Resources and capacity: lessons learned from post-disaster reconstruction resourcing in Indonesia, China and Australia

Yan Chang, The University of Auckland, ycha233@aucklanduni.ac.nz;
Suzanne Wilkinson, The University of Auckland, s.wilkinson@auckland.ac.nz
Regan Potangaroa, UNITEC, rpotangaroa@unitec.ac.nz
Erica Seville, University of Canterbury, erica.seville@canterbury.ac.nz

Abstract

Post-disaster reconstruction poses resourcing challenges specific to the construction practitioners and requires constant improvements of the construction industry and of the environment in which it operates. By drawing on in-field surveys and observations in the disaster affected areas in Indonesia, China and Australia, the research examines their respective resourcing practice following a disaster with a particular focus on identifying the resource and capacity constraints that confronted the reconstruction practitioners in a post-disaster situation. This mapping exercise helps draw attention from decision makers and the construction sector to the vulnerable areas in post-disaster reconstruction and also generates lessons and experiences worthy of adoption in other disaster situations. Practical measures are suggested to improve the implementation of physical reconstruction through laws, regulations and policies, along with the according mechanisms in the industry and at a project level.

Keywords Construction industry, post-disaster reconstruction, resources, capacity, lessons

1. Introduction

The economic impacts of a large-scale disaster are regularly symbolized by the monetary losses or GDP figures in disaster damage assessment reports or newspapers. The following examples can be representatives standing out people's images in terms of the financial bill we paid for a disaster:

- Between the 1950s and the 1990s, the reported global cost of natural disasters increased 15-fold. Major natural catastrophes in the 1990s caused economic losses estimated at an average US$66 billion per year (in 2002 prices) (Benson and Clay, 2004, p. 3).
- In a five-year period, between 1989 and 1994, five U.S. disasters (Hurricane Hugo 1989, Loma Prieta earthquake 1989, Hurricane Andrew 1992, Mississippi Flood 1993, and Northridge earthquake 1994) caused US$75 billion in damages, half of which was in residential structures (Comerio, 1998, p. 15).
- The Kobe earthquake in Japan in 1995, losses in Osaka city of about US$178 billion were recorded, the equivalent of 0.7 percent of global gross domestic product (Munich Re, 2002, p. 34).

- In the twentieth century, people's vulnerability is however not reduced by advanced construction technology and materials. The most catastrophic events highlighted the enormous economic losses. For instance, the financial suffering of the 2004 Indian Ocean Earthquake and Tsunami disaster was estimated at US$10 billion (RMS, 2006, p. 10); Hurricane Katrina 2005 with the economic loss of US$138,000 became the most expensive natural catastrophe for the US insurance industry (Munich Re, 2008, p. 50); China's Wenchuan earthquake in 2008 with direct economic losses reaching approximately US$123.69 billion (State Planning Group, 2008, p. 10) was the worst disaster since the 1976 Tangshan Earthquake.

According to Schilderman (2004), whilst the number of natural hazards does not appear to be increasing greatly, their impact on people, and therefore the number and scale of disasters, is increasing. The public view to a natural disaster is increasingly shifted from striving to survive a physic event to more optimistic 'thrive' attitude by taking advantage of post-disaster reconstruction 'window of opportunity'. However, the underlying implications of these economic losses for post-disaster reconstruction, however, was not clearly and fully understood and recognized by policy makers and recovery practitioners. The real impact later on after a large-scale high-profile disaster is the 'social-economic displacement' induced by subsequent construction boom and massive resource demands in a short term, and manifested in forms of inflationary chaos, 'Dutch disease', and cost surge. As Jayasuriya et al. (2005) observed in Sri Lanka after the 2004 Indian Ocean Tsunami, the tsunami hit at a time of serious macroeconomic imbalances, and paradoxically helped to mask them for a time. But they re-emerged afterwards, fuelling inflation, lowering the real value of aid funds, constraining government's fiscal capacity, and adversely affecting reconstruction. The reason for sharp escalation in construction costs after a disaster was mainly attributed to the dramatic resource shortage and unavailability caused by the macroeconomic imbalance between reconstruction demand and supply (Nazara and Resosudarmo, 2007; Steinberg, 2007; Jayasuriya and McCawley, 2008).

This paper addresses resource availability issue after a disaster, and how it affects the post-disaster reconstruction performance and the socio-economic, environmental and political structures in disaster affected areas, and what can be done to solve the resource constraints inherent in different recovery systems.

2. Resourcing for post-disaster reconstruction

In contrast with normal project construction, post-disaster reconstruction is likely to suffer project deficiencies in relation to the availability of resources. The post-disaster field observations by Russell

(2005) and Zuo et al. (2008) provided examples in rework or disruption of reconstruction projects, as a result of failure to procure resources required for projects post-disaster. On the other hand, a range of role models demonstrated that post-disaster reconstruction practitioners benefitted from proactive resourcing strategies and planning (Mitchell, 2004) and from good command of potential vulnerabilities and bottlenecks when sourcing resources (Singh and Wilkinson, 2008). As occurrence of disasters continue to rise throughout the world, the reconstruction task could only be achieved through ensured resource availability (Masurier et al. 2008) and prudent allocation of limited resources (Freeman, 2004).

Problems such as 'Cost Surge' (Rodriguez et al. 2007), profiteering (Nazara and Resosudarmo, 2007) and 'Dutch Disease'[1] (Corden, 1984; Adam and Bevan, 2004) induced by resource shortages after a disaster could have a longer term adverse impact on sustainability of local economy and market in the disaster affected areas. In response to market disorder caused by speculative behaviour, regulatory authorities normally turn to 'hard intervention' solutions by directly interfering in manufacturing and circulation (Hirshleifer, 1956). Herein lies another problem, that of generic restrictions posing a major disincentive to other suppliers from actively getting engaged in post-disaster reconstruction resourcing efforts (Oxfam Australia et al., 2007). According to McGee (2008), price controls cause resources to be allocated inefficiently and could serve to delay disaster relief.

Resourcing broadly encompasses a wide range of activities that have a bearing on resource management for post-disaster reconstruction projects, embracing pre-event resource planning and preparedness, resource procurement, resource delivery, and development of resource alternatives. The type of resourcing approach can be defined in terms of the way and extent to which the stakeholders leverage their influence and value into resourcing activities. There are four main resourcing approaches widely applied in past disaster reconstruction practice:

- Government-driven resourcing: post-disaster reconstruction resource availability is mainly driven by governmental agencies and other authorities.
- Donor-driven resourcing: donors play a dominant role in resourcing efforts for a post-disaster reconstruction project.
- Market-driven resourcing: the instruments, forces and rules in the construction market have a major influence in resource availability for post-disaster reconstruction.
- Owner-driven resourcing: house owners are responsible for rebuilding their own houses through self-maintenance with limited external financial, technical and material assistance.

During post-Indian Ocean tsunami housing reconstruction, the donor-led resource approach was predominant in Aceh, Indonesia, whereas in China the government-led resource management was key to the housing reconstruction after the Wenchuan earthquake and in Australia bushfire reconstruction resource availability was mainly oriented by the construction market. The remainder of this paper is focused on comparing these three resourcing models in Indonesia, China and Australia in terms of the resourcing challenges under each approach pertaining to their specific recovery context.

3. Research methodology

The method of analysis adopted in this investigation is case study due to its explanatory nature of study (Yin, 2003). The research data was collected through field-based observations and interviews. The interviewed population consisted of the main implementing professionals in resource procurement and other important informants in Indonesia, China and Australia (See Table 1). Three countries were selected in terms of disaster impacts, types of resourcing approach and field accessibility. Between March and June 2008, the first and third author were tasked with post-tsunami housing seismic assessment in Banda Aceh, Indonesia, working with CARE International, and gained the opportunity to interact with a range of stakeholders such as governmental officials, construction professionals and donor representatives engaged in post-Indian Ocean tsunami reconstruction in Indonesia. Six weeks after China's devastating Wenchuan earthquake in May 2008, these two authors went to the earthquake impacted zone and set up a baseline for a longitudinal case study to understand post-disaster resource management in China. Between December 2008 and January 2009, between June and July 2009, and in February 2010, the four authors conducted three follow-up research trips to China. In August 2009, the first three authors visited the Victoria February Bushfire disaster zone in Australia and undertook a grounded survey, assessing resourcing problems faced by the governmental officials, implementing construction corporations and people affected.

Qualitative data was captured focusing on the following themes:

- Resourcing difficulties confronting decision makers and reconstruction practitioners in each country;
- Lessons and experiences learned from their respective resourcing practice after a disaster;
- Possible solutions to address the resourcing problems in a post-disaster situation.

The reminder of the paper presents research findings in as a combination of in-field observations, interviews and past studies. The lessons derived from the three cases point to what constitute resource availability for post-disaster reconstruction. A discussion along with proposed recommendations is offered accordingly.

Table 1 Profile of field-based interviews

Country	Field trip time	Places visited	Main Interviewees
China	• June, 2008 • Dec. 2008-Jan. 2009 • Jun.-Jul. 2009 • Feb, 2010	• Mianzhu, • Dujiangyan, • Beichuan	• 16 construction contractors (C1-C16) • 5 academic researchers (R1-R5) • 5 governmental officials (G1-G5)
Indonesia	March-June 2008	Banda Aceh	• 12 project managers from 6 NGOs[2] (P1-P12) • 4 donor representatives/reconstruction coordinators (Co1-Co4) • 4 governmental officials from BRR (BRR1-4)
Australia	August 2009	• Marysville, • Flowerdale, • Kinglake	• 8 governmental officials (V1-V8) • 2 academics from CRC and 2 researchers from RMIT (A1-A4) • 3 contractor company representatives (Cr1-Cr3)

Note: BRR is the Agency for Rehabilitation and Reconstruction for Aceh and Nias in Indonesia, CRC is Australian Bushfire Co-operative Research Centre, RMIT is the Royal Melbourne Institute of Technology.

4. Donor-driven resource procurement in Indonesia

On December 26, 2004, a massive earthquake measured at 8.9 on the Richter scale with its epicentre near Sumatra Island occurred in the Indian Ocean. The induced tsunami waves affected 11 countries in the world including the most impacted Aceh territory of Indonesia. As of January 14, 2005, 110,229 lives were accounted for as dead, 12,132 people as missing and 703,518 as displaced in Indonesia (BAPPENAS and the International Donor Community, 2005). In the aftermath of this large-scale disaster, a large number of NGOs fluxed into Indonesia engaging in post-tsunami housing reconstruction in Aceh and Nias.

As could be expected, the increased construction activity and the need to import many of the most common construction materials such as brick, cement, steel and timber, along with the increase in energy price led to an unprecedented increase in the cost of construction materials, which had gone up 200-50% since early 2005 (Steinberg, 2007). The significant cost escalation of labour and the main building materials is displayed in Table 2.

Table 2 Costs of labour and building materials in Aceh, late 2004-late 2006

resource	unit	End 2004	Mid-2005	Early 2006	Oct 2006	Change (%)
labour	Rp 000/day	30	40	50	50	67
wood	Rp million/m^3	1.0	1.5	1.9	2.2	120
cement	Rp 000/50kg	20	26	34	37	85
sand	Rp 000/ $3m^3$	150	300	300	300	100
brick	Rp each	250	580	700	700	180

Source: adapted from (Nazara and Resosudarmo, 2007, p. 40); Rp is Indonesian currency symbol.

The impacts of these price escalations, however, during the time the first and third authors visited between March and June 2008, were still visible in terms of large funding gap, construction delays, cost overruns, and even inferior construction quality. The following common resourcing problems are found in the donor-driven reconstruction in Indonesia.

- Shortage of local materials, qualified construction contractors, and labour;
- Construction market inflation chaos caused by the shortages of main building materials;
- Difficulties in acquiring suitable quality construction timber in Indonesia;
- Logistical and environmental issues with importing timber from outside of Aceh and overseas;
- Lack of collaborative activities in resource procurement among the aid agencies and between the donor community and the local governmental institutions;
- Lack of project management and procurement skills and lack of information systems for resource scheduling and management within NGOs.

5. Contractor-driven resource management in China

On May 12, 2008, the Wenchuan earthquake, as it is commonly known, measuring the magnitude (M) 8.0[3], killed 69,266 people, injured 374,643 people, left 17,923 people missing[4] and caused widespread destruction to buildings and infrastructure in China's Sichuan Province and its neighbours. More than 15 million housing units collapsed during the earthquake and resulted in direct losses to buildings and infrastructure of over US$150 billion (Paterson et al., 2008). As the overall earthquake reconstruction unfolded in August 2008, the lack of building materials along with supply disruptions greatly impeded the housing reconstruction process in the impacted Sichuan Province. Much of the resource shortage was attributed to the large-scale rebuilding demands. The inadequacy of local production capacity, raised transportation fees and the scarcity of local raw materials contributed to the subsequent inflationary chaos in the quake affected areas. The costs of labour and the main building materials in Sichuan Province during mid 2008 to mid 2009 are tabulated in Table 3.

Table 3 Costs of labour and building materials in Sichuan, mid 2008-mid 2009

resource	unit	Mid 2008	End 2008	Early 2009	Mid 2009	Change (%)
labour	RMB /day	30	60	100	80	167
brick	RMB each	0.33	0.53	0.55	0.35	6
cement	RMB/ton	390	460	550	480	23.1
aggregate	RMB/ m^3	25	50	55	75	200
steel	RMB/ton	5400	3800	3600	4200	22.2

Source: Authors' own market investigation; RMB is Chinese currency symbol.

In the wake of the Wenchuan earthquake, the construction sector assumed the main reconstruction and restoration work for infrastructure, public facilities, and housing. Based on our one-and-half-year longitudinal case study in China, the main resourcing problems encountered by these Chinese practitioners in each of the phrases of their post-disaster reconstruction were observed by the researchers and summarised below.

- Price upsurge of cement, brick, and aggregate curbed the affordability of the affected house owners;
- Cost ceilings of the above main construction materials stipulated by the Sichuan Provincial Government in December 2008 intensified the difficulty for construction professionals in procuring these resources;
- The eagerness of celebrating Chinese Spring New Year (in February 2009) in newly rebuilt homes spurred the local affected populations to speed up housing reconstruction, triggering their competition for limited resources;
- The 2008 global financial crisis affected the steel production in China and thus the steel supply to the earthquake areas;
- By July 2009, with the majority of housing reconstruction (80%) in rural areas completed one year after the earthquake, the over-invested brick production industry began to suffer 'crisis of excessive production';
- By February 2010, a number of environmental concerns surfaced such as illegal logging and exploitation of river banks induced by intensive resourcing and excessive souring activities for housing reconstruction.

6. Market-driven post-bushfire reconstruction resourcing in Australia

The 2009 Victorian bushfires were the worst in Australia's history. The fires devastated nearly 80 communities across the state, destroyed more than 2000 homes and damaged around 430,000 hectares of land. By the time the fires were contained, 173 people lost lives and many others were seriously injured. While disaster and emergency relief services were activated immediately, the task of responding to a tragedy of this scale is massive, unprecedented and challenging. On 10 February 2009, the Commonwealth and Victorian Governments established the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA) to oversee and coordinate the largest recovery and rebuilding program Victoria has ever faced. The funding for reconstruction of bushfires devastated houses was composed of grants from the government and other social organizations, bank loan, and insurance payments. According to the VBRRA (2009, p. 14, 15), at the end of September 2009, $867 million had been invested in the reconstruction and recovery effort. Insurance assessments had been completed for 99% of damaged residential properties and commercial properties and claims had been settled for 80% of destroyed homes.

In the wake of the devastating bushfires, the Victorian Government introduced a new residential building standard to ensure that new homes, alterations and additions in Victoria are designed, constructed and located to a higher degree of fire safety. The changes in the building rules incurred a huge increase of rebuilding costs. Furthermore, when the housing rebuilding commenced in May 2009, the non-combustible materials, such as masonry, brick veneer, aerated concrete, for constructing a new house located at BAL-29, BAL-40 and BAL-FZ level[5] (flame zone) were not available in the market, and material suppliers had not tested some of the materials for window and roof system. The disconnect between the policy and the market at the early stage of the reconstruction did not allow for cost-effective selection of building materials and forced a number of house owners to purchase expensive fire-resistant products, driving the construction cost up. As a result, VBRRA had to spend most of the time to get the reconstruction technology and methodology right and to advise house owners for right decisions. It also took long time for social organizations to understand the vulnerabilities and assess local capacities before commencing a project.

However, the following common issues that would confront other reconstruction countries can also be seen during post-bushfire rebuilding in Australia:

- Confusion about whether insurance should cover the cost incurred by improvements into the housing structure for both retrofit or reconstruction

- Non-synchronization of building code changes and material market development
- Shortage of registered builders and long lead time to employ them for housing repair or reconstruction
- Logistics and accommodation for outside builders and artisans and labour force
- Provision of low-cost housing

7. What constitutes post-disaster resource availability?

The above retrospective review of resourcing difficulties for housing reconstruction in Indonesia, China and Australia cast a light on the underlying problem as to what constitutes post-disaster resource availability for reconstruction in a given context? The following points should be considered in each case by involved stakeholders in post-disaster reconstruction resourcing.

7.1 Pre- and post-disaster construction capability mapping

Measurement of resource availability both before and after a disaster is fundamental to fully understand the operating circumstances and relationships before strategy development and approach adoption. Post-disaster resource mapping includes gaining the knowledge of the true needs driving the feasibility of the project, contextual knowledge and matters relating to resource planning and logistics. Each disaster event provides a good opportunity for stakeholders especially the construction industry to think about resource availability for reconstruction. As it is such a strategic innovation which brings together of seemingly disparate parties into a holistic approach, it necessitates continuous learning, commitment, and facilitation from the government.

7.2 Government resourcing facilitation

Invariably, governments should make significant advances in improving the post-disaster reconstruction resourcing environment for implementing agencies. The efforts need to be put on pre-event resource planning and preparedness, maintaining a functioning construction market by forging strategies to compliment market forces rather than substitute or restrain their abilities, by monitoring sourcing activities and by encouraging low-cost environmentally-benign housing development. All these require local authorities to closely interact and communicate with resourcing stakeholders in both pre-event and post-disaster situations.

7.3 Institutional and infrastructure capacity building

It is important to build the in-house capacity in the implementing institutions and to strengthen the infrastructure capacity in tackling resource procurement and transportation. Aid agencies, local builders, and house owners need to be technically equipped in the reconstruction context. Continuously maintaining and improving the skill base of these groups is an important component of resource availability, and the training and education in supply chain management and logistics will pay off in the future reconstruction if the next disaster strikes.

7.4 Developing market instruments

According to Freeman (2004, p. 435), a component of social risk management is the use of market instruments that can absorb risks at times of natural disasters. Instead of relying on external financial assistance or borrowing funds, these tools must be in place before the disaster occurs. The priority of consideration in developed countries like Australia should be improving the existing instruments to solve emerging problems after recent massive disasters, such as insurance coverage for disaster mitigation measures. Similarly, the structure and planning programs for effective material supply and provision in the construction market should also be initiated and operational for handling the resource needs of post-disaster reconstruction.

7.5 Engaging the construction industry

As a ‘Chief Executive’ of resourcing in most of cases of disaster reconstruction, there is a need for the construction industry to take a more proactive and positive stance for the purpose of assuring and enhancing resource availability for the built environment. A healthy and functioning construction industry with policies and strategies in place is critical to maintaining the viability of construction market and ensuring the availability of resources required for long-term reconstruction efforts. Large-scale contractors with experience of good practice in resource procurement after a disaster have in important role to play in contributing this ability to the industry.

In all, a strategy of seeking stakeholders’ collaboration in resource availability is imperative. The focus should not be on finding suitable overarching frameworks, but on understanding opportunities and pitfalls of different resourcing approaches and what can realistically achieve in a given context. This requires recognizing the trade-off between policy and the market and supporting the central role of stakeholders in resource supply, delivery, and procurement. Furthermore, developing specific mechanisms to engage the active introduction of exogenous human and material resources into disaster affected areas through both bilateral and multilateral channels for post-disaster reconstruction is profoundly necessary. It encourages a wider range of leadership taking away the bottlenecks of channelling resources through a strategic planning.

8. Conclusion

Resource availability is a critical issue demanding attention; especially in disaster prone countries which fall short of natural resources, effective recovery programs must address this chronic condition of vulnerability. Little on-the-ground research has however been conducted to examine its potential implications for a successful post-disaster reconstruction. More specifically and in the context of post-disaster reconstruction, the paper attempts to review the contemporary disaster resourcing experiences in which resource constraints inherent in the reconstruction process are indentified.

The concept of resource availability generates attention to the damage and loss assessment along with community needs assessment in the aftermath of a disaster as a potential way of fostering reconstruction at an early stage, with involved stakeholders examining how they forge strategies and solutions to cope with possible resource constraints. Resource availability can be further enhanced by the government commitment to improve its environment and to help facilitate the procurement and development of resources. The materialization of potential benefits or outcomes of a market-driven resourcing approach will depend on the particular design of implementing mechanisms, and on the legal and governance context of its implementation at national and local levels. The findings will be relevant for stakeholders especially the construction sectors engaged in post-disaster housing reconstruction in other countries.

Acknowledgments

As part of *'Resilient Organisations'* research program (2004-2010) www.resorgs.org.nz, the research was supported by the Foundation of Research Science and Technology (FRST). The authors wish to thank CARE International, Construction Bureau of People's Government of Mianzhu in Sichuan Province, Sichuan University, P.R. China and the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA) in Australia for their assistance in data collection for this study.

References

Adam, C. S., and D. L. Bevan (2004) Aid, Public Expenditure and Dutch Disease. *Growth, Poverty Reduction and Human Development in Africa*. St Catherine's College, Oxford, University of Oxford.

BAPPENAS, and the International Donor Community (2005) Indonesia: Preliminary Damage and Loss Assessment The December 26, 2004 Natural Disaster, BAPPENAS of Indonesia and the International Donor Community.

Benson, C., and E. J. Clay (2004) Understanding the Economic and Financial Impacts of Natural Disasters. *Disaster Risk Management Series No.4*, The World Bank.

Comerio, M. C. (1998) *Disaster Hits Home: New Policy for Urban Housing Recovery*, University of California Press, Berkeley and Los Angeles, California.

Corden, M. W. (1984) "Booming Sector and Dutch Disease Economics: Survey and Consolidation". *Oxford Economic Papers* 36(2): 359-380.

Freeman, P. K. (2004) "Allocation of post-disaster reconstruction financing to housing". *Building Research and Information* 32(5): 427-437.

Hirshleifer, J. (1956) "Some Thoughts on The Social Structure After A Bombing Disaster". *World Politics* 8(2): 206-227.

Jayasuriya, S., and P. McCawley (2008) Reconstruction after a Major Disaster: Lessons from the Post-tsunami Experience in Indonesia, Sri Lanka, and Thailand. *ADB Institute Working Paper No. 125*, ADB Institute.

Jayasuriya, S., P. Steele, D. Weerakoon, M. Knight-John, and N. Arunatilake (2005) Post-tsunami Recovery: Issues and Challenges in Sri Lanka. *ADB Institute Research Paper* Asian Development Bank Institute.

Masurier, J. L., S. Wilkinson, K. Zuo, and J. Rotimi (2008). "Building resilience by focusing on legal and contractual frameworks for disaster reconstruction", *International Workshop on Post-Earthquake Reconstruction and Safe Buildings*, Chengdu, Sichuan, China, Sichuan University & Sichuan Postdisaster Reconstruction Support and Research Centre.

McGee, R. W. (2008) "An economic and ethical analysis of the Katrina disaster". *International Journal of Social Economics* 35(7): 546-557.

Mitchell, J., K. (2004). "Re-conceiving recovery", *New Zealand Recovery Symposium Proceedings 2004*, the Ministry of Civil Defence and Emergency Management.

Munich Re (2002) Topics Annual Review: Natural Catastrophes 2002, Munich Re Group.

Munich Re (2008) Topics Geo Natural Catastrophes 2007 Analyses, Assessments, Positions. *Knowledge series*, Munich Re Group.

Nazara, S., and B. P. Resosudarmo (2007) Aceh-Nias Reconstruction and Rehabilitation: Progress and Challenges at the End of 2006. *ADB Institute Discussion Paper,* Asian Development Bank Institute.

Nazara, S., and B. P. Resosudarmo (2007) Aceh-Nias Reconstruction and Rehabilitation: Progress and Challenges at the End of 2006. Tokyo, Asian Development Bank Institute.

Oxfam Australia, Australian Red Cross, and W. Vision (2007) Emergency Response Supply Chain Assessment.

Paterson, E., D. D. Re, and Z. Wang (2008) The 2008 Wenchuan Earthquake: Risk Management Lessons and Implications. *RMS Publications*. S. Ericksen, Risk Management Solutions (RMS).

RMS (2006) Managing Tsunami Risk in the Aftermath of the 2004 Indian Ocean Earthquake and Tsunami. I. Fehr, P. Grossi, S. Hernandezet al. Newark, CA, USA, Risk Management Solutions, Inc.

Rodriguez, H., E. L. Quarantelli, and R. R. Dynes (2007) *Handbook of Disaster Research*, Springer, New York.

Russell, T. E. (2005) The humanitarian relief supply chain: analysis of the 2004 South East Asia earthquake and Tsunami. *Massachusetts Institute of Technology, Engineering Systems Division*, Massachusetts Institute of Technology. Master thesis.

Schilderman, T. (2004) "Adapting traditional shelter for disaster mitigation and reconstruction: experiences with community-based approaches". *Building Research and Information* 32(5): 414-426.

Singh, B., and S. Wilkinson (2008). "Post-Disaster Resource Availability Following A Wellington Earthquake: Aggregates, Concrete and Cement", *I-Rec 2008 Building Resilience: Achieving Effective Post-Disaster Reconstruction*, Christchurch, New Zealand.

State Planning Group of Post-Wenchuan Earthquake Restoration and Reconstruction (2008) The State Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction (Public Opinion Soliciting Draft). National Development and Reform Committee. Beijing, China.

Steinberg, F. (2007) "Housing reconstruction and rehabilitation in Aceh and Nias, Indonesia - Rebuilding lives". *Habitat International* 31(1): 150-166.

VBBRA (2009) Rebuilding Together: A State wide Plan for Bushfire Reconstruction and Recovery. Victorian Bushfire Reconstruction and Recovery Authority. Melbourne.

Yin, R. K. (2003) *Case Study Research: Design and Methods (3rd ed.),* Sage Publications, Thousand Oaks, California.

Zuo, K., R. Potangaroa, and S. Wilkinson (2008). "Supply chain analysis and the sustainability of post-disaster construction: The Boxing Day Tsunami reconstruction experience in Aceh, Indonesia", *International Workshop on Post-Earthquake Reconstruction and Safe Buildings,* Chengdu, Sichuan, China, Sichuan University & Sichuan Post disaster Reconstruction Support and Research Centre.

Endnote

[1] Whenever a particular sector in a particular economy experiences a marked boom, the demand for inputs used in that sector tends to increase. This increased demand, in turn, tends to cause negative impacts for other industries that compete for the inputs used in the booming sector. The increased prices of inputs raise costs and reduce profitability in the competing (non-booming) industries. The resulting negative impact on the non-booming sectors is known as 'Dutch Disease', named after the experience in the Netherlands of de-industrialization in the wake of large inflows of export revenues from North Sea Oil in the last 1970s.

[2] IFRC, CARE, Canadian Red Cross, UNDP, Australian Red Cross, and British Red Cross

[3] M 8.0 represents surface wave magnitude (Ms), the national standard used by the Chinese government for earthquake magnitude. M7.9 for the Wenchuan Earthquake from The United States Geological Survey (USGS) reports represents moment magnitude (Mw).

[4] As of September 11, 2008 noon

[5] For further information, refer to 'A guide to assessing your property's Bushfire Attack Level (BAL)', and 'A guide to building in Victoria after the bushfires, Building Commission Victoria' at http://www.wewillrebuild.vic.gov.au