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Resourcing for post-disaster reconstruction: a comparative study of Indonesia and China

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Abstract

Purpose – There is a need to understand resourcing issues when reconstructing the built environment in a post-disaster situation. The purpose of this paper is to determine the resourcing difficulties that are likely to face the international practitioners in post-disaster reconstruction by identifying and comparing the factors that affected resource availability following natural disasters in Indonesia and China respectively.

Design/methodology/approach – The research methodology included field-based questionnaire surveys, semi-structured interviews and observations. A comparative analysis was used to extract similarities and differences with regard to resourcing approaches in Indonesia and China.

Findings – Despite the different resourcing approaches adopted in Indonesia and China in their recovery from large-scale disasters, there are common issues facing post-disaster reconstruction stakeholders, including competence of the implementing agencies, capacity of transportation, governance and legislation, and market conditions. Specifically, community-related housing features played a dominant role in donor-driven resourcing practice in post-Indian Ocean tsunami reconstruction in Indonesia, whereas factors related to project control and management primarily contributed to resourcing performance of Chinese reconstruction specialists following the Wenchuan earthquake.

Research limitations/implications – To solve resourcing problems, countries need to create an enabling environment and build institutional capacity. The cross-cultural comparative analysis encourages policy makers and practitioners to exchange experiences from recent recovery operations.

Originality/value – The paper illustrates the infrastructural and institutional weaknesses that hindered effective resource procurement during post-disaster reconstruction in Indonesia and China. The research findings show common areas in need of improvement in other disaster prone countries, along with the issues to be addressed in the donor-led or contractor-led resourcing practice in the two studied countries.

Keywords Indonesia, China, Disaster management, Resource management, Resource allocation, Disaster reconstruction, Resourcing, Comparative study

Paper type Research paper

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Introduction

Post-disaster reconstruction is a process with potential for creating a resilient built environment or for generating further vulnerabilities to the disaster affected communities. Oliver-Smith (1991, p. 20) advocated that the success of post-disaster reconstruction is much more than a matter of delivering and constructing houses and towns, it is as much a matter of how it is done as it is of what, or how much, is done. A number of academics and practitioners have been engaged in defining a set of cross-cutting challenges that face post-disaster reconstruction stakeholders. The issues such as disaster mitigation (Reddy, 2000; Schilderman, 2004), cultural sensitivity (Boen and Jigyasu, 2005; Barenstein and Pittet, 2007), reconstruction financing (Comerio, 1997; Freeman, 2004), and environmental sustainability (Chang *et al.*, 2006; Shaw, 2006) have been identified as inherent in a post-disaster reconstruction process.

Large-scale disasters in recent years such as the 2004 Indian Ocean tsunami, the 2005 Great Pakistan earthquake, and the 2008 Wenchuan earthquake highlighted the significance of the availability of resources, such as building materials and construction practitioners, and its implications for desired reconstruction outcomes. According to Jayasuriya and McCawley (2008), the seemingly prosperous construction boom after a large-scale disaster is likely to paradoxically mask resourcing difficulties for a temporary period, especially when funding and external assistance are available. However, when stocks become depleted and increased rebuilding demands overtake the local supply capacity, a secondary economic disaster would be represented by inflationary chaos (Nazara and Resosudarmo, 2007). "Dutch disease" further exacerbates the impacts of the natural hazard event (Adam and Bevan, 2004). These adverse economic conditions are in turn likely to compound the shortage of resources, hindering the reconstruction process (United Nations Development Programme (UNDP), 2005; International Federation of Red Cross and Red Crescent Societies (IFRC), 2006), even leading to project failures and rework (Saunders, 2004; Regnier *et al.*, 2008).

Resourcing is a recurrent problem facing reconstruction practitioners in a post-disaster situation, especially after a major event. Very little research has been done to investigate the reasons for any resourcing difficulties and the possible solutions to address them. This paper compares two resourcing approaches in Indonesia and China in their recovery from large-scale disasters by looking at the factors that affected their post-disaster resource availability. Field-based case studies and a comparative analysis are provided. By drawing on the research findings, a resource availability model and recommendations were suggested to deal with the factors identified, improve the efficiency of resourcing process, and therefore reduce resource waste and cost overruns, and expedite housing reconstruction to the affected populations after a catastrophe.

Resourcing for post-disaster reconstruction

Resourcing broadly encompasses a wide range of activities that have a bearing on resource management for post-disaster reconstruction projects; pre-event resource planning and preparedness; resource procurement; resource delivery; and development of resource alternatives. In terms of the way and extent to which the stakeholders organize and manage resourcing activities, three resourcing implementation approaches are widely applied (Chang *et al.*, 2010a):

(1) Donor-driven resourcing: donors play a dominant role in resourcing the post-disaster reconstruction projects.

(2) Contractor-driven resourcing: professional contractors are tasked with housing reconstruction work including overall resource procurement and delivery.

(3) Community-driven resourcing: the resourcing for rebuilding their own houses after a disaster is mainly driven by the affected communities. This approach uses local materials or any salvaged material in circumstances where owner-build housing construction is a tradition and the communities are capable of doing self-building.

Dynamic resource availability for post-disaster reconstruction requires relevant stakeholders to continuously address the likely constraints related to resource cost (Nazara and Resosudarmo, 2007), quality (Boen, 2006), quantity (Christianson, 1995), environmental concerns (Shaw, 2006; O'Brien *et al.*, 2008), and cultural acceptance (Barenstein and Pittet, 2007). By examining China's Wenchuan earthquake reconstruction, Chang *et al.* (2010b) illustrated that in order to achieve a resilient and sustainable built environment after a disaster, resourcing efforts should be made around four components: legislation and policy, capacity of the construction industry, capacity of the construction market, and capacity of the transportation system. Management of these four components can reduce frustration in a post-disaster resourcing environment.

This study identifies and compares the key factors that affected resource availability in donor-driven reconstruction in Indonesia following the 2004 Indian Ocean tsunami and in contractor-organized reconstruction in China after the 2008 Wenchuan earthquake. The information this paper provides will demonstrate the common factors that are likely to confront international reconstruction practitioners in donor- or contractor-driven disaster situations. The recommendations in this study lead to more effective disaster resource procurement in both countries' reconstruction practices.

Research methodology

The method of analysis adopted in this investigation is a comparative case study due to its explanatory nature of study (Yin, 2003). The Indian Ocean tsunami in 2004 and the Wenchuan earthquake in 2008 were studied for this research paper. On December 26, 2004, an earthquake measured at 8.9 on the Richter scale with its epicenter 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 disaster, NGOs flowed into Indonesia to construct post-tsunami housing in Aceh and Nias.

On May 12, 2008, the Wenchuan earthquake, as it is commonly known, measuring the magnitude (M) 8.0[1], killed 69,266 people, injured 374,643 people, left 17,923 people missing (as of September 11, 2008 noon) and caused widespread destruction to buildings and infrastructure in China's Sichuan Province and its neighbors. 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). In the wake of the Wenchuan earthquake, the construction sector assumed the main reconstruction and restoration work for infrastructure, public facilities, and housing.

Both the Indian Ocean tsunami and the Wenchuan earthquake were the most destructive disasters in their respective countries. In both aftermaths of the two events,

the aid agencies in Indonesia and contractors in China underwent difficulties in procuring resources for post-disaster reconstruction. Thus, comparing these two jurisdictions will help to determine whether common factors affecting resource availability exist in a post-disaster situation. 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. The research data were collected through field-based observations, questionnaire surveys, and interviews. The research profile of the two studied countries is presented in Table I.

A total of 37 factors that have a potential influence on resource availability for post-disaster reconstruction were derived from the extensive literature review[2]. In attempt to make the questionnaire orderly and "user friendly," according to the content and internal features of these identified variables, the content analysis research tool, which contains a conceptual analysis and a relational analysis (Krippendorff, 1980), was applied to categorize these 37 factors into five groups: construction market-related factors, logistics-related factor, reconstruction project-related factors, reconstruction stakeholders-related factors, and environment-related factors. The questionnaire was designed to determine the critical factors that affected resource availability in post-disaster reconstruction. The variations exist between the two questionnaires in the two selected countries, Indonesia and China, due to their specific resourcing context and approach.

A total of 20 questionnaire surveys were carried out with selected stakeholders involved in post-Indian Ocean tsunami reconstruction in Banda Aceh, Indonesia between March and June 2008. The respondents were asked to rank the importance of these five categories from 1 to 5 where 1 denotes the most important and so on, and then to rank the top five factors under each category. Similarly, 26 questionnaire

Country	Disaster impacts	Resourcing approach	Questionnaire survey participants
Indonesia	Life loss 126,900 Economic loss US$4.5 billion	Donor-driven	12 project managers from 6 NGOs[a] (P1-P12) 4 donor reconstruction coordinators (Co1-Co4) 4 governmental officials from BRR (BRR1-BRR4)
China	Life loss 69,266 Economic loss US$123.66 billion	Contractor-driven	16 construction contractors (C1-C16) 5 academic researchers (R1-R5) 5 governmental officials (G1-G5)

Table I.
Profile of field surveys and selected case studies

Notes: BRR is the Agency for Rehabilitation and Reconstruction for Aceh and Nias in Indonesia.
[a]IFRC, CARE, Canadian Red Cross, UNDP, Australian Red Cross, and British Red Cross

surveys in China were conducted between December 2008 and January 2009 with the professionals engaged in post-Wenchuan earthquake reconstruction in Sichuan Province. In the questionnaire, the Chinese respondents were asked to rank the importance of each factor on a five-point Likert scale from 1 to 5, where 1 symbolizes "not important at all" and 5 represents "very important." Due to the different approaches of questionnaire surveys in the two selected countries, the ways to measure the significance of each factor to resource availability under the two contexts are thus different. When analyzing the survey data collected from the Indonesian respondents, a set of weights ranging from 100 to 20 was allocated, where 100 was allocated to the factor which the respondent rated it as 1 the most important and 20 was allocated to the factor which the respondent rated as 5 the fifth important. By calculating the value of each factor based on the respondent's rating score (1-5), the significance of factors was ranked in terms of their respective value (see Appendix Table AI). In comparison, the data processing in China's case is more straightforward by using descriptive *t*-test in SPSS (Triola, 2008). The significance of factors was ranked in terms of their respective mean as shown in Appendix Table AII[3].

Following the questionnaire survey, qualitative data on perceptions and perspectives of these participants were captured in subsequent interviews and follow-up visits to clarify and provide depth to the information yielded in the questionnaire, including a focus on:

- comments on the validity of questionnaire and the proposed resource availability model;
- explanations for ranking of each factor that affected resource availability for reconstruction projects; and
- possible solutions to address resourcing problems during their post-disaster reconstruction process.

A comparative case study method was used, on a basis of the survey results, to analytically discuss the likely similarities and differences between the two resourcing situations. The purpose of the following case study sections are to analyze the experience of managing resources, to specify resourcing problems, and to study lessons learned from resource procurement in their respective post-disaster environment in Indonesia and China. The research findings are presented in as a combination of questionnaire survey result, interview records, and observations.

Factors affected post-disaster resource availability and a comparative analysis

Both post-disaster reconstruction experiences in Indonesia and China demonstrate that resource availability is an essential prerequisite for disaster recovery. The questionnaire findings displayed in both Tables AI and AII reveal that various impediments inherent in their post-disaster environments posed significant obstacles to reconstruction resourcing. The post-disaster reconstruction resource availability model in Table II[4] shows the critical factors identified by questionnaire surveys that affected donor-driven and contractor-driven resourcing outcome in the two studied countries. In general, community-related housing features in Aceh such as housing type, housing culture and customs, community influence, and participation played a predominant role in donor-led resource procurement, whereas factors in relation to project control and management including project schedule, project resourcing

Donor-driven resource availability in Indonesia		Contractor-driven resource availability in China	
Critical factors	Rank	Critical factors	Rank
Competition for resources among aid agencies	1	Legislation and policy	1
Local transportation capacity	2	Project schedule	2
Housing type	3	Competency of resourcing manager	3
Resource procurement lead time	4	Qualification of contractor	4
Local housing culture and customs	5	Project resourcing plan	5
Community influence and participation	6	Quantity of resources required	6
Local government support and assistance	7	Resource procurement lead time	7
Competence of contractor	8	General economic environment	8
NGOs competency of resource procurement	9	Transportation cost	9
Local production capacity	10	Transportation method	10

Table II.
Post-disaster reconstruction resource availability model

plan, resource procurement lead time were brought to fore under the contractor-led resourcing circumstance in China. In line with the previous study by Chang *et al.* (2010b), four key areas for a successful resourcing emerged from this model: resourcing platform: construction market; resourcing access: transportation system; resourcing implementer: construction industry; and resourcing facilitator: governance and legislation. Around these four issues, a comparative analysis is offered.

Resourcing platform: construction market

The construction market-related factors such as competition for resources among aid agencies and local production capacity were raised by the Indonesian respondents as being determinants in donor-driven resourcing in Aceh. However, it appears that the market-related factors did not play a significant role in China's resourcing during the Wenchuan earthquake reconstruction. Instead, the global economic crisis in 2008 had an impact on China's construction market, with a great impact on the steel supply to the earthquake impacted areas. According to the China Iron and Steel Association (2009), in the second half of 2008, steel producers in China were cutting their production due to the reducing demand for steel nationwide. Nevertheless, these major steel makers were not willing to provide steel products for the needed earthquake affected areas with a lower price. This profit-driven behavior of Chinese steel makers made steel supply a problem in the earthquake reconstruction areas.

As was recorded by the research team, the housing culture of Aceh traditionally utilized organic building materials such as timber, thatched grasses, and bamboo. The lack of a sustainable local timber industry within Aceh, coupled with the local demand for westernized "modern" housing after the tsunami, required reconstruction housing to be reliant on external aid agencies with imported industrialized materials such as cement, steel, concrete, and mass-produced products. However, the inadequate local capacity for producing these materials was unable to meet the large-scale reconstruction needs. The quantity and schedule pressure of housing programs from off-site donors, along with the lack of effective overarching leadership and coordination, intensified competition among NGOs for limited resources. The indigenous shortage of resources combined with NGOs' competition compounded their resourcing problem in Aceh.

By contrast, by the time when housing reconstruction in China peaked about five months later, an attempt from the government was made to impose restrictions on building material prices in the earthquake impacted areas. According to the interviews, a series of measures were adopted by the Chinese authorities including setting up price ceilings for each building material, assigning inspectors to monitor the selling price, and establishing a transparent supply-demand information platform detailing daily prices of steel, cement, and brick in 51 affected counties. In addition, the sanctioning of building 75 cement production plants, 760 brick factories, and two large-scale high-performance steel factories also contributed to increase capacity of material production and supply in the local market. This comparison between Indonesia and China reveals the importance of an appropriate level of governance and coordination in the construction market to regulate and supervise behaviors of different resourcing stakeholders. Further research is needed to identify the specific mechanisms in the post-disaster reconstruction period by which trade-off between market regulations and incentives affect resourcing results.

Resourcing access: transportation system

Albeit the different ranks in the resource availability model in Table II, the significant role of transportation in post-disaster resourcing was identified in both cases. As was observed by the researchers, the transportation difficulty encountered by NGOs in Banda Aceh resided with the lack of key requirements for infrastructure such as roading connected to the housing system due to NGOs' over-investment in housing and their ignorance of infrastructure connections. In China, the road and railway system in the earthquake affected areas was mainly damaged and disrupted by a large number of secondary hazards, such as landslides, landslips, mud-rock flow, and "quake lakes." Reopening access was a slow process due to the particular mountainous topography. All modes of transport for delivering building materials to construction sites were applied in China, including human and pack-animal carrying methods. The Transport Ministry of China approved four river-land joint routes for large cargo delivery by fully capitalizing on a comprehensive national transport system. The local authorities enhanced supplementary subsidies for transportation cost and exempting highway tolls for vehicles, which transport materials to the earthquake-affected zone. These strategies of extending transport capacity after the earthquake to expedite the reconstruction process eased transportation pressure for the procuring contractors to deliver important production materials.

Resourcing implementer: construction industry

Despite the varied resourcing approaches used in Indonesia and China, competence of contractors was still regarded in the two cases as being significant in post-disaster resourcing. A number of historical reasons, according to the interviews, can account for the poor competence of local construction industry in Aceh. During decades of conflict, construction and development activities in Aceh were limited. Skilled workers had to be brought in to meet the demand of construction work. As the interviewee P4 pointed out that the construction industry in Banda Aceh was particularly limited by decades of civil conflict, and therefore insufficient for large-scale reconstruction. Nearly 95 percent contractors, solutions, materials, and expertise were imported from outside Banda Aceh, mainly from Java. Our subsequent interviews also confirmed the rank of NGOs competence of resource procurement. Apart from the essential resourcing role required for the local construction, the lack of competency within NGOs was a key

constituent to resourcing failure and thus poor reconstruction performance in Indonesia. Without qualified procurement personnel, suitable facilities and database systems, basic knowledge, and technology regarding resource management in place within these aid agencies, the resourcing issue escalated to a level that significantly impeded the development of post-tsunami housing programs.

In comparison with the Indonesian case, the credentials of the Chinese implementing contractors including the qualification of contractors, competency of resourcing managers, and project management skills of these specialists such as project scheduling, resource planning, and logistical arrangements stood out in the model of Table II as dominant factors for the success of contractor-led reconstruction resourcing. The primary explanation could be that the post-earthquake reconstruction in China was mainly carried out by building professionals from the construction industry. Resource availability of their reconstruction projects was thus mainly determined by their competence and capability of resourcing. However, as was learned from the interviews, resource procurement was conducted in a fragmented and competitive manner, with few alliances spanning industry or with other stakeholders. The awareness of the involved practitioners to engage in disaster prevention and management was poor. This similarity between the two countries points to concerns about whether the construction sector in a disaster prone country is adequately prepared for post-disaster reconstruction, in particular for resource procurement in a possible post-disaster situation.

Resourcing facilitator: governance and legislation

With regard to the governance issue, local government support was perceived by the Indonesian respondents as being the eighth important for donor-driven reconstruction resource availability, whereas legislation and policy was recognized by the Chinese practitioners as the most significant in determining contractor-driven resourcing result. As was learned from the in-depth interviews in China, apart from the *Regulations on Post-Wenchuan Earthquake Restoration and Reconstruction* (The State Council of the People's Republic of China, 2008b) setting the guidelines for the overall earthquake reconstruction, the *One-On-One Assistance Program for Post-Wenchuan Earthquake Restoration and Reconstruction* (The State Council of the People's Republic of China, 2008a) formulated by the National Government became a cornerstone in China's post-disaster recovery management framework. According to the "Program," each affected area is twinned with a developed locality in China with support of 1 percent funding of their annual GDP, human resources and other in-kind assistance. This policy unquestionably impacts on China's nationwide deployment and mobilization of resources for Wenchuan earthquake recovery and reconstruction. In contrast, in Indonesia, the Master Plan[5], formulated by the Indonesian National Government as the "blueprint" to guide tsunami reconstruction operations, received a "cold welcome" at the local level despite the widespread consultation with NGOs, local governments, and communities. As a conciliatory measure, the Master Plan was put aside by BRR and replaced by an evolutionary approach with an emphasis on providing opportunities for communities to participate in the process of reconstruction. The lack of consistency in mandates, operations, and leadership from the government authorities in Indonesia gave a "free hand" to NGOs involved in post-tsunami housing reconstruction. These NGOs, without appropriate resourcing capabilities, tended to pass a "free hand" to local unqualified construction practitioners. Given this, a variety of resourcing problems during post-tsunami reconstruction thus arose.

Proposed solutions for addressing resourcing difficulties

Each of the four main areas derived from the questionnaire findings is presented separately, though in reality the areas are interdependent. The four areas provide a framework within which both two countries, Indonesia and China, can set its own resourcing development agenda to position itself to perform more effectively in a post-disaster situation. The research suggests recommendations to agencies involved in post-disaster resourcing. The most useful recommendations are outlined as follows:

- After a disaster, the local affected community or government needs to assess and identify the resources, skills, and capacity they can provide for reconstruction. A substantial investment in resource mapping nationwide or regionally pre- and post-event is important in informing decision making.
- The implementing agencies' resourcing plans should be developed in line with the political, socio-economic, cultural context in the disaster-affected areas.
- The involvement of the government by means of legislation, policies, administrative interventions, and facilitations is essential. Effective consultation with the local government and communities are required in formulating a resourcing strategy and action plan.
- Priority should be placed on the timely and quick reconstruction and restoration of infrastructure such as transport and telecommunication system and other key public facilities to improve the basic logistics for reconstruction.

The recommendations to improve donor-driven resourcing are given as:

- A combination of NGO's private authority and governmental authority need a collaborative post-disaster reconstruction approach. The actions should be concentrated on building in-house capacity of the aid agencies and the government.
- Government authorities need to work with NGOs to understand resourcing constraints. These authorities should strengthen their own administrative systems and policy making, and enhancing national capacity.
- The focus of the local government and NGOs should be on mapping construction capability and local material supply capacity at the early recovery stage.
- Both local government and NGOs should make effort to enhance the capacity of market supply by improving the local economic circumstances for business and investment and strengthening the critical economic infrastructure.

In China the awareness of construction professionals to engage in post-disaster reconstruction and their continuous capacity building are crucial to a contractor-driven resourcing practice. The recommendations to improve the reconstruction resourcing requirements in China are:

- A comprehensive reconstruction planning in a well-phased and consulted manner is needed. Resourcing bottlenecks should be identified and incorporated into this resource planning before a reconstruction work commences.
- Continuous resourcing capacity building in the construction industry should be undertaken by the local governmental agencies in conjunction with the construction associations, providing training in resourcing procedures, assessing quantities of resources required, and procurement skills to reduce lead time and cost.

- The administrative and technical skills of project managers and resourcing managers in particular should be enhanced by education. Network building with key stakeholders, such as material suppliers and governmental agencies, is required for these resourcing professionals to cope with tougher resourcing tasks after a disaster.

It should be noted that during the surveys in this research, the involved stakeholders strongly supported the construction industry, government, and other key actors working together to advance effectiveness of resource procurement in both pre- and post-event situations. A culture of self-improvement, mutual recognition, and support among the implementing organizations underpins this vision. On the execution side, building practitioners leveraging the construction capabilities into either donor-driven or contractor-driven reconstruction can provide better staffing and practice for post-disaster recovery interventions.

Conclusions

This study provides an investigation into resource challenges and factors that affected resource availability in a post-disaster situation in Indonesia and China. The comparative analysis shows vulnerable issues that would commonly face the international reconstruction practitioners including capacity of the implementing agencies, capacity of the market, capacity of transportation, and governance and legislation. Moreover, the research identified that community-related housing features contributed to the resourcing problem encountered by the donor society in post-tsunami reconstruction in Indonesia, whereas factors related to project control and management predominantly impinged on the resourcing performance conducted by the construction contractors in China. While the decision makers and practitioners are concentrating on finding suitable overarching frameworks for post-disaster recovery and reconstruction, opportunities, and threats of different resourcing approaches should be understood. This paper provides insights into the issues the reconstruction interventions could contribute in arriving at resource availability for a successful disaster recovery.

Notes

1. M 8.0 represents surface wave magnitude, the national standard used by the Chinese government for earthquake magnitude. M 7.9 for the Wenchuan earthquake from The United States Geological Survey reports represents moment magnitude.
2. The literature review on the possible factors that affect resource availability for post-disaster reconstruction projects is reported in the authors' other two working papers.
3. The statistical rationale and analysis for identifying the critical factors that affected resource availability within both Indonesia and China contexts were reported in the authors' other two working paper.
4. Table II presents the top ten factors identified as very important by the respondents in Indonesia and China with their sum score more than 1,200 and with their mean more than 4.5, respectively.
5. The Master Plan was released through the President Regulation (Perpres) No. 34/2005 in April 2005.

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Appendix

Table AI. Questionnaire survey result: Indonesia case study

No.	Factors affecting project resource availability in post-disaster reconstruction	W_1 100	W_2 80	W_3 60	W_4 40	W_5 20	Score	Rank
(I)	*Construction market-related factors*		4	6	10		1,080	III
1.	Resource price fluctuation in market	4	2	1	9	4	1,060	14
2.	Local production capacity	5	4	4	3	4	1,260	10
3.	Pre-existing market structure		6	6	3	5	1,060	14
4.	Competition for resources from other industries			8	5	7	820	20
5.	Competition for resources from among aid agencies	11	8	1			1,800	1
(II)	*Logistics-related factors*		1	3	4	12	660	V
1.	Local transportation capacity	10	10				1,800	1
2.	Transportation method		2	9	9		1,060	14
3.	Transportation cost		4	10	6		1,160	12
4.	Location of depot					20	400	25
5.	Resource procurement lead time	10	4	1	5		1,580	4
(III)	*Reconstruction project-related factors*	2	2	7	5	4	1,060	IV
1.	Project design drawings	4	4	4	6	1	1,220	11
2.	Housing type	12	4	3	1		1,740	3
3.	Quantity of resources required		4	4	2	4	720	21
4.	Resource procurement method	1	2	1	1	3	420	24
5.	Construction technique/technologies		1	1			140	31
6.	Project resourcing plan		1			5	180	30

(*continued*)

No.	Factors affecting project resource availability in post-disaster reconstruction	W_1 100	W_2 80	W_3 60	W_4 40	W_5 20	Score	Rank
7.	Housing reconstruction approach				2		80	33
8.	Project schedule/urgency	2	4	4	4	4	1,000	17
9.	Construction funding	1		1	2	2	280	27
10.	Location of construction site			3	1	1	240	28
(IV)	*Reconstruction stakeholders-related factors*	13	5	1	1		1,800	I
1.	Qualification of contractor	8	1	7	1	1	1,360	8
2.	Selection of material suppliers				1		40	34
3.	Partnership and supplier management				1	4	120	32
4.	Contractor resource database system					1	20	36
5.	Contractor inventory				1		40	34
6.	Supplier inventory						0	37
7.	Cooperation of parties in construction		1	2	5	6	520	23
8.	Coordination among agencies	2	3	1	7	5	880	18
9.	Communication with local authorities			2	2	2	240	28
10.	Local government support and assistance	4	10	3	2		1,460	7
11.	NGOs competency of resource procurement	6	5	5		1	1,320	9
(V)	*Environment-related factors*	5	8	3		4	1,400	II
1.	Legislation and policy	4		8	6	2	1,160	12
2.	General economic environment	1	1	2	4	8	620	22
3.	Social and political stability		1		2	7	300	26
4.	Physical impact of the disaster	2	3	3	5	3	880	18
5.	Local housing culture and customs	7	7	5			1,560	5
6.	Community influence and participation	6	8	2	3		1,480	6

Note: W_1-W_5 symbolize the weights 100, 80, 60, 40, 20, respectively

Table AI.

No.	Factors affecting project resource availability in post-disaster reconstruction	Mean	*t*-value	SD	Significance (2-tailed)
(I) Market-related factors					
1.	Resource price fluctuation in market	3.97	6.009	0.865	0.000
2.	Local production capacity	4.24	9.040	0.739	0.000
3.	Competition for resources from other reconstruction projects	4.07	8.844	0.651	0.000
4.	Competition for resources from other existing construction projects	3.59	3.829	0.825	0.001
5.	Competition for resources from other industries	3.34	1.625	1.143	0.115
(II) Logistics-related factors					
1.	Local transportation capacity	4.38	9.581	0.775	0.000
2.	Transportation method	4.48	12.602	0.634	0.000
3.	Transportation cost	4.55	12.183	0.686	0.000
4.	Resource procurement lead time	4.59	12.520	0.682	0.000
5.	Location of depot	4.10	7.697	0.772	0.000
(III) Project-related factors					
1.	Project design drawings	4.21	8.401	0.774	0.000
2.	Quantity of resources required	4.59	13.607	0.628	0.000

(*continued*)

Table AII.
Questionnaire survey result: China case study

No.	Factors affecting project resource availability in post-disaster reconstruction	Mean	*t*-value	SD	Significance (2-tailed)
3.	Project type	4.00	5.203	1.035	0.000
4.	Project schedule	4.66	18.427	0.484	0.000
5.	Project budget	3.90	5.617	0.860	0.000
6.	Type and method of construction	3.66	4.118	0.857	0.000
7.	Project procurement method	4.00	6.075	0.886	0.000
8.	Resource procurement contract type	3.52	3.057	0.911	0.005
9.	Project resourcing plan	4.59	9.034	0.946	0.000
10.	Location of construction site	4.38	11.945	0.622	0.000
(IV) Stakeholders-related factors					
1.	Qualification of contractor	4.59	10.360	0.825	0.000
2.	Selection of suppliers	3.41	2.268	0.983	0.031
3.	Partnership and supplier management	4.14	8.250	0.743	0.000
4.	Contractor resource database system	4.48	13.899	0.574	0.000
5.	Supplier inventory	3.97	7.112	0.731	0.000
6.	Contractor inventory	4.14	7.353	0.833	0.000
7.	Cooperation of parties in construction	3.86	5.073	0.915	0.000
8.	Coordination among parties in construction	3.69	4.170	0.891	0.000
9.	Communication with local authorities	4.34	6.717	1.078	0.000
10.	Contractor top management commitment	3.62	3.186	1.049	0.004
11.	Competency of resourcing manager	4.59	9.855	0.867	0.000
(V) Environment-related factors					
1.	Legislation and policy	4.83	25.601	0.384	0.000
2.	General economic environment	4.55	13.229	0.632	0.000
3.	Local pre-event economic condition	4.10	7.697	0.772	0.000
4.	Physical impact of the disaster	4.14	8.250	0.743	0.000
5.	Social public attitude	3.21	1.099	1.013	0.281
6.	Community influence	2.62	−2.262	0.903	0.032

Notes: Scale ranges from 1 = not important at all to 5 = very important. The null hypothesis is *H0*: $\mu = \mu_0$ and the alternative hypothesis is *H1*: $\mu > \mu_0$, where μ is the population mean, μ_0 is the critical rating at 3. The level of significance for the one-tailed test is 0.05

Table AII.

About the authors

Yan Chang (Alice) has a Bachelor of Engineering Honours degree in Civil Engineering Management and a Master's degree in Management Science and Engineering, from Central South University in China. She is currently a PhD Student at the Department of Civil and Environmental Engineering, University of Auckland. Yan Chang is the corresponding author and can be contacted at: alicechang918@hotmail.com, ycha233@aucklanduni.ac.nz

Suzanne Wilkinson graduated with a BEng (Honours) and a PhD from Oxford Brookes University. Her PhD was in the area of Construction Management. She then moved to New Zealand and worked at Unitec before joining The University of Auckland in 1996. Her research interests are in project management, construction management and construction law. She is currently involved in two large Government-funded research projects (over $5 million). The first project is Resilient Organizations, where she is leading the contract management component of the project (see www.resorgs.org.nz for all the research publications and project details). This project examines the management problems associated with post-disaster reconstruction. The second project is "Retrofit Solutions" where she is also leading the financial analysis section of

the project which is examining retrofitting New Zealand buildings to protect them against seismic damage (see www.retrofitsolutions.org.nz for all the research publications and project details).

Regan Potangaroa is an Associate Professor at the School of Architecture, Unitec, Auckland. However, during the semester breaks he is on standby as a RedR Engineer (refer to www.redr.org) often being assigned to the United Nations in various disaster situations throughout the world. In the last seven years he has worked in Aceh (following the 2004 tsunami disaster), Pakistan (following the Afghanistan conflict and again for the 2005 earthquake), Syria (at the time of the Iraq conflict), West Timor (at the establishment of a separate Timor), West Darfur (at the initial onset of internal conflict) and Geneva (with UNHCR). Regan has a Bachelor degree and a Master's degree in Civil Engineering from Canterbury University, a Master's in Architecture from Victoria University, a Master's in Business Administration and a PhD in Architectural Engineering from James Cook University in Townsville, Australia. Despite this academic background, his professional experience has been as a Consulting Structural Engineer of 25 years experience gained in 13 different countries.

Erica Seville is a Research Fellow with the Department of Civil Engineering at the University of Canterbury, and also director of Risk Strategies Research and Consulting. She has a Bachelor of Engineering Honours degree and a PhD in Risk Assessment. After completing her PhD she spent four years in the UK where she worked as a Risk Management Consultant, providing advice for leading public and private sector clients, including London Underground Ltd, Railtrack, the UK Ministry of Defence, National Audit Office, Defence Procurement Agency, and Shell Gas Trading. She also worked with JP Morgan Chase in London managing operational risks during the trade settlement process.