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**Resilient Organisations Research Report 2012/07**

# **Resourcing issues in past disaster recoveries: Some perspectives**

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## **Preface**

Resource availability is likely to be a significant issue for the Canterbury rebuild. Systematic mapping, monitoring, and modelling of the labour demand in Canterbury has been happening since the quakes. Other input materials for reconstruction such as aggregate and cement are also being modelled to reflect the sector trends and performance in response to a large-scale disaster. However, understanding what is going on and what might happen remains a particular challenge for forecasters and policymakers.

This report looks at general lessons that have emerged from other post-disaster reconstruction efforts around the world that are relevant to the Canterbury rebuild from a resource perspective. Whilst the details of every country's experience differ, the nature of the recovery process post-disaster remains consistent.

The information included in this report is derived from Resilient Organisations' longitudinal studies of disasters in Indonesia, China and Australia. Much of the resourcing issues observed in those countries following their disasters are now being experienced in Christchurch. The data collected provides insights into the dynamic mechanism of resource changes over time.

The way the past is understood will inevitably influence the way current challenges are approached. This report should inform the current long-term recovery planning in Christchurch, as well as post-disaster recovery planning for future events.

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## List of Abbreviations

BAL-FZ	Bushfire Attack Level – Fire Zone
BCAs	Building Consent Authorities
CERA	Canterbury Earthquake Recovery Authority
CDEM	Civil Defence Emergency Management
GFC	Global Financial Crisis
MCDEM	Ministry of Civil Defence and Emergency Management
NGO	Non-government Organisation
OCR	Official Cash Rate
PMO	Project Management Office

# 1. Introduction

The aim of this report is to identify features of resource trends and challenges that need to be considered in recovery planning to expedite post-disaster recovery and reconstruction. It is intended that the results of this report will help to inform the economic and infrastructure recovery components of Canterbury Earthquake Recovery Authority (CERA) by offering insights into resourcing dynamics in past disaster recovery efforts.

## 1.1 Outline of the report

The report reviews learnings of longitudinal studies undertaken by the Resilient Organisations research programme, dealing with the resourcing issue in past disaster events. The report highlights key areas that need to be managed during the resource monitoring and planning process for the Canterbury rebuild.

## 1.2 Summary of implications

Comparison of the Canterbury rebuild with past recovery trends indicates that familiar resource issues following a large-scale disaster continue to recur, and others are likely as reconstruction continues. Key overarching considerations include:

- Economic conditions, such as continued effects of global financial crisis (GFC), Government's economic strategy (2012 Treasury's Budget) and Reserve Bank's response, explain potential resource shortfalls in disaster-related rebuild works relative to 'business as usual' construction activities.
- Technical reconstruction decisions in response to risk mitigation and market needs (e.g. changes to the Building Code and Standards, advocating innovative construction materials and techniques, and amendments to local planning) bring improvements to buildings. However, these decisions, along with environmental concerns regarding the use of natural resources, change resource requirements in design, manufacturing and construction throughout the recovery period.
- Underlying demographic components (e.g. age, working experience, individual and/or family needs) of workforce migration patterns have an impact on the composition of markets across regions, sectors and organisations.
- Construction businesses' responses to market conditions vary. The organisational behaviour in resourcing including, such as recruiting nationally and internationally, and across industries, enhancing management capability, and increasing wage levels, has a ripple effect on resource projections at a macro-level.

This report suggests ways forward in managing and improving the recovery environment during the long-term recovery of Christchurch.

## 2. Resource learnings from the past events

A large number of reports prepared by the Resilient Organisations research programme have been published over the last four years dealing with post-disaster reconstruction environments<sup>1</sup>. Most studies report field investigations in disaster-affected countries. This section provides a background of disaster recovery research by Resilient Organisations, with a focus on resource issues.

Resilient Organisations has undertaken longitudinal studies in countries including Indonesia, China and Australia. Field trips consisted of surveys of the availability of resources for their post-disaster reconstruction, and tracking trends evident in the surveys (See Appendix 1). Resilient Organisations undertook surveys in Banda Aceh (Indonesia), Mianzhu (China) and Marysville (Australia) and reported factors that influence resource availability over longer-term recovery. These issues included:

- Post-disaster response and interventions from the Government, such as recovery strategy, economic stimulus plans, changes to the Building Standards and new environmental rules, is a major factor in influencing the construction capability for rebuild, followed by the capacity of the industry itself.
- Fluctuations in prices of labour and building materials/products in disaster-affected regions were the source of most of the variations in local inflation.
- Project delivery mechanisms (e.g. Project Management Offices (PMOs)) may create competition among PMOs for limited resources and influence resource flows.
- For building materials that come from the natural environment, such as cement and aggregate, transportation costs and environmental damage concerns were two factors accounting for cost changes.
- The availability of a reconstruction workforce was largely determined by market drivers such as wage levels and job availability, followed by workers' risk perceptions.
- Organisational aspects such as a construction company's skills retention and recruitment strategies were important in influencing resource flows for reconstruction.

The impacts of the above dynamics on other sectors should be taken into consideration when the recovery decisions are made.

## 3. Generic patterns of a resourcing issue

### 3.1 Economic shocks 'bite' recovery

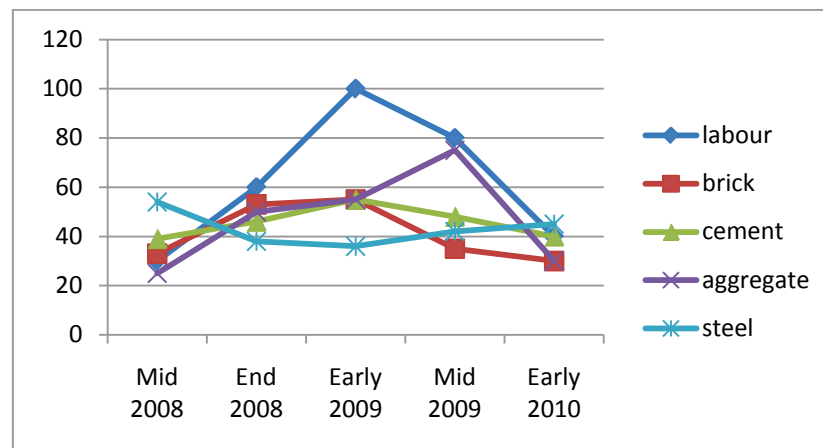
Longitudinal studies of the Wenchuan earthquake in China and the Victorian 'Black Saturday' bushfires found some correlation between changes in resource needs and changes in economic conditions.

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<sup>1</sup> <http://www.resorgs.org.nz/publications/>

### 3.1.1 Steel crisis in the quake zone in China

The Chinese Government set its recovery policy on the assumption that the prices of building materials would rise rapidly with the rebuild, but would gradually fall again as the peak of reconstruction passed the spikes in construction demand. However, Figure 1<sup>2</sup> shows that the price change of steel products went against the normal trends of reconstruction demand, showing a continual decline in the aftermath of the quake.



**Figure 1: Price changes of resources over the recovery time in Sichuan**

The rebuild in Sichuan Province created a large demand for steel products. Most steel businesses in China are national and international-based. They felt stronger impacts from the global financial crisis (GFC) in the second half of 2008. The price of steel products started dropping as the overall national and global demand reduced. Maintaining its profit margin in such a climate became their first priority. Their production decisions were made in the context of a great deal of uncertainty about the future economic environment. Firstly, steel manufacturers halted their production in response to a dampened global market. Secondly, they were not willing to cater for the rebuild priorities with a significantly reduced price. The quake-affected regions thus suffered a major steel crisis and recovery proceeded slowly.

The shortages of steel products supply lasted for a year in the quake zone until mid-2009 when Central Government's infrastructure expenditure took effect. In the third quarter of 2008, the Government initiated a US\$600 billion investment programme to boost the economy. This budget targeted the construction of highways, railways and airport infrastructure which required large-scale products from the steel supply industry. In the second half of 2009, the price of steel products began rising, as shown in Figure 1, as the steel manufacturers had benefited from this programme and began to increase their manufacturing capacity.

### 3.1.2 Labour shortages in bushfire housing rebuild

Similar effects were seen in the labour market in bushfire-stricken towns in Australia. The bushfires devastated parts of the State of Victoria in February 2009 when the impacts of GFC were spreading more widely across the country. Issued in

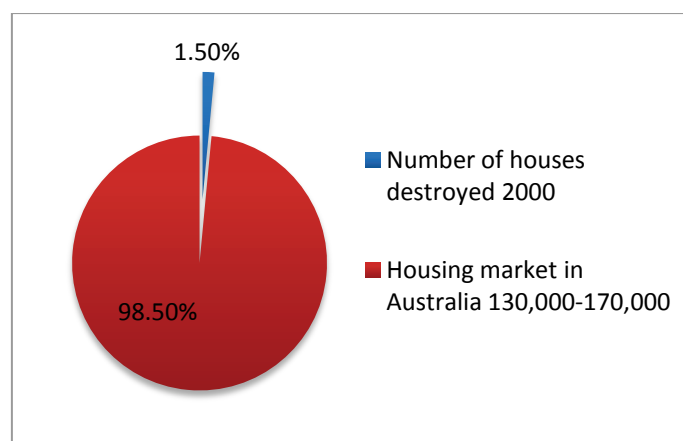
<sup>2</sup> The scale of each price unit is adjusted to indicate the trends of price changes of different resources.

September 2009, the Nation Building – Economic Stimulus Plan (the Plan)<sup>3</sup> was a key component of the Australian Government’s response to the GFC.

The Plan consisted of a range of building and construction projects such as investments in school and community infrastructure, and the first-homeowner’s grant. A longitudinal study over the bushfires recovery period observed that, by July 2011, achievements under this Plan were significant. However, unintended outcomes of this Plan have also had a long-lasting impact on the bushfire zone in terms of sourcing skills and labour for housing rebuild.

At the time of the bushfires, Victoria was in the middle of an active home building cycle fed by migration and the Government’s economic stimulus package, especially the first-homeowner’s grant. This was soaking up much of the labour capacity in the construction industry.

Approximately 2000 houses were destroyed in the bushfires. That is about 1.5% of the total housing market (130,000 to 170,000 houses) in Australia each year (see Figure 2). Interviews with the local volume builders found that the wage level in the bushfire-related rebuild works was much lower than building works in other places because the work in those urban areas is more profitable. Builders and contractors were reluctant to take up this small volume while there were plenty of opportunities available elsewhere.



**Figure 2: Proportion of housing market in Australia**

### **3.1.3 Implications for the Canterbury rebuild**

The two cases show potential effects of similar economic situations on the Canterbury rebuild. The Canterbury sequence took place in the context of a depressed construction sector prior to the earthquakes. Recent soaring house prices in Auckland have signalled to the market that a construction boom is likely as its population growth continues. The Reserve Bank’s policy to Official Cash Rate (OCR) is likely to increase (Reserve Bank of New Zealand, 2012). This will have a general impact on the New Zealand housing market, influencing home buyers’ behaviour. If the rebuild market in Canterbury is lagging behind Auckland and Australia, skills

<sup>3</sup> <http://www.economicstimulusplan.gov.au/pages/default.aspx>



retention and sourcing problems in Canterbury will be a major concern for rebuild, as happened in the bushfire zone in Victoria.

As the recovery in Canterbury picks up, there will be a ripple effect of material demand on construction activities throughout the economy. Reinforcing steel and cement, as essential inputs for the production of concrete for construction, may become problematic resources if there are emerging markets such as Auckland's housing construction boom and nationwide seismic retrofit works. These emerging markets may create major bottlenecks to concrete supply and use for rebuild purposes.

Pacific Steel is the sole manufacturer of all reinforcing steel produced in New Zealand, and Golden Bay and Holcim are the only two companies producing cement in New Zealand. This leaves the resourcing exposed to possible economic problems such as changes in domestic economic policy (e.g. planning for the development of the steel supply industry and investment in domestic demand growth), other unexpected global factors (e.g. peak oil, world price of steel products and the economic situation in Europe), and new market members/overseas companies importing materials into New Zealand.

The two cases in China and Australia suggest that the scale of market for reconstruction and new development in Christchurch is needed to attract and retain essential resources. For disaster recovery agencies, a systems approach is needed for phasing the timing of programmes by reading market structure, considering people and capital investment, and estimating the capacity of the construction industry as a whole to respond to likely changing resource requirements.

### **3.2 Impacts of technical and environmental decisions on resource requirements**

Studies in three disaster events found that technical and environmental decisions – a common response to addressing building safety and environmental concerns following a disaster – have ramifications on recovery resource availability.

#### **3.2.1 Changed Code causing a chain of impacts on resourcing in Victoria**

Shortly after the bushfires in March 2009, the Victorian Government introduced the new residential bushfire building standard, AS 3959-2009 Construction of Buildings in Bushfire-prone Areas,<sup>4</sup> to better protect the bushfire-affected communities from future fire events. AS 3959-2009, however, was expected by the building supplies industry to come into effect at the end of 2009. The bushfires in February 2009 had expedited its adoption, giving manufacturers not enough time to respond to changed material requirements under the new Code.

A longitudinal study found that until July 2011, twenty-eight months after the fires, reconstruction was proceeding slowly despite the institutions and procedures set up for expediting community recovery (Chang et al., 2012). The unavailability of required building materials to meet the new Code was the major reason for this slow reconstruction (Wilkinson and Chang, 2011).

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<sup>4</sup> AS3959-2009 was to replace AS3959-1999.

Given the small number of houses that needed to be rebuilt in the Bushfire Attack Level-Flame Zone (BAL-FZ) (3%), the building product manufacturers were reluctant to put effort into developing new products. It took four months for the compliant roofing products to be used in the highest bushfire risk zone BAL-FZ to be released onto the market, and ten months for the external cladding materials, twelve months for the new window system, and fifteen months for the standard house design (See Table 1).

**Table 1: Time implications of changed Building Standards for BAL-FZ**

Bushfires	AS3959-2009	Roofing system	External cladding materials	Window system	House design
7 Feb. 09	11 Mar. 09	July 2009	Jan. 2010	Mar. 2010	June 2010

The costs of the new construction requirements were also significantly under-represented. Official assessments put the extra cost for construction between AU\$10,000-40,000 (NZ\$ 13,300-53,300) depending on the level of protection, but the real extra cost to rebuild a house to the new Code was up to AU\$100,000 (NZ\$133,300). The cost increases placed financial pressures on home owners who were already struggling to procure suitable resources to rebuild their houses.

A longitudinal study by Resilient Organisations found that the bushfire impacts were felt particularly strong in some areas where properties were uninsured or under insured. Around 300-400 house owners needed extensive help since they belonged to low-income groups and their houses were under-insured. Even for the insured houses, the owners also faced financial difficulties with significant insurance payment shortfalls occurring as a result of changed building standards.

### **3.2.2 Timber crisis in housing recovery programmes in Banda Aceh**

The post-tsunami rebuild in Indonesia also faced problems of material changes. Between 2005 and 2006, the donor-driven reconstruction programmes mainly sourced timber resources locally. In 2007, however, the Indonesian Government suddenly changed its resource use policy. The 'Green Aceh' timber administration rules were issued in 2007 to limit exploitation of timber resources from local forests.

This mandate eliminated the possibility of donors purchasing timber products from local sources in Indonesia. A number of Non-government organisations (NGOs) had to turn to donor countries or other producing countries (e.g. Australia, Canada and New Zealand) importing wood products into Aceh. The lead-time of off-shore timber procurement was unpredictable, varying between three and four months, or longer.

The time spent negotiating and obtaining approvals from Indonesian Customs was significant. Even worse, some NGOs had difficulties accessing quality construction timber with suitable guidelines from export countries. The impacts of this timber crisis were widespread across housing recovery programmes. Expensive imports of timber materials resulted in shortfalls of donors' funding for their promised house numbers. As a result, aid agencies compromised their housing number commitment to the local government. Others changed their standard house design from timber-frame to steel structure.

### **3.2.3 Aggregate shortages from the legal controls in Sichuan**

The landscape of Sichuan, with its vast numbers of mountains and rivers, provides multiple sources of aggregate materials. At the outset of housing reconstruction in mid-2008, the Provincial Government of Sichuan was positive about the local aggregate supply for reconstruction and thus encouraged businesses to increase their production. However, illegal mining and quarrying activities pursuing short-term profits caused environmental damage. Only at the end of 2008 did the environmental issues as a result of this abuse receive attention from the local authorities.

A series of mandatory restrictions on quarrying were implemented in early 2009 to reduce illegal access to riverbanks and quarry sites for materials such as sand and gravel. The restrictions, however, slowed down the reconstruction and pushed up the cost of aggregates. In pursuit of speed, many builders and contractors set up contracts with aggregate suppliers from outside the quake zone.

Imported aggregate materials were more expensive and subject to greater price volatility than the locally-sourced material. As a high weight and low value product, transport costs were significant for aggregate. Higher prices for aggregate materials filtered through to higher costs for construction of damaged houses and infrastructure throughout the quake zone in Sichuan. Fluctuations in prices of aggregates were the major source of local inflation.

### **3.2.4 Implications for the Canterbury rebuild**

In both Canterbury and New Zealand, it is likely that a range of technical decisions will be made to increase the performance of buildings in earthquakes. This has included: (1) changes to the Building Standards, (2) new technical guidelines for housing repair, and (3) more sustainable features in new buildings. Building innovation will be advocated, including the use of, for instance, (1) prefabrication technology, (2) 'light weight' housing solutions, and (3) changed environmental solutions.

As illustrated by the Victorian bushfires, technical decisions made following a disaster will change the landscape of resource use in construction. Without financial support and a marketing and communications strategy, these decisions will directly create resource shortages in disaster areas. A realistic time and cost assessment is needed and these time and cost implications should be considered in ongoing recovery planning. It is equally important to ensure that industry has time to plan and invest in regulation changes and good environmental practices so these do not have an inflationary effect on prices.

It is also possible that further slow-down of reconstruction as a result of these technical decisions may come from Council building consents, designers and rebuilders who will have to become familiar and competent in the new Code or guidelines, for instance. An effective mechanism for communicating these technical changes is needed across different stakeholders, particularly to local communities.

It is likely that sourcing raw materials including timber and aggregates that come from New Zealand's natural environment will trigger environmental concerns, particularly when there are political pressures. Both the Government and material manufacturers

are very aware of the public's attitude towards environmental conservation. However, there is an emerging concern that the scale of materials required for the Canterbury rebuild will boost the quarry industry with associated environmental impacts.

### 3.3 Workforce demographic features

Lifestyle and cost factors are the dominant determinants of workforce migration patterns (Blair and Premus, 1993). Resilient Organisations found that in a disaster reconstruction situation, such labour demographic-related factors play a major role in a workforce's decision-making and changing directions of resource flows.

#### 3.3.1 'Available' or 'suitable'? It's a quality issue in Aceh

The construction industry in Aceh, after decades of civil conflict, was insufficient for large-scale reconstruction following the tsunami. Skilled construction labour was in scarce supply. Time limits for NGOs' reconstruction programmes meant that relying on skills-training to meet labour demand was not realistic. They had to bring in a large number of construction workers from outside Aceh.

Nearly 95% contractors, solutions, materials and expertise were imported mainly from Java. A Resilient Organisations study found that in March 2008, more than three years after the tsunami, many houses managed by the aid agencies were sub-standard. These houses had to be demolished or retrofit strengthened.

There are a variety of explanations as to why the rebuild in Aceh had major quality issue, such as poor workmanship of incoming workers and a lack of proper supervision and quality control.

It was difficult for migrant workers from Java to adapt to a completely different life style and livelihood customs in Aceh. They did not tend to stay long. There was a high rate of worker turnover from one construction project to another and from one Project Management Office to another. The associated competition among aid agencies increased labour wages as agencies were desperate for available workers. Some workers jumped to higher paid projects without finishing the work at hand. Figure 3 illustrates examples of housing projects that were suspended due to poor workmanship and workers' lack of responsibility.

(1) House of poor workmanship



(2) Construction workers turnover leaving construction suspended



**Figure 3: Rebuilding quality issues due to construction workers lack of ethic**

### 3.3.2 Risk aversion behaviours of construction workers in Australia

In terms of the pattern of workforce migration in Victoria following the bushfires, where to go for work was determined by workers' risk perceptions. In fire-affected towns, there were very few local contractors available. As discussed earlier, lack of economies of scale made it difficult to attract builders from outside. Builders perceived differences between the relativity of potential risks and profit margins between fire-related works and the 'business as usual' works in the fast growing urban areas.

By comparison, Melbourne metropolitan fringe areas are flat and offer a big share of construction growth, whereas the fire-affected towns such as Marysville and Kinglake are located in more remote, bushy mountains. The bushfires destroyed most tourism facilities. A lack of suitable accommodation, particularly rental properties, had discouraged many construction workers to work on rebuild projects. Under the new Code, rebuilding a house on its original site required more custom-design, longer building time and higher costs. All these factors were weighed up by workers outside the bushfire zone when they decided if it was worthwhile going for rebuild jobs.

### 3.3.3 Implications for the Canterbury rebuild

Looking at employment, Canterbury has the greatest need for skilled construction workers. The latest report from an ongoing study of Resilient Organisations (Chang-Richards et al., 2012) show, both in Canterbury and nationwide, there are not enough people of the right experience/background in certain specialised construction occupations, particularly civil engineers and building control professionals, including project managers, site engineers and building inspectors.

As has been the case since the September 2010 earthquake, construction companies have been hiring mature project management skills from Europe. Engineering consultancies have been looking for engineers with seismic experience from earthquake-prone countries, particularly from the US. These two categories of people (project managers and civil/structural engineers) continue to be the largest inbound demographic group involved with the rebuild in Christchurch. Table 2 shows the general demographic characteristics of these incoming construction workers.

**Table 2: Demographic attributes of incoming workers in Christchurch**

	Civil engineers	Building control professionals
Country	Earthquake-prone countries: US, Italy, Chile	UK, Ireland
Age category	Young, 25-35: many of them are not married	More family category Variations between 30 and 50 year olds
Years of experience	New graduates or more than 2 years experience	At least 5-10 years plus experience

Migrant workers from outside Canterbury, especially those from overseas, fall within a general working-age group. Whether they would choose a short-term stay for merely gaining seismic work experience in Christchurch, or opt for a permanent settlement, depends on their individual or family needs as a whole. Those needs

include accommodation, access to amenities and to social networks, particularly for easy family establishment.

There has been a shortfall in new house building in Auckland and around NZ since 2009. As the housing and commercial rebuilds speed up, there will be a stronger demand for skilled trades workers and elementary skilled workers such as building labour. If the remedial building activities for weather tightness in other regions across New Zealand pick up at the same time, competition for those lower-skilled workers throughout the construction industry is likely. Additionally, the construction boom in Australia, as well as the residential building construction in Auckland means Canterbury will face the possibility of losing those skills to other regions in New Zealand or Australia.

Similar to aid agencies in Aceh, a resourcing challenge will come from a labour pool where lack of skill and experience in the building industry may create quality concerns, which is how the weathertightness crisis arose. Competition among insurers' housing Project Management Offices (PMOs) for available resources is likely to create or amplify the effects of skills shortages in Christchurch. PMOs hold major contractors accountable for work quality and project signoff identifies re-work required to meet the standards. However, the overall standard of a house repair/rebuild will be eventually driven by the quality of staff the principal contractors employ or subcontractors they use. Therefore, more effort, such as new quality control methods and training, is needed to help PMOs to manage their skills at a site level.

### **3.4 Construction business behaviours matter**

Previous investigations by Resilient Organisations employed a long-term focus on resourcing behaviour and the structure of construction organisations. It found that a good theory of resourcing needs to include an organisational perspective which explains both internal resourcing dynamics and the linkages between construction organisations and the wider recovery environment.

#### **3.4.1 A cost-compensated wage strategy in Sichuan**

Following the Wenchuan earthquake, the Provincial Government of Sichuan and Central Government created numerous programs and supporting packages in an attempt to help the construction businesses recover. Commonly-used supports included tax reduction, revenue bonds, and internal infrastructure assistance. Many construction organisations, particularly the large ones, were more concerned about the impacts of the quake on their employees' wellbeing. They provided monetary incentives to employees in order to increase their long-term productivity. In some cases, the wage levels in those companies, including bonuses of all kinds, were three times higher than before the earthquake.

Small organisations, in comparison, emerged in the rebuild market in order to secure longer-term contracts. Most of these firms were young and used to be subcontracted under a principal contractor. Immediately after the quake in May 2008, many of those small construction businesses tended to cluster in big urban cities such as Chengdu and Deyang that offered an abundance of engineers, new college graduates, and

construction labourers. By offering an appealing work package, they also attracted a large number of former Sichuan workers of comparable experience and skill to return to Sichuan for earthquake-related jobs.

Without a doubt, this cost-compensated wage strategy adopted by most construction firms contributed to the rise of post-disaster regional inflation. The state of competition in the construction industry also mattered. Most construction SMEs grew strongly by absorbing the labour market and poaching staff from other companies. As the construction boom reached its peak, at different times for different sectors (housing, infrastructure, and commercial), competition for construction labour became a major deterrent to the overall reconstruction progress.

#### **3.4.2 Volume builders enhancing local management, a case in Victoria**

In Victoria, a lack of builders and construction workers in the bushfire zone directly affected housing recovery. The local support and incentives from the Government were criticised as being insufficient. The value of a subsidy from firms to their workers was less than the actual cost of travel and accommodation incurred. Construction firms in the Melbourne metropolitan area reported that the risk that much higher living cost in bushfire zones would act as a material drag on rebuild unless other remedies from the Government could compensate.

A longitudinal study conducted by Resilient Organisations found that only local volume builders were actively engaging in the rebuild activities in bushfire zones as they had historical bonds with the place and communities. Instead of recruiting workers, they tended to increase their management capability by using a series of project management software and techniques. The effect of this strategy was obvious as there was less inflationary pressure coming from the human resource side than from the building materials and products requirements under the new Building Code.

One notable labour problem reported in the case of the Victorian bushfires was the ability of construction workers to understand the needs of traumatised bushfire victims. There were cases of disputes rising between the house owners and the building company. Unlike construction in normal times, house rebuilding was a complex business for the builders and construction worker involved.

#### **3.4.3 Implications for the Canterbury rebuild**

The above two examples show that organisational behaviours, including innovation, benchmarking, wage strategies, project management, and introducing new processes and technologies, affect resourcing decisions. A combination of market and regulatory pressures mean companies need to rely on a long term business model that will sustain them through peaks and troughs.

In Canterbury, some construction businesses are more concerned with short-run outcomes than pursuing profits over the long term. This is particularly the case in the wake of the February 22, 2011 earthquake. Engineering companies have had a significant increase in engineers' wages since the second half of 2011. Many building companies are busy expanding their businesses through national and international

recruitment. These post-quake behaviours, however, are having/will have an impact on the labour force requirements and building costs in Christchurch.

Recruiting from other industries with a similar skills-base or employing skilled migrant labour could mean the actual training requirement is lower. Means of enhancing productivity by enhancing the organisation's management techniques could also mean actual labour demand is lower than expected. With an understanding of these resourcing issues at a firm level, and their interactions with the wider economy, skills training and education initiatives could be more responsive to the rebuild needs.

## **4. Conclusions**

This report has discussed post-disaster recovery and rebuilding in China, Indonesia and Australia, and noted common themes which potentially may also arise in Canterbury. These include:

- The potential need of building in the recovery zone having to compete with other national initiatives which are stimulating growth elsewhere, such as economic stimulus packages;
- The potential adverse effects of reactionary newly introduced modifications to the Building Code or Building Standards. The industry needs time to understand the requirements, manufacturers may have to gear up, building consent authorities (BCAs) need to understand them. Consumers may be hit with higher prices. Rapid introductions have legacy effects.
- Resource shortages will happen unless the rebuild process is carefully managed.

The lessons presented in this report are intended to enable a shared understanding of resourcing issues and to guide intervention decisions at the governmental, industry and organisational levels. The quantum and timing of reconstruction activity will determine the resource requirements and the trajectory of their changes. However, there is a high level of uncertainty surrounding both the timing and cost of post-disaster reconstruction in places like Christchurch.

In terms of projection of resource requirement, a range of factors identified in this report could see the effects differ from those built into the normal workforce demand forecasts. These factors include the regional wider economic and market drivers, technical and environmental decisions, workforce migration patterns and construction businesses' responses to resource issues. Indeed, the on-going recovery in Canterbury is seeing similar resource effects and a dynamic resource landscape over time.

Many of these new challenges and associated price pressures can be linked to the growing role of construction organisations. This has helped reinforce the underlying strength of individual and organisational behaviours and their impacts on the availability of resources for disaster rebuild – a topic under investigation by Resilient Organisations.



The Canterbury Earthquake Recovery Act (2011) defines recovery as '[including] restoration and enhancement' which has raised expectations that a variety of enhancements to infrastructure and services will be delivered as part of the rebuild. At a structural level, a review of past events also highlighted possible solutions to enhancing the service delivery for rebuild in Canterbury. Recovery planning needs to be dynamic and needs involvement of construction organisations in the area of skills training, resource mapping and recovery needs assessment.

The information summarised in this report should not only inform the current recovery planning process in Canterbury about what is likely to happen against different scenarios and why, but should also inform the future Civil Defence Emergency Management (CDEM) recovery planning in New Zealand about what should be considered in order to cope with resourcing issues and mitigate their impacts on long term recovery.

For further information please visit [www.resorgs.org.nz](http://www.resorgs.org.nz), and [www.recres.org.nz](http://www.recres.org.nz) or contact:

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## Appendix: Resources in short supply and factors affecting their availability

IRs	Attainability	Usability	Accessibility
<b>2004 Indian Ocean tsunami</b>			
<b>Timber</b>	<ul style="list-style-type: none"> <li>• Large stocks of seized illegal timber resources</li> <li>• Low capacity of local timber supply</li> <li>• Significant impact of increased cost</li> </ul>	<ul style="list-style-type: none"> <li>• Quality concerns about both local procured and overseas imported timber</li> <li>• Lack of substitutes for timber resources</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of access to the illegal timber stocks</li> <li>• Legal constraint on accessibility of domestic forest product since 2007</li> <li>• Concerns about secure transportation and other infrastructural capacity</li> <li>• Complex logistics from overseas imports</li> </ul>
<b>Cement</b>	<ul style="list-style-type: none"> <li>• Reduced production capacity due to the impact of tsunami</li> <li>• Limited number of cement producers</li> <li>• Significant impact of increased cost</li> </ul>	<ul style="list-style-type: none"> <li>• Quality concerns about overseas imported cement from Indian and Malaysia</li> <li>• Easily hardening property requires proper logistics and infrastructure facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Damaged transport networks</li> <li>• Sparse geographic coverage of cement production in Indonesia</li> <li>• Lengthy procurement lead time of cement</li> </ul>
<b>Brick</b>	<ul style="list-style-type: none"> <li>• Salient inflation of brick price</li> <li>• 20-30% production capacity associated with good quality of bricks</li> <li>• Significant impact of increased cost</li> </ul>	<ul style="list-style-type: none"> <li>• Quality concerns of the local brick supply</li> <li>• Quality of raw materials and skilled labour operating machines</li> <li>• Quality of timber brick kilns</li> </ul>	<ul style="list-style-type: none"> <li>• Poor infrastructure for dispersal and delivery of imported bricks</li> <li>• High transportation costs</li> <li>• Beneficiaries' unwillingness to use concrete blocks as a substitute for bricks</li> </ul>
<b>Skilled labour</b>	<ul style="list-style-type: none"> <li>• Low local supply capacity due to the pre-existing industry problem</li> <li>• Lengthy skill development time</li> <li>• Significant impact of increased cost on the implementing agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Workmanship concern with specialized labour such as carpenters and masons</li> <li>• Effective skills training for unemployed local tsunami survivors was required</li> </ul>	<ul style="list-style-type: none"> <li>• Imported from outside of Aceh, mainly from Java and North Sumatra</li> <li>• Less accessibility to local qualified labour</li> <li>• Unstable supply due to the competition among aid agencies</li> </ul>
<b>2008 Wenchuan earthquake</b>			
<b>Brick</b>	<ul style="list-style-type: none"> <li>• Reduced production capacity due to the earthquake</li> <li>• Effect of Government 'hard' interventions into market</li> <li>• Significant impact of inflationary brick price on</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of social acceptance of using concrete blocks as a substitute to bricks</li> <li>• Quality concern about concrete blocks</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of access to local available resources in the market</li> <li>• Government's supply redirection limited local access to available bricks</li> </ul>

	affected house owners		
<b>Aggregate</b>	<ul style="list-style-type: none"> <li>• Limited existing aggregate manufacturing capacity</li> <li>• Government underestimation of the reconstruction demand for aggregate</li> <li>• Significant impact of inflationary aggregate price on affected house owners</li> </ul>	<ul style="list-style-type: none"> <li>• Quality concern of recycled aggregate materials</li> <li>• Increased environmental concerns regarding aggregate exploitation</li> </ul>	<ul style="list-style-type: none"> <li>• House owners' lack of access to local available aggregate resources due to large demands in infrastructure restoration</li> <li>• High transportation cost</li> <li>• Reduced accessibility to aggregate sources due to environmental concerns</li> </ul>
<b>Labour</b>	<ul style="list-style-type: none"> <li>• Limited local skills base</li> <li>• Increased labour flow by returning migrant workers and from other regions</li> <li>• Lower skill from outside the quake affected areas</li> <li>• Impact of inflationary labour wage</li> </ul>	<ul style="list-style-type: none"> <li>• Concerns about labour reliability and liability</li> <li>• Workmanship concerned with specialized labour for seismic resistant structures, such as carpenters and masons</li> <li>• Code of Conduct is required for both house owners and construction professionals</li> </ul>	<ul style="list-style-type: none"> <li>• Influx of labour from areas outside Mianzhu</li> <li>• Less accessibility to local qualified labour</li> </ul>
<b>2009 Victorian bushfires</b>			
<b>Windows</b>	<ul style="list-style-type: none"> <li>• Few fire-proof shutters or fire-rated window systems in BAL-FZ situations on the market after the fires</li> <li>• Product innovation took place with considerable facilitation from the Building Commission</li> <li>• Impact of window prices on recovery</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of alternative window solutions for houses in BAL-FZ category</li> <li>• Reservations in the building standards with respect to test methods increased uncertainty of product testing and manufacturers' reluctance to test and release new products to market</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of access to available window systems in the market</li> <li>• Building Commission's facilitation increased local access to available combined window and screen systems</li> </ul>
<b>Roofing system</b>	<ul style="list-style-type: none"> <li>• Few options for roofing systems in BAL-FZ zone on the market within a few months after the bushfires</li> <li>• Roofing system testing took place in a collaborative approach with manufacturers</li> <li>• Significant impact of roof prices on affected house owners</li> </ul>	<ul style="list-style-type: none"> <li>• The property of a comprehensive roof system depends on all the components which were required to be tested independently</li> <li>• The information session to the construction industry influenced the application of the products</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of access to available tested roof systems in the market</li> <li>• The industry manufacturers and trade associations played a major role in testing and introducing the new roofing systems to houses in BAL-FZ zone</li> </ul>
<b>Builders/ trades people</b>	<ul style="list-style-type: none"> <li>• Low interest of construction builders and tradespeople in house rebuilding</li> <li>• Skills pulled out to Melbourne region</li> <li>• Impact of increased quoted price on house owners</li> </ul>	<ul style="list-style-type: none"> <li>• House owners' concerns about builders' reliability and liability</li> <li>• Contract and payment issues between house owners and builders</li> </ul>	<ul style="list-style-type: none"> <li>• Less accessibility to qualified builders with reasonable quote</li> <li>• Logistical barriers of the builders and tradespeople to providing building services</li> </ul>