needs varied across different user groups.

Table 1 Temporary accommodation user categories post-cyclone Larry in Queensland

User category	Finance of accommodation	Long-term need?
1) Insured householders whose houses will be under repairs	Insurance companies	×
2) Renters who will not be paying rent on their affected properties during the reconstruction period	Self-fund or eligible for rental assistance from the Government	√ also depends on the circumstance
3) Recipients of benefits	Rental assistance from the Government	×
4) Uninsured owners who accepted an element of risk in their decision	Rental assistance from the Government	Some discretion needs to be taken with regard to circumstance
5) Trades people and/or recovery workers	Self-fund	×
6) Other workers	Self-fund or financed by workers' organisation	Needs on a seasonal/regular basis

During the first 12 months, there were 977 individuals and families who have used the emergency accommodation since its construction. Many occupants were long-term tenants. This initiative improved occupancy rates for operators, increased revenue and allowed those with available land to finance expansion plans to meet the demands of an increasing workforce over time.

Fundamental to the tenancy management approach was the concept of tenants paying appropriate levels of rent. The rent for temporary accommodation units reflected the market rate. A discounted rate was provided for cyclone affected residents. In general, the principle of this

'tenant rent charge' was to be fair and to allow for an exit strategy of most temporary-stay tenants. An example of rent charges is shown in Table 2 below.

Table 2 Post-cyclone Larry temporary accommodation weekly rental charge example

Description	Community	Pensioners	Trades people/Contractors
Bunkhouses	$140	$125	$160
4 bedroom transitional homes	$200	N/A	$400 ($100 per person per week)
Hutchinson buildings	$165	$145	$200
1 bed room single (Ausco)	$165	$145	$200
2 bedroom relocatable units (Ausco)	$180	$160	$250
Caravans	$160	$130	$180

If insurance covers accommodation Council will negotiate a market rental value with individuals

Source: The Department of Housing and Public Works, Queensland Government

In the case of the Cassowary Coast Regional Council, there was also significant input from Council in the provision of infrastructure for these temporary accommodation units, such as road construction, connection of services, provision of site, which further validated them receiving rentals obtained from tenants. Tenancy was managed by the caravan park owners, as there was a high turnover rate and therefore a need for close management. For tenants who required longer-term housing support, the Department of Housing and Public Works worked with other housing stakeholders to assist their transfer from temporary accommodation to longer-term solutions.

4. Recommendations for Christchurch

Table 3, overleaf, compares the magnitude and impact of the three disaster events – the 2010/11 Queensland floods and cyclone Yasi, 2006 cyclone Larry, 2010/2011 Christchurch earthquakes. The event severity was such that each of these disasters overwhelmed local capacity. Each was rated the strongest and most expensive natural disaster in the region's history. In the three events, housing was a great component of all losses in terms of economic value and buildings damaged. The varied composition of industries means different employment structures prior to the event, as well as different skills sets needed in local economy.

Table 3 Comparison of impacts in three disasters

	Queensland Cyclone Larry	Queensland floods and Cyclone Yasi	Christchurch earthquakes
When	March 2006	November 2010 to January 2011	4 September 2010 and 22 February 2011
Event	Cyclone	Floods & cyclone	Earthquake
Human losses	0	36	185
Housing damage	19,000 houses needed repair Overall insurance claims AUD369 million	97,000 insurance claims in respect of damages to private assets, of which 50-60 percent were for privately owned residential properties	150,000 houses needed repair
Damage estimates	AUD 1.5 billion	AUD 15.7 billion	NZD 40 billion
% of national GDP	0.2%	1%	19%
Industrial structure affected	Innisfail, where Larry made landfall, suffered severe damage. The region's banana industry, which employed up to 6000 people, suffered extreme losses of crops, accounting for more than 80% of Australia's total banana crop.	Coal mining and tourism were most affected. Specific agricultural loss estimates include sugarcane, cotton, grain and banana crops. All of Queensland's 54 coal mines were affected resulting in decreased exports.	Tourism hub, accounting for about 20% of total arrivals in New Zealand. Manufacturing centre although manufacturers outside worst affected areas. Agricultural sector largely unaffected.
Initial conditions	Innisfail region was a base for production of sugar, fruits, especially bananas, and timber. Sugar is the core economic base, with total sugar revenue having a gross value in excess of AUD87 million, and total cane revenue valued at AUD55 million.	Resources sector is core industry. Queensland coal production accounts for 56 per cent of Australia's black coal production and 62 per cent of the country's coal exports. Agriculture is another income generating industry, with sugarcane production alone accounting for 30 per cent of harvest nationwide.	Canterbury was going through modest recovery from recession with positive medium-term outlook, and some spare capacity. There were high agricultural and commodity prices. Agriculture is central to the Canterbury economy, creating seasonal work opportunities in the region.

Source: (APEC, 2013) and (Queensland Government, 2007)

Comparison in Table 3 provides an insight as to the relevance of the Queensland temporary accommodation solution elements. The accommodation issues and challenges faced by Queensland after Cyclone Larry are similar to that in Christchurch in that there are significant demands for rebuilding, a lack of temporary accommodation, and the forecasted higher demand for skills when local resources are overstretched.

A review of temporary accommodation in Christchurch (Chang-Richards et al., 2013a; 2013b) showed that commercial accommodation in Christchurch and surrounding areas had a total capacity of about approximately 65 per cent of pre-quake levels. Because of the seasonal nature of tourists, there was an opportunity for construction workers to take up some unused capacity during the low season. Pressure on rental accommodation from greater Christchurch residents will continue over a number of years as many red-zone residents need to vacate houses and other residents need to relocate while homes are under repair.

Studies undertaken by the research team showed that at least 30 per cent of the workforce across construction organisations would be transient in nature and require rental and temporary accommodation (Chang-Richards et al., 2013c). The shortages of accommodation were most felt at the trades' level of construction companies. Affordability and accessible space for parking work vehicles were reported by construction workers, particularly most builders and tradespeople, as top two priorities when they look for accommodation (Chang-Richards et al., 2013a).

The Household Growth Model (HGM) used by the Christchurch Urban Development Strategy (UDS) partners (Christchurch City, Waimakariri District, Selwyn District and Environment Canterbury) outlines four plausible recovery scenarios: rapid recovery, quick recovery, moderate recovery and slow recovery. The four scenarios are shown in Figure 6 below, and have not yet factored in the expected demand for temporary worker accommodation or temporary rental demand to accommodate residents while repairs are undertaken. According to Environment Canterbury (2012), initial indicators are that the recovery is tracking relatively close to the moderate recovery scenario.

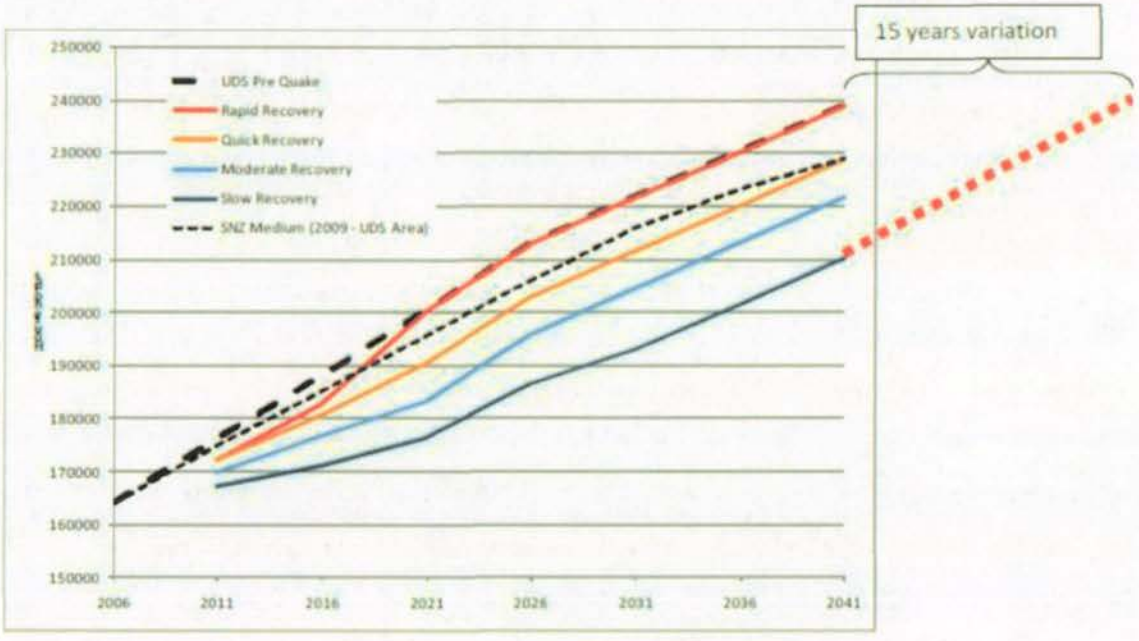

Figure 6 Recovery scenarios in Christchurch, source (Environment Canterbury Regional Council, 2012)

As a result of this long timeframe it is likely that surrounding housing markets might be capable of absorbing progressive increases in rental demand. It is reasonable to assume that if there is a longer-than-expected lead time before the maximum number of workers, planning for temporary housing from the construction sector can be more accurate.

The temporary accommodation assistance to construction workers after the Cyclone Larry, particularly for construction workers (e.g. trades people), can be informative in terms of re-considering options for the Christchurch rebuilt. A comparison of two possible options for Christchurch is tabulated in Table 4. Drawing on the learnings from this initiative, we suggest six recommendations for Christchurch.

Table 4 Comparison of two accommodation options for construction workers

Issues to consider	Using existing operators (e.g. holiday parks, motor camps)	Establishing new workers' camps
Land and infrastructure	Using existing infrastructure and available land	Need to put in new infrastructure and need approvals from Council for land use
Financial viability	• Improve occupancy rates for operators • Increase revenue • Cost-effective as it utilises the available land & infrastructure	• Need some level of certainty of demand to enable developers to take a solid business case to banks and financiers • High cost for decommissioning and asset disposal unless has 2nd life
Timeframe/ duration	• Medium to longer-term • There is a need to consider an 'exit strategy'	3.5 years' operation is likely to be profitable. But if the worker numbers peak for a relatively short period of time (2 years out of the 10-15 years of recovery time), this timing does not justify the construction of a workers' camp
Social and environmental factors	There are social and environmental benefits in housing workers where there is existing infrastructure in urban areas.	Location is a primary concern as other likely social and environmental impacts need to be factored in the plan.

Recommendation 1: Accommodation issues in Christchurch should be re-examined. A model of governance that is similar to that of Queensland will be helpful to facilitate the housing assistance for a wider spectrum of people in Christchurch (low-income people, former State/Council Housing tenants, renters, red-zone home owners, seasonal workers, construction workers, other recovery-related workers).

Recommendation 2: Regular information sessions are needed between the insurance industry, construction industry, other interested groups (e.g. Salvation Army, Habitat International), commercial accommodation operators, and government departments to update the key agencies on existing accommodation availability and capacity, repair and construction schedules and arrival of workers, housing needs of displaced homeowners, enabling effective accommodation planning.

Recommendation 3: A Register of Accommodation Needs can be set up by working with construction industry associations and their member organisations to identify and monitor the demand for temporary accommodation from the construction workforce.

Recommendation 4: Different recovery timeframe scenarios will produce different accommodation needs and all options should be modeled to achieve optimization of recovery scenarios versus accommodation needs.

Recommendation 5: It is worth investigating the existing capacity of private operators and the availability of their lands for potential placement of extra accommodation units, and identifying those that are interested in being involved in a capacity expansion project facilitated by the Government.

Recommendation 6: Methods of innovative building techniques and processes such as modular/prefabricated/offsite manufactured houses, as well as other transportable housing units, should be used to expedite delivery of temporary units that responds to the need for affordable housing stock.

5. Conclusion

Part of the solution to accommodation needs for the incoming workforce might be found in the solutions used by Queensland. The model of temporary accommodation provision for construction workers and how it was integrated into, and balanced with assistance for cyclone-displaced residents represents a good example for Christchurch.

The leadership taken by the Department of Housing and Public Works within the Queensland Government and their vision of integrating workers' accommodation into an economic and employment response appear to have been effective. The achievements of the initiative are a clear indication of the value achieved through the partnership model between Queensland Government, local councils and private accommodation operators.

The tenancy management approach undertaken, and the hands-on role of the Department of Housing and Public Works, ensured an industry-participative response with the facilitation of government agencies. Drawing on Queensland's experience, this report provides specific learnings for agencies and organisations with an interest in coordinating and delivering housing services and recovery assistance in Christchurch.

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Resilient ORGANISATIONS

A collaboration between research & industry

Workforce behaviour and business responses

Case studies of construction organisations

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About the Resilient Organisations Research Programme

"Building more resilient organisations, able to survive and thrive in a world of uncertainty, through research and practice"

We live in an increasingly complex world dealing with a broad spectrum of crises arising from both natural and man-made causes. Resilient organisations are those that are able to survive and thrive in this world of uncertainty.

Who we are:

The Resilient Organisations Research Group (ResOrgs) is a multi-disciplinary team of over thirty researchers and practitioners that is New Zealand based and with global reach. A collaboration between top New Zealand research Universities and key industry players, including the University of Canterbury and the University of Auckland, ResOrgs is funded by the Ministry for Science and Innovation through the Natural Hazards Research Platform and supported by a diverse group of industry partners and advisors. The research group represents a synthesis of engineering disciplines and business leadership aimed at transforming organisations into those that both survive major events and thrive in the aftermath.

We are committed to making organisations more resilient in the face of major hazards in the natural, built and economic environments. Resilient organisations are able to rebound from disaster and find opportunity in times of distress. They are better employers, contribute to community resilience and foster a culture of self-reliance and effective collaboration.

What we do:

The ResOrgs programme of public good research is aimed at effective capability building through research activities with significant impacts on policy and practice. Activities and outputs of the group, in existence since 2004, include informing and focusing debate in areas such as Civil Defence Emergency Management, post-disaster recovery, and the resilience of critical infrastructure sectors, in addition to core activities in relation to organisation resilience capability building and benchmarking. We have produced practical frameworks and guides and helped organisations to develop and implement practical resilience strategies suitable to their environment.

Why we do it:

In an increasingly volatile and uncertain world, one of the greatest assets an organisation can have is the agility to survive unexpected crisis and to find opportunity to thrive in the face of potentially terminal events. We believe such resilience makes the most of the human capital that characterises the modern organisation and offers one of the greatest prospects for differentiating the successful organisation on the world stage. This resilience is typified by 20/20 situation awareness, effective vulnerability management, agile adaptive capacity and world class organisational culture and leadership. More resilient organisations lead to more resilient communities and provide the honed human capital to address some of our most intractable societal challenges.

For more information see our website: www.resorgs.org.nz

Executive summary

This report is the fifth report in a series of Resilient Organisations reports on the changing employers' behaviour in response to employment demand and supply for the Canterbury rebuild and wider recovery. The work aims to inform decision-making and provide an improved understanding of the ongoing resourcing issues for the reconstruction in Christchurch.

The **main findings** are:

- ***Fluctuating workflows***: Construction organisations are still facing fluctuating workflows. Although companies have expanded capacity, the expected workflows are not matching capacity. Workflow fluctuations have particularly put pressure on subcontractors and SMEs in terms of maintaining their ability to staff projects where project timelines are uncertain.
- ***Lack of quality of new workers and high turnover rate***: The competence of newly hired employees is a concern, as is the high turnover rate. The high turnover rate has made employers of small size less willing to invest in recruiting and training new workers.
- ***Loss of skills and subcontractors to other sectors***: The continued growth in new subdivisions in Canterbury and strong housing and infrastructure investments elsewhere, particularly Auckland, are drawing away skilled employees and subcontractors from the Canterbury rebuild. Skills retention and in-house training are becoming a main focus for large construction organisations.
- ***Consistent demand for certain roles***: There is still a consistent demand for project managers and civil engineers in the infrastructure sector, whereas in the building sector the demand for project management and engineering professionals has declined since 2012 and 2013, respectively. For the infrastructure sector, drain layers, welders, plant/machine operators as well as safety and quality control staff are still in short supply and will be needed for the continued rebuild. For the housing rebuilds, there is continued demand for tilers, asbestos removal specialists, roofers, brick and block layers.
- ***Changed workforce employment strategies***: Construction organisations were concerned about the risks of overcapacity in Christchurch. The trend of workforce resourcing strategies is now moving from long-term/permanent recruitment towards more temporary

contracts in the short-to-medium term; and moving from recruitment towards replacement. The risk of employing less experienced labour and questions over the training requirements of this labour, and the costs of training, were of concern.

- ***Temporary accommodation and wage increases***: The issue of temporary accommodation still exists but seems to be absorbed by the market regardless of rent increases. Construction organisations expected the cost of labour in Canterbury to continue to increase over the coming years. There is an expectation of minor increases in plant and material prices.

Looking forward, the following **emerging issues** are likely to affect the needs of the construction sector in Canterbury.

- ***House repair and rebuild for cash settled home owners***: The scale and scope of residential rebuild are growing due to cost escalation and house owners' intention to do other renovations or changes at the same time. Rebuild cost shortfalls may lead some home owners who receive cash settlements to hire less qualified professionals and trades who offer lower rates. There is also a risk that they may go for cheaper and unproven materials and products with consequent poor performance. In such a situation, there exist risks of cost overruns as well as technical and other project risks.
- ***Difficulty in matching labour to skills among younger workforce***: A mismatch of labour and skills is likely to continue to occur, or worsen, if companies are less willing to invest in training new entrants. This mismatch will prevail among younger employment groups and could manifest itself in the form of a skills gap, under-qualification and increased skills shortages.
- ***Loss of good staff due to burnout and other well-being issues***: The recovery will slow if more employees with Christchurch rebuild experience look for opportunities elsewhere. There is a related issue of good people leaving in the running down phase of projects due to burnout after three years of rebuild. Construction organisations face risks of losing human capital that is valuable for business operation as a result of staff 'burnout' or other wellbeing issues.

- ***Exit strategy of companies and agencies***: There is a perception that employees in organisations created for recovery and reconstruction[1] (such as CERA, SCIRT, EQR, amongst others) are feeling uncertain over their future employment situations. The Human Resource implications of exit strategies of key organisations will increasingly become an issue of concern.

Findings from these case studies show that the availability of resources needs to be seen in the wider context of an effectively functioning labour market. This is a key message from case study participants. For construction organisations, two interrelated components are needed to leverage the workforce flows: 1) a steady work flow from the construction of anchor projects and infrastructure rebuild at the regional level; and 2) company's ability to meet staff needs at the organisational level. At the employee's level, however, there is a need to regulate the labour market in terms of addressing the workforce quality issue reported in the case studies and increasing the efficiency of skills matching. It is recognised that unless such an approach to matching the labour and skills is formalised, the problems identified in the case studies will continue to affect the smooth running of the industry, and construction companies will remain frustrated while the recovery progress will remain below optimal levels.

[1] In literature, these organisations are also called 'emerging organisations' after a natural event.

Contents

Acknowledgements

This study is part of the project 'Resourcing the Canterbury Rebuild' under the Resilient Organisations Research Programme. The project is funded by the Building Research Association of New Zealand (BRANZ), the Ministry of Business, Innovation and Employment (MBIE) and the Earthquake Commission (EQC).

Taking time to reflect on learnings from rebuild resourcing experience in Christchurch is critical to our longitudinal study and so we continue to be grateful for the time given by our case study organisations. We would also like to give special thanks to Andrew Fox of Peak Recruitment and Barry Akers of Fletcher EQR for providing insights into the case studies. Additional inputs from Wayne Sharman of BRANZ are greatly appreciated.

1. Introduction

1.1 Purpose of this report

It is important to recognise that each stage along the recovery timeline will have varied resource pressure points and therefore require different, or updated, resourcing strategies. Resilient Organisations initiated a longitudinal study of construction organisations examining ongoing resourcing challenges for the Canterbury rebuild. Case studies with 15 construction organisations in December 2012 illustrated the types of resourcing problems being faced following the earthquakes and the study provided examples of resourcing best practice (Chang-Richards et al., 2013a).

Based on updated case studies in April and May 2014, this report provides an examination of the changed employers' behaviours and perceptions in relation to employment demand and supply for the Canterbury rebuild and wider recovery. The business resourcing factors that influence workforce flows are captured from case studies. The study aims to inform decision-making and provide an improved understanding of the ongoing resourcing issues for the Canterbury rebuild.

Comparing the changes with findings in the December 2012 case studies and those of April/May 2014 case studies leads to a reappraisal of the resource risk to the Christchurch rebuild for the construction sector. Reflecting on the lessons learnt since the first case studies and the key steps towards a productive workforce and a successful rebuild, this report identifies ongoing 'pinch points' and emerging issues that concern the industry as the rebuild continues.

1.2 Case study methods

Longitudinal case studies of construction organisations can provide insights into how hiring strategies across the construction industry and industry strategies for workforce development will change as the rebuild progresses. In December 2012, 15 case study organisations were selected to participate in the research. The chosen case studies collectively provided an overview of current experience with regard to the resourcing of skills for building activities (Chang-Richards et al., 2013a).

Between April and May 2014, Resilient Organisations conducted a second series of interviews with the case study organisations. The focus was to examine their experiences of resourcing in Canterbury and changing business strategies in relation to workforce employment. Of 15 organisations, 10 participated in the April/May 2014 study. The reasons for the other 5 organisations not being able to participate included unavailability at the time of the case studies and absence from Christchurch operations. 3 new construction organisations took part in the study. A total of 16 interviews were undertaken across 13 organisations in Christchurch (See Table 1).

Table 1: Description of organisations used for case study data collection

13 case study organisations	Characteristics
• **2 Engineering consultancies**	1 large size and 1 medium size
• **7 Contractors/builders**	3 large civil contractors, 2 subcontractors, 1 home builder, 1 large construction company
• **2 Building supplies companies**	2 large concrete product manufacturers
• **2 Project Management Offices**	Horizontal infrastructure rebuild & EQC's residential repairs

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520).

2. Case study findings

The findings reveal six key points relating to the changes in construction organisations' resource needs and initiatives. These six points were:

- Fluctuating workflows;
- Lack of quality of new workers and high turnover rate;
- Losing skills and subcontractors to other sectors;

- Consistent demand for certain roles;
- Changed workforce employment strategies;
- Temporary accommodation and wage increases.

2.1 Fluctuating workflows

The general sentiment across the case study organisations was that rebuilding progress has been made but that the recovery is proceeding much slower than they had expected. A lack of a Master Plan for the overall built environment reconstruction was considered by most case study organisations to be a critical obstacle to recovery. The sentiment in common was that having a Master Plan is important to establish a steady flow of work, to speed up the progression of anchor projects and to give private investors more confidence to commit to the rebuild.

In the case studies in December 2012, most organisations expected to see increased building activity to peak over the next 12 months into 2014. These expectations about the peak of rebuild have shifted in case studies in April/May 2014. Two-thirds of the organisations believed the volume of rebuild works would peak between mid-2015 and 2016, likely to come from the anchor projects in the precincts within the central city.

Examining the current recovery process, respondents pointed to an inconsistent pattern of work with peaks and troughs at various times. One interviewee noted that the perceived patchy recovery is partly as a result of a failure to plan and schedule works earlier, a shortcoming that has been exacerbated by weaknesses in understanding how earthquakes impact on the conditions of infrastructure and buildings.

However, one interviewee considered an ideal recovery curve should be gradual, based on the industry's capacity and a vision for leaving a sustainable construction workforce as well as a resilient built environment post rebuild. Another suggested that an optimised approach can be applied to consider recovery trajectory:

> *"For recovery ... if the demand climbs too fast to a peak, the big boom and bust is inevitable, the economic and social consequences of such a boom is that recovery won't*

deliver the workforce needed for future economy. So the force and speed are key parameters for achieving an optimal recovery."

Greater visibility as to when projects are going to market and the resources they may require is beginning to happen, especially since the Christchurch Rebuild – Construction Market Engagement Forum[2] in January this year. However, prolonged lead times from planning to construction was another problem reported by interviewees which impacted resourcing and created inconsistent work flows.

Contractors and suppliers reported that their spare capacity was a result of the inconsistent workflows, affecting their workforce demand. For instance, some interviewees noted that the slow pace of vertical rebuild is affecting their cash flow and this then affects the rate and number of people they can take for employment.

2.2 Lack of quality of new workers and high turnover rate

The skills issue in terms of a workforce able to produce quality work is one of the most reported problems, especially by small-to-medium-sized organisations. Terms like '*lack of competency*', '*lack of experience*', '*low level of skill*', '*absence of work ethic*' and '*incorrect work attitude*', were used by studied employers as a reason, in part, for their reluctance to recruit younger inexperienced workers.

According to Work and Income, vacancies related to the rebuild are taking longer to fill (MBIE, 2013). A continuing low unemployment rate (3.2 per cent for the December quarter of 2013) in Christchurch makes sourcing appropriate labour more difficult (CDC, 2014). The Construction Sector Leaders Group (2013), however, considered a current inhibitor to increasing the labour pool to be the lack of skilled supervisors to manage the growing crews, and suggested sourcing strategies for supervisory staff. Case study findings in this research show that resource pinch points also exist in areas of pipe laying, plant operating and building component installation.

[2] Major clients in the Canterbury rebuild shared their forward work programmes at the Christchurch Rebuild – Construction Market Engagement Forum in Christchurch on 28 January 2014. The Forum was instigated by the Productivity Partnership and hosted by CERA with the support of MBIE.

Construction organisations find it increasingly difficult in sourcing qualified people in these occupations.

SME employers were particularly challenged by a range of staff quality issues, namely a lack of experience, skill and competence at semi-skilled and operative levels. Additionally, organisations highly valued the quality of workmanship and services, which was not always easy to achieve with the high turnover of staff. Employment of less skilled young employees and their relatively high turnover rate seem to be an expanding problem and will become more prominent as more construction work gets underway.

2.3 Loss of skills and subcontractors to other sectors

Case studies of April/May 2014 found that organisations are inclined to take more work in Canterbury's new subdivision areas. Some of them have successfully secured contracts in government's housing construction and transport projects. Because of this trend, medium to large-sized infrastructure contractors reported that since mind-2013 they have been experiencing some staffing pressures as their rebuild projects gradually lose subcontractors and expertise to new building activities.

The pattern of people moving away from the rebuild to other sectors was most prominent among those who entered the rebuild sector following the earthquakes, such as overseas migrant workers and those entrant skills from outside Canterbury. This pattern can be explained by a variety of dynamics that plays out in the construction market. The following dynamics were observed by the case study organisations:

- New workers are looking for better career opportunities in other places after gaining Christchurch rebuild experience.
- Small-to-medium sized businesses are seeing work levels in housing and transport sectors rise over the last year and are optimistic about development prospects in buildings and infrastructure industry across the region.
- Large engineering and construction companies are focussing on winning contracts for large rebuild anchor projects. However, the delay or uncertainty around when these

projects will start is causing their high rates of staff turnover and problems with retaining their subcontractors who, as pointed above, are moving to new building activities. The pressures faced by some large organisations are captured in the following quote:

> *"This year (2014), we start seeing a significant resource pinch on our external subcontractors. For instance, we sent 100 invitations for tender, only a third got back to us as those subcontractors are busy and their resources got tied up. It will be difficult for us to find compliant tenders and keep us competitive." (Interviewee of a large contracting company)*

- General changes in construction demand in different locations have an impact on the rebuild. For example, due to the increased construction demand and higher rates offered in other places (like in Auckland), some companies which established local operations in Christchurch and secured work in the rebuild following the earthquakes have now moved back to housing and building markets in Auckland. As one interviewee put it,

> *"As the Auckland market picks up whereas the Christchurch market raised but is not super busy, some of those companies had pulled out their presence from Christchurch as they can survive now in other markets."*

There is a general concern across organisations that with increased infrastructure investments in Canterbury, and growth pressures in other major cities, competing demands for resources between the business-as-usual projects and rebuild projects may increase over the next three years. The shortages of resources – not only skills but capitals – might be exacerbated by cost escalation in the rebuild sector. To address this concern, case study organisations suggested that Government invest in project management in terms of programme and portfolio management for the rebuild of commercial buildings in central Christchurch to protect both public and private investment from cost overruns.

2.4 Consistent demand for certain roles

Consultants and contractors in the infrastructure rebuild sector reported ongoing demand for project managers and civil engineers in 2014. Companies working in the commercial building sector, however, noticed the declining trend for professionals in project management and

engineering disciplines since the end of 2012. One interviewee noted that the demand for building project managers peaked in 2011/12 (1 April 2011 to 31 March 2012) whereas the demand for engineering professionals in structural and building services peaked in 2012/13 (1 April 2012 to 31 March 2013). Contracting organisations reported drain layers, welders, plant/machine operators as well as safety and quality control staff are still in short supply and will be needed for continued infrastructure rebuild.

EQC's Canterbury Home Repair Programme is set to wrap up at the end of 2014, with up to 70,000 homes having been repaired and about 20,000 houses still requiring repair. The residential repair sector has a high proportion of small and independent contractors, many of whom have started coming to the market as EQC repair work comes to an end. However, for the remaining jobs in house repairs, some roles are still challenging to fill, such as the specialist trades (especially tilers, asbestos removal specialists, roofers, brick and block layers) and the leading hand/supervisors, and these shortages still continue.

In the building supplies sector, there is an unmet demand for experienced truck drivers. The studied building supplies organisations reported an average 30 per cent turnover rate of truck drivers. One interviewee noted that some of these turnover groups, especially young men without families, are transient. Companies had to turn to overseas migrants from the Philippines to fill local truck driving gaps. Quick turnover of other specialist trades, such as painters and plumbers, has also been reported by subcontractors as a significant risk factor for businesses working on the rebuild.

2.5 Changed workforce employment strategies

There were changes in skills needs since the December 2012 case studies. A general observation was that most organisations reached a certain level of capacity at the end of 2012 although some skills remained in short supply, and since then that capacity has remained stable and relatively static. The number of building structural engineers reached a plateau in 2013, but civil engineers were still generally in short supply. Since the second half of 2013, most of the studied companies have replaced staff with fewer new recruitment intakes. As mentioned earlier, the Auckland

market picked up in 2013, taking some focus away from Christchurch. Newly-entered companies also started pulling away their Christchurch operations to focus on their Auckland market.

By mid-2015, MBIE is predicting a peak of non-residential development at around $1.3 billion per quarter and to remain above $1 billion per quarter until mid-way through 2018 (Speirs, 2014). Case study organisations were worried that workforce mobility from the rebuild to other developments may continue to increase in response to the market growth on other areas. There is a consensus that they need to ensure they have enough resources to be able to plan for continued rebuild within their own organisations and supply chains; and the focus needs to be on skills retention and up-skilling. Strategies already implemented included employee performance review changing from annual to quarterly reviews, line manager having more frequent contact with staff, increased focus on staff development, and staying competitive in the market in terms of pay rates.

Retaining trained employees has been particularly challenging, as one interviewee highlighted:

> *"Finding the right people who are willing, able and motivated has been problematic. The more frustrating is you take on new people and spend a lot of time and money training them up. Once they have gained that experience, they move to another company. This is certainly not good for apprenticeship with fewer companies willing to invest in youth training."*

Given the current the high turnover, construction organisations need to secure key people to maintain the core competency of their business. Competing demands for staff from other projects and other sectors have led businesses to rethink their resourcing strategies. Some of them are changing their workforce models to take account of the high staff turnover rate and the lower quality workforce. Small-to-medium sized organisations reported that it may be uneconomic to hire wage workers.

One studied organisation re-assessed their business development strategies and opted to re-structure the company by replacing wage employees with sub-contractors in order to reduce their operational costs. The outcome of this approach was beneficial from an employer's point of view, with increased revenue, improved productivity and work efficiency. However, if such an

employment trend prevails in the coming years, there are implications for training and workforce development in the construction industry.

2.6 Temporary accommodation and wage increases

Case study organisations were asked to list top resourcing problems in terms of their effect on their workforce planning and strategies. In December 2012, case study organisation's top resourcing problems were around temporary accommodation and wage escalation. The updated case studies found some changes.

Companies appeared less concerned about workers' accommodation. The issue of temporary accommodation still exists but seems to be absorbed by the market regardless of rent increases. According to Work and Income, the lack of accommodation and high rental costs continue to make it difficult for people to relocate from other areas to work in Christchurch (MBIE, 2013). Although accommodation was not raised as a major challenge facing case study organisations, this is an area in which recovery agencies need to keep alert, especially when the rebuild of anchor projects rolls out (See Resilient Organisations report Chang-Richards et al. (2013b; 2014), for a more complete study on this issue).

The rates for construction work in Christchurch continued to increase over the past year. This result is broadly in line with the results of MBIE's labour market report that the cost of labour in Canterbury construction continues to increase, but at a lower rate. In the year to the December 2013 quarter, salary and wage growth in the Canterbury construction industry increased 2.8 per cent (MBIE, 2013). Case study organisations reported two different views on wage rises for the coming years. Some expected significant wage rises will only happen to some roles that are more challenging to fill while others predicted a general wage rise by over 5 per cent across the construction sector in Canterbury.

3. Emerging issues: A 2014 perspective

Looking forward, case study organisations suggested the following emerging issues that are likely to affect the needs of the construction sector in Canterbury.

3.1 House repair and rebuild for cash settled home owners

The large number of houses with under $100,000 worth of damage repaired under the Fletcher EQR programmes meant that many professionals and trades are coming to the market. However, some interviewees were concerned that there are not enough project managers with adequate training and knowledge for house reconstruction in coming years.

The scale and scope of residential rebuild in Christchurch are growing due to cost escalation and house owners' intention to do other renovations or changes at the same time. The rebuild costs may exceed the insurance settlement amounts, which may challenge some home owners who choose to self-manage their house rebuild.

Financial constraints faced by some cash-settled owners can lead them to hire less-qualified professionals and trades who offer lower rates. There is also a risk that they may go for cheaper and unproven materials and products with consequent poor performance. One interviewee noted that in such situations, there exist risks of cost overruns as well as technical and other project risks (See Resilient Organisations report Wilkinson et al. (2014) for a more complete analysis of this emerging issue).

3.2 Difficulty in matching labour to skills among younger workforce

Case study organisations suggested that a mismatch of labour and skills is likely to continue to occur or worsen if fewer companies are willing to invest in training new entrants. This mismatch will prevail especially among youth groups and manifest itself in the form of skill gaps, under-qualification and skills shortages.

While there have been solid numbers of enrolments in institutes of technology and polytechnics (ITPs) and industry training organisations (ITOs) over the last year, completions do not appear to

be making a significant impact on the supply of trades workers in Canterbury (MBIE, 2013). Case study organisations indicated that there may be some time before workers from these programmes are fully productive.

Low efficiency in skills matching was more related to high staff turnover among less experienced younger workers than older employees. As a result, investing in training has become more costly and less effective. Construction employers will need to be incentivised in training those young workers to be fully productive. The real challenge is to tackle the issues of some of young workers being unmotivated. As one interviewee noted:

> "*Being willing should always come before being able, which is a behavioural element that can fundamentally address our industry's productivity. As employers, we can provide opportunities to enhance their ability to do the work, but without their willingness to be motivated and participate, our efforts will be in vain.*"

3.3 Loss of good staff due to burnout and other well-being issues

According to the Resilient Organisations' study on post-disaster employee needs, there is a trajectory of evolving needs at workplaces (Nilakant et al., 2013). Three years after the February 2011 earthquake, organisations reported that some employees start looking for changes outside the rebuild zone. In contrast, prospective employees who want to move to Christchurch for rebuilding work are struggling with a range of ongoing issues such as escalating house prices and/or high rents and they may also face a work environment that is different from business-as-usual. Therefore, 2014 will be a year of human resource solutions with a focus on staff retention.

There is a related issue of good people leaving in the running down phase of projects. Some construction organisations reported losing senior people and managers who after three years of *'wading through the swamp'* have just had enough. Changing roles and staff also affect the state of productivity and business operation. Staff 'burnout' and other wellbeing issues, such as increasing stress, are reported to be emerging challenges facing construction organisations.

3.4 Exit strategy of companies and agencies

The uncertainty around staffing movement and resourcing reduction of newly created recovery organisations with set end dates will impact on resourcing for the rebuild. Proactively managing 'exit strategy' is being needed to provide a smoother transition for employees from one role to the other. There is a perception that employees in organisations created for recovery and reconstruction (such as CERA, SCIRT, EQR, amongst others) are feeling uncertain over their future employment situations. An interviewee stated:

> *"We're running on 'blind faith' – we don't know what we'll do once our mandate finishes and where to go. Some are panicking. Sadly nobody can make any commitment to our job security. You only have to wait and think positively that something will come up in the end."*

Given that the overall rebuild may take longer than anticipated, a business case for some of these organisations extending their mandate could be made. In addition, residual work in the housing repair sector could possibly extend the existence of Fletcher EQR beyond its expiry date. CERA have reportedly experienced a high turnover of staff, and many of the existing CERA staff will need to be transitioned to Christchurch City Council, Central Government or the private sector. This requires planning and will have budget implications.

The Human Resource implications of exit strategies of key organisations will increasingly become an issue of concern. The ability of agencies and the construction sector to absorb these resources is of importance to the continued functioning of the labour market.

4. Conclusion

The changes in construction demand in Canterbury since the first case studies in December 2012 have led to a reappraisal of the resource risk to the Christchurch rebuild by the construction sector. There are signs that business–as-usual, along with new developments both region-wide

and across the country, are growing stronger, to the extent that Christchurch is losing skills needed for the rebuild.

The updated case studies in this report show that the bigger issues for construction organisations to grapple with in creating a sustainable workforce lie in how to decrease staff turnover and how to create the best business environment to retain core competencies. Skills retention has, therefore, become a main focus for construction businesses operating for the rebuild.

The Government's Apprenticeship Reboot programme and the recent '$3K to Christchurch' initiative mean that the Christchurch construction industry will experience a resurgence of growth. However, the key message from case study participants is that the availability of resources needs to be seen in the wider context of an effectively functioning labour market. An increased concern for high turnover rate and quality of new workers requires an additional education and training component to address workforce competency issues fundamentally in order to support the changing resourcing paradigm for the construction sector.

Above all, for construction organisations, two interrelated components are needed to leverage the workforce flows: 1) a steady work flow from the construction of anchor projects and infrastructure rebuild at the regional level; and 2) company's ability to meet staff needs at the organisational level. At the employee's level, however, there is a need to regulate the labour market in terms of addressing the workforce quality issue reported in the case studies and increasing the efficiency of skills matching. It is recognised that unless such an approach to matching the labour and skills is formalised, the problems identified in the case studies will continue to affect the smooth running of the industry, and construction companies will remain frustrated while the recovery progress will remain below optimal levels.

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Resilient Organisations research reports: http://www.resorgs.org.nz/Publications/research-reports.html

Priscilla Cheung

From:	Alice Chang-Richards <ycha233@aucklanduni.ac.nz>
Sent:	Friday, 5 February 2016 11:08 a.m.
To:	Priscilla Cheung; Richard Smith
Cc:	Suzanne wilkinson Wilkinson; Resilient Organisations; David Brundson
Subject:	Progress reporting February 2016 - Resourcing the Canterbury Rebuild Project
Attachments:	Resource Project Progress Report for EQC - February 2016.pdf; Research Report 1 - Subcontractors Features Resourcing Motivating Factors and Barriers 2016.pdf; Research Report 2 - Trends in resourcing and employment practice - Latest resourcing report 2016.pdf; Building Resilience Conference 2015 paper.pdf; i-Rec 2015 Conference paper.pdf; Journal Article 1- accepted by Engineering Construction and Architectural Management.pdf; Journal Article 2 - Submitted to Earthquake Spectra - under revision.pdf; Journal Artilce 3 - Submitted to Disasters - under 2nd revision.pdf; Build article-150-84-Research-Issues-Facing-Subcontractors (1).pdf

Dear Priscilla and Richard

Happy New Year!

Re: Resourcing the Canterbury Rebuild Project

This is to report our research activities and progress made since our last reporting in May 2015.

Please find attached:

1. Project Progress Report (May 2015-now)
2. Research Report [1] - Subcontractors features, resourcing motivating factors and barriers, February 2016 - please be advised that this report is currently under review, and to be released soon
3. Research Report [2] - Trends in resourcing and employment practice of Canterbury construction organisations, latest updates, February 2016 - please be advised that this report is currently under review, and to be released soon
4. Conference paper [1] - presented at the 2015 Building Resilience Conference, Newcastle, Australia, 15-17 July, the paper received the 2015 Emerald Best Conference Paper Award
5. Conference paper [2] - presented at the 7th i-Rec Conference 2015: Reconstruction and Recovery in Urban Contexts, London, UK 6-8 July
6. Journal article [1] - accepted by Engineering, Construction and Architectural Management
7. Journal article [2] - submitted to Earthquake Spectra - the review comments were received and currently under 1st revision - please do not circulate the attached draft until further decision is made by the journal
8. Journal article [3] - submitted to the Journal of Disasters - the review comments were received and currently under 2nd revision - please do not circulate the attached draft until further decision is made by the journal
9. BRANZ Build article - 'Issues facing subcontractors', Build 150/85, October/November 2015

The research team had undertaken a data collection trip to Christchurch in October 2015. The objective of this trip was to investigate the latest resourcing issues/challenges faced by the construction organisations and agencies in undertaking rebuild, the trend of rebuild, their strategies in response to these changes and expectations of a likely slowdown in the rebuild, as well as how construction organisations perceived the alignment of public policies (from MBIE) with the industry response. The findings of this trip are reported in the Research Report [2].

In the meantime, we continued our stakeholder engagement with our construction organisations and key recovery agencies like the Canterbury Earthquake Recovery Authority (CERA), the Ministry of Business, Innovation and Employment (MBIE) and PMOs (SCIRT and Fletcher EQR), etc.

We would like to thank EQC, and give special thanks to you and Richard for the continued support throughout this period.

Please feel free to contact us should you have any questions.

Kind regards
Alice

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THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Resourcing the Canterbury rebuild Research Project

PROGRESS REPORT TO EQC

February 2016

Project Manager	Professor Suzanne Wilkinson
Principal investigator	Dr. Alice Yan Chang-Richards (Lecturer)
Project Advisors	Dr. Erica Seville & David Brunsdon
Chair of Project Advisory Committee	Dr. Wayne Sharman
Project title:	Resourcing the Canterbury Rebuild
Project Start Date:	1- January -2014
Project End Date:	31-December -2015
Type of Report:	Progress report

Summary of research project activities undertaken from 13 May 2015 to date (1 February 2016)

The objectives at this stage are to:

- Collecting data on the latest strategies adopted by construction organisations in Canterbury and their expectations of a likely slowdown in the rebuild.
- Finalising the report on subcontracting businesses – their features, motivating factors and obstacles to their capacity and capability development, thus resourcing when going through the bust and boom cycle (the 2008 global financial crisis and the subsequent 2010/11 Canterbury earthquakes)
- Disseminating research findings with regard to the resourcing case studies of subcontracting businesses via industry channel – BRANZ Build magazine to reach decision makers, training agencies and practitioners in the industry
- Continuing to inform policy and disseminate report to the key stakeholders including the Canterbury Earthquake Recovery Authority (CERA) and the Ministry of Business, Innovation and Employment (MBIE), Earthquake Commission (EQC), along with construction organisations through established dialogues

- Communicate research findings through international publications
- Presenting research results at two internationally recognised conferences

Therefore, the researchers have

- Conducted a research **data collection trip to Christchurch in October 2015**. The objective of this trip was to investigate the latest resourcing issues/challenges faced by the construction organisations and agencies in undertaking rebuild, the trend of rebuild, their strategies in response to these changes and expectations of a likely slowdown in the rebuild

- Presented a paper at **the 5th International Conference of Building Resilience**, Newcastle, Australia 15-17 July 2015, titled 'A systems approach to managing human resources in disaster recovery projects' – **the paper received the Emerald Best Conference Paper Award**
- Presented a paper at **the 7th i-Rec Conference 2015: Reconstruction and Recovery in Urban Contexts**, London, UK July 6-8, 2015, titled 'Beyond 'business as usual': Capability challenges in earthquake reconstruction in Christchurch, New Zealand'

- Communicating research findings by contributing **an article to the BRANZ Build magazine** and **3 internationally peer-reviewed journal articles** (currently one accepted and two under review)

- Data analysis and reporting
    - The latest updates on the changes to the resourcing approach, the trend of rebuild and construction organisations' response to future market volatility were captured during the data collection in October 2015, the report is under final review before release – see the draft (not to be circulated)
    - A report on subcontracting businesses – their features, motivating factors and obstacles to their capacity and capability development, thus resourcing when going through the bust and boom cycle (the 2008 global financial crisis and the subsequent 2010/11 Canterbury earthquakes) has been finalised
    - A comparative analysis on resourcing strategies between civil infrastructure subcontractors and commercial rebuild subcontractors has been finalised
    - Three journal articles aiming to be published in the Earthquake Spectra (ERA 2010 A* Journal, Impact Factor 3.744, the Top 1 journal in earthquake engineering); Engineering, Construction and Architectural Management (ERA 2010 A* Journal, Impact factor 0.672); and Disasters (ERA 2010 B Journal, Impact factor 1.023) have been submitted, one accepted, the other two are subject to revision after having received review comments.

Summary of what has been achieved

- **Two finalised reports** – to be released

  [1] Chang-Richards, Y., Wilkinson, S., Seville, E., & Brunsdon, D. (2016). Capacity and capability development of Canterbury subcontracting businesses: Features, motivating factors and obstacles, February 2016. Resilient Organisations Research Report 2016/01

  [2] Chang-Richards, Y., Wilkinson, S., Seville, E., & Brunsdon, D. (2016). Resourcing the Canterbury Rebuild: Changes, responses and expectations of construction organisations, February 2016. Resilient Organisations Research Report 2016/02

- **Two conference papers**

  [1] CHANG-RICHARDS, Y.; WILKINSON, S; SEVILLE, E; BRUNSDON, D (2015) 'Beyond 'business as usual': Capability challenges in earthquake reconstruction in Christchurch, New Zealand'', the 7th i-Rec Conference 2015: Reconstruction and Recovery in Urban Contexts, London, UK July 6-8, 2015

  [2] CHANG-RICHARDS, Y.; WILKINSON, S; SEVILLE, E; BRUNSDON, D (2015) 'A systems approach to managing human resources in disaster recovery projects', the 5th Annual International Conference on Building Resilience, Newcastle, Australia, July 15-17, 2015 - ***This paper received the Building Resilience Conference 2015 Emerald Best Conference Paper Award***

- **A research journal article**
  - CHANG-RICHARDS, Y.; WILKINSON, S., SEVILLE, E., BRUNSDON, D. (2016). 'Effects of a major disaster on skills shortages in the construction industry: Lessons learned from New Zealand', Engineering, Construction and Architectural Management, Accepted, in press. (Impact factor 0.672)

- **A research journal article** was reviewed and under revision
  - CHANG-RICHARDS, Y.; WILKINSON, S., SEVILLE, E., BRUNSDON, D. (2016). 'Housing the workforce for post-disaster reconstruction: Christchurch's experience', Journal of Disasters, under revision. (Impact factor 1.023)

- **A research journal article** was reviewed and under revision
  - CHANG-RICHARDS, Y.; WILKINSON, S., SEVILLE, E., BRUNSDON, D. (2016). 'A capability framework for effective earthquake response and reconstruction', Earthquake Spectra, under revision (Impact factor 3.744)

- One BRANZ Build article
    - CHANG-RICHARDS, Y; WILKINSON, S.; SEVILLE, E.; BRUNSDON, D. (2015) 'Issues facing subcontractors', Building Research Association of New Zealand (BRANZ) BUILD, 150, (October/November 2015), p82-83

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Resilient ORGANISATIONS
A collaboration between research & industry

Capacity and capability development of Canterbury subcontracting businesses: Features, motivating factors and obstacles

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David Brunsdon

Resilient Organisations Research Report 2016/01

February 2016

About the Resilient Organisations Research Programme

"Building more resilient organisations, able to survive and thrive in a world of uncertainty, through research and practice"

We live in an increasingly complex world dealing with a broad spectrum of crises arising from both natural and man-made causes. Resilient organisations are those that are able to survive and thrive in this world of uncertainty.

Who we are:

The Resilient Organisations Research Group (ResOrgs) is a multi-disciplinary team of over thirty researchers and practitioners that is New Zealand based and with global reach. A collaboration between top New Zealand research Universities and key industry players, including the University of Canterbury and the University of Auckland, ResOrgs is funded by the Ministry for Science and Innovation through the Natural Hazards Research Platform and supported by a diverse group of industry partners and advisors. The research group represents a synthesis of engineering disciplines and business leadership aimed at transforming organisations into those that both survive major events and thrive in the aftermath.

We are committed to making organisations more resilient in the face of major hazards in the natural, built and economic environments. Resilient organisations are able to rebound from disaster and find opportunity in times of distress. They are better employers, contribute to community resilience and foster a culture of self-reliance and effective collaboration.

What we do:

The ResOrgs programme of public good research is aimed at effective capability building through research activities with significant impacts on policy and practice. Activities and outputs of the group, in existence since 2004, include informing and focusing debate in areas such as Civil Defence Emergency Management, post-disaster recovery, and the resilience of critical infrastructure sectors, in addition to core activities in relation to organisation resilience capability building and benchmarking. We have produced practical frameworks and guides and helped organisations to develop and implement practical resilience strategies suitable to their environment.

Why we do it:

In an increasingly volatile and uncertain world, one of the greatest assets an organisation can have is the agility to survive unexpected crisis and to find opportunity to thrive in the face of potentially terminal events. We believe such resilience makes the most of the human capital that characterises the modern organisation and offers one of the greatest prospects for differentiating the successful organisation on the world stage. This resilience is typified by 20/20 situation awareness, effective vulnerability management, agile adaptive capacity and world class organisational culture and leadership. More resilient organisations lead to more resilient communities and provide the honed human capital to address some of our most intractable societal challenges.

For more information see our website: www.resorgs.org.nz

Executive summary

This report provides an understanding of the nature of the Canterbury subcontracting businesses operating in the space of earthquake reconstruction in Christchurch. It offers an in-depth look at the factors that influence the development of their capacity and capability to withstand the impact of volatile economic cycles, including the 2008 global financial crisis and the subsequent 2010/11 Canterbury earthquakes.

There have been significant changes to the business model of the 13 subcontracting businesses studied since the earthquakes. These changes can be seen in the ways in which businesses have adapted to cope with the changing demands that the rebuild posed. Apart from the magnitude of reconstruction works and new developments that directly affect the capacity of subcontracting businesses in Canterbury, case studies found that subcontractors' capacity and capability to meet the demand varies and is influenced by the:

- **subcontractors' own unique characteristics, which are often shaped by**
- **changing circumstances in a dynamic and uncertain recovery process; and**
- **internal factors in relation to the company's goal and employees' needs** (See Figure 1)

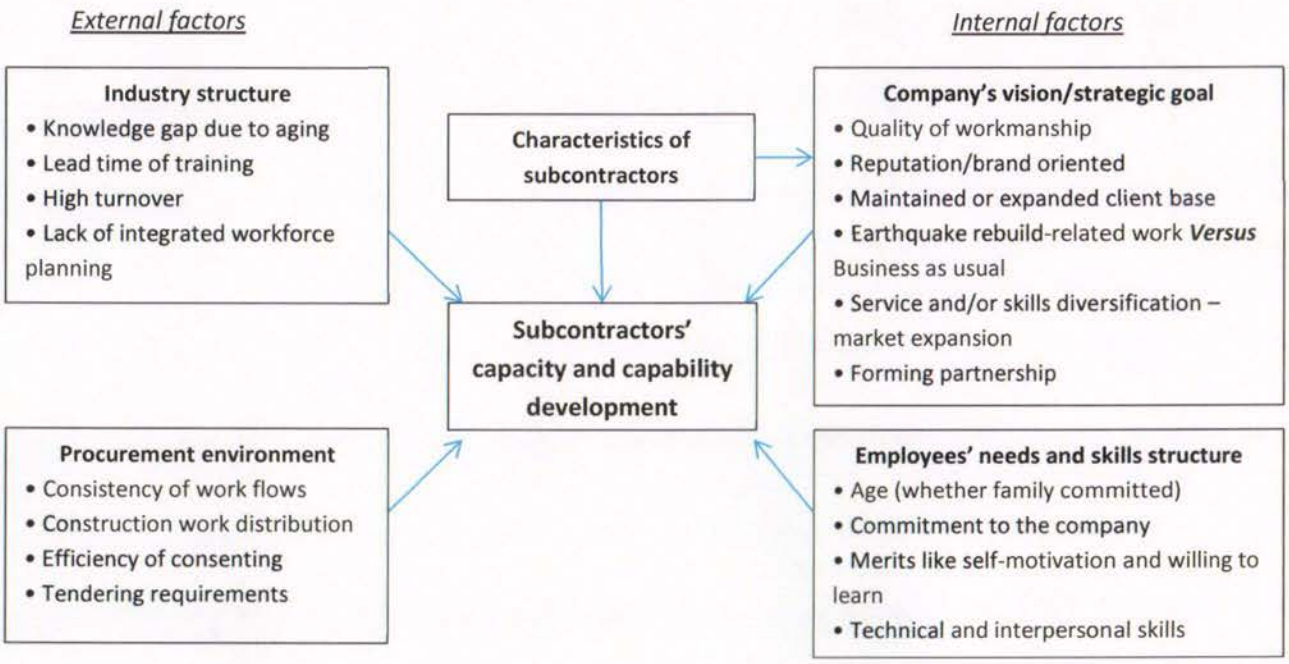

Figure 1: Factors influencing capacity and capability development of case study subcontractors

- The report shows that case study subcontractors **share common features** which to some degree affect the way resources are organised and managed. As most subcontractors being small-sized enterprises, there appears to be a close link between the management style of the entrepreneur and its resourcing practice. They tend to have a limited financial resource base and internal knowledge base. The size of business operations and capacity is relatively small compared to larger contractors. However, subcontractors tend to have a close link with the local communities.

- The lingering issues related to the **construction industry's structure**, such as aging problem, lead time of training, high turnover (30% on average) and lack of integrated workforce planning across the subcontracting sector were particular challenges that add difficulty to subcontractors' workforce planning and increase their costs of recruitment and training.

- With small size of business operations and capacity, subcontractors were particularly vulnerable to **market forces and fluctuating workflows**. Workflow fluctuations, low efficiency of consenting and tendering process were reported to have a particular impact on subcontractors. Subcontractors form a continuum, with some fully involved in the infrastructure-rebuild related works and others having reduced the rebuild commitment while increased presence in business as usual. There was a significant move between 2013 and 2014 from horizontal rebuild towards newly subdivided areas in Canterbury region.

- **Individual subcontractors' business strategy and/or their vision** have a substantial impact on the way skills are sourced and developed. A solid client base was found to be the first priority among most subcontractors, which largely dictates the direction of capability development and resourcing approaches, such as recruitment on a permanent basis, expanding business as usual market, forming partnership with other companies and diversification of services and skills.

- **Characteristics of workforce** including their technical and interpersonal skills, commitment to the company, merits like self-motivation and willing to learn, and their age were subcontractors' primary considerations when offering employment. Most

workers engaged in the subcontractors studied are in the 30-to-late-50s age bracket. Subcontractors generally opted for contingent workers by recruiting younger workers (under 25 years old) in an attempt to ensure flexibility in the use of labour and to enable them to respond to uncertainties in the economic environment.

- **Sectoral variations** have been identified with vertical rebuild in the central Christchurch nominated as facing the most challenges with demand outstripping supply of tradespeople and challenges in retaining subcontractors in infrastructure repair and rebuild works. The size of the shortfall is dependent on the ability of government, project clients and contractors to successfully import and re-deploy new workers (new entrants, apprenticeships, and workers from outside) into Christchurch. There is a need to provide the necessary structural and social infrastructure, including temporary accommodation and/or housing facilitation.

The cases show that for many subcontractors, a low level of skills development is due less to unwillingness of company to invest than to limited financial and operational capacity. Hence, policy makers who are interested in raising the profile of subcontractors in the county might want to focus more on helping them to build their capacity to develop skills.

Case studies demonstrate that the state of capacity and capability development in a construction subcontractor is not static. It changes over time as the mix of determinant factors changes. Being through the bust and boom cycle following the 2008 financial crisis and the 2010/11 Canterbury earthquakes, most subcontractors realised that having productive and competent workforce and core capability is the key to creating a virtuous circle between quality of work and sustained client base in a small company. It remains critical that some of the issues identified in this report, such as high turnover, youth employment, lack of knowledge transfer within the subcontractor and at the sector level, and lack of investment in training and skills development, can be addressed in a systematic way. Better engagement of subcontractors should be the first step towards any of the solutions.

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Acknowledgement

This study is part of the project 'Resourcing the Canterbury Rebuild' under the Resilient Organisations Research Programme. The project is funded by the Building Research Association of New Zealand (BRANZ), the Ministry of Business, Innovation and Employment (MBIE) and the Earthquake Commission (EQC). We are grateful for the time and information offered by case study subcontractors who operate and contribute to post-earthquake reconstruction in Christchurch.

1. Introduction

During the 2008/09 global economic crisis, the New Zealand construction industry was amongst the hardest hit, with employment down by 5% from 190,000 to 181,000 by June 2009 (Department of Labour, 2009). The downturn had an employment impact on the subcontracting businesses which are vital to the performance of the sector (BCITO, 2008). The surge in construction activity following the Canterbury earthquakes offered the sector the chance to develop skills and capital base for improving its economic prospects. However, increasing rebuild requirements in the region raised concerns about the capability of the entire construction industry to deliver a timely rebuild.

As the demand of repairs and rebuilds in Christchurch escalated over time, contracting organisations reported that their business model was fundamentally changed due to the restructuring of construction activities as a consequence of the earthquake sequence itself and of the reconstruction (Chang-Richards et al., 2015a). The impact of the earthquakes, however, was felt most by small to medium subcontracting businesses (Chang and Wilkinson, 2012):

- For micro-sized subcontracting businesses, the impact was primarily associated with time and cost overruns due to the stretched capacity across both earthquake-related jobs and business as usual projects;
- For medium-sized subcontractors, their aspiration of growing business was limited by the shortages of experienced personnel who can form there core competency;

By casting construction subcontractors' thoughts back to the year of 2008 when the global financial crisis occurred, and the following years of the 2010/11 Canterbury earthquakes, this study offers an in-depth look at the factors that have affected the development of their capacity and capability to withstand the impact of such a bust and boom cycle.

Key areas examined in this study include:

- the characteristics of the construction subcontractor businesses in Canterbury;
- the motivating factors for, and existing obstacles to developing their capacity and capability; and

- the key learnings for developing sustainable subcontracting business concerning human resources management systems, reducing the knowledge gap, training requirements, and any issues currently being encountered during the rebuild and future expectations.

The emerging issues facing Canterbury rebuild subcontractors and case study findings of 13 subcontractors, including such as the ways in which they develop their resource capability, their recruitment and retention strategies, the challenges they were facing during the rebuild and their resourcing policies and practice, were reported in (Chang-Richards et al., 2015b) and (Chang-Richards et al., 2015a), respectively. This report, however, concentrates on the nature of subcontracting sector, which allows for more detailed analysis, including backward linkages with major contractors and forward linkages with suppliers and labour. It also focuses exclusively on understanding the motivating factors and obstacles faced by subcontractors in Christchurch in developing their capability to sustain their business. The results are based on the case study of a range of subcontracting businesses in May 2014.

This study will be of use to those who are interested in improving employment and business development practice in construction subcontractors. This includes policy makers, productivity centres and training organisations. Entrepreneurs and managers of construction subcontractors may also find it useful to learn from other businesses' experiences, particularly their learnings from the 2008 financial crisis and subsequent earthquake reconstruction. Furthermore, the New Zealand construction industry leadership groups can benefit from better understanding many of the factors that influence the strategic resourcing choices firms make in attaining a sustainable goal.

2. About the case studies

The case study organisations were selected in consultation with Christchurch employers' organisations such as the Canterbury Chapters of the Specialist Trade Contractors Federation and the New Zealand Building Subcontractors' Federation. A sample of 30 subcontracting businesses was drawn. The initial list was then reduced, based primarily on whether the company is involved in civil works for infrastructure rebuild in Christchurch and the company's willingness to be interviewed in depth. However, other considerations such as the diversity of companies in terms of size, type of business, years in business and form of labour were also taken into account. In total, 13 subcontracting businesses who were engaged in civil works for infrastructure rebuild were studied in May 2014 (See Table 1).

Table 1: Basic profile of case study subcontractors

Case study subcontractors	Number	Organisational coding
Business ownership category		
Family business	4	S1, S2, S7, S11
Incorporated	3	S3, S9, S13
Incorporated family	3	S4, S10, S12
Limited company family	3	S5, S6, S8
Organisational size		
Micro-sized (Ep≤10)	3	S1, S2, S7
Small-sized (Ep≤50)	7	S3, S5, S6, S8, S9, S11, S13
Medium-sized (50 <Ep≤100)	2	S10, S12
Large-sized (Ep>100)	1	S4
Years in business		
Less than 10 years	1	S13
10-20 years	3	S1, S9, S11
21-30years	3	S3, S6, S7
31-40 years	2	S5, S12
More than 40 years	4	S2, S4, S8, S10

Note: Ep denotes the number of employees

Face-to-face interviews with 13 subcontractors were conducted, collecting the following information:

a) their business experiences during the 2008/09 financial crisis and subsequent to the 2010/11 earthquakes;
b) changes to business model and capacity requirements since the earthquakes
c) the motivating factors for, and existing obstacles to their successful resourcing; and

d) the key learnings for developing sustainable business

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520). The Annex provides a short description of each company.

3. Characteristics of the construction subcontractor businesses

Apart from the magnitude of reconstruction works and new developments that directly affect the capacity of subcontracting businesses in Canterbury, case studies found that subcontractors' capacity and capability to meet the demand varies and is influenced by the:

- subcontractors' own unique characteristics, which are often shaped by
- changing circumstances in a dynamic and uncertain recovery process; and
- internal factors in relation to the company's goal and employees' needs (See Figure 1)

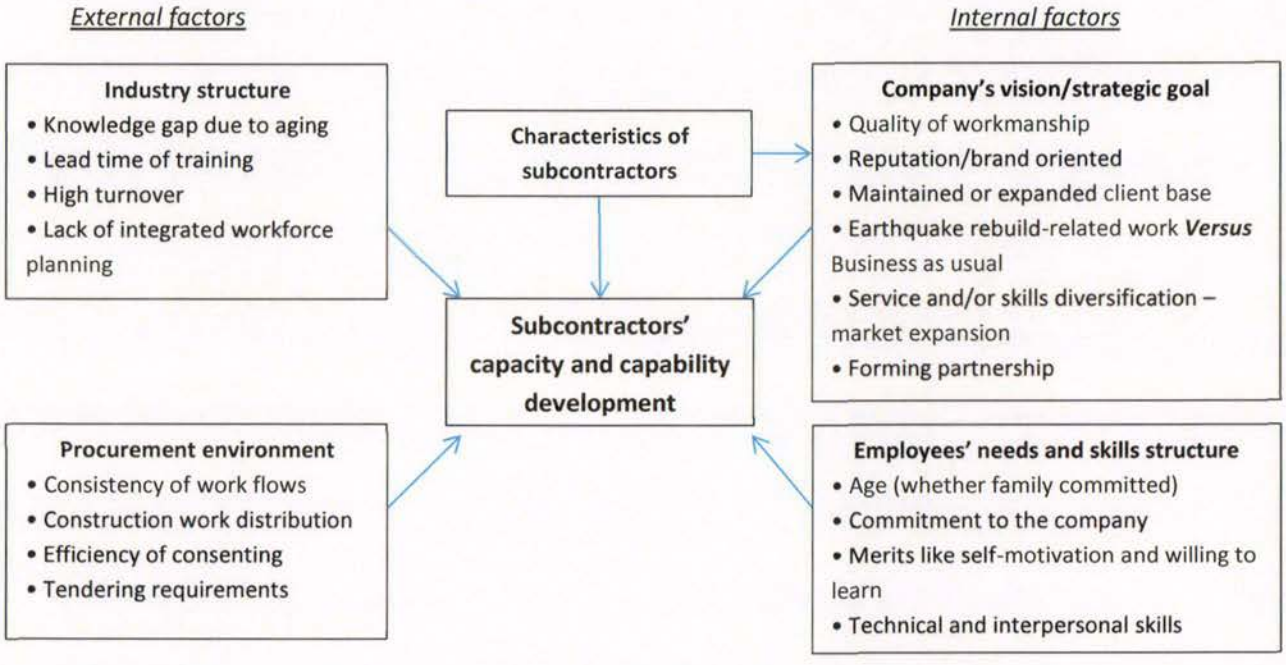

Figure 1: Factors influencing capacity and capability development in case study subcontractors

A preliminary study shows that the extent and forms of resourcing practice adopted by subcontractors, especially those small ones (number of employees is less than 50) differ from that in large organisations (Chang & Wilkinson, 2012). Case studies of subcontractors in this research, however, show some particular characteristics of subcontracting firms that influence their capability development and thus resourcing practice (Table 2).

Table 2: Capability implications of observed characteristics of construction subcontractors

Observed characteristics	**Implications for resourcing practices**
Close link between the management style of the entrepreneur and resourcing practice	• Strong client orientation • Good brand/reputation is the first priority • Lack of succession plans • Strong personnel loyalty considerations
Limited financial resource base	• Narrow budget for personnel recruitment and development • Strong retention culture for retaining 'identified' core staff • Over-riding goal of reducing turnover through non-monetary benefits and providing opportunities for career development • Limited strategic workforce planning
Small size of business operations and capacity	• Simple and flexible processes and systems • Increased multi-tasking requirements • Strong reliance on on-the-job training • Shortage of management and other administrative resources
Limited internal knowledge base	• Dependence on knowledge, experience (know-how) of particular individuals • Focus on knowledge transfer among staff • Recruitment of skills in other specialist areas becomes a channel to diversity business types • Limited use of computer-based facilities
Close link to the local community	• Strong preference of recruiting local people to create a local workforce legacy • Informal approach to workforce recruitment and development (e.g. reliance on the Word of Mouth approach) • Company's social events combined with community events • Community culture has a strong influence on the business

3.1 Close link between the management style of the entrepreneur and resourcing practice

Most of the subcontractors studied were managed by owners, labelled as family business or limited company family (Table 1). Several (i.e. S1, S2, S7 and S11) were family businesses with less than 20 employees. Case studies of these subcontractors show that there is a close link between the management style of owner-manager and their resourcing practice. Interviewed entrepreneurs in these companies felt it was very important to sustain business success through developing a strong client base and sustaining the good brand or reputation of the company. There tended to be a more personalised management style and those entrepreneurs were inclined to recruit staff by themselves.

The interviewed owner-managers seemed to have strong personnel loyalty considerations when deciding which recruits to take on for employment. They tended to prefer candidates recommended by acquaintances. According to subcontractors S9, recruiting workers based on the personal recommendations of current employees and other people has the benefit of strengthening the bond of loyalty, trust and commitment to organisational goals. Subcontractor S11, also commented that:

> "*Most of our work and our workforce are acquired through 'Word of Mouth'. If our people can do a good job; then jobs come to us, rather than we go to look for jobs. Also if people trust that we are a good company, they would recommend their friends to come to work for us.*"

It should be noted, however, that relying on the management capability of owner-managers in those subcontractors also brings with it the risk that there is often a lack of succession plans in the company. For instance, subcontractor S8 ceased its operation in early 2000s as the owner manager retired and no replacement was found at the time. The company has gone through significant transformation from a family business to a subsidiary of Fletcher Construction.

3. 2 Limited financial resource base

Case study subcontractors identified one of the particular constraint that subcontractors face when deciding to invest in skills development was the capital and thin margin constraints which

make them reluctant (or in many cases unable) to provide training access like larger organisations. Several interviewees (e.g. S7, S11 and S12) mentioned that there is also a higher risk of losing good staff that they have trained than that of larger companies.

Subcontractor S9 emphasised that in order for small subcontractors to form an effective workforce, there needs to be '*deliberate financial support from the government and deliberate cooperation by subcontracting businesses to identify common problems and find and implement common solutions. This requires vision, trust and information sharing*'. Subcontractor S1 also made a comment on the impact of financial constraints on the development of human capital in his company:

> "*Constrained budget for small companies like us means advertisement for vacancies become a costly investment. When considering the costs of employing staff, those costs do not just relate to the basic wages. You need to consider the on-costs of things like insurance and annual leave. Advertising costs, our time for sifting applications all have a cost. Training for current staff and induction training for new staff will also add to the costs. In the meanwhile we need to maintain our cash flows. When we add these figures together, we found that we simply cannot afford external training like large companies.* "

3.3 Small size of business operations and capacity

Most of the firms studied use simple and flexible processes and systems to help reconcile the desire to recruit good workers with limited human management resources. The limited resource base means that most subcontractors lack the funds to hire independent managers or administrators until they reach a certain degree of maturity. Consequently, the owner-managers and family as reported by smaller subcontractors (e.g. S1, S2, S3 and S7), needed to carry out the tasks of other functional areas, such as marketing, resourcing and finance, in addition to their day-to-day handling of relationships.

According to subcontractors S8, small size of business operations also places some demands on their employees to be multi-tasked, this is particularly the case in terms of their dealing with suppliers, customers and other stakeholders in the business environment. Small subcontractors were, therefore, inclined to recruit people having both technical skills and interpersonal skills.

Across the subcontractors studied, there was strong reliance on on-the-job training. With limited capacity, some subcontractors (S2, S5, S6, S8, S11) also reported that they were less able to provide attractive jobs and social protection such as pensions and health care and therefore they had more difficulty attracting and retaining skilled workers.

3.4 Limited internal knowledge base

The interviewed subcontractors generally relied on the technical knowledge/skills of the entrepreneur-manager, or a small group of key and experienced employees in the company. This weakness was highlighted by subcontractor S11 as being a major barrier to innovation, the upgrading of processes and further skills development, exposing the company to the risk of loss of that technical capacity.

Despite differences in resourcing strategy, all the subcontractors studied share an important feature that they all have a business strategy which emphasises quality, along with a matching human resource strategy that provides incentives for maintaining quality and focuses on knowledge transfer among staff. In most cases, construction work undertaken by interviewed subcontractors was manual work and involved 'quality control' by a senior worker or supervisors. As highlighted by interviewees S1 and S7, the productivity and quality performance of their workers, especially those less experienced workers, was limited by the small numbers of expertise in subcontracting businesses.

3.5 Close link to the local community

For most subcontractors there is no written recruitment policy as such, but there appears to be a deliberate preference to recruit workers from local communities in Christchurch. Various reasons were given for this, including employers' perception that local tradespeople are more reliable than those from outside Christchurch because of their connection with local communities and familiarity of the working and living environment. One of the main reason given by these subcontractors was due to their sense of obligation to contribute to the social and economic development of Christchurch city.

For instance, the owner-manager of subcontractor S2 informed that he felt he had a moral obligation to contribute to Christchurch community through the employment of youth. This sense of responsibility towards the community is also the driving force for the recruitment choice of subcontractors S5, S11, S12 and S13. Subcontractor S5 recruits most of its core and casual workers from the community of Kaiapoi, which accounted for 70% of total workforce.

With the privilege of having readily accessible resources in local communities, more than half of subcontractors studied used informal approach to workforce recruitment and development (e.g. reliance on the 'word of mouth' approach). Several subcontractors also reported their companies were constantly involved in various kinds of community events in terms of co-organising or providing sponsorship. It was also found that community culture has a strong influence on the business in the subcontractors studied. As subcontractor S4 explained that:

> "*The conventional wisdom concerning local subcontractors is that the prosperity and spirit of local communities (which) we serve is the key or sole motivating factor for many of us to connect closely with locals. So we exist not only as a business, but as part of the community which comes out of it and eagers to give back in some tangible or intangible ways.*"

4. External factors influencing subcontractors' resourcing

External factors that influence subcontractors resourcing approach include 1) the lingering issues related to the construction industry's structure, such as aging problem, lead time of training, high turnover and lack of integrated workforce planning; and 2) the procurement environment in which the subcontracting businesses are operating, such as the consistency of work flows from the clients, decisions on construction work distribution, efficiency of consenting and tendering requirements. All these factors, often combine together, seemed to play a predominant role in influencing the subcontractors' decision on whether resourcing is a 'beneficial and affordable'.

4. 1 Lingering issues related to the construction industry structure

Some of the subcontractors studied are highly concentrated in a specific market and relied upon a small group of experienced workers. Aging of workers was reported by these subcontractors as a particular concern that placed additional stress on small businesses. An investigation into the revealed that older workers in the construction industry want to remain in their jobs, but although their skills, experience and commitment are valued, there is often a trade-off between that and physical fitness (BCITO, 2013).

However, as mentioned by subcontractors S4 and S13, that preventing older workers from retiring early from the construction industry, along with substantial knowledge transfer between these older workers and new workers, has financial implications. The influx of workers in Christchurch means that older workers can be easily replaced. Some subcontractors (S1, S7 and S10) suggested that incentives are needed to encourage those near-retirement workers to stay longer and help the company to build up the skills of new workers.

The New Zealand construction industry has a labour turnover rate of over 20% on average (CIPD, 2007). Subcontracting businesses studied reported that that the Canterbury earthquake reconstruction has seen higher labour turnover rate (30%) than the pre-event level. Case study subcontractors highlighted that the high turnover adds difficulty to their workforce planning and increases the costs of recruitment and training. In particular, subcontractor S4 indicated that

> "*Before the GFC and earthquakes, we knew that we've got a problem in the industry as the annual staff turnover (i.e. the percentage of leavers compared with the size of the total workforce) was above 15% or 20% across the board. This may possibly due to low levels of reward, or to poor working conditions, or unpleasant or repetitive work.*" (Subcontractor S4)

Observations from several subcontractors (i.e. S3, S5, S6, S9 and S12) revealed that the problem of high staff turnover post-earthquakes might also lie elsewhere in the structure of the industry where the less competent and/or unmotivated people have entered the career due to the high demand in the rebuild sector; or in the recruitment method of the business where inappropriate methods of selection were used. Other symptoms of the problem reported by case study

organisations include rising rates of absenteeism and poor motivation among young people resulting in low productivity.

The lead time for apprenticeships from trainees to become competent worker without supervision was another factor reported by subcontractors studied influencing their decision on resourcing. Case study organisations indicated that there may be some time before workers from these programmes are fully productive. Subcontractor S7 reported that it will take at least 2 years to train a new entrant to become a qualified drain layer.

When asked about the implementation of the Construction Sector Workforce Plan (Construction Sector Leaders Group, 2013) at the subcontracting sector, more than half of subcontractors studied raised the need for the sector to receive more attention from the government departments in terms of funding and employment benefits. Some subcontractors (e.g. S4, S9, S12) suggested that there was still a lack of integrated workforce planning in the subcontracting sector due to the lack of engagement of employers. In addition, subcontractor S2 commented that:

> "*We are aware that the training providers are geared up and responsive to our workforce needs. But we felt that they should disseminate information about training to us in advance in order to assist us to re-align our respective annual training for trades with their training schedules. Otherwise, late publication of their training schedules will result in insufficient response, and we also have to postpone our training plans. Better engagement from either side (the subcontractor and the training provider) is needed to help them tailor their provision to our needs.*"

4.2 Procurement environment

Government economic policy, according to the majority of subcontractors studied, have a great influence on the local market demand and revenues for businesses targeting that market. Case study subcontractors were asked to estimate the percentage change to their rebuild work since 2013 relative to the level of new works in other markets. Results show that the subcontractors form a continuum (Figure 2), with some fully involved in the infrastructure-rebuild related works and others having reduced the rebuild commitment while increased presence in business as usual.

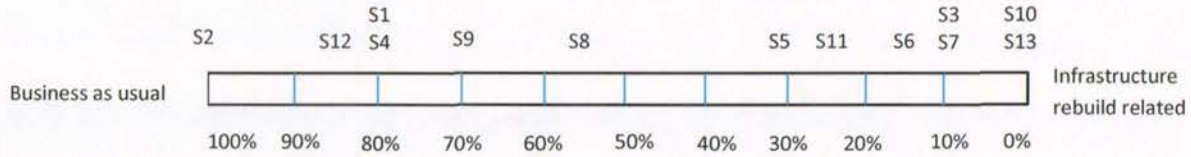

Figure 2: Business-as-usual and rebuild-related infrastructure work: Relative proportions of the subcontractors' involvement

Previous case studies indicated that the continued growth in new subdivisions in Canterbury and strong housing and infrastructure investments elsewhere, particularly Auckland, are drawing away skilled employees and subcontractors from the Canterbury rebuild (Chang-Richards et al., 2014). Evidence from subcontractors in this research reinforced this point and shows that there was a significant move between 2013 and 2014 from horizontal rebuild towards newly subdivided areas in Canterbury region.

Several subcontractors S1, S4, S8, S9 and S12 which primarily focused on the rebuild works for SCIRT immediately following the earthquakes in 2011 have decreased their rebuild-related workloads and increased presence in new subdivisions since beginning of 2014. According to S8, for instance, the housing demand and development strategies post-earthquakes has particularly stimulated the growth of new subdivision areas in Christchurch, while the work of SCIRT alliance was anticipated to wind down in 2015. As a result, some of subcontractors were in the transition phase moving from the earthquake-related rebuild market to the subdivision market.

Furthermore, there is a general consensus among the case study subcontractors that the heavy burden of red tape imposed by government particularly regarding the perceived low efficiency of consenting and tendering process and/or client on health and safety of infrastructure rebuild projects has fallen disproportionately on them. Several subcontractors complained about the compulsory safety rules around the heavy gearing requirements in summer time which was imposed by SCIRT support office. The complexity of varied requirements has partially resulted in the reluctance of some subcontractors to continue working for SCIRT alliance contractors.

5. Internal factors influencing subcontractors resourcing

The cases examined suggest that a complex combination of internal factors unique to each subcontractor together influence the resourcing approach adopted. Business strategies that shape resourcing strategies in case studies include: focus on the quality of workmanship, reputation/brand oriented, maintained or expanded client base, deciding on operations in earthquake rebuild-related work and business as usual, service and/or skills diversification for market expansion and forming partnership. On the other hand, it was found that the majority of case study subcontractors considered their resourcing strategies in terms of employees' age, their commitment to the company, their merits like self-motivation and willing to learn, and their technical and interpersonal skills.

5.1 Business strategy and vision

As was discussed in previous sections, individual subcontractors' business strategy and/or their vision has a substantial impact on the way skills are sourced and developed. Case study results show that most of subcontractors pursue a sustainable goal that can help them cope with future 'bust' periods. Therefore, their resourcing approaches were largely guided by policy that can be more consistently tied to business objectives.

There is a consensus across case companies that for business to withstand any other future shocks, a solid client base is the first priority. Figure 3 below describes a common pattern shown in most case studies. For instance, many subcontractors have seen the future opportunities coming from the new subdivision areas in Christchurch and/or other building activities likely in Canterbury region. A conscious move from the infrastructure rebuild to new market areas has been made by several subcontractors studied. It is yet unknown if these subcontractors who gradually moved out of the horizontal rebuild zone will likely target for vertical rebuild once the building momentum is gained in the CBD.

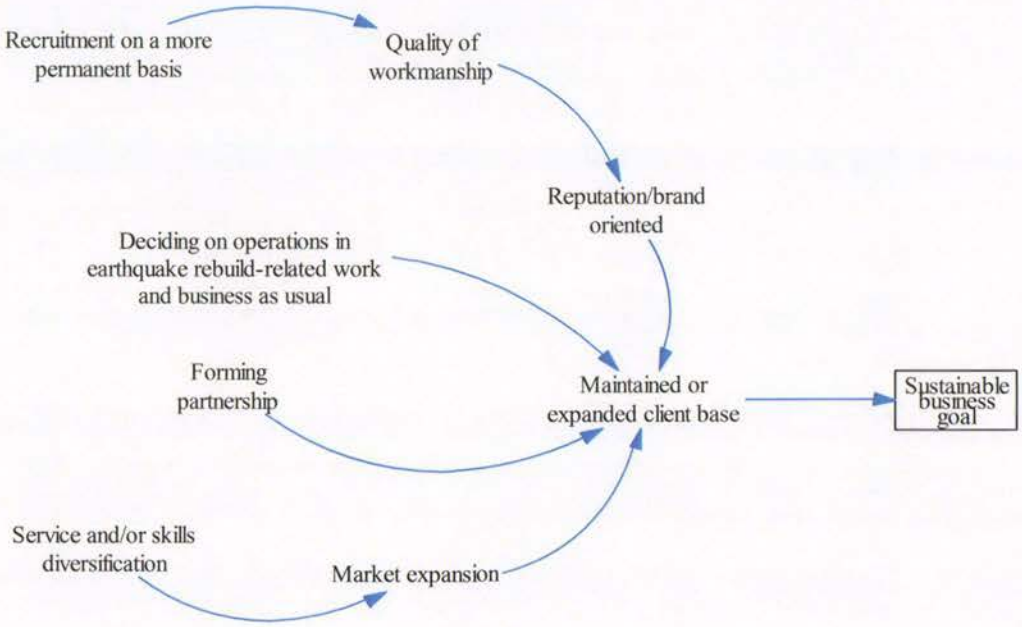

Figure 3: Business goal influencing resourcing strategies of subcontractors studied

Out of 13 studied subcontractors, 6 had the vision to recruit staff on a permanent basis as they found that causal labour required more supervision and often re-work was needed due to their substandard quality of workmanship which may affect the reputation of the company. Additionally, to either maintain the existing client base (e.g. Christchurch City Council, New Zealand Transport Agency) or expanding, focus on business as usual markets to build up their client base will benefit the company in a longer term as rebuild-related work was only perceived to be short-term nature. Skills diversification was also preferred by many subcontractors as one of best measures for market expansion.

Furthermore, the firms studied form a continuum with some having relatively independent operational system with no intention for partnership with other companies, and others having developed sound contractual and management structures for partnership of some kind. Recruitment of skills in other specialist areas, in some cases, combined with resource sharing through partnership, becomes a channel to diversity business types. The subcontractors which emphasised the role of workers in its mission statement all aim to produce the best quality of

business services in the local market through its competent staff. Those companies had thus invested heavily in skills development.

5.2 Employee skills structure and needs

The characteristics of workforce (prospective labour pool in the market or existing workforce within the company) were also key factors considered by case study subcontractors when deciding on their resourcing strategies. Evidence in case studies found that the majority of subcontractors paid attention to the employees' technical and interpersonal skills, their commitment to the company, their merits like self-motivation and willing to learn, and their age.

Most workers engaged in the subcontractors studied are in the 30-to—late-50s age bracket. At subcontractor S10, for instance, while the core workers were generally in their 30s and 40s, the majority of casual workers (about 65%) in truck driving and machine operating were in their late 20s. Surprisingly across the case study organisations, only one exception (subcontractor S2) had a positive attitude towards recruiting young-age group under 25 years old. Lack of reliability, motivation and willingness to learn, together with the fact that those group tends to have a high turnover, were the major reasons given by many subcontractors for not willing to take them on for employment.

Case study subcontractors generally opted for contingent workers by recruiting younger workers (under 25 years old) in an attempt to ensure flexibility in the use of labour due to the lower skill sets these workers have and to enable them to respond to uncertainties in the economic environment. However, as reported by several subcontractors (S2, S5, S11 and S13) that this form of flexibility comes at the price of increased turnover rate among younger workers and hence lower performance of the company. Subcontractor S5 stressed that:

> '*The problem of youth employment in the industry needs to be addressed in a systematic way. Young people whom we brought in as a casual basis often do not see themselves as part of the 'family' because they have no sense of attachment to us. In small firms like ours, no extra money can be spent on training them up or offering equal conditions as regular workers. This in turn 'dilutes' their interests in the job and they may have no real*

commitment to the career they choose – they became 'jumping ship' later on in the industry.'

Overall, the characteristics of the workforce, linked to the company's business goal, had a substantial predictive view for a subcontractor's resourcing strategies because certain strategies depend heavily on worker input and commitment. Case studies show that subcontractors studied had paid more attention to workers' needs and concerns by the time of interviews, compared to their pre-event status. As they became more financially viable by reviving from the 'boom' of post-earthquake reconstruction, they started investing in good conditions of work to promote worker buy-in, which is consistent with their expectation that workers are the driving force in achieving a sustainable business.

6. Conclusion

This report has collated information about the factors that influence the strategies of capacity and capability development, thus their resourcing approaches, adopted by the studied subcontractors in Christchurch. The cases indicate that the majority of subcontractors made conscious efforts to put in place policies and practices that create a competent workforce and motivate workers to contribute to business performance.

It needs to be noted that the resourcing strategies adopted by subcontractors (e.g. investment in skills development, skills diversification, using causal or permanent workers) are shaped by their own characteristics and a range of internal and external factors. Overall, business strategy and a vision to achieve a sustainable business appear to be a driving force to invest in employment and skills development. There is no golden rule or formula to addressing the capacity and skills problem during a boom and bust cycle, as the optimum system depends on the industry structure, procurement environment, characteristics of workforces and the nature of the business.

Being through the bust and boom cycle following the 2008 financial crisis and the 2010/11 Canterbury earthquakes, most subcontractors realised that having productive and competent workforce and core capability is the key to creating a virtuous circle between quality of work and sustained client base in a small company. It remains critical that some of the issues identified in

this report, such as high turnover, youth employment, lack of knowledge transfer within the subcontractor and at the sector level, and lack of investment in training and skills development, need to be addressed in a systematic way. Better engagement of subcontractors by relevant stakeholders, however, should be the first step towards any of the solutions.

Annex: Profiles of studied subcontractors

Company code	Year established	Ownership structure	No. of Ep	Products/services	Market	BAU Vs. EQ-related	Pinch resources	Resourcing strategies	Business strategies
S1	1999	Family business	7	Commerical machine laid kerb and channel for roading Subdivisions and car parks	Canterbury	80%:20%	• Excavator operator • Kerb & channel machine operator	• Ensuring job security • Recruitment on a permanent basis • Investment in training and offering promotion to identified 'loyal' staff •Good conditions of work	• Strong client oritentation • Expanding client network • Quality improvement of workmanship
S2	1968	Family business	10	Drain laying and maintenance Manhole installation Trench shield work and excavation	Canterbury	100%:0%	Drain layer	• Investment in recruiting and training local young people • Empowering workers to take initiatives • Good benefits	• Strong brand/reputation • Improving company-wide communications
S3	1985	Incoproated	45 (30 in Chch)	Drainage/pipe laying Sheet piling/trench shields Pump stations and manholes Dewatering Pipe bursting and thrusting	Hamilton Christchurch	10%:90%in Christchurch	• Excavator operator • Truck drivers • Civil pipe-layer/drain layer	• Retaining mature staff aged between 30 and 50 • Encouraging knowledge transfers among staff	• Service diversity • Market expansion
S4	1950	Incoporated family	190	Construction, surfacing, bitumen products, transport, quarrying, contract management services	South Island	80%:20%	• Excavator operator • Drain layer • Project manager	• Reduced recruitment and increased retention and skills development • Improved career path • Good conditions of work	• Forming long-term relationship with other subcontractors • Product and service diversifaction • Regular review of business plan
S5	1983	Limited company Family	16	Construction of driveways, vehicle crossings, car parks and small subdivisions Asphalt Laying and excavations	Canterbury	30%:70%	• Drain layer • Excavator operator	• Retaining family-committed staff aged between 25 and 40 • Strong preference for recruiting local people in Christchurch • Fast track of career path • Good pay at the market rate and other benefits	• Maintain the current size of the company • Maximise business stability • Build good reputation • Employee multi-tasking
S6	1984	Limited company Family	50	Drainage, subdivision, traffic management, project management, quantity surveying, road infrastructure and bridge construction	Canterbury	15%:85%	• Truck driver • Excavator operator • Drain layer	• Recruit staff in other newly established services (e.g. electrical services, dairy effluent disposal design and resource consenting application) • Investment in recruiting by using Big Splash and Hayes & Stellar recruitment agency • 2 weeks probationary period	• Reduce rebuild-related work from 85% to 15% by end of 2015 • Expand client base • Diversity services • Instil corporate structure with family values • A possible partnership by joint venture

								• An information sharing policy for knowledge transfer	
S7	1985	Family business	4	Drainage	Canterbury	10%:90%	Drain layer	• Recruting through recrtuiment agencies and 'buy out' good recruits from them • Direct in-house training provided by directors • Prefer to recruit workers aged between 30 and 50	• Joint venture with a local main contractor and be in charge of the drainlaying jobs • Adding Health and Safety into training schemes
S8	1954	Limited company Family – a subsidiary of Fletcher	31 in Chch	River and marine works Engery pipelines, civil structure and foundation work	Auckland Hamilton Wellington Canterbury	55%:45%	• Plant/machine operator	• Having a mentoring and knowledge transfer scheme for new staff • 250 hours of on-job-training before employees are permitted to undertake unsupervised work • Using recruitiment agencies for recruirting temporary staff	• Gradually reducing the rebuild-related work and increase the BAU road contracts from NZTA • Having access to all benefits provided by Fletcher
S9	1998	Incoproated	40	Ground remediation, excavation and other earthworks Driveways and footpaths Foundations, retaining walls Civil construction Truck and excavator hire	Canterbury	70%:30%	• Truck driver • Plant operator • Civil engineer	• Using recruitiment agencies to find skilled engineers and machine/plant operators • Recruitment from Ireland • Encoruaging workers to achieve higher qualifications and participate in Health and Safety training	• Improving relationships and form partnership with other companies • Exploring the potential of recruiting secondary school students
S10	1955	Incoporated family	57 (9 based in chch)	Civil construction in roading, subdivisions, drainage, water reticulation, site works, traffic management, aggregate supply, transporting, landscape supplies	Whanganui Canterbury	0%:100% in Christchurch	• Truck driver • Plant operator	• Relocating staff from Whanganui office • Recruiting people from other cities of NZ and from overseas • Strong perference for employees aged between 25 and 40	• Building presence and reputation in Canterbury • Diversifying client base
S11	1999	Family business	11	Construction, surfacing and maintenance, bridge maintenance and construction, civil construction and commercial works	Canterbury	25%:75%	• Machine operator • Labourer	• Strong perference for recruting locally through 'Word of Mouth' • 'Equal productivity' policy to increase staff morale and reduce animosity • Rapid growth of staff • Relationship building activities between managers and staff	• Expanding client base by including major consturction companies • Strong barnd/reputation • Quality improvement of workmanship
S12	1979	Incoporated family	90 (50 based in chch)	Subdivisions, road works, site clearance, house foundations, drainlaying, landscaping, and forestry work	Canterbury (Timaru and Christchurch)	85%:15%	• Excavator operator • Site worker • Truck driver	• Intensive in-house training other workers to become skilled excavator operators • Strong preference for local recruits • Using recruitiment agencies for recruiting temporary staff	• Christchurch office established after the earthquakes • Relationships formed with large contractors in the SCIRT Alliance team

									• Increase the workloads from new subdivisions in Christchurch
S13	2008	Incoproated	20	Pipe and drainage	Auckland Christchurch	0%:100%	Drain layer	• 90 day trial for new recruits • Strong preference for candidates with interpersonal skills • Increasing organisational capacity to attract local people	• Semi-alliances with Christchurch subcontractors • Investment in building company capacity (premises, facilities) • Increasing the subdivision work by end of 2014

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5/2/16 - under review, to be released soon.

Resilient ORGANISATIONS

A collaboration between research & industry

Trends in resourcing and employment practice of Canterbury construction organisations

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Resilient Organisations Research Report 2016/02

February 2016

About the Resilient Organisations Research Programme

"Building more resilient organisations, able to survive and thrive in a world of uncertainty, through research and practice"

We live in an increasingly complex world dealing with a broad spectrum of crises arising from both natural and man-made causes. Resilient organisations are those that are able to survive and thrive in this world of uncertainty.

Who we are:

The Resilient Organisations Research Group (ResOrgs) is a multi-disciplinary team of over thirty researchers and practitioners that is New Zealand based and with global reach. A collaboration between top New Zealand research Universities and key industry players, including the University of Canterbury and the University of Auckland, ResOrgs is funded by the Ministry for Science and Innovation through the Natural Hazards Research Platform and supported by a diverse group of industry partners and advisors. The research group represents a synthesis of engineering disciplines and business leadership aimed at transforming organisations into those that both survive major events and thrive in the aftermath.

We are committed to making organisations more resilient in the face of major hazards in the natural, built and economic environments. Resilient organisations are able to rebound from disaster and find opportunity in times of distress. They are better employers, contribute to community resilience and foster a culture of self-reliance and effective collaboration.

What we do:

The ResOrgs programme of public good research is aimed at effective capability building through research activities with significant impacts on policy and practice. Activities and outputs of the group, in existence since 2004, include informing and focusing debate in areas such as Civil Defence Emergency Management, post-disaster recovery, and the resilience of critical infrastructure sectors, in addition to core activities in relation to organisation resilience capability building and benchmarking. We have produced practical frameworks and guides and helped organisations to develop and implement practical resilience strategies suitable to their environment.

Why we do it:

In an increasingly volatile and uncertain world, one of the greatest assets an organisation can have is the agility to survive unexpected crisis and to find opportunity to thrive in the face of potentially terminal events. We believe such resilience makes the most of the human capital that characterises the modern organisation and offers one of the greatest prospects for differentiating the successful organisation on the world stage. This resilience is typified by 20/20 situation awareness, effective vulnerability management, agile adaptive capacity and world class organisational culture and leadership. More resilient organisations lead to more resilient communities and provide the honed human capital to address some of our most intractable societal challenges.

For more information see our website: www.resorgs.org.nz

Executive summary

Five years on since the first major earthquake striking the Canterbury region, the reconstruction is well advanced. Christchurch is a city in transition. This report considers trends in resourcing and employment practice of Canterbury construction organisations in response to the projected market changes (2015-2016). The report draws on the interviews with 18 personnel from 16 construction organisations and recovery agencies in October 2015. It provides a summary of perceived changes in the construction market in Canterbury, evidence about what steps construction businesses have been taking, how they have prepared for likely changes in the reconstruction sector, as well as the perceived alignment of public polices with the industry response.

The key findings are as follows:

- There is a consensus among interviewed construction businesses that the Canterbury rebuild work, particularly the residential rebuild work and SCIRT's horizontal infrastructure repair work, plateaued in 2014, started falling in 2015 and is expected to wrap up by end of 2016.

- In anticipating the potential downward pressure in the residential and infrastructure rebuild sectors, subcontractors of different tiers had re-structured their businesses while building companies especially the small or new start-up businesses had or were considering 'downsize' staff to a manageable level.

- There are still reported shortages in certain types of specialist trades, such as drive way contractors, scaffolders and tilers. Improving efficiency seems to be a key focus for most interviewed construction organisations, such as improving staff performance; reviewing business structures, improving supply chains and focusing on increasing their customer base.

- In stock-taking public policies, interviewed organisations commended that the immediate fixed term policy responses to alleviate labour force impacts of the disaster, a dedicated one-stop Canterbury 'Skills and Employment Hub' and the New Zealand Apprenticeships

had been effective in assisting construction businesses to recover, retain staff and continue to operate in the rebuild sectors.

- As the rebuild work gets 'slow down' in the near future, it is likely that further challenges will emerge in retaining the core skills and competences that have been developed during rebuild in the region. The availability and affordability of housing and career prospects in Christchurch, the retention strategies adopted by construction businesses, and coordination across the relevant agencies and sectors will have a strong influence on labour supply.

- Industry structure related factors, such as high turnover, youth employment, lack of knowledge transfer within the subcontractor and at the sector level, and lack of investment in training and skills development at business level, still need to be addressed in a systematic way. Certainty issues for workers in emergent organisations such as CERA, Fletcher EQR and SCIRT have therefore emerged that will influence the development of an effective workforce strategy in Canterbury for the long term.

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Acknowledgement

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James Mackechnie, South Island Plant Engineer (Technical Division), Allied Concrete Ltd

Mike Blair, Managing Director, KB Contracting and Quarries

[1] According to the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520), the identity of the interviewees and their organisations will be kept confidential in this report.

1. Introduction

Five years on since the first major earthquake striking the Canterbury region, the reconstruction is well advanced. The latest estimate from Westpac (2015a) is that the Canterbury rebuild has peaked and the demand for construction workers in Canterbury is expected to fall from late 2016. In comparison with those macroeconomic estimates, the perception of many of those working in the Canterbury market is reasonably aligned, that the maximum output levels of the rebuild will be in between 2016 and 2017, and it is expected to be sustainable over a number of years (AECOM, 2015).

Christchurch remains a city in transition. SCIRT's programme of works is nearing completion with activity expected to continue at current levels for another 12 months until 2017. The longitudinal study by the authors of this report suggests that the speed of recovery has so far been gradual with the momentum of growth picked up in 2012, a year after the February 2011 earthquake (Chang-Richards et al., 2014). The recovery accelerated quite quickly, given that the spending on infrastructure repairs has been smooth, a majority of damaged property was insured and the payments regarding these had been finalised between 2012 and 2013.

As construction businesses prepare themselves for a likely downturn in the near future, a significant reversal in employment practice was observed, changing from recruitment to subcontracting and workforce retention (Chang-Richards et al., 2015a). The concern of a possible bust in 2016 when the residential reconstruction and infrastructure repairs are complete is considerable among companies.

There is still a large amount of rebuild work to be completed in Christchurch. Providing some offset to the moderation in residential construction activity is a pick-up in non-residential reconstruction spending. This includes:

- Around $2.5b of spending on horizontal infrastructure by SCIRT. In mid-2015 around 75% of this work was complete, with the program expected to be largely complete by the end of 2016[2].

[2] SCIRT- http://strongerchristchurch.govt.nz/more-progress

- Around $8b of spending on public and social assets, such as education and health care facilities (CERA, 2015).
- Finally, there will be a large amount of privately funded spending on commercial construction. This includes the replacement of damaged assets (many of which will be rebuilt to a higher standard than pre-earthquake levels), and the construction of new assets (Westpac, 2015b).

In addition to the expected demand in non-residential rebuild activities in Christchurch, it is expected that extra pressure will be placed on the workforce requirement from other markets over the next two or three years, including increase in housing development growth in Auckland, improved economic prospects in Europe (given the fact that nearly a third of expanded workforce in the studied organisations were migrated from Europe, in particular the UK and Ireland), and the infrastructure investments in other cities in New Zealand (Chang-Richards et al., 2015b).

Against this backdrop, this report considers trends in resourcing and employment practice of Canterbury construction organisations in response to the projected market changes (2015-2016) described above. The report draws on the interviews with 18 personnel from 16 construction organisations and recovery agencies in October 2015. It provides a summary of perceived changes in the construction market in Canterbury, evidence about what steps construction businesses have been taking, how they have prepared for likely changes in the reconstruction sector, as well as the perceived alignment of public polices with the industry response.

2. About the interviews

In October 2015, the research team carried out a series of interviews with 18 individuals from 16 construction organisations and recovery agencies that have been involved in the rebuild in Christchurch. The sampled organisations in each sector (housing, commercial, and infrastructure) included building and construction, material/product manufacturing and supply, subcontracting, and trades. Other personnel from relevant agencies such as the Canterbury Earthquake Recovery Authority (CERA), Fletcher EQR and Statistics New Zealand were also interviewed in order to gain a multiple view of observed changes in the Christchurch construction market. Table 1 below provides basic information about the interviewed organisations and the interviewees.

Table 1: Information about interviewed organisations and interviewees

Organisation (16)	Interviewee (18) and the interviewee coding
Building and construction	4 (3 personnel from 2 residential building companies, coding BC1, BC2 and BC 3; 1 interviewee from 1 civil main contracting business, coding BC4)
Material/product manufacturing	3 (1 interviewee from a steel manufacturer, coding S1 and 2 interviewees from 2 concrete manufacturers, coding C1 and C2)
Material/product supply	2 (1 interviewee from a brick supply company, coding BS1; and 1 from a door/window products supply company, coding DS1)
Subcontracting	2 (2 interviewees from 2 civil subcontractors, coding CS1 and CS2, respectively)
Trades	2 (coding T1 and T2)
Master Builders Canterbury	1 (coding MB1)
CERA	2 (coding CE1 and CE2)
Fletcher EQR	2 (coding FE 1 and Fe2)
Statistics New Zealand	1 (coding S1)

Face-to-face interviews were conducted during a field trip to Christchurch in October 2015, including the collection of following information:

a) their perceived changes in the construction market in Canterbury;
b) how they have prepared for likely changes in the reconstruction sector and the steps that have been taking; and

c) the perceived alignment of public polices with the industry response.

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520).

3. Perceived market changes and the potential employment impact in the Canterbury construction industry

There is a consensus among interviewed construction businesses that the Canterbury rebuild work, particularly the residential rebuild work and SCIRT's horizontal infrastructure repair work, plateaued in 2014, started falling in 2015 and is expected to wrap up by end of 2016.

As of October 2015, construction businesses reported that the impact of this downturn is already being felt in the Canterbury construction labour market. The observed trend is that:

- Some tier one contractors[3] new to the Canterbury construction market started re-evaluating their presence in Christchurch in 2015 and/or diversifying into other industries.to make alternative employment arrangements.

- Since the beginning of 2015, some tier two contractors (the subcontractors to tier one contractor) relocated back to where they came from. In most cases, the owner/manager of those tier two contractors may have shifted back while the Cantabrian workers they employed since the earthquakes are at risk of unemployment.

- Tier three contractors (sub-contractors to sub-contractors of the main/head contractor, often very small/specialist sub-contractors) who were new to the Canterbury market are less able to cope with the downturn pressure on Canterbury rebuild. Since the third quarter of 2014, a number of new to Canterbury tier-three contractors with initial bases from outside the Canterbury region have started leaving the region.

[3] The term 'tier one contractor' was commonly cited by interviewed construction organisations in Canterbury. It could also refer to the Head Contractor. It refers to a main/general contractor who is responsible for providing management, material, labour, equipment and services necessary for the construction of the project. The main/general contractor hires specialist subcontractors to perform all or portions of the construction work.

With a large amount of residential repair work complete, there are signs that residential reconstruction is starting to ease back. This is accompanied by a waning demand for new housing development in subdivisions. There is a general concern among interviewed builders that some post-quake start-up building businesses will downsize or re-structure their business. Small builders need to plan for the 'slowdown' to reduce the likely employment impact. In anticipating the potential downward pressure on some of their member organisations, the Master Builders has been taking a proactive approach by offering business reshaping and restructuring advice to their members.

In contrast with residential and horizontal infrastructure repair works, the workloads in earthquake-related commercial rebuild are entering a period of growth driven by good visibility of public spending on anchor projects in the Christchurch CBD. Companies interviewed were optimistic about such growth and expected that commercial rebuild activities will continue to increase for a sustained period of time.

4. Response of construction businesses in Canterbury

Interviewees in October 2015 suggested that even though the Canterbury rebuild pipeline is clear over the next three to five years, the levelling out in the residential sector as a whole (both reconstruction and business as usual new housing developments) will have significant implications for the construction industry. Reflecting on the year of 2015 and looking into 2016, the way construction businesses are coping and adjusting in response to the market changes can be summarised as follows.

The upwards pressure on costs in the housing and construction sector, in particular, the pressure on wages seemed to be eased off due to reduced activities in residential reconstruction and in new subdivisions. There are still reported shortages in certain types of specialist trades, such as drive way contractors, scaffolders and tilers. Builders had typically factored a margin for risks, including uncertain material and labour costs and availability.

There is a concern among a number of companies that the new health and safety law (the Health and Safety at Work Act) and associated regulations being developed will increase compliance costs, especially for small businesses.

> *"The biggest challenge for small companies like us is to get head around the process. It took us six months to be familiar with the process, and a good year before we get a good amount of work to sustain our business. The new Health and Safety will come soon and the whole processes will change again, we are just waiting to see the changes."* (Interviewed builder BC2, October 2015)

Nearly all the interviewed companies reported that they have (as of October 2015) reached a steady business state, but with differing outcomes, for instance, some downsizing to the pre-earthquake levels and some maintaining the same labour capacity as in 2014 without further expansion.

"Efficiency" seems to be a key word/aim for most interviewed construction organisations to achieve. This word was particularly cited by interviewed building supplies companies, when asking about how they have managed to increase their business viability and reduce the total cost. Re-checking staff performance; reviewing their business structure, their supply chain and customer base; as well as using subcontractors; were the common strategies reported by construction businesses in attaining such efficiency.

> "*What we have learned from those few years (since the earthquakes) is that apart from having good competent workers, we also need efficiency to achieve better work flows and reduce the cost of business operation.*" (Interviewed building supplies company BS1, October 2015)

5. Perceived alignment of public polices with the industry response

This section 'stock take' on whether policies from public agencies, particularly MBIE, are aligned with the industry response following the earthquakes. The interviewees from construction organisations were asked if any government support initiative and strategies from MBIE have affected the construction labour supply and demand in Canterbury and assisted the response of construction businesses to the changing demand.

In reviewing MBIE's strategies, it was found that following the earthquakes the broad approach taken by MBIE can be characterised as providing a stable strategic framework to promote and develop the city's economic opportunities, while providing employment and training support to those in need. An important focus is on trying to coordinate the rebuilding and recovery work so that economic opportunities for investment, innovation and job creation are maximised, along with efforts to improve the wellbeing of the community. A range of government interventions were introduced following the earthquakes. Some have since been scaled back while others are on-going.

Government assistance in terms of a workforce strategy can be grouped into two broad streams:

- Short-term (often under a year) assistance to restore confidence and minimise labour market disruption
- Longer-term, expansion and development of a suitably skilled workforce to undertake the rebuild

5.1 What government assistance seemed most effective for construction businesses in Canterbury?

When asked what government assistance seemed most effective for construction businesses in Canterbury? Most interviewees highly commended **the immediate fixed term policy responses to alleviate labour force impacts of the disaster** including such as

- income support to workers temporarily laid off due to the damage of the earthquakes;
- grants and interest free loans to eligible businesses to cover earthquake costs; and
- a wage subsidy for employers who hired job seekers in the Canterbury region;

For the rebuild, several interviewees spoke highly of the expanded training programmes and employment matching programmes, such as the dedicated **Canterbury 'Skills and Employment Hub'** to help match labour supply and demand, particularly in the Canterbury construction market. As the interviewee CS1 commented that,

'It is 'one stop shop' for us (employers) and job seekers. The Hub website allows us to list vacancies and be matched with jobseekers from Christchurch and elsewhere in New Zealand. It saves us a lot of time in searching any suitable candidates in the country, and frees us up for searching highly skilled people from overseas if needed' (Interviewee CS1, October 2015)

The interviewed small-to-medium businesses (e.g. BC4, BS1, T1 T2 and DS1) shared the common view that it seems that greater priority of MBIE had been given to short-term business assistance in order to retain people in jobs, with a few initiatives focused on developing resources that proactively assist small to medium enterprises to build resilient, sustainable businesses. In particular, the interviewee T2 commented that the Construction Sector Workforce Plan for the Greater Christchurch lacks information on how businesses can adopt certain strategies to attract, retain and develop appropriately skilled and experienced people for the rebuild.

There are changes to the government's industry training model (from 'Modern Apprenticeships' to '**New Zealand Apprenticeships**') since 2014 to encourage more New Zealanders in vocational careers, in response to emerging opportunities – particularly with the rebuilding of Christchurch. Most interviewees suggested that the increased funding for apprenticeships had allowed the industry training organisations to invest more in the quality of education, lowered fees for employers and encouraged growth in the uptake of apprenticeships. Other Canterbury-specific training-related initiatives such as the following received positive comments from several interviewees:

- He Toki kit e Rika Maori trades training initiative – partnership between Ngai Tahu (the largest indigenous Maori tribe in Canterbury) and local polytechnics, which has had some hundreds of primarily young Maori men undergo trades training.

- Pacifica trades training initiative launched nationwide, which has enrolled more than 200 Pacific people into trades training

- Local polytechnics have been working with key infrastructure and construction partners, such as SCIRT, to offer a programme where learners complete appropriate entry level

skills to become work ready and then progress into employment and complete their qualifications through industry training.

5.2 Comments on other policies

There is a concern among a number of companies that the new health and safety law (**the Health and Safety at Work Act**) which will come into force on 4 April 2016 and associated regulations being developed will increase compliance costs, especially for small businesses. Several interviewees (e.g. BC1, BC2, CS2, T1 and T2) were uncertain about the impact of such new Act on their business operations, as the interviewee BC2 commented that,

'*The new Health and Safety will come soon next year, all the processes will change. Some of the training courses are not available because people are waiting for the changes. We have been holding on many things as we possibly need to change many things in our business to accommodate such new regulation.*' (Interviewee BC2, October 2015)

Two interviewees BC1 and T1 commented that the compliance to such a new regulation will certainly increase the level of safety at the workplaces, as well as the cost of operating a small business and managing staff. They both hoped that the government can provide certain financial support or subsidies to help top up the compliance cost incurred by the small-to-medium sized construction businesses.

There is one case raised by the interviewee T2 that he hoped to see another tier of license by trade qualification so that tradespeople in his trade (i.e. gib fixers) can carry out certain restricted building work without the supervision of a licensed building practitioner (LBP). He the following comment:

'*I can completely understand where the LBP comes from. For certain tradespeople like plasterboard, no matter how experienced you are, you cannot be LBP, but we have been doing restricted building work for years and have got the skills and knowledge. We felt like there is no flexibility in the LBP scheme and we got missed out*' (Interviewee T2).

5.3 Overall assessment

In terms of outcomes, positive comments on staff retention and job matching assistance provided by MBIE indicate that the labour market programme in the Canterbury construction sector has been effective, even though it is hard to attribute this to any particular policy.

Some of the factors noted in earlier reports (Chang-Richards et al., Chang-Richards et al., 2013; Chang-Richards et al., 2014; 2015), such as high turnover, youth employment, lack of knowledge transfer within the subcontractor and at the sector level, and lack of investment in training and skills development at business level, need to be addressed in a systematic way.

There is evidence from our longitudinal study (2011 to now) that government policies enabled many firms to retain staff through the period of greatest uncertainty. Most interviewed employers who received the Earthquake Support Subsidy felt it helped a great deal. Our interviews in October 2015 also showed that due to the timely assistance from the government, many employers felt confident to retain staff even though they lost revenue immediately following the earthquakes.

As the rebuild work gets 'slow down' in the near future, it is likely that further challenges will emerge in retaining the core skills and competences that have been developed during rebuild in the region. The availability and affordability of housing and career prospects in Christchurch, the retention strategies adopted by construction businesses and coordination across the relevant agencies and sectors will have a strong influence on labour supply. Certainty issues for workers in emergent organisations such as CERA, Fletcher EQR and SCIRT have therefore emerged that will influence the development of an effective workforce strategy in Canterbury for the long term.

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A systems approach to managing human resources in disaster recovery projects

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Abstract

Lack of construction resources and capacity has always presented difficult challenges to the construction industry following a major disaster. In the case of the Canterbury earthquakes that took place in 2010 and 2011 in Christchurch, New Zealand, a number of factors combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. Research findings show that the limited technical capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies. The study suggests that the design of policy instruments in managing human resources in Christchurch should be informed by a detailed understanding of the dynamics that mediate between policy objectives and outcomes over time. A systems approach should be applied to increase the efficiencies in resource management in the continued reconstruction.

Keywords: Systems dynamics, Human resources, Disaster reconstruction, Construction firms, Christchurch

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1. Introduction

The gradual shift in modern concept of 'building resilience' that has occurred over the past decade is having far-reaching implications for the construction industry who plays a pivotal role in disaster risk reduction and carrying out the post-disaster reconstruction tasks. In many countries, disaster recovery projects are given equal or even more priority over other development projects. Compared to conventional construction projects, disaster recovery construction projects are seen as requiring different management and delivery systems [1, 2]. In particular, disaster recovery construction projects following a large disaster tend to have resource challenges [3, 4] and capability issues [5].

When the Darfield earthquake struck Christchurch in 2010, the New Zealand construction industry was going through a recessional period of low activity caused by the 2008 global financial crisis. Many construction businesses had managed to come from the bust of economic cycle and aiming for a reviving opportunity in post-earthquake reconstruction [6]. Nevertheless, the shortage of skills is a recurrent problem in the New Zealand construction industry [7, 8]. And there was a limited pool of professionals in the country who had the experience of seismic assessment and design. The Canterbury region subsequently suffered a sequence of aftershocks. The earthquake of magnitude 6.3 on 22 February 2011 was the most severe, taking the lives of 185 people and causing buildings to collapse, further damage to infrastructure and widespread liquefaction [9]. High pressures of skills needs in undertaking the reconstruction following the earthquake events raised questions concerning how these skills needs can be met given the limited resource pool in New Zealand construction sector [10].

A number of factors such as the change of the building standards [11], insurance pay-out [12] and the decisions made by the Immigration New Zealand on Canterbury Skills Shortage List[1], combined to influence the post-disaster recovery environments and increase the demands for better approaches to managing human resources for reconstruction projects. By using a systems approach, this study aims to identify the dynamics that have changed construction companies' resourcing behaviours in relation to the employment demand and supply in the Canterbury recovery. The study was undertaken longitudinally with 15 construction organizations over an extended period. Research findings from this study is hoped to provide insights into future disaster response with respect to addressing the problem of rebuilding capability.

[1] The Canterbury Skills Shortage List (CSSL) highlights occupations in shortage that are needed during the rebuild in Canterbury region (area of South Island), and facilitates the grant of temporary work visas for those occupations. For more information, see http://www.dol.govt.nz/immigration/knowledgebase/item/4551

2. The construction industry skills shortage

Having a skilled, well-trained and productive workforce has always been central to the construction sector's growth and success [13-15]. The literature reveals a number of factors which have impinged upon the construction skills problem (See Table 1).

Table 1: Contributing factors that shape the skills problem in the construction industry

Category	Contributing factors
1) Contextual factors	• Workforce aging and demographic downturn • Reduced numbers of young people entering the construction sector • Technological changes • A lack of investment in skills development
2) Structural factors	• Absence of human resource management strategies at a project level • A lack of partnership between sector employers and training bodies • Low levels of training • Increased casual self-employment and sub-contracting • Rigidity of skills divisions
3) Inherent factors in the construction industry	• Poor image of the industry • Poor perception of pay and workplace conditions • Working practices • Cyclical labour demand • Fragmented, transient and heterogeneous workforce structure • Fragmentation between training provision and employment

Context-specific factors included such as workforce aging and demographic downturn [13, 16], reduced numbers of young people entering the construction sector [17, 18], technological changes [19, 20] and a lack of investment in skills development [21]. Structural factors causing construction skills shortfall included the absence of human resource management strategies at a project level [22], a lack of partnership between sector employers and training bodies [23, 24], low levels of training [7, 25], increased casual self-employment and sub-contracting [26, 27] and the rigidity of skills divisions [28].

Adding to the list are factors in relation to the very nature of construction industry, including the poor image of the industry [29, 30], especially regarding the pay and workplace conditions [31]; working practices [32]; cyclical labour demand [33, 34] and often fragmented, transient

and heterogeneous workforce structure [35, 36]. Above all, Dainty et al. found that fragmentation that flows from the structure of training provision and employment is likely to narrow the industry's skills base and reduce innovation within the sector [17].

By comparing construction industry concerns 50 years apart, O'Donnell et al. concluded that how to attract and develop apprentices and graduates remained to be a major industry concern [37]. Chan and Dainty [14] suggested that genuine skills improvement requires a sustained effort to understand the practical realities of skills provision at a project level. Lobo and Wilkinson [7] advocated a focus on examining the efficiency of skill level in the existing workforce, rather than quantity of skills. In practice, there has been a shift of emphasis from top-down labour market policy measures towards demand-led skills development systems [35, Dainty et al., 38]. This shift, however, calls for employers and employees to play a more proactive role in formalising the industry's training and employment practices if improved performance and productivity is be achieved [39, 40].

There is a growing awareness of the importance of skills development among construction organisations as a means of improving productivity [35, 41, 42]. Research points towards a direct correlation between skills, productivity and employment. Enhancing labour productivity was proposed by Chan and Dainty [14] as one of the solutions to alleviating the problem of skilled labour shortages in construction. This view, however, emphasised the efficacy of skills utilisation and development, rather than increasing their supply. Other solutions to addressing skills crises have been used in the past, primarily in such areas as training [25, 31], multi-skilling [43], industry promotion [13, 14], employing migrant workers or outsourcing [28], and the development of new technologies and construction techniques [44]. However, as Dainty et al, suggested such measures are difficult to sustain unless backed by a bespoke regional labour market approach [17, 45].

3. Resource issues faced by construction organisations post-earthquake in Christchurch

Past disaster events have shown that in the aftermath of a major disaster where the operational environment is often uncertain, complex and dynamic, the "business as usual" way of managing resources may not be fully applicable [46, 47]. In a post-disaster environment, there is strong pressure to act quickly to get back to normal [48]. Under the pressure of limited time, the need to replace lost housing, building and infrastructure facilities often generates a demand surge for labour [49, 50].

According to Dainty et al. [51], workforce planning models need to take account of a wide range of factors determining both labour supply and demand. However, the complexity of the post-earthquake situation has rendered accurate forecasting of skills needs extremely difficult. Variations in the size, speed and scope of reconstruction had a marked effect on the employment practice which further influenced skills demand [52]. In the case of New Zealand,

despite a relatively brief hiatus created by the global financial crisis, significant skills shortages have re-emerged from the earthquakes. The construction sector has moved from bust to boom and the employment situation in construction has dramatically changed [53].

Construction organisations, largely being labour-intensive, are more influenced by human resource effects. Following the 2010/11 earthquakes, construction organisations in Christchurch experienced major resource shortages for both post-quake damage emergency response and reconstruction stages [54]. Ongoing aftershocks caused structural and land inspection professionals to be constantly diverted from existing jobs to new damage [55, 56]. A questionnaire survey commissioned by the Resilient Organisations between October 2011 and January 2012 revealed that resource pressures experienced by the construction organisations in Canterbury region were primarily from human resources associated with structural, architectural and land issues. And the three most frequently reported 'problematic' human resources were: structural engineers, geotechnical engineers, and draughtsperson [54].

A follow-up survey in 2013 showed that as the reconstruction progressed, many construction organisations started encountering difficulty in finding suitable project management expertise such as site engineers, project managers and quantity surveyors [57]. Some engineering consultancies have reported ongoing issues with sourcing workers of high skill levels [53]. Since the September 2010 earthquake, young engineers and mature project management skills from Europe continue to be the largest inbound demographic group involved with the rebuild in Christchurch [56, 58]. At the same time, there has been an inflationary impact which flows through to higher property rents, and makes attracting tradespeople from other parts of New Zealand harder [59].

Against this backdrop, this research attempts to investigate the dynamic factors that influence the resourcing behaviours of construction organisations operating on post-earthquake projects in Christchurch. By capturing perspectives from construction organisations, this study provides an understanding of how companies are responding to a looming skills and labour shortage for the Canterbury rebuild and how their resourcing approaches might affect the environment where they operate. The research methods used, the findings from this research along with a discussion are presented in the remaining sections. This paper concludes by reflecting on the implications of research findings for future studies.

4. Research Methods

4.1 Case study method

A case study method was adopted for this research due to its theory-building nature [60, 61]. As proposed by Yin [62], the case study design develops an empirical approach to research of a contemporary phenomenon within its own context. Longitudinal case studies of construction

organisations can provide insights into how hiring strategies across the construction industry and their strategies for workforce development will change as the landscape of Christchurch changes. The selection of case study organizations was based on criteria such as: the type of organization, size2, business characteristics, and involvement in the earthquake recovery process.

The key strategy used for selecting the sample was that all organisations would come from a spectrum of areas of the New Zealand construction industry. The case study sample was selected from the New Zealand Construction Industry Council (NZCIC) membership database. Sample organisations were all based and operated in Christchurch and registered with regional industry bodies under the umbrella of NZCIC. In December 2012, 15 case study organisations were selected to participate in the research. The chosen case studies collectively provided a reasonable overview of current experience with regard to the resourcing of skills for building activities [57].

In April 2014, the researchers conducted a second series of case studies with previously selected organisations. The focus of the second case studies was to examine the dynamics that influence their experiences of resourcing in Canterbury and changed business strategies since. Of 15 organisations, 10 participated in the second case studies. The reasons for the other 5 organisations not being able to participate included unavailability at the time of the case studies and absence from Christchurch operations. 3 additional organisations took part in the case studies. A total of 16 interviews were undertaken across 13 organisations in Christchurch in April 2014 (See Table 2).

Table 2: Description of organisations used for case study data collection

Types of construction organisations	Characteristics
2 Engineering consultancies	1 large size and 1 medium size (E1 and E2)
7 Contractors/builders	3 large civil contractors, 2 subcontractors, 1 home builder, 1 large construction company (C1-C7)
2 Building supplies companies	2 large concrete product manufacturers (M1 and M2)
2 Project Management Offices	Horizontal infrastructure rebuild & EQC's residential repairs (P1 and P2)

The research design and data collection methods complied with the requirements of the Human Ethics Committee of the University of Auckland (Reference number 7520). The interview records within case studies were recorded, transcribed, coded, and further analysed using NVivo 9 qualitative data analysis software. NVivo 9 coding comparison of queries allowed for

[2] The size of the organization was pre-defined in the survey in terms of the number of employees. A large organization has more than 100 employees; a medium sized organization has more than 50 but less than 100 employees; a small organization has 50 or fewer employees; and a micro-sized organization has less than 10 employees.

similar comments and suggestions being synthesised under common themes. A case study report that relates to individual organisations was sent back to interviewees for data validation.

4.2 Qualitative systems dynamics

System dynamics is a method to enhance learning in complex systems [63, p4]. Based on the findings from the interviews, further analysis was conducted by using causal loop diagrams to describe the dynamics and how they have influenced the behaviours of case study construction organisations in resourcing for disaster recovery. This paper only reports the qualitative system dynamics, often referred to as system thinking. The quantitative system dynamics which is based on quantified simulation will be reported in future published works.

The System Dynamic modelling approach was first introduced by Jay Forrest [64]. It offers a rigorous method for the description, exploration and analysis of complex organisational system comprised of organisational elements and the environmental influence. In the security world, systems thinking is a powerful tool for analysing and interpreting risks, and for developing control or intervention options [65]. While systems methods are not yet widely used in disaster management, experience in related disciplines, such as earthquake mitigation decision making [66] and planning for disaster recovery [67], indicates that they will be an increasingly useful tool for addressing complex issues in the aftermath of a large disaster.

We approached the analysis with the intent of exploring the critical dynamics of organisational resourcing process following the Canterbury earthquakes. By aggregating the findings from the case studies, the issues and processes that were relevant across a range of case study organisations can be identified. Those dynamics and how they have influenced the resourcing behaviours of case study organisations are presented in the causal loop by using Vensim modelling technique. In the following section, the generalised thematic findings will be presented and discussed, with illustration of dynamics identified in case studies.

5. Results and Discussion

5.1 Changed business operational model

Case studies in April 2014 show that there is a general trend for the workforce that were involved in the Canterbury earthquake reconstruction to move away from disaster recovery projects, as shown in Figure 1. In particular, the medium to large-sized infrastructure contractors were experiencing some human resourcing pressure as they have lost expertise to the new subdivision sectors. Case study organisations reported a renewed interest in moving

back to their business-as-usual market, driven by the development of new subdivisions in Canterbury and New Zealand Government's housing and transport commitments.

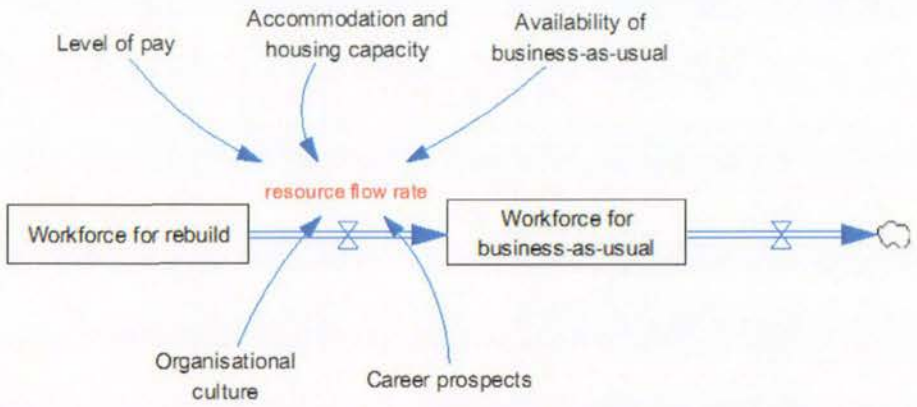

Figure 1: Dynamic factors that influence workforce flows between sectors

Lifestyle and cost factors are the dominant determinants of workforce migration patterns [68]. Such labour demographic-related factors play a major role in a workforce's decision-making and changing directions of resource flows [35, 36]. Case study organisations reported that the phenomenon of moving away from reconstruction to other sectors was most prominent among those who entered the reconstruction sector following the earthquakes, including overseas immigrants and those entrant people from outside Canterbury. Anecdotally, it appears that some new entrants tended to pursue better career opportunities in other places with their Christchurch reconstruction experience. This tendency, however, will likely be moderated somewhat by rebuild-related organisations providing needed support with organisational culture and certainty of career development playing a central role [59].

Small-to-medium sized businesses have seen work levels in non-reconstruction sectors rise over 2013 and were optimistic about development prospects in buildings and infrastructure industry. Large engineering and construction companies, however, remained to be focused on the reconstruction projects, in the meantime, dealing with high rate of staff turnover and the challenge of staff retention. As reported by interviewee C6,

> *'This year (2014), we start seeing a significant resource pinch on our external subcontractors. For instance, we sent 100 invitations for tender, only a third got back to us as those subcontractors are busy and their resources got tied up. It will be difficult for us to find compliant tenders and keep us competitive.'*

General changes in the demand landscape for different sectors of reconstruction and new developments were also affecting business operational behaviours. For example, as shown in Figure 1, the change in demand and higher rates in other places meant that those who established local operations in Christchurch and secured reconstruction projects following the earthquakes had now moved back to housing and building markets in Auckland or Wellington. As one interviewee E2 put it,

> '*As the Auckland market picks up whereas the Christchurch market raised but not super busy, some of those companies had pulled out their presence from Christchurch as they can survive now in other markets.*'

This finding bears resemblance to the situation following the 2009 Victorian 'Black Saturday' bushfires [69] and the situation in Queensland' flood-affected areas in Australia [70]. Comerio [71] stressed that with prospects of economic development and growth pressures in other areas, the impact of their competing demands for construction skills should not be underestimated. Some case study organisations were concerned that escalating accommodation costs may discourage some construction workers from outside Christchurch. Case study organisations highlighted the importance of Government's investment in temporary housing for additional out-of-town workers as a strategy to retain these resources for the reconstruction projects.

5.2 Shifted focus from recruitment to retention and up-skilling

The skills issue in terms of resource quality is one of the most reported problems – so to a certain extent was viewed by small-to-medium-sized organisations as their top concern. This is not surprising as Mahamid [72] argued that a lack of labour experience is among the top-five factors negatively affecting construction business performance. A range of terms, such as 'lack of competency', 'lack of experience', 'low level of skill', 'absence of work ethics' and 'incorrect work attitude', were used by studied employers as a reason, in part, to explain their reluctance to recruit young workforce which does not seem to have a sufficient skills set for work elements of the reconstruction. A continuing low unemployment rate (3.2 per cent for the December quarter of 2013) in Christchurch will make sourcing appropriate labour more difficult [73]. This is an issue that may become more prominent once more construction works get underway.

Prolonged lead time from planning for forward work programmes to their eventualisation was another key resourcing barrier identified by case study organisations. This is also intertwined with an inconsistent work flow issue. For construction businesses, there is added instability and uncertainty in planning, particularly human resources which causes waste and increased costs [74]. According to Hua [75], firms are more likely to invest in physical assets if they expect demand to remain high and long-term economic conditions to be good. If the economic prospects are unfavourable, they tend to be conservative about their investment due to potential fiscal risks.

Some interviewees noted that slow reconstruction of commercial buildings was capping the rate of the cash flow and the rate and number of people coming in. This is in line with the findings of Ng et al. [76] which emphasised that private construction investment is more sensitive to general economic conditions, creating uncertainty in the future levels of construction workloads. Contractors and suppliers also reported some of their spare capacity was a result of the inconsistent workflows, affecting their workforce demand. One contractor C2 in the infrastructure rebuild sector shared its particular concern:

> *'In 2014, we are particularly concerned that the new subdivisions as a result of the earthquakes and the vertical rebuild will be sucking a lot of our subcontractors. What's gonna happen next might be they are going to suck our own staff, our engineers and project managers.'*

Case studies opened up a discussion about a focus in 2014 for skills retention and up-skilling. Strategies already implemented included changing from annual to quarterly reviews, touching base on a regular basis, increasing the focus on staff development and staying competitive in the market in terms of pay rates. It appears that the high turnover rate among newly recruited workforce undermines the skills retention and in-house up-skilling strategies adopted by case study organisations. As one interviewee (C4) highlighted:

> *'Finding the right people who are willing, able and motivated has been problematic. The more frustrating is you take on new people and spend a lot of time and money training them up. Once they have gained that experience, they move to another company. This is certainly not good for apprenticeship with fewer companies willing to invest in youth training.'*

This is not supervising given that the New Zealand construction industry has a labour turnover rate of over 20 per cent on average [77]. It in turn increases recruitment and training costs. With the higher turnover rate, construction business owners will need to secure key people who maintain the core competency of the business [26, 27]. The need to effectively 'self-insure' for human resource loss, and escalating competing demand from the business-as-usual sectors, will potentially lead some businesses to rethink their resourcing strategies.

5.3 Changing dynamics and relative nature of hiring

Some construction businesses of small-to-medium size indicated that it may be uneconomic to hire wage workers, partly due to quick turnover and some of the work ethics issues of their recruits. This is similar to the findings in the European construction sectors, which lead to the increased sub-contracting [24]. One studied organisation C5 reported that they had to re-assessed their business development strategies and opted to re-structure the company by using sub-contractors to reduce operational costs. The interviewee acknowledged that this change of staffing approach had increased its revenue in terms of improved productivity and work efficiency.

As mentioned above, the change in business resourcing behaviour brought about by staffing experience through a rapid growth cycle post-earthquake will in turn affect the in-take of new staff and buy-in of industry training programmes. If a growing number of construction businesses choose to cancel or reduce the pipeline of their recruitment, it is less likely that a skilled workforce will be delivered to Christchurch in the long term. Figure 2 shows that three critical dynamics – staff turnover rate, competency of hired workforce and business operational capacity – play out together to have an impact on company's ability to work efficiently. The more difficulties a company finds in achieving work efficiency, the lower the productivity [78, 79]. This will in turn make hiring less desirable and less affordable, causing more businesses not to hire.

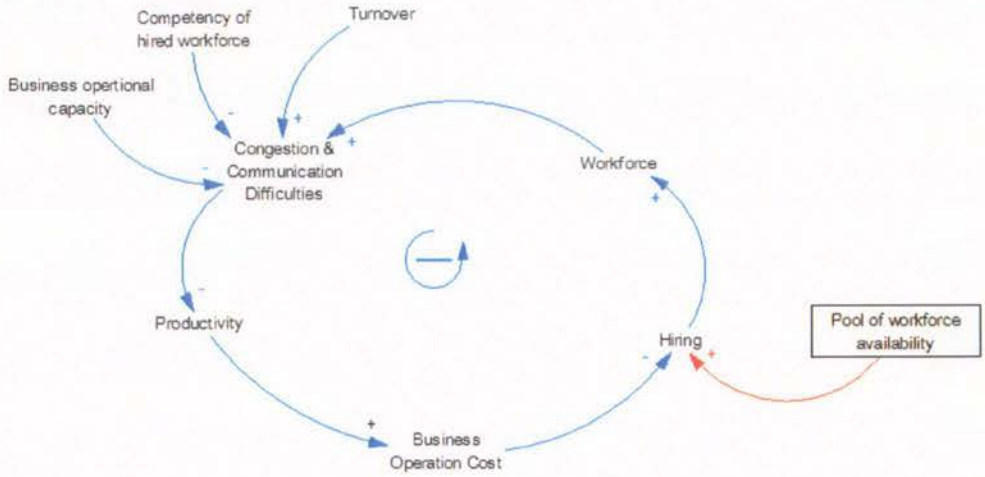

Figure 2: Changing business dynamics and relative nature of hiring

As mentioned earlier, the issues of rapid turnover and lack of competency are particularly found among the youth workforce. The implications from the dynamic model in Figure 2 are that the trend of recruitment is now moving to more temporary contracts on short-to-medium terms. However, there are economic and social consequences of the industry labour market in not delivering the supply of workforce at a rate to meet the required demand by employers [23, 80, 81]. In the meantime, construction organisations were understandably concerned about the risks of overcapacity in Christchurch. In particular, the risk of influx of a less experienced labour force and questions over the training buy-in from the industry were of concern.

6. Conclusion

The nature of reconstruction following a large disaster is often fraught with uncertainties, leading to pronounced fluctuations in its demand [50]. By using a systems approach, this study identified the dynamics that have changed construction companies' resourcing behaviours in

relation to the employment demand and supply in the Canterbury recovery from 2010/11 earthquakes. In particular, the limited engineering and project management capability available nationally, lack of motivation among new entrants, combined with high turnover rate, had accounted for socially produced skills shortages in Christchurch. This shortage was further compounded by factors such as the shortage of temporary accommodation, time lags of training and a lack of information about reconstruction workloads from the recovery agencies.

It is difficult to separate pre-existing contributing factors that influence construction skills problems from those of the effects of reconstruction demands. Comerio suggested that disasters do not completely change pre-disaster economic conditions; instead they simply magnify trends or conditions in place before disaster strikes [82]. As shown in this research, the Canterbury earthquakes and the reconstruction demand had brought about fluctuations in the economic cycle. However, the pre-event issues such as the high staff turnover rate, competency of hired workforce, organisational culture and company retention ability still played a dominant role impinging upon the practice of human resource management of construction organisations in disaster recovery projects.

The dynamic models developed in this research provide visual directions for decision makers and construction organisations to implement supporting measures for improved capacity and capability for ongoing reconstruction. The study offers an improved understanding of disaster effects on the construction skills needs and of changes in the skills requirements post-event, enabling better future industry preparedness for a similar event. It is suggested that the design of policy instruments in managing human resources in Christchurch should be informed by a continued investigation of the dynamics that mediate between policy objectives and outcomes over time.

More than that, the study makes the case for a new approach to looking at resourcing problems following a major disaster. Those methods that are based on neoclassical economics and deal mostly with the larger economy tend to consider resource availability as a consequential result of market processes. The systems approach used in this research demonstrates that for enhancing the reconstruction capability in complex post-disaster settings, an organisational perspective should be considered in the decision making, which explains both internal resourcing dynamics and the linkages between construction organisations and the wider recovery environment.

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Beyond 'business as usual': Capability challenges in earthquake reconstruction in Christchurch, New Zealand

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Abstract

Four years on after the February 2011 earthquake in Christchurch, New Zealand, the pace of reconstruction of the damaged built environment has gained momentum. In spite of the various stakeholders involved and different funding mechanisms and organisational structures applied for reconstruction, capability issues have emerged over time which posed unique challenges to the region's construction industry. By using a longitudinal approach to studying the resourcing practice of the construction companies, this paper revealed that the earthquake effects have compounded pre-existing resource shortages in the construction sector. Capability constraints on disaster recovery projects were caused by factors, such as the limited skills base, logistics for labour supply, delays in the consenting process, inconsistent workflows and lack of coordination across the recovery sectors. To improve the performance of the construction industry in the longer-term reconstruction and in coping with future events, there is a need for the construction sector to adopt a capability approach to addressing resource challenges in a concerted manner. The results are informative in the context of a large-scale natural disaster where resources and capacity play a critical role in attaining successful post-disaster reconstruction.

Keywords: *Canterbury earthquakes, construction industry, capacity, resourcing, longitudinal study*

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Introduction: Background to effects of capability limitations on reconstruction

The impacts of resource shortages on recovery following a major disaster are profound when time is tight and the government is under political pressures to rebuild quickly (Olshansky, Hopkins et al. 2012). Demand surge is a prominent feature following large-scale disasters, one which entails higher repair or rebuild costs. Although the circumstances contributing to increased reconstruction costs are disaster-specific, there are common explanations for demand surge across events. Research in this area suggests the increased cost of reconstruction labour and materials is the most common explanation for demand surge (Olsen & Porter, 2013). When the resourcing of labour and materials is not handled well, the adverse market responses can worsen local economies, causing time and cost effects on disaster reconstruction projects (Jayasuriya, Steele et al. 2005, Chang et al., 2010).

As a result of these resource-related capability constraints, many post-disaster housing projects suffered problems, such as funding shortfalls (Comerio 1993, 1997, Peacock et al., 2007), further strains on government expenditure (Skoufias 2003, Freeman 2004) and revised scope of projects (Chang et al., 2011, 2012). This can be an insurmountable issue and, in some cases, result in a waste of resources when projects are left half-constructed (Chang et al., 2012, Chang-Richards et al., 2013). The Victorian Government, Australia, for example, found that they had to step in four years after the 2009 'Black Saturday' bushfires and provide financial assistance for those whose house was half constructed due to fund shortfalls as a result of cost escalation (Freame et al., 2013).

Literature suggests that restoration costs of housing have increased between 20% and 80% following past disasters. Following the 1994 Northridge earthquake, insurers observed a 20% increase in the costs to settle property claims (Kuzak and Larsen, 2005). The 2006 Cyclone Larry in Queensland, Australia saw an increase of 50% in house reconstruction costs (Australian Securities and Investments Commission, 2007). Rebuilding damaged houses in Sichuan, China had a cost increase by 80% in the six months of Wenchuan earthquake in 2008 (Chang et al., 2012). Increases of 60% in the costs of house reconstruction were also observed in the affected areas after the 2004 Indian Ocean tsunami (National Construction Association of Sri Lanka 2005, Steinberg 2007).

The ongoing reconstruction in Christchurch, New Zealand following earthquake sequence that happened in 2010 and 2011 also raised concern about potential cost increase for rebuilding houses, especially in relation to the lack of capability (Chang et al., 2012). However, there is little empirically longitudinal research on identifying the factors that influence the capability constraints faced by construction companies over the period of post-disaster reconstruction (Drabek and McEntire 2003). In particular, what mechanisms will play together to limit the reconstruction capability in Christchurch and its effects on wider recovery remains an unsolved question.

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Research methodology

The research seeks to empirically investigate the critical factors that contribute to capability constraints in reconstruction following the Canterbury earthquakes. To achieve this goal, two research questions are formulated:

- What are key factors in post-earthquake Christchurch that limit the capability and capacity building of construction organisations during post-earthquake reconstruction?
- How do different factors affect the resourcing ability of construction organisations?

A triangulation method was adopted for data collection, including an online questionnaire survey of construction organisations, field-based observations and interviews within case studies (See Table 1.1). Specifically, the research questions were addressed in the following three steps.

1) Collecting the statistical data which include the construction organisations' opinions on the perceived capability constraints in Christchurch through a questionnaire survey from October 2011 to January 2012
2) Identifying the critical factors and interplay effects of those factors that influence the capability of construction organisations in rebuilding over time through long-term case studies of 15 selected construction organisations
3) Empirically validating research results through the method of expert judgement.

Table 1.1 A triangulation method of data collection

Data collection methods	Time	Profile of participants
Online questionnaire	Between October 2011 and January 2012	*61 organisations responded to the survey* 2 Design companies 28 Consulting companies 17 Construction contracting companies 1 Consenting organisation 4 Building supplies organisations 9 Construction project client and project manager
Interviews for case studies	May 2012 December 2012 May 2013 April 2014	*15 case study organisations* 6 Engineering consultancies (3 large-sized and 3 SMEs) 5 Contractors/builders (2 large civil contractors, 1 subcontractor, 1 home builder, 1 large construction company) 2 Building supplies companies (2 large building product manufacturers) 2 Project Management Offices (1 for infrastructure reconstruction and 1 for residential repairs)

Invitations to participate in the online survey were sent via the New Zealand Construction Industry Council internal mail system, targeting the CIC member organisations in Canterbury region. Of a sample of 155 CIC Canterbury construction organisations, 61 responded to the survey with a response rate of approximately 39%. Of 61 surveyed organisations, 15 were selected for longitudinal case studies (see Table 1.1). A case study method was adopted for this research due to its theory-building nature (Eisenhart, 1989; Yin, 2003). Lorch (2005) also

highlighted the importance of a longitudinal research for evidence-based post-disaster recovery decision-making.

Results and discussion

Analysis of questionnaire survey and longitudinal case studies revealed the key factors and how they have influenced the capability building of construction organisations in post-earthquake Christchurch. They are discussed below:

Limited skills base

Emergency repairs and land zoning issues post-earthquake had posed an initial demand for engineering technical professionals such as structural engineers and geotechnical engineers. Repairs of damaged houses were also proceeding well, which placed a burden on the availability of architects and essential trades such as electricians, painters, and carpenters. Longitudinal case studies showed that quality control personnel became essential emerging skills that were needed by construction organisations as Christchurch moved to a stage of reconstruction. The perennial paucity of skills with experience in quality control, site supervision and project management has been a lingering issue in New Zealand construction (Lobo and Wilkinson 2008). The available pool of these essential skills nationwide was not able to satisfy the large proportion of demand for reconstruction due to pre-existing skills shortages, the losses caused by retirements and movements to other industries. Furthermore, the effects of aging and retirement have also had an impact on skills levels post-earthquakes.

Logistics for labour supply

One of the important implications posed by the earthquakes is that they imbued a specific component to the labour supply problems in reconstruction. Given that the habitable housing stock has been greatly reduced in the earthquakes, Christchurch City has found it difficult to ensure that the market provides enough affordable housing for displaced residents. Compounding this shortage was the need to house a large number of additional rebuild workers. A lack of temporary accommodation has been an on-going concern which has constrained labour supply. An estimated minimum of 10,000 homeowners and occupants will have to relocate to temporary accommodation while further repairs are carried out (MBIE 2013). As the rebuild proceeds, construction-related inflation as a result of this rent inflation is likely to put extra pressure on the Canterbury labour market, community recovery and regional economic development. The logistics aspect of labour supply, oftentimes, appears to be missed out on the post-disaster recovery and reconstruction agenda (Baroudi and Rapp 2014).

Delays in the consenting process

Another emerging constraint on construction organisations' effective participation in reconstruction is the speed at which local territorial authorities can issue consents. The research participants had concertedly been expressing a significant level of concern over the time needed for consent which impeded their ability to assess their skills needs and plan for staff allocation.

The frustration experienced by home owners and recovery agencies over the delays for consent processing was reflected in a decision in July 2013 by the International Accreditation New Zealand (IANZ) to revoke Christchurch City Council's capacity as a building consents authority.

Inconsistent workflows

Longitudinal case studies highlighted that the delays caused by complexities around land zoning decisions and insurance pay-outs created an information 'vacuum' for the construction industry. The discontinuous nature of construction jobs has sometimes tended to influence maintenance of the status quo at the expense of readiness strategies for the future (Dainty, Grugulis et al. 2007). There were inconsistent workflow figures released by government and recovery-related agencies to the construction organisations operating on Christchurch reconstruction projects. In particular, the slow pace of reconstruction was affecting construction businesses' cash flow and further affecting the pace and number of people they could employ with a detrimental effect on workforce planning in the construction sector.

Lack of capacity for workforce growth

A lack of operational capacity of construction organisations in response to workforce growth was another key factor identified by most studied organisations. Workforce capacity expansion across the interviewed organisations was 30% on average above the pre-event level. In many cases, smaller companies increased their number of workers by more than 50%. This result is significant especially to construction industry with majority businesses being SMEs and agrees with other findings about the orientation of the industry, which mainly focuses on the organisational level capacity building (Allan and Yin 2010, Chang, Wilkinson et al. 2012).

Conclusion

The research is of value not only in improving the understanding with regard to the dynamics of capability building of construction industry in participating in post-disaster reconstruction, but also to policy makers towards addressing those capability challenges in order to expedite recovery from large events. The paper has identified the critical factors that affect capability building of construction organisations in Christchurch following the 2010/11 earthquakes. These factors should be considered the basis for a new capability approach as one of the means for addressing resource challenges in a concerted manner.

The results are informative in the context of a large-scale natural disaster where resources and capacity play a critical role in attaining successful post-disaster reconstruction. Future research could be directed towards comparative studies of the element of capability building of construction industries across different countries that have had major disasters. Such a cross-country comparison will be essential to consolidate the theory of capability building of disaster recovery projects.

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Effects of a major disaster on skills shortages in the construction industry: Lessons learned from New Zealand

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Abstract

Purpose – This research aims to empirically investigate the effects of a major disaster on the management of human resources in the construction sector. It sets out to identify the construction skills challenges and the factors that affected skills availability following the 2010/11 earthquakes in Christchurch. It is hoped that this study will provide insights for on-going reconstruction and future disaster response with respect to the problem of skills shortages.

Design/methodology/approach – A triangulation method was adopted. The quantitative method, namely a questionnaire survey, was employed to provide a baseline description. Field observations and interviews were used as a follow-up to ascertain issues and potential shortages over time. Three focus groups in the form of research workshops were convened to gain further insight into the feedback and to investigate the validity and applicability of the research findings.

Findings – The earthquakes in Christchurch had compounded the pre-existing skills shortages in the country due to heightened demand from reconstruction. Skills shortages primarily existed in seismic assessment and design for land and structures, certain trades, project management and site supervision. The limited technical capability available nationally, shortage of temporary accommodation to house additional workers, time needed for trainees to become skilled workers, lack of information about reconstruction workloads and lack of operational capacity within construction organisations, were critical constraints to the resourcing of disaster recovery projects.

Research limitations/implications – The research findings contribute to the debate on skills issues in construction. The study provides evidence that contributes to an improved

understanding of the industry's skills vulnerability and emerging issues that would likely exist after a major disaster in a resource-limited country such as New Zealand.

Practical implications – From this research, decision makers and construction organisations can gain a clear direction for improving the construction capacity and capability for ongoing reconstruction. Factors that affected the post-earthquake skills availability can be considered by decision makers and construction organisations in their workforce planning for future disaster events. The recommendations will assist them in addressing skills shortages for on-going reconstruction.

Originality/value – Although the study is country-specific, the findings show the nature and scale of skills challenges the construction industry is likely to face following a major disaster, and the potential issues that may compound skills shortages. It provides lessons for other disaster-prone countries where the resource pool is small and a large number of additional workers are needed to undertake reconstruction.

Keywords: Skills shortage, construction demand, natural disaster, labour market, New Zealand

Paper type: Research paper

1. Introduction

Having a skilled and productive workforce has been central to the construction sector's growth and success (Agapiou et al., 1995; Chan and Dainty, 2007; Construction Skills, 2005). Literature has revealed a number of factors which can create a shortage in construction skills. In particular, cyclical changes in construction demand has been recognised as a major challenge facing construction firms and their workforce (Bennett, 2005; Fan et al., 2011). This has manifested as large boom periods where there is more demand for labour than can be met, followed by bust periods where significant numbers of partially-trained and fully-trained construction workers are often lost to other industries and rarely return (McGrath-Champ et al., 2011).

The nature of demand within the construction industry is often fraught with uncertainties, leading to pronounced fluctuations (Hua, 2012), adding instability and uncertainty in workforce planning for the industry at all levels (PWC, 2011). For example, as construction demand fluctuates, employees in the construction sector often face uncertainty in regard to their employment, which has a detrimental effect on their social wellbeing (Allan et al., 2008). The cyclical nature of the industry deters young people from considering the industry as a future employer (Briscoe, 1988; Hillebrandt, 2000). The 'gains' in the booms and 'losses' in the busts also challenge sustainable development of construction firms (Fox and Skitmore, 2007).

In the past decade, to counteract the effects of economic cycles on construction workforce development, considerable effort has been put into developing various methods, tools and techniques to improve forecasting of labour demand and supply (e.g. (Sweeney, 2004); (Wong et al., 2007); (Ho, 2010); (Sing et al., 2014)). The basic rationale underlying many of these tools is the use of a limited amount of data at the project or firm level to achieve a similar degree of

accuracy to that of other statistical forecasting models. Wong (2006) emphasised the fact that workforce forecasting is a key strategic managerial practice for construction organisations. Such a viewpoint sees human resource management as a critical factor in enhancing the performance of construction businesses.

Other solutions to address vulnerability to economic cycles in regard to construction skills have also been used, primarily in such areas as the training of transferable skills (Clarke, 2006; Clarke and Wall, 1998), multi-skilling (Burleson et al., 1998), promoting the construction industry as an attractive workplace (Agapiou et al., 1995; Chan and Dainty, 2007), employing temporary workers or outsourcing, (McGrath-Champ et al., 2011) and developing new technologies and construction techniques that substitute manpower (MacKenzie et al., 2000). Despite the achievements in construction skills research, Dainty et al. (2005) suggested that workforce planning needs to take account of a wide range of factors determining both labour supply and demand. There remains a paucity of empirical research into the nature of a highly complex and dynamic labour market (Pearce, 2003). In particular, very little attention has been paid to the effects of external shocks, such as major natural disasters, on the construction sector in terms of skills profile and capacity (Chang et al., 2011b).

The global financial crisis of 2008 and the earthquakes which occurred in Christchurch, New Zealand in 2010 and 2011, however, created a unique economic cycle affecting the construction industry. The research reported in this paper seeks to fill the knowledge gap by empirically investigating the effects of a major disaster on the management of human resources in post-disaster recovery projects. To attain this goal, two research questions were formulated.

1) What skills challenges were faced by construction organisations in post-earthquake Christchurch?
2) What factors influence the availability of critical skills for longer-term post-disaster reconstruction?

The paper begins by presenting an overview of skills issues faced by the construction sector in New Zealand, followed by a review of the effect of the external shocks on construction employment. The methods for examining the recovery experience after the 2010/11 earthquakes in Christchurch are presented in the research method section, followed by the research results section. The interplay of factors that combine to impinge upon the prevailing skills issues in Christchurch will be discussed. The paper's conclusion suggests the types of policy solutions and associated supporting measures needed to address the skills challenges faced by the New Zealand construction industry. Findings from this research, including skills challenges and factors affecting their availability identified in a major disaster setting, provide insights into the development of a collective workforce plan for disaster-affected areas to align the industry and organisational workforce strategies with real-time demands.

2. Literature review

2.1 Skills shortage faced by the New Zealand construction industry

The New Zealand construction sector plays a large role in driving economic growth; however, it is subject to boom-bust cycles (PWC, 2011). As in countries such as the U.K. (e.g. (Agapiou et al., 1995); (MacKenzie et al., 2000), (Dainty et al., 2005)) and the U.S. (Srour et al., 2006), skills shortage is a lingering issue faced by the construction industry in New Zealand (Lobo and

Wilkinson, 2008; Wilkinson, 2001). There are specific engineering skills that have been continuously listed on the Long Term Skill Shortage List[1]. These skills include civil engineers, geotechnical engineers, structural engineers and transport engineers. In the construction and building sector, a survey undertaken by the Department of Labour (2004) identified genuine skill shortages[2] in 15 trades. Of these, electricians, brick layers and plumbers were skills which construction employers found it increasingly difficult to recruit. In recent years, another skill that has been reported by the construction industry as being in high demand is construction project manager (Productivity Partnership, 2012).

Le Masurier and Hodgkinson (2006) and Lobo and Wilkinson (2008) have identified the factors causing skills shortages in the New Zealand construction industry. These factors included erratic apprenticeship schemes, poor public image of the industry, and an emphasis on a high-tech knowledge economy by the government to the detriment of construction industry training. In parallel with research initiatives, the New Zealand government has made efforts in aligning the requirements of construction skills development with a national skills agenda. The agenda primarily focused on reforming training schemes (Constructing Excellence, 2008; Productivity Partnership, 2012), reinforcing health and safety (Department of Labour, 2011) and standardising 'best practice' for human resource management for construction firms (Edgar, 2002; Klein, 2004).

There were changes in construction skills requirements as the national skills agenda rolled out. In 2009, the Ministry for the Environment (2009) emphasised the need to achieve greater sustainability in the built environment. The call for sustainability has led a demand for more eco-friendly and sustainable design, standards, products and processes in construction. In addition, technological changes in the past decade have also affected the New Zealand construction

industry in relation to prefabrication (Chris, 2009), energy efficiency (Hoque, 2010; Kestle and Rimmer, 2010) and the management of construction projects (Wilkinson, 1998, 2001). As a result, a need for a range of new skills in relation to such changes has emerged.

2.2. Effects of external shocks on construction employment

In a report commissioned by the World Bank, Marzo and Mori (2012) described how different external shocks, including economic crisis, pandemic, natural disaster and conflict, impact local communities. An investigation into the effects of natural disaster on labour markets shows that disasters differ from other shocks and disturbances to a local economy and workforce. A labour market can be fundamentally changed due to the restructuring of economic activities as a consequence of the disaster itself or by the reconstruction process (APEC, 2013). In the aftermath of a major disaster, where the operational environment is often uncertain, complex and dynamic, the "business as usual" way of managing labour resources may not be applicable (Chang et al., 2011a and 2011b).

Unlike an economic crisis, a major disaster often causes significant damage to buildings and infrastructure. The construction sector may also be directly affected by natural events in terms of staff casualties, damage to premises and loss of revenue (Craigie et al., 2012). While disasters may directly affect some economic sectors, post-disaster reconstruction can create employment opportunities in construction (Venn, 2012). In a post-disaster environment, there is strong pressure to act quickly to get back to normal (Johnson and Olshansky, 2013). Under such pressure, the need to replace lost housing, building and infrastructure facilities often generates a demand surge for labour (Chang et al., 2012; Olsen and Porter, 2013). Depending on its pre-existing labour capacity, however, post-disaster skills shortages may arise or escalate during post-disaster reconstruction (Chang et al, 2012; Jha et al., 2010; Moe and Pathranarakul, 2006).

During the Queensland floods in Australia in late 2010 and early 2011, for example, the construction sector sustained a 12% revenue loss which was among the highest when compared to other industries (CCIQ, 2011). The industry also faced severe competition from the mining sector for skilled workers in undertaking post-flood reconstruction (Queensland Reconstruction Authority, 2011). This is also the case in other disaster-affected countries such as Indonesia and China, where competition for limited manpower was a major issue that compounded skills shortages post disaster (Chang et al., 2010; 2012). Consequently, the construction labour market becomes less efficient in matching skills required by employers and those of job seekers (Craigie et al., 2012).

The interplay between the pricing mechanisms and industry pooling of resources also influences the capacity of the construction industry to respond to major disasters (Wein and Rose, 2011). Revised building codes and standards, regulatory requirements, construction innovation, environmental concerns, an altered housing culture and budgetary constraints tend to combine to require new skills sets for building a more resilient built environment (Chang-Richards et al., 2013; Chang et al., 2010). All of these changes which occur in the wake of a major disaster present resource challenges which require a coherent, overarching strategy of the construction sector (Bosher, 2014).

A study into the cyclical performance of the New Zealand construction industry revealed that with almost full employment levels coupled with net migration effects, it is difficult for construction companies to undertake workforce planning (Allan and Yin, 2010). Previous economic cycles have had a particular impact on the New Zealand construction labour market. In boom conditions, skilled workers were usually attracted to other industries or overseas to countries such as Australia and the U.K., which had closely coupled economic cycles. In

recession periods, however, skilled workers were also attracted overseas for better job opportunities (Bollard and Hunt, 2008; PWC, 2011). The New Zealand construction industry has a labour turnover rate of over 20% on average (CIPD, 2007). High turnover creates further difficulty in workforce planning and increases the costs of recruitment and training.

During the 2008/09 global economic crisis, the New Zealand construction industry was amongst the hardest hit, with employment down by 5% from 190,000 to 181,000 by June 2009 (Department of Labour, 2009). The downturn had an impact on the number of construction apprentices which is vital to the productivity of the sector. According to the New Zealand Building and Construction Industry Training Organisation (BCITO, 2008), construction employment peaked in June 2007 and experienced a significant fall in the number of new apprentices as a result of the financial recession in 2008.

The 2010 and 2011 earthquakes in Christchurch and the subsequent high demand for labour presented an opportunity for the construction sector to revive itself from the global recession. However, the complexity of the post-earthquake situation has rendered accurate forecasting of skills needs extremely difficult (CESB, 2011). It was estimated that reconstruction might challenge the industry's already strained labour capacity (PWC, 2011).

Against this backdrop, the research reported in this paper uses an empirical approach to investigate the skills challenges faced by construction organisations in Christchurch. The study was undertaken longitudinally over an extended period with a view to tracking the changes in skills requirements post-earthquake. Empirically, the purpose of this research is to provide an improved understanding of skills issues that likely face the construction industry in a large disaster event, thus enabling better resource planning in response to future events.

3. Research method

A mixed method approach, namely triangulation, was adopted for this research due to the nature of the inquiry. Creswell (2003) suggested that triangulation suits research that involves collecting data either simultaneously or sequentially to best understand research problems. The methods used for data collection in this study were an online questionnaire survey of construction organisations, field observations, interviews, and focus groups. According to Chang (2010), basic quantitative descriptions can provide a valuable baseline background to help identify issues for a more in-depth, qualitative or quantitative study for a particular event. Therefore, the quantitative method, namely a questionnaire survey along with statistical analysis, was employed at the first stage to identify the skills challenges faced by construction employers in Christchurch and the critical factors they perceive have affected their skills availability.

By undertaking a series of field visits to Christchurch, observations and interviews were used as a follow-up to ascertain issues and potential shortages over time. Three focus groups in the form of research workshops were convened to gain further insight into the feedback provided by the survey and interview sessions. Selected representatives from the construction organisations interviewed and from the reconstruction-related agencies were invited to participate in the focus groups. The workshops allowed the researchers to meet research participants, ask questions of them and identify the changes in capacity reserves and shortages in relation to the earthquake recovery. Focus groups were also used as an instrument for clarifying conclusions reached from prior study sessions and validating research data (Krueger and Casey, 2000). The research was approved by the University of Auckland Human Participants Ethics Committee in October 2011, reference number 7520. To maintain confidentiality, the organisations interviewed were coded.

Details of the data collection methods for this research and the codes of organisations interviewed are shown in Table 1.

Insert Table 1 here

Between October 2011 and January 2012, an online questionnaire survey was conducted to assess the skills needs of construction organisations in Christchurch. The questionnaire classified skills sets according to the Australian and New Zealand Standard Classification of Occupations (ANZSCO, 2006). The occupations selected for use in the questionnaire were further examined by a senior economist based with the Building Research Association of New Zealand (BRANZ). Survey respondents were asked to select and rank the types of human resources that were in short supply. Semi-structured questions were designed to investigate other labour resource challenges faced by construction organisations and the factors that affected their ability to acquire the desired skills.

The key strategy used for selecting the sample was that organisations came from a spectrum of areas of the New Zealand construction industry. Therefore, the survey sample was selected from the New Zealand Construction Industry Council (NZCIC) membership database. Sample organisations were all based and operated in Christchurch and registered with regional industry bodies under the umbrella of NZCIC. Invitations to participate in the survey were sent via the NZCIC internal mail system, targeting NZCIC member organisations in the Canterbury region. Of a sample of 155 NZCIC Christchurch construction organisations, 61 responded to the survey with a response rate of approximately 39%.

Of 61 surveyed organisations, 24 were selected for follow-up interviews. In 2012, interviews with 33 key stakeholders from Christchurch construction companies and recovery agencies were

conducted over three field visits in May, November and December 2012 respectively. Qualitative data from the perspectives and insights of these participants were captured, including:

- impact of the earthquakes on the skills shortages and wider construction industry, and
- emerging issues and potential resource shortages over time.

In September 2012, November 2012 and July 2013, focus groups in the form of research workshops were organised by the researchers in Christchurch, investigating the validity and applicability of the research findings. In general, focus groups provided a practical perspective on what the implications of the research findings were, and how the participants could actively use the information. Discussions with these industry representatives were important in terms of establishing the value and relevance of this research. Secondary data provided by the government and the construction industry were also studied to supplement research data in order to draw an in-depth picture of how the issue of skills shortages was handled, as well as its effects on wider recovery. The questionnaire survey results were analysed using Excel's statistical descriptive tool, whereas the interview records were transcribed, coded and analysed using NVivo 9 qualitative data analysis software.

In this paper, data analysis was undertaken at two levels. The first level dealt with the results from the questionnaire survey. This analysis answers the research question as to the skills challenges posed by the earthquakes to the construction industry and the factors that affected their resource availability. The second level dealt with the assessment of changes over time in order to capture the effects of longer-term reconstruction on construction skills needs. The analysis focused on the longitudinal qualitative data generated from interviews and focus groups. The diachronic analysis of the conditions and emerging issues reveals the changing dynamics in

organisational resourcing practice during post-earthquake reconstruction. The presence of data such as examples, comments and suggestions in the paper was approved by the related respondents. In what follows, the research results are presented in the form of a synthesis of quantitative and qualitative results using coding as shown in Table 1.

4. Research results

4.1 Skills challenges faced by construction employers

The respondents to the questionnaire survey represented a range of organisations of varied type and size (Table 2). The size of the organisation was pre-defined in the survey in terms of the number of employees. Approximately 41% of respondents were from large organisations with more than 100 employees. 21% of the organisations represented were small organisations with 50 or fewer employees, and 18% of respondents were from micro-sized organisations with 10 employees or fewer. 17% of respondents were self-employed sole traders. Each organisation was asked to list the types of construction projects in which they were involved at the time of the survey. This was to measure the level of their existing work commitments and the level of earthquake-related work. It was found that a large proportion of projects undertaken by the surveyed organisations were earthquake-related (73%) with the rest being non-quake related, business-as-usual building projects (27%).

Insert Table 2 here

The shortage of human resources was determined by the questionnaire. Respondents were given a list of skills types required for the Christchurch earthquake reconstruction and were asked what the capacity shortages would be and the level of difficulty in acquiring such skills. Survey results

show that the skills shortages appeared primarily in engineering and trades. The average shortfall was approximately 30% of demand for the top 10 'problematic' skills (Figure 1). The most-needed labour included structural engineers and geotechnical engineers with more than 10% of respondents reporting such shortages. This was followed by draughtspersons, electrical engineers, mechanical engineers, resource and environmental engineers, carpenters, painting trades, electricians and building services engineers.

Insert Figure 1 here

Interviews with construction organisations in May 2012 confirmed that the major issues noted in the questionnaire survey remained current. Discussions with interviewees further revealed that the skills shortages largely existed in the engineering sector which played a major role in structural and land assessment in the immediate aftermath of the earthquakes. Engineering employers specifically required personnel with engineering skills experienced in dealing with seismic-related damage. Shortfalls in structural and geotechnical engineers were expected to be met from imports from other earthquake-prone countries such as the U.S., Chile and Italy. However, many questionnaire respondents (65%) reported that 'poaching' labour from other construction companies had intensified since the earthquakes. There was a consensus among the interviewees that quality control personnel, particularly site project management and supervisory staff would become 'pinch resources' as Christchurch moved into the stage of long-term recovery and reconstruction. Field observations and the focus group in July 2013 confirmed that this concern had eventuated since early 2013.

Most organisations in successive interviews in 2012 reported that increased workloads from the earthquake-related repairs and rebuild had overwhelmed their existing capacity and they found it difficult in fulfilling their existing work commitments. As interviewee E2 described:

> "*A significant proportion of our resources was directed to the quake-related jobs. Most of our staff have been working overtime and juggling between our existing projects prior to the earthquakes and new projects as a result of the quakes. Our capacity was so much over-stretched that we had to turn away any new projects that came along*".

Small to medium sized companies (E1, E2, D3 and C4) sensed that skills constraints may have limited the growth of their business. Other challenges consistently reported by the interviewees over three interviews included the wellbeing of their employees. According to some interviewees (D1-D3, E5, G1, Bs2, C1, C4 and PMO2), skills shortages, accompanied by increased workloads, had put more stress on the delivery of projects in terms of quality and timeline, and also impaired their staff morale. Some companies (e.g. E1, E5, C5 and D2) expressed their frustration at the need for repeated advertising for staff and time spent on filling vacancies. There was a sense of time and money being wasted finding the skills required both in terms of quantity and quality for their projects.

The focus groups in September and November 2012 further highlighted the fact that certain impacts of skills shortages, such as overtime and increased recruitment costs, have a negative impact on an organisation's growth and productivity. It seemed that construction employers in Christchurch were commonly faced with challenges posed by the disproportionately increased workloads relative to their operational levels in normal times. One focus group participant, Fr 5, raised his concern over the staff wellbeing issues such as fatigue, stress and low productivity

observed in his company. This situation, however, was compounded by the fact that some employees were themselves also affected by the earthquakes and were struggling with recovery demands at a personal level. Both interviews and focus groups that were conducted in 2012 indicated that managing staff wellbeing following the earthquakes was one of the biggest challenges facing construction organisations.

4.2 Critical issues that impinge upon post-earthquake skills availability

Questionnaire participants were asked what they perceived were the factors that affected the availability of skills. Respondents were also asked to rank the top five factors. Results from the questionnaire showed that the top five critical factors included limited technical capability in New Zealand nationwide, the shortage of temporary accommodation to house non-local workers, time needed for trainees to become skilled workers, lack of reconstruction workload information from recovery agencies, and lack of operational capacity within construction organisations to accommodate additional resources (Table 3).

Insert Table 3 here

Interviews show that the major reason for the shortages of skills in undertaking reconstruction-relate work was a lack of technical capability and expertise in the country as a whole. Interviewee E5 suggested that,

> "*New Zealand has never had a large technical base in seismic design and in dealing with quake-related liquefaction, and this capacity strain already existed at the time of the earthquakes.*"

Participants (Fr1-Fr2, Fr5, Fr7 and Fr8) in the focus group in September 2012 emphasised that, in spite of a strong desire to use local resources and skills, construction organisations had to turn to offshore recruitment for specific professional and managerial expertise.

When asked what initiatives were taken in response to skills shortages, there was a difference in the responses of large companies and smaller ones. Several large organisations (E3, E4, C1-C3, D2) reported they were supporting industry workforce planning by sitting on the Canterbury Employment and Skills Board and liaising with recruitment agencies, schools and other training bodies, and also with Immigration New Zealand. In comparison, small organisations preferred resource-sharing, setting up a partnership with other domestic or overseas companies. The potential benefits of this resource-partnering mechanism, according to some interviewed organisations (E1-E2, D3 and C4), were that

> "*Small organisations were able to quickly gain the resources and capacity advantages by utilising existing capacity elsewhere, without worrying about the size of the company and the skills constraints.*"

The second ranked factor affecting skills availability (identified by 80% of respondents) was the shortage of temporary accommodation for housing the construction workforce. This was a major concern among interviewees given the significant housing damage caused by the earthquakes. It was estimated that over 150,000 homes, or about three-quarters of Christchurch's housing stock, sustained some damage (Earthquake Commission, 2011). A projection of labour demand showed that around 24,000 additional construction-related workers would be required at the peak of the recovery (CESB, 2011). The sheer amount of housing needed to accommodate additional workforce posed a big challenge to the construction industry. Interviewee C5 emphasised that,

"*The shortage of temporary accommodation in Christchurch was a major constraint for us (the company) to attract skilled people from outside. Many builders seeking work were reluctant to move to the region because of the accommodation problems.*"

Interviews in November 2012 also raised concern over the potential adverse effects of displaced homeowners and the construction workforce competing for limited housing resources. To accommodate the projected size of the workforce, the focus group in November 2012 suggested that approximately one community in eight would need a sizable lodge (workers village). The willingness of communities to absorb this inflow of workers, however, according to focus group participant Fr9, was the major issue that the local authority should consider in addressing the dual effects of housing crisis and skills crisis.

Another top factor accounting for the reconstruction skills shortage was the time required for trainees to become skilled workers. This was identified by 74% of respondents. The Government continued with its skills programmes after the earthquakes but the question raised during the follow-up interviews was, '*Are we training enough people in the right sectors to address the skills shortages for the reconstruction*?' Interviewee G1 lamented that these training initiatives may take too long to produce workers when the industry needs them most. This sentiment was echoed in the focus group held in November 2012. Representative Fr5 from a local construction company made the following statement.

"*The skills learning process in the construction sector cannot be simply fast-tracked. People we need most in Christchurch are those who are senior and have had earthquake design experience before. It takes at least three years for a graduate structural engineer*

to become competent in building design and capable of communicating with clients. Skills training should've started three years ago before the earthquakes."

The fourth-ranked factor, by 66% of questionnaire respondents, was a lack of reconstruction workload information from recovery agencies. Field observations and interviews made it clear that the delays caused by complexities around land zoning decisions and insurance pay-outs created an information 'vacuum' for the construction industry. It seemed that there were inconsistent workflow figures released by government and recovery-related agencies to the construction organisations operating on Christchurch reconstruction projects. Interviewees from smaller companies (E1, D3 and C4) noted that the slow pace of reconstruction was affecting their cash flow and further affecting the pace and number of people they could employ. The focus group in July 2013, in particular, highlighted that the lack of information as to when projects are going to market and the resources they may require had a detrimental effect on workforce planning in the construction sector.

A lack of operational capacity of construction organisations in response to workforce growth was another key resourcing barrier identified by more than half of surveyed organisations (52%). Interviews in December 2012 suggested that this factor, combined with a high turnover rate in the sector, had an impact on companies' ability to work efficiently. The questionnaire survey also revealed that the majority of respondents who ranked this factor as critical were small to medium sized companies. Interviewee E2 explained:

"*Most companies in the construction sector are relatively small in size. Many project opportunities in the reconstruction had somehow inspired SMEs to grow their businesses. But the capacity of these businesses was still limited, like they tend to have small or*

micro-sized financial systems, office facilities and HR (human resource) systems; this capacity couldn't match the growing number of staff."

Interviews in December 2012 also revealed that workforce expansion across the interviewed organisations was 30% on average above the pre-event level. In many cases, smaller companies increased their number of employees by more than 50%. The focus group in July 2013 voiced the concern that such a growth was not sustainable. More and more companies encountered congestion and communication difficulties caused by having a larger workforce than they could efficiently deal with. As interviewee C4 reported:

"*Rather than saying we have 'gained' from workforce expansion, we actually have 'lost' the ability to operate efficiently due to the space and communication issues. We were talking about the competence of people, but somehow lost the sight that, as a company, we need competency to manage our people.*"

5. Discussion

The types of skills that were subject to shortages during the Christchurch earthquake reconstruction were similar to those of normal times. According to Comerio (1998), disasters do not completely change pre-disaster economic conditions; instead they simply magnify trends or conditions in place before the disaster strikes. This was the case in Christchurch, where the pre-existing shortages for both structural and geotechnical engineering occupations, along with the specialist trades associated with housing and infrastructure construction, and project management professionals seemed to be intensified by the earthquakes. Research findings show

that the earthquakes had changed the landscape of employment requirements and compounded the skills shortages in the construction industry.

An apparent challenge facing the construction industry was to do with the nature of damage caused by earthquakes (Bosher, 2014; Dainty and Bosher, 2008). In fact, the perennial paucity of skilled personnel with experience in seismic design and land liquefaction failed to draw sufficient attention prior to the earthquakes. This is perhaps due to the fact that New Zealand had had no event of this nature before which requires large numbers of seismic professionals (IPENZ, 2012). However, the resourcing challenges facing engineering companies, as identified in this study, created a sense of urgency to embrace an all-hazard educational element into the engineering programmes offered by tertiary education and training organisations.

It was found that earthquakes caused additional participation barriers such as the lack of accommodation and psychological well-being issues for individual workers. This result is in line with the findings from an APEC-commissioned report which examined the effects of disaster events on labour market participation (APEC, 2013). Employee wellbeing issues, as highlighted in the interviews, including stress, fatigue, trauma from earthquakes, together with other family concerns which construction employees had, particularly affected the capability of construction organisations. Page (2004) suggested that the ability of the industry to respond to disaster events also depends on the level of existing work commitments throughout the country. In the case of the Christchurch earthquakes, however, a degree of resource priority appeared to have been given to reconstruction projects over business-as-usual projects. The low level of activities in the construction sector during the pre-earthquake recession might be a reason for organisations to increase their involvement in post-disaster recovery (PWC, 2011).

A basic assumption in neoclassical economics is that market forces will direct resources to the recovery zone (Hallegatte and Przyluski, 2010; McGee, 2008). Long-term observations in Christchurch show that government policy in providing assistance to the construction workforce is also critical in ensuring skills availability. As Chang et al., (2012) suggested, the effective resourcing for post-disaster reconstruction depends somewhat on the competence of construction organisations and government's facilitation in the reconstruction. The shortages in temporary accommodation, as shown in this research, exacerbated the local shortage of resources, imposing time and cost repercussions on reconstruction. Similar to the situations in Australia following the Victorian 'Black Saturday' bushfires in February 2009 (Chang-Richards et al., 2012) and in New Orleans, in the U.S. post-Hurricane Katrina (Fletcher et al., 2007; NAHB, 2005), few housing options in the disaster areas had limited Christchurch's ability to attract and retain the workforce that is essential for restoring the damaged built environment.

According to Jha et al. (2010), construction skills needed for disaster reconstruction can be met by giving priority to training, developing new entrants to the industry and using the existing workforce, balanced by importing appropriately skilled internal and external migration. However, it appears that training was not the panacea to solve the problem of skills shortages in post-disaster Christchurch. There was a tension between the time needed for training competent workers and the urgency for responding to the upswing in building and construction activity. Skills import, therefore, became a popular approach adopted by the construction organisations studied. This situation resembled that of Aceh, Indonesia when rebuilding its communities after the devastating tsunami in 2004. While there was a substantial number of contractors (95%) from Java, the issues which emerged during the reconstruction in Aceh, such as differences in building standards, workmanship, lifestyle, climate and even language, added difficulty for construction

organisations in managing their workforce effectively (Chang et al., 2011a; Dercon, 2007; Zuo et al., 2008). The impact of large skills migration after the earthquakes in Christchurch, however, remained untested and need to be further investigated.

Findings from this research showed that information asymmetry compounded the construction labour market problem. As opposed to normal circumstances, operating in an environment of considerable uncertainty often involves inadequate information sharing between the decision-makers and construction professionals (Allan et al., 2008; Howes, 2000; McGrath-Champ et al., 2011). One of the main reasons for information delays in Christchurch concerned the decisions regarding land and structural assessment. This is consistent with findings by Wamsler and Lawson (2011) who recognised that timely demand information from recovery agencies (e.g. government and insurance companies) on repairs and reconstruction is critical to the response of the construction industry. Evidence in this research suggested that the time aspect of the reconstruction was a significant factor that affected the demand for recovery in Christchurch. When faced with 'patchy' workflows, without having information about future construction workload, construction organisations faced difficulties in skills development and forward workforce planning.

6. Conclusion and recommendations

Skills development is fundamental to the development of the construction industry (Fox and Skitmore, 2007). Based on a questionnaire survey and in-field investigations in Christchurch during its recovery from the 2010/11 earthquakes, this study sheds light on the sorts of resource challenges faced by the construction industry responding to the demand for large-scale

reconstruction. By surveying construction employers operating in Christchurch, this paper has focused on identifying the factors that affected skills availability for disaster recovery projects in order to gain insights into the effects of a large earthquake event on construction skills development.

The research findings show that skills shortages post-earthquake existed in seismic assessment and design for land and structures, certain trades, project management and site supervision. Difficulties in acquiring these resources that were traditionally on the list of construction skills shortage were intensified due to the significant demand created by earthquake reconstruction. Growing work demands from the recovery, increased competition for skilled labour, and staff well-being issues were additional challenges faced by construction organisations. Despite various resourcing efforts, five top factors, namely, limited technical capability nationwide, shortage of temporary accommodation for housing additional workers, time needed for trainees to become skilled workers, lack of information about reconstruction workloads and a lack of operational capacity within construction organisations were identified as critical constraints to the resourcing of disaster recovery projects.

A triangulation method provides a multi-perspective view of the construction organisations on the skills issue in disaster recovery. Findings show that the 'problematic' skills identified in this research were subject to shortages prior to the earthquakes. This means that post-disaster resource availability intrinsically links to the pre-planning and preparedness of the industry for disaster events. For countries such as New Zealand where there is a limited resource pool and a large number of additional workers will be needed after a major event, the housing needs of external reconstruction workforce should be considered by recovery agencies. The critical human resources required for reconstruction will inform workforce planning in the construction industry

to establish appropriate retention and training arrangements. Factors that affected the availability of these critical resources serve as directions for reconstruction stakeholders to design supporting measures to reduce the impact of fluctuating demands on skills development.

The study of the earthquakes in Christchurch reveals most of what we know that distinguishes post-disaster recovery processes from similar processes in normal times. This paper also offers lessons to help academics and industry practitioners to think about how the effects of a large disaster can change their normal lenses when viewing skills development in the construction sector. The following recommendations are suggested based on the research findings.

- To facilitate proactive workforce planning within organisations and sustainable skills development in the industry, reconstruction demand data should be shared with the construction sector. Construction companies, especially those small- to medium-sized firms, should consider what level of business maturity they need to achieve and take steps to build their workforce base by increasing operational capacity and applying improved skills management and retention practice simultaneously.
- Construction organisations should work with government agencies to develop bespoke initiatives in support of reconstruction workers, in addition to staff retention strategies used by individual construction organisations. A collaborative campaign between recovery agencies and industry groups would be ideal, including initiatives such as increasing awareness of the wellbeing of the earthquake-related workforce, identification and sharing of good practices for addressing the needs of the reconstruction workforce, community events to integrate migrant workers into local neighbourhoods and collective housing assistance for the external workforce.

- Industry training organisations should scope out the broad skills required for basic reconstruction (e.g. replace linings and claddings of a damaged house, re-piling and roofing) that could be undertaken by previously unskilled or semi-skilled people by providing a short training course. A coordinated approach across tertiary education institutes should be adopted to have targeted training courses for upskilling professionals in damage assessment, architectural and structural design and construction project management. The projected number of apprentices in the industry should be fed into recovery agencies and construction organisations for workforce planning purposes.
- When the boom starts to slow as reconstruction building work nears completion, it is imperative that non-earthquake related growth is maintained. Planning for building of major sectors, such as an improved infrastructure and transport network, housing construction and building community facilities will provide this strength. The growth and retention of employment opportunities in the construction sector will also be essential in attracting people to Christchurch.

Although the findings reported are country-specific, this research provides learnings for other disaster-prone countries where the building and construction sector is especially vulnerable to boom and bust cycles. Evidence in this paper suggested that without appropriate facilitation from the government and industry, market forces are not able to direct resources to post-disaster recovery. Successful resourcing implementation in the wake of a disaster requires capacity building in the construction sector along with facilitation from the government (Chang et al., 2012).

It is hoped that this study will encourage the development and application of a shared workforce demand model considering the complexities and issues reported in this paper. The research

results highlight the changing skills requirements as reconstruction proceeds. The effects of earthquake events are likely to change over time. Continued longitudinal studies of skills challenges are therefore needed, with a view to better preparing the construction sector for future major disasters.

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Endnotes

[1] The Long Term Skill Shortage List is a list used by Immigration of New Zealand to show the occupations for which New Zealand has a sustained and ongoing skill shortage. The list is updated annually. Immigrants who are qualified and skilled in an occupation on the list may be eligible for a work visa under the Long Term Skill Shortage List Work Category. For more information, see http://www.immigration.govt.nz

[2] Genuine skills shortages are distinguished from recruitment difficulties. Skill shortages are genuine when there are not enough skilled employees to meet demand. Recruitment difficulties, on the other hand, can mean there are enough skilled employees, but they are not willing to take on jobs at the pay and conditions offered.

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Issues facing subcontractors

Subcontractors involved in the Christchurch rebuild say seven key factors need addressing so that they can continue to support the rebuild.

Construction of new-build office block, Christchurch.

PHOTOGRAPH – SNIPA/ROSS SETFORD

WITH SMALL BUSINESS OPERATIONS and limited capacity, subcontractors are particularly vulnerable to market forces and fluctuating workflows. Subcontractors in Christchurch continue to face a number of challenges as they rebuild the city.

A research study following 13 case study organisations provides insight into everyday issues facing subcontractors. Seven key issues faced by subcontractors require some innovative industry solutions.

Increased workforce mobility

Construction industry workers are generally mobile, responding to major developments and infrastructure projects across the country. Several subcontractors faced competition for construction employees from infrastructure investment and housing developments.

Subcontractors report that workforce mobility is often an issue for the industry as employee turnover rate is increased by increased competition. If labour mobility in the construction industry rises, this affects industry costs, and these costs increase the overall rebuild budget.

Potential shortages of workers and materials

Resourcing shortages have been a recurring issue for the rebuild. Feedback from case study subcontractors continues to identify potential issues in the supply of labour and materials for the Canterbury reconstruction efforts. Subcontractors identified the vertical rebuild in central Christchurch as facing the most workforce challenges.

Subcontracting businesses are also losing people from repair-related jobs, which are perceived as having a low margin and being more demanding. Workers are drawn to new developments in Canterbury and other parts of New Zealand, which are seen as more attractive.

There are also still hot spots for skill shortages, for example, project managers and general labourers. This is particularly the case in Christchurch where unemployment is low and infrastructure, housing developments and the city centre rebuild are progressing. Subcontractors report heightened competition for people, which is still likely to increase.

Uncertain workflows

Several subcontractors report concerns that changes in project timeframes result in changes to the peak levels of projected labour demand.

Previous case studies by the research team identified potential short-term skills challenges as anchor projects commence. There

is likely to be a shortfall in the capacity and skills needed for CBD construction and to maintain the progress of existing projects. These include those managed by SCIRT, repairs by Fletcher EQR and new housing developments.

The size of any workforce shortfall is dependent on factors such as the rebuild pipeline and the rebuild trajectory (predicted and actual market changes). The ability of government, project clients and contractors to redeploy workers - new entrants, apprentices and workers - throughout Christchurch and the Canterbury region is also key.

Required social infrastructure

Significant other challenges reported by subcontractors include the need to provide structural and social infrastructure, including accommodation solutions and housing, to support the construction workforce. Otherwise, there is a likelihood of increased mobility to work outside the Canterbury region.

Ageing workforce

The demanding physical requirement of the majority of jobs in the construction industry means the career span of workers using physical labour is typically shorter. This leads to early retirement and a loss of valuable knowledge and skills.

Subcontractors are worried about their ageing workforce and likely retirements in their organisations. Expertise and knowledge of senior workers are gradually lost as they retire.

Several subcontractors suggest that much of the skills, knowledge and experience workers gain working on infrastructure repairs and rebuild could be lost, as there seems to be no mechanism to capture knowledge.

Skills development and training

Across the case studies, there is also a perception the subcontracting sector lacks a long-term career focus. This deters candidates from considering the industry as a potential career.

Subcontractors grapple with requirements to train staff on limited budgets and mostly use informal training mechanisms rather than externally offered courses.

Poaching of staff

Several subcontractors say that efforts made to train up a worker put them at greater risk of having their employees poached by other companies seeking workers with higher skill levels.

Subcontracting businesses have historically faced cycles of workforce supply and demand and, as a result, are adaptable to market changes. Subcontracting businesses often find innovative solutions to any workforce problems. The research team is currently exploring means of supporting subcontractor businesses in developing long-term resilient businesses in Christchurch.

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A capability framework for effective earthquake response and reconstruction

Yan Chang-Richards,[a] M.EERI, Suzanne Wilkinson,[a] Erica Seville,[b] and David Brunsdon[c] M.EERI

The capability of organizations who undertake post-disaster response and reconstruction tasks has a major influence on the cost and pace of recovery. A capability framework for effective post-earthquake reconstruction was developed after studying longitudinally 15 engineering and construction organizations, the capability challenges they were facing and how they responded to these challenges following the 2010/11 earthquakes in Christchurch, New Zealand. The framework presents the post-earthquake decisions that have an impact on reconstruction demands, and thus affect an organization's ability to respond. The key capabilities identified as being critical to effective earthquake response and recovery included seismic disaster 'know-how', collective support from the construction industry and the authorities, and organizational adaptability to meet changing demands. The framework can be of value to those policy makers attempting to address key engineering and construction capability challenges that influence disaster reconstruction, or to those predicting recovery trajectories and the corresponding skill and capacity demands.

INTRODUCTION

When the Darfield earthquake struck Christchurch in 2010, the New Zealand engineering and construction sectors were going through a recession period of low activity. There was a limited pool of engineering professionals in the country who had seismic assessment and design experience (PWC, 2011). Professional institutions, universities and building regulatory agencies assembled in workshops and seminars to share solutions for damage assessment and safety evaluation of damaged buildings. The Canterbury region subsequently suffered a sequence of aftershocks. The earthquake of magnitude 6.3 on 22 February 2011

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was the most severe, taking the lives of 185 people and causing buildings to collapse, further damage to infrastructure and widespread liquefaction (GNS Science, 2011). This earthquake also triggered incidents of land movement, the collapse of cliffs and rock falls in the Port Hills (Stevenson et al., 2011). The effects of liquefaction resulted in the need for substantial land review and zoning across the city (Environment Canterbury Regional Council, 2012).

Unlike the September 2010 event, when limited-to-moderate damage was observed in engineered reinforced concrete (RC) buildings, the February event in 2011 severely damaged about 16% of 833 RC buildings in the Christchurch Central Business District (Elwood et al., 2012). Nationwide engineering resources were greatly stretched in dealing with structural and land issues, and large numbers of professionals were imported from seismic countries by local consultancies and authorities to assist (Chang et al., 2012c). Some national development activities and large construction projects that had been planned before the earthquakes had to cease as resources were prioritized for disaster recovery projects (Parker & Steenkamp, 2012). As the reconstruction in Christchurch proceeds, the increased construction demand, while great uncertainty remains, poses challenges for the supply of construction labor and materials available throughout the country (Chang & Wilkinson, 2012; MBIE, 2012).

From the initial earthquake response to longer-term reconstruction, activities such as initial and detailed assessment of safety and damage, emergency repairs for restoring basic utility and service functionality, and restoration of damaged infrastructure and housing, all require sufficient engineering and construction capability in terms of resources, skills, processes and knowledge. There are a number of interdependencies through both pricing mechanisms and industry pooling of resources that influence the region's ability to rebuild (Wein & Rose, 2011). Other factors, such as revised building codes and standards (Chang-Richards et al., 2013; Chang et al., 2010), regulatory requirements (Le Masurier et al., 2008; Rotimi et al., 2006), construction innovation and environmental concerns (Zuo et al., 2009), altered housing needs and budgetary constraints (Boen, 2006; Mukherji, 2010), through their interaction and combined effects, also inflate the demands for engineering and construction resources following a major event.

A long-standing issue in rebuilding following large disasters has been the inadequacy of resources and capacities (Chang-Richards et al., 2014b). Post-disaster recovery and reconstruction can be times of great pressure for the engineering and construction sectors who assume the major role in restoration and rebuilding. There is a need to respond quickly,

using or building on existing skills, capacity and arrangements. While disasters directly affect some sectors in a country, post-disaster recovery often creates emerging employment opportunities in construction (Venn, 2012). However, due to the time-compressed nature of post-disaster recovery (Johnson & Olshansky, 2013), the need to replace lost housing, buildings and infrastructure facilities often generates a demand surge for materials and labor, one which entails higher repair or rebuild costs (Chang et al., 2012a; Olsen & Porter, 2013).

Despite the recognition of the important role the engineering and construction sectors could play in disaster response and recovery (Haigh et al., 2006; Myburgh et al., 2008; Ofori, 2002), there remains a paucity of empirical research into their capability requirements for achieving effective response outcomes. One study undertaken in New Zealand revealed that, across the board, organizational responses and their resourcing strategies shape the region's long-term economic trends and recovery (Stevenson et al., 2014). The research reported in this paper seeks to further investigate what particular capability challenges have been faced by Christchurch engineering and construction organizations and how they have addressed those challenges during the post-earthquake reconstruction.

The study was undertaken longitudinally with 15 engineering and construction organizations over a period of three years (2012-2014). To assist public officials and disaster researchers with conceptualizing the challenges faced by those organizations, a framework of key capabilities required for effective earthquake response and participation in recovery was developed. The framework provided the structure to analyze the resource issues, gaps and supporting measures for improved capability at the individual, organizational and sectoral level.

The first section of this paper presents a review of literature, offering a theoretical context in which engineering and construction organizations often find themselves unable to apply 'business-as-usual' practice in post-disaster involvement. The characteristics of post-major disaster conditions in which engineering and construction organizations operate are summarized. The case studies are then introduced, detailing the data collection and analysis methods. The results are organized in a capability framework around four thematic analyses. The discussion is focused on how engineering and construction organizations responded to capability constraints that influenced the Canterbury reconstruction process. The conclusion provides reflections based on case study results, along with empirical observations that can guide informed decisions on capability enhancement in response to future seismic events.

92 **THEORETICAL CONTEXT**

93 Following a major disaster, the construction market tends to be in disorder, contested and
94 highly adversarial (Nazara & Resosudarmo, 2007). Material inventories are vulnerable to
95 damage in affected warehouse districts and the intervening transportation systems are usually
96 in disarray (Singh & Wilkinson, 2008). In such an environment, the reconstruction projects
97 are likely to have major resourcing issues, such as a lack of skills and materials (Steinberg,
98 2007), competition between projects for limited resources (Chang-Richards et al., 2013),
99 disrupted supply chain due to damage to transport systems (Cho et al., 2001; Zuo et al., 2009)
100 and associated cost escalation (Nazara & Resosudarmo, 2007; Olsen & Porter, 2011).

101 The tendency in post-disaster situations is for government authorities to revise building
102 codes and standards in order to enhance the performance of structures in future disasters
103 (Comerio, 2004; Spence, 2004). This regulatory change can lead to changes in requirements
104 for materials, skills, tools and techniques in new construction. New materials and skills may
105 not be available at the time of reconstruction as they may require time for manufacturers to
106 undertake the research and development, to test and release these new materials onto the
107 market (Chang-Richards et al., 2013). Furthermore, the additional costs of the new
108 construction requirements are often not well understood during repair and rebuilds
109 (Hallegatte & Przyluski, 2010).

110 The impacts of resource shortages on recovery are more profound when time is tight and
111 the government is under political pressures to rebuild quickly (Olshansky et al., 2012).
112 Demand surge is a prominent feature following large-scale disasters, one which entails higher
113 repair or rebuild costs (Olsen & Porter, 2013). Literature suggests that restoration costs of
114 housing have increased between 20% and 80% following past disasters. Following the 1994
115 Northridge earthquake, insurers observed a 20% increase in costs to settle property claims
116 (Kuzak and Larsen, 2005, p.113). Cyclone Larry in 2006 in Queensland, Australia saw an
117 increase of 50% in house reconstruction costs (Australian Securities and Investments
118 Commission, 2007). Rebuilding damaged houses in Sichuan, China had a cost increase of
119 80% in the six months after the Wenchuan earthquake in 2008 (Chang et al., 2012d).
120 Increases of 60% in the cost of house reconstruction were also observed in the affected areas
121 after the 2004 Indian Ocean tsunami (National Construction Association of Sri Lanka, 2005;
122 Steinberg, 2007).

Although the circumstances contributing to increased reconstruction costs are disaster-specific, there are common explanations for demand surge across events. Research in this area suggests the following factors: the total amount of repair work; the costs of reconstruction materials, labor and equipment; reconstruction timing; construction contractor fees; general economic conditions; insurance claims handling, and decisions by insurance companies (Olsen & Porter, 2011). Among these factors, the increased cost of reconstruction labor and materials is the most common explanation for demand surge (Olsen & Porter, 2013). When the resourcing of labor and materials is not handled well in reconstruction projects, the lack of capability in terms of human resources and their skills, knowledge and competence, together with physical resources, is a critical contributor to demand surge (Chang et al., 2010; Jayasuriya et al., 2005; Olsen & Porter, 2011).

As a result of demand surge, many post-disaster housing projects suffered problems such as, funding shortfalls (Comerio, 1993, 1997; Peacock et al., 2007), further strain on government resources (Freeman, 2004; Skoufias, 2003) and revised scope of projects (Chang et al., 2011; 2012a). This can be an insurmountable issue and, in some cases, result in a waste of resources when projects are left half-constructed (Chang-Richards et al., 2013; Chang et al., 2012b). The Victorian Government, Australia, for example, found that they had to step in four years after the 2009 'Black Saturday' bushfires to provide financial assistance to those whose houses were half constructed due to funding shortfalls as a result of cost escalation (Freame et al., 2013).

In the case of recent events in Canterbury, the latest figures, released on 28 April 2013 by the Government, suggested that the reconstruction could reach NZ$40 billion with high levels of uncertainty remaining. The ongoing reconstruction in Christchurch also raised concern about potential cost increases due to over-stretched resources and capability challenges faced by the engineering and construction industry. Current literature, however, only provides limited anecdotal guidance regarding an appropriate response to demand fluctuations post-disaster (Chang et al., 2012c; Olshansky & Chang, 2009). There is little empirical research on capability requirements for response and restoration in major disaster settings (Döhrmann et al., 2013; Olsen & Porter, 2013). In particular, questions such 1) what are the key engineering and construction capabilities needed for an effective disaster response? And 2) what can be done to enable an effective and long-term response by

154 organizations and individuals in the engineering and construction sectors to large seismic
155 events, remain unsolved.

156

157 **RESEARCH METHODS**

158 This paper draws on longitudinal research which undertaken in Christchurch to help
159 improve the capability of engineering and construction organizations in longer-term recovery
160 and reconstruction. We conducted empirical studies of 15 construction organizations between
161 2012 and 2014, all of which were actively engaged in earthquake reconstruction-related work
162 in Christchurch. The research was designed to develop an analytical framework for decision
163 makers and organizations to better plan for augmentation of disaster response and
164 reconstruction capability.

165 A case study method was adopted for this research due to its theory-building nature
166 (Eisenhart, 1989). As suggested by Yin (1984), the case study design develops an empirical
167 approach to research of a contemporary phenomenon within its own context. Lorch (2005)
168 highlighted the importance of longitudinal research for evidence-based post-disaster recovery
169 decision-making. In this particular research, the case study was important as it allowed us to
170 understand the interplay during earthquake response and recovery among different actors,
171 especially between government authorities, engineering and construction organizations and
172 industry bodies. The study was undertaken over an extended period from 2012 to 2014, as the
173 Christchurch recovery proceeded, which enabled us to capture real-time data and examine
174 patterns and trends in depth.

175 The selection of case study organizations was based on criteria, including the type of
176 organization, size of organization[1], business characteristics, and involvement in the
177 earthquake recovery process. The key strategy used for selecting the sample was that all
178 organizations would come from a spectrum of areas in the New Zealand construction
179 industry. The case study sample was selected from the New Zealand Construction Industry
180 Council (NZCIC) membership database. Sample organizations were all based and operated in
181 Christchurch and registered with regional industry bodies under the umbrella of NZCIC.

[1] The size of the organization was pre-defined in the survey in terms of the number of employees. A large organization has more than 100 employees; a medium sized organization has more than 50 but fewer than 100 employees; a small organization has 50 or fewer employees; and a micro-sized organization has fewer than 10 employees.

182 The sampling process started with an online questionnaire survey investigating the issues
183 and challenges faced by engineering and construction organizations between October 2011
184 and January 2012. Invitations to participate in the survey were sent via the NZCIC's internal
185 mail system, targeting the CIC member organizations in the Canterbury region. Of a sample
186 of 155 organizations, 61 responded (39% response rate). We conducted follow-up interviews
187 with 35 selected survey participant organizations in May and September 2012. We reviewed
188 all organization profiles and stratified them by type of organizations, then applied the set of
189 case study selection factors. In September 2012, a total of 15 engineering and construction
190 organizations were selected for more in-depth case studies over a three year period from 2012
191 to 2014 (Table 1).

192 **Table 1**. Case study organizations and their characteristics

Case study time	15 Case study organizations	Characteristics
November-December 2012	6 Engineering consultancies	3 large-sized and 3 Small & Medium Enterprises (SMEs)
May-June 2013	5 Contractors/builders	2 large civil contractors, 1 subcontractor, 1 home builder, 1 large construction company
	2 Building supplies companies	2 large concrete product manufacturers
May-June 2014	2 Project Management Offices	Horizontal infrastructure rebuild & Earthquake Commission's residential repairs

193

194 The design of the case study included a common structure that was developed as part of
195 the research (Leedy & Ormrod, 2010). It included 1) an explanation of research and practice
196 relevant to the case; 2) a description of capacity, skills and knowledge gaps that the
197 organization is facing in undertaking earthquake-related response and rebuilding tasks; 3)
198 emerging challenges faced by the organization and their employees; 4) their response
199 strategies and initiatives; 5) key drivers for such initiatives to be adopted, and 6) suggestions
200 to improve overall capability for further events and/or long-term recovery in Christchurch.
201 Key changes between the findings of case studies at different time points were noted. An
202 emphasis was also placed on gathering some quantification around the conditions of business
203 operations, such as the level of training in terms of the percentage of allocated time or
204 budget, the proportion of workload between the quake-related projects and non-quake-related
205 business-as-usual projects, the percentage of wage increases and percentage of engineering

206 and construction workers who were recruited to supplement their response capacity following
207 the earthquakes.

208 The cases were analyzed using thematic cross-case analysis, an approach which treats
209 each organization as an individual case and allows evidence from each organization to be
210 compared to generate common patterns. According to Yin (2008), this type of analysis can
211 produce elements of both explanation building and hypothesis generation. We approached the
212 analysis with the intent of exploring the capability elements of organizational processes
213 following the Canterbury earthquakes. By aggregating the findings in case studies, we were
214 able to identify key capability dimensions that were relevant across the range of
215 organizations studied.

216 Because the capability framework was intended to support the continuous decision
217 making for the ongoing reconstruction in Christchurch, and for responding to future major
218 earthquake events in New Zealand, it is important to engage end-users and stakeholders in
219 the research process. We used focus groups (Krueger & Casey, 2000) to engage stakeholders.
220 A series of four focus groups in the form of research workshops were organized by the
221 researchers in Christchurch, in September 2012, November 2012, July 2013 and September
222 2014, respectively (See Table 2).

223 **Table 2**. Participants in the focus groups

Date	No. of participants	Organization affiliated
12 September 2012 13 November 2012 23 July 2013 16 September 2014	1	Building Research Association of New Zealand (BRANZ)
	1	Canterbury Earthquake Recovery Authority (CERA)
	2	Ministry of Business, Innovation & Employment (1 from Building and Housing Group & 1 from Labour Group)
	1	EQC Housing Repairs Project Management Office
	1	Infrastructure Recovery Project Management Office (SCIRT)
	2	Contracting companies
	1	Large building supplies company
	1	Engineering consultancy
	1	Academia

224

225 We invited practitioners in the Canterbury Earthquake Recovery Authority (CERA) who
226 deal with recovery as part of their day-to-day job to participate in the focus groups. The focus
227 groups involved eleven participants, from government agencies, industry bodies and

228 engineering and construction organizations. These included CERA, Canterbury Rebuild and
229 Recovery Unit within the Ministry of Business, Innovation and Employment (MBIE),
230 Building Research Association of New Zealand (BRANZ), Earthquake Commission (EQC),
231 a housing recovery project management office (Fletcher EQR), an infrastructure recovery
232 project management office (SCIRT), a local concrete manufacturer, a local engineering firm
233 and two local construction firms. The conceptual framework was evaluated empirically
234 through the most recent focus group held in September 2014, with the results of analysis
235 being used to guide the development of this paper.

236 The interviews used for case studies and focus group discussions were recorded,
237 transcribed, coded, and further analyzed using NVivo 9 qualitative data analysis software.
238 The NVivo 9 coding comparison of queries allowed for similar comments and suggestions to
239 be synthesized under common themes. In the following results section we present these
240 generalized thematic findings in an organizing framework, illustrating them with findings
241 from case studies and focus groups, as well as the cross-case comparison.

242

243 ## RESULTS AND DISCUSSION

244 An organizing framework of the capability elements for post-earthquake response and
245 reconstruction and the relationships among those elements is provided in Figure 1. We begin
246 by describing the contextual setting following the Canterbury earthquakes in which
247 engineering and construction organizations operate (i.e. policies and decisions made post-
248 earthquake; and characteristics of the Canterbury recovery). We then consider how the
249 Canterbury earthquake sequence and the decisions that were made post-earthquakes have
250 affected the technical and capacity demands of the construction and engineering sector, and
251 thus the ability of the engineering and construction organizations to respond to challenges.
252 We discuss the three key components required for improved engineering and construction
253 capability and professionalism in undertaking recovery tasks, drawing links between pre-
254 event construction and engineering practice and post-event requirements.

255

256 ### POST-EARTHQUAKE DECISIONS AND ORGANISATIONS' RESPONSE

257 In order to provide context to the involvement of engineering and construction
258 organizations in the response and recovery process, critical contextual factors are discussed

in this section, along with longitudinal observations on their implications post-earthquake. These factors cover both the decisions made after the Canterbury earthquake sequence and local conditions as a result of the earthquakes, which were considered by case study organizations as having influenced the way they have been involved in the response and recovery phases.

Technical demands as a result of the earthquake sequence

The Canterbury earthquake sequence itself has several unique characteristics, including the extended period over which the sequence of damaging events occurred and the number of events (Bradley et al., 2014), the intensity of shaking produced in the Christchurch CBD by each of the major aftershocks in February, June and December 2011 (Brunsdon et al., 2012) and the significant damage from secondary effects of ground deformation and slope damage across the hill suburbs (King et al., 2014). These unique characteristics had posed professional challenges to many aspects of engineering activities.

For engineering organizations, the heavy workload has been continuous from the initial response to the 4 September 2010 Darfield earthquake. At the time of the Darfield earthquake, only a limited number of engineers nationwide had undertaken training in building safety evaluation. The damage assessment response to this earthquake, however, was largely driven by individual engineers and professionals on a 'good will' basis. There was a lack of legislative mandate to enable an effective organizational structure and management process for resourcing qualified engineers in undertaking rapid building assessment (NZSEE, 2011). Case study engineering companies reported that many of their consulting engineers were engaged by IPENZ as volunteers in the rapid building evaluation process during the emergency period.

When the rapid building safety evaluations were nearly complete, under Section 51 of the Canterbury Earthquake Recovery Act 2011, CERA required all owners of commercial buildings and multi-unit residential buildings in the CBD to undertake a detailed engineering evaluation of their building. Case studied engineering consultancies indicated that such investigation involved a significant element of forensic engineering and considerable judgement as alternative repair strategies were needed. The associated technical procedures for undertaking such investigation was subsequently provided by the Engineering Advisory Group following the February 2011 earthquake (Hare et al., 2012). However, case study engineering firms revealed that their consulting engineers still faced difficulty to quantify the

residual capacity and categorize the strength of the building in terms of the percentage of New Building Standard (NBS), especially for moderately damaged buildings.

Engineering and construction capacity challenges

Longitudinal case studies show that geotechnical and structural engineers have been the most critical resources in constant high demand, commencing with urban search and rescue responses and rapid building evaluations, and extending through the more detailed assessments and repair specifications during the recovery phase. The year of 2012, one year after the February 2011 earthquake, however, witnessed a dramatic increased demand for other construction professions, including quantity surveyors and building control professionals (project managers, site engineers and building inspectors). The demand for tradespeople in the housing repair sector continued to soar. Accompanying such growth in the engineering and construction industries was the increased demand for service workers who support the functions and services of the industries, including people filling administrative and service roles in construction businesses.

Under huge time and workload pressure, many companies invested heavily in overseas recruitment of highly skilled and experienced engineering and construction professionals. Additional workforce had to be brought in from countries such as Australia, the United Kingdom, Ireland, Italy, Spain and the United States. As of December 2012, expansion of workforces across case study organizations had been significant, with a range of 10% to 60% of new employees sourced from overseas. Nearly half of the case study organizations cited cultural and professional challenges experienced when dealing with the different training backgrounds of overseas recruits. In addition, most workers from overseas were on a temporary contract and this introduced delays and issues in relation to inconsistent skillsets, quality control and knowledge preservation within the sector.

Compounding this was the need to accommodate a large number of out-of-town engineering and construction workers in the already depleted housing stock in Christchurch due to the scale of damage from the earthquakes. More than 150,000 homes, or about three-quarters of Christchurch's housing stock, sustained some damage from the earthquakes (EQC, 2011). The rental market, in particular, failed to meet the needs of both residents and workers who were looking for affordable accommodation. Case studies in 2012 show that the average weekly rent in several Christchurch suburbs had increased by at least 20% during the year. Some areas such as inner north and north west Christchurch city recorded above-

323 average rent increases of 39% and 32% respectively (MBIE, 2013b). Construction
324 organizations were particularly concerned that a lack of accommodation in Christchurch
325 would become a prominent issue in attracting skilled workers into reconstruction sectors and
326 thus impede recovery. This is similar to the situation in New Orleans that one year after
327 Hurricane Katrina, the pace of reconstruction was limited by the availability of skilled
328 workers who were themselves limited by the availability of local housing (ENR Staff, 2006).

329 Follow-up case studies in 2013 showed that the effects of housing shortages had been
330 evident throughout as competing demands emerged between out-of-town workers and
331 displaced residents, including red-zone home owners and those whose houses are subject to
332 repairs. Most case study organizations had at least one HR professional managing the
333 relocation of temporary workers and those recruited from overseas. The reported wage rises
334 in 2012 cases studies were in the range of 5% to 20% across the case study organizations.
335 Isolated cases suggested that the cost for engineering services had increased by 40%
336 compared to pre-event level. The full impact of the earthquakes is still uncertain, as the
337 extent of demand surge post-earthquake. However, there are strong lines of evidence from
338 the case studies in 2014 which show that additional costs of travel and accommodation
339 associated with out-of-town workers have been built into the rates charged by these workers.

340 **Professional requirements in an emergency context**

341 The effects of the 22 February 2011 earthquake on buildings and the subsequent human
342 loss had led to public scrutiny of the adequacy of policy settings and regulations for
343 rectifying earthquake-prone buildings, and the effectiveness of their implementation and
344 administration. Adding to the technical demands described above had been the requirement
345 for many engineers to provide input into the Canterbury Earthquakes Royal Commission's
346 Inquiry and other investigations (Brunsdon et al., 2012). Case study engineering companies
347 reported that the public reporting of the Royal Commission hearings placed additional
348 pressure on many engineering professionals, especially those who volunteered their services
349 following the Darfield earthquake. How to interpret seismic risks for buildings, communicate
350 a 'safety' notion, and interface with different stakeholders (e.g. insurers, building owners and
351 regulatory authorities) in meeting the objectives of these different sectors has been a major
352 challenge for engineering organizations in the face of liability concerns.

353 The changes in building regulations and the delays in land and insurance decisions are
354 among the factors that have exacerbated resource constraints of studied organizations for

355 post-quake repairs and reconstruction. Case study organizations reported that the opening
356 wording of insurance policies and the updated guidance on house repairs and reconstruction
357 had significantly increased the complexity and detail of engineering work required. For
358 example, the updated guidance reflects new scientific and geotechnical information and
359 knowledge about the impact of earthquakes and the effects of liquefaction on residential
360 dwellings (MBIE, 2013a). In particular, a large number of houses damaged in the
361 earthquakes would require a new foundation in order to withstand the effects of liquefaction
362 in future events. This required a new set of engineering knowledge and skills that few
363 previously possessed in the engineering sector.

364 The processes set in motion by the national emergency declaration and state regulations
365 and the insurance program managed by EQC and private insurers were aimed at establishing
366 governance. Along with these decisions, lingering issues concerning land-use decisions,
367 insurance payments and building consent processes, were cited by case study organizations
368 as impinging upon the demand fluctuations in reconstruction. Prolonged lead time from
369 planning for forward work programs to their implementation was another key resourcing
370 barrier identified by case study organizations. This was intertwined with inconsistent work
371 flow issues which was considered the most apparent stress point throughout case studies from
372 2012 to 2014. For construction businesses, instability and uncertainty in construction demand
373 can cause significant human capital waste and increase costs (Allan et al., 2008). Delays in
374 rebuilding Christchurch created such uncertainty and harmed construction organizations. The
375 impact of this uncertainty was felt most by the small to medium sized organizations. Case
376 studies in 2014 found that without clear and adequate information on the prospective work
377 streams from the government and insurers, companies of smaller size were unable to
378 undertake forward workplace planning, and this had impacted their decisions on business
379 development.

380

381 **CRITICAL CAPABILITIES FOR EFFCTIVE EARTHQUAKE RESPONSE**

382 **Seismic disaster 'know-how'**

383 Seismic disaster 'know-how' was a common term used by most studied organizations. It
384 refers to the knowledge of post-disaster reconstruction processes and issues as well as
385 hazard-specific technical knowledge and awareness of societal issues related to disaster

386 impact. The NZSEE (2011) highlighted that the emergency context and assessment process is
387 a departure from usual engineering practice and not one that engineers are familiar with or
388 extensively trained in. Case study organizations reinforced this point and suggested that an
389 enhanced engineering profession in addressing seismic risks should include the
390 understanding of the differences between the emergency context and usual engineering and
391 construction practice, improved engineering design and construction practice and a
392 knowledge bank for lessons learned and principles of good practice.

393 Another aspect of post-disaster know-how relates to an understanding of recovery issues
394 for those affected by the disaster and the associated social skills required. Construction
395 organizations which were involved in repairs of earthquake damaged houses reported that
396 their work may proceed more smoothly if their workers know in advance:

397 • What psychological impacts exist for home owners whose houses suffered major
398 damage, or for those who were severely traumatized by the quake and ongoing
399 aftershocks;

400 • What external social assistance is available for home owners; and

401 • How to respond to unexpected enquiries and disruptions posed by affected home
402 owners.

403 These issues required a certain amount of soft skills of construction workers that are often
404 overlooked at normal times (Petrovic-Lazarevic, 2008). After the 2009 Victorian 'Black
405 Saturday' bushfires, there was a similar dilemma in which construction workers found they
406 themselves had to tackle some of the socio-psychological issues presented by disaster-
407 affected residents (Chang-Richards et al., 2013). Observations in Christchurch show that
408 residents affected by the disasters tended to have higher expectations and preferences for
409 house repairs than for house construction at normal times. In disasters, cases of
410 dissatisfaction and dispute between home owners and those who repair or rebuild houses are
411 more frequent in comparison with construction in normal times (Barakat & Zyck, 2011;
412 Barenstein, 2008). Awareness and a better understanding of the main social issues of post-
413 quake victims, as suggested by case study organizations, is useful for acceptable or
414 appropriate delivery of works in a socially sensitive environment.

415 **Collective support from the industry/authorities**

Collective support from the engineering and construction sectors and from the regulatory authorities has been cited by case study organizations as being an essential condition of efficient organizational response. Studied organizations complained that the lack of collective support from the government agencies and industry bodies regarding temporary accommodation for outside workers resulted in a constraint on their capacity and had raised associated costs. Any limitation to workers arriving from out of region will allow the cost of repair and reconstruction to increase (Boissonnade, 2007). Although much research has focussed on the strategies for establishing temporary housing for displaced home owners, detailing experiences that are directly related to and consequent upon pre- and post-event planning for timely, quality temporary housing (El-anwar et al., 2008; Johnson, 2007), more recent research has highlighted the potential public support to address housing shortages for out-of-town workers in order to reduce the impact on local communities (Chang-Richards et al., 2014a; Olsen & Porter, 2010).

Case study organizations suggested a strong need for a consistent training system provided for seismic-related building evaluation, design and construction. This training is timely in an environment where the amended earthquake prone building policies required inspection and associated strengthening work for seismically-prone buildings across New Zealand. Another common suggestion from case study organizations was that the training provision strategies should consider the cyclical nature of reconstruction without creating overcapacity once the reconstruction activities pass their peak.

Having been through the bust and boom cycle following the 2008 financial crisis and the 2010/11 Canterbury earthquakes, case study organizations recognized that a leadership role in the construction industry is likely to enhance their post-earthquake response capability. However, such leadership seemed to be lacking previously. As suggested by Stevenson et al. (2014), in a contested and highly adversarial market, industry support can contribute to a high level of resourcing ability as strong industry leaders recognize the need for mutual support and work to attain this across the industry.

The first and second focus groups, however, defined certain industry leadership characteristics that will facilitate capacity and capability building of individual construction organizations in response to future major events. Among them are:

- a vision of what the reconstruction demand could and should be like;

447 • an ability to monitor the demand and supply of necessary skills for the development
448 of the construction industry;

449 • an ability to negotiate with public agencies and private sectors on policies and actions
450 to address critical capability issues that curtail the industry's effective participation in
451 post-disaster response and reconstruction;

452 • ability to facilitate the acquisition of hazard-specific knowledge with a cost
453 advantage; and

454 • strong inter-organizational links to other decision makers, both in the public and
455 private sectors.

456 **Organizational adaptive capacity**

457 The construction industry are subject to demand cycles, therefore, the time of disaster
458 vent and the economic situation at the time is critical in determining the industry's ability to
459 respond. As alluded to earlier, when the Darfield earthquake struck Christchurch in 2010, the
460 New Zealand construction industry was going through a recessional period of low activity
461 caused by the 2008 global financial crisis. These two shocks have had a significant effect on
462 the resilience of construction organizations (Stevenson et al., 2014). Many construction
463 businesses had managed to come out of the bust of the economic cycle and were aiming for a
464 reviving opportunity in post-earthquake reconstruction. The earthquakes have led to a shift in
465 organizational focus from running business operations to increasing its adaptive capacity
466 through innovation and partnership (Chang-Richards et al., 2012).

467 Longitudinal case studies show that through participation in the earthquake repairs and
468 rebuild activities, small construction organizations tended to form partnering and alliance-
469 like clusters for mutual promotion and to attract skilled expertise whereas organizations of
470 larger size were more likely to form joint ventures to secure contracts. There are indications
471 that following the earthquakes many local engineering and construction businesses had
472 reinvented themselves in regard to innovative technology and techniques, such as social
473 media, new IT software, satellite phones, web-based seminars, video conference facilities and
474 GPS.

475 In addition to costly offshore recruitment, some organizations changed their business
476 operation model by using technological innovation to substitute labor input and reduce
477 pressure resulting from skills shortages. The larger organizations were able to rotate staff

478 across sub-organizations or manage workloads according to priority needs. Smaller
479 organizations reported that after the earthquakes they mostly relied on reciprocal cooperation
480 with other businesses and continual provision of incentives to employees to retain highly
481 skilled people.

482 The resourcing solution most cited by case study organizations was work-share
483 arrangements with other organizations. In observing their methods of resourcing, two aspects
484 have been noted. First, an emerging alliance strategy has been increasingly used by case
485 study organizations to stimulate resource availability in a post-disaster situation. This is not
486 surprising as sharing resources through an alliance-like strategy to foster competitive
487 advantage has become fundamental to strategic thinking for many organizations under
488 environmental volatility (Chatterji & Patro, 2014; Wu, 2010). On the other hand, pre-event
489 industry networks in place are important instruments to incorporate in organizational
490 resilience in terms of gaining benefits of optimized resource use (Stevenson et al., 2014).
491 Nearly half the organizations had contractual arrangements with other domestic or overseas
492 partners to exchange or share workers on secondment or relocation. There is a general
493 consensus that, apart from technological innovation, a dynamic capability approach through
494 cross-organizational partnership was adopted by case study organizations in addressing skills
495 shortages and continuing post-recovery operations in face of demand fluctuations.

496

497 **CONCLUSIONS**

498 The engineering and construction sectors have been playing a pivotal role during the
499 recovery of Christchurch following its earthquake sequence in 2010 and 2011. The extent and
500 scale of damage caused by earthquakes, both in residential and commercial sectors, coupled
501 with requirements in response to the uniqueness of such events, have combined to test the
502 sector. The most salient challenge facing construction organizations are the technical and
503 capacity demands and associated resourcing issues. The Canterbury Earthquake Recovery
504 Authority (2012) implicitly factored in the construction industry's competence into the
505 Labour Market Recovery Program, with caveats concerning multi-agency cooperation and
506 leadership assumed in the construction industry. However, by incorporating organizational
507 perspectives, the longitudinal research reported in this paper provides a reference for industry
508 associations and other decision-making agencies to pinpoint capability issues faced by
509 recovery-participating organizations and identify needs and appropriate courses of action.

A framework of key capabilities required for effective earthquake response and participation in the recovery phase was developed from case studies of 15 engineering and construction organizations. It presents critical factors that influence post-earthquake response from the engineering sector and demands for construction resources in the recovery phase. The framework can be used by the engineering and construction sectors to form dialogues with public agencies in addressing those external factors that affect a specific component of their capability.

An improved understanding of organizational resourcing practice helps to map the aggregated resource capability at both the local and regional level (Stevenson et al., 2014). Key capabilities identified as being critical for effective earthquake response and recovery included seismic disaster 'know-how', collective support from the engineering and construction industry and authorities, and organizational adaptive ability to meet changing demands. The results highlighted that the earthquake sequence and the relentless nature of the workload created professional challenges to the engineering profession in particular. Many post-earthquake decisions and regulatory facets (e.g. official inquiries and changes to the building code) at play underpin those challenges in that they required a new set of skills and knowledge that few previously possessed. The challenges of increasing engineering and construction capacity and capability, however, require not only smart design and building solutions, but also responsive legislation and adaptive organizations (Joffe et al., 2013; Walker & Musulin, 2015).

A number of lessons are being drawn from experiences in the engineering and construction sector, relating to evaluation of seismic risks, communication of a safety notion, interface with different stakeholders and associated training needs. A better understanding of the technical, procedural and skills requirements has resulted from the work undertaken in response to the earthquake sequence. Much of this understanding has now been translated into useable tools, guidelines and recommendations aimed at improving design and construction practice as well as engineering education programs, and can be of considerable benefit in response to future major earthquakes. Other capability requirements suggested from case studies are worth attention from relevant decision makers and practitioners, such as key supporting measures collectively undertaken by the construction industry and government agencies, leadership in the sector, and alignment of engineering and construction practice with emerging needs related to post-earthquake issues. Long-term observations

suggested that without appropriate facilitation from the government and industry, market forces were not able to direct resources to post-disaster recovery.

It is hoped that the framework can be of value to those policy makers attempting to address key engineering and construction capability challenges that influence the outcomes of disaster recovery. The critical components in the framework and their interplay can be considered by those predicting recovery trajectories and the corresponding skill and capacity demands. Continued longitudinal studies of construction organizations are needed, with a view to better understanding the changes of their response over time and the associated implications for reconstruction.

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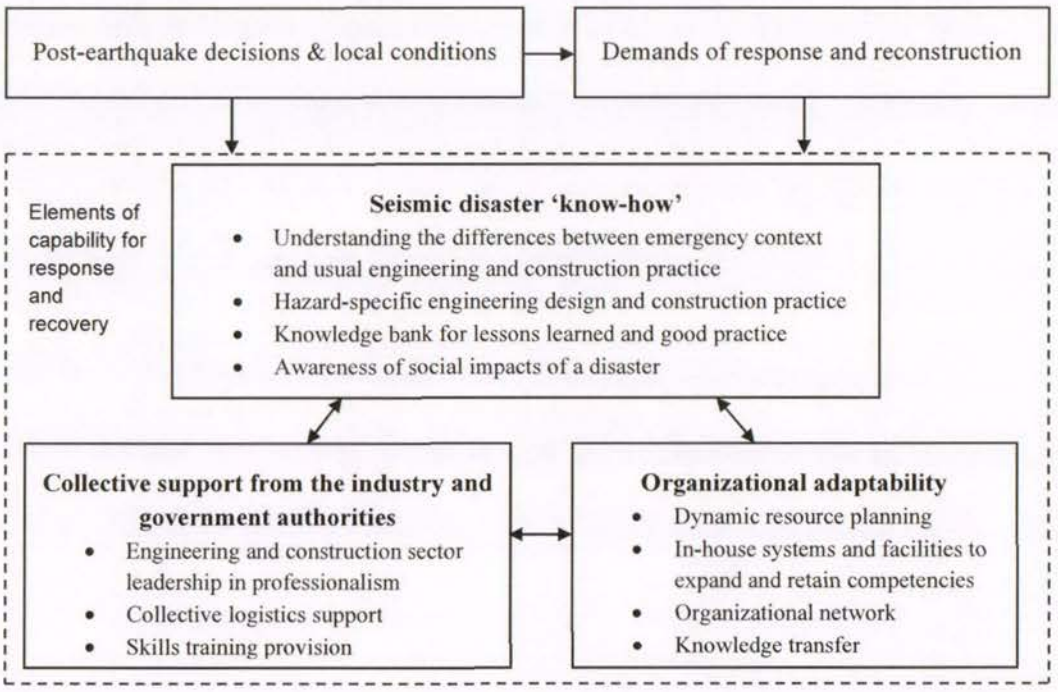

Figure 1. An organizing framework of capabilities for effective earthquake response and reconstruction

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Effects of an influx of workers on a post-disaster housing environment: Lessons from New Zealand

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Effects of an influx of workers on a post-disaster housing environment: Lessons from New Zealand

Abstract

A construction workforce from outside the disaster zone is critical to restoring communities following a major disaster when reconstruction demands overwhelm local capacity. The major challenge associated is the accommodation requirements of these additional labour resources. This research empirically investigates the effects of an influx of workers on the post-disaster housing environment and wider recovery in the wake of the 2010 and 2011 earthquakes in Christchurch, New Zealand. A typology of the incoming workforce's housing needs was identified. Construction workers from outside Christchurch largely fall within a general working-age group and their housing needs are similar to those of displaced home owners and renter households. Public policy and recovery plans failed to factor in the expected demand for housing the construction workforce, resulting in cost escalation across housing markets in Christchurch and displacement of low-income and renter households from the housing recovery process.

Keywords: Influx of workers, post-disaster reconstruction, housing, recovery planning, Christchurch earthquakes

1. Introduction

Following a major disaster, damage to the built environment often poses a significant demand for human resources in the engineering and construction industry. Research in the hazards field points out that post-disaster recovery planning and policies often fail to consider the needs of construction workers who play a crucial role in restoring communities (Chang-Richards et al., 2013; Haigh & Sutton, 2012; Rapp, 2011). In many cases, when reconstruction demands overwhelm local capacity, construction workers from outside the disaster zone need to be brought in to assist (Boen, 2006; Douglas & Rapp, 2011; Nazara & Resosudarmo, 2007). While the demand for construction workers can be satisfied by re-deployment of out-of-town workers [1] from other areas, the real issue lies with the accommodation requirements of these additional resources (Lanigan, 1995).

Recent urban disasters have made it clear that housing is the single greatest component of all losses in terms of economic value and in terms of buildings damaged (Comerio, 1997; Zhang & Peacock, 2010). One of the key challenges after a large disaster is ensuring the market provides sufficient affordable housing and temporary accommodation, given that the inhabitable housing stock is greatly reduced and this will affect the construction labour supply. Other emerging constraints that may create a major post-disaster housing crisis include:

- the capacity of insurance companies to finance the repair or reconstruction of units lost within a reasonable time frame (Comerio, 1997);
- the speed that local territorial authorities can issue building consents for restoring and rebuilding damaged houses (Fields, Wagner, & Frisch, 2015; Rathfon et al., 2013);

- the availability of temporary housing both for residents displaced from the damaged houses while their houses being repaired or replaced, and for the temporary additional workforce needed for the reconstruction (Baroudi & Rapp, 2014; Olsen & Porter, 2010); and
- delays in housing recovery associated with the need to re-assess relevant building codes and guidance (APEC, 2013).

Housing and labour supply issues have always been inextricably interwoven in large disaster settings (APEC, 2013). Research into post-disaster demand surge [2] reveals that the establishment cost of incoming workers in terms of travel and accommodation contributes to overall demand surge pressure (Olsen & Porter, 2010; 2013). Any limitation on workers arriving from out-of-region would allow demand surge to continue to increase (Boissonnade, 2007). On the other hand, a lack of housing options in the disaster area may discourage outside workers from participating in reconstruction. During reconstruction following the Victorian 'Black Saturday' bushfires in Australia in February 2009, for example, a lack of accommodation made it difficult to attract construction workers from outside the fire zone to work on housing reconstruction projects (Chang-Richards et al., 2013). Similarly, the massive rebuilding effort in New Orleans post Hurricane Katrina in the United States in 2005 created new demands for rental properties needed by construction workers, which were already in short supply as a result of the event (Fletcher et al., 2007; NAHB, 2005). High housing costs limited New Orleans' ability to attract and retain a workforce that was essential for restoring a healthy economy (Plyer et al., 2009).

Despite their importance, the challenges faced by the out-of-town construction workforce in post-disaster reconstruction have received little attention from either the research community

or public policy. In particular, how the influx of workers impacts on the post-disaster housing environment and long-term recovery in cases of large-scale displacement remains understudied (Chang-Richards et al., 2012; Page, 2004). There is little consistent, detailed information about the composition of the incoming construction workforce, patterns of their migration, and the complexities associated with their housing needs in disaster-affected areas. This article seeks to fill these gaps in the literature by empirically investigating the effects of an influx of construction workers on the housing environment in Christchurch, New Zealand following its 2010/11 earthquake events. To achieve this goal, two research questions were formulated.

- What are the characteristics of the migrant workforce which participated in the post-earthquake reconstruction work in Christchurch?
- How does the influx of these workers affect the post-earthquake housing environment and community recovery?

Drawing on a succession of field studies, this paper points to the importance of a critical, yet overlooked housing issue for workers arriving from outside the disaster zone, in relation to the potential impact on community recovery. This introduction has described the problem. The remainder of the paper is structured as follows: first, it reviews the literature on housing environments after a large disaster, followed by a review of the effects of the influx of construction workers into the disaster-hit area. Field study methods and a triangulation approach will be presented in the research methodology section. The empirical results are then presented and these results are discussed against the backdrop of public policies and recovery plans that had failed to factor in the expected demand for housing an additional construction workforce. The study contends that identifying and mapping the housing needs

of an additional workforce and integrating this information into housing recovery planning is essential. Finally, the paper looks at the possible mechanisms for reducing the impact of workforce influx on a local housing market. While public assistance to meet the housing needs of disaster-affected home owners remain necessary, a public and private partnership model toward provision of housing measures for incoming workers, together with its integration into, and balance with, housing assistance for disaster-displaced groups, will lead to added social and economic benefits for local communities.

2. The post-disaster housing environment

Housing, as an integral part of the built environment, is a complex phenomenon and has its unique political, economic and social connections with its human occupants (Clapham, 2009). Besides the loss of family or friends, people experience a disaster mainly through the loss of or damage to their homes. Therefore, helping to restore housing expeditiously remains one of the most perplexing of all post-disaster policy challenges (Andrew et al., 2013). Recent major disaster events, such as the 2008 Wenchuan earthquake in China (Paterson et al., 2008), the 2010 and 2011 floods in Queensland, Australia (World Bank & Queensland Reconstruction Authority, 2011) and the 2011 Great East Japan earthquake and tsunami (Nanto et al., 2011), show that housing comprises the greatest portion of building damage in any community. Understanding the nature of housing stock and the potential for housing loss is central to understanding the impact that disasters have on people's lives and on their ability to recover (Comerio, 1998, p16).

In an attempt to help accommodate displaced populations after a large event, governments and aid agencies often face a series of operational challenges. The first is the provision of

emergency shelters to ensure the basic needs of disaster-affected households are quickly met (Barakat, 2003; Peacock, Dash, & Zhang, 2007). Temporary shelter plays a crucial role at the initial stage, when the critical services and infrastructure are damaged and dysfunctional. As disaster response progresses, the next challenge pertains to the provision of temporary housing for those whose houses have suffered damage and become uninhabitable (Bolin & Stanford, 1991; Brezar, 2005; Gould, 2009). To meet these demands, governments in many countries tend to establish disparate temporary housing assistance programmes. Regardless of its format, temporary housing functions as a type of protection for the well-being of households and their livelihoods (Levy-Vroelant, 2012). From this stage a final challenge arises: how to help those residents living in temporary housing to move to the next stage of housing reconstruction and return to their normal lives (Johnson, 2007). Quarantelli (1982) noted that the above process from sheltering to housing may not be linear or sequential as there can be many repetitive steps and jumps, and members of affected communities or households may be found in every form of shelter or housing simultaneously.

Estimates of housing stock lost due to disasters are often used by government agencies and social groups to determine the scope of diverse housing assistance. Essentially, the combination of other factors, such as the availability of units on the market (Comerio, 1997; Fields et al., 2015), population changes (Zhang, 2006; Zhang & Peacock, 2010) and individual response in terms of preference for re-housing arrangements (Oliver-Smith, 1990; Plyer et al., 2009; Spokane, Mori, & Martinez, 2012), is likely to affect the overall housing pressure in disaster-affected areas and the process of re-housing those affected. If the housing loss is significant while the number of units available is low, a significant complication might exist where disaster victims likely compete for limited housing resources with other groups of

people, including disaster responders (Yelvington, 1997), business people and service workers (Peacock et al., 2007) and pre-event homeless groups (Phillips, 1993).

In examining the shelter decisions and recovery policies made after the 1994 Northridge earthquake in California, Comerio (1997) suggested that the housing assistance from both public agencies and private insurance sectors was largely targeted to single family homes, even when the losses were predominantly in multi-family apartment buildings. There seems to be a similar pattern appearing in many other countries that housing recovery often fails to understand the needs of vulnerable people, such as low-income renters or squatters (Freeman, 2004; Mukherji, 2010). Post-disaster housing assistance is most likely to give high priority to upper-income groups with access to insurance or other financial resources (Andrew et al., 2013; Bolin & Stanford, 1991; Comerio, 1998). While the housing literature provides grounding in the keys to an inclusive housing programme that considers the needs of vulnerable groups (Jacobs & Williams, 2011; Limoncu & Celebioglu, 2006; Meisl et al., 2006), much remains to be learned about the design components of targeted assistance, especially in large displacement settings (Rathfon et al., 2013; Wamsler, 2006).

Disaster recovery presents a unique lens through which to examine housing solutions and tools for re-housing displaced population. Past events show that no matter how well-intentioned a disaster assistance policy may be, it may not always translate into a positive experience for the survivors of the disaster (e.g. (Abt Associates Inc., 2009; Andrew et al., 2013; Wu & Lindell, 2004)). Questions of whether to return, rebuild or relocate, as well as decisions as to where to stay while houses are being restored, are bound together in a complicated set of public and private recovery decisions (Olshansky et al., 2008; Wagner & Frisch, 2009). The reason housing is not rebuilt after disasters, according to Comerio (1997),

is not solely a function of recovery programme design or implementation, it is tied with the economics of the marketplace. In examining the housing recovery process in New Orleans after Hurricane Katrina in 2005, Rathfon et al. (2013) and Fields et al. (2015) further confirmed that the trajectories of post-disaster housing recovery largely depend on the contexts of both pre-event and post-event housing market conditions.

3. Effects of an influx of workers into a disaster area

In a post-disaster environment, there is strong pressure to act quickly to get back to normal (Johnson & Olshansky, 2013). Under such pressure, the need to replace lost housing, buildings and infrastructure facilities often generates a strong demand for labour (Chang et al., 2012; Olsen & Porter, 2013). Depending on its pre-existing labour capacity, however, post-disaster skills shortages may arise or escalate during post-disaster reconstruction (Chang et al, 2012; Jha et al., 2010; Moe & Pathranarakul, 2006). Local labour may be augmented by outside labour to meet the increased demand over time during reconstruction. However, the unique characteristics of a disaster may pose professional and skill challenges to many aspects of recovery activities (APEC, 2013; Queensland Reconstruction Authority, 2012).

Following the 2004 Indian Ocean tsunami, due to the limited capability of the Indonesian government, international and national NGOs entered the worst-affected zone, Aceh and Nias provinces, and became the real drivers of post-tsunami relief, rehabilitation and reconstruction. According to Steinberg (2007), at its peak in 2005, more than 200 aid agencies were registered with the authorities and documented by the United Nations Humanitarian Information Center (UNHIC) in Indonesia. A large number of engineering and construction professionals from overseas were brought in as many of the NGOs expanded

their initial commitment from emergency aid to reconstruction (Chang et al., 2011; Potangaroa et al., 2010). A substantial number of contractors (95%) were from the Indonesian island of Java. There were issues with the influx of Javanese workers during reconstruction, including differences in building standards, workmanship, lifestyle, climate and even language (Chang et al., 2011; Dercon, 2007; Zuo, Potangaroa, & Wilkinson, 2008).

In addition, many workers employed by the NGOs were from overseas on temporary contracts and this introduced problems of high worker turnover and issues in relation to inconsistent skillsets, quality control and knowledge management within a disaster recovery project (Boen, 2008; Jayasuriya & McCawley, 2008; Pathiraja & Tombesi, 2009). Compounding this was the need to accommodate large numbers of outside workers in the depleted housing stock in Aceh due to the scale of damage from the tsunami (ILO, 2010; Nazara & Resosudarmo, 2007).

Housing pressure as a result of post-disaster workers' influx has been frequently seen in recent disaster events. In a survey of construction workers rebuilding the City of New Orleans after Hurricane Katrina, Fletcher et al. (2007) found that 70% of workers surveyed were U.S. citizens, with most coming from other states such as Texas and Florida. Others were from countries such as Mexico, Honduras, and El Salvador. Of the workers surveyed, half of them lived in rented houses and apartments, with many sharing accommodation with other construction workers (with an average of five people per housing unit) (Fletcher et al., 2007). Plyer et al. (2009) also found that the high housing demand by out-of-town workers had largely contributed to rent escalation, with many displaced households and low-income renters being priced out of the rental market.

Similar effects of a lack of housing for construction workers were observed in some prefectures in Tohoku ravaged by the March 11, 2011 Great East Japan earthquake and tsunami. Specialist tradespeople such as carpenters and roofers were in a severe high demand for home repairs (Asia and Japan Watch, 2011). Many construction companies operating in the Tohoku region, however, were able to find accommodation for those high-demand workers in Sendai city, which is about 90 minutes driving distance. Some of out-of-town workers secured rental apartments on a long-term lease while others managed to stay in hotels or ryokans (Japanese style hotel) in nearby cities (Higuchi et al., 2012; Zhou, 2012). As the transport network is highly accessible across the country, most of those who stayed at a distance often travelled to work by train or high-speed Shinkansen (bullet train). In many respects, the accessibility of public transportation in Japan made commuting an affordable option for construction workers. However, the associated cost, including inflated rents and travel fares were inevitably built into the cost of home repairs and passed onto home owners (Asia and Japan Watch, 2011).

In the case of recent earthquake events[3] in Christchurch, New Zealand, over 150,000 homes, or about three-quarters of Christchurch's housing stock, sustained some damage (Earthquake Commission, 2011). The region suffered a loss of 7,860 houses due to properties being deemed uninhabitable and classified as within the 'red zone[4]'. A further 9,100 properties were uninhabitable as they required major repairs or rebuilds. After taking into account new houses being built in the region[5], it was estimated that the total housing stock has been reduced by a net 11,500, or 6.2% of the previous housing stock (MBIE, 2013). On the other hand, given the amount of damage caused by the earthquakes[6], post-earthquake reconstruction in Christchurch has seen a precipitous increase in the number of construction

workers flowing in to participate in recovery-related activities. It was estimated that around 24,000 additional construction-related workers would be required at the peak of the reconstruction (CESB, 2011). Current literature, however, only provides limited anecdotal evidence regarding the housing needs of reconstruction workers in large disaster settings (Olsen & Porter, 2011; Page, 2004). Against this backdrop, the research reported in this paper employs an empirical approach to examining the effects of a large influx of workers on a post-disaster housing environment and community recovery. By investigating the post-earthquake Christchurch experience, it is hoped that this study can provide an improved understanding of the likely housing issues that result from an expanded reconstruction capacity, thus enabling better recovery planning in response to future events.

4. Research method

A mixed method approach, namely triangulation, was adopted for this research owing to the nature of the inquiry. Creswell (2003) suggested that triangulation suits research that involves collecting data either simultaneously or sequentially to address research questions. Variations in information sources and the triangulation of data also reduce the risk of chance associations and systematic biases as a result of using a specific method, and ensure a coherent justification (George & Bennett, 2005; Maxwell, 2005). The methods used for data collection in this study included field observations, interviews, an online questionnaire survey and focus groups. The research was approved by the University of Auckland Human Participants Ethics Committee in October 2011, reference number 7520. The details of the data collection methods used for this study are shown in Table 1.

Table 1: Methods of data collection

Objectives	Data collection methods
1. To identify the patterns of labour influx and characteristics of migrant workers employed by construction organisations	1) Interviews with 33 representatives from 24 recovery agencies and large construction companies during 3 field trips to Christchurch in May, November and December 2012, including • 3 Design organisations (D1-D3) • 5 Structural engineering consultancies (E1-E5) • 1 Large geotechnical engineering company (G1) • 5 Construction contractors and builders (C1-C5) • 2 Building supplies companies (Bs1 and Bs2) • 5 Project Management Offices (PMOs) (PMO1-PMO5) • 1 Building Industry Association (B1) • 2 Government agencies/departments (Building and Housing Group & Labour Group in the Ministry of Business, Innovation and Employment) (G1 and G2)
2. To understand the impact of labour influx on the housing environment	2) Online questionnaire survey of housing providers between April and May 2013 (sample size 128, 38 respondents with a response rate of 30%) 3) Follow-up interviews with 29 selected housing providers during a field trip in May 2013, including: • 3 Holiday park owners/operators (Hp1-Hp3) • 2 Bed & Breakfast accommodation owners (B1 and B2) • 1 Hotel operator (H1) • 19 Motel owners/operators (M1-M19) • 2 Rental property managers (R1 and R2) • 2 Home-stay managers (Hs1 and Hs2)
3. To gain insights into the effects of labour influx on wider community recovery and to consolidate and verify interview and survey data	4) Four focus groups held in Christchurch with 11 representatives from recovery agencies and construction organisations on 12 September 2012, 13 November 2012, 23 July 2013 and 16 September 2014, respectively, including (coded Fr1-Fr11): • 1representative from the Building Research Association of New Zealand (BRANZ) (Fr1) • 1 representative from the infrastructure reconstruction project office (SCIRT[1]) (Fr2) • 1 representative from the housing recovery and repairs project office (Fletcher EQR[2]) (Fr3) • 1 representative from the building supplies industry (Fr4) • 1 business manager from an engineering consultancy (Fr5) • 2 project managers from two large contracting companies (Fr6 and Fr7) • 1 representative from the Canterbury Earthquake Recovery Authority (CERA[3]) (Fr8) • 2 representatives from the Ministry of Business, Innovation and Employment (MBIE) (Fr9 and Fr10) • 1 representative from the Statistics New Zealand (Fr11)

Note: 1. The Stronger Christchurch Infrastructure Rebuild Team (SCIRT) is responsible for rebuilding horizontal infrastructure in Christchurch following the earthquakes of 2010 and 2011.

2. Fletcher EQR is a Fletcher Construction business unit which works on behalf of the Earthquake Commission to project manage the repair of earthquake damaged homes referred to as the Canterbury Home Repair Programme.

3. The Canterbury Earthquake Recovery Authority (CERA) is the agency leading and coordinating the ongoing recovery effort following the earthquakes of September 2010 and February 2011.

In 2012, interviews with 33 representatives from recovery agencies and large construction companies who engaged in the reconstruction were conducted during three field trips to

Christchurch in May, November and December 2012. Qualitative data on perspectives and insights of these participants were captured, including:

- challenges faced by construction organisations who sourced workers from outside Christchurch for reconstruction purposes
- characteristics of their newly sourced migrant workforce (e.g. skillsets, demographic features and housing needs)

Between April and May 2013, an online questionnaire survey was conducted to assess the effects of the influx of out-of-town labour on the post-earthquake housing environment. A survey participation invitation was sent to a sample of 128 housing providers[7] via the Motel Association of New Zealand (MANZ) internal mail system in Christchurch. Survey respondents were asked to provide information about their accommodation capacity, changes in vacancy rate over time, features of customers/occupants, the percentage of occupancy and average length of stay for housing out-of-town workers, as well as the perceived impact of the influx of labour on the housing environment. In total, 38 housing providers responded to the survey with an appropriate 30% response rate. In May 2013, field observations and follow-up interviews were undertaken with 29 selected questionnaire participants who indicated in their willingness to participate in a follow-up interview in the questionnaire survey. These follow-up interviews were used to ascertain issues and clarify conclusions reached from the questionnaire survey.

In order to gain insights into the emerging issues during recovery and the effects of labour influx on wider community recovery, four focus groups in the form of research workshops in Christchurch were convened between 2012 and 2014. As shown in Table 1, eleven selected representatives from the construction organisations interviewed and from the recovery

agencies were invited to participate in focus groups. Each focus group lasted for two hours, started with a presentation of research findings and was followed by discussions on topics such as the relevance of research to practice, emerging challenges faced by construction organisations and their employees, effects of labour influx on community recovery and suggestions for improved practice and policy intervention. Focus groups were also used as an instrument to investigate the validity of research findings (Krueger & Casey, 2000) and to establish the significance and applicability of research findings (Wilson, 2012).

In this paper, data analysis was undertaken at three levels. The first level dealt with the results from three sets of interviews undertaken in 2012. This analysis aimed to address the research question as to the patterns of workforce influx and characteristics of migrant workers in post-earthquake Christchurch. The second level dealt with the perspectives of housing providers to capture the effects of labour influx on the housing environment. The analysis focused on the triangulation of data generated from the questionnaire survey and the follow-up interviews in 2013. The questionnaire survey results were analysed using Excel's statistical descriptive function. The third level dealt with the diachronic analysis of four focus group discussions between 2012 and 2014. It reveals the impact of labour influx on the wider community recovery. The interviews and focus group discussions were recorded, transcribed and analysed using NVivo 9 qualitative data analysis software. The NVivo 9 coding comparison of queries allowed for similar comments and suggestions to be synthesised under common themes. In what follows, the research results are presented in the form of a synthesis of quantitative and qualitative results using the coding as shown in Table 1.

5. Results

5.1 Characteristics of incoming construction workers in post-earthquake Christchurch

Given the impact and widespread damage to residential land and buildings in Christchurch and surrounding districts, there had been significant demand for specialist engineers for rapid building evaluation and land damage assessment from the initial response to the September 2010 Darfield earthquake. A series of interviews in 2012 reported that geotechnical and structural engineers were the most critical resources in short supply, being needed initially for urban search and rescue response and rapid building evaluations, and then extending through the more detailed assessments and repair specifications during the recovery phase. According to interviewees E1, E3-E5, PMO2 and G1, extensive liquefaction caused by the earthquakes had particularly challenged the earthquake engineering profession in New Zealand which had a limited resource pool before the event. Although new graduates from tertiary institutions could fill a number of vacancies, construction companies particularly targeted overseas engineers with more than two-year work experience from seismic-prone countries, such as the United States, Italy, Spain and Chile.

As the number of claims received by insurance companies was overwhelming, both in number and complexity, additional loss adjustors had to be brought in from Australia, the United Kingdom, South Africa and the United States. Arrangements were put in place by insurance companies and construction organisations to engage building expertise to undertake damage inspections and initiate standardised repair strategies. As Christchurch moved into the recovery stage in 2012, there was a dramatically increased demand for other construction professions, including quantity surveyors and building control professionals (project managers, site engineers and building inspectors). The demand for tradespeople for

home repairs continued to soar. Accompanying this growth in the engineering and construction industry was an increased demand for service workers to support the functions and services of the industry, including people filling administrative and service roles in construction businesses.

Many companies reported that with limited capacity, they were unable to meet the increased requirements for earthquake-related repairs and rebuilds. Under great time and workload pressure, they have all invested heavily in the overseas recruitment of highly skilled and experienced engineering and construction professionals. Nearly half the organisations interviewed had contractual arrangements with other domestic or overseas partners to exchange or share workers on secondment or relocation. As of December 2012, expansion of workforces across the organisations interviewed had been significant, with a range of 10% to 60% of new employees being sourced overseas. Relocation of employees from other branches across New Zealand was a common practice. Interviews with construction organisations revealed that among the workforce sourced from overseas and from other parts of the country, younger engineers and mature building control professionals continued to be the largest inbound demographic groups involved with the Christchurch reconstruction (See Table 2).

Table 2: Demographic features of reconstruction migrant workers in Christchurch

Skillsets	**Specialist engineers**	**Building control professionals**
Origin	Earthquake-prone countries including the U.S., Italy, Spain, Chile and other parts of New Zealand	Europe, Australia, the U.S. and other parts of New Zealand
Age cohort	25-35 (young, most single)	30-50 (mature, family category)
Work experience	New graduates or more than 2 years' experience	At least 5-10 years plus experience

Most incoming engineers, according to the interviewed organisations, were young and single individuals ranging in age from twenty-five to thirty-five years old. During the recovery phase, there were many different legal facets at play depending on the focus of the client, which in turn required personnel of higher skills to ensure controlled quality for disaster recovery projects. Construction companies responded by recruiting building control professionals, such as project managers, site engineers and supervisors, with a requirement of more than five-year work experience in the field. Interviews in 2012 revealed that most companies favoured candidates from Europe, Australia and the United States as they believed that workers from these countries tended to have higher productivity and better skills in terms of managing projects. A large proportion of their new recruits working as building control professionals were relatively mature and aged between thirty and fifty years old. Together with their families, they relocated to Christchurch for better career prospects and lifestyle.

In order to attract skilled workers, companies tended to offer varying remuneration packages. For example, the employee relocation assistance offered by one interviewed construction company (to which C5 was affiliated) included assistance to gain an immigration visa, temporary accommodation, schooling arrangements for young children, social networking opportunities and employment assistance for the worker's spouse. When asked what the challenges associated with acquiring skilled workers from outside Christchurch were, companies interviewed unanimously reported that a lack of temporary accommodation and the difficulty in finding suitable housing for those workers had been a real concern, and, in most cases, a time-consuming and frustrating experience.

5.2 Housing needs of incoming construction workers

A synthesis of interview data and questionnaire survey results revealed that most construction companies managed to provide accommodation for incoming workers through various housing solutions, including head-leasing rental properties and renting hotels/motels. In summary, a typology of housing needs of incoming construction workers is shown in Figure 1 and summarised as follows.

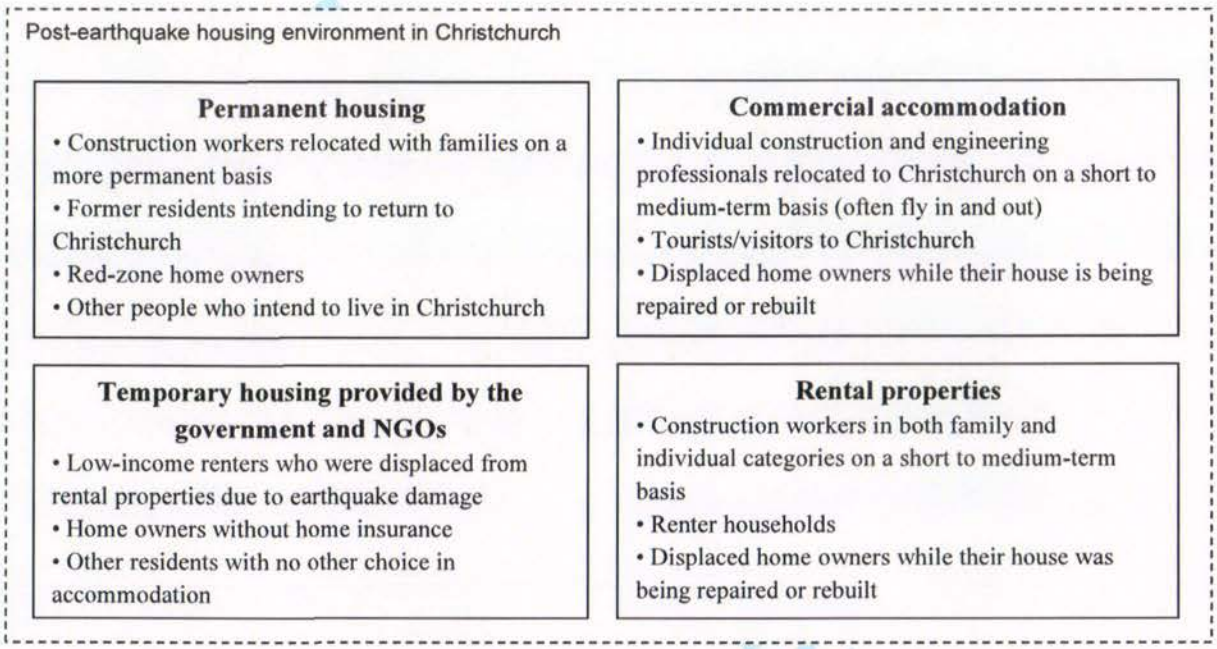

Figure 1: Post-earthquake housing environment in Christchurch

- Many inbound highly-skilled workers, such as engineers and project managers from overseas or other parts of New Zealand, relocated with their families and they were inclined to seek single-family, permanent or rental properties in Christchurch city. Their choice of housing was largely based on the structure (space, amenities, architecture), location (neighbourhood, schools, proximity to work and land conditions) and financial potential (appreciation and cash value) if they intended to

purchase the property. The availability of suitable and affordable housing for these workers with families had been the largest concern given that habitable housing stock was greatly reduced in the earthquakes.

- There were a large number of individual workers who were relocated to Christchurch on a short to medium-term basis. Their need for singles accommodation had largely been met by commercial housing providers in dwelling places such as rental properties, apartments, townhouses, motels, hotels, Bed & Breakfast accommodation and other types of boarding houses. Although the employment of these people might be transient, some construction companies purchased residential properties to meet the needs of these temporary workers. Nevertheless, housing the individual workers of this group had been costly due to inflated housing prices and rents in Christchurch.

- The accommodation shortage amongst the construction workforce was most pronounced at the manual worker level, namely tradespeople who came from other parts of New Zealand. Affordability and an accessible space for parking their work vehicles and storing their equipment were considered top priorities when they sought accommodation. Those workers had a strong preference for seeking accommodation in holiday parks[8], motor camps and backpacker lodges as most of these facilities allowed parking flexibility and the rates were relatively cheap compared to other commercial lodging options. Unlike highly skilled overseas professionals such as engineers and project managers, workers in this group tended to be self-employed and their housing needs were largely overlooked in reconstruction efforts.

5.3 Effects of the influx of workers on the housing environment and disaster recovery

As shown in Figure 1, the housing needs of inbound workers to assist with the Christchurch reconstruction span a range of housing sectors in Christchurch, including commercial accommodation (facilities for tourism and hospitality purposes), the rental market, existing housing stock and new housing development. The questionnaire survey of housing providers in 2013 further showed that following the September 2010 earthquake, construction workers along with displaced home owners who were having emergency repairs or permanent repairs and rebuilds became a large force taking up half the capacity of the commercial accommodation sector. Follow-up interviews revealed that, since 2012, there was a significant increase in the number of displaced home owners staying in commercial accommodation, and this was due to multiple factors such as the timing of the insurer's housing repair programme, a decrease in rental supply and increased housing demand by the red-zone residents in the same period.

In the week following the February 2011 earthquake, the central government established a working group comprising representatives from different agencies to respond to short-term (from two to three weeks) and medium-term (three to six months) temporary housing needs. One of the key targets of this group was to measure temporary housing demand across displaced residents. In April 2011, the Department of Building and Housing[9] made arrangements for several hundred campervans to be used as a low-cost[10] temporary accommodation option for quake-affected people (Giovinazzi et al., 2012). In the meantime, the central government created the Canterbury Earthquake Temporary Accommodation Service (CETAS) providing temporary housing assistance for dislocated home owners. Housing New Zealand[11] also initiated a progressive approach to rebuilding quake-damaged

social housing properties in the eastern suburbs. With help from CETAS, between 2011 and 2012, the government established three Temporary Villages placed on council land (Linwood Park, Rawhiti Domain and Kaiapoi Domain) and developed around forty permanent units to accommodate the displaced residents.

While government agencies continued to explore options for further housing solutions, other plans for temporary housing assistance had been put on hold or cancelled due to the lack of demand (Christchurch City Council, 2011). The questionnaire survey and two focus groups in 2013 revealed that the majority of displaced residents seeking temporary housing were inclined to use their own resources or commercial housing providers. Those who used public facilities were likely to belong to a lower socioeconomic group who lived in rental properties prior to the earthquakes or had fewer familial resources. The lack of demand for the temporary villages, however, had sent a misleading message to government agencies who might have interpreted that further public housing assistance was no longer needed.

Longitudinal field observations since 2012 found that, in most cases, insurance availability for most home owners had allowed them to lodge in temporary accommodation for the period of their houses being repaired. The majority of home owners had a strong preference for staying in rental properties or using commercial hospitality facilities (e.g. motels and hotels) that were close to their damaged house. Temporary housing provided by the government, however, was the last resort.

The rental market, however, failed to meet the needs of both residents and reconstruction workers who were looking for affordable accommodation. Field trips conducted in 2012 show that the average weekly rent in several Christchurch suburbs had increased by at least 20% during the year. Some areas such as inner north and north west of Christchurch city

recorded above-average rent increases of 39% and 32% respectively (MBIE, 2013). The questionnaire survey of housing providers shows that the occupancy rate of Christchurch commercial accommodation (e.g. hotels, motels, holiday parks, etc.) doubled from a 40% pre-earthquake level. As one interviewed rental property manager R1 described:

> *'Following the earthquakes, we have received the unprecedented number of enquires or visits by home owners who are looking for a temporary rental property to stay during their housing repairs, as well as many HR (human resources) people of construction companies looking for temporary accommodation to house their workers coming from out of town.'*

The most significant housing issue that emerged from the Christchurch experience was re-housing displaced renters. Interviews with two rental property managers R1 and R2 suggested that there were concentrated losses of rental properties in Christchurch. Many low-income renter households were unable to find alternative housing that was similar in size and rental cost to that which they had before the earthquake. With such a low vacancy rate, crowding was common in post-earthquake rental housing, particularly at the bottom of the housing market. Anecdotal evidence suggested that many holiday parks were accommodating an increased number of low-income people, often at discounted rates. Interviews with three holiday park owners (Hp1-Hp3) showed that most of their enquiries came from construction tradespeople looking for accommodation or home owners having their house repaired following a late notice by the insurance company. Interviewee Hp3 stressed that

> *'We had received some accommodation enquiries from low-income households who couldn't afford to stay in motels or rent a unit. But most (of) these requests had to be*

turned down due to full capacity and affordability issues. We also have to make sure we keep some units available for our tourists when needed.'

Adding to these immediate effects on the Christchurch housing environment as a result of a large influx of construction labour was the observed impact on community recovery. All the interviewed construction organisations reported that the housing shortfalls had an inflationary impact on reconstruction. According to the contractors interviewed (C1-C3 and C5), lack of housing created a barrier for skilled people to come to Christchurch. Some companies (D2, E1-E5, and C1-C4) suggested that apart from higher remuneration, provision of temporary housing was critical to attracting people. It was also a leverage point for competitor companies to poach workers. As one interviewee from a large construction company (C2) emphasised:

'*...it has become a vicious cycle biting us: in response to the increased reconstruction demand, we had to bring in many skilled workers from outside; on the other hand, the shortages of housing had discouraged people from coming. There is an overwhelming need for affordable and suitable housing that simply cannot be addressed by the market itself.*'

Focus groups in 2012 and 2013 confirmed that a lack of accommodation for construction workers was a constraint to the capability required for rebuilding Christchurch. This was particularly relevant to New Zealand as it is a small nation where the local construction sector is unable to carry out the reconstruction on their own. Interviews with selected housing providers also found that the influx of labour has not only changed the relative price structure in the Christchurch housing market, contributing to post-disaster rent inflation, but also displaced the low-income renter households from the housing recovery process. Furthermore,

a lack of housing and the slow pace of housing recovery was considered by interviewed housing providers as being an impediment to the rapid return of former residents who wanted to move back to the city.

6. Discussion

Empirical data in this research provides a multi-perspective view of post-disaster housing issues due to the large influx of the reconstruction workforce. The findings of this research add support to the economics of housing recovery and show that the interplay of housing needs between different groups and their social and economic circumstances give greater insights into the complexity of a disrupted housing environment (Comerio, 1993; Peacock et al., 2007). Often, decision-makers largely focus on providing housing assistance for disaster-affected home owners to help take the pressures off the housing market (Comerio, 1998; Spokane et al., 2012). The Christchurch experience, in this research, illustrates that the measurement of post-disaster housing needs should also consider other types of needs and their effects on the housing environment and wider recovery, especially in cases which require a significant amount of additional workforce to rebuild the community.

In line with post-disaster housing recovery theory (Lindell, 2013; Peacock et al., 2007), the research findings show that the significant level of damage to residential housing, the acute labour demand to undertake reconstruction, combined with the slow pace of housing recovery, can lead to adverse social and economic consequences for disaster-affected communities. In Christchurch's case, the housing needs of out-of-town workers (largely rental properties and commercial accommodation) in relation to their demographic characteristics are similar to those of displaced home owners and renter households. But their ability to pay well above the

market price to secure accommodation exacerbates the housing problem with an inflationary effect on the local economy, as well as a displacing effect on those lower-income renters. The response of Christchurch local construction businesses, through investing in recruitment from overseas and from other places throughout New Zealand, however, created an impetus to drive the speed of workforce influx and their leveraging power in the housing market.

This study also found a significant correlation between reconstruction skills shortages and housing shortages within a major disaster setting, and their interplaying effects on the outcomes of post-disaster recovery and reconstruction. This affects situations where the scale of post-disaster reconstruction overwhelms local construction capacity. As Hallegatte and Przyluski (2010) previously showed, the lack of capability in the local construction industry in undertaking reconstruction can lead to unintended recovery outcomes, such as slow pace of reconstruction and associated cost increases. Lack of affordable and suitable housing for construction tradespeople, as shown in this study, acted as a primary constraint to attracting such skilled people from outside Christchurch.

At a policy level, the effects of a large influx of labour into the disaster-affected areas raise the possibility that the recovery process may be expedited by housing strategies that promote a coordinated approach between all agencies and the private sector to addressing housing-related issues. As noted by Glaeser and Gottlieb (2008), a policy to tackle the spillover effects of a problem requires knowledge of which groups are likely to benefit most. There was a united appeal from the interviewed construction organisations for a public and private partnership to address accommodation demand across different groups. As disaster recovery is a resource-driven process, other important market forces may play out during the course of recovery that can influence its trajectory and hinder its progress (Rathfon et al., 2013). The

narrowly defined public policy and recovery plans were made in an assumption that surrounding housing markets in Christchurch might be able to absorb progressive increases in rental demand for the local population, but it failed to factor in any expected accommodation demand by the additional construction workforce.

The research results also revealed cost implications due to the influx of an outside workforce in reconstruction projects. In contrast with previous studies that largely advocate the use of local human resources (e.g. (UNDP, 2007), (Chang et al., 2011)), this study suggested that although costly, sourcing construction professionals from outside has had a positive impact from organisations' perspectives in terms of their confidence in work quality, their economic position, and business performance. Post-earthquake response and reconstruction in Christchurch involved a significant element of professional earthquake engineering and quality control, skillsets that usually require considerable experience. The importing of skilled workers such as these had been instrumental in enhancing efficiency in construction businesses and thus had an important impact on economic progress. Altay and Ramirez (2010) suggested this to be a general effect of reconstruction on a local economy from the business perspective. On the other hand, negative cost impacts were also noticed with regards to a lack of housing to accommodate external workers. Since there is no comprehensive review of housing demand post-earthquake, neither the government nor the construction industry has a clear view as to to what extent rent inflation due to the influx of labour had contributed to the increased cost of recovery.

7. Conclusion

This paper has explored the effects of a large influx of construction workers on the post-disaster housing environment and the wider recovery in Christchurch following its 2010/11 earthquake events. Empirical findings suggest that the earthquake events have presented capacity and professional challenges to the New Zealand construction industry and created a need to import a large number of skilled workers from outside the region. The large influx of skilled workers, however, added pressure to an already deprived housing market due to the number of houses damaged in the earthquakes. It was found that construction workers from outside Christchurch, especially those from overseas, fall within a general working-age group and their housing needs are similar to those of displaced home owners and renter households. While rebuild companies were able to provide accommodation for incoming workers through head-leasing rental properties or renting hotels/motels, home owners and low-income renters continued to struggle to secure affordable housing. Public policy and recovery plans failed to factor in the expected demand for housing the construction workforce, resulting in cost escalation across housing markets and displacement of renter households from the housing recovery process.

While public assistance was mainly targeted to meet the housing needs of home owners, the findings from this research suggest that a deeper understanding of the different types of housing needs during the period of recovery, both the needs of local communities and the needs of an external reconstruction workforce, is needed to allow a full evaluation of housing pressures over time as recovery unfolds. Linking housing damage data, vacancy rates of inhabitable housing stock, assessment of the housing needs of both residents and out-of-town

workers, and property development data is a powerful way to create a full picture of the housing issues post-disaster and the likely progression of housing recovery.

Christchurch's post-earthquake experience offers important lessons for countries where large numbers of outside workers are needed to undertake a large-scale reconstruction. Findings of this paper not only add to post-disaster housing literature, but also challenge conventional housing assistance which is solely community-oriented without considering the interplaying effects of housing needs generated by a large influx of outside labour. Based on the research presented here, this paper offers the following key suggestions that present ways to develop a more effective housing recovery policy response, applicable not only within New Zealand but also other places as well.

First, the research findings suggest that the housing recovery policy needs to take a broader view that focuses not only on the housing needs of local displaced residents but also on that of workers who would come from outside to participate in reconstruction tasks. As this study shows, in face of professional and capacity challenges, local construction businesses needed external assistance as a core capability regardless of the associated cost of bringing in skilled labour. Moreover, a lack of suitable and affordable housing had made it difficult to attract self-employed tradespeople from outside Christchurch. Therefore, the presence of an inclusive housing strategy that provides a broad framework for considering each housing need is critical for post-disaster recovery.

Second, a multi-faceted approach is needed to enable all agencies and private sectors to work together to address housing-related issues as a result of a large influx of labour. The study shows that there were three broad groups in Christchurch – home owners, low-income renters and self-employed specialist tradespeople – and each had struggled to find affordable housing

given their different needs and circumstances. This paper suggests that instead of a narrow approach that looks solely at ways to provide public assistance, policy makers could consider to work with private sectors, such as using the existing infrastructure and available land in the region to facilitate housing assistance for a wider spectrum of people. It is worth investigating the existing capacity of private accommodation operators and the availability of their lands for potential placement of additional accommodation units and identifying those that are interested in a capacity expansion that can be facilitated by the government. A register of housing needs can be set up by working with the construction industry to identify and monitor the housing demand by the construction workforce. Policy makers should consider a model of temporary accommodation provision for construction workers and its integration into, and balance with, housing assistance for disaster-displaced groups.

This research serves as a starting point for assessing the nature of post-disaster housing issues caused by a large influx of labour. It opens up channels for future research. Further research to model the intersecting mechanisms between skills issues and housing issues and how they contribute to post-disaster demand surge is needed. Since the current research only captured perspectives from construction organisations, studies of construction workers with respect to the challenges and difficulties they face in securing affordable housing are needed. Additionally, best practice, case studies, successful strategies and methods to address the housing needs of construction workers in different recovery contexts should be explored, increasing cross-country transferrable knowledge overall.

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Endnotes

[1] Terms, such as outside labour, external workers or migrant workforce, are interchangeably used in this paper, referring to those workers from other parts of New Zealand or overseas and who came to Christchurch specifically for the reconstruction process.

[2] Demand surge is a process resulting in a higher cost to repair building damage after a large disaster than to repair the same damage after a minor incident.

[3] The major aftershocks following the Darfield earthquake on 4 September 2010 include Mw 4.7 26 December, 2010, Mw 6.8 on 22 February, 2011, Mw 6.0 13 June, 2011, Mw5.8 23 December, 2011 and Mw 5.2 7 January 2012. The earthquake that struck on 22 February 2011 was the most severe aftershock, causing the deaths of 185 people, the collapse of many buildings in the CBD, further damage to infrastructure and extensive liquefaction. Since the Darfield earthquake, more than 7000 aftershocks with magnitudes up to 6.2 have been recorded by the New Zealand GNS Science. These earthquakes are together termed the Canterbury earthquake sequence.

[4] The earthquakes caused widespread liquefaction which changed residential land in the wider Christchurch area. Substantial land use reviews and zoning were required across the city. On 23 June 2011, the central government announced that all land in greater Christchurch and in the Waimakariri District had been classified into four zones – red (no rebuilding allowed), orange and white (further assessment needed), and green (rebuilding allowed) based on geotechnical assessment. Due to significant land damage, some areas of Christchurch were categorised as residential red zone. Central government offered a buy-out package to home owners living in the red zone so that they could leave their uninhabitable houses and relocate elsewhere. For more information on the land zoning decisions, see http://cera.govt.nz/land-information/land-zones

[5] The estimate of new houses built after the February 2011 earthquake was based on residential building consents from the Statistics New Zealand and assumed a 0.93 weighting factor for unfulfilled consents/non-earthquake demolitions.

[6] The latest figures, released on 28 April 2013 by the New Zealand Government, suggested that reconstruction costs could reach NZ$40 billion with high levels of uncertainty remaining.

[7] A housing provider in this study refers to a commercial accommodation provider in the market, including dwelling places such as rental properties, rental apartments, rental townhouses, motels, hotels, Bed & Breakfast accommodation, holiday parks and other types of boarding houses. Occupants/customers need to pay a certain rate to stay in those places.

[8] Holiday Parks, sometimes referred to as campgrounds, are plentiful in New Zealand. Holiday parks provide sites for tents, caravans and campervans and many also have simple cabins, self-contained motel units and backpackers' lodges.

[9] The Department of Building and Housing was established in November 2004 with its primary focus being on the building and housing sector. It became the Building and Housing Group of the Ministry of Business, Innovation and Employment (MBIE) on 1 July 2012.

[10] The Department of Building and Housing charged potential renters of those campervans a discounted rate to make them affordable.

[11] Housing New Zealand is a Crown agent that provides housing services for people in need. It focuses on the management of state houses/social housing and the tenancies of those living in them. For more information, see http://www.hnzc.co.nz