http://researchspace.auckland.ac.nz

ResearchSpace@Auckland

Copyright Statement

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

This thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- Any use you make of these documents or images must be for research or private study purposes only, and you may not make them available to any other person.
- Authors control the copyright of their thesis. You will recognise the author’s right to be identified as the author of this thesis, and due acknowledgement will be made to the author where appropriate.
- You will obtain the author's permission before publishing any material from their thesis.

To request permissions please use the Feedback form on our webpage. http://researchspace.auckland.ac.nz/feedback

General copyright and disclaimer

In addition to the above conditions, authors give their consent for the digital copy of their work to be used subject to the conditions specified on the Library Thesis Consent Form and Deposit Licence.

Note : Masters Theses

The digital copy of a masters thesis is as submitted for examination and contains no corrections. The print copy, usually available in the University Library, may contain corrections made by hand, which have been requested by the supervisor.
Resourcing for Post-disaster Housing Reconstruction

Yan Chang

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Civil Engineering, The University of Auckland, 2012
Abstract

Large-scale disasters often present significant recovery challenges to the built environment in terms of resources and capacity. This dissertation examines the resourcing for housing recovery projects following a major disaster. The dissertation reviews existing conceptualizations of post-disaster housing reconstruction patterns and processes, and presents an analytical model that situates resourcing in the context of post-disaster housing recovery. The research is designed as a comparative study around five components in the analytical model to understand resource availability for post-disaster housing reconstruction: 1) post-disaster recovery and reconstruction environment, 2) housing reconstruction approach, 3) resourcing stakeholders for housing reconstruction, 4) ‘indicator resources’ and their availability, and 5) critical factors that affect resource availability for post-disaster housing reconstruction.

The analytical model is applied, respectively, to examine the varied resourcing issues and long term housing recovery following major disasters in Aceh, Indonesia, in Sichuan, China, and in Victoria, Australia. Based on questionnaire survey and in-depth field interviews, a set of spatial, statistical, and descriptive analyses identify the dynamics of resource availability in varied recovery environments, and test the relationship between the contextual factors, such as the institutional arrangements, housing approach and resourcing stakeholders, and the resourcing outcomes. This is complemented by an in-depth comparative discussion across three cases.

Study findings show that the specific contextual factors, such as cultural elements, socio-economic environment, and political agenda, in the studied cases influenced the manifestation of the resourcing problems and solutions. The essential difference in terms of resource availability topology depends mainly on legal arrangements for disaster recovery, and the adopted approach to housing reconstruction. The research also demonstrates that despite different resourcing approaches in the three cases, competence of construction professionals, and government response and intervention are common determinants to resource availability for housing recovery projects.

This dissertation promotes a multi-stakeholder approach to integrated resource planning and preparedness for post-disaster housing recovery. Central to its success is that the construction industry, a pivotal actor in disaster recovery, adopts engagement practices that would facilitate
this integration, and that the governmental authorities empower the industry to realize its full potential. The study expects to contribute to future public and industry planning policy debates on post-disaster housing recovery, in Indonesia, China, Australia and beyond, by providing an understanding of resource availability for housing reconstruction following a large-scale disaster.
Dedication

“\textit{I have loved you with an everlasting love; I have drawn you with loving-kindness.}”

\textit{(Jeremiah 31:3)}

To my grandmother, my parents, my twin sister Fei, and my fiancé Jamie

Without whom I will not be here

For the people of Aceh, Sichuan and Victoria
Acknowledgments

For me, who never learned how to be independent, a four year PhD study is not easy. Four-year overseas study makes me grow mature and sober. Four-year learning changes my life, my mindset, and attitude to life. Four-year PhD, to me, is not only an academic journey, but more a pathway to re-define and understand ‘love’—Love the following people who never give me up, who hold me tight, walk with me, and become the essence of my life; Love the people in the disaster fields, whether I met them, or not, who carry their courage, faith, and hope to build up a new life.

I am deeply grateful to my main supervisor Dr. Suzanne Wilkinson for trusting me in the first instance and offering me the opportunity to do a PhD overseas. She has been fully engaged in my dissertation project and walking with me along this journey with her whole-hearted support, encouragement, and unrelenting TLC (tender, loving and caring). All her comments, suggestions, and intelligence contribute significantly to the accomplishment of this dissertation.

I am greatly indebted to my co-supervisor Dr. Regan Potangaroa and his lovely and wonderful wife Florence, who ‘adopted’ me to their family — a family full of love, warmth and security. Their encouragement has helped me build up my confidence. I give my special thanks to Dr. Regan Potangaroa whose experience and wisdom provided me with much needed guidance, and whose admirable commitment to the humanitarian aid work injected strength and vitality into the purpose of my life and meaning of my work.

I owe thanks to the ‘Resilient Organisations’, especially Dr. Erica Seville who provided diverse opportunity to expand my knowledge and offered thoughtful and constructive advice tailored to my research needs. I also thank the ‘Resilient Organisations’ for awarding a research grant that supported this dissertation research, along with the University of Auckland (UOA) and The Chinese Scholarship Council (CSC) for providing administrative and financial support.

I want to express my sincere appreciation to other advisors from the ‘Resilient Organisations’ Dave Brunsdon, Tony Fenwick, and Dr. Dean Myburgh for their generous assistance and
constant support, for their sharing their perspectives, and providing inputs that have made this dissertation possible. Special thanks are given to ‘Resilient Organisations’ researchers Charlotte Brown, Tom Wilson, and Sonia Giovinazzi at the University of Canterbury for their stimulating discussions, mutual support and correspondence to keep me on the track.

While it is difficult to mention everyone, I am grateful to the following institutions and people who generously offered their time, shared their experience, helped with data collection, and transformed this project from theoretical proposal into a grounded life experience. First, I thank Care International, UNDP, Canadian Red Cross, IFRC, and BRR office in Banda Aceh for helping me gather data. In particular, I appreciate the help from Bikram Chand Thakuri, Yam Kumar Gurung, Jurgen Dorbecker, and Fakri Karim who consistently facilitated the data collection in Aceh. Second, I thank Sichuan University, the Construction Bureau of People’s Government of Mianzhu, and the reconstruction support team of Hunan Province for their facilitation of data collection in Sichuan. Special thanks go to Professor Hong Chen and Professor Da-lu Tan from Sichuan University, and to Yi Huang, Jun Chen, Li-min Wang, Guo-an Zhang, and Hui Zou for their help in innumerable ways. Finally, I owe great thanks to Max Ginn from VBRRRA who provided significant assistance and facilitation to make my data collection in Victoria possible. I am also grateful to Paul Steinfort, John Hanna, Hank Leine, Sue Hill, Paul Jones, and Rob Freeland for sharing their time and perspective, and providing assistance in data collection.

I have a heart of gratitude to the people of Aceh, Sichuan and Victoria for trusting me with their stories, sharing their perspectives, providing their insights into my research. Special thanks go to the friends I made during my field trips to these places. For so many reasons — welcoming me, helping me find a place to stay, sharing home with me, and showing me around the city, providing transportation for me to do data collection, inviting me to enjoy their fantastic cooking — I give my thanks to these simple, but lovely people for their valuable friendship and help.

My special thanks go to Dr. Anuradha Mukherji from the University of California, who posted her PhD thesis to me and shared research experience with me; to Dr. Richard Haigh from Salford University and Dr. Lee Bosher from Loughborough University who I never met, but have been providing remarkable comments, guidance, and support to my research; to Professor Stephanie Chang from the University of British Columbia and Professor George Ofori from the National
University of Singapore who shared their time and experiences with me, and strengthened my dedication to my research; to Professor Men-jun Wang and Professor Feng Guo from Central South University, and Professor Dong-ping Fang from Tsinghua University in China for their unfaltering help and support; and finally to those anonymous reviewers who made insightful comments and critiques on my works, expanding my knowledge and advancing my writings.

I own thanks to colleagues and friends Fei Ying, Grace Scafer, Kelvin Zuo, James Rotimi, Reza Jafarzadeh, Mohammad Reza Zare, Temitope Egbelakin, Tingting Liu, Sandeeka Mannakkara, Sakina Mokhtar, Joshua Olorunkiya, Mohammad Akli, Bo Li, and Nasee Ameer Ali for their constant support to my study. Most of the time I spent with them in office made the thesis writing process seem less lonely and painful for me. In particular, I give my thanks to Fei Ying and her families for always lending me a home to stay, and lending me a shoulder to lean upon. I thank Kelvin Zuo and his wife Yan Yang who provided me with a comfortable place to stay when I first came to New Zealand, and who offered me wonderful friendship over these years.

Special thanks go to my wonderful friends Jacky Zhang, Xiumin Zhao, Justin Liu, Jane Wu, Victor Peng, Emma Wang, and Stoney Si, and my best friends in China Qi Chen, Shi-ping Yuan and his families, Rui-bo Tian, Lin-lin Kong, Jun-fang Li, Jun Le, Jian Gu, and Xin Zhang for being in my life and for always being available when I need. I also greatly thank my brothers and sisters in Auckland University Maclaurin Capel for their constant encouragement and support, and for always remembering me in their prayers.

Finally, and above all, to my grandparents, my parents Yuan-jun Chang and Qing-qun Zou, my sister Fei Chang and brother-in-law Yong Yu, and my beloved fiancée Jamie Richards and his families for their immutable love, unconditional support, and adamant sacrifices. Because of them, my commitment, my efforts, and my devotions to this study are all worthwhile. In particular, I give my gratitude to my fiancé Jamie who has shared this journey with me and looked after me to make sure I stay healthy and happy. His constant encouragement, love and patience have been the beacon of my journey.
# Table of Contents

Abstract ................................................................................................................................. ii
Dedication ............................................................................................................................... iv
Acknowledgments .................................................................................................................. v
List of Figures ......................................................................................................................... xvi
List of Tables ......................................................................................................................... xviii
Glossary .................................................................................................................................... xxi

**Chapter 1 Introduction** .................................................................................................... 1

1.0 Introduction ..................................................................................................................... 1

1.1 Background ..................................................................................................................... 1

1.2 The research problem ...................................................................................................... 4
   1.2.1 The disaster and its meanings .................................................................................. 6
   1.2.2 Housing recovery .................................................................................................... 8
   1.2.3 Resourcing and resource availability for housing recovery ..................................... 9

1.3 The research analytical framework ................................................................................ 11

1.4 Research methodology .................................................................................................. 15

1.5 Organization of this dissertation .................................................................................... 19

**Chapter 2 Disaster management and housing recovery** .................................................. 22

2.0 Overview ........................................................................................................................ 22

2.1 Understanding disasters .................................................................................................. 22
   2.1.1 What constitute a disaster? ..................................................................................... 22
   2.1.2 What result from a disaster? – Two sides of a coin ................................................. 25

2.2 Managing disasters ........................................................................................................ 28
   2.2.1 Paradigms of disaster management ....................................................................... 29
   2.2.2 Disaster response: risk, vulnerability and resilience ............................................... 33

2.3 Country-specific disaster management systems ............................................................ 40
2.3.1 The United States ........................................................................................................... 40
2.3.2 Australia .......................................................................................................................... 43
2.3.3 New Zealand ...................................................................................................................... 45
2.3.4 China .................................................................................................................................. 48
2.3.5 Indonesia ............................................................................................................................ 50
2.3.6 Critique of the different approaches to disaster management ........................................... 52

2.4 Post-disaster recovery and reconstruction ........................................................................... 57
  2.4.1 Understanding recovery and its implications ................................................................. 58
  2.4.2 Post-disaster rebuilding and reconstruction ................................................................. 67
  2.4.3 Why housing? And its reconstruction approaches ......................................................... 72

2.5 Concluding statements ........................................................................................................ 81

Chapter 3 Resourcing for post-disaster reconstruction .............................................................. 83
  3.0 Overview ............................................................................................................................. 83
  3.1 Construction resources and resource management ............................................................ 83
    3.1.1 Resources for house construction ............................................................................... 84
    3.1.2 Resource management in construction projects ......................................................... 89
  3.2 Resourcing approaches to post-disaster housing reconstruction ........................................ 94
    3.2.1 Understanding resourcing for housing projects ......................................................... 94
    3.2.2 Resourcing approaches to post-disaster reconstruction ........................................... 106
  3.3 Resource availability for disaster recovery projects ......................................................... 107
    3.3.1 Post-disaster ‘indicator resources’ ............................................................................... 108
    3.3.2 Understanding resource availability for post-disaster housing reconstruction ......... 109
    3.3.3 Factors affecting resource availability in disaster recovery projects ......................... 114
  3.4 Overall summary of knowledge gaps in literature ............................................................ 121

Chapter 4 Research framework and methodology .................................................................. 124
4.0 Overview ........................................................................................................................................ 124

4.1 Analytical framework and research questions ............................................................................ 124

   4.1.1 Housing recovery and reconstruction after a major disaster: A synthesis .............................. 125
   4.1.2 The concepts of ‘resourcing’ and ‘resource availability’ in housing recovery .............. 127
   4.1.3 A conceptual model for resource availability in housing reconstruction .................. 129
   4.1.4 Research questions ........................................................................................................... 132

4.2 The research process ...................................................................................................................... 133

4.3 The research design ....................................................................................................................... 137

   4.3.1 Selection of research design .............................................................................................. 137
   4.3.2 Selection of mixed research method .................................................................................... 146

4.4 Research methods .......................................................................................................................... 152

   4.4.1 Literature review ............................................................................................................... 152
   4.4.2 Case studies ....................................................................................................................... 154
   4.4.3 Questionnaire survey within case studies ........................................................................... 160
   4.4.4 Field-based observations and interviews .............................................................................. 167
   4.4.5 Research workshops and conferences events ........................................................................ 174

4.5 Relevant issues with research design ............................................................................................ 178

   4.5.1 Reliability and validity of research ...................................................................................... 178
   4.5.2 Limitations of using case study research methods ............................................................... 183
   4.5.3 Cross culture and country comparison ............................................................................... 184

4.6 Ethical considerations .................................................................................................................... 186

4.7 Summary ......................................................................................................................................... 187

Chapter 5 Resourcing housing recovery following the 2004 Indian Ocean tsunami in Indonesia ........................................................................................................................................ 189

5.0 Overview ....................................................................................................................................... 189

5.1 Post-tsunami recovery and reconstruction environment ............................................................... 189
7.1.3 Institutional arrangements for post-bushfire recovery ........................................ 301

7.2 Post-bushfires housing recovery approach ............................................................. 310
7.2.1 Building controls for housing construction before the bushfires ....................... 310
7.2.2 Changes in building controls for housing reconstruction after the bushfires ........ 314
7.2.3 Post-bushfires housing recovery actors ................................................................ 316

7.3 Resourcing stakeholders for housing recovery in Victoria ...................................... 323
7.3.1 Resourcing facilitator: VBRRA and Building Commission .................................... 324
7.3.2 Resourcing procurer: construction contractors/builders .................................... 325
7.3.3 Resourcing driver: building product manufacturers ............................................ 326

7.4 ‘Indicator resources’ and their availability for post-bushfire housing recovery ..... 328
7.4.1 Availability of windows for housing recovery ...................................................... 329
7.4.2 Availability of roofing systems for housing recovery ........................................... 331
7.4.3 Availability of builders and trades people for housing recovery ......................... 333
7.4.4 Impacts of low resource availability on housing recovery projects .................... 335

7.5 Critical factors that affected resource availability in bushfire housing recovery ..... 337
7.5.1 Market-related factors ....................................................................................... 338
7.5.2 External factors in bushfire recovery environment ............................................. 341
7.5.3 Local contextual factors ................................................................................... 345

7.6 Conclusions and recommendations ...................................................................... 349

Chapter 8 Cross case comparative discussion ............................................................ 352
8.0 Overview ................................................................................................................. 352

8.1 Post-disaster recovery and reconstruction environment ........................................ 352
8.1.1 Banda Aceh, Mianzhu and Marysville ................................................................. 352
8.1.2 Multi-stakeholder responses to the disaster event ............................................. 354
8.1.3 Institutional arrangements for post-disaster recovery ....................................... 357
8.2 Post-disaster housing recovery approach ......................................................... 367
  8.2.1 Housing culture and type ............................................................................. 367
  8.2.2 Post-disaster housing reconstruction actors ................................................ 371
  8.2.3 Characteristics of housing recovery approach ............................................... 378
8.3 Resourcing stakeholders for housing recovery .................................................. 383
  8.3.1 Roles and responsibilities of resourcing stakeholders for housing recovery .... 384
  8.3.2 Resourcing approaches for housing recovery ............................................... 385
8.4 ‘Indicator resources’ and their availability for post-disaster housing recovery .... 388
8.5 Critical factors that affected resource availability for housing recovery .......... 394
  8.5.1 Government response and intervention ....................................................... 395
  8.5.2 The construction market ............................................................................. 396
  8.5.3 Transportation system ................................................................................. 398
  8.5.4 Construction professionals ......................................................................... 399
  8.5.5 Specific local conditions ............................................................................. 400
8.6 Summary ............................................................................................................ 401

Chapter 9 Conclusions and recommendations ....................................................... 403
9.0 Overview ............................................................................................................ 403
9.1 Resourcing for post-disaster housing reconstruction: A Synthesis ............... 403
  9.1.1 Recovery governance and Institutional arrangements for housing recovery .... 404
  9.1.2 Revisiting resource availability for housing recovery .................................. 406
  9.1.3 Evaluation of research findings ................................................................... 407
9.2 Research recommendations ................................................................................. 409
  9.2.1 Legislation and policy revamping ................................................................. 410
  9.2.2 Construction industry capability enhancement ........................................... 411
  9.2.3 Market re-measurement and re-structuring ............................................... 412
9.2.4 Transportation planning for capacity development ................................................. 413
9.2.5 Consideration of local conditions into overall planning ...................................... 414
9.2.6 A synthesis vision for integrated resource planning ............................................. 414

9.3 Contribution to knowledge base ............................................................................ 418
   9.3.1 Research theoretical contributions ................................................................. 418
   9.3.2 Research limitations ....................................................................................... 425
   9.3.3 Future research directions ............................................................................. 427
   9.3.4 Reflective comments on the research process ................................................ 427

9.4 Practical implications ............................................................................................. 429

9.5 Postscript ............................................................................................................. 431

Bibliography ............................................................................................................. 433
List of Figures

Figure 2.1 Process of disaster repercussion with multiple impacts ................................................................. 25
Figure 2.2 Interaction of vulnerability factors (UN/ISDR, 2004).................................................................. 34
Figure 2.3 The disaster management cycle (Alexander, 2002).................................................................... 52
Figure 2.4 Emergency management drivers (Britton, 2002, p.47)............................................................... 53
Figure 2.5 Hass et al. (1977)'s recovery process (Sullivan, 2003)................................................................. 60
Figure 2.6 An enhanced recovery process (Sullivan, 2003)........................................................................ 61
Figure 2.7 Charlotte's Doughnut (Sullivan, 2003).......................................................................................... 62
Figure 2.8 Integrated and holistic recovery (MCDEM, 2007), (VBBRA, 2009).............................................. 63
Figure 2.9 Five stages in recovery process (Brunsdon and Smith, 2004)...................................................... 68
Figure 3.1 Cost calculation for building projects (Klein, 2008, p.42)........................................................... 89
Figure 3.2 Research rationales for project resource management ................................................................. 92
Figure 3.3 Project resource supply and management systems, adapted from (Jones, 2005, p.309).............. 95
Figure 3.4 Stakeholders in the resourcing post-disaster reconstruction projects..................................... 102
Figure 3.5 Three dimensions of resource availability .................................................................................... 109
Figure 4.1 Framework for analyzing resource availability for post-disaster housing reconstruction..... 130
Figure 4.2 Research process ......................................................................................................................... 134
Figure 4.3 Diagram of the overall research design ....................................................................................... 144
Figure 4.4 Two-fold role of the literature review in the research ................................................................. 152
Figure 4.5 Case study chapter structure in the research, in line with Yin (2003, p.50)............................. 160
Figure 4.6 Linkages between the interviews and other data gathering methods........................................ 169
Figure 5.1 Areas affected by the 2004 Indian Ocean tsunami, source: ReliefWeb Map Centre (2005)... 191
Figure 5.2 Map of Aceh and Nias in Indonesia and city of Banda Aceh....................................................... 192
Figure 5.3 Comparative photos of Banda Aceh before and after the tsunami......................................... 194
Figure 5.4 Aceh and Nias rehabilitation and reconstruction timeframe ....................................................... 199
Figure 5.5 Traditional Acehnese house, source: (BRR, 2006)........................................................................ 202
Figure 5.6 Masonry houses rebuilt by the international aid agencies in Aceh............................................. 204
Figure 5.7 Houses rebuilt by aid agencies with poor workmanship ............................................................. 208
Figure 6.1 Areas affected by the 2008 Wenchuan earthquake, source: (IFRC, 2008).............................. 239
Figure 6.2 Map of Mianzhu City and Deyang Prefecture in Sichuan Province.......................................... 241
Figure 6.3 Comparative photos of Hanwang in Mianzhu before and after the quake ........................................... 244
Figure 6.4 Post-Wenchuan earthquake recovery and reconstruction governance structure ........................................ 249
Figure 6.5 Traditional Qiang ethnic house in Aba Tibetan-Qiang Autonomous Prefecture .............................. 254
Figure 6.6 Rebuilt houses in Sichuan after the Wenchuan earthquake ................................................................. 257
Figure 6.7 Rebuilt houses of Qiang and Tibetan ethnics in Sichuan Province ......................................................... 258
Figure 6.8 Change in price of bricks between 2008 and 2010 .............................................................................. 272
Figure 6.9 Change in price of aggregate between 2008 and 2010 ................................................................. 274
Figure 6.10 Change in wage of labour between 2008 and 2010 .......................................................................... 277
Figure 7.1 Areas affected by the ‘Black Saturday’ fires in the State of Victoria (CFA, 2009a) ..................... 295
Figure 7.2 Map of bushfire-affected Shire of Murrindindi and field trip sites (CFA, 2009b) ....................... 297
Figure 7.3 Comparative photos of Marysville before and after the bushfires .................................................. 299
Figure 7.4 Temporary accommodation for displaced people in Marysville Temporary Village .................. 305
Figure 7.5 Bushfire recovery and reconstruction framework ............................................................................. 306
Figure 7.6 Murrindindi bushfire recovery and reconstruction agencies .......................................................... 309
Figure 7.7 Victorian planning and building legislation in relation to wildfire (Bushfire CRC, 2009) .... 316
Figure 8.1 Ladder of community participation in post-disaster housing reconstruction ............................... 374
Figure 8.2 Factors that affected resource availability for housing reconstruction ......................................... 394
Figure 9.1 Integrated resource planning framework for post-disaster housing reconstruction ............ 410
List of Tables

Table 1.1 Human and economic loss of major disasters between 2005 and 2010 ........................................... 2
Table 1.2 Research questions and objectives ................................................................................................. 13
Table 2.1 Comparative summary of disaster paradigms (McEntire et al., 2002) .............................................. 32
Table 2.2 Comparison of approaches to disaster risk reduction ................................................................. 39
Table 2.3 Key points with respect to disaster management systems in the U.S., Australia, NZ, China and Indonesia ....................................................................................................................... 56
Table 2.4 Linkages between components of recovery, vulnerability and resilience .................................... 65
Table 2.5 Predominant issues in post-disaster reconstruction .......................................................................... 71
Table 2.6 Matrix of post-disaster housing reconstruction approaches ......................................................... 81
Table 3.1 Classes of building product types (Mitchell et al., 2005) ............................................................... 84
Table 3.2 Bulk class building product lines (Mitchell et al., 2005) ............................................................. 85
Table 3.3 Shaped class building product lines (Mitchell et al., 2005) ......................................................... 85
Table 3.4 Itemized building product lines (Mitchell et al., 2005) ............................................................... 86
Table 3.5 Estimated resource inputs into construction projects (Hillebrandt, 1988) .................................. 90
Table 3.6 Comparative summary of four resource-related operations in construction projects .......... 99
Table 3.7 Likely participants in a post-disaster reconstruction project (Davidson, 2010, p.101) .......... 101
Table 3.8 Summary of roles and responsibilities of resourcing stakeholders ............................................ 105
Table 3.9 Effects of resource availability on the outcome of disaster recovery projects ..................... 111
Table 3.10 Factors that are likely to have an effect on resource availability .............................................. 120
Table 3.11 Summary of knowledge contributions and knowledge gap in literature .............................. 121
Table 4.1 Relevant situations for different research designs (Yin, 2003, p.5) ............................................. 128
Table 4.2 Matrix of research features and considerations for selecting case study method .......... 138
Table 4.3 Multiple research methods to address research questions 1-5 ................................................. 148
Table 4.4 Research methods to address the research question 6 ............................................................... 149
Table 4.5 Data collection types, advantages and limitations ................................................................. 151
Table 4.6 Selection of multiple case studies ................................................................................................. 156
Table 4.7 Summary of pilot study details in three case studies ................................................................. 162
Table 4.8 Summary of the information on questionnaire respondents ...................................................... 166
Table 4.9 Summary of the information on interviews ............................................................................... 171
Table 4.10 Research related conference events and presentations

Table 4.11 Workshops and seminars attended by the researcher during the research

Table 4.12 Case study tactics for four design tests in the research

Table 5.1 Impacts of the 2004 Indian Ocean tsunami (Athukorala and Resosudarmo, 2005, p. 5)

Table 5.2 Characteristics of Banda Aceh before the tsunami (Nurdin, 2006)

Table 5.3 Impacts of the tsunami on Banda Aceh (Nurdin, 2006)

Table 5.4 Ten propositions for defining post-tsunami 'Build Back Better'

Table 5.5 Funding commitments to post-tsunami reconstruction (BRR and Partners, 2005)

Table 5.6 Policies and guidelines for tsunami recovery

Table 5.7 Cost of resources in Aceh, from 2004 to 2006 (Nazara and Resosudarmo, 2007)

Table 5.8 Availability of timber materials for tsunami housing reconstruction

Table 5.9 Availability of cement for tsunami housing reconstruction

Table 5.10 Availability of bricks for tsunami housing reconstruction

Table 5.11 Availability of skilled labour for tsunami housing reconstruction

Table 5.12 Cost of an ETESP house in Aceh (Asian Development Bank, 2009)

Table 6.1 Impacts of the 2008 Wenchuan earthquake

Table 6.2 Characteristics of City of Mianzhu before the earthquake

Table 6.3 Impacts of the earthquake on Mianzhu City

Table 6.4 Principles for post-Wenchuan earthquake reconstruction

Table 6.5 Reconstruction divisions in the earthquake affected areas

Table 6.6 Retrofit and rebuilding housing units in rural areas

Table 6.7 Retrofit and rebuilding housing area in urban areas

Table 6.8 Housing reconstruction progress in Mianzhu, from 2008 to 2010

Table 6.9 Observed resource availability over the reconstruction trajectory

Table 6.10 Estimated supply shortfalls of cement, brick and steel in Sichuan

Table 6.11 Cost of labour and materials in rural areas between 2008 and 2009

Table 6.12 Availability of bricks for earthquake housing reconstruction

Table 6.13 Availability of aggregate for earthquake housing reconstruction

Table 6.14 Availability of labour for earthquake housing reconstruction

Table 6.15 Determinants affecting resource availability in housing recovery in Sichuan
Table 7.1 Impacts of the 2009 Victorian ‘Black Saturday’ bushfires ................................................................. 296
Table 7.2 Statistics of damage from bushfires in the Shire of Murrindindi ................................................................. 297
Table 7.3 Impacts of the bushfires on Marysville ........................................................................................................... 298
Table 7.4 Immediate response to the 'Black Saturday' bushfires .................................................................................. 300
Table 7.5 Initiatives under the Bushfire Recovery Assistance Package (Disaster Assist, 2011) ........................................... 302
Table 7.6 VBRRA principles for post-bushfire recovery and reconstruction ................................................................. 307
Table 7.7 BALs within the new building standards (Building Commission Victoria, 2009) .............................................. 315
Table 7.8 Summary of roles and responsibilities of housing reconstruction stakeholders in Victoria .......................... 322
Table 7.9 Additional cost of building a single storey house under AS3959-2009 (Building Commission Victoria, 2009) .......................................................................................................................................................................................... 328
Table 7.10 Availability of windows for bushfire housing reconstruction ................................................................. 331
Table 7.11 Availability of roofing systems for bushfire housing reconstruction ................................................................. 333
Table 7.12 Availability of builders and tradespeople for bushfire housing reconstruction ................................................. 335
Table 7.13 Determinants affecting resource availability in housing recovery in Victoria ............................................. 338
Table 8.1 Comparative profiles of the three cities ............................................................................................................. 354
Table 8.2 Comparative responses to the disaster event ................................................................................................. 355
Table 8.3 Comparative institutional arrangements for disaster recovery ......................................................................... 358
Table 8.4 Comparative housing type and culture in case studies ..................................................................................... 368
Table 8.5 Comparative roles and responsibilities of housing reconstruction stakeholders ............................................. 371
Table 8.6 Comparative funding sources for post-disaster housing reconstruction ......................................................... 381
Table 8.7 Comparative roles and responsibilities of resourcing stakeholders .................................................................. 383
Table 8.8 Comparative 'indicator resources' (IRs) and their availability in housing recovery ............................................. 389
Table 9.1 Research objectives fulfilled by relevant thesis sections .................................................................................. 408
Table 9.2 Planning areas for improving post-disaster recovery resource availability ..................................................... 416
Table 9.3 Knowledge gaps fulfilled by relevant thesis sections .......................................................................................... 418
Table 9.4 Required paradigm shift in resourcing for post-disaster reconstruction ............................................................ 424
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
</tr>
<tr>
<td>AELG</td>
<td>Auckland Engineering Lifelines Group</td>
</tr>
<tr>
<td>AOTULE</td>
<td>Asia-Oceania Top University League on Engineering</td>
</tr>
<tr>
<td>AUD</td>
<td>Australian currency</td>
</tr>
<tr>
<td>BNPB</td>
<td>The National Disaster Management Agency (Indonesia)</td>
</tr>
<tr>
<td>BRR</td>
<td>The Agency for Rehabilitation and Reconstruction for Aceh and Nias</td>
</tr>
<tr>
<td>BAPPNAS</td>
<td>The National Development Planning Agency (Indonesia)</td>
</tr>
<tr>
<td>BPS</td>
<td>Aceh Bureau of Statistics</td>
</tr>
<tr>
<td>BAL</td>
<td>Bushfire Attack Level</td>
</tr>
<tr>
<td>Bushfire CRC</td>
<td>The Bushfire Cooperative Research Centre (Australia)</td>
</tr>
<tr>
<td>CRED</td>
<td>Centre for Research on the Epidemiology of Disasters</td>
</tr>
<tr>
<td>COAG</td>
<td>The Council of Australian Governments</td>
</tr>
<tr>
<td>CDEM</td>
<td>Civil Defence and Emergency Management</td>
</tr>
<tr>
<td>CNCIDR</td>
<td>The Chinese National Committee for International Disaster Reduction</td>
</tr>
<tr>
<td>CRC</td>
<td>The Canadian Red Cross</td>
</tr>
<tr>
<td>CRC</td>
<td>Community Recovery Committee</td>
</tr>
<tr>
<td>CPERRF</td>
<td>The Central Post-Wenchuan Earthquake Restoration and Reconstruction Fund (China)</td>
</tr>
<tr>
<td>CFA</td>
<td>Country Fire Authority (Australia)</td>
</tr>
<tr>
<td>CSIRO</td>
<td>The Commonwealth Scientific and Industrial Research Organization (Australia)</td>
</tr>
<tr>
<td>DHS</td>
<td>The Department of Homeland Security (US)</td>
</tr>
<tr>
<td>DHS</td>
<td>The Department of Human Services (State of Victoria, Australia)</td>
</tr>
<tr>
<td>EM-DAT</td>
<td>Emergency Events Database</td>
</tr>
<tr>
<td>ENLA</td>
<td>The Emergency Network Los Angeles</td>
</tr>
<tr>
<td>EMA</td>
<td>Emergency Management Australia</td>
</tr>
<tr>
<td>EMO</td>
<td>Emergency Management Office (China)</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>EMMA</td>
<td>The Emergency Market Mapping and Analysis Toolkit</td>
</tr>
<tr>
<td>EA</td>
<td>Emergency Architects</td>
</tr>
<tr>
<td>ETESP</td>
<td>Earthquake and Tsunami Emergency Support Project</td>
</tr>
<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency (US)</td>
</tr>
<tr>
<td>FRST</td>
<td>The Foundation of Research Science and Technology</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GNS</td>
<td>Institute of Geological and Nuclear Sciences</td>
</tr>
<tr>
<td>GFDRR</td>
<td>Global Facility for Disaster Reduction and Recovery</td>
</tr>
<tr>
<td>GAM</td>
<td>Gerkan Aceh Mardeka (Free Aceh Movement)</td>
</tr>
<tr>
<td>HFFA</td>
<td>Hyogo Framework for Action</td>
</tr>
<tr>
<td>IFRC</td>
<td>The International Red Cross and Red Crescent</td>
</tr>
<tr>
<td>INGOs</td>
<td>International Non-government Organizations</td>
</tr>
<tr>
<td>IDNDR</td>
<td>The International Decade for Natural Disaster Reduction</td>
</tr>
<tr>
<td>IRP</td>
<td>The International Recovery Platform</td>
</tr>
<tr>
<td>ILO</td>
<td>The International Labour Organization</td>
</tr>
<tr>
<td>ISO</td>
<td>The International Organization for Standardization</td>
</tr>
<tr>
<td>IOM</td>
<td>International Organization for Migration</td>
</tr>
<tr>
<td>MCDEM</td>
<td>The Ministry of Civil Defence and Emergency Management (New Zealand)</td>
</tr>
<tr>
<td>MCA</td>
<td>The Ministry of Civil Affairs (China)</td>
</tr>
<tr>
<td>MPBI</td>
<td>The Indonesian Society for Disaster Management</td>
</tr>
<tr>
<td>MPW</td>
<td>The Ministry of Public Works (Indonesia)</td>
</tr>
<tr>
<td>MoU</td>
<td>The Memorandum of Understanding</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-government Organizations</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>NDRC</td>
<td>The National Development and Reform Commission (China)</td>
</tr>
<tr>
<td>OCHA</td>
<td>Office for the Coordination of Humanitarian Affairs</td>
</tr>
<tr>
<td>PMI</td>
<td>Project Management Institute</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>PLA</td>
<td>The People’s Liberation Army (China)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RMIT</td>
<td>Royal Melbourne Institute of Technology</td>
</tr>
<tr>
<td>RMB</td>
<td>Chinese currency</td>
</tr>
<tr>
<td>Rp</td>
<td>Indonesian currency</td>
</tr>
<tr>
<td>RBP</td>
<td>Registered Building Practitioner (Australia)</td>
</tr>
<tr>
<td>RAS</td>
<td>Rebuilding Advisory Service (State of Victoria, Australia)</td>
</tr>
<tr>
<td>RAC</td>
<td>Rebuilding Advisory Centre (State of Victoria, Australia)</td>
</tr>
<tr>
<td>RTAA</td>
<td>The Roofing Tile Association of Australia (Australia)</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium Sized Enterprise</td>
</tr>
<tr>
<td>SERP</td>
<td>The State Emergency Recovery Plan (State of Victoria, Australia)</td>
</tr>
<tr>
<td>TEWS</td>
<td>Tsunami Early Warning System</td>
</tr>
<tr>
<td>UN/ISDR</td>
<td>United Nations/The International Strategy for Disaster Reduction</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNDHA</td>
<td>United Nations Department of Humanitarian Affairs</td>
</tr>
<tr>
<td>UN</td>
<td>The United Nations</td>
</tr>
<tr>
<td>UK</td>
<td>The United Kingdom</td>
</tr>
<tr>
<td>US</td>
<td>The United States</td>
</tr>
<tr>
<td>USD</td>
<td>US currency</td>
</tr>
<tr>
<td>UNHCR</td>
<td>United Nations High Commissioner for Refugees</td>
</tr>
<tr>
<td>UNDRO</td>
<td>United Nations Disaster Relief Organization</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
</tr>
<tr>
<td>UNFAO</td>
<td>United Nations Food and Agriculture Organization</td>
</tr>
<tr>
<td>UNSYIAH</td>
<td>Universitas Syiah Kuala (State University of Syiah Kuala, Banda Aceh, Indonesia)</td>
</tr>
<tr>
<td>UNJLC</td>
<td>United Nations Joint Logistics Centre</td>
</tr>
<tr>
<td>USAID</td>
<td>The United States Agency for International Development</td>
</tr>
<tr>
<td>UNCRD</td>
<td>United Nations Centre for Regional Development</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>VBRC</td>
<td>The 2009 Victorian Bushfires Royal Commission</td>
</tr>
<tr>
<td>VBRRA</td>
<td>The Victorian Bushfires Recovery and Reconstruction Authority</td>
</tr>
<tr>
<td>VDC</td>
<td>The Village Development Committee</td>
</tr>
<tr>
<td>WHE</td>
<td>World Housing Encyclopedia</td>
</tr>
<tr>
<td>WWF</td>
<td>World Wildlife Fund</td>
</tr>
<tr>
<td>WMO</td>
<td>The Wildfire Management Overlay</td>
</tr>
</tbody>
</table>
Chapter 1 Introduction

1.0 Introduction
Large-scale disasters often present significant challenges to the built environment, in terms of resources and capacity. Availability of resources for disaster rebuilding projects may face problems of supply, demand, cost escalation and quality. These impacts emerge in ways that reinforce, exacerbate, and undermine the reconstruction process and outcomes of longer-term community recovery. This inquiry into post-disaster resourcing practice aims to understand resource availability in housing reconstruction following a major event. By researching the impacts of inadequate availability of resources on disaster recovery projects, problematic resources causing these impacts, dynamics of resource availability during housing reconstruction, the factors that affect resource availability for housing reconstruction, and variations in resource availability and resourcing issues in different recovery environments, a thorough understanding of resource availability for post-disaster housing reconstruction can be attained to inform resource planning and preparedness for future disasters.

1.1 Background
The *Hyogo Framework for Action 2005-2015 (HFFA): Building the Resilience of Nations and Communities to Disasters* (UN/ISDR, 2005) in 2005 and the establishment of the *Global Platform for Disaster Risk Reduction* in 2006 underlined the crucial role of reducing risks and strengthening community resilience to disasters. In spite of efforts made to achieve this goal, the five year period between 2005 and 2010 has seen an increased number in major disasters. The events in Table 1.1 give details of disasters in this timeframe. The human life and the financial losses involved as a result of these disasters stand out as an indication to nations facing disaster events.
Table 1.1 Human and economic loss of major disasters between 2005 and 2010

<table>
<thead>
<tr>
<th>Major disasters (2005-2010)</th>
<th>Hurricane Katrina</th>
<th>Great Pakistan Earthquake</th>
<th>Cyclone Nargis</th>
<th>Wenchuan Earthquake</th>
<th>‘Black Saturday’ Bushfires</th>
<th>Haiti Earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
<td>US</td>
<td>Pakistan</td>
<td>Myanmar</td>
<td>China</td>
<td>Australia</td>
<td>Haiti</td>
</tr>
<tr>
<td>Death toll</td>
<td>1836</td>
<td>90,000</td>
<td>85,000</td>
<td>69,266</td>
<td>173</td>
<td>230,000</td>
</tr>
<tr>
<td>Economic loss¹</td>
<td>$138 billion</td>
<td>$5 billion</td>
<td>$4 billion</td>
<td>$123.69 billion</td>
<td>$4 billion²</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: 1. US dollars; 2. The exact economic cost is still not clear, but the 2009 Victorian Bushfires Royal Commission estimated it to be more than AUD$4 billion, which is seen as approximately equivalent to USD$4 billion. NA: not available
Source: (Munich Re, 2008), (Munich Re, 2009), (Guy Carpenter's Instrat, 2006), (China's State Planning Group2008), (VBBRA, 2009), (The 2009 Victorian Bushfires Royal Commission, 2010)

The disaster information in Table 1.1 is statistically in line with Cutter and Emrich (2006)’s observation that hazard vulnerability is increasing, and is not evenly distributed geographically and socially. Antecedent evidence shows that when media and public attention has receded in the aftermath of an event, the survivors in disaster-impacted areas are left confronting the significant challenges of recovering from disaster. Of the recovery elements in the built environment, housing, as one of the basic human needs, is often placed as the top priority in a country’s recovery agenda (Oliver-Smith, 1990; Comerio, 1997; Brezar, 2005). However, increased complexities and uncertainties in a post-disaster environment mean that delivery of housing is more difficult than it is for conventional projects (Alexander, 2004). As such, the ways in which housing and resources are procured may not be able to cope with challenges posed by the large-scale disaster recovery (Barakat, 2003; Masurier et al., 2006a; Jha et al., 2010).

A number of studies have focused on exploring the efforts to improve the performance of reconstruction projects (e.g. (Ofori, 2002; Lizarralde, 2004; Lorch, 2005; Makhanu, 2006; Ahmed, 2008; Mumtaz et al., 2008)), and on advocating a series of community and government initiatives in disaster mitigation (e.g. (Schilderman, 2004; Wu and Lindell, 2004; Burby, 2005; Kenny, 2005; James, 2008)). Previous research directs this study, as they show that there is much still unknown about the ways in which communities and countries recover and rebuild after a disaster. In particular, the literature is mostly sketchy on the understanding of resource management for housing reconstruction post disaster. On-the-ground realities differ from
theoretical studies and the implications of a large-scale disaster for longer term reconstruction are not fully understood. Of the research evidence available on resource management, it tends to show that post-disaster recovery projects after a major event are more likely to suffer resource shortages (UN-Habitat, 2005; Steinberg, 2007; Kennedy et al., 2008) and supply disruption (Jayasuriya and McCawley, 2008; Zuo and Wilkinson, 2008). These resourcing problems can transform into final recovery project failures such as cost overruns (Koria, 2009; Chang et al., 2010) and deferred delivery (Nazara and Resosudarmo, 2007; Boen, 2008) in the disaster-affected areas.

For instance, after the 2004 Indian Ocean tsunami, a lack of building materials such as sand, stone, cement, timber and brick in Indonesia created a major bottleneck to housing recovery (ADB, 2007; Nazara and Resosudarmo, 2007; Zuo and Wilkinson, 2008). Prior to the Christchurch earthquakes of 2010 and 2011, the shortage of aggregate, human resources, and heavy equipment, was identified as one of the potential constraints to the recovery process in New Zealand if a large-scale disaster were to strike (Brunsdon and Smith, 2004; Singh, 2007). Moreover, one of the longer term effects caused by resource shortages following a disaster can be ‘socio-economic displacement’, which was manifested in tsunami impacted Indonesia and Sri Lanka in forms of inflationary chaos (Jayasuriya et al., 2005; Nazara and Resosudarmo, 2007), ‘Dutch Disease’¹ (Adam and Bevan, 2004), and cost surge (Jayasuriya and McCawley, 2008). As Jayasuriya et al. (2005) observed, the impact of the tsunami had intensified resource shortages that existed pre-event in Sri Lanka, fuelled inflation, constrained the government’s fiscal capacity, and adversely affected housing reconstruction. These problems, combined with procurement deficiencies of the implementing agencies and resourcing-induced environmental degradation, reduced the overall effectiveness of recovery in tsunami-impacted countries (UNDP2005; IFRC2006).

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.
On the other hand, a number of experiences have shown positive results when resource bottlenecks are dealt with by appropriate post-disaster policies. Taking the Tangshan earthquake (1976) recovery as an illustration, resourcing in this situation was not a threat to post-quake physical reconstruction whereby, “A master plan was formulated, heavy equipment was purchased and industrial plants were established to produce reconstruction materials” (Mitchell, 2004, p.52). A number of scholars such as Ye & Okada (2002) and Sullivan (2003) have recognized that desirable post-disaster reconstruction could only be made possible by systematic recovery planning, with a focus on making the resources available for long-term reconstruction. In addition, when examining their post-tsunami reconstruction involvement, many non-government organizations (NGOs), international non-government organizations (INGOs) such as the International Red Cross and Red Crescent Society (IFRC) (2006), and the UN agencies such as United Nations Development Programme (UNDP) (2005b; 2006a) also highlight the importance of resource availability as being an integral constituent in the ultimate efficacy of post-disaster recovery efforts.

While these findings have clear implications for resourcing reconstruction, little attention has been given to an overall and systematic analysis of the underlying resource vulnerabilities and constraints inherent in a longer term recovery process. Many studies concerned with resource deployment and allocation are mainly targeted at emergency response to meet short-term humanitarian relief needs after a disaster (e.g. (Perry and Lindell, 2003; Thompson et al., 2006; Troy et al., 2008)). This dissertation precisely attempts to address such a knowledge gap by examining resource availability for post-disaster housing reconstruction in varied environments.

1.2 The research problem

While the immediate research objectives have to do with resourcing for post-disaster housing reconstruction following a large event, the underlying reason for undertaking this study is to shed light on the residential reconstruction process. The research shows how resource procurement and management for post-disaster housing recovery projects are more difficult than in normal construction times. The research develops an analytical tool to understand resource availability in a post-disaster environment, examines the dynamics of resource availability, and analyzes the
subsequent outcomes of housing recovery. Apart from highlighting contrasts which entail significant disparities of resource availability and reconstruction performance within case studies, this study goes beyond the variations to identify the intricate resourcing-related commonalities in different post-disaster recovery contexts. These commonalities are particularly interesting for policy decision makers, as they can be used to develop robust post-disaster resource planning policies.

This research investigates the dynamics of resource availability for post-disaster housing reconstruction following large-scale events. Post-disaster recovery and reconstruction processes, practices, and outcomes depend on a number of factors such as the relations between stakeholders (Mukherji, 2008; Davidson, 2010), institutional organization and arrangements (Inam, 1997, 2005), and the capacity of local communities (Comerio, 1998). Variations also exist within a community, with different reconstruction approaches applied to different housing programs. Such variances limit the ability to generalize findings related to community resilience, housing damage, and recovery of the built environment, but allow insights into how differing communities cope with their recovery.

The outcomes of the longer-term post-disaster reconstruction in terms of quality, cost and timeliness are not uniform across the events, places, times and contexts. While some disaster-impacted areas may suffer immediate shortages of resources for reconstruction, other areas may experience longer-term economic distortions and significant recovery delays due to scarcity of resources. Similarly, the varied resourcing processes that are put in place by relevant decision makers or reconstruction practitioners may have varied implications for housing recovery across regions. Central to this research is an effort to examine and explain variations in the resourcing of the housing projects following contemporary disaster events — the 2004 Indian Ocean tsunami, the 2008 Wenchuan earthquake, and the 2009 Victorian ‘Black Saturday’ bushfires, and to understand the processes and drivers that led to such disparities. Before discussing how to tackle this specific set of questions, it is useful to establish the theoretical framework and intellectual boundaries of the research.

The overarching theme of this research is post-disaster resource availability for housing reconstruction in disaster-affected areas. By examining different disaster case studies, resource availability can be seen to be intrinsically linked to the specific post-disaster context in terms of
physical, social, and economic environments. Resource availability is also associated with the chronic vulnerability conditions in existence before the event. Therefore, in order to understand resource availability and its effects on housing recovery, it is imperative to re-examine existing knowledge and paradigms with respect to the following three sets of issues.

1) **First**, how do we understand and theorize ‘disasters’, its causes and its impacts — such as physical, social, economical, and ecological. More specifically, what is the relationship between natural hazards and human vulnerabilities, and how do we manage the consequences of our vulnerabilities.

2) **Second**, what is ‘housing’? What patterns and types of housing are important to meet our needs after a disaster? What are the technical and social effects of disasters on housing? How do house owners rebuild their homes? What causes variations in post-disaster housing recovery outcomes? What is the relationship between physical housing reconstruction and other components of community recovery, such as social, economic and environmental?

3) **Third**, how do we understand ‘resourcing’, as it is compared with the well established concepts in construction project management, such as resource management, resource procurement, and supply chain management? What role does resourcing practice play in shaping the recovery outcomes of housing and communities? What implications does resource availability have for project implementation at both normal times and a post-disaster situation?

### 1.2.1 The disaster and its meanings

The disaster is traditionally understood by its consequences on human society. Earthquakes, floods, tornadoes, and hurricanes fail to qualify as disasters if they do not involve people. They are purely natural phenomena, and regarded as natural hazards that constitute one type of ‘trigger agents’ to disasters. By removing its ‘natural’ veil, ‘disasters’ are essentially social phenomena (Cuny, 1983; Hewitt, 1995), and it is vulnerability that constitutes the other part of ‘trigger agents’ to disasters (Alexander, 1997). A number of examples such as the 1994 Northridge earthquake in Los Angeles, the U.S. (Petak and Elahi, 2000), and the 2010 Darfield earthquake in Canterbury, New Zealand (GNS, 2010) had shown relatively positive results, in terms of
building damage and life loss, due to pre-existing stringent Building Codes in the two jurisdictions. In contrast, extensive building collapse and damage, and loss of life in the 2010 Haiti earthquake had reflected the impact of physical vulnerability upon the human community in an earthquake (Lindell, 2010). Likewise, the 2005 Hurricane Katrina in New Orleans, the U.S. has been recognized by a number of researchers, such as Comfort (2005a), and Lotke and Borosage (2006) as a disaster that was created by nature while devastated by human failure to prepare for and respond to an environmental hazard.

The scope, magnitude and scale of disasters are normally used as indicators to measure and categorize a disaster. According to the response capacity, for instance, the disastrous events can be classified into three types, namely, emergency, disaster, and catastrophe (Quarantelli, 2000). However, a disaster also creates opportunities for the improvement of affected communities. These opportunities are inherently embedded in the recovery process after a disaster (International Recovery Platform, 2007). A holistic framework for disaster management should be based on a full understanding of both impacts and opportunities resulting from a disaster.

There are several paradigms which guide disaster management practice, including disaster-resistant communities, disaster-resilient communities, sustainable development/sustainable hazards mitigation, and comprehensive vulnerability management (McEntire et al., 2002; McEntire, 2003; 2004a; 2005). Along with the recent paradigmatic shift from ‘vulnerability’ to ‘resilience’, and from ‘disaster management’ to ‘disaster risk management’, the disaster management operations in countries such as the U.S., Australia, New Zealand, China and Indonesia have also demonstrated an realization of importance of disaster risk reduction through ‘built-in resilience’. Such perspectives help to further understand the role and nature of recovery in disaster management.

Opportunities are inherent in the post-disaster recovery process. These opportunities have broadened out the range of recovery activities that can be integrated into the recovery environment to make the disaster-affected communities more resilient. In spite of variations in recovery definitions and classifications, recovery is seen as all encompassing of rehabilitation, reconstruction, recovery and restitution and reinstatements with the objective of bringing the affected communities back, as a minimum, to pre-event normalcy or, as a preference, with an enhanced level of resilience. Invariably, the fundamental notion in this dissertation is that
recovery should be a community-centric process. With community in the centre, integrated recovery extends into the social, built, natural and economic environments. Among these four components of recovery, the built environment is the focus of this present study.

1.2.2 Housing recovery

Everyone is surrounded by, and in constant interaction with the built environment. The impacts of a large event on the built environment can be profound to wipe out years of development and investment (Bosher, 2011a). Ofori (2008) suggests that the immutable nature of built assets, the inability to accurately test them for resilience to hazards, the legislative and socio-economic requirements of development, the requirements for ongoing maintenance, adaption and redevelopment, and the potential appropriation by the end-user, all render built assets especially vulnerable to a wide range of hazards, and these hazards change over time. In particular, housing, as an integral part of the built environment, is a unique phenomenon and has its unique political, economic, and social connections with humans (Clapham, 2009).

Aside from the fact that the United Nations charter of human rights (Article 25 of the Universal Declaration of Human Rights) establishes the right to adequate housing as a fundamental human right, the housing infrastructure of an urban region is essential for the social stability and economic competitiveness of regions. This thesis argues that without timely rebuilding of the housing stock and without the adequate provision of housing for the disaster-affected populations, a disaster can further generate significant negative effects that may extend beyond the confines of affected areas. This effect was demonstrated in research where concentrated housing damage and slow reconstruction led to the so-called ‘ghost town’ and a downward spiral of residential decline (Kamel and Loukaitou-Sideris, 2004).

The condition of housing is the result of concerted social resilience efforts: it has an economic cost involved, and it has a cultural role to play, and its implementation of recovery and reconstruction requires a multi-stakeholder approach. As Zhang and Peacock (2010) suggest that housing recovery is key to revitalizing communities following a major disaster. Further, the level of community resilience to natural disasters is not only a function of the physical built condition, but it is also affected by the degree to which social systems can absorb and adjust to systematic stresses introduced by natural phenomena (Kamel, 2004). Resilience of housing can in turn affect the level of community resilience. Post-disaster housing studies should be placed in a
broader recovery context, including cultural conditions, material conditions, socio-economic conditions, and institutional conditions. The disruption brought about by a natural disaster in housing sector, however, creates an opportunity for social and material-oriented improvements through housing recovery, particularly in the longer-term permanent housing reconstruction.

To determine the most appropriate approaches to housing reconstruction becomes one of the most complex tasks facing recovery managers after a disaster. There is a common consensus about the importance of community involvement in post-disaster reconstruction projects (Jha et al., 2010). However, as Davidson et al. (2007, p. 113) pointed out, construction in general and reconstruction in particular are rooted in their socio-politico-economic contexts and there is no single ‘best’ approach for community participation. The community participatory methods need to be embedded into the context of the target areas (Ganapati and Ganapati, 2009). Otherwise, ‘participatory development’ may be used as a convenient ‘buzzword’ to satisfy a specific group, while the integrity of the approach is ignored (James, 2008). Therefore, by examining post-disaster housing reconstruction approaches, this research offers a contribution towards the study of this problem with a particular focus on how the post-disaster housing environment is best resourced. The research conducted for this thesis presents a detailed analysis of three varied housing recovery models and the reconstruction practice used, and shows how the findings can be applied to improve future disaster reconstruction practices.

1.2.3 Resourcing and resource availability for housing recovery

Resource availability is a key constituent to construction project success (Belassi and Tukel, 1996; Chua et al., 1999; Korde et al., 2005). Masurier et al. (2006b) note that the disaster reconstruction differs from routine construction in terms of interrelated reconstruction challenges such as allocation of responsibility for coordination, scarcity of resources, and the application of legislation and regulations that were written for routine construction rather than post-disaster reconstruction. In the aftermath of a large-scale disaster, access to normal resource levels will be insufficient (Masurier et al., 2006a; Resilient Organisations, 2006a). Resource pressures including shortages of materials, components, and specialized skills and professionals are likely to affect reconstruction cost, quality and timeliness.

Unlike resource procurement in normal construction times, the reconstruction effort involves many different stakeholders concerned with resourcing for house rebuilding after a major
disaster. However, who holds overall responsibility for resourcing, to a great extent, depends on the relative power of the resourcing participants in a specific reconstruction model. In comparison with definitions of resource management, resource procurement and supply chain management, the term resourcing in this thesis is used to encompass a wide range of activities in a broader construction environment than normal construction business environments, so that the post-disaster acquisition of resources for construction projects can be captured. By identifying the principal stakeholders involved in resourcing for disaster housing projects, along with their roles and responsibilities, this research provides an understanding of potential opportunities and constraints inherent in project procurement, as well as the prospective contributions from each stakeholder to improve post-disaster recovery resourcing results.

Past events have shown that there are certain types of resources that are of particular interest and importance during the period of disaster reconstruction. For example, difficulties in timber procurement, posing a deterrent to the housing reconstruction in Aceh after the 2004 Indian Ocean tsunami (Zuo et al., 2009; Asian Development Bank, 2010). In this research, resources that are likely to be subject to shortages during construction and thus have an impact on the delivery of a housing recovery project are defined as ‘indicator resources’. This study deals exclusively with resourcing operations associated with ‘indicator resources’ including building professionals such as contractors and builders, and labour, along with building materials and products. By recognizing ‘indicator resources’, their availability, and the factors affecting their availability in a post-disaster recovery situation, this research assists the recovery decision makers and practitioners to plan for and respond to the likely shortages of these resources in any future events.

Finally, housing reconstruction is potentially a highly political process because the extent and scale of the resources involved and the impact of this work has on people’s lives (Barakat, 2003). Variations in the resourcing practice of post-disaster housing reconstruction across jurisdictions can also depend on the political importance of stakeholders and their ability to influence and mobilize resources in the disaster recovery areas (Freeman, 2004). This research offers a contribution towards the study of this problem. The scope of the research is international comparisons, examining resource availability for post-disaster housing recovery in developing and developed countries, and considering natural disasters of all types. There is a focus on case
studies and experience in donor-driven, government-driven and market-driven resourcing modes in Indonesia, China and Australia. A cross-cultural comparison looks at ways in which interventions for the provision and supply of construction resources are being used so as to draw lessons, determine good practice, and promote the sharing of experiences from different disaster recovery practice to increase post disaster community resilience.

1.3 The research analytical framework

This research is part of a six year national ‘Resilient Organisations’ research programme funded by the Foundation of Research Science and Technology (FRST) in New Zealand. ‘Resilient Organisations’ is collaboration between New Zealand research universities, including the University of Canterbury and the University of Auckland, and key industry players; and supported by a diverse group of industry partners and advisors. The main objective of this PhD research is to develop an integrated resource availability framework for post-disaster reconstruction for the purpose of improving housing recovery and reconstruction.

This research consists of developing and testing a model for understanding resource availability for post-disaster housing reconstruction. This model, in the following diagram, is based on five elements of a post-disaster recovery resourcing process: the post-disaster recovery and reconstruction environment, the housing reconstruction approach, the resourcing stakeholders for housing reconstruction, ‘indicator resources’ and their availability, and the critical factors that affect resource availability. This model is tested in the cases of the 2004 Indian Ocean tsunami in Aceh, Indonesia, the 2008 Wenchuan earthquake in Sichuan, China, and the 2009 ‘Black Saturday’ bushfires in Victoria, Australia. The conceptual framework is situated in the recovery process and the object of analysis is the built environment, with particular emphasis on the residential housing sector. To realize a full understanding of resource availability for housing recovery in a post-disaster situation, the following research questions and objectives in Table 1.2 are proposed.

---

2 ‘Resilient Organisations’ is a six year research project designed to assist New Zealand organizations to recover economic competitiveness after hazard events by improving their resilience. For further details are available at ‘Resilient Organisations’ website: www.resorgs.org.nz
The methodology applied in this study consisted of two main parts. To answer the research questions Q1 to Q5, the first part examines the process of post-disaster housing recovery and resourcing within each individual disaster case. To answer the research question Q6, the second part of research discusses and compares the five elements in the analytical framework for an in-depth analysis of resourcing processes and outcomes in different recovery environments. Findings from both sections are integrated to validate the suggestions on resource planning and preparedness in order to improve resource availability for post-disaster housing recovery.
Table 1.2 Research questions and objectives

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Research objectives</th>
</tr>
</thead>
</table>
| **Q1. What is recovery and reconstruction environment like after a major disaster?** | (a) To identify post-disaster institutional arrangements, policies, programs, and practices for disaster recovery and reconstruction.  
(b) To identify specific contextual elements that affect the way the housing recovery is organized and managed. |
| **Q2. What approach is adopted for post-disaster housing recovery?** | (a) To recognize the predominant issues for housing recovery after a disaster.  
(b) To identify housing recovery approach and methods applied to rebuilding houses for communities. |
| **Q3. Who are the principal stakeholders involved in resourcing for disaster housing projects?** | (a) To undertake stakeholder analysis with respect to principal stakeholders involved in resourcing practice in post-disaster recovery operations and their relationships. |
| **Q4. What are ‘indicator resources’ in the wake of the disaster that hinder housing reconstruction?** | (a) To identify ‘indicator resources’ for housing recovery projects.  
(b) To assess the availability of these identified ‘indicator resources’. |
| **Q5. What are the critical factors that affect resource availability for housing recovery?** | (a) To identify critical factors that affect resource availability for post-disaster housing reconstruction.  
(b) To identify the relationships between these resource availability determinants. |
| **Q6. How does the resource availability for disaster housing recovery vary across different recovery environments?** | (a) To compare the resource availability elements across different recovery environments.  
(b) To identify the commonalities and disparities with respect to resourcing for disaster recovery projects across different recovery environments. |

The following explains the sub-objectives proposed to address the research questions.

1. **(a) To identify post-disaster institutional arrangements, policies, programs, and practices for disaster recovery and reconstruction**  
   (b) To identify specific contextual elements that affect the way the housing recovery is organized and managed**

This study aims to understand the institutional arrangements adopted for disaster housing reconstruction and emerging issues in each of examined case studies. This requires a meticulous
understanding of existing resourcing strategies and methods in the disaster recovery field and locates their disaster recovery practice within the overall disaster spectrum. This objective is fulfilled through an analysis of literature and field-based investigations.

2. (a) To recognize the predominant issues for housing recovery after a disaster
(b) To identify housing recovery approach and methods applied to rebuild houses for communities

For analytical purposes, this research makes a distinction among three reconstruction approaches that were pursued after a major disaster. By comparing reconstruction approaches, the degree of community decision making and control, the form of external assistance, the role of the actors can be identified.

3. (a) To undertake stakeholder analysis with respect to principal stakeholders involved in resourcing practice in post-disaster recovery operations and their relationships

4. (a) To identify ‘indicator resources’ for housing recovery projects
(b) To assess the availability of these identified ‘indicator resources’

5. (a) To identify critical factors that affect post-disaster resource availability
(b) To identify the relationships between these resource availability determinants

To examine the resourcing issues and resource availability under each studied disaster. This objective is achieved through a triangular research method designed to identify the involved resourcing stakeholders, ‘indicator resources’ and their availability, factors of significance to resource availability, and propose the likely solutions by which the impact of resourcing problems on recovery could be reduced. Achievement of these three sets of sub-objectives helps reinforce the understanding of resourcing problems inherent in varied disaster contexts and helps prioritize strategies to improve their respective resourcing practice.

6. (a) To compare the resource availability elements across different recovery environments
(b) To identify the commonalities and disparities with respect to resourcing for disaster recovery projects across different recovery environments
This comparative discussion across the case studies seeks to encourage cross-cultural sharing and learning from past disaster events and suggest improvements to allow for a multi-stakeholder approach to resourcing for disaster recovery projects. Insights gained from this comparative exercise also provide a basis for developing an integrated planning framework to address the challenges and issues commonly presented in the examined recovery environments.

1.4 Research methodology

When selecting an appropriate research design to articulate the whole research process, an overhaul of research questions and objectives was conducted to align with the relevant research methods. By conducting such a matching exercise, the mixed methods research design was selected embracing the methods of case study, triangulation and comparative analysis. The research design in the following diagram shows the process of developing each case study and the specific tactics of data collection, analysis, and validation. The main research methods described in this chapter include: literature review, case studies, questionnaire survey, field-based observations and interviews, research-related workshops, conferences, and seminars.

(1) Literature review

According to Kumar (1996), reviewing the literature can help to bring clarity and focus to a research problem, improve the methodology, and broaden the knowledge base in the research area. In line with these three functions, a literature review is used throughout the dissertation at three different levels. At the first level, a thorough literature review that is relevant to the current subject is undertaken to analyze issues and challenges in disaster recovery practice. The research further reviews the reconstruction mechanisms and resourcing approaches used in disaster recovery projects. Factors that affect resource availability in both conventional project management and post-disaster reconstruction are reviewed. The literature review at this level serves as an instrument to help identify the research gap and implications, and is presented in this dissertation in Chapter One and Two.

The reviewed literature at level two serves as sources of secondary data to provide background materials and information concerning the research background and case study. This type of
literature review can be seen in the introduction Chapter One, case study Chapters Five, Six and Seven. The third level of literature review acts as an analytical tool to provide evidence in discussing the research results and justify the contributions of the current study in a broader research field. Therefore, the literature review at this level is integrated into the presentation of research results and discussion in case study Chapters of Five, Six and Seven, as well as cross-comparison Chapter Eight.

(2) Case studies

A rationale for case study use is when the case represents an extreme case or a unique case which is worth documenting and analyzing (Yin, 2003). The nature of disaster events, however, is likely to align with this rationale. To answer the research questions and address the research objectives, case studies of the recent disastrous events in Indonesia, China and Australia were conducted to capture their specific circumstances and conditions with respect to resource availability for post-disaster housing recovery. An overarching analytical design is cross case comparison to compare and discuss the resource availability for housing reconstruction in the varied post-disaster environments.

(3) Triangulation for data collection and analysis

A triangulation data collection method was used, mixing qualitative and quantitative methods in the case studies (Todd, 1979). To fulfil the research objectives, the quantitative evidence was collected through the pilot study and questionnaire survey to indicate critical factors that impinged upon resource availability in disaster housing recovery projects. The qualitative data was captured via in-depth interviews and on-site observations to understand the underlying relationships revealed in the quantitative data, and to assess the post-disaster recovery and reconstruction environment, housing recovery approach, and resourcing practice in each case. In response to two differing types of data, statistical analytical techniques were utilized to deal with questionnaire data, whereas the specialized NVivo software was used to transcribe and interpret qualitative data. A series of validation methods was used to ensure the internal and external validity of research methods and findings.
(4) Other supporting research activities

Apart from the main research methods used for data gathering within case studies, to achieve a thorough understanding of the researched topic, the researcher attended a number of workshops, conferences, and seminars, all of which provided the valuable opportunity to refine the research topic and present outcomes. Meanwhile, information provided by other industry practitioners or academic researchers on the current research helped guide the focus of the research and research directions. The overall research process and the applied research methods at varied stages of research are shown in the following flowchart. The detailed information on research methodology is presented in Chapter Four.
Comparative analysis

Case studies

Case study of Indonesia
(2004 Indian Ocean tsunami housing reconstruction)

case study of China
(2008 Wenchuan earthquake housing reconstruction)

Case study of Australia
(2009 Victorian ‘Black Saturday’ bushfires housing reconstruction)

Quantitative method:
Questionnaire

Qualitative methods:
Documentation
Archival records
Field observations
Interviews

Step 2: Data gathering - Chapter 4, 5, 6, 7

Step 3: Comparative analysis & synthesis - Chapter 8

Step 4: Conclusion - Chapter 9

Figure 4.3 Diagram of the overall research design
1.5 Organization of this dissertation

The body of this dissertation is divided into three sections. Section I, comprising this introduction and Chapters 2, 3 and 4, sets out to explore in detail an argument for the analysis of resource availability for post-disaster reconstruction, based around a variety of concepts in studies of disasters and project management. This theoretical debate is grounded in Section II in case study Chapter 5, 6, and 7, which examine resource availability for housing recovery projects in three contrasting post-disaster contexts. In Section III, three case studies and theoretical debate are then synthesized in a comparative analysis presented in Chapter 8. Chapter 9 concludes the research findings and contributions, and provides insights generated from case study findings to inform research and practice.

The three case study countries have different political, economic, social and environmental systems. These differences fulfil two purposes. First, they form a bridge in the literature on disaster recovery which has largely focused on places with easy access to data, and with institutional similarities. Second, they represent examples of post-disaster recovery in both developing and developed countries under contrasting political-economic regimes. The first case study of a donor-driven resourcing approach is set in Banda Aceh, Indonesia, one of the most devastated areas in the 2004 Indian Ocean tsunami. In Banda Aceh, where local capacity and resources were inadequate, post-disaster housing recovery and reconstruction required assistance from outside of the nation. In comparison, the second case study is set in China where a centralized administrative system largely managed post-disaster recovery, and resource availability under such an environment was likely to manifest itself in a different manner. The third case study focuses on the Victorian bushfires in Australia where there is a relatively robust economic and political system. Post-disaster management settings and housing recovery in Victoria were primarily reliant upon their institutional routines in helping communities recover from the bushfires.

By comparing three cases in-depth, an argument is made for pre-planning and preparedness as a basis that can move forward theory and policy on resourcing post-disaster. An integrated resource planning and preparedness solution prior to a disaster incorporates the notion of proactive response to likely resourcing problems and impacts. Finally, some priority planning...
areas for further study and reflection are identified to encourage a broader discourse on resourcing for post-disaster reconstruction.

The dissertation is organized in the following manner.

**Chapter 1:** introduces the research subject and provides background information on the scope and focus of the research problem. The need for undertaking this study is justified by both theory and practice in the field of disaster management, post-disaster housing recovery, and resourcing for housing recovery. The research analytical framework is therefore developed, based on which the research questions and according objectives are presented and discussed. The research methodology to address the stated research problem, including research methods and procedures, is outlined.

**Chapter 2 and 3:** presents fundamental concepts and models with respect to the studied topic via the literature review. Previous research on disaster management, post-disaster recovery and reconstruction, resourcing approaches for housing recovery, along with factors that affect resource availability in conventional construction management and post-disaster reconstruction are presented and critically analyzed. The identified knowledge gaps serve as a basis for guiding case studies and a comparative discussion in studying resourcing issue in disaster recovery.

**Chapter 4:** based on the literature review, methodologically formulates the multi-method strategies for achieving the research objectives, including the quantitative and qualitative methods employed for data collection, statistical and computational methods of data analysis, and multi-dimensional methods of data validation. It provides rationale to justify research methods selected for the research. It also discusses approaches for addressing different levels of analysis – single case and multi-case analysis. The chapter also outlines the ethical process and issues considered in a cross-cultural comparative study.

**Chapter 5, 6, 7:** present research findings within individual case studies of China, Indonesia and Australia during their recovery after a major disaster, in line with the five elements presented in the resource availability analytical framework. A systematic discussion of these findings is presented in a manner of combining empirical evidence gathered from the ground, literature review and commentary. The case study chapters also propose a consortium of recommendations.
specific to each examined case for the improvement of their resourcing outcomes and disaster recovery practice.

**Chapter 8**: presents a synthesis of the research findings generated from the individual case studies from a comparative perspective. Similar to the case study chapters, this cross case comparison is conducted in terms of the five elements in the resource availability analytical framework. Thematic analyses of the research findings bring underlying insights and provide evidence-based foundation for developing possible solutions to identified common resourcing issues in the selected cases.

**Chapter 9**: concludes the dissertation by summarizing the major research findings and proposing an integrated planning framework for addressing resourcing problems commonly identified in cross-case comparison. It discusses the limitations of the study research design and future research directions. The chapter also discusses the relevance of research findings to existing knowledge regarding post-disaster recovery and resource management, as well as the practical implications for disaster planning and preparedness.
Chapter 2 Disaster management and housing recovery

2.0 Overview
This chapter establishes a theoretical context for the dissertation. It deals with the extant disaster management and housing recovery literature with a view to pinpointing the locus and scope of this research in a broader milieu. To set the scene, it first begins with an understanding of a disaster by examining its causes and effects. It then looks at two predominant paradigms of disasters — vulnerability and resilience. In comparison with the concept of reducing vulnerability to disasters, it highlights that resilience should be considered as not just a new vision overarching the process of disaster management, but a capacity required for any involved individuals and organizations to cope with a disaster and its aftermath. The chapter then exemplifies and compares several overseas approaches to disaster management. This chapter focuses on the element of recovery in a disaster management system, placing a high premium on post-disaster housing recovery, given its importance in community recovery from a disaster. An overview of issues and challenges in post-disaster reconstruction is presented. The chapter concludes with thematic approaches to housing reconstruction in past disaster recovery practice.

2.1 Understanding disasters
When entering the research field of disasters, it is important to begin with a robust understanding of what is a disaster. There has been a multiplicity of disaster-related studies from differing perspectives, both technically and managerially. The knowledge about disaster type, origin, scale, frequency, and prediction has encompassed decades of considerable change and evolution (IFRC, 2010). The conceptualization of disasters helps to justify attention to where the management of disasters comes from and to define the varied disaster reduction objectives. To grasp the key elements of a disaster, the current research study focuses on the causes and effects of a disaster, as a starting point for comprehending fundamental concepts with regard to disaster management.

2.1.1 What constitute a disaster?
During the last decades, there has been much debate about how to accurately define disasters. The debate has been circling around what elements should be included in a definition to present a
whole picture of disasters. According to Drabek and McEntire (2003), a disaster was first understood as a natural phenomenon of God’s acts in ancient times; and has been considered as a catastrophic instance with man-made contributions in present days. The most commonly accepted definition of disaster was given by UNDHA (1992, p. 27) in the advocacy of the International Decade for Natural Disaster Reduction (IDNDR), as follows.

‘A serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected people to cope using its own resources. Disasters are often classified according to their cause (natural or manmade)’.

Likewise, the Centre for Research on the Epidemiology of Disasters (CRED) gives a similar definition to a disaster as follows.

‘Disaster is a situation or event, which overwhelms local capacity, necessitating a request to national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering. Though often caused by nature, disasters can have human origins’ (The EM-DAT Glossary).

These two widely acknowledged definitions of a disaster have described the impacts of a disaster on human society. However, they fail to explain what actually contribute to a disaster. In another word, the key meaning of why disasters happen is missing. Following the UNDHA’s definition, other scholars such as Blaike el al. (1994) and Hewitt (1995) have emphasized this concern. To address this flaw in definition, Quarantelli (1995b) introduced the concept of ‘vulnerability’ to portray disasters as being caused largely by the social conditions. Indeed, the concept of vulnerability is not new. Over thirty years ago, O’Keefe et al. (1976) had suggested that many disasters are essentially the consequence of the combination of natural hazards, and social and human vulnerability. In reviewing the study of natural disasters between 1977 and 1997, Alexander (1997) reinforced this point by claiming that vulnerability is one of the key determinants of a disaster. This view was recently reiterated by UN/ISDR (2007), and consistently highlighted by Bosher (2008; 2011b).

Despite variations in definition, evolving apprehension of a disaster has elicited research attention to its social dimensions and its social impact on humans. The triggering agent in a disaster is considered to be either the natural event, or human activities, or in some cases a
combination of the two. In another word, disasters are seen as the convergence of hazards with vulnerability. This inclusive view of a disaster was promoted by Comfort (2005b, p. 338) who defines a disaster as:

‘representing the interdependent cascade of failure triggered by an extreme event that is exacerbated by inadequate planning and ill-informed individual or organizational actions’.

According to this definition, an increase in physical, social, economic, or environmental vulnerability, involves an increase in the occurrence and impacts of disasters (Jha et al., 2010).

There are a number of comparison studies of contemporary events in the literature, which have revealed the intimate correlation between human-contributory elements of a disaster and the corresponding effects. For instance, in examining the impacts of the 1994 Northridge earthquake in Los Angeles, the U.S., Petak and Elahi (2000) claimed that the small fraction of the affected populations in terms of deaths and injuries in the earthquake can be attributed to the successful application of a modern building code. Lindell (2010) presented a striking contrast in the number of causalities between the 2010 earthquake in Haiti and the substantially stronger 2010 earthquake in Chile. The difference in disaster impact, however, was largely due to variations in building location, design and construction in the two countries. Without a well devised legislative mechanism for construction before the event, Haiti suffered more severe devastation from the earthquake than it was in Chile. Furthermore, the Darfield earthquake on September 4, 2010 in New Zealand on a similar scale as affected Haiti created a miracle of ‘zero casualty’ with very few residential buildings collapsed. This distinct outcome, as illustrated by GNS (2010), was also attributed to the stringent Building Code and earthquake design standards introduced to New Zealand since its Hawke's Bay earthquake with a magnitude of 7.8 in 1931.

In recent years, the human-made development issues such as urbanization and industrialization have been brought to the fore due to their impacts on the natural and social environment (Quarantelli, 2003; IFRC, 2010). As disaster data collection and analysis improves, the correlation between the speed of urban growth and the level of risk exposure is becoming clear. As both Comerio (1998) and Pelling (2003) illustrated, new patterns of living styles on the near coast and river banks, of settlements in the hazard-prone areas, and of urban growth and human activities, have increased human vulnerability to hazards. The 2005 Hurricane Katrina, for
instance, has been recognized by a number of researchers, such as Comfort (2005a), Gutmann (2006), and Lotke and Borosage (2006), as a tribute to a disaster that was created by nature while devastated by human failure to prepare for and respond to an environmental hazard.

2.1.2 What result from a disaster? – Two sides of a coin

When asked ‘what a disaster brings about?’, one can easily visualize a disaster with a series of devastating images – suffering humans, disrupted networks, and damaged buildings, as illustrated in both disaster definitions given by UNDHA and CRED in the preceding section. Conventionally, disasters are measured by number of victims and economic damage (Jha et al., 2010). Apart from these two elements, Alexander (1997) also advocated the use of the impact upon the social system to describe disaster devastation. Other impacts of a hazard event on local capacities, as shown in Figure 2.1, encompass the interrelated built environment, social system, natural environment and economic system (Gordon, 2004, p.131).

![Figure 2.1 Process of disaster repercussion with multiple impacts](image)

Some of the impacts shown in Figure 2.1 are immediately visible such as the destruction to the built and natural environment, and are often evaluated through post-event damage assessment (Asef, 2008). Demographic changes have been introduced in recent years as an important measure of disaster impact on communities. According to Weiss (2006), for instance, after the Hurricane Katrina in 2005 in the U.S., between July and November 2005, the population in Orleans Parish declined by 69%, in Jefferson Parish by 27%, in Plaquemines Parish by 48%, and in St. Bernard Parish by 89%. The population in New Orleans metro area declined by 37%, and
in Louisiana by 6%. It has to be noted that the longer-term and often invisible disaster effects, such as the continuing distress of the affected populations (Paton and Johnston, 2001; Mukherji, 2008; Gardoni and Murphy, 2010), vitiated poverty (Fengler et al., 2008; UN/ISDR, 2009), reinforced social inequity (Oliver-Smith, 1990; Comerio, 1997; McKenzie, 2004), and changed community cohesion (Williams, 2006; Chang, 2010), are likely to substantially compound the physical impacts and impinge on the ability of a community to recover from a disaster.

The University of Delaware’s Disaster Research Centre provided a useful distinction between the different categories of disasters in relation to their scales (Quarantelli, 2000). The impacts of a hazard event, however, are used to differentiate disasters from emergencies and catastrophes, as described below.

1) **Emergency**: An event that may be managed locally without the need of added response measures or changes to organized procedure. During the last decades, there has been a continuous evolution in the common understanding and practice of emergency management. These bodies of emergency response practice have been variously known as emergency assistance, civil defence, civil protection, and homeland security in different regions. The emergency is often locally dealt with by the emergency agencies.

2) **Disaster**: An event that involves more responding groups who normally do not need to interact in order to manage emergencies. It also requires the involved parities to relinquish the usual autonomy and freedom to special response measures and organizations. The scale of this hazard event dictates changes to the usual performance measures. A closer cooperation between those involved organizations is also needed. Disasters may involve the inter-regional or even national response, such as the 2009 Victorian ‘Black Saturday’ bushfires and the 2008 Wenchuan earthquake, which will be detailed in the following chapters.

3) **Catastrophe**: An event that causes most severely impact on communities. It destroys most of a community, prevents local officials performing their duties, causes most community functions cease, and even prevents adjacent communities from providing aid. Typical examples of catastrophes can be the 2004 Indian Ocean tsunami and the 2010 Haiti earthquake, require significant international aid and assistance to deal with
devastation on communities. The 2005 Hurricane Katrina in New Orleans, US was also described by a number of scholars such as Comfort (2005a), Mitchell (2006), and Lotke and Borosage (2006) as an urban catastrophe with a region wide destruction, challenging the recovery capacity of the entire nation.

The varied categorization of disaster events, in terms of their impacts and scales, points to common questions about 1) how the impacts are dealt with — both visible and invisible, in a short-term and a long-term, and on a small scale and a large scale; 2) how the communities could have been better prepared; and 3) how disaster mitigation and response could be improved to reduce these impacts. The answer to these questions, however, pertains to the other side of a coin — the opportunities a disaster creates for the improvement of affected communities. A disaster, therefore, offers a good opportunity to formulate forward-looking policy concepts associated with social development and equity, economic growth, environmental quality and justice, and sustainability (UN/ISDR, 2004). This view was shared by the International Recovery Platform (IRP) (2007) who claimed that disasters can be viewed through an optimistic prism as an event offering a ‘window of opportunity’ of recovery to improve circumstances that are prior to its occurrence. This insight has helped us to shift attention to the recovery aspect to seek these opportunities of improvement. Lorch (2005) thus suggested the creation of a ‘learning culture’ in order to build upon past disaster and recovery experiences, and to apply their lessons so that future risks may be attenuated.

There has been a multiplicity of literature that advocates three key focus areas of capitalizing on the opportunities resulting from a disaster. These areas include 1) institutional changes for the purpose of disaster reduction; 2) crafted insurance programs for residences and businesses; and 3) public education and training. For instance, Bolin and Stanford (1998) highlighted the role of the Emergency Network Los Angeles (ENLA) established after the 1994 Northridge Earthquake in the U.S. in providing extra protection for the vulnerable members of society. Additionally, other institutional arrangements, such as increased level of geological hazard mapping, the development of new building code standards, and improved emergency preparedness, also contributed to the community recovery following the Northridge earthquake (Petak and Elahi, 2000). Similarly, new building guidelines with safe seismic features appropriate to local cultural standards were promoted in India following earthquakes in Latur, Maharashtra in 1993 (Arya,
2000; Jain and Nigam, 2000) and in Gujarat in 2001 (Gupta, 2001; Barenstein, 2006a). An institutional policy framework for disaster management in the Maldives after the 2004 Indian Ocean tsunami was highly commented on by UNDP (2006b), comprising a legal foundation, well-defined organizational responsibilities and a strengthened Disaster Management Centre.

The above examples provide a rich spectrum of experiences and evidences which show that improved management of disasters in a complex recovery environment is achievable. As promoted by the IRP (2007), well considered recovery is likely to provide this possibility and introduce changes in disaster management practice. By recognizing the consequences a disaster brings about, the current study places an emphasis on the value of opportunities in the aftermath of a disaster through recovery to help people rebuild lives. A holistic framework for disaster management should be based on a full understanding of both impacts and opportunities resulting from a disaster. Before the study proceeds into the recovery dimension, the following section summarizes the core principles and approaches to disaster management. A contrasting discussion between these varied concepts will furnish a picture of their evolving conceptual understanding and practical implications in the field of disaster management.

2.2 Managing disasters

During the last decade, disaster management has changed its focus, moving from a linear disaster ‘stages’ model to more dynamic decision-making process (Deegan, 2007). The US Federal Emergency Management Agency (FEMA) (2004) identified four phases of a disaster life cycle, including mitigation, preparedness, response, and recovery. Based on this classification, McEntire et al. (2002) proposed a comprehensive framework incorporating a wide variety of players involved in disaster management in public, private, and non-profit sectors. UN/ISDR (2004), and Moe and Pathranarakul (2006) gave a slightly different definition to disaster management which includes five phases, namely: predication, warning, emergency relief, rehabilitation, and reconstruction, and a range of essential activities, such as mitigation and preparedness, response, and recovery, in these phases. In spite of varied classification, the functional areas in a disaster life cycle are fundamentally similar. This research study aims to
look at the predominant paradigms, philosophies and approaches that have essentially informed the management of disasters.

2.2.1 Paradigms of disaster management

Essential changes in the way the natural disaster is viewed have significantly influenced the trend of disaster management research (Alexander, 2004). There are several paradigms in literature aiming to guide scholarly and practitioner efforts to understand disasters and reduce their impacts. This section outlines four main paradigms of disaster management, in line with McEntire (2003; 2004b; 2005)’s research study in the context of a comprehensive emergency management.

2.2.1.1 The disaster-resistant community

The disaster-resistant community model has been defined as a ‘means to assist communities in minimizing their vulnerability to natural hazards by maximizing the application of the principles and techniques of mitigation to their development and/or redevelopment decision-making process’ (Geis, 2000, p.152). There are significant advantages associated with the disaster-resistant community paradigm, as illustrated by McEntire et al. (2002), such as to decrease the degree of loss resulting from physical agents, and its marketability to encourage communities to participate in mitigation. While the disaster-resistant community paradigm aids in physical disaster mitigation, the inherent weaknesses lie in its ignorance of other social, cultural and political triggering agents and functional areas that comprehensive emergency management covers. Therefore, the resistance model is most applicable to urban planners and engineers.

2.2.1.2 The disaster-resilient community

There is no consensus on the definition of community resilience. By comparing the concepts of resistance, sustainable development, and sustainable hazards mitigation, with that of resilience, Mileti (1999) illustrated their interrelations. Comfort et al. (2010) defined resilience as the capacity for collective action in response to extreme events, with an emphasis on initiatives such as building awareness of the risk, sharing knowledge of threatening conditions, increasing flexible options for adaptation to potential danger, and developing capacity for self organization at individual, organizational and community levels of action. Regardless of various definitions, McEntire et al. (2002) pointed out that the disaster-resilient community is commonly related to
social factors (economic, psychological, and cultural) pertaining to recovery, but has overlooked the importance of vulnerability in multidisciplinary disaster scholarship.

2.2.1.3 The sustainable development/sustainable hazards mitigation

Sustainable development has evolved since it was first introduced and has been used in a variety of ways in diverse disciplines. Mileti (1999) applied the sustainability concept in disaster studies and advocated five tools to be used to achieve sustainable hazard mitigation. These five tools include 1) better land-use planning and management, 2) enforcement of building codes and standards, 3) increased reliance on insurance, 4) enhanced prediction, forecasting, and warning systems, and 5) improved engineering for buildings and infrastructure. Undoubtedly, the paradigm of sustainable development and hazard mitigation reinforces the understanding of the complex relation between development and disasters, and also underscores the importance of disaster recovery in community development (McEntire et al., 2002). However, the focus of this paradigm on limited functional areas of disaster such as mitigation and recovery means its less relevance with emergency preparedness and response (Mileti, 1999).

2.2.1.4 Comprehensive vulnerability management

Comprehensive vulnerability management is defined by McEntire (2005) as holistic and integrated activities directed towards the reduction of emergencies and disasters by diminishing building risk and susceptibility to hazardous events. Vulnerability is clearly related to each of the triggering agents, emergency functional areas, and actors involved in disaster (Blaikie et al., 1994; Cardona, 2003). According to McEntire (2003; 2004b), the specific variables that are captured by comprehensive vulnerability management can be placed under physical, social, cultural, political, economic, technological and developmental categories. In this sense, with a better understanding of vulnerabilities and capabilities at all levels, paradigm of comprehensive vulnerability management is inclusive of the concepts of development and disasters, as well as of community resistance and resilience to disasters.

A comparative summary of these four predominant paradigms is shown in Table 2.1. The four paradigms of disaster management have suggested varied conditions that can help communities to reduce the likelihood of disaster occurrence and the impacts of a disaster. The specific circumstances of a disaster and the related natures of communities are likely to influence the
development of effective disaster management models. According to McEntire et al. (2002), although perspectives of disaster resistance, resilience and sustainability provide many unique advantages for disaster scholarship and management, they fail to sufficiently address the triggering agents, functional areas, actors, variables, and disciplines pertaining to calamitous events. A more holistic approach with incorporation of disaster risk and vulnerability can be seen in the paradigm of comprehensive vulnerability management. The objectives of emergency management are achievable when disaster vulnerability levels are well evaluated and understood (McEntire, 2005; Green et al., 2006).

The subject of vulnerability management draws its relevance from previous practices in the disaster management field where traditionally the focus has been on preparedness for response (UN/ISDR, 2004). However, there is now an increased emphasis placed on risk, and an increased understanding of the inextricably linkages among disaster, vulnerability, and resilience. This understanding is essential if communities are to become more resilient to the effects of hazards so that their vulnerability to disasters can be reduced. However, this current research is not aiming to weight up which paradigm is better than the other, but to compare and present their contributions to the practice of disaster management. Like Rotimi (2010) claimed that community resilience could only be achieved through the alteration and subsequent reduction of vulnerabilities.
Table 2.1 Comparative summary of disaster paradigms (McEntire et al., 2002)

<table>
<thead>
<tr>
<th>Disaster Paradigms</th>
<th>Comprehensive emergency management</th>
<th>Disaster-resistant community</th>
<th>Disaster-resilient community</th>
<th>Sustainable development/sustainable hazards mitigation</th>
<th>Comprehensive vulnerability management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazards/triggering agents</td>
<td>Natural, technological, civil, biological</td>
<td>Natural</td>
<td>Natural</td>
<td>Natural and technological to a lesser extent</td>
<td>Natural, technological, civil, biological</td>
</tr>
<tr>
<td>Phases/functional areas</td>
<td>Mainly preparedness and response</td>
<td>Mitigation</td>
<td>Recovery and mitigation to a lesser extent</td>
<td>Mitigation and recovery</td>
<td>Mitigation, preparedness, response and recovery</td>
</tr>
<tr>
<td>Actors</td>
<td>Mainly the public sector (particularly emergency managers and first responders)</td>
<td>Mainly the public sector (particularly urban planners and engineers)</td>
<td>Mainly individuals and groups involved in recovery from the public, private, and non-profit sectors</td>
<td>Urban planners, engineers, insurance agencies, nongovernment organizations, environmentalists, and citizens</td>
<td>Most, if not all, organizations from the public, private, and non-profit sectors, as well as citizens in general</td>
</tr>
<tr>
<td>Variables</td>
<td>Mainly physical</td>
<td>Mainly physical</td>
<td>Social and physical to a lesser extent (depending on the scholar and due to the excessive focus on hazards)</td>
<td>Physical and social to a lesser extent</td>
<td>Physical and social</td>
</tr>
<tr>
<td>Disciplines</td>
<td>Mainly sociology and public administration</td>
<td>Mainly geography and engineering</td>
<td>Mainly psychology, sociology, and economics; geography and engineering to a lesser extent</td>
<td>Geography, engineering, and environmental science; anthropology, economics, and sociology to a lesser extent</td>
<td>The vast majority of fields from the hard and soft sciences, epidemiologists and others in the medical field</td>
</tr>
</tbody>
</table>
2.2.2 Disaster response: risk, vulnerability and resilience

UNDHA (1992) defined risk as a function of hazard and vulnerability. Since, the concept of risk management has been extended within contemporary emergency management or disaster management. Paton et al. (2000) explained that the less prescriptive risk concept provides a more flexible framework for the conceptualization and analysis of disaster phenomena. In addition, some researchers, such as Spence (2004), and Schipper and Pelling (2006), have recognized that the risk management model renders the human activities consistent with the prevailing strategic and operational paradigm in emergency and disaster management in terms of either enhancing resilience or reducing vulnerability.

The cognition of vulnerability as a key element in risk has been accompanied by a growing interest in understanding the capacity of people to cope with, withstand and recover from the impact of hazards, which is known as ‘resilience’. UN/ISDR (2004) proposed a more elaborated risk equation as \( \text{Risk} = \text{Hazard} \times \text{Vulnerability} / \text{Capacity} \). This formula of risk explains why emphasis is frequently made in technical literature on the study of vulnerability reduction as a measure of risk mitigation (Cardona, 2003). This equation also indicates that the reduction of disaster risks can be made through mitigation of hazards, mitigation of vulnerabilities, and enhancement of resilience. To understand this correlation, the remainder of this section examines the components of risks, namely hazard, vulnerability, and capacity, as well as their implications for the apprehension and management of disasters.

2.2.2.1 Vulnerability to disasters

Conceptualization of risk generally includes vulnerability as a determinant of differences in individual susceptibility to hazard effects. Vulnerability has been well expressed in many different forms and there is a diversity of studies that identified the factors determining disaster vulnerability. Blaikie et al. (1994) defined vulnerability as the combination of characteristics of a person or a group, in terms of their capacity to cope with, resist, and recover from hazard impacts that threaten their life, well-being and livelihoods. The key elements in this definition such as ‘cope’, ‘resist’ and ‘recover’, however, are consistent with the concept of resilience (McEntire, 2004b). UN/ISDR (2004) defined vulnerability as the conditions determined by physical, social, economic, and environmental factors or processes, which increases the susceptibility of a
community to the impact of hazards. This definition captures four aspects of vulnerability which are depicted in Figure 2.2, and described as follows.

Figure 2.2 Interaction of vulnerability factors (UN/ISDR, 2004)

1) **Physical factors**: Physical aspects of vulnerability mainly refer to the location considerations and susceptibilities of the built environment. It can be described as exposure to hazards and determined by factors such as density levels, remoteness of a settlement, its sitting, design and materials used for critical infrastructure and for housing. However, physical vulnerability is often poorly modelled in disaster prone areas. According to Douglas (2007), the reasons include lack of observational data on the hazard, complex structural damage mechanisms, and inadequate ability to modify the hazard level. In response, a rigorous methodology has been empirically sought for assessing vulnerability of buildings (Kemp, 2007; Dall'Osso and Dominey-Howes, 2010) and infrastructure facilities (Popescu et al., 2008; Oh et al., 2010), with a view to limiting the loss of life and property during a disaster.

2) **Social factors**: Social vulnerability is linked to the level of well being of individuals, communities and society. It relates to peculiar characteristics of a social group, such as levels of literacy, access to resources, and cultural aspects. There are certain vulnerable groups — the low income, immigrants, unemployed and elderly groups, who are less likely to achieve any semblance of their prior socio-economic level. Those groups may have the least access to resources to manage their losses (Bolin and Stanford, 1998;
Bosher et al., 2007; Ruwanpura, 2009). In addition, social, economic and political processes also structure the lives of different groups of people in different ways and affect their ability to react to a natural hazard. Because social vulnerability connects to other important factors such as hierarchy system, leadership, and governance structures in the concerned society. This type of vulnerability only becomes apparent in the face of a disaster (Blaikie et al., 1994).

3) **Economic factors**: Economic factors of vulnerability play a decisive part in determining the impacts of a disaster and community’s capacity to recover from disasters. Economic vulnerability includes the economic status of individuals, communities and nations, such as levels of reserves and debts, the degree of access to credit, loans and insurance. In recent years, greater attention has been given to the vulnerability of community businesses to natural disasters due to their increased economic cost from a disaster (Zhang et al., 2009). In addition, inadequate access to critical and basic socio-economic infrastructure, including communication networks, utilities and supplies, transportation, water, sewage and health care facilities also increases people’s exposure to risk (Bosher et al., 2007). Economic aspect of community vulnerability is linked with livelihoods and development issues within a community, and acts as a key constituent to community viability.

4) **Ecological factors**: Ecosystems are complex adaptive systems that require flexible governance with the ability to respond to environmental feedback (Olsson et al., 2004). Ecological aspects of vulnerability embrace the extent of natural resource depletion, the state of resource degradation, loss of resilience of the ecological systems, loss of biodiversity and exposure to toxic and hazardous pollutants. The concept of ecological vulnerability, however, implies the coupled human-environmental linkages and their implications for environmental change and sustainability. A number of researchers such as Cash and Moser (2000), Turner et al. (2003), and Surjan and Shaw (2009) have highlighted the fact that many environmental hazards or disasters originate from vulnerabilities that exist in eco-system and in the interface between natural environments and human activities. Furthermore, disaster recovery operations are also likely to intensify pre-existing ecological vulnerabilities and trigger secondary calamity to
communities (Chang et al., 2006; Shaw, 2006). Integration of ecological considerations into the assessment framework of vulnerability is, thus, of paramount importance.

In all, it can be concluded that vulnerability is a reflection of the physical, social, economic and environmental conditions that are shaped continually by attitudinal, behavioural, cultural, socio-economic and political influences at different levels of human groups. Therefore, it is likely that human-centred approaches that transcend across economic, physical, social and ecological domains of community vulnerability can contribute towards the reduction of environmental and hazard risks.

2.2.2.2 Resilience to disasters

An alternative approach to dealing with disaster risks, as mentioned earlier, is to improve the resilience of communities (Foster, 1995; Pelling, 2003; IFRC, 2004; Manyena, 2006; COAG, 2009; Comfort et al., 2010). This tenet is well demonstrated in UN/ISDR’s risk equation in the preceding section. Resilience has been widely discussed within studies of ecology, systems and disasters (Tobin and Montz, 1997). Scholarly work provides several variations in resilience streams. From a social sustainability perspective, for instance, resilience has been defined as the capacity of individuals, groups and communities to identify and advocate for their needs, both now and for future generations (McKenzie, 2004). According to Paton et al. (2000), the recognition of a relationship between disaster experience and positive growth outcomes introduces a need within disaster management to seek ways in which such outcomes can be facilitated. The term of ‘resilience’ thus was identified as a new paradigm that accommodating the analysis and facilitation of this growth.

Over the last decade, the research perspective on disaster reduction has shifted from the former component looking at elements that contribute to a community’s vulnerability to the latter advocating a focus on a community resilience to thrive rather than just survive when a disaster strikes (Manyena, 2006; Resilient Organisations, 2007). Increased attention has been paid to what affected communities can do for themselves and how best to strengthen them (IFRC, 2004). The 2005 World Conference on Disaster Reduction highlighted the importance of the entrance of resilience into disaster discourse, and based on which formed a new culture of disaster response. Recent disasters such as the Hurricane Katrina and the Hurricane Rita in the U.S. in 2005 have
highlighted visible improvements in the way the recovery system organized itself around enhancing community resilience (Berke and Campanella, 2006; Litman, 2006). Resilience has thus increasingly become a watchword in the disaster management field to refine and reshape post-disaster reconstruction. The UN/ISDR (2004, p.24) defined ‘resilience’ as:

‘The capacity of a system, community or society to resist or to change in order that it may obtain an acceptable level in functioning and structure. This is determined by the degree to which the social system is capable of organizing itself, and the ability to increase its capacity for learning and adaptation, including the capacity to recover from a disaster’.

This concept of resilience is reflective of its multi-faceted nature with integrated physical, natural and socio-political aspects. According to Prosser and Peters (2010), the concept of disaster resilience is characterized by its complexity, interactivity and interconnectedness. Resilience can be found in hazard-resistant buildings or adaptive social systems (Pelling, 2003). Apart from the physical aspect, Paton et al. (2001) recognized that community resilience comprises three components: dispositional, cognitive and environmental, which respectively relate to the economic, emotional and cultural aspects of recovery. In a synthesis view, the components of community resilience can be categorized into three areas and outlined below.

1) **Physical/technical facets**: A resilient built environment represents human-created physical systems that are essential to the key operations of the communities and perform well when a disaster strikes. It has been suggested that to attain a more resilient built environment, a more resilient social context with regards to the professions, structures, and processes that govern construction activity is also required (Dainty and Bosher, 2008). To enhance the physical coping ability, resilience of a property should span across the life cycle of a structure and the continuum of stakeholders it relates to. As also proposed by Bosher (2008, p.13), a resilient built environment should be designed, located, built, operated and maintained in a way that maximizes the ability of built assets, associated support systems (physical and institutional), and the people that reside or work within the built assets, to withstand, recover from, and mitigate for the impacts of extreme natural and human-induced hazards. In this sense, built-in resilience goes beyond merely reducing the vulnerabilities of physical structures in a technical way, but more
focusing on enhancing capacity from institutional, social, and political perspectives for future disaster response.

2) **Organizational facets**: Organizational resilience is often described as the capacity of an organization to minimize the impact of severe disruptive events on the organization’s objectives — the ability to ‘bounce back’ (Parsons, 2010). Therefore, the theory of organizational resilience has been widely accepted into institutional, social, economic organizations and at industry and national level as a strategic approach to manage disaster risks. In literature, there have been a variety of conceptual models of organizational resilience and a range of inter-dependant factors that are recognized as important in the management of risks. However, Gibson and Tarrant (2010) pointed out that enhancing organizational resilience is based on a fundamental understanding of disaster risks. Further, Resilient Organisations (2006b) and Seville (2009) suggested that effective organizational resilience is built upon a range of different strategies that enhance both ‘hard’ and ‘soft’ organizational capabilities including resilience ethos, situation awareness, management of keystone vulnerabilities, and adaptive capacity.

3) **Socio-psychological facets**: community resilience in psychology and social aspect refers to a capacity to function in immensely demanding settings, as well as the ability to cope with stress (Norris et al., 2009). The socio-psychological resilience is often connected to the community’s experience in mediating natural disasters. An assessment of resilience in this respect has been largely used as an invaluable input into post-disaster rehabilitation programs to assist the affected communities with recovery (Pelling, 2003). Contemporary disaster events such as the 2005 Hurricane Katrina in the U.S. (Weiss, 2006), the 2008 Wenchuan earthquake in China (Potangaroa et al., 2008), and the 2009 Victorian ‘Black Saturday’ bushfires (Pooley et al., 2010) have highlighted the importance of mapping the socio-psychological impact of communities, along with its changes over time during disaster recovery. The conditions and elements that can enhance the psychological coping ability of communities should be well understood.

In summary, the above literature review shows that the concepts of ‘risk reduction’, ‘vulnerability’, and ‘resilience’ have become keywords in dealing with hazardous events. Despite different perspectives of approaching risk reduction, reducing vulnerability and
enhancing resilience share common themes and activities in different dimensions. A comparison between those two approaches to risk reduction is summarized in Table 2.2.

Table 2.2 Comparison of approaches to disaster risk reduction

<table>
<thead>
<tr>
<th>Common objective</th>
<th>Risk reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components of risk</td>
<td>Vulnerability</td>
</tr>
<tr>
<td>Nature</td>
<td>Conditions</td>
</tr>
<tr>
<td>Perspective</td>
<td>Circumstance-centred</td>
</tr>
<tr>
<td>Dimensional categories</td>
<td>• Physical • Social • Economic • Ecological</td>
</tr>
<tr>
<td>Approaches to risk reduction</td>
<td>Reducing vulnerabilities</td>
</tr>
<tr>
<td>Emphasis</td>
<td>Creating resistant nature</td>
</tr>
<tr>
<td>Pattern</td>
<td>Reactive</td>
</tr>
</tbody>
</table>

In contrast with the concept of reducing vulnerability, however, the idea of enhancing resilience suggests a more proactive stance towards risks. Resilience is not just about a condition where communities bounce back from adversity, but is more concerned with an adaptive ability to resist and recover from this adversity. The level of community resilience, therefore, relates to how people better understand and address uncertainties in their internal and external environments. Table 2.2 shows that towards a common objective of risk reduction, the vulnerability approach places stress on the production of conditions to resist the natural hazard, whereas the resilience approach requires an enhanced ability to cope with and recover from disasters. Emphasizing the concept of resilience means to focus on the quality of life of the people at risk and to develop opportunities to enhance a better outcome (Cimellaro et al., 2010). Therefore, it can be concluded that irrespective of approaches to disaster risk reduction, the optimum outcome is to provide a mechanism through which communities can have a clearer understanding of what they
can expect from various governments, agencies and industries, and be more prepared and less vulnerable, in order to achieve adequate resilience.

2.3 Country-specific disaster management systems

The various definitions of disaster risks, as reviewed in the preceding section, require a holistic approach to managing these risks. Many disaster-related scholars and practitioners have been working towards this end. Moe and Pathranarakul (2006) proposed an integrated approach which includes both proactive and reactive strategies for managing natural disasters. A Systems approach has also been introduced by a number of researchers, such as Cooke (2003), Helm (2009), and Chandana and Leung (2010), into disaster research field, as a tool for analyzing and interpreting risks, and for developing control options. The United Nations has advocated regional cooperation, communication and policy coherence as part of a focus on developing disaster resilient communities (United Nations, 2009). Many countries have been searching for a comprehensive and integrated approach to dealing with disasters in the modern era. This section presents the various disaster management theories and practices in the United States, Australia, New Zealand, China and Indonesia, with a focus on presenting the important elements in each country that relate to its particular context.

2.3.1 The United States

Emergency management in the United States has undergone a series of changes and evolution since its early history in 1800s. Throughout the 1990s, as the U.S. and the world experienced an unprecedented number of severe disasters, the critical role the emergency management plays in protecting social and economic stability of communities became salient. Emergency management began to grow beyond the response environment and focus on risk analysis, communications, risk mitigation, and social and economic recovery (Lindell et al., 2007). This trend had resulted in a better educated, multidisciplinary, proactive approach to emergency management in the United States. Emergency management system in the U.S. has been regarded as one of the most respected in the world.

In recent years, the US emergency management system has been largely developed in response to specific major disasters (William L. Waugh, 2000). The terrorist attacks of September 11,
2001 resulted in a significant reformulation of the purpose and nature of emergency management in the country. Since, terrorism has become the hazard of priority. The establishment of the Department of Homeland Security (DHS), with the incorporation of the Federal Emergency Management Agency (FEMA) which was formerly an independent agency, was the most visible move of government reorganization in response to the September 11 events. However, among the effects of these actions was a decrease in emphasis on preparedness and response for natural and technological disasters (Tierney, 2005). In addition, the role of FEMA which was the only agency tasked with management of natural disasters was significantly compromised and marginalized (McEntire, 2004a). The Hurricane Katrina which struck New Orleans in 2005 had brought these effects back to the fore.

As a renewed attention, the Hurricane Katrina had also brought emergency management to a new level of significance. A series of reforms were initiated by government authorities at different levels to enhance comprehensive disaster planning and preparedness. These initiatives include revising laws, developing disaster mitigation and preparedness programmes, and redirecting existing resources and capacities. Indeed, there has been numerous publications such as (William L. Waugh, 2000), (Lindell et al., 2007), (McEntire, 2007), (Haddow et al., 2008), and (Blanchard, 2010) that provide authoritative guide on historical context and development of emergency management in the U.S. The present study focuses on the review of the institutional elements of US emergency management.

The comprehensive emergency management model defines four phases of emergency management: mitigation, preparedness, response, and recovery (National Governor's Association, 1978). In the U.S., FEMA (2004) used these four phases to describe a disaster life cycle through which emergency managers prepare for emergencies and disasters, respond to them when they occur, help people and institutions recover from them, mitigate their effects, reduce the risk of loss, and prevent disasters from occurring. In line with William L. Waugh (2000, p.12)’s study, the four phases of the US emergency management are summarized as follows.

1) **Mitigation** is an ongoing effort to lessen the disaster impact on people and property. It consists of pre-disaster activities such as assessment of risks and lessening the potential effects of disasters, and of post-disaster activities to reduce the potential damage of future disasters. Mitigation programs, for instance, include land-use regulations, building codes,
structural barriers to prevent or control hazards, and insurance programs to lessen the economic impact of disaster. It is usually considered the initial phase of emergency management, although it may be a component of other phases. Mitigation is the cornerstone of the U.S. emergency management. Built on the foundation of the Disaster Mitigation Act, FEMA’s ‘Planning for a Sustainable Future’ (2000a) provides a roadmap for local governments to take a proactive approach to mitigation and achieving integrated community planning and sustainability.

2) **Preparedness** includes pre-disaster activities involved in preparing for expected threats, such as contingency planning, resource management, mutual aid and cooperative agreements with other jurisdictions and response agencies, public information, and the training of response personnel. It is focused on the development of plans and capabilities for effective disaster response. Preparedness in the U.S., according to FEMA (2004), covers leadership, training, readiness, exercise support, and technical and financial assistance to strengthen a variety of groups of people as they prepare for disasters. In comparison with mitigation which pertains to risk reduction, preparedness deals with disaster response and recovery (EMI, 2007).

3) **Response** contains activities during a disaster, including search and rescue, evacuation, emergency medical services, and fire fighting. It is an immediate reaction to a disaster. It may occur as the disaster is anticipated, as well as soon after it begins. Response efforts also include reducing the likelihood of secondary damage. Similar to other countries, in the U.S., the small and localized disasters, such as local flooding, fires and landslides, which do not result in a significant loss of life or property, are dealt with by local emergency agencies and services. For a major disaster or emergency which overwhelms local ability to respond effectively, the National Response Plan in 2005 stipulates how the federal government implements the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, to assist state and local governments.

4) **Recovery** includes post-disaster activities designed to restore basic services, including repairing lifelines such as power and water, provision of temporary housing, food and clothing, debris clearance, psychological counselling, job assistance, and supporting business recovery. These activities continue beyond the emergency period to restore
critical community functions and manage reconstruction. Increasingly, the recovery process has focused on long-term reconstruction of the affected community and its economy. Recovery from natural disasters presents a unique opportunity to consider alternatives to the damage-rebuild-damage cycle. With this realization, FEMA’s ‘Rebuilding for a More Sustainable’ (2000b) was developed to provide guidance on post-disaster response and recovery process.

In the wake of the Hurricane Katrina in 2005, the US government had realized the importance of being adequately prepared for a natural disaster. In October 2006, the US Congress passed the Post-Katrina Emergency Management Reform Act, which redefined a stronger FEMA who was granted a more robust preparedness mission. This statutory FEMA mission is to increase the nation’s ‘resilience’ by leading and supporting the comprehensive risk-based emergency management system. The statute also adds a fifth component — protection — to the four components of preparedness, response, recovery, and mitigation, but does not define the term (Congressional Research Service, 2006).

Under the Post-Katrina Emergency Management Reform Act, emergency management was granted a new definition as:

‘the governmental function that coordinates and integrates all activities necessary to build, sustain, and improve the capability to prepare for, protect against, respond to, recover from, or mitigate against threatened or actual natural disasters, acts of terrorism, or other man-made disasters’ (National Congress, 2006).

Meanwhile, ‘capability building’ has been proposed as a key ‘watchword’ to address the increased challenges posed by disasters, emergencies and terrorist events in the country. With the incorporation of the concept of capability, FEMA (2008) developed a strategic plan to guide the US emergency management efforts in order to build the whole nations’ resilience to disasters in the years of 2008-2013.

2.3.2 Australia

With significant changes in structure of the emergency management environment, Australia has been reviewing and restructuring its emergency management system in recent years. Analogous to the U.S., new hazards and the recurrence of certain hazards, such as human and animal
diseases, bushfires, acts of terrorism, environmental pollution, and infrastructure vulnerabilities had led to a range of reform initiatives to emergency management in Australia. The 1974 Cyclone Tracy and 1989 Newcastle earthquake were triggering events for this reform. In 2002, the Council of Australian Governments (COAG) commissioned a review of Australia’s approach to natural disaster relief, recovery and mitigation. The review recognized that current emergency management arrangements could be improved through a fundamental shift in focus towards cost-effective, evidence-based disaster mitigation.

The Australian Government, through Emergency Management Australia (EMA), supports a comprehensive approach to emergency management. EMA is part of the National Security and Criminal Justice Group within the Attorney-General’s Department, representing the Australian Government’s commitment to assisting states and territories to develop their emergency management capabilities. It provides national leadership in the development of measures to reduce risk to communities and manage the consequences of disasters under the Commonwealth Government Disaster Response Plan (COMDISPLAN). The Emergency Management Act 2006 and Local Government Act 1993, however, establish other provisions and powers to complement hazard-specific legislation (EMA, 2004a).

Australia has adopted a comprehensive and integrated approach to developing programs for the effective management of emergencies and disasters (EMA, 2004a). The comprehensive approach to emergency management recognizes four types of activities (PPRR) that contribute to the reduction of vulnerabilities and to the increase in resilience of a community or environment.

1) **Prevention/mitigation**: to hinder, deter and mitigate disasters, while maintaining readiness to deal with disaster events. Prevention activities seek to eliminate or reduce the impact of hazards and/or to reduce the susceptibility and increase the resilience of the community subject to the impact of those hazards. Typical prevention programs include such as building codes, public education, insurance, and land-use management.

2) **Preparedness**: to protect people, assets, infrastructure and institutions from disaster events; and to establish, train and exercise arrangements to respond to, and recover from a disaster event. Preparedness activities establish arrangements and plans, and provide education and information to prepare the community to deal effectively with emergencies.
and disasters. Typical preparedness programs can be such as emergency response plans, warning systems, evacuation plans, mutual aid agreements, resource inventories, and training programs.

3) **Response**: to respond rapidly and decisively to a disaster event and manage its immediate consequences. Response activities activate preparedness arrangements and plans, and take effective measures to deal with emergencies and disasters. Typical response activities include such as search and rescue, immediate relief, emergency declarations, evacuation, mobilizing resources, and damage assessment.

4) **Recovery**: to return national and community life to normal as quickly as possible after a disaster event through the restoration of social, economic, physical and environmental wellbeing. Typical examples of recovery activities can be restoring essential services, counselling programs, temporary housing, financial assistance, and initiating reconstruction tasks.

The comprehensive approach to emergency management requires that the four elements of this PPRR model be effectively integrated (EMA, 2004b). The aim of current emergency management policy in Australia, according to COAG (2009), is to use this model to work towards a more disaster resilient country by recognizing current and future risks, and reducing and managing those risks to be able to adapt to change and recover from disasters. The risk management methodology has supported the move away from simply treating hazards towards dealing with risks (Prosser and Peters, 2010). Therefore, this PPRR model requires more attention given to the vulnerability of communities to hazards.

### 2.3.3 New Zealand

In New Zealand, 1931 Napier earthquake was a milestone that triggered legislative changes in Building Code to reduce the vulnerabilities of the built environment. Taking a cue from the devastation caused by the 1994 Northridge earthquake in Los Angeles, the U.S., a series of review on disaster management regime in New Zealand had been undertaken during 1990s. The review included the revision and implementation of a variety of legislative and policy reforms in disaster risk management. According to UN/ISDR (2004), with a motivation to encompass an
all-hazards approach to risk, New Zealand has made the following accomplishments over the last few years.

1) Broadened responsibilities for local authority emergency managers, with increased roles in the training and development of community capacities for risk identification, vulnerability reduction and disaster resilience.

2) Decentralized Emergency Management Groups, with membership including neighbouring local authorities, emergency services and utility companies in order to ensure that while the national emergency management strategy is focused at the local level, there is improved cooperation and coordination of human and technical resources across the country.

3) A comprehensive risk management strategy that integrates disaster management into environmental and community management practices at national and local levels. The AS/NZS 4360 Risk Management standard has been adapted for the Civil Defence and Emergency Management (CDEM) practice.

There has been a shift in focus from emergency response to risk management and building resilient communities. Towards this vision, a comprehensive ‘4R’ approach has been taken in New Zealand to integrate the legislative framework, local government structures, training and education, and research activities in emergency management. The newly established the Ministry of Civil Defence and Emergency Management (MCDEM) aims to link together existing processes involved in land-use management, risk reduction, and sustainable development, in a way that supports economic and social development, and reduces social and economic risks. The Civil Defence Emergency Management Act (CDEM Act) 2002 came into effect on December 1, 2002, replacing the Civil Defence Act 1983. The CDEM Act 2002 updates and redefines the duties, functions and powers of central government, local government, emergency services, lifeline utilities and the general public. Under this Act, a sound-structured CDEM framework was developed, involving instruments such as CDEM Regulations, National CDEM Strategy, National CDEM Plan, CDEM Group Plans and Director’s Guidelines and other CDEM related statutes (The New Zealand Government, 2002).
It can be concluded that the current emergency management in New Zealand encompasses an all-hazards, all-risks, multi-agency, integrated and community-focused approach. The CDEM Act 2002 requires a risk management based approach to the management of all hazards across ‘4R’ model of risk reduction, readiness, response and recovery. The present study outlines the definitions of the ‘4R’ elements in New Zealand emergency management system, which are similar to the scope and activities of PPRR model applied in Australia.

1) **Reduction**: identifying and analyzing long term risks to human life and property from hazards and taking steps to eliminate these risks if practicable, and if not, reducing the magnitude of their impact and the likelihood of their occurring.

2) **Readiness**: developing operational systems and capabilities (including public education) before an emergency happens.

3) **Response**: taking action immediately before, during or directly after an emergency to save lives, protect property and help communities to recover.

4) **Recovery**: using coordinated efforts and processes to bring about the immediate, medium term and long term holistic regeneration of a community following an emergency (National Civil Defence Emergency Management Strategy, 2008, p. 5).

‘4R’ approach starts with recognizing the potential hazards and the vulnerability of communities to those hazards. By addressing what these hazards could do to communities, the focus moves to measures for reducing the risks and for managing the disaster impacts. While New Zealand has developed a progressive approach to comprehensive emergency management and provides a sound model for reducing the risks, there are still challenges that New Zealand faces as they continue to progress with this approach.

The consequences of the 2004 Indian Ocean tsunami prompted the New Zealand Government to review New Zealand’s risk from tsunamis and its preparedness for them. A report commissioned as part of this review gave several recommendations for improving national and regional management of tsunami risk (Webb and McEntire, 2008). As a result, a Tsunami Working Group was set up in 2006 to focus on improving warning systems and, in the longer term improving tsunami risk management. Following the Samoan tsunami in 2009, further reviews on tsunami
risk management had been undertaken. Current challenges that confront the New Zealand emergency management include such as flood risk reduction (Ministry for the Environment, 2008), land-use planning (Glavovic et al., 2010), response capacity for a large-scale disaster (Resilient Organisations, 2006a), and business continuity management (Powell, 2010). All these existing concerns, however, fully embrace the need for consolidation of emergency/disaster management practice as a priority for the future.

2.3.4 China

China is one of the few countries that have been afflicted severely by multiple types of natural disaster with high occurrence rates, massive economic and life losses, and large amounts of affected population (IFRC, 2010). Since 1989, in response to the UN’s appeal of the International Disaster Reduction Decade, the Chinese Government has launched a series of disaster reduction and mitigation initiatives. In response to the direction of UN/ISDR, the Chinese government established the Chinese National Committee for International Disaster Reduction (CNCIDR) in October 2000, consisting of 30 official agencies, such as the State Council, ministries, national committees and bureaus, the military services and additional social groups. CNCIDR is an inter-ministerial coordinating institution led by a State Councillor responsible for designing a national disaster reduction framework, developing guiding policies, coordinating relevant departments, and supervising disaster reduction works undertaken by local governments.

In comparison, China does not have national level emergency management departments like FEMA in US, EMA in Australia, and MCEDM in New Zealand. Instead, many departments share their responsibility for emergency management with a varied scope and approach. The Ministry of Civil Affairs (MCA) is a leading agency for natural disaster relief with support from other related departments. The National Disaster Reduction Centre (NDRC) of MCA is a specialized agency under the Chinese Government, providing information services and technical support to inform decisions for disaster-reduction undertakings.

The Chinese government has made many efforts to establish a modern emergency management system. In December 2005, China established an Emergency Management Office (EMO) and started to build an integrated emergency management system. The Emergency Management Office covers emergency planning, natural disasters, technological accidents, public sanitation
issues, social security concerns, and recovery and reconstruction activities. The State Council issued the *Master State Plan for Rapid Response to Public Emergencies* in January 2006. And on November 1, 2007, the *Law of the People's Republic of China on Emergency Responses* came into effect, which became a milestone of systemic emergency management in China. Under this law, emergency management in China obtained legal support from all levels of authority.

A number of devastating events in China have driven the changes in disaster policy at the national level. The 1976 Tangshan earthquake, the 1998 Yangze River floods, the mass epidemic of SARS in 2003, and the 2008 Wenchuan earthquake have highlighted the vulnerabilities of communities in response to emergencies (Bai, 2008). By realizing the importance of disaster reduction activities, China has integrated disaster mitigation into overall national economic and social development plan. The core element of this integration is the implementation of the *National Disaster Reduction Plan of the People's Republic of China (NDRP)* running from 1998 to 2010. The formulation of the plan has, however, demonstrated essential links between disaster risk reduction and China’s development interests (UN/ISDR, 2004).

A top-down approach to disaster management can be seen from the above overview. By establishing a new emergency management office, activities and operations related to emergency management are likely to be more centralized and integrated in China. Moving forward, one of the most important issues is to improve capacity building, especially in terms of developing emergency management capacity and resources, early warning systems, the development of resilient infrastructure, and the application of technologies to form a safer society (UN/ISDR, 2004). In addition, a lack of uniformity in policy approaches in China is likely to pose additional hindrances for improving cooperation in disaster management at the regional and local levels.

Furthermore, the China’s National Committee for International Disaster Reduction (2008) summarized the disaster management challenges that are inherent in China’s social and economic development processes as follows.

1) The development of disaster reduction projects cannot keep up with the rapid development of the national economy;

2) Disaster reduction plans of governments at various levels have yet to be systemized and standardized;
3) Disaster assessment and predication technology and methods are relatively backward;
4) The level of disaster reduction publicity and education nationwide is low and people’s awareness of participation is poor.

2.3.5 Indonesia

Sitting on three main crustal plates and the Pacific ‘Ring of Fire’ where 90% of the world’s earthquakes occur, Indonesia experiences a high degree of earthquakes and tsunamis. These seismic events, along with other hazards such as flooding, volcanic eruptions, social unrest, and civil conflicts, have labelled the country as a ‘supermarket of disasters’ (James, 2008). The 2004 Indian Ocean tsunami with significant devastations to Indonesia served as a natural catalyst for the country to review and improve its disaster management system. In 2005 following the tsunami, a Tsunami Early Warning System (TEWS) was established and linked to a larger Indian Ocean Tsunami Warning and Mitigation System.

The disaster management landscape in Indonesia has changed greatly since the 2004 Indian Ocean tsunami and was further influenced by the *Hyogo Framework for Action 2005-2015* in 2005. Prior to the tsunami, disaster management in Indonesia was largely reactionary, with little effort devoted to capacity building, disaster preparedness and disaster mitigation. The management of disasters at a national level was mainly charged by BAKORNAS, which was a mechanism to coordinate line government ministries. The 2004 tsunami was a turning point from which a range of governmental actions, NGO initiatives and community engagement activities took place towards improving the country’s disaster system functions.

Indonesia’s civil society was crucial to driving the legal reform process (UNDP, 2009). The Indonesian Society for Disaster Management (MPBI), a NGO formed in 2003, comprising disaster management practitioners, UN representatives, the Indonesia Red Cross, International Federation of Red Cross, scientists and observers from the government sector, private sector and national NGOs, played a significant role in advocating a legal reform for enhancing disaster management in Indonesia. In 2007, Indonesia enacted *Disaster Management Law (24/2007)*. The Law has been further elaborated upon in the subsequent *Government Regulations, Presidential Regulation* and numerous implementing guidelines (GFDRR, 2009).
A major change brought by the new **Disaster Management Law** is the establishment of a dedicated agency in 2008 — the National Disaster Management Agency (BNPB) to deal with disaster. Other key government and community sector partners work with BNPB to achieve the mitigation and risk reduction components of Law 24/2007. The **Disaster Management Law** provides a comprehensive basis for disaster management during the following three phases of a disaster management cycle in Indonesia.

1) **Pre-disaster planning and preparedness**: including disaster risk reduction, mitigation, preparedness and contingency planning;

2) **During emergency response**: including search and rescue, and emergency relief;

3) **Post-disaster longer-term recovery**: including rehabilitation and reconstruction (UNDP, 2009, p.10).

In addition, the **Disaster Management Law** provides a mandate to the BNPB to coordinate all contingency, preparedness, mitigation, prevention, disaster management training and disaster risk reduction activities pre-event. And in the post-disaster phase, the law empowers the BNPB to coordinate the implementation of rehabilitation and reconstruction. Further, the **National Action Plan for Disaster Risk Reduction (2010-2013)** and the **Disaster Management Plan (2010-2014)** present a road map for the coming years to mainstream disaster management in Indonesia (James, 2008).

It is worth noting that behind both MPBI and the National Plan has been a unit of UNDP which has provided funding and technical input, and played an important role in prompting the Indonesian government to strike towards a comprehensive disaster management. This reform, therefore, can be seen as a multi-stakeholder approach, combining responses from government at different levels and efforts from the international community. However, according to James (2008), the main challenges in disaster management still remain in Indonesia, including improving coordination between different organizations, creating a culture of disaster-risk management, implementing appropriate methods, and maintaining momentum on disaster preparedness. Further, more attention should be given to disaster risk management as a focus for future sustainable development.
2.3.6 Critique of the different approaches to disaster management

Although a range of terminology is used in describing the constituents to disaster management in the above five countries, comprehensive disaster management is based upon four common components: mitigation (reduction), preparedness (readiness), response, and recovery. Various diagrams illustrate this cyclical nature of disaster management in literature. These diagrams, such as the one shown in Figure 2.3, are generalizable. Four basic components are intermixed and are performed during and after disasters (Coppola, 2007).

Figure 2.3 The disaster management cycle (Alexander, 2002)

A review of the evolution of and analysis of key elements in the disaster management system in the U.S., Australia, New Zealand, China and Indonesia shows that emergency management is commonly influenced by broader social changes in these countries. The reform of institutions in any particular country is rooted in its past events. The country’s legislative and governmental systems provide the basis for plans and organizing disaster risk reduction. The governance structures exhibit formal and informal institutions which shape the policy formulation and implementation specific to the discussed country.

The researchers and practitioners working in the disaster management area in these countries seem to use similar concepts and approaches for attaining successful, efficient and effective disaster management. The conceptual frameworks and terminologies to understand and interpret disaster risk in each country have varied depending on the disciplinary perspective considered.
Regardless of the differences, there are common conceptions of ‘disaster risk’, ‘vulnerability’, ‘resilience’ and ‘capability’ inherent in these countries’ disaster management practice. This common vision, however, brought organisations and individuals together to work towards a comprehensive disaster management.

Britton (2002) suggested six key drivers that alter the ways in which individuals as well as institutions frame perspectives and actions to disaster management (see Figure 2.4).

![Figure 2.4 Emergency management drivers (Britton, 2002, p.47)](chart)

In light of the six generic drivers, as shown in Figure 2.4, it seems that the five countries, to a varying degree, have engaged these drivers to enable an improved emergency management/disaster management. There were characteristic disaster events that played a significant role in driving legal and institutional reforms for addressing the issues arising after a disaster. Before these symbolic events, disaster management policies and programs in these countries were concertedly instituted, based solely on a particular disaster experience, and with little investment in capacity building to deal with the next disaster. However, the current disaster management framework in these countries compliments their traditional approaches.

The disaster management approaches in both China and Indonesia share two weaknesses. They neither adequately synthesize the recovery and preparedness imperatives of managing a disaster,
nor give adequate weight to the social issues of community vulnerability and resilience. The fragmented vision of disaster management can be seen in the two countries’ regimes. Particularly in China, policy and planning institutions are oriented towards disaster response and mitigation rather than preparation and recovery. Agencies that are in a position to respond to disaster risk reduction tend to react individualistically. Further, like other developing nations, both China and Indonesia have yet to make a dedicated effort toward initiating or improving their pre-disaster management activities. The low priority afforded to disaster recovery and reconstruction is reflected in the dearth of information about recovery in these two countries. However, establishment of a new national disaster management law in both countries seems to be a key step explicitly showing the government’s obligations and commitment to setting up a holistic and integrated disaster management framework.

Increasing political and economic pressures to reduce disaster losses can be seen in the five countries, as well as the political, economic, and socio-cultural obstacles to the development of an effective national emergency management system. In contrast, however, disaster management systems in the U.S., Australia and New Zealand differ from that of China and Indonesia in the fact that they focus on a centralized disaster management leadership and decentralized disaster preparedness and mitigation measures. While there has been more investment in emergency management during the last decade in the U.S., Australia, and New Zealand, much needs to be done to improve their respective national system. Adequate understanding and appropriate policy responses are needed to ameliorate vulnerabilities to post-disaster recovery. In addition, a good governance mechanism is an important prerequisite for success of disaster management in the three countries.

Finally, as common as all of these attributes are to any sustained strategy of disaster management, one must also take account of the various political, cultural, and social distinctions that exist among all countries (UN/ISDR, 2007). There are fundamental elements in each disaster management system, but the priorities, relative emphasis, available resources, and specific ways of implementation vary. The disaster management practices are also suited to their local conditions. A summary of key changes and constituents to disaster management/emergency management system in the five countries is presented in Table 2.3. The unique set of hazards, risks and vulnerabilities in each county requires their specific strategies and policy innovations.
It has to be noted that whilst individual countries will face their own challenges in addressing emergency management, learning lessons from past events and sharing experience with other nations can often provide innovative ideas, offer differing perspectives, and ultimately inform the way in which the government protects people, property and the environment from disasters.
### Table 2.3 Key points with respect to disaster management systems in the U.S., Australia, NZ, China and Indonesia

<table>
<thead>
<tr>
<th>Country</th>
<th>Driver events</th>
<th>Leading agency</th>
<th>Main mandates</th>
<th>Disaster Management Model</th>
</tr>
</thead>
</table>
| The U.S.  | • 2001 Sept. 11 terrorist attacks  
• 2005 Hurricane Katrina                                                      | DHS  
FEMA | • Disaster Mitigation Act  
• Post-Katrina Emergency Management Reform Act  
• FEMA Strategic Plan 2008-2013                                             | Capability-based **MPPRR** model  
(Mitigation, Preparedness, Protection, Response, Recovery) |
| Australia | • 1974 Cyclone Tracy  
• 1989 Newcastle earthquake  
• A series of bushfires                                                      | EMA | • Emergency Management Act 2006  
• Local Government Act 1993                                                   | Risk management-based **PPRR** model  
(Prevention, Preparedness, Response, Recovery) |
| New Zealand | • 1931 Napier earthquake  
• Learning from the 1994 Northridge earthquake in US                         | MCDEM          | • CDEM Act 2002  
• National CDEM Strategy  
• National CDEM Plan                                                            | Risk management-based ‘**4R**’ model  
(Reduction, Readiness, Response, Recovery) |
| China     | • 1976 Tangshan earthquake  
• 1998 Yangze river floods  
• 2003 SARS epidemic  
• 2008 Wenchuan earthquake                                                     | MCA  
EMO   | • Emergency Response Law of the People’s Republic of China  
• National Disaster Reduction Plan of the People’s Republic of China           | A **top-down** approach with a focus on  
disaster mitigation                                                               |
| Indonesia | • 2004 Indian Ocean tsunami                                                  | BNPB  
NPDRR | • The Disaster Management Law 24/2007  
• National Action Plan for Disaster Risk Reduction (2010-2013)                | **Disaster Management Cycle**  
(Pre-disaster planning and preparedness, emergency response, post-disaster longer-term recovery) |
2.4 Post-disaster recovery and reconstruction

This study adopts New Zealand ‘4R’ model of emergency management for further discussion of post-disaster recovery and reconstruction in this section. According to Gerber (2007), the ‘4R’ stages encompass a diverse set of issues such as land use regulation, public health, community vulnerability and resilience, and hazard identification and mitigation. The creation of an environment where these issues are addressed and integrated is important for enabling effective disaster management. Past research shows that among the four phases, recovery is the least studied and understood (Haas et al., 1977; Rubin et al., 1985; Berke and Beatley, 1997; Fothergill et al., 1999; Olshansky, 2005; Tootle, 2007). Two reasons can be summarized as follows to explain why recovery and reconstruction has not been sufficiently recognized as a priority and has been overlooked in the mainstream disaster management.

1) First, the concept of ‘each disaster is unique’, together with perceptions about disasters as being low probability events, has to some extent hindered decision makers from effective pre-planning for ‘anything that is subject to change’. Lizarralde et al. (2010) recognized that the emergency services are mainly constrained by the differing procedures and various objectives of disaster preparedness, response and relief. Recovery is often considered as a ‘business as usual’ for the involved agencies, groups and individuals. Furthermore, there is little practical guidance to inform the management of disaster recovery (IRP, 2007). There is also a lack of knowledge sharing on disaster recovery and reconstruction from past and international events. As a result, post-disaster recovery is conducted in a piecemeal approach.

2) Second, the effect of time seems to play a significant part in disaster management cycle. There is a contradiction between the need for delicate recovery and the urgency for rapid restoration of housing and livelihoods (Ingram et al., 2006; International Recovery Platform, 2007). The need to ‘get back to pre-event normalcy as soon as possible’ greatly compromised an aspiration for recovery in a way that provides sustainable environments with improved conditions for communities (Kamel and Loukaitou-Sideris, 2004). In addition, if an integrated mechanism for leadership and coordination is absent, recovery responses from individual authority departments and agencies are likely to be undertaken in a fragmented way (Mitchell, 2004). As many researchers such as Berke et al. (1993),
Schwab et al. (1998), and Comerio (1998) have observed, attention from public and media tends to fade as the recovery and reconstruction proceeds, which if coupled with lack of commitment from governments and agencies for longer-term community recovery and redevelopment, can lead to abandonment of priorities and turning back to routine actions.

The last decade, however, has seen increased attention from both disaster practitioners and academicians to post-disaster recovery and reconstruction. As mentioned earlier, recovery intrinsically provides a ‘window of opportunity’ for the improvement of communities following a disaster. Many achievements can be made through recovery practice, such as economic and social re-structure (William L. Waugh and Smith, 2006; Ishihara, 2007; McGee, 2008; Ruwanpura, 2009), urban re-development (Comerio, 1998; Kamel and Loukaitou-Sideris, 2004; Olshansky et al., 2006; Dercon, 2007), community resilience augmentation (IFRC, Paton and Johnston, 2001; 2004; Manyena, 2006), and disaster mitigation enhancement (Reddy, 2000; Schilderman, 2004). According to the International Recovery Platform (IRP) (2007), recovery is a collective challenge for people involved to make varied efforts to minimize the likelihood of future disasters. This section is focused on understanding disaster recovery and the peculiar conditions that have a major influence on the success or frustration of recovering from a disaster.

2.4.1 Understanding recovery and its implications

In recent years, disaster recovery and reconstruction has been increasingly considered to be a locus of opportunities for structural adjustments to other key components of disaster mitigation, preparedness and response. The International Recovery Platform (IRP) was launched in May 2005 in support of the Hyogo Framework for Action (HFA). IRP seeks to fulfil the strategic goal of the HFA by functioning as a thematic platform of the International Strategy for Disaster Reduction (ISDR) system to address the conditions inherent in a recovery stage of disaster management. The key role of IRP is to identify gaps and constraints experienced in post-disaster recovery and to serve as a catalyst for the development of tools, resources, and capacity for resilient recovery. The establishment of IRP, however, is indicative of a global aspiration for drawing attention to recovery and improving the recovery practice in disaster prone countries. Furthermore, countries such as the U.S. (Inam, 2005; Zhang and Peacock, 2010), Japan (Ye and
Okada, 2002), and New Zealand (Norman, 2004) have placed a greater emphasis on strategic planning for community recovery after a natural disaster.

Recovery is a term that has been used interchangeable with reconstruction, restoration, rehabilitation and restitution (Quarantelli, 1999). Its description depends on the context within which it is defined. For instance, recovery is described by Aysan and Davis (1993) as a period following the emergency phase, when actions are taken to enable victims to resume their normal lives and means of livelihood, and to restore infrastructure, services and the economy in a manner appropriate to long-term needs and development objectives. EMA (1996) defined recovery as a coordinated process of supporting disaster-affected communities in reconstruction of the physical infrastructure and restoration of emotional, social, economic and physical well-being. The International Recovery Platform (IRP) describes recovery as follows.

‘Recovery is restoration and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. The recovery task of rehabilitation and reconstruction begins soon after the emergency phase has ended, and should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action and enable public participation. Recovery programmes, coupled with the heightened public awareness and engagement after a disaster, afford a valuable opportunity to develop and implement disaster risk reduction measures and to apply the “build back better” principle’ (IRP Glossary-recovery).

The above definitions however,concertedly highlight a number of important aspects of what constitutes recovery, and denote that recovery is all encompassing of rehabilitation, reconstruction, restoration, restitution and reinstatement. The objective of recovery, as illustrated in the above definition, is to bring the affected communities back to pre-event normalcy or enhanced level of conditions. Invariably, recovery is a community-centric process. This notion is fundamental to the recovery process and will be reinforced throughout the dissertation. IRP’s recovery definition is likely to be more informative and inclusive of recovery period, elements and components. Thus it is adopted in this research as the working definition of recovery. In order to locate the current research in a wider area of recovery, the following sections are focused on the understanding of recovery timeframe and components.
2.4.1.2 Recovery timeframe

The scant literature that exists on disaster recovery further divides the phase of recovery into different stages. The pioneering work of Hass et al. (1977) proposed a recovery continuum, shown in Figure 2.5, encompassing four sequential periods: emergency, restoration, replacement, and reconstruction for post-disaster commemoration, betterment, and development.

1) **The emergency period**: covers the hours and days immediately following the disaster when the community has to come to terms with property and life loss as well as injury and an overall disruption of routine activities.

2) **The restoration period**: directly follows the emergency period and is in effect until major urban services, transportation and evacuees return and debris is removed.

3) **The replacement reconstruction period**: is marked by rebuilding the city’s capital stock to pre-disaster level. In addition, social and economic activities return to normal as well. This period’s completion is denoted by the return of pre-disaster population levels and the replacement of homes, jobs and activities.

4) **The commemorative, betterment and development reconstruction period**: is marked by the completion of major reconstructive activities, and future growth and development.

![Figure 2.5 Hass et al. (1977)'s recovery process (Sullivan, 2003)](image-url)
Quarantelli (1982) disputed the sequential progression of these four periods and proposed a non-sequential recovery framework composed of four overlapped stages in a disaster-impacted community, namely, 1) emergency sheltering (the temporary housing of disaster victims); 2) temporary sheltering; 3) temporary housing; and 4) permanent housing. Instead of being orderly and routine, as shown in Figure 2.5, disaster recovery was portrayed as an uncertain and conflict-laden process (Bolin and Bolton, 1983; Rubin et al., 1985). The recovery outcomes are characterized by social disparities (Berke et al., 1993), and shaped by decision making and institutional capacities (Rubin and Popkin, 1990; Mileti, 1999). Further, Nigg (1995) added that recovery should not only be conceptualized as an outcome, but a social process that begins pre-event and encompasses decision making pertaining to response, restoration and reconstruction activities post-disaster.

Sullivan (2003) proposed an augmentation to the Hass et al.’s recovery model, as illustrated in Figure 2.6. In this model, the recovery process acknowledges that the emergency management process generally conforms to an approximate sequence of events. However, Sullivan (2003)’s model in Figure 2.6 still fails to present the interaction between all elements of the recovery process. To make a compliment, Sullivan (2003) advocated the use of ‘Charlotte’s Doughnut’, representing the interactions between recovery and other elements of emergency management, as shown in Figure 2.7.
Charlotte’s Doughnut in Figure 2.7 shows that recovery is a complex, protracted and dynamic process, and is an integral element of emergency management. By using both Figure 2.6 and Figure 2.7, Sullivan (2003) claimed that recovery comprises seven extra and intra elements of relevance. There are three ‘extra-recovery’ elements, namely, prevention, preparedness and response; and four ‘intra-recovery’ elements, including post-impact, restoration, replacement reconstruction, and commemorative, betterment and developmental reconstruction. Such a combination of using Figure 2.6 and Figure 2.7 reveals the key elements for communities to have in place during a recovery phase in order to achieve a desired recovery outcome.

2.4.1.2 The components of community recovery

As could be expected, there are varying needs across communities and throughout the entire recovery process. According to Norman (2004), a successful recovery takes place where all these needs are addressed in a coordinated way. Therefore, a holistic recovery framework contains multi-faceted aspects which, when combined, support the foundations of community sustainability. This study adopts the recovery models applied in New Zealand and Australia, both of which, as shown in Figure 2.8, are representative of the generic recovery structures. The basic constituents to community recovery in the two models include community-centered social, natural, infrastructural, and economic recovery.
In line with Norman (2006)‘s holistic recovery framework, the four components of disaster recovery are outlined below.

1) **Social environment**: is comprised of three distinct elements — safety and well-being, health, and welfare. Social recovery of communities is to ensure an individual or group’s emotional, spiritual, cultural, psychological, social as well as basic needs are addressed in the immediate, medium and long-term recovery following a disaster. In recent years, however, the social dimension of recovery, has been highlighted by a number of researchers, such as Berke and Beatley (1997), Alexander et al. (2006), and Ruwanpura (2009), as being the most intrinsic component to rebuilding disaster-affected communities. According to EMA (1996) and MCDEM (2002), recovery can be understood as a social process and can be best achieved when the affected community exercises a high degree of self-determination. Social recovery thus needs to deal with social vulnerabilities existing in a particular affected community.

2) **Built/physical environment**: is comprised of five elements, namely residential, commercial/industrial, rural, public buildings and assets, and lifeline utilities. Recovery of the physical infrastructure after a disaster is normally defined as post-disaster rebuilding and reconstruction, which is the focus of this present study and will be detailed.
in the following sections. Recovery activities for the built environment include the repair, reconstruction or relocation of these five elements. In order to expedite reconstruction of the built environment, Schwab et al. (1998) highlighted the importance of pre-event planning in areas such as urban planning, mitigation measures, skills and resources required for recovery, and coordination mechanisms. In addition, physical recovery of the built environment should incorporate the long-term strategies for improving community sustainability and resilience (Resilient Organisations, 2006a).

3) **Natural environment**: is comprised of four distinct elements: biodiversity and ecosystems, amenity value, waste and pollution, and natural resources. Amenity value describes aspects of the physical environment that have some form of recreational, cultural or social importance. Other amenities may include culturally significant sites and buildings. Pre-identification of such amenities will help prioritize recovery activities (Olshansky, 2005). In addition, in the early stage of recovery, the adverse effects of the disaster in respect of waste and pollution on human well-beings must be addressed. The need for deconstruction has also become more apparent in recent years. Denhart (2010) suggested the deconstruction as a cost-effective and environmentally friendly solution to waste management after a disaster. Further, during the recovery process, how to achieve a balance between utilizing natural resources and maintaining the vitality of the ecosystem has been putting onto sustainability agenda (Shaw, 2006).

4) **Economic environment**: is comprised of four distinct elements, namely individuals, businesses, infrastructure and government. The individual needs at a microeconomic level represent the demand and supply side of economic management during disaster recovery. It relates to livelihoods such as employment, access to bank loans, and insurance payment. Business recovery (Zhang et al., 2009), infrastructural restoration (Brunsdon et al., 2004) and central government’s role of economic recovery (Waugh Jr., 2009; Kim et al., 2010) at a macroeconomic level, however, play a large part in increasing the overall economic resilience. In addition, a number of empirical studies such as (Tierney, 1997; Paton, 1999; Webb et al., 2002; Powell, 2010) have brought economic recovery into focus as the sustainable commercial recovery has been recognized as one of the most challenging needs after a disaster. The economic impacts
of a disaster may transfer to recovery burdens and have a compounding effect (Resilient Organisations, 2006b). Therefore, as an integral element, the implications of business recovery need to be considered and incorporated into pre-event planning.

By analyzing the components of disaster recovery and their interrelationships, the opportunities of reducing community vulnerabilities and enhancing their resilience during the recovery phase can be recognized. These opportunities inherent in the varied functioning areas of a community are summarized in Table 2.4 below. The study anticipates that by linking recovery with the predominant paradigms of disaster management — vulnerability and resilience, an enhanced understanding of recovery and of its pivotal role in disaster management can be obtained.

Table 2.4 Linkages between components of recovery, vulnerability and resilience

<table>
<thead>
<tr>
<th>Vulnerability to disasters</th>
<th>Reduce</th>
<th>Recovery</th>
<th>Increase</th>
<th>Resilience to disasters</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Section 2.2.2.1)</td>
<td></td>
<td></td>
<td></td>
<td>(Section 2.2.2.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social factors</th>
<th>Social environment</th>
<th>Socio-psychological facets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical factors</td>
<td>Built/physical environment</td>
<td>Physical facets</td>
</tr>
<tr>
<td>Environmental factors</td>
<td>Natural environment</td>
<td>Physical facets</td>
</tr>
<tr>
<td>Economic factors</td>
<td>Economic environment</td>
<td>Organisational facets</td>
</tr>
</tbody>
</table>

2.4.1.3 Post-disaster recovery governance and institutional arrangement

After major disasters, the process of recovery and reconstruction tends to follow one of four models: the paternalistic model, the infusion of aid model, the limited intervention model, and the market model (Comerio, 1998). Those four models cover a wide range of institutional frameworks of recovery and reconstruction following a disaster. On one side of the spectrum is the recovery governance structure in which a government takes on the entire program of rebuilding; on the other side is a market-centred approach in the recovery effort. In order to understand the recovery process at various points of this spectrum, various stakeholders and their level of influence and power over reconstruction should be identified (Inam, 2005). This section outlines the four models of recovery governance.
1) *The paternalistic model*: this model promotes an idea that only an activist government has the capacity to provide aid for communities to restore some level of normalcy and decency in the aftermath of large-scale disasters (Dreier, 2006; Hartman and Squires, 2006). However, the success of this model depends on the capacity of governments at different levels under an overarching governance system (Alexander, 2002). This government-driven recovery is assisted by various organizations, both civic, and non-profit with a limited degree of community participation. This model was seen in the city of Tangshan, China, during its recovery from devastating earthquake (Comerio, 1998). The entire program of rebuilding was undertaken by the government with national and local funds. The process of recovery is primarily influenced by the decisions from the governmental authorities.

2) The infusion of aid model: involves the international relief organizations to finance and oversee the reconstruction of damaged infrastructure and properties. Like many disasters in developing countries, the recovery of Sumatra from the 2004 Indian Ocean tsunami (Meisl et al., 2006), of Bam from the 2003 Bam earthquake (Ghafory-Ashtiany and Hosseini, 2008; Omidvar et al., 2009) is comparable to this capital infusion model. The infusion of outside capital, in the form of international aid combined with outside and local expertise, is used to support reconstruction for communities. This model, however, has received criticism such as the possibility of misappropriating funds and rebuilding projects lack of cultural sensitivity (Comerio, 1998).

3) The limited intervention model: over time, the world has witnessed a shift from government-led approach to market-oriented approach in the response to disasters, particularly in the reconstruction phase. The limited intervention model calls for a more participatory post-disaster rebuilding from both the private sector and communities with less government involvement. In some cases, the stakeholder participation philosophy prevailed particularly in the stage of recovery planning and implementation (Ganapati and Ganapati, 2009; Ying, 2009). The program of community involvement in recovery activities requires to be well designed with a combination of technical, financial, and administrative assistance from public and private sectors.
4) The market model: this model simply lets the market place sort out the winners and losers after a disaster, focusing government and charitable aid only on the emergency period (Comerio, 1998). This is a typical model used in the United States and other developed countries where the market forces such as banks and insurance and private sector play a predominant role in recovery. A number of scholars such as Gotham (2008) and Peck (2006), examined the process of post-disaster recovery and rebuilding in New York City since the September 11 event and in New Orleans since the Hurricane Katrina in 2005 through the lens of ‘neoliberalism’. They argued that using market-centred approaches for urban recovery and rebuilding in those two areas should be seen not as coherent or sustainable responses since private sector-oriented restructuring of disaster aid only exposes and even reinforces the socio-economic vulnerabilities of affected communities.

Additionally, the post-disaster reconstruction governance also includes the enactment of legislative and regulatory arrangements, establishment of national and local institutions, formulation of national policies implemented at the local level and involvement of other social and private agencies. These elements, according to Inam (2005) however, are particularly relevant to each political-economic context and set of specific urban conditions.

2.4.2 Post-disaster rebuilding and reconstruction

Among the four components of recovery, the built environment is the focus of this present study. As alluded to earlier, reconstruction is a subset of recovery and concerned with rebuilding of the physical structures affected by a disaster. This study uses Brunsdon and Smith (2004)’s model, as shown in Figure 2.9, to illustrates the recovery process for the built environment. The physical reconstruction comprises five stages, including impact assessment, restoration proposition, funding arrangements, regulatory process, and physical construction.
As can be seen in Figure 2.9, five stages are broadly sequential and the early stages prior to physical construction are typically iterative. Each stage requires a varied range of skills and human resources and involves varied set of stakeholders. This section will review the research trends and practical challenges of disaster recovery and reconstruction. This is to be done by examining the predominant issues at each of the five stages.

1) **Impact assessment**: forms the most important basis for a favourable disaster recovery. Until the impact of a disaster in the built environment is assessed, no significant or systematic recovery and reconstruction can be initiated. For this reason, rapid and accurate assessment of disaster impacts is pivotal for carrying on other reconstruction operations. Assessments help to establish the extent of post-disaster damage, loss, and needs (Jha et al., 2010). Impact assessment seems to be a technical operation and involves mainly engineering society after the disaster. Indeed, a consistent framework for multi-sector and sector-specific data collection is needed at this stage to ensure efficiency, quality and common understanding of the post-disaster situation. Therefore, impact assessment processes need to be linked to an information management system that can consolidate data within and across affected areas at a national level (Brunsdon and Smith, 2004). Apart from damage assessment, assessment of social conditions of people, of community needs and expectations, and of resources and capacity regionally and
nationwide after a disaster should also be included (Barakat, 2003; Berke and Campanella, 2006).

2) **Restoration proposal**: depends on the extent the built environment is damaged by a disaster. As mentioned in the previous part, the physical structure may be subject to differed choices such as repair, rebuild or rehabilitation. The restoration proposals/reconstruction plans give an outline of the projected reconstruction needs which are directly related to estimation of reconstruction cost and resource allocation. In many developing countries where government acts as the principal reconstruction implementer, it is the government who formulate the overall recovery and reconstruction plans to guide community redevelopment (Ahmed, 2008). In contrast, however, in countries where insurance plays an important role in assisting community recovery, the insurance sector working with government and the building and engineering industry, bears responsibility for reconstruction planning (Wu and Lindell, 2004; Masurier, 2006). In addition, while crafting the proposal for longer-term reconstruction, the decisions, such as whether to relocate or rebuild on the original site, whether to establish temporary housing for displaced people or provide other social assistance, should be taken into account. All these decisions, however, are associated with requirement for systematic land use planning. Therefore, restoration proposals or rebuilding plans should not only include individual plans for each sector or household, but also incorporate considerations of boarder regional and urban recovery (Brunsdon and Smith, 2004).

3) **Funding arrangements**: There are varied sources of funding for post-disaster reconstruction. For housing recovery, apart from households’ personal funding resources, public financial assistance and monetary donations from the private sector are common funding arrangements. In the developed nations, however, financing reconstruction is largely reliant on market sources such as insurance payment and bank loans (Comerio, 1997). In comparison, reconstruction of the built environment, in most developing countries is often funded by the international aid agencies or local government (Freeman, 2004). In most cases, there is a concern about how financial resources reach marginalized segments of the affected society (Oliver-Smith, 1990; Kamel and Loukaitou-Sideris, 2004). To bridge the reconstruction financing gap, Bolin and Stanford (1998), Kamel and
Loukaitou-Sideris (2004), and Comerio (2004) proposed to link recovery funding with broader urban plans and program design for sustainable and equitable development through a better-informed public and a more democratic process. The outcome of financing recovery and other statutory compliance applications may necessitate adjustments to initial restoration plans, thus the feedback arrows shown in Figure 2.9.

4) **Regulatory process**: refers to operations of statutory compliance, such as building consent application, construction approvals, and compliance to building code and to other construction-related statutes. In a post-disaster situation, however, routine documentation procedures for construction may slow the reconstruction process (Burby et al., 2006). The reconstruction experience after the 2004 Indian Ocean tsunami (Ahmed, 2008; Lyons, 2009) and recovery evidence after the 2005 Hurricane Katrina (Masurier et al., 2006a) revealed that existing building legislation and policy seemed to be unable to cope with large scale disaster situations (Zuo et al., 2006; Ahmed, 2008; Lyons, 2009). Inappropriate legislative and governmental systems can substantially hinder effective post-disaster resource procurement and allocation (Hanaoka and Qadir, 2005). Therefore, the regulatory processes for the overall post-disaster recovery and reconstruction should go beyond the scope shown in Figure 2.9. A systematic review and revamping the existing legislation to meet the requirements of post-disaster reconstruction is needed (Gopalakrishnan and Okada, 2007; Rotimi et al., 2009).

5) **Physical construction**: differs from conventional construction at normal times in a number of ways. According to Oliver-Smith (1991, p. 20), the success of post-disaster reconstruction depends on how it is done as it is of what, or how much, is done. Following this line of thinking, a large number of academics and practitioners have been engaged in defining a set of cross-cutting challenges in physical reconstruction process. Poor reconstruction performance has been a major concern in disaster-affected developing countries (Lizarralde, 2004). Availability of resources after a disaster has been highlighted in recent years as a key contributory factor to the success of disaster recovery (Resilient Organisations, 2006a; Singh and Wilkinson, 2008). The issues such as disaster mitigation through quality control (Boen, 2006a; Gharaati, 2006; Kennedy et al., 2008), integration of cultural aspects (Boen and Jigyasu, 2005; Limoncu and
Celebioglu, 2006; Barenstein and Pittet, 2007; Ahmed, 2008) and environmental sustainability (Shaw, 2006; O’Brien et al., 2008; Roseberry, 2008) have been widely discussed at the community, regional and country levels in literature.

In all, the process of post-disaster reconstruction involves a series of ongoing and interrelated processes, all taking place at a varied time and having a different impact on the outcome of disaster recovery. The nature and scope of these processes, as revealed in the above discussion, vary according to the magnitude of the disaster, the type of hazard involved, and the size and technical capacities of recovery participants. However, there are issues common to the vast majority of post-disaster situations. Table 2.5 summarizes these issues as follows. The present study aims to examine the issue of resource availability in post-disaster housing reconstruction. The following section and Chapter Three will lay out the literature review specific to this issue.

Table 2.5 Predominant issues in post-disaster reconstruction

<table>
<thead>
<tr>
<th>Stages of post-disaster reconstruction</th>
<th>Emerging issues in post-disaster reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact assessment</td>
<td>Consistent framework for damage assessment</td>
</tr>
<tr>
<td></td>
<td>Information management system</td>
</tr>
<tr>
<td></td>
<td>Social assessment</td>
</tr>
<tr>
<td></td>
<td>social conditions of people,</td>
</tr>
<tr>
<td></td>
<td>community needs and expectations</td>
</tr>
<tr>
<td></td>
<td>resource and capacity assessment across other industries</td>
</tr>
<tr>
<td>Restoration proposal/Reconstruction plans</td>
<td>Critical decision making</td>
</tr>
<tr>
<td></td>
<td>Relocation or on-site rebuilding</td>
</tr>
<tr>
<td></td>
<td>Temporary housing</td>
</tr>
<tr>
<td></td>
<td>Social assistance (livelihood)</td>
</tr>
<tr>
<td></td>
<td>Land use planning</td>
</tr>
<tr>
<td></td>
<td>Reconstruction cost estimation and resource allocation plans based on reconstruction needs</td>
</tr>
<tr>
<td>Funding arrangements</td>
<td>Impacts of funding solutions on recovery and reconstruction</td>
</tr>
<tr>
<td></td>
<td>Funding mechanism</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
</tr>
<tr>
<td></td>
<td>Government or NGO funding strategies</td>
</tr>
</tbody>
</table>

71
### Sustainable community redevelopment

- Compliance of statutory mandates
- Review and revamping the existing legislative and regulatory framework

### Regulatory processes

- Effectiveness and applicability of existing mandates
- Institutional arrangement
- Governance structure

### Physical Construction

- Reconstruction performance
- Quality control
- Time and cost implications
- Resource availability
- Cultural, environmental, and sustainable considerations
- Community participation

### 2.4.3 Why housing? And its reconstruction approaches

Housing, as an integral part of the built environment, is a unique phenomenon and has its unique political, economic and social connections with human users (Clapham, 2009). In reviewing historical context of housing development, Harris and Arku (2006) played a high premium on the role of housing in economic development. The political level of government interventions were also advocated by Bhattacharya (1994) to address affordability of households in urban development. The need for provision of low-cost and environmental-sensitive housing in the most developing world and poor urban areas of developed countries has surfaced in recent years. Furthermore, many scholars such as Brezar (2001) and Pugh (2001) called for a fresh look at the relationship between housing and its residents, highlighting the intimacy between housing construction and community sustainable development.

Everyone has a right to adequate housing. Article 25 of the Universal Declaration of Human Rights states that:

> Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.
The United Nations High Commissioner for Refugees (UNHCR) defines the characteristics of ‘adequate’ housing as being legal security of tenure; availability of services, materials, facilities and infrastructure; affordability; habitability; accessibility; location; and cultural adequacy. Recent urban disasters, however, have made it clear that housing is the single greatest component of all losses in terms of economic value and building damage (Comerio, 1997). Over years, housing, as being one of the fundamental human needs, has won great attention from the public and is always the concern of disaster specialists.

Housing recovery is key to revitalizing communities following a major natural disaster (Zhang and Peacock, 2010; Bosher, 2011b). Additionally, in reviewing the literature, the issues summarized in Table 2.6 in the previous section are likely to play a more dominant role in housing sector during post-disaster reconstruction. Housing recovery is a focal point for addressing other economic, social, political and environmental recovery (Brezar, 2005). Housing reconstruction also encompasses a wide variety of topics and priorities. In the present study, the focus is placed on looking at the basics of post-disaster housing reconstruction including housing patterns and approaches applied in post-disaster housing reconstruction.

2.4.3.1 Post-disaster housing patterns

According to Quarantelli (1982), housing recovery encompasses four stages in the aftermath of disaster: emergency shelter; temporary shelter; temporary housing; and permanent housing. However, the terms of ‘sheltering’ and ‘housing’ was used in a somewhat inconsistent way. Therefore, Quarantelli (1995a) proposed a differentiation between ‘sheltering’ and ‘housing’. Sheltering denotes the activity of staying in a place during the height and immediate aftermath of a disaster where regular daily routines are suspended. However, housing denotes the return to normal daily activities such as work, school, cooking at home, shopping, and so on. Based on this distinction, the four patterns of post-disaster housing are outlined below in line with the work of Johnson (2007).

1) **Emergency shelter**: is usually established following a disaster at the instigation of individuals and households in accordance with chance availability, convenience, proximity and perceived safety (Bolin, 1993). It may take the form of a public shelter,
refuge at a friend’s house, or shelter under a plastic sheet, and is generally employed for one night to a couple of days during the emergency.

2) **Temporary shelter**: is often sought in a second home, friend’s house, motel, tents or public facility (Tierney et al., 2001). These shelters can be used for a few weeks following the disaster and also accompanied by the provision of food, water and medical treatment.

3) **Temporary housing**: is the return to the daily activities of home life and the possible return to work and school. Families will be living in a temporary residence until a permanent housing solution can be found. Temporary housing can take the form of a rented apartment, a prefabricated home, or a small shack, depending on the context.

4) **Permanent housing**: is the return to the former home after its reconstruction or resettlement in a new home where the family can plan to live on a permanent basis. It involves disaster victims returning either to their repaired or rebuilt original homes or moving into new quarters in the community. In both cases, however, the moves involve occupying permanent, residential faculties.

In comparison with sheltering, housing involves resumption of household responsibilities and activities in the new quarters (Quarantelli, 1995a). The four patterns of housing solutions after a disaster are not linear and oftentimes overlapped. House owners affected by a disaster may or may not pass through all these stages, and some stages may be applied simultaneously for different sectors (Johnson, 2007). However, the displaced populations after a disaster need to confront the fact that the displacement and the altered living arrangements may exceed a mere emergency or temporary basis, and extend for a longer-term recovery period. Therefore, while even accommodating themselves in temporary shelters or in so-called transitional housing, the major purpose of housing recovery is still to re-establish household routines by rebuilding permanent residential units. Unlike other three patterns, the permanent housing depends on the pre-disaster housing situation and the influence of various local interest and power groups. Quarantelli (1982) highlighted permanent housing as being a process with the potential for either creating a resilient built environment, or generating further vulnerabilities to the disaster-affected communities. Therefore, putting permanent housing in pace is of primary importance on a
recovery agenda after a disaster. This present study sheds the spotlight on housing recovery with respect to permanent housing reconstruction.

2.4.3.2 Housing reconstruction approaches

One of the most complex tasks facing recovery managers after a disaster is to determine and implement the most appropriate approaches to housing reconstruction. Post-disaster housing reconstruction can be undertaken through different approaches in terms of a household’s degree of control over the reconstruction process (Jha et al., 2010). According to IRP (2007) and the World Bank (2010), the choice of a reconstruction approach – or approaches – to be employed is context-specific and should take into consideration of several important elements. These elements include: (1) wider political milieu and operational requirements, (2) cultural context, (3) reconstruction costs, (4) improvement in housing and community safety, (5) restoration of livelihoods, and (6) expectations and preferences of the people most affected. There have been some researchers, such as Comerio (1998), Barakat (2003), and Barenstein (2006b; 2008; 2010), proposing and comparing different approaches to permanent housing reconstruction after a disaster. Invariably, the method of reconstruction implementation contains two options (Barakat, 2003).

- Owner-build/community-build model: Communities collectively or house owners individually undertake building work themselves.
- Contractor-build model: Construction specialists such as contractors and builders undertake building work for house owners.

The involved stakeholders for housing reconstruction after a disaster can be broadly categorized into government; donor society including NGOs and other civil societies; construction sector; insurance sector; financial industry; and house owners. In the present study, this section makes a distinction among the reconstruction-involved stakeholders by categorizing them at two levels — operational environment, and reconstruction implementation. The housing reconstruction can be undertaken in a market or government or donor operational environment, depending on who plays the lead role among the involved stakeholders. It can be implemented by either house owners individually or community collectively or construction professionals. The remainder of this section will elaborate on these categories with examples.
1) Market-dominant operational environment

Housing recovery in most developed countries is largely a market-driven process (Comerio, 1997; Zhang, 2006). Government plays an important role in temporarily accommodating displaced victims, however, long term permanent housing is organized by the affected people themselves under a market economy. Self-build in the form of ‘do it yourself’ (DIY) and builder/contractor-build methods are common for post-disaster housing reconstruction. There has been a diversity of empirical studies on housing recovery patterns under a market economy (e.g. (Reddy, 1992; Eoh, 1998; Cole, 2003; Kamel, 2004; Lovekamp, 2006; Zhang, 2006; Lu, 2008)). Research findings from these studies revealed that for those seeking to rebuild after a disaster within a market-driven context, their social status and economic circumstance are key determinants in their ability to recover from disasters. According to Comerio (1998), for instance, how Americans finance, build, own, and insure housing influences the type of losses caused by disasters, as well as their capacity to recover socially and financially from disasters. Market economy, therefore, provides a mechanism to finance housing. This also applies in a post-disaster reconstruction situation. Home owners are expected to insure their properties against catastrophic losses or borrow from banks to finance housing rebuilding following a disaster. Therefore, the market forces such as insurance companies, financial industry along with house owners’ savings are the major funding sources for housing reconstruction. Other external assistance, such as subsidies and grants from the government and donations from the aid agencies, takes on the additional role of providing supplementary assistance to house owners for home repairs and rebuilding.

In recent years, particularly after the Hurricane Katrina in 2005 in the U.S., a debate has been sought between government, civil society organizations and international agencies about whether a government should take a more leading role and burden of responsibility in longer-term post-disaster reconstruction (Comerio, 2004; Bailey and Pavanello, 2009; Lyons, 2009). There has been a tendency to look at substantial policies to tie mitigation with the availability of insurances and availability of public assistance for housing recovery. However, as alluded to in preceding sections, without a robust market instrument like insurance in place, the affected population in most less industrialized nations are more dependent on outside assistance from both government
and aid organizations (Comerio, 1998; Freeman, 2004). The government- and NGOs-dominant reconstruction will be discussed in the following sections respectively.

2) **Government-dominant operational environment**

One approach to recovery is for a government to take on the entire program of rebuilding. This is rarely done, however, except in cases of massive devastation, such as the reconstruction of the city of Tangshan in China (Comerio, 1998). Under a government-dominant environment, government, taking a ‘paternalistic’ role, provides the majority of regulatory, funding and technical assistance to the affected communities. The post-disaster reconstruction in Darwin following the Cyclone Tracy in 1974 in Australia was a government-oriented recovery protocol. By setting up a construction ‘supremo’, the Australia government initiated restrictions on building projects in order to control resource prices, along with a range of policies to oversee the overall reconstruction of the city (Walker, 1995).

Likewise, government response and interventions played a predominant role in housing rebuilding in China after the 2008 Wenchuan earthquake (Chang et al., 2009). In a more government-driven, less market-oriented economy, owner-build/community-build models for rural housing and contractor-build model for urban housing reconstruction can be seen in the earthquake impacted zone. As observed by Paterson et al. (2008), an owner-build reconstruction approach, utilizing a combination of governmental subsidies, partnership assistance, and social help and support was advocated in rural affected areas. Some rural counties adopted innovative approaches, encompassing accessible education and training for farming communities not only in the technical specifics of building codes, but also in the basic reasoning that underlies them, and linking the provision of subsidies to inspection and monitoring at each stage of the house reconstruction process. In contrast, in the affected urban cities, the predominant high-rise residential housing required reconstruction work to be carried out by professional contractors and other construction specialists.

3) **Donor-dominant operational environment**

Over the last twenty years, the international aid agencies have been involved in physical reconstruction after a disaster. This usually takes place in most developing countries where the local capacity is unable to deal with disaster situations. In most cases, the international relief
organizations play a leading role in financing and overseeing the construction of housing projects. In the aftermath of the 2004 Indian Ocean tsunami, for instance, the ‘infusion of aid’ model was preferred and applied in the majority of housing reconstruction projects. Under the donor-driven reconstruction environment, differing implementation approaches have been pursued in past events, including cash grants, contractor-build reconstruction in situ or ex nihilo, self-rebuild, and community-build method. In line with the categorization of Jha et al. (2010), the following describes the commonly used reconstruction implementation methods.

**Cash approach:** With this reconstruction method, financial support for repair and reconstruction of damaged houses is provided exclusively by aid agencies in terms of cash grants or cash transfer. This approach is appropriate for disasters that have a relatively limited impact and where housing damage was not caused by shortcomings in local construction practices. And this approach may also give affected people the choice to use the fund based on their own priorities. However, Adams and Harvey (2006), and Doocy et al. (2006) suggested the risks involved in applying this approach, such as house owners’ misuse of funds and risk of corruption.

**Contractor-build approach:** Aid agencies’ housing reconstruction programmes are contracted to professional construction companies. Under this approach, houses can be reconstructed on the original location or on a new relocated site. Past experience with this approach often involved construction companies, solutions, materials and expertise imported from outside of the target community (Barakat, 2003). Barenstein (2008) suggested that by using construction companies, a large number of houses can be constructed with standard specifications in a rapid manner. Therefore, this approach can work well in places where skills have become specialised, knowledge of construction is limited to professionals and there is no longer a tradition of community self-building. However, in places where homeowners expect to carry out their own rebuilding and repairs, using outside contractors may be problematic. There exists a risk of introducing technology, skills and building techniques that might be alien to the local community.

**Self-build approach:** this model is also called self-help or owner-driven which aims to enable communities to undertake building work themselves by providing some combination of financial, material and technical assistance. This method is particularly
suitable for communities who are accustomed to building their own homes. In comparison with contractor-build reconstruction, the owner self-build approach is empowering and participatory, and thus was popular among NGOs for post-2004 Indian Ocean tsunami reconstruction, such as UNHCR (2006), UNICEF (Jaspars et al., 2007), World Vision (Bailey et al., 2008). There are other types of self-build housing reconstruction. For instance, UNDP (2007), in conjunction with UN-Habitat, designed the Aceh Nias Settlements Support Program (ANSSP) in which self-construction was adopted with funding support from aid agencies in the form of cash grant or transfer. Barenstein (2008) commented that owner-driven post-disaster housing reconstruction is socially, financially and technically viable. However, quality concern about self-construction will be greater in disaster-prone areas. Therefore, successful adoption of this approach requires significant commitment from the aid agencies to site monitoring and supervision.

**Community-build approach:** under this approach, the degree of control by aid agencies over post-disaster housing reconstruction may vary. The agency may take the lead, suggesting housing designs, techniques and materials, and delivering construction inputs and training. The agency may also employ skilled and unskilled labour from the community or facilitate the formation of construction committees. In other cases, the community may manage the reconstruction process and receive only the technical support from the aid agencies. Therefore, community-build approach involved a continuum of reconstruction methods with varying degree of participation and intervention from the aid agencies and communities. In comparison, the owner-build housing can be undertaken individually by affected populations to meet their own priorities, whereas the community-build housing projects can be planned and managed by community members as a group maximizing the use of capacities and resources.

In comparing owner-build and contractor-build models in housing reconstruction, researchers such as Barenstein (2008), and Jha et al. (2010) and aid organizations such as UNDP (2007) and UN-Habitat (2007) have advocated the use of owner-driven reconstruction, which was regarded as the most empowering, dignified, sustainable, and cost-effective approach. The review of these reconstruction approaches also demonstrates that, a community participatory approach to
physical rebuilding has been increasingly considered to be central for a successful disaster recovery and mitigation. However, some researchers have recognized the difficulties in applying community participatory approach in disaster recovery. For instance, according to Wisner (1998), a change of culture is required amongst city planners and disaster mitigation professionals to respect the involvement of vulnerable people. Further, marginalized communities with high vulnerability are often unwilling or unable to become involved.

As Davidson et al. (2007, p. 113) pointed out that construction in general and reconstruction in particular are rooted in their socio-politico-economic contexts and that there is no single ‘best’ approach for community participation. To be successful, the community participatory methods need to be planned and tailored in light of the context of the target areas (Ganapati and Ganapati, 2009). Otherwise, ‘participatory development’ may be used as a convenient ‘buzzword’ to satisfy a specific group, while the integrity of the approach is ignored (James, 2008). Moreover, it has be to recognized that effective community participation takes time and necessitates continuous facilitation (Steinberg, 2007). Without an effective community capacity assessment (Barakat, 2003) and financial and technical assistance in place (IRP 2007), this initiative may give rise to other problems such as quality control issues (Barenstein, 2006a), overstretched cost for site monitoring (Barakat, 2003), delays in adoption of building codes and standards (Stephenson, 2008) and even increased physical and social vulnerabilities (Kennedy et al., 2008).

Above all, the discussed housing reconstruction approaches have both advantages and disadvantages. An ideal housing reconstruction approach is the one that addresses the needs of households and also contributes to economic recovery and restoration of livelihoods. The reconstruction approaches discussed above are not mutually exclusive and are often found in combination in practice. The roles of actors – government, agencies, community, contractor and private sector can be combined and shared in many ways, as shown in Table 2.6 matrix. The degree of house owners’ control varies across the different reconstruction approaches. Regardless of which approach is used, it has to be noted that when time and political and financial resources are limited, there is a danger that housing restoration and reconstruction are drawn out or never fully completed, exposing vulnerable communities to additional hazard, or that pre-disaster conditions are simply replicated. Therefore, recovery managers need to bear in
mind the advantages and disadvantages with each reconstruction approach. Varied mechanisms should also be in place to address the potential risks in a selected approach to rebuilding houses.

Table 2.6 Matrix of post-disaster housing reconstruction approaches

<table>
<thead>
<tr>
<th>Who plays a lead role in the recovery operational environment?</th>
<th>Who principally implements reconstruction?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>House owner (individual)</td>
</tr>
<tr>
<td>Market</td>
<td>Community (collective, cluster)</td>
</tr>
<tr>
<td>Government</td>
<td>Owner-build model</td>
</tr>
<tr>
<td>Donor</td>
<td>Community-build model</td>
</tr>
<tr>
<td></td>
<td>Contractor-build model</td>
</tr>
</tbody>
</table>

2.5 Concluding statements

We are living in a world of growing risks, with the most devastating disasters possibly taking place in anywhere and at anytime. Set against this, disaster management continues to be seen as a consistent pursuit for practitioners and researchers in hazard field. Insufficient explanation of disasters is likely to direct policy and research towards a preference for physical rather than social science analysis and policy recommendations in disaster management. The evolved knowledge about what constitute a disaster has verified an inclusive definition within which both natural and social components and their on-going relationship play in the production of disaster. Linkages between hazardous nature of a disaster and its social relations with human beings are weakly theorized and, as a consequence, resilience is rarely integrated into disaster mitigation policies. Setting within a broad co-evolutionary framework, this chapter sought to outline the pathways through which institutional changes and renewed disaster experiences influence the way of managing disasters in the U.S., Australia, New Zealand, China and Indonesia. It is found that the features and processes of their disaster management systems shape the social and physical distribution of disaster risks and community vulnerabilities.

Although disaster recovery is an under-researched area across the disaster life cycle, the opportunities to reduce community vulnerabilities and enhancing their resilience inherent in
post-disaster recovery have been unveiled in literature. There is also recognition that when the recovery is ill-handled, pre-existing conditions and disaster impacts of all kinds – economic, social, physical and environmental are most likely to combine to produce community vulnerabilities or increase their exposure to future disasters. Therefore, by in-depth analyzing disaster recovery and its implications for community development in this chapter, the linkage between recovery and addressing ‘vulnerability’ and ‘resilience’ through recovery become clear. Innovative activities and access to external assistance from market, government and aid agencies have the potential to create a conducive environment for community recovery. It also seems likely that coping at a community level with varying combinations of housing reconstruction approaches will be enhanced if the risks involved in these approaches are dealt with by appropriate mechanisms.

Under each stage of post-disaster reconstruction, there are unsolved issues and challenges that were brought to fore by disaster practitioners and researchers. The main focus of this research, departing from many other identified issues in post-disaster housing recovery, is placed on looking at resource availability for post-disaster housing reconstruction. The next chapter will review existing resource management literature and resourcing practice in disaster recovery. It builds on the conceptual foundations laid in this chapter.
Chapter 3 Resourcing for post-disaster reconstruction

3.0 Overview

Having introduced the fundamental concepts with respect to disaster management and housing recovery in the preceding chapter, this chapter looks at research work on resourcing and resource availability for post-disaster reconstruction. This chapter begins with defining ‘resourcing’ for construction projects and compares it with other resource-related operations in project management. Such a comparison generates the implications of understanding and implementing resourcing in a post-disaster recovery context. This chapter encapsulates resourcing stakeholders and approaches in past and current disaster events. The second part of this chapter examines the concept of resource availability. Contrary to traditions, this research proposes three dimensions that constitute the availability of resources in disaster recovery projects. The implications of resource availability for disaster recovery projects in terms of construction time, cost, and quality are analyzed. This chapter also takes a closer look at the factors affecting resource availability in conventional project management and the factors impinging upon resource availability in disaster recovery projects.

By undertaking literature review on resource management in construction projects, this chapter provides a preliminary understanding of the dynamics in a resourcing process, particularly in a reconstruction situation after a major disaster. Combined with the preceding Chapter Two, this chapter provides a foundation for the current research to build up an analytical framework on resource availability for post-disaster reconstruction. This analytical framework also governs the overarching research design in the following chapters.

3.1 Construction resources and resource management

This section lays out the thematic issue of dissertation by reviewing research on, and practice of, resource management for construction projects. Since resources such as building materials, construction professionals, expertise, along with information, funds, and other intelligent works are essential inputs into a building project, this section provides an overview of 1) categorization
of construction resources; 2) considerations for the selection of construction resources; and 3) resource management-related operations in construction.

3.1.1 Resources for house construction

3.1.1.1 Types of resources for construction and focus of this research

Delivering any building is a highly complex task. Various resources are used to support a construction project delivery process. Funding, labour, materials, equipment, and construction specialists such as structural engineer, architect, and building contractor are traditional tangible construction resources. The intangible resources include information and space which are also important for undertaking a construction project. There have been other different classifications of resources. For instance, construction resources can be categorized into manufactured building products and raw materials; or basic construction materials and refined products. Particularly, Mitchell et al. (2005) classified main building materials and products by supply chain and product characteristics, and their impacts on natural environment. This classification is adopted in this present study and listed in Table 3.1 below. Table 3.1 shows that building material products for construction can be categorized into four types: infrastructure products, bulk products, shaped products and itemized products. The following provides a description of these four categories of resources, with an emphasis on their potential impacts on environment and ecosystem, in line with a study by Jones et al. (2009).

Table 3.1 Classes of building product types (Mitchell et al., 2005)

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Bulk</th>
<th>Shapes</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel, feedstock, power, water, transport, minerals, forestry, agriculture</td>
<td>Concrete, cement, sand; lime, plaster, stone, clay, masonry, metal, glass, structural steel, aluminium, grain, timber</td>
<td>Masonry, metals, cables, composites, ceramics, porcelain, polymers, fittings, furnishings</td>
<td>Paper, fibres and fabrics, paints, pigments, sealants, intermediates, glues, packaging</td>
</tr>
</tbody>
</table>

1) **Infrastructure products**: include supply and distribution of water, mineral, fuel, feedstock, energy, power, forestry, agriculture, and transport of commodities and services. Infrastructure operations claim the major share of fossil fuel use and related impacts on the environment. By virtue of reliance on land use, it also offers the major share of opportunity for carbon sequestration, particularly in forestry and agriculture to mitigate
some impacts such as the greenhouse effect. This class has the largest impact on habitat loss, and hence the largest opportunity for enhanced flora and fauna conservation by provision of nature corridors, restoration of extractive sites of materials.

2) **Bulk products**: including cement, glass, aggregate and structural steel, as shown in Table 3.2. These building commodities have high rates of local supply. By virtue of mass and volume, they form the major building share of resource and biodiversity depletion impacts, as well as embodied energy-related impacts.

*Table 3.2 Bulk class building product lines (Mitchell et al., 2005)*

<table>
<thead>
<tr>
<th>Base product</th>
<th>Components and lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Cement, mortar, crushed aggregate, sand; lime and plaster</td>
</tr>
<tr>
<td>Steels</td>
<td>Reinforcing and structural</td>
</tr>
<tr>
<td>Timber</td>
<td>Structural, formwork and laminated beams</td>
</tr>
<tr>
<td>Glass</td>
<td>Float, flat and coated</td>
</tr>
<tr>
<td>Clay, masonry</td>
<td>Tiles, bricks, blocks and pavers</td>
</tr>
</tbody>
</table>

3) **Shaped products**: Table 3.3 provides examples of shaped products which have relatively low levels of imports, high surface area and tensile strength, with price based on area or length, and differentiated by finish. Operations are less resource and energy intensive than bulk operations per unit mass, but chemical finishing operations commonly involve emissions to air and water that impact on human and ecosystem health. With shapes comprising the highest surface area per unit mass class, they continue human health impacts from emissions connected with interior installation, cleaning and maintenance of surfaces.

*Table 3.3 Shaped class building product lines (Mitchell et al., 2005)*

<table>
<thead>
<tr>
<th>Base material</th>
<th>Product lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board</td>
<td>Plasterboard, particleboard; ply; timber panelling, composite laminates</td>
</tr>
<tr>
<td>Panel and strip</td>
<td>Steel, aluminium; copper, polymer: PE, PP, PVC, PU and PA and composites</td>
</tr>
<tr>
<td>Sheeting</td>
<td>Paper, aluminium; iron, copper and Cr/Al/Zn/Si/polymer coated steels</td>
</tr>
<tr>
<td>Coating</td>
<td>Paint, sealants, finishes, pigments, lime-putty, plaster, render</td>
</tr>
</tbody>
</table>
Forms| Pipe, wire and extrusions: iron, aluminium, copper, steel and plaster
Cables| Copper, aluminium, glass, polymer and stainless steel composites
Fabric| Wool/cotton/hemp/PE/PP/PVC/PU/PA composites/carpet/underlay/linoleum
Wool/foil| Insulation batt/blanket: mineral, wool, polymer, aluminium, glass, resin, paper


4) **Itemized products**: including glues, composites, connections and fittings, as shown in Table 3.4. This type of products forms the smallest commercial building product mass flow. With the highest churn rate, however, the items comprise the major building fabric share of impacts related to solid waste to landfill and subsequent emissions to water and air. In addition, potential for such impact reduction by adaptability, reuse, take-back and recyclability is considerable.

<table>
<thead>
<tr>
<th>Type</th>
<th>Product lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composites</td>
<td>Glues, fillers, putties, adhesives, chemicals, solder, jointing tapes</td>
</tr>
<tr>
<td>Connections</td>
<td>Nuts, bolts, nails, screws, rods, tubes, hinges, flats and angles</td>
</tr>
<tr>
<td>Small shapes</td>
<td>Timber, ceramic, metal, glass and high density and low density PE, PVC, PS&lt;sup&gt;1&lt;/sup&gt; polymers</td>
</tr>
<tr>
<td>Finished items</td>
<td>Timber, polymer, ceramic, metal, porcelain and glass</td>
</tr>
<tr>
<td>Fittings</td>
<td>Polymer, metal, timber, glass and ceramic components</td>
</tr>
<tr>
<td>Fabrications</td>
<td>Timber, paper, metal, polymer, ceramic, glass and laminations</td>
</tr>
</tbody>
</table>

Note 1: PE: polyethylene, PVC: polyvinylchloride, PS: polystyrene

The above classification of resources and the description of their functional and environmental characteristics show that whichever a resource is to be used, it is likely to have an impact on the efficiency of project delivery, and the natural and human environment. The effect of resource availability on a construction project is indicative of the ‘wooden barrel theory’ in economics that the capacity of a barrel is determined not by the longest wooden bar, but by the shortest (Mankiw, 2008). That means the lack of any type of building products described above, is likely to affect the whole functioning of a construction project. The attention should, therefore, be paid to those resources that are likely to be ‘the shortest wooden bars’, subject to shortages during
construction and have an impact on the delivery of a construction project. It can be a certain type of building materials, can be labour force, and also can be some kind of equipment needed for carrying on a construction project. The focus of this research, however, is to examine the availability of these problematic resources and their implications for the recovery of housing projects following a major disaster.

3.1.1.2 Selection of resources for housing construction

When commencing a construction project, selecting suitable resources for different structures can be complicated given the vast variety of options in the market. The government authorities concerned and construction industry have been making efforts to streamline this process and make it straightforward for construction clients. This section summarizes the likely factors that govern decision making with respect to the selection of resources for a building project. In principle, selection of resources can be governed by four major considerations.

1) **Building code and standards:** The planning and design of housing projects are primarily governed by building codes and zoning regulations. According to Fewings (2005), the current building standards, directives, regulations, and laws are an unalterable basis for selection of resources for single housing construction. Pivotal to transforming resources to safe elements of a building are the codes of practice which are universally acknowledged and accepted by the construction industry and public. Specifications on the development of materials in the manufacturing process, and on the use of suitable materials in design and construction processes are essential to meet the safety and other quality-related criteria (Emmitt and Yeomans, 2008).

2) **Environmental concerns:** It has to be recognized that the construction industry, together with the materials industries which support it, is one the major global exploiters of natural resources, both physical and biological (Spence and Mulligan, 1995). Inevitably, extraction of natural resources for producing building materials, and the production process consume energy and causing environmental degradation. According to the United Nations Environment Programme (2003) and the Intergovernmental Panel on Climate Change (2007), worldwide environmental degradation mainly arises from building supply chain production sequences. Therefore, considering the vast amount of natural resources
consumed by conventional building materials, more environmental-friendly alternatives have been advocated and developed in recent years to mitigate the associated adverse environmental effects (Newton et al., 2009). With an increased awareness of environmental reservation, house owners have also shown their environmental sensitivity through careful design and material selection.

3) **Housing culture and traditions**: Contemporary architectural practice is dominated by the need to take into account legislative compliance and environmental considerations to achieve effective and efficient selection of building materials and products (Platt, 2004). However, it is ultimately the house owner’s preferences and choices that define the final use of materials in construction. According to Segal (2006), housing culture and traditions embody significantly higher level of use of building techniques, materials and products. The World Housing Encyclopedia (2009) exhibited a large number of construction materials and technologies that have been and are being adopted worldwide to build houses. The most commonly used housing types include adobe houses, wood houses, stone masonry houses, brick masonry houses, confined masonry houses, reinforced concrete frame buildings, buildings with advanced technologies and vernacular housing. The choice of a particular type of house is dependent on locally available materials and skills, and the level of technology. Therefore, housing culture and traditions play a dominant role in household’s selection of building techniques and materials.

4) **House owner’s budget**: When it comes to the realization state of construction, individual budget for house construction comes to the fore in deciding on the choice of materials. According to Park (2005), construction resources constitute a large proportion of the total cost of construction. The construction cost calculation is based on the determined building standards and housing characteristics, as shown in Figure 3.1. This cost assessment process, however, gives the house owner a basis for deciding whether the building project should go ahead as planned or not (Klein, 2008). Therefore, selection of and purchasing building materials and products are captive to the house owner’s budget and their affordability, which, as Weippert (2009) suggested, may become problematic for building safety if the construction is constrained by funding availability.
In conclusion, in selecting building resources, housing features such as architectural features, structural features, and environmental concerns, and legal requirements are the major considerations of construction professionals. However, the use of suitable building materials and products is ultimately contingent upon the house owners’ socio-economic conditions such as local housing culture and house owners’ budget. Understanding these considerations represents a key step in comprehending the broader housing project environment and embracing the need to explore resource management practice in a project-based scope. The following section therefore reviews literature in resource management from the perspective and experiences of project management in conventional construction practice.

3.1.2 Resource management in construction projects

As alluded to earlier, construction resources constitute a large proportion of the total cost of construction. The estimated proportions of resource input into a construction system are tabulated in Table 3.5. Given this considerable input, management of resources has been emphasized in mainstream construction management literature as the key to meeting a project schedule (Shtub et al., 1994; Harris et al., 2006; Walker, 2007; Eisner, 2008; Lewis, 2008). Park (2005) even claimed that construction management is nothing, but, resource management.
Table 3.5 Estimated resource inputs into construction projects (Hillebrandt, 1988)

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Operative manpower (%)</th>
<th>Materials (%)</th>
<th>Plant (%)</th>
<th>Other (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New housing</td>
<td>30</td>
<td>43</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>New other building</td>
<td>28</td>
<td>42</td>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>New civil work</td>
<td>15</td>
<td>35</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>Repair and maintenance</td>
<td>46</td>
<td>30</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>All work</td>
<td>35</td>
<td>37</td>
<td>5</td>
<td>24</td>
</tr>
</tbody>
</table>

Oliveira et al. (1997) recognized that managing resources in the construction sector is a complex task. There are many factors contributing to this complexity, such as the variety and great number of existing resources, both human and material; the diversity of tasks that each working unit is able to execute; the performance of each working unit; the involved costs; and the spatial distribution of all resources over the different places. At the operational level, Hegazy and Kassab (2003) added four reasons for complex resource management in construction, such as segregation of resource management, inadequacy of traditional optimization algorithms, difficulties with simulation modelling, and availability of a new breed of tools. In attempt to address these issues, over the last decade, various techniques and algorithms have been developed for improving project resource management through effective resource-constrained project planning and scheduling. This section summarizes the research work in this regard.

1) **Resource-based project planning**: The most popular project planning method, critical path method (CPM), assumes unlimited resources for a project, however, is not valid in most practical situations. To overcome this problem, many modified-models have been developed since 1970s. Kim and De La Garza (2005) proposed and evaluated a resource-constrained critical path method (RCPM) which provides more flexibility to the project schedule, compared to other traditional scheduling methods. Lu and Li (2003) promoted the resource-activity critical path method (RACPM), potentially leading to an integrated scheduling and cost estimating process. Lu et al. (2007) developed an innovative, fully automated solution to resource-constrained CPM, namely the Simplified Simulation-based Scheduling system (S3), by means of the simplified discrete event simulation approach (SDESA) and the evolutionary optimisation technique particle swarm optimizer (PSO). Further, Lu and Lam (2008) incorporated the effects of multiple resource
calendars on the total float determination through P3 software and assessed both advanced resource scheduling functions and potential errors of P3 in total float determination. Compared with CPM, Vaziri et al. (2007) also advocated the linear scheduling model (LSM) for planning resources along a linear path/space.

2) **Resource allocation**: Resource allocation is an integral part of the broader management function of project scheduling, which falls into two basic categories — resource levelling and resource allocation/assignment. In comparison, resource allocation is used when there are definite limitations on resources that are available for a project, whereas resource levelling is used when there are adequate resources but the fluctuations of resource usage need to be levelled. Therefore, appropriate allocation of resources throughout the whole project life cycle requires advanced simulation technology and skills. Some scholars such as Shi and AbouRizk (1997) and Oloufa et al. (1998) advocated the development of resource-based simulation libraries for the automation of resource allocation. Park (2005) devised an automated dynamic resource management model using system dynamics to design the optimal resource allocation for construction. By simulating the model, it can examine the effect of resource coverage on project performance and obtains policy implications for dynamic resource allocation. Regardless of simulation technique used, these studies commonly demonstrated how resource-driven scheduling could enhance project performance and contribute to the optimal use of resources.

3) **Resource levelling**: The resource levelling process implies shifting only the non-critical activities within their floats (Khattab and Soyland, 1996). Levelling also requires an analysis of resource needs of an entire project and attempts to minimize problems associated with insufficient quantities and/or fluctuations in resource demand on a day-to-day basis (Nosbisch and Winter, 2006). The resource levelling method was first introduced by Burgess and Killebrew (1962) to solve the problem of fluctuating resource requirements during the project. Since, many heuristic approaches have been developed for effective resource levelling (Burgess and Killebrew, 1962; Levy et al., 1962; Harris, 1978, 1990; Martinez and Ioannou, 1993; Neumann and Zimmermann, 2000; Hiyassat, 2001; Fakhrzad and Heydari, 2008). Davis and Patterson (1975) made a comparison of
eight different heuristic scheduling rules. Khattab and Soyland (1996) suggested a set of heuristics to be used for projects in such conditions as when resource requirements exceed the resources available or the computer programmes are likely to be unable to provide the optimum scheduling solutions. For the same purpose, Son and Skibniewski (1999) developed a hybrid multi-heuristic approach to addressing resource levelling problem.

The literature review shows that the research framework in resource management for construction projects draws on work in three areas: 1) resource planning techniques, 2) resource-constrained project scheduling, and 3) combined simulation-optimization methods. By drawing on these techniques, the research rationales of solving project resource-related problems to improve resource management are summarized in Figure 3.2 below.

**Figure 3.2 Research rationales for project resource management**

Traditional resource optimization was based on either mathematical methods or heuristic techniques. Mathematical methods such as integer, linear, or dynamic programming have been proposed for individual resource problems. Numerous optimization techniques for tackling resource-based project scheduling problems have been developed in recent decades, mainly
comprising mathematical programming, dynamic programming (DP), artificial intelligence techniques such as genetic algorithms (GA), constraint programming (CP), heuristics, and other hybrid algorithms, such as enumerative barch-and-cut procedure (EBAC) (Jiang and Shi, 2005), DP-based optimization model (El-Rayes and Moselhi, 2001), a fuzzy dynamic resource allocation model (FDRA) (Zhang and Tam, 2003), and a chance-constrained programming model (Yang and Chang, 2005).

Heuristic methods, on the other hand, use experiences, rather than mathematical formulations. In recent years, researchers have proposed various heuristic methods for resource allocation and resource levelling. For instance, Zhang and Li (2004) developed an optimisation methodology that integrates discrete-event simulation (DES) with a heuristic algorithm to optimise dynamic resource allocation for construction scheduling. Zhang et al. (2006) introduced a particle swarm optimization (PSO)-based methodology to implement pre-emptive scheduling under break and resource-constraints (PSBRC) for construction projects. Moreover, a set of pre-programmed procedures is also used to generate and calculate the schedule using software packages like Primavera for Windows (Khattab and Soyland, 1996).

Despite the significant progress of developing techniques for project resource management, there are still resourcing bottlenecks emerging beyond project managers’ control, and the potential causes for these deterrents have been historically neglected in both discourse and practice on construction management. As recognized by Park (2005), factors such as low resource coverage and long lead time in resource acquisition are likely to delay the project schedule by creating resource bottlenecks. These factors, however, are beyond the project scope and related to the availability of resources in the construction market. Low availability of resources was revealed by Mohamed (1996) as a main reason for labour idling, construction disruption, and suspension. This is an issue particularly associated with complex and large projects (Pheng and Chuan, 2006). In recent years, availability of resources has been increasingly emphasized by a number of scholars, such as Tukel and Rom (1998), Chua et al. (1999), and Bassioni et al. (2005), as being a driving force necessary for the successful performance of construction projects.

However, the research on resource management for construction projects, as reviewed above, has largely overlooked the issue of resource availability, in preference for internal resource planning and optimization. This is possibly because availability of resources is considered by construction
academics and practitioners as a prerequisite for building a project. However, as this study aims to convey is that a good grasp of techniques and skills for resource management, derived from the past research, appears to be insufficient for successful construction project if resources are not available. In recognizing this knowledge gap, the current research advocates that resource management should incorporate the element of resourcing capability and should inculcate resource availability to its research framework. A systematic understanding and analysis of resourcing environment at the early stage of project planning is crucial to ensuring the availability of resources. This comes one of the objectives of this study, — to examine resourcing environment in a post-disaster situation, exploit the likely constraints hindering resource procurement as well as opportunities for improving resource availability for successful housing recovery.

3.2 Resourcing approaches to post-disaster housing reconstruction

Following upon the literature review from the previous section, this section examines the research work with respect to resource management in the post-disaster reconstruction discourse. As alluded to earlier in this dissertation, past experience in disaster recovery shows that the conventional resource management in construction projects are not likely to be able to deal with disaster recovery projects. This is particularly the case following a large-scale disaster. Therefore, to lay out the theoretical foundation, this section begins with a clear distinction of key terminologies of ‘resourcing’, ‘resource procurement’, ‘resource management’ and ‘supply chain management’. The current study defines ‘resourcing’ and specifically applies it in the context of post-disaster housing reconstruction.

3.2.1 Understanding resourcing for housing projects

The diversity of clients, buildings, sites, and construction requirements means that building projects have a wide range of supply systems supplying labour, skills, materials, components and sub-assemblies. These external supply systems have developed to service the range of technologies and processes associated with the different phases of the internal project and the different parts of the building under construction, as shown in Figure 3.3. To further understand resourcing for post-disaster housing reconstruction, by drawing on disaster practice and literature,
the definition of ‘resourcing’ will be overhauled at two levels — resourcing stakeholders, and resourcing approaches.

Figure 3.3 Project resource supply and management systems, adapted from (Jones, 2005, p.309)

Figure 3.3 presents the interaction of project external supply systems and internal resource management systems, which relates to the critical operations such as resource management, resource procurement, and supply chain management. However, this research proposes a new definition of ‘resourcing’ in construction projects. To gain a thorough understanding of resourcing for construction projects, the following sections distinguish and compare it with the above resource-related operations in terms of their definition, operational scope and timeframe, and concerned stakeholders/participant individuals and organizations.

3.2.1.1 Definition of resourcing

The project construction requires different sets of resources and services from the construction market. The project market environment comprises a number of elements including customers, clients, labour market, wholesalers and retailers, suppliers, trade unions, professional bodies and other groups and associations (Fewings, 2005). The common elements in a construction system encompass the whole life cycle of a construction project including owners, design professionals and constructors. By integrating resource inputs and services from the project market into a construction system and transforming them into built products, project management fulfils its essential role in project construction (Chen et al., 2008). Throughout this process, the specific roles of the related stakeholders in both project market environment and construction system with respect to resource-related input and output activities are variously involved in the following operations.
1) **Resource management (RM):** involves project-wide activities to manage resources to carry out project activities, as presented in the previous section. The basic objective of resource management is to support construction operations so that established time objectives can be met and costs can be kept within the construction budget (Sears et al., 2008). It is primarily the responsibility of the project manager to identify and schedule future work needed to make the most efficient use of resources available. For instance, the project manager must determine long-range resource requirements for general planning and short-term resources for detailed planning. Where shortages, conflicting demands, or delays occur, the project manager must devise appropriate remedial measures. The project plan and schedule may have to be modified to accommodate or work around supply problems, by using one of the possible techniques reviewed in the section 3.1.2. The scheduling and allocation of workers, equipment and materials are interrelated. Resources are allocated on a project-wide basis in this regard, and management action is based on techniques and skills of project managers.

2) **Resource procurement (RP):** involves arrangements made by the project managers for the timely arrival of resources with regular follow-up actions taken by the related procurement personnel/procurement specialist to ensure that promised delivery dates are kept (Cox, 1996). Once the resource for each task is identified, the project manager will need to provide a specification for the resource, identify the potential supplier and then order the resource. Procurement is a specialist job and requires dedicated focus to make sure all items arrive on time at the beginning of tasks (Fewings, 2005). Therefore, resource procurement on a construction project is essentially a matter of logistical support. Resources needed in the proper quantity and specified quality must be available at the right place and time for construction continuity. Toward this objective, a system of checks and controls by the specialist procurement manager in all aspects of material procurement, from ordering to delivery, should be established (Sears et al., 2008). The procurement for any resource will go through particular stages including document preparation, order preparation, order delivery, and resource preparation (March Ltd., 2010). Procurement performance is determined by economic factors intrinsic in the construction market and by the particular situation in the project.
3) **Supply chain management (SCM):** derives from two roots of practically oriented management theory: operations management and partnership philosophies (Jones, 2005). Supply chain management includes the steps involved in bringing the end product to the consumer (Wilkinson and Scofield, 2003). Within operations management a typical definition of a supply chain, as proposed by Aitken (1998), is that a network of connected and interdependent organisations mutually and cooperatively working together to control, manage and improve the flow of materials and information from suppliers to end users. Most definitions link supply chain management with the integration of systems and processes within and between organisations, which include the upstream suppliers and downstream customers. For instance, SCM is viewed by Harland (1996) as the coordination of manufacturing, logistics and material management functions across the organizations. A broader concept of SCM includes purchasing and supply management, physical distribution, logistics and materials management (Jones, 2005). Differing from resource management and resource procurement, supply chain management adopts a more holistic approach to optimize the overall activities of participant organizations within a supply chain. The objective of SCM is to enable these participant organizations to work together to improve productivity of their respective activities. SCM is therefore a multi-stakeholder operation and largely reliant on the network and relationships formed by the supply chain.

4) **Resourcing:** broadly encompasses a wide range of activities in a broader construction context, which have a bearing on resource acquisition for construction projects. It encompasses activities such as resource planning and preparedness, resource procurement, resource delivery, and development of resource alternatives. The objective of resourcing is to increase the flows and stocks of resources in the market, by integrating all resource-related activities, processes and interfaces to achieve resource availability. Resourcing, therefore, emerges as a broad concept covering actions and operations within the project and between construction related stakeholders. Apart from the stakeholders in the project and its supply systems, stakeholders in a wider construction environment, including the construction industry, government, and research institutes, also play an important role in increasing resource flows and stocks in the construction market. In contrast with supply chain management, resourcing is a more stakeholders-involved and explicitly
interdependent operation for a common purpose of securing resources available for project construction.

In conclusion, the four resource-related operations, namely resource management, resource procurement, supply chain management, and resourcing are interrelated and to some extent overlap. The management of resources primarily embeds itself in the context of a project and requires higher level of skills and techniques from project managers. In comparison, however, procurement of resources can be seen as part of resource management overseen by a project manager with a view to ensuring resource availability for consistent construction. Research on resource procurement in construction projects mainly deals with resource limitation and its impact on project delivery from such perspectives as logistical optimization (Agapiou et al., 1998; Voordijk, 2000), and supply chain reengineering (Arbulu et al., 2003; Cheng et al., 2006). However, it is a more logistical operation carried out by a specialist procurement manager in support of the overall resource management in a project system.

Supply chain management (SCM), however, goes beyond the scope of project system, extends its operation to a broader market environment where the network of organisations involved in a supply chain is critical to its success. Further, resourcing is an extension of SCM in considering the flows and stocks of resources from a wider stakeholder context, including house owners/clients, research agencies, industry associations and government. While supply chain management considers the best way to deliver and add value to a project, resourcing seeks to integrate other stakeholders in order to offer efficiency of resource procurement and increase resource alternatives. Therefore, resourcing also involves issues such as increasing resource inventory and development of resource alternatives.

A comparative summary of these four resource-related operations are presented in Table 3.6. In light of its wider scope and strategic approach to resource availability, the operation of resourcing for housing reconstruction in a post-disaster situation is considered in the present research. The next section analyzes main resourcing stakeholders that may play a role in the resourcing practice in post-disaster housing reconstruction.
<table>
<thead>
<tr>
<th>Operation</th>
<th>Aim</th>
<th>Scope</th>
<th>Operator/stakeholder</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource management</strong></td>
<td>Ensure project time and budget objectives</td>
<td>Project-wide</td>
<td>Project manager</td>
<td>• Resource planning&lt;br&gt;• Resource scheduling (resource allocation and levelling)</td>
</tr>
<tr>
<td><strong>Resource procurement</strong></td>
<td>Ensure the timely delivery of resources</td>
<td>Project-wide and logistics</td>
<td>• Specialist procurement manager&lt;br&gt;• Project manager</td>
<td>• Document preparation&lt;br&gt;• Order preparation&lt;br&gt;• Order delivery&lt;br&gt;• Resource preparation</td>
</tr>
<tr>
<td><strong>Supply chain management</strong></td>
<td>Improve the efficiency of resource delivery</td>
<td>Supply chain-wide</td>
<td>Participants in the supply chain:&lt;br&gt;• Suppliers&lt;br&gt;• Manufacturers&lt;br&gt;• Distributors&lt;br&gt;• Customers</td>
<td>• Purchasing and supply management&lt;br&gt;• Physical distribution&lt;br&gt;• Logistics&lt;br&gt;• Materials management&lt;br&gt;• Relationship management</td>
</tr>
<tr>
<td><strong>Resourcing</strong></td>
<td>Ensure resource availability for project construction</td>
<td>Multi-stakeholder-wide Construction environment-wide</td>
<td>• Project stakeholders&lt;br&gt;• Supply chain participants&lt;br&gt;• Government&lt;br&gt;• Industry&lt;br&gt;• R&amp;D agencies</td>
<td>• Resource planning and preparedness&lt;br&gt;• Resource procurement&lt;br&gt;• Resource delivery&lt;br&gt;• Development of resource alternatives</td>
</tr>
</tbody>
</table>
3.2.1.2 Resourcing stakeholders in post-disaster reconstruction

There is a multitude of stakeholders involved and playing specific roles in post-disaster recovery, and as time passes, their mix and focus changes (Maret and Amdal, 2010). According to Davidson (2010), the success of post-disaster reconstruction depends, to a large extent, on the complex relationships between the multiple actors. These actors include such as the affected people, community-based organizations, local and central government, NGOs, international agencies, designers and builders. In the reconstruction context, the participants are loosely categorized as the user group and the production group.

1) **The user group**: the project initiator or building owner (who may or may not be a user of the future facility) assumes responsibility for organizing the project on his or her behalf and on that of the users; the building owner has a general responsibility for steering the use-related tasks and is also responsible for setting up the production group, either in detail or in principle.

2) **The producer group**: includes the designers (usually architects/engineers) responsible for determining the nature of the product, which should respond to the building owner’s requirements, and the building contractor and sub-contractors responsible for the actual production of the required buildings. However, in self-build reconstruction cases, as discussed in Chapter Two, the actual construction work is carried out by the affected people themselves without involvement of building specialists like contractors and builders. Suppliers and manufacturers support these production activities.

As shown in Table 3.7, the composition of these participants can adopt many forms. However, not all participants will be involved in a given project across the whole reconstruction period. As revealed in the last chapter, the composition of likely participants into a project depends on the specific reconstruction approaches adopted. With respect to the resourcing operation for post-disaster reconstruction, the potential stakeholders fall into the same categorization as listed in Table 3.7. Likewise, who holds an overall responsibility for resourcing largely depends on the relative power of the resourcing participants in a specific reconstruction model. Resourcing-related stakeholders in a disaster reconstruction project can be broadly categorized into the following groups including policy makers, construction contractors, aid agencies, scientific or
research institutions and manufactures and trade associations, as shown in Figure 3.4. The roles of these stakeholders are outlined below.

Table 3.7 Likely participants in a post-disaster reconstruction project (Davidson, 2010, p.101)

<table>
<thead>
<tr>
<th>User Group</th>
<th>Production group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The users</strong></td>
<td><strong>The designers</strong></td>
</tr>
<tr>
<td>Known survivors</td>
<td>Local architects and/or engineers</td>
</tr>
<tr>
<td>Unknown survivors of known social categories</td>
<td>External architects and/or engineers (e.g. from donor countries)</td>
</tr>
<tr>
<td>Community representatives or leaders</td>
<td>Local technicians</td>
</tr>
<tr>
<td></td>
<td>Local craftsmen</td>
</tr>
<tr>
<td><strong>The project initiators</strong></td>
<td><strong>Building contractors and sub-contractors</strong></td>
</tr>
<tr>
<td>Surviving community groups</td>
<td>Local building enterprises</td>
</tr>
<tr>
<td>Religious groups or leaders</td>
<td>‘Off shore’ building firms</td>
</tr>
<tr>
<td>Local NGOs</td>
<td>Local craftsmen</td>
</tr>
<tr>
<td>External NGOs (e.g. from donor countries)</td>
<td>Self-help labourers</td>
</tr>
<tr>
<td>Local governments at national or regional levels</td>
<td>Construction manager</td>
</tr>
<tr>
<td>Political entities</td>
<td></td>
</tr>
<tr>
<td>Project managers</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Controlling bodies</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Manufacturers and suppliers</strong></td>
</tr>
<tr>
<td>Local professional bodies</td>
<td>Local producers and local resources</td>
</tr>
<tr>
<td>International professional bodies</td>
<td>Local distributors</td>
</tr>
<tr>
<td>Local codes authorities</td>
<td>National or regional producers</td>
</tr>
<tr>
<td>Local standards bodies</td>
<td>International producers</td>
</tr>
<tr>
<td>International standards bodies (e.g. ILO, ISO)</td>
<td>Logistics and transport enterprises</td>
</tr>
<tr>
<td>International funding sources (e.g. World Bank)</td>
<td>Customs and shipping agents and brokers</td>
</tr>
</tbody>
</table>
1) **Policymakers**: include notably reconstruction planners and national and local authorities. The decision to organize post-disaster reconstruction, however, is based on damage assessment and estimation of resource requirements. Each of the recovery plans develops a rebuilding strategy with varying degree of impacts on resourcing approach undertaken on the ground. In the aftermath of a major disaster, unique challenges confronting decision makers in a disaster-affected area mainly pertain to how to facilitate the recovery organizations and communities to acquire resources needed for reconstruction. As discussed in Chapter Two, there are some cases in which the government acted as a project participant providing in-kind support and materials directly into the reconstruction system as part of housing assistance (Jha et al., 2010). To ameliorate the shortages of resources for reconstruction, solutions adopted by government include to increase longer-term resource flows and stocks through market interventions (McGee, 2008), financial and policy support of construction technique and material innovations (Emmitt and Yeomans, 2008), and support to the recycling and reuse industry (Denhart, 2010).

2) **House owners/communities**: As discussed in Chapter Two, depends on which reconstruction approach applied, house owners/communities may play a varied role in resourcing for rebuilding their houses. For instance, under self-help approach, people who lose their houses are given some combination of technical, material and financial assistance from government or aid agencies to repair or rebuild their houses. House owners or a recovery committee established in a community may undertake the resource procurement, either purchasing resources themselves or employing a local contractor or by using some combination of these options. The choice of materials and building
techniques may also involve quality concerns. For instance, when restrained by funding, house owners may turn to available inferior resources or traditional construction techniques that are not disaster resistant (O’Brien et al., 2008). Without a good understanding of construction market, they may also bear the brunt of construction cost inflation and shortcomings in local construction practices (Jha et al., 2010).

3) **Construction contractors**: Under the contractor-build housing reconstruction approach, the construction professionals may only get involved in resource procurement for house owners. The contractor-led resource procurement, in comparison with owner-driven resource procurement, means that contractors and builders may be accountable to the house owners when purchasing suitable resources with a reasonable price. In most cases, according to Wilkinson and Scofield (2003), builders have trade accounts that give discounts depending on the volume of business they generate. There may also be special promotions throughout the year in conjunction with the manufacturer. Moreover, the integration of a wide range of innovative technologies for reconstruction housing projects, comprising the structure, fabric, services and installations in a safe and efficient manner is a prime concern for the construction practitioners (Page, 2004). From this perspective, along with responsibilities of resource procurement, construction contractors/builders play a significant role in connecting other important resourcing activities such as resource innovations and development, resource planning and preparedness, and transforming technology into applicable inputs into construction.

4) **Aid agencies**: involve in resourcing practice at a varied degree, from merely providing material assistance to fully undertaking resource procurement for a rebuilding project. In recent years, as presented in Chapter Two, the role of aid agencies in resource assistance to housing reconstruction, especially large international aid organizations from donor countries, has been evolving. In the case of post-Indian Ocean tsunami reconstruction, some of aid agencies acted as a supplier, supplying materials and/or labour needed to operationalize an intervention into housing recovery programmes (Boen, 2006b). Other international funding bodies such as the Asian Development Bank (2007), and the World Bank (2008) had wider views of resourcing participation in disaster reconstruction. Their practice is known to have outcomes that are socio-economic in nature such as training
construction labours, financing or co-financing the construction of material manufacturing facilities and the establishment of R&D agencies in the disaster-impacted areas. In addition, there has been an increasing collaboration between the market development practitioners and emergency response agencies. For instance, with the support of IFRC, the Emergency Market Mapping and Analysis Toolkit (EMMA) was developed for aid agencies to design and implement recovery and reconstruction interventions with respect to resource procurement after a disaster (Albu, 2010).

5) **Scientific or research institutions**: Research on and development of resource alternatives contribute to the overall construction capability in the building industry (Lewis, 2008). According to Roseberry (2008), in addition to reuse and recycling of building materials and wastes, developing low-cost materials and products to increase alternatives for construction buildings is somewhat overlooked, especially in a post-disaster situation. Over the resourcing spectrum, the research institutes are tasked with material innovation and providing related material specification, selection and detailed design solutions (Emmitt and Yeomans, 2008). In a post-disaster environment where time and cost for this innovation may not allow for its rapid application to rebuilding projects, long term collaboration among the research institutes, government agencies and market players such as manufacturers and trade associations is needed for any future events.

6) **Manufacturers and trade associations**: contribute to availability and/or production chain capacity for resources and also play a part in monitoring price levels to control price gouging in the market. Damage to production facilities in a disaster, if combined with higher demands for resources for post-disaster reconstruction, often poses a large challenge to material manufacturers and other trade associations. In this situation, according to Bauer (2008), government interventions in response to interruptions in the market supply of construction materials may be general or localized, depending on the level of disaster impact. Rapid restoration of production facilities and manufacturing businesses is important for consistent resource distribution to the needed reconstruction individuals or agencies. In addition, by providing information and other in-kind support, the manufacturing industry and associated trade organisations can help identify the critical dimensions of a market system including institutions and rules; value chain actors
and services and infrastructure after a disaster (Albu, 2010). Therefore, this group of resourcing stakeholders, to a great extent, contributes to the functioning of the construction market and to maintaining the industry/market capacity to provide the quantity or quality of materials required for reconstruction.

A summary of responsibilities of these resourcing stakeholders is presented in Table 3.8. As can be seen in Table 3.8, these resourcing-related stakeholders assume distinct roles in varied resourcing activities, each having their own individual priorities and needs. However, in literature there is an absence of an integrated strategy among these differing stakeholders. A stakeholder analysis is needed before the commencement of any recovery project to identify the potential opportunities and problems for the project resource procurement, along with the prospective contribution from each stakeholder to the outcome of resourcing. With this realization, the current study suggests that a well articulated and implemented resourcing operation for post-disaster reconstruction, should not only provide an ad hoc means of increasing resource availability for addressing the shortages of resources, but also become a mechanism of facilitating resource flows to meet the reconstruction needs by applying a multi-stakeholder approach.

*Table 3.8 Summary of roles and responsibilities of resourcing stakeholders*

<table>
<thead>
<tr>
<th>Resourcing stakeholder</th>
<th>Resource assistance</th>
<th>Resource procurement</th>
<th>Increasing Resource alternatives</th>
<th>Directing resource flows in market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy makers</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
</tr>
<tr>
<td>House owners/communities</td>
<td></td>
<td>Δ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractors</td>
<td>Δ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aid agencies</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td></td>
</tr>
<tr>
<td>Scientific or research institutions</td>
<td></td>
<td></td>
<td>Δ</td>
<td></td>
</tr>
<tr>
<td>Manufacturers and trade associations</td>
<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
<td></td>
</tr>
</tbody>
</table>
3.2.2 Resourcing approaches to post-disaster reconstruction

The dynamic process of post-disaster reconstruction means that resource availability changes over this process and depends on how relevant stakeholders address constraints emerging during this process. A post-disaster reconstruction resourcing approach defines the relationships, roles and responsibilities of stakeholders and activities required to provide rebuilding resource availability. Therefore, similar to housing reconstruction approaches discussed in Chapter Two, the type of resourcing approach can be identified in terms of the way and extent to which the stakeholders leverage their influence and value into resourcing activities. The examples are presented as follows.

In the wake of a disaster, the government may control the supply of building materials which may be purchased by a contractor or a NGO for construction work undertaken by the affected community themselves. For instance, after the 2004 Indian Ocean tsunami, the local government intervened into construction market by restricting the supply of cement in Sri Lanka (The Sunday Times, 2007) and the timber supply in Simeulue, Indonesia (Jayasuriya and McCawley, 2008; Zuo et al., 2009). Following the 2005 Kashmir Earthquake, the local government also controled the supply of roofing in quake affected areas in Pakistan (Mumtaz et al., 2008). In these cases, the INGOs imported building resources from outside of the affected areas where local contractors and communities were unable to cope with resource shortages. Therefore, government resourcing interventions does not necessary imply that the government becomes involved in actual resource procurement for housing reconstruction projects, but that the authorities retain full control over the resource provision and supply process.

There was also resource assistance from both the government and aid agencies in Banda Aceh, Indonesia after the 2004 Indian Ocean tsunami (Boen, 2008). The 1994 Northridge earthquake in US shows that resource availability can be further enhanced by government commitment to facilitating the procurement and development of resources. Wu and Lindell (2004) pointed out that having a pre-impact recovery plan in Los Angeles facilitated housing reconstruction and allowed the local officials to manage the reconstruction process more effectively. Research on cyclone mitigation and post-disaster reconstruction in India (Winchester, 2000) and research on post-disaster reconstruction following the Bam earthquake in Iran (Omidvar et al., 2009) demonstrate that the support provided by the government enhanced the capacity of the
construction and manufacturing industry in coping with large-scale disaster reconstruction demand.

Regardless of varied combination of stakeholders involved in the resourcing process of post-disaster reconstruction, the success of resourcing depends on multi-stakeholder’s collaboration and the development of policies, plans and tools to allow market flexibility, project resource management and appropriate interventions. As alluded to earlier, the resourcing focus for post-disaster housing reconstruction should not be on finding suitable overarching frameworks, but on understanding opportunities and pitfalls of different resourcing operation and what can realistically be achieved in a given context. Therefore, the current study is not representative for all disaster recovery projects that can be thought of, but provides a view of a resourcing process during post-disaster reconstruction. Identification of the types of stakeholders and characterization of these stakeholders concerning resourcing practice in the disaster recovery constitute a basis for understanding the underlying resource constraints and resourcing bottlenecks. Further, it involves a need for the current research to capture information from primary stakeholders to achieve this understanding. These aspects are discussed in greater detail in the following chapters.

3.3 Resource availability for disaster recovery projects

As mentioned in the preceding chapter, the focus of this research is placed on the ‘problematic’ resources for post-disaster housing reconstruction. These ‘problematic resources’ are those that are likely to subject to shortages during construction and thus have an impact on the delivery of a house construction project. Therefore, instead of looking at the overall post-disaster reconstruction capability, in the construction industry and market supply systems, the study attempts to understand the availability of ‘problematic’ resources which, in this research, are defined as ‘indicator resources’.

This section then sets out to present a thorough understanding of resource availability for disaster recovery and reconstruction. Finally, this study brings into play the factors that are likely to affect resource availability after a disaster from perspectives of both conventional project construction and post-disaster reconstruction. The theoretical foundations in this chapter and the
literature review Chapter Two help to develop an analytical framework for understanding resource availability in disaster recovery.

3.3.1 Post-disaster 'indicator resources’

‘Indicator resources’ are defined in this research as being the selected resources that seem likely to be of particular interest and importance during the period of disaster reconstruction, for example they are likely to be a large component of total cost, or to be in short supply, or are sensitive for other reasons. This study deals exclusively with resourcing operations associated with ‘indicator resources’, including building professionals, such as contractors, builders and labour, and building materials and products.

In situations where a certain type of resource is used extensively, considerable requirements may challenge the local supply capacity. The capacity reserves/shortages would be with the disaster occurring on top of the existing workloads (Page, 2004). The shortfalls have to be met from imports outside the disaster-affected region and even further afield. Considerable delays and suspension of projects may occur. In an example taken from the 2004 Indian Ocean tsunami reconstruction, a lack of building materials such as sand, stone, cement, timber and brick in Indonesia created a major bottleneck for housing recovery (ADB, 2007; Nazara and Resosudarmo, 2007; Zuo and Wilkinson, 2008). The shortage of aggregate, human resources and heavy equipment has been identified as one of the potential constraints to the recovery process in New Zealand if a large-scale disaster were to strike (Brunsdon and Smith, 2004; Singh, 2007).

It has to be noted that the requirements for a specific ‘indicator resources’ may change in response to market conditions over the reconstruction period (Jha et al., 2010). Resource demand is unevenly distributed across different stages and different sectors of reconstruction. One type of resource may be problematic at a certain stage of reconstruction and may not have an impact on disaster recovery projects at a later stage. Therefore, a specific investigation period should be selected, which can most reflect the ‘burning resourcing issues’ for post-disaster recovery projects. During this period, ‘indicator resources’ should be recognized, as well as the implications of their availability for the execution of post-disaster reconstruction projects. Beyond the identification of ‘indicator resources’ lies the need to explain the parameters for their availability in a post-disaster situation. The following section aims to address these research needs.
3.3.2 Understanding resource availability for post-disaster housing reconstruction

3.3.2.1 Definition and dimensions of resource availability

Definition of availability is well established in the literature of stochastic modelling and optimal maintenance. Cambridge Advanced Learner’s Dictionary (2005) defines availability in terms of ability to be obtained, used or reached. Based on this definition, availability of resources for construction projects pertains to a favourable status or an outcome where resources are ready to be handy when required for construction. Availability of resources following a disaster, therefore, refers to the actual ability to achieve the acquisition and use of resources for post-disaster reconstruction. This research study suggests three dimensions that constitute resource availability, are shown in Figure 3.5. This section outlines these three dimensions of resource availability in the context of post-disaster recovery and reconstruction.

![Diagram of resource availability](image)

*Figure 3.5 Three dimensions of resource availability*

1) **Attainability**: implies the capacity of local construction industry and affordability of house owners to purchase resources required for construction. Following a major disaster, there exist such situations as (1) the building workforce may not adequate; (2) building materials are in short supply; and (3) supply capacity is reduced as a result of disaster impact (Jha et al., 2010). All these situations, on one hand, pose a significant challenge to the construction practitioners, on the other hand, are likely to produce competition for available resources in the construction market, and causing cost inflation. There are instances where cost implications were significant for both house owners and implementing agencies who were seeking to rebuild disaster damaged houses (Steinberg,
2007; McGee, 2008; Pathiraja and Tombesi, 2009). It is important to recognize that from the affected populations’ perspective, resource availability for rebuilding their houses after a disaster carries an intonation of house owners being able to attain the resources needed for house rebuilding financially.

2) **Usability**: stipulates the quality reliability aspect required for resources to be used into a construction system. In construction projects, poor quality materials can directly cause failure of physical connections between construction elements (Belassi and Tukel, 1996) or interrupt such connections when defective materials are replaced (Love et al., 1999). This dimension of resource availability can further extend to environmental concerns with regard to construction activities and raw material exploitation. Timber logging, as Shaw (2006) proposed, both legal and illegal, contributed to the incidence of flooding and landslides. A comparative study conducted by O’Brien et al. (2008) in Banda Aceh, Indonesia demonstrated that the level of greenhouse gas emissions of new housing types with industrialized materials after the 2004 Indian Ocean tsunami was fifty times higher than traditional types and the ecological footprint triple. Similarly, Roseberry (2008, p.4) pointed out that the materials needed for construction may be harvested or extracted beyond the renewable rate of the local ecosystem, possibly tipping the balance beyond its capacity to recover in a suitable timeframe. Therefore, in considering eco-effects caused building materials, usability of these materials also involves a need of seeking alternatives to address the impacts on natural environment.

3) **Accessibility**: is concerned with resource logistics and transportation. In a post-disaster situation, the capacity to move materials is affected by (1) damage to access routes; (2) reductions in transport capacity (e.g. damage to trains or competition for trucks); (3) security problems in transportation; and (4) barriers to transportation, such as border crossings and hazardous areas (Jha et al., 2010). In considering the outside procurement and delivery of materials, long transportation distance may require a large network of warehousing and shipment nationwide and internationally. However, this may involve a risk of lengthy lead time that can be detrimental to project performance. According to Singh (2007), long lead time of procuring resources may have an impact on disaster recovery projects, especially in a construction industry which relies heavily on ‘just-in-
time’ delivery. The fact that most reconstruction projects are likely to be fast tracked also means that lead time and delays will be even more critical. As a result, low resource coverage and long lead times in the resource procurement process lead to cost overrun and project delays, as illustrated by Steinberg (2007) and Kennedy et al. (2008) after the 2004 Indian Ocean tsunami.

As this analysis demonstrates, resource availability cannot be simply understood as a degree in which supply and demand balance each other. It contains an inherent socio-economic fabric and a multi-stakeholder approach within a post-disaster recovery context. Therefore, it is imperative to understand the three dimensions of resource availability in a specific disaster context. By doing so, interfaces between the resourcing issue and other disaster recovery operations can be identified. Table 3.9 below summarizes the above discussion and shows the effect of resource availability on the performance of disaster recovery projects.

Table 3.9 Effects of resource availability on the outcome of disaster recovery projects

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Elements</th>
<th>Effect on project performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attainability</strong></td>
<td>Capacity of the construction industry</td>
<td>✫ Short supply (quantity)</td>
</tr>
<tr>
<td></td>
<td>Capacity of supply systems</td>
<td>✫ Cost overruns</td>
</tr>
<tr>
<td></td>
<td>Affordability of house owners</td>
<td></td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td>Resource quality reliability</td>
<td>✫ Quality concerns</td>
</tr>
<tr>
<td></td>
<td>Resource alternatives</td>
<td>✫ Environmental impact</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>Resource logistics</td>
<td>✫ Increased procurement cost</td>
</tr>
<tr>
<td></td>
<td>Transportation and other infrastructural capacity</td>
<td>✫ Lengthy lead time</td>
</tr>
</tbody>
</table>

3.3.2.2 General implications of resource availability for post-disaster reconstruction

As alluded to earlier, availability of resources has been recognized as a driving force for the success of construction projects (Tukel and Rom, 1998; Chua et al. 1999; Bassioni et al. 2004; Bassioni et al. 2005). Large-scale disasters in recent years such as the 2004 Indian Ocean tsunami (Zuo et al., 2009) and the 2005 Hurricane Katrina (McGee, 2008) highlighted the significance of the availability of resources, such as building materials and professionals in disaster recovery projects, and its implications for desired project success. When examining their
post-tsunami reconstruction involvement, many NGOs, INGOs such as IFRC (2006) and the UN agencies such as UNDP (2005; 2006) highlighted the importance of resource availability as being an integral element in the ultimate efficacy of post-disaster recovery efforts.

A number of scholars such as Ye & Okada (2002) and Sullivan (2003) have also recognized that desirable post-disaster reconstruction could only be made possible by systematic recovery planning with a focus on making the resources required available for long-term reconstruction. This section presents a summary of resource availability implications for post-disaster recovery. In other words, the following summarises the effect that lack of, or absence of resource availability could have on post-disaster reconstruction outcomes.

1) **Economic impact on local market:** After a large-scale disaster, according to Jayasuriya and McCawley (2008), the seemingly prosperous construction boom is likely to paradoxically mask resourcing bottlenecks for a temporary period, especially when funding and external assistance are available. However, when increased rebuilding demands overtake the local supply capacity, lack of resources may bring in a secondary economic disaster manifested by inflationary chaos (Nazara and Resosudarmo, 2007), ‘Dutch Disease’ (Adam and Bevan, 2004), or cost surge (Kennedy et al., 2008). These adverse market conditions further compound the shortage of resources for construction, leading to delays of recovery projects, or even imposing longer-term impacts on the local economy in the disaster-affected areas (UNDP, 2005; IFRC, 2006).

2) **Reinforcing social vulnerability:** More resourcing constraints may challenge the disaster-impacted countries such as Kenya (Makhanu, 2006) and Indonesia (O’Brien et al., 2008) where the local natural resources were severely depleted prior to a disaster. In some cases, as Freeman et al. (2003) pointed out, existing construction projects or development programmes in these countries may absorb wider market space, diverting essential resources from recovery priorities. Therefore, when financial resources are limited, there is a danger that restoration and reconstruction are carried out in an *ad hoc* way, exposing vulnerable communities to additional hazards, or that pre-disaster vulnerabilities are simply reinforced.
3) **Reconstruction quality concern**: There were cases in which house owners or aid agencies may turn to inferior resources available in the market (Jayasuriya et al., 2005; Kennedy et al., 2008), or sought to import materials from outside of the region with lengthy lead time (Dercon, 2007; Zuo et al., 2009). As could be expected, without appropriate site supervision and quality control in place, poor building materials and workmanship may result in a variety of construction defects and failure, undermining the success of disaster recovery projects (Leitmann, 2007; Steinberg, 2007; Boen, 2008).

4) **Construction cost escalation**: Cost escalation is the most visible effect that low availability of resources is likely to bring about in a post-disaster environment. Following the 2004 Indian Ocean tsunami, for instance, the potential threat of resource shortage was not considered by involved NGOs at the initial stage of reconstruction in Aceh, Indonesia, due to their funding availability (Dercon, 2007). The increased construction activity, the need to import many of the most common construction materials (wood, cement, steel), and the increase in energy prices intensified the inflationary tension in Indonesia. Increases of 200-250% in the cost of construction materials were observed in tsunami affected Aceh of Indonesia two years after the tsunami (Steinberg, 2007). Cost escalation had also caused significant funding shortfalls within the implementing agencies in Aceh (Asian Development Bank, 2010).

5) **Construction delays**: The shortage of construction materials also directly leads to undesired construction delays. According to the Asian Development Bank (2009), following the 2004 Indian Ocean tsunami, the materials required for housing reconstruction in Simeulue island had to be imported from the west coast of Sumatra or even Medan on the east coast. Also skilled labour was imported by contractors from mainland Sumatra and from Java. In these difficult circumstances, procurement of construction material and labour was further aggravated in Simeulue by informal restrictive procurement practices exercised by influential local interests, which caused additional delays.

6) **Environmental concern**: The availability of resources may influence how assistance is targeted and materials and techniques are selected and sourced, and eventually contribute to an impact on the natural environment and ecosystem. In examining the 2004 Indian
Ocean tsunami impacts on the local natural environment, Shaw (2006) and Budidarsono et al. (2007) revealed the close interaction between the disaster and environment. Likewise, Olshansky (2006) pointed to the subsequent environmental related disasters after the 2005 Hurricane Katrina. Shaw (2006) suggested two problems that have become increasingly prominent environmentally after the 2004 Indian Ocean tsunami. Firstly, raw material exploitation for making building components and products poses a threat to the natural environment system. Secondly, inappropriate sourcing approaches are likely to induce secondary hazards; timber logging, for example, both legal and illegal, contributes to the incidence of flooding and landslides.

3.3.3 Factors affecting resource availability in disaster recovery projects

In response to the above resourcing problems, conventional measures have been employed in reconstruction practice such as new investment in production (Jayasuriya and McCawley, 2008), and importing resources from outside the affected areas (Walker, 1995; Zuo et al., 2009). These arrangements, according to Jayasuriya and McCawley (2008), seem to be ineffectual in the alleviation of resource shortages in the long run. Therefore, an understanding of critical factors that affect resource availability is needed if understanding resource availability for post-disaster housing reconstruction is to be achieved. This section presents a literature review on factors that affect resource availability in conventional construction projects, followed by an analysis of factors affecting resource availability for recovery projects in disaster situations.

3.3.3.1 Factors affecting resource availability for conventional construction projects

The factors that may contribute to resource availability in a construction project can be broadly classified into three groups: factors related to the construction project and its management, factors related to project stakeholders, and factors related to the project operational environment.

1) Factors related to the construction project

Project conditions and the specific characteristics inherent in construction management have a great impact upon the effectiveness of resource procurement. With regard to a construction project, project location (El-Rayes and Khalafallah, 2005), and site layout planning techniques (Chan and Lu, 2008) influence the efficacy of materials handling system. Factors pertaining to project operations such as resourcing plans (Faniran et al., 1999; Tserng et al., 2006; Li et al.,
2009) and material inventory management (Liu and Wang, 2007) are considered to have a bearing on resource availability in terms of material transportation time and cost. As such, theories in relation to logistics have been widely used in resource procurement to plan and control the stock and flow of materials on the construction site (Said and EI-Rayes, 2010).

Yeo and Ning (2002) recognized that closer cooperation between procurement and other functions in construction management enables direct receipt of materials from suppliers to a construction site. Further, Ala-Risku and Karkkainen (2006) illustrated the positive correlation between pro-active resource procurement methods and their delivery results. Walker and Rowlinson (2008) reinforced this point by comparing the varied impact that resource procurement alternatives have on project delivery. Design specifications and drawings (Tatum, 2005), project type (EI-Rayes and Kandil, 2005), and the construction method and techniques (Spence and Mulligan, 1995) also determine how the project team is mobilized and how resources are procured.

2) Factors related to project stakeholders

Research and practice indicate that integration of different organizations in the supply chain is fundamental to successful project procurement. In examining the relationships between stakeholders in construction projects, Dey (2002) and Gadde and Dubois (2010), identified the particular benefit of strategic partnering with material suppliers for project resourcing performance. Selection of material suppliers and increasing their involvement in the project planning process helps to decrease deviation and attain resource procurement improvement (Tserng et al., 2006). Koch (2005) and Eom et al. (2008) suggested a client-contractor-supplier relationship to enhance overall productivity within the construction supply chain. Shi and Halpin (2003), and Bansal and Pal (2009) advocated that construction businesses establish a robust resource database to facilitate project resource planning.

Additionally, Pryke (2004) underlined the important role of the social network of project practitioners, especially the significance of the competence of contractors in resource procurement. On account of purchasing power, however, large contractors are able to deal directly with manufacturers and wholesalers and thus acquire resources more easily than small and medium units (Agapiou et al., 1998). More well-established contractors are also capable of
handling such issues as organizational weakness, supplier default, and transportation delays to achieve timely and cost-effective resource delivery (Manavazhi and Adhikari, 2002).

3) Factors related to the project operational environment

Project operational environment in this study refers to the external environment of a project including social, political, technological, legal, and economic factors and their implications on the project. Likely changes in this environment during the life of a project will certainly influence decisions and activities with respect to resource procurement (Pheng and Chuan, 2006). Morris and Hough (1987) illustrated that increasing material alternatives for construction requires political involvement in promoting innovative technology, design and construction practices. In response to natural resource conservation and utilization, government’s stringent regulation and controls serve as catalysts to sustainable development in the construction materials industries (Spence and Mulligan, 1995). Further, Belassi and Tukel (1996) advocate economic and social stimulus for developing material alternatives in order to address resource constraints for complex and large construction projects. Above all, specific cultural elements such as architecture, construction type and techniques play an essential role in utilizing and selecting building materials and have an corresponding effect on project resourcing practice (Fewings, 2005).

3.3.3.2 Factors affecting resource availability in a post-disaster situation

Following a large-scale disaster, the disaster impact on the local economy, infrastructure and natural environment influence the initiation of a recovery project (Brunsdon and Smith, 2004). Changed circumstances in the aftermath of a disaster shape the level of resource availability and the ability to procure essential resources for reconstruction. The likely factors that may impinge upon resource availability for disaster recovery projects can be classified into five categories, namely: factors related to the construction market, factors related to transportation, factors related to the reconstruction project, factors related to project stakeholders, and factors related to the project operational environment.
1) Factors related to the construction market

The construction market conditions following a major disaster, mainly manifested by resource price fluctuation, were recognized by Albu (2010), as being a dominant factor affecting resource availability for recovery projects. The impacts of the resource price volatility after the 2004 Indian Ocean tsunami on disaster recovery resourcing are well documented by (Jayasuriya and McCawley, 2008). After a major disaster, the markets and procurement systems tend to be disrupted (Koria, 2009), and the existing local production systems tend to be insufficient to cope with recovery requirements (Brunsdon and Smith, 2004; Jayasuriya et al., 2005). For post-disaster reconstruction projects in developing countries, there are a large number of recovery stakeholders such as aid agencies, construction companies and the affected community, competing for limited resources (Nazara and Resosudarmo, 2007; Koria, 2009). Resource demands required by the existing construction projects and programmes may also affect resource requirements for disaster recovery projects (Freeman et al., 2003).

2) Factors related to transportation

The transport network, including roads, airports, port, and railways, provides essential access to available resources needed for a country’s rapid and successful recovery (Hanaoka and Qadir, 2005). Many studies, such as (Cho et al., 2001; Seville and Metcalfe, 2005; Litman, 2006; Orabi et al., 2009), highlighted the vulnerability of transport system during a natural disaster and its pivotal role in resourcing recovery. Research looking into post-disaster logistics shows that the high cost of resource transportation (Limoncu and Celebioglu, 2006), and lack of transport alternatives (Singh, 2007) were major barriers to post-disaster reconstruction.

Singh and Wilkinson (2008) also discussed the importance of location of depot when procuring resources from outside of the recovery region. As illustrated by the Asian Development Bank (2007), after the 2004 Indian Ocean tsunami, the Aceh Territory of Indonesia experienced a shortage of cement, which, coupled with price speculation, drove up cement prices in Aceh by 63%. A significant portion of this price gap can be attributed to high transportation costs as a result of the limited port and shipping capacity, along with lengthy resource procurement time.
3) Factors related to the disaster recovery project

Following a large-scale natural disaster, resourcing bottlenecks for disaster recovery projects are largely created by a sudden increase in demand on construction services. Koria (2009) stressed the fact that large, complex disaster projects usually call for extensive quantity of resources which are beyond the existing supply capacity. The urgency of rebuilding, especially for housing projects, according to Dercon (2007) and Boen (2008), adds to the difficulty in acquiring most commonly used materials. Additionally, in line with recovery objectives in a disaster-impacted country, most recovery projects are required to be more culturally and environmentally sensitive (Barenstein and Pittet, 2007; O'Brien et al., 2008) and disaster-resistant (Berke et al., 1993; Winchester, 2000; Pribadi et al., 2003; Schilderman, 2004).

Varied project types consequently pose differing requirements for availability of compatible resources. The housing reconstruction approach, as concluded by Barenstein (2006b), also influenced how outside assistance is targeted and materials and techniques are selected. In comparing varied reconstruction approaches between the developing countries and developed nations, both Comerio (1998) and Fengler et al. (2008) showed that the type of reconstruction approach is highly related to project funding mechanisms in which the major funding body is likely to play a lead role in resourcing disaster recovery projects.

4) Factors related to project stakeholders

Davidson (2010) identified that an appropriate organizational design and in-house competence of procurement personnel have a major impact on the procurement of disaster recovery projects. Both Steinberg (2007) and Zuo (2009) have reported the resourcing frustrations encountered by the implementing organizations in Indonesia after the 2004 Indian Ocean tsunami, as a result of lack of coordination among those recovery agencies and their lack of communication with local authorities. Consistent support and assistance from the government, such as regulating construction markets (McGee, 2008), providing training and education for practitioners (AELG, 2005), and facilitating logistics (Brunsdon et al., 1996), was identified in the literature as factors that could improve the overall project resource availability.
5) *Factors related to the project operational environment*

In most cases of a large-scale disaster, availability of resources is governed by the policies and strategies put in place by the authorities to deal with the reconstruction phase (Singh and Wilkinson, 2008). For instance, the new timber administration rules issued by the Indonesian government in 2007 significantly reduced the possibility of donors procuring local timber for their reconstruction projects after the 2004 Indian Ocean tsunami (Zuo et al., 2009). Resourcing constraints challenge the recovery agencies in countries where the local economy is severely impacted by the disaster (Makhanu, 2006). Steinberg (2007) and Kennedy et al. (2008) also exemplified the impact of the political conditions on construction industry capacity in Indonesia, particularly after the 2004 tsunami. Due to decades of civil war, there were shortages of qualified construction labour for tsunami reconstruction in Aceh Province of Indonesia. However, the need to import personnel from other parts of the country such as Sumatra and Java contributed to the escalation of construction costs for housing recovery projects (Steinberg, 2007).

The above literature review unveils the similarity and difference in factors affecting resource availability between the conventional construction projects and post-disaster recovery projects. The disparities mainly concentrate on areas pertinent to the impacts of a disaster, such as market disturbances, access disruption, and increased complexity of stakeholder relationships. A synthesis of the factors that are likely to have an impact on resource availability in disaster recovery projects is demonstrated in Table 3.10. In either mainstream construction or post-disaster reconstruction, the potential attributes from the previous works, however, merely deal with specific aspects of a resourcing practice. Resource availability for disaster recovery projects needs to be investigated in a broader context where changed conditions may come into play. The following section summarizes the knowledge gap with respect to resource availability and management in post-disaster reconstruction, as reviewed in this chapter.
### Table 3.10 Factors that are likely to have an effect on resource availability

<table>
<thead>
<tr>
<th>Categorization</th>
<th>Factors affecting project resource availability in post-disaster reconstruction</th>
</tr>
</thead>
</table>
| **Construction Market-related factors** | ✗ Resource price fluctuation in market
|                                       | ✗ Local production capacity
|                                       | ✗ Competition for resources from other industries
|                                       | ✗ Competition for resources from among aid agencies |
| **Transportation-related factors**    | ✗ Local transportation capacity
|                                       | ✗ Transportation method
|                                       | ✗ Transportation cost
|                                       | ✗ Location of depot
|                                       | ✗ Resource procurement lead time |
| **Reconstruction project-related factors** | ✗ Project design drawings
|                                        | ✗ Project type
|                                        | ✗ Quantity of resources required
|                                        | ✗ Resource procurement method
|                                        | ✗ Construction technique/technologies
|                                        | ✗ Project resourcing plan
|                                        | ✗ Housing reconstruction approach
|                                        | ✗ Project schedule/urgency
|                                        | ✗ Construction funding
|                                        | ✗ Project location |
| **Project stakeholders-related factors** | ✗ Competence of contractor
|                                         | ✗ Selection of material suppliers
|                                         | ✗ Partnership and supplier management
|                                         | ✗ Contractor resource database system
|                                         | ✗ Cooperation of parties in construction
|                                         | ✗ Coordination among aid agencies
|                                         | ✗ Communication with local authorities
|                                         | ✗ Local government support and assistance
|                                         | ✗ NGOs competency of resource procurement |
| **Operational environment-related factors** | ✗ Legislation and policy
|                                          | ✗ General economic environment
|                                          | ✗ Social and political stability
|                                          | ✗ Physical impact of the tsunami
|                                          | ✗ Local housing culture and customs |
3.4 Overall summary of knowledge gaps in literature

The research study thus far has identified some of the issues in the theory and practice of disaster recovery resource availability and provides some articulation of the concepts and methods reviewed. Resource management within a construction project is an emerging research field in the last two decades in the project management discipline, but less attention has been devoted to investigating the resourcing environment. The failure to understand the resourcing circumstances following a major disaster, however, is likely to render disaster recovery projects a difficult situation where resource availability may play out. By drawing on the literature review in Chapter Two and the current chapter, a summary of the knowledge contribution and existing gap is presented in Table 3.11.

<table>
<thead>
<tr>
<th>Knowledge contribution</th>
<th>Knowledge gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>✌ Implications of resource availability for post-disaster recovery projects: cost, time and quality</td>
<td>✌ Lack of understanding of the factors in the resourcing operations that creating bottlenecks to disaster recovery projects</td>
</tr>
<tr>
<td>✌ Implications of resource availability for the overall success of disaster recovery</td>
<td>✌ Limited suggestion of the appropriate interventions and solutions to address resourcing issues</td>
</tr>
</tbody>
</table>

### Project resource management

<table>
<thead>
<tr>
<th>Knowledge contribution</th>
<th>Knowledge gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>✌ Emphasis on resource management in project internal environment to achieve project objectives of time, cost and quality</td>
<td>✌ Potential causes for resourcing bottlenecks to project construction has been historically neglected</td>
</tr>
<tr>
<td>✌ Recognizing availability of resources as a driving force for successful performance of construction projects</td>
<td>✌ Resource availability is singled out in project resource management framework</td>
</tr>
<tr>
<td>✌ Recognizing low availability of resources is a potential a risk associated with project performance</td>
<td>✌ Lack of a holistic view of resource procurement environment</td>
</tr>
<tr>
<td>✌ Recognizing low availability of resources is a potential a risk associated with project performance</td>
<td>✌ Lack of understanding the likely constraints hindering resource procurement</td>
</tr>
<tr>
<td>✌ Recognizing low availability of resources is a potential a risk associated with project performance</td>
<td>✌ Lack of understanding the likely opportunities for project managers to enhance their resource procurement</td>
</tr>
</tbody>
</table>
### Resourcing construction projects and resourcing post-disaster reconstruction

- Focus on project-based resource management and procurement, and supply chain-based supply chain management
- Likely participants in post-disaster reconstruction projects
- Lack of analysis of project resource procurement from a wider disaster recovery stakeholders perspective
- Lack of resourcing stakeholder analysis for disaster recovery projects

### Resource availability for post-disaster recovery projects

- Overall reconstruction capability
- Effect of resource availability on disaster recovery
- Identification of factors that affect resource availability in conventional construction projects
- Identification of factors that affect resource availability in post-disaster recovery projects, merely deal with specific aspects of a resourcing practice
- Limited knowledge on ‘indicator resources’ that are likely to subject to shortages during construction and thus have an impact on the delivery of a house construction project
- Limited understanding on resource availability in a post-disaster context
- Limited understanding on critical factors that impinge upon resource availability in disaster recovery projects

The literature review shows that while the findings in past research have clear implications for resourcing reconstruction, the added value of framing resourcing activities and strategies into the post-disaster reconstruction has not been demonstrated. This knowledge gap exists for three main reasons.

1) difficulties in translating experiences and lessons learned from disaster-impacted countries into other specific contexts and actions;
2) limited understanding along with absence of mechanisms in linking resource availability with local economic, social and environmental settings; and
3) resource availability for post-disaster reconstruction is often construed as a procurement responsibility for construction professionals rather than an integral issue in disaster recovery.
However, little empirical research has demonstrated the underlying resource vulnerabilities and constraints inherent in the reconstruction process when sourcing resources for housing projects. As this present study demonstrates, it is not enough to simply identify which materials are in short supply or that prices have escalated. It is necessary to understand the conditions and factors in the resourcing operations are creating bottlenecks, and to identify the appropriate interventions. Therefore, to gain a full understanding of resource availability for post-disaster reconstruction, the identified research gap and the above issues need to be addressed. To attain a full understanding of resource availability for post-disaster housing reconstruction, an analytical framework will be developed. The next chapter summarizes the key elements that contribute to an understanding of resource availability in post-disaster recovery environments based on the two literature review chapters. Based on this understanding, the methodologies employed for addressing the research questions will be presented.
Chapter 4 Research framework and methodology

4.0 Overview
This chapter starts with a synthesis and articulation of the main elements of understanding resource availability for post-disaster housing reconstruction reviewed in the literature. This is followed by a discussion about how to explore the concepts of resourcing and resource availability as they pertain to the delivery and outcome of disaster recovery projects. These concepts will be then applied to situate resource availability in the context of post-disaster housing reconstruction. Based on this understanding, a theoretical model of resource availability for post-disaster housing reconstruction will be described and the main research hypotheses and questions will be outlined. The second part of this chapter describes the research methodology applied to address questions and achieve the objectives of this research.

This research adopts a combination of case study, narrative, and comparative research strategies. Disaster theories described in the preceding chapters and the resource availability analytical framework guide the gathering of data and empirical evidence, which in turn influence the analytical framework of resource availability. Based on this framework, the chapter presents an explanation of the process of developing this research from inception to completion. The selection of research methods at different phases across the research process are detailed in research design, as well as the logic links between the research questions and selected research methods. This is followed by the relevant considerations in the study such as the validity of research design, cross-culture comparison, and ethical issue.

4.1 Analytical framework and research questions
This study is designed to build and test a theoretical understanding of resource availability for recovery and reconstruction following a major disaster, with a particular emphasis on residential housing reconstruction. In order to do so, this section will first synthesize the main elements of the resource availability in the context of disaster recovery and reconstruction reviewed in the last two literature chapters. The concepts of resourcing and resource availability will be reinforced in this section with a review to linking these concepts to other elements in disaster
housing recovery. A theoretical model which integrates those key elements and concepts will be presented, along with main research hypotheses and questions.

4.1.1 Housing recovery and reconstruction after a major disaster: A synthesis

The outcome of post-disaster recovery and reconstruction, from an integrated perspective, is seen as the result of the interplay between the recovery elements in social, economical, environmental and physical characteristics of a community. The literature review Chapter Two indicates that housing is seen as a space of living necessary for social livelihoods, a site for building capacity and resilience, and a political and economical arena where the government and the market forces exert their influence and articulates building safety, social stability, urban growth, through tools such as the building standards, land use planning, insurance, and property development. Variations in housing recovery observed by the disaster practitioners and researchers are explained as the outcome of the varied configurations of pre-existing conditions and post-disaster institutional arrangements. Therefore, housing reconstruction should be not only seen as an end-product for communities (Davidson, 2010), but also a process necessary for community development and social reproduction, when it is situated in post-disaster context (Oliver-Smith, 1991).

In this section, a framework that links elements from these two perspectives — housing as a product, and housing as a process, will be presented, which also recognizes the importance of both sets of factors in shaping housing reconstruction. The linkage of these two perspectives is achieved by conceptualizing the housing as a transformation of inputs, including both tangible inputs such as resources, and intangible inputs such as processes, structures, information, capacity, and institutional setting. By doing so, the approaches to rebuilding houses after a major disaster identified in the literature are problematized beyond the pure project management procurement modes, into a broader vision of community recovery from a disaster. This framework also cut-crosses the multidisciplinary nature of disaster studies, and also demystifies the all-encompassing political, economic, social and cultural relations responsible for shaping recovery patterns in different countries.

The role of housing and the value of housing recovery for communities are understood in this research as contextually constructed and institutionally structured. The effects of the way the decision makers and agencies respond to a disaster, of the way they organize risk reduction and
disaster preparedness, and of the way the communities organize their post-disaster recovery, on community growth and development are not uniform. Decisions regarding the implementation of disaster management solutions, and public assistance to residential recovery and rebuilding are structured by the complex network of institutional relations in a specific administrative regime. Therefore, in contrast with a ‘bottom-up’ view in which community capacity, resources, capability, and resilience shape their recovery outcomes following a large-scale disaster, this dissertation favours the view in which ‘top-down’ institutional arrangements play a critical role in contextually determine the implementation of any recovery and reconstruction choices and activities and as such, shape the outcome of recovery.

Similarly, socio-demographic characteristics of a disaster-affected area, and local housing culture and traditions, if isolated from the context of institutional arrangements, will be void of meaning. All these physical, social, economic and political conditions have an intrinsic effect on housing recovery and reconstruction. Further, the literature review also revealed that the trends of humanitarian development towards housing recovery in most developing countries have resulted in varied forms of participation and engagement in housing reconstruction among various groups. The interests of different participants or stakeholders materialize in the housing recovery process through varied reconstruction approach. These interests will also influence the subsequent reconstruction activities such as resourcing for disaster housing projects.

Finally, the solely technical reconstruction of housing after a disaster in of itself has no endogenous role in community growth. Only when it is placed into the network of social and economic relations, and placed into the livelihood development context, it can be transformed into a component contributing to community resilience. Considered from a market relations perspective, mitigation of risks of housing is tied with availability of market mechanism and public assistance. From a government intervention viewpoint, housing is seen as a channel to achieve rapid and manageable post-disaster recovery. From a donor-driven rebuilding perspective, housing projects offer a space for ‘build back better’ and opportunity to enhance community resilience. These housing approaches are not mutually exclusive but rather in most cases coexist in a varied degree, and are institutionalized in the post-disaster environment.

Therefore, the first two key elements are post-disaster recovery and reconstruction environment and housing reconstruction approach, both of which provide valid entry points for understanding
the ways the housing recovery is defined, organized and managed in varied disaster contexts. This understanding will be reinforced as the concept of resourcing is applied to analyze and explain the implications of resource availability for housing recovery process and results. By doing so, the housing is seen as both the manifestation of post-disaster recovery and reconstruction environment as well as a platform on which resourcing, along with other key reconstruction activities can be actualized into the post-disaster recovery environment.

4.1.2 The concepts of ‘resourcing’ and ‘resource availability’ in housing recovery

The review of the construction project management literature highlighted the necessity to include ‘resourcing’ into post-disaster reconstruction theory and practice following a large-scale disaster. The resource-related operations in conventional construction management, such as resource management, resource procurement, and supply chain management, have their concrete representation in the construction project management and organization. Of the many stakeholders responsible for constructing a housing project, house owners play a critical role in socio-economically enabling the selection and acquisition of suitable resources. Furthermore, the government and research and industry institutions for construction innovation are also likely to play a part in directing resource flows. Particularly in the aftermath of a disaster, the government plays a crucial role in managing post-disaster recovery operations.

As mentioned earlier, public assistance programs and disaster-related policies from the ‘top’ can have an impact on the implementation of on-the-ground reconstruction activities such as resourcing for housing projects at the ‘bottom’. The literature review provides examples of the integration of various interests of resourcing stakeholders in the reconstruction of physical built environment. Therefore, the structure of resourcing stakeholders and their relationships can reveal how resourcing is approached and resource pressures for reconstruction are dealt with by different groups. The analysis of resourcing stakeholders can provide insights into how the resource availability is institutionally considered and pursued in a disaster-impacted region.

The literature review also emphasized the need to re-define ‘resource availability’ in a post-disaster recovery context. The notion of resource availability as a condition determined by supply and demand in the construction market should be extended to a broader community recovery setting. The new definition specified in this dissertation sought to bring to the forefront the socio-economic dimension of recovery and the process of resourcing for post-disaster
reconstruction. The reconstruction project failures or rework in past events was not simply the result of the lack of adequate resources for reconstruction. Rather, community-related socio-economic features, the logistical barriers caused by physical disruption, along with capacity for material and technical innovation were all embedded in the reconstruction realities. They also manifested a certain degree of and affected resource availability when rebuilding houses after a disaster.

1) **Attainability** is the most basic dimension of resource availability. Conventionally, the notion of resource availability depicts a status or an outcome where resources are ready to be handy when required for construction. This notion is merely accounts for quantity as well as resource functional descriptions. Instead, attainability provides an inclusive dimension of resource availability that describes both the capacity of construction industry from the resource supply perspective and affordability of house owners from the resource demand perspective.

2) **Usability** is another prevalent dimension of resource availability. The construction requirements for resources that are used into a project system do not provide an understanding of the intrinsic requirement for quality reliability aspect of resources. Usability here is indicative of the requirements for both resource quality control and its environmental concerns. In a post-disaster situation, where the access to normal resource level is unlikely, quality control and environmental considerations of using suitable resources are the critical dimensions of resource availability that reflects the tenets of integrating disaster risk mitigation into post-disaster recovery and reconstruction.

3) **Accessibility** is the third dimension of resource availability. It is defined by the process that available resources are procured and delivered. Accessibility not only provides a physical access to resources required, rather it describes the logistical process of reaching these resources. In a post-disaster reconstruction setting, accessibility is a critical dimension that represents both the transportation and various possibilities for using resource alternatives for disaster recovery projects.

Evidence in the past events pointed to the importance of looking at a certain number of ‘problematic resources’ that are likely to have an impact on housing recovery in terms of
construction time, cost and quality. Post-disaster recovery projects to a varied degree channel the flows and stocks of capitals and resources. As discussed in the literature on resource availability for disaster recovery projects, availability of resources is subjected to change and needs to be constantly re-assessed as recovery and reconstruction proceeds. The ‘resource crisis’ vary during the different post-disaster phases and in different places. Variations in the resource availability are the result of a number of emerging factors over the post-disaster reconstruction period. Resource availability can be seen as a function of various possible configurations of the social and material conditions that existed at the time of recovery. It is also a function of the possible opportunities introduced by resourcing solutions from different stakeholders. Therefore, the ‘indicator resources’, their availability, and the critical factors affecting their availability under the unique circumstance of disaster recovery constitute the other parts of the conceptual model.

4.1.3 A conceptual model for resource availability in housing reconstruction

In this section, the concepts of housing recovery and reconstruction, resourcing, and resource availability will be applied and integrated to provide a conceptual model for understanding resource availability for housing reconstruction. Based on the review of the literature on disasters, disaster management, housing recovery and reconstruction, resourcing, resource availability, and by considering resourcing as being a dynamic process, the model proposed in this dissertation is based on the following tenets.

1) As many recovery problems in disaster-affected areas pertaining to housing, resource availability is intrinsically linked to the specific post-disaster context as well as to the chronic vulnerability conditions in existence long before the event. As such the post-disaster recovery and reconstruction environment embodies the struggles associated with resourcing for housing projects.

2) Resource availability is regulated by various approaches to housing reconstruction. Housing reconstruction approach is a reflection of various combinations of local and external institutional resources, capacities and arrangements. As the housing stakeholders that are institutionally defined, these stakeholders operate their leverage into decision making, recovery implementation, funding mechanism.
3) Resource availability is articulated by various resourcing-related stakeholders. These multiple stakeholders can work in a concerted or individual manner to increase the availability of resources in multiple ways including through control over the production and circulation of materials, price control over inflation, as well as finding alternatives to resources.

4) Resource availability is unevenly distributed across different stages and sectors of reconstruction. The ‘indicator resources’ that are likely to be of particular interest and importance during the period of disaster reconstruction, their availability, and critical factors affecting their availability can provide insights into the execution of post-disaster reconstruction projects in any future events.

Based on the above assumptions, a model connecting disaster recovery, housing reconstruction, resourcing for housing reconstruction is conceptualized. Figure 4.1 provides a diagrammatic illustration of the relations between the different elements of the model.

![Figure 4.1 Framework for analyzing resource availability for post-disaster housing reconstruction](image)

The basic components of this model are: 1) post-disaster recovery and reconstruction environment, 2) housing reconstruction approach, 3) resourcing stakeholders for housing reconstruction, 4) ‘indicator resources’ and their availability, and 5) critical factors that affect resource availability. In this present research, the availability of resources for post-disaster
reconstruction is understood as an outcome of resourcing for disaster recovery projects. The overhaul approach to resource availability within the disaster reconstruction context provides a strong analytical framework to increase the understanding of resource availability in post-disaster recovery projects.

The usefulness of this overhaul analysis rests on three main reasons. First, by investigating the implications of resource availability for post-disaster recovery outcomes, the framework allows for an approach that looks at post-disaster housing reconstruction in a broader disaster recovery context. Although the framework considers individual ‘indicator resources’ as the shortest ‘wooden bar’ in a ‘wooden barrel’ and focuses primarily on their availability, the framework can be extended to understand the overall capabilities in the construction industry and market. While housing cultures and disaster contexts vary, the resource availability framework offers a means of understanding the differences and commonalities in the resource needs in various post-disaster situations and the corresponding difference in the approaches and capabilities of various implementing organizations to source for rebuilding houses destroyed in a disaster.

Second, in context of post-disaster reconstruction where recovery housing projects are likely to suffer resource shortages and limitations, to understand the significant factors that impinge upon resource availability can provide critical levers for resourcing stakeholders to mitigate impacts on disaster recovery outcomes. By using this framework, the research, rather than merely focusing on various factors that may or may not affect resource availability in different disaster recovery environments, can instead analyze the aspects that enhance and improve the resourcing ability of the affected people or implementing agencies, as well as the aspects that impede and constrain the effectiveness of resourcing during the recovery period. The assessment of a certain post-disaster recovery process with respect to resource availability and management is likely to be multi-stakeholder involved and ‘indicator resources’-focused according to this framework.

Third, this resource availability analytical framework can give valuable insights into the difference in recovery institutions and capacities involved in resourcing for disaster recovery projects. This difference may differentiate the housing reconstruction approach and thus accounts for the difference in housing recovery outcomes among varied post-disaster environments. Such an insight can be informative in guiding future public policies and construction industry
initiatives. Therefore, the resource availability framework provides a useful analytical approach to not only understand resourcing issues in post-disaster housing recovery, but also to examine resource availability and management within the framework of the post-disaster reconstruction scholarship, which emphasizes a multi-stakeholder approach to disaster recovery efforts. From this position, improvement schemes can be suggested by identifying those attributes that might best be mustered to build resiliency in the post-disaster housing recovery.

4.1.4 Research questions

The literature review presented in the preceding chapters, along with the synthesis in this chapter also provide a discussion of what might be expected in terms of future policy and research challenges in the area of post-disaster reconstruction, and how these two are likely to intersect. Therefore, an empirical research is needed, building on the current body of work, to examine what critical factors hinder or enable resource availability in post-disaster housing reconstruction. As an exploratory study and theory building framework, the above discussions of resource availability conceptual model can be operationalized into a number of research questions, which provide the main lines of inquiry of this dissertation.

1) What is recovery and reconstruction environment like after a major disaster?

2) What approach is adopted for post-disaster housing recovery?

3) Who are the principal stakeholders involved in resourcing for disaster housing projects?

4) What are ‘indicator resources’ in the wake of the disaster that hinder housing reconstruction?

5) What are the critical factors that affect resource availability for housing recovery?

6) How does the resource availability for disaster housing recovery vary across different recovery environments?

The purpose of this research is to understand resource availability for post-disaster housing reconstruction and the nature of variations in recovery patterns by answering the above research questions. According to the model described above, differences in resource availability are a function of the five elements. In order to test this model and to capture the variability across
different disaster contexts, the research design and methodology applied will be specified in the following sections.

4.2 The research process

This research is part of a six year national ‘Resilient Organisations’ research programme funded by the Foundation of Research Science and Technology (FRST) in New Zealand. The ‘Resilient Organisations’ is collaboration between New Zealand research universities and key industry players, and supported by a diverse group of industry partners and advisors. The relationship between the Resilient Organisations and this doctoral study was a facilitative relationship. The Resilient Organisations (2006a) established an overall framework of key research issues and areas that should be addressed in terms of improving organizational resilience across regions and sectors. It has all the systems in place to help a particular researcher to fulfil a research study, such as annual writing retreats, regular workshops, and financing field trips to the disaster-affected areas. The Resilient Organisations also have a range of industry expertise as external advisors to help postgraduate-level study by providing comments on academic papers, reviewing the reports, and providing industry workshop and seminar opportunities. It serves as a platform the investigator of this research can use to undertake an independent doctoral study at the University of Auckland.

The main objective of this PhD research is to develop an integrated resource availability framework under the circumstances of post-disaster reconstruction for the purpose of improving housing recovery and reconstruction at a strategic level. To accomplish this objective, the research process is divided into four phases, as shown in Figure 4.2.

---

3 ‘Resilient Organisations’ is a six year research project designed to assist New Zealand organizations to recover economic competitiveness after hazard events by improving their resilience. For further details are available at ‘Resilient Organisations’ website: www.resorgs.org.nz
Figure 4.2 Research process
1) **Problem identification**: involves preliminary readings around the subject area and review of contemporary thoughts and trends from the theory and practice on disaster management, post-disaster recovery and reconstruction, and project resource management. In addition to literature review, the researcher also participated in a series of National Lifelines Forum in New Zealand, seminars organized by the New Zealand Ministry of Civil Defence and Emergency Management (MCDEM), seminars organized by the ‘Resilient Organisations’ regarding post-disaster reconstruction. Discussions with main disaster management practitioners in New Zealand took place constantly during the first year of this study to refine the knowledge gap identified from the literature. As presented in the preceding section, an analytical framework for understanding resource availability for housing recovery projects is developed as a basis for further advancing the current research. Based on this framework, research questions and according objectives were developed, as well as the research design which will be described in the following sections to guide the overall research activities.

2) **Data collection and analysis**: involves multiple techniques in the research design in arriving at an accurate perception of reality, knowledge and truth (McMurray et al., 2004). A number of researchers such as Creswell (2003), Yin (2003), and McMurray et al. (2004) have pointed out that the selection of research methods, to a large extent, depends on the research aim and research questions posed. In this research, case study research design was selected to assess the resource availability framework. Multiple methods and techniques were used for data gathering and analysis in the hope that each technique produces complementary data. The researcher conducted a range of research field visits for case study data collection. As one of the key elements of a research design, validity encompasses external validity of quantitative methods and the transferability of qualitative methods (Tashakkori and Teddlie, 2003). Thus, multiple strategies for validating research methods and findings were conducted throughout the research process.

3) **Comparative analysis and synthesis**: International comparisons require articulated conceptual frameworks (Inam, 2005). In this present research, based on the analytical framework developed for understanding resource availability in post-disaster housing reconstruction, comparative analysis involves a number of tasks. These tasks include,
such as analyzing the housing recovery approach adopted in each post-disaster recovery environment; analyzing the method of provision of housing resources and services; identifying resourcing patterns and critical factors that affect post-disaster resource availability; and specifying similarities and differences across varied disaster environments. A synthesis and comparison of all the information yielded from case studies was undertaken to arrive at pertinent suggestions for improving the resourcing practice in post-disaster situations. Verification exercise was initiated after each case study to gauge the practicability of some of the suggested improvements in their disaster recovery and reconstruction practice.

4) **Conclusions and recommendations**: contains a review of the entire study. In concluding the research, primary research findings were summarized, as well as recommendations for improving resourcing practice in post-disaster housing reconstruction. A respective approach was used to review the research work and achievements against the checklist of knowledge gaps summarized in Table 3.11 in Chapter Three. The research contributions to the current knowledge base were discussed. Research limitations and constraints were summarized. In line with the unfilled research gaps and areas that were not dealt with by this research, at the final stage of this research, this thesis summarized the directions needed for future research and practical efforts.

Throughout the entire research process, the researcher consistently explored opportunities to validate and disseminate the research outputs at different stages so that the final research findings may be relevant to practice needs and other disaster prone countries. The following outlines the examples of where the staged research outputs were presented.

- Presentation to the industry practitioners in disaster management and post-disaster recovery and reconstruction, along with visualized displays of research activities and results to public, particularly the university students. A list of these presentations is tabulated in Table 4.10 in the following sections.

- A series of papers consistently published in the journals related to the research subject and also presented at the internationally organized conferences. A large amount of the peer reviewers’ comments on the research focus, novelty, rigorousness, practical
applicability and result generalizability significantly improved the way the final dissertation is structured and organized. A list of these publications is included in Appendix 1.

4.3 The research design

A research design is the logical sequence that connects the empirical data to a study’s initial research questions and, ultimately, to its conclusions (Yin, 2003). There are a number of research design approaches in literature to guide an investigator in the process of collecting, analyzing, and interpreting data and research results. The research design strategies that are commonly used include: experiment, survey, archival analysis, history, and case study. Depending on the specific research problem and nature, selection of an appropriate research design is critical to the entire validity of a research (Frankfort-Nachmias and Nachmias, 1992). This study adopts the case study research design. The reasoning of selection of case study research design and the associated research methods will be explained in details.

4.3.1 Selection of research design

4.3.1.1 Selection of case study research design

This section explains why the case study design is selected in this research. The choice of a research design is based on linking the nature of research problems in this study with the available design options — to display the logical connections between the research and the decisions on data collection and data analysis. Case study method, along with the other four common qualitative designs are presented and compared in the following Table 4.1. Three considerations listed in Table 4.1 are the main criteria for selecting a research design in this study, namely: 1) forms of research questions; 2) the extent of control an investigator has over the behavioural events; and 3) whether the research focus is on contemporary events or not.
As proposed by Yin (1984), the case study design develops an empirical approach to research of a contemporary phenomenon within its own context. Contrary to scientific experimentation, case studies analyse the phenomenon in its own environment considering, as much as possible and in a holistic manner, the elements of the context that interact with the phenomenon under study. The following matrix in Table 4.2 summarizes how the research characteristics in the present study match with the three considerations in choosing the case study design.

Table 4.2 Matrix of research features and considerations for selecting case study method

<table>
<thead>
<tr>
<th>Nature of the current research</th>
<th>Matching the case study considerations?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research questions</td>
<td>Forms of research questions:</td>
</tr>
<tr>
<td>Q1. What is recovery and reconstruction environment like after a major disaster?</td>
<td>What?</td>
</tr>
<tr>
<td>Q2. What approach is adopted for post-disaster housing recovery?</td>
<td></td>
</tr>
<tr>
<td>Q3. Who are the principal stakeholders involved in resourcing for disaster housing projects?</td>
<td></td>
</tr>
<tr>
<td>Q4. What are ‘indicator resources’ in the wake of a disaster that hinder the housing reconstruction?</td>
<td>How?</td>
</tr>
<tr>
<td>Q5. What are the critical factors that affect resource availability for housing recovery?</td>
<td></td>
</tr>
<tr>
<td>Q6. How does the resource availability for disaster housing reconstruction vary across different disaster</td>
<td></td>
</tr>
</tbody>
</table>
recovery environments? | Why?
--- | ---
**Investigator role** | **Requires control?**
• Direct observation or participant-observation of the events being studied  
• Interviews of the persons involved in the events  
• Dealing with a full variety of evidence: documents, arti-facts, interviews, observations  
No, only informal manipulation occurs in form of participant observation  
Yes

**Focus events** | **Contemporary events?**
• The 2004 Indian Ocean tsunami  
• The 2008 Wenchuan earthquake  
• The 2009 Victorian ‘Black Saturday’ bushfires  
Large-scale natural disasters  
Yes

This research aims to develop an understanding of resource availability for disaster housing projects in a post-disaster situation. With a view to achieving this overall objective, the units of analysis are in line with the five key elements of resource availability framework in Figure 4.1, namely 1) post-disaster recovery and reconstruction environment, 2) housing reconstruction approach, 3) resourcing stakeholders, 4) ‘indicator resources’ and their availability, and 5) critical factors affecting resource availability. The overarching objective of the research requires grounded investigation of contemporary post-disaster reconstruction practice with respect to resource availability for housing recovery. According to Leedy and Ormrod (2010), a case study is especially suitable for learning more about a little known or poorly understood situation. As shown in the literature review Chapter Two and Three, both subjects of post-disaster housing recovery and resource availability in construction projects are under-researched. Case study method can therefore promote the limited understanding of the selected research topic.

According to Yin (2003), a case study is a ‘how’ and ‘why’ question that is asked about a relatively contemporary set of events over which the researcher has little or no control. The research questions posed in the study require investigations on the results of resourcing measures or interventions adopted by relevant stakeholders in disaster recovery projects. Therefore, contemporary disaster events will be the focus of this research, through which the resourcing process will be examined. In addition, the research questions, however, have to do with the post-disaster recovery and reconstruction practice associated with varied stakeholders. Such questions can be answered only if the researcher collects information directly from these stakeholders.
Further, if the researcher collects information merely from one disaster event case, the researcher cannot draw accurate conclusions about resourcing practice in a post-disaster situation. Multiple cases that are different in certain key ways are needed to help make comparison, build theory, or propose generalizations regarding commonalities and differences (Yin, 2003). Therefore, the fundamental research design is the case study approach, and a comparative analysis.

In the present research, details about the context surrounding the case, including information about the physical environment, historical, economic, and social factors that have a bearing on the situation are also considered in the research objectives. This is also in line with the extensive scope of data collected from case studies. Based on the established analytical framework for understanding resource availability in post-disaster situations, the case study method is adopted to identify the major themes and patterns associated with the phenomenon of resourcing post-disaster reconstruction. In another word, the case study is used in this research to examine the theoretical conclusions generated from the literature review in the real world contemporary events.

### 4.3.1.2 Multiple case studies and a comparative analysis

The main purpose of the design is to help avoid the situation in which the evidence does not address the initial questions (Yin, 2003). In this sense, the case study research design has to deal with how the research questions in this dissertation can be answered. The case study design in this research consists of multiple case studies and a comparative analysis cross cases. The single case study investigates the nature of housing policies and resourcing activities for post-disaster housing reconstruction in different recovery environments. A comparative analysis allows for the differences and similarities with respect to resource availability in different recovery environments.

According to Philliber et al. (1980), another way of thinking about the case study research design is to deal with four questions: 1) what questions to study, 2) what data are relevant, 3) what data to collect, and 4) how to analyze the results. By answering these four questions, the following presents how the case study research design connects the empirical data to the research questions, and ultimately to the conclusion.
1) **Research question 1**: What is recovery and reconstruction environment like after a major disaster?

- **Data relevant**: post-disaster recovery and reconstruction environment

- **Data collection and analysis**: refers to analysis of post-disaster institutional arrangements, policies, programs, and practices for disaster recovery and reconstruction. Such a background analysis provides an understanding of the basic disaster management framework and structures, and the forms of decision making in a disaster-impacted jurisdiction. In addition, policies for disaster recovery also characterize the process and outcomes of recovery from a disaster. Specific contextual elements can be also identified as potential factors that affect the way housing recovery is organized and managed.

2) **Research question 2**: What approach is adopted for post-disaster housing recovery?

- **Data relevant**: Post-disaster housing reconstruction approach

- **Data collection and analysis**: refers to analysis of predominant issues for housing recovery and the methods which the affected communities had used to organize rebuilding their houses. This reflects the rules of the game in the housing systems which vary considerably as priorities and dominant concepts vary in different post-disaster recovery and reconstruction environments. This involves an analysis of specific housing types and programs in the examined case studies, in order to determine the decision making rationalities, which may be socially constructed and culturally relative. Analysis of recovery approach applied for housing projects also points to characteristics of the implementing agencies or individuals and their roles in housing recovery.

3) **Research question 3**: Who are the principal stakeholders involved in resourcing for disaster housing projects?

- **Data relevant**: Resourcing stakeholders for disaster housing reconstruction
Data collection and analysis: refers to identifying principal stakeholders involved in resourcing practice in post-disaster recovery operations and their relationships. Such a discussion provides an understanding of the value and influence a certain type of stakeholder can offer to improve the overall resourcing performance for disaster recovery projects. Further, possible constraints and opportunities a stakeholder can bring into a resourcing process can also be identified.

4) **Research question 4**: What are ‘indicator resources’ in the wake of a disaster that have an impact on housing reconstruction?

- **Data relevant**: ‘indicator resources’ for post-disaster housing reconstruction

- **Data collection and analysis**: refers to identifying the problematic resources that are subject to shortages in a post-disaster situation, and their low availability has an adverse impact on the housing recovery performance. Assessment of their availability in terms of three dimensions of resource availability, as presented in Chapter Three is necessary. This is critical to providing a general view of the resourcing issue that emerged during recovery and reconstruction from a major disaster.

5) **Research question 5**: What are the critical factors that affect resource availability for housing recovery?

- **Data relevant**: Critical factors that affect resource availability post-disaster

- **Data collection and analysis**: this refers to the identification of the determinants that characterize a resourcing process for disaster recovery projects in different recovery context. This includes a study of typical resourcing environment or strategies and refers to predominant themes including both impetus and impediments that are likely to affect resource availability. Systematic suggestions to improve resourcing practice in the studied case studies are based on sound identification and discussion of these critical factors.
6) **Research question 6**: How does the resource availability for disaster housing recovery vary across different recovery environment?

- **Data relevant**: All the research findings associated to the above five research questions

- **Data collection and analysis**: this refers to a synthesis of the research findings that are associated with the preceding five questions, and compare these findings to generate similarities and disparities with respect to resource availability for post-disaster housing reconstruction in different disaster recovery environments.

The first five research questions, along with the required data, and data collection and analysis methods require single case study method, whereas the last question dictates a comparative analysis across multiple cases. The overall research design is illustrated in Figure 4.3. As can be seen in Figure 4.3, in different phases of the research process, there are differing research methods applied. To address the research questions posed by the resource availability analytical framework, a multi-method case study design, along with a comparative analysis are used in this research. The relevant chapters are also arranged according to the research procedures in Figure 4.3, which demonstrates the logic flow of the entire thesis, as well as the research methods used in each research phase. In the following two sections, the primary research methods adopted in this PhD study will be reviewed and discussed. The rationale for selecting the specific methods, case or research participant will be discussed and justified accordingly.
Comparative analysis

Case studies

Case study of Indonesia
(2004 Indian Ocean tsunami housing reconstruction)

Quantitative method:
Questionnaire

Case study of China
(2008 Wenchuan earthquake housing reconstruction)

Qualitative methods:
Documentation
Archival records
Field observations
Interviews

Case study of Australia
(2009 Victorian ‘Black Saturday’ bushfires housing reconstruction)

Q1: What is recovery and reconstruction environment like after a major disaster?

Q2: What approach is adopted for post-disaster housing recovery?

Q3: Who are the principal stakeholders involved in resourcing for disaster housing projects?

Q4: What are ‘indicator resources’ and their resource availability?

Q5: What are critical factors that affect resource availability for housing recovery?

Q6: How does the resource availability for disaster housing recovery vary across different recovery environment?

Step 1: Problem Identification - Chapter 1, 2, 3

Step 2: Data gathering - Chapter 4, 5, 6, 7

Step 3: Comparative analysis & synthesis - Chapter 8
Step 4: Conclusion - Chapter 9

Figure 4.3 Diagram of the overall research design
In disaster recovery research, much knowledge has been gained by detailed, one-time surveys or focused investigations of disaster-affected communities (Chang, 2010). In their path-breaking comparative study of reconstruction processes following four major disasters, Hass et al. (1977) noted the dearth of such comparative studies at the time. Rubin et al. (1985) suggested, however, that the real need was not for findings that could be applied among other case studies, but for theories that would advance the entire field of study. Over the last decade, there have been a number of different approaches to the comparison of case studies in disaster research field. Some studies were based on the same, or similar disaster context comparing the effects of different community behaviours on disaster recovery at the local level (e.g. (Eoh, 1998; Lovekamp, 2006; Mukherji, 2008)). Some researchers compared characteristics inherent in certain elements of recovery, for example, the individuals, the institutions, or the systems in order to assess the impact of their various features on recovery outcomes (e.g. (Kamel, 2004; Zhang, 2006; Lu, 2008)). Other studies have examined the efficacy of a certain process, system or mechanism that had been set up for recovery by comparing them in different types of disasters or countries (e.g. (Neal, 1985; Inam, 1997; Wu, 2003)).

According to Wu and Lindell (2004), and Chang (2010), comparative study across disasters is important for systematically developing a knowledge base on how communities recover from disasters. Cross-case comparison in this research allows the researcher to capitalize on the uniqueness of a specific case and the emergence of new themes to improve resultant theory. Therefore, drawing on both quantitative and qualitative results in each individual case study of Indonesia, China and Australia, the research is designed as a comparative analysis in accordance with the resource availability analytical model. Three guidelines are also applied in the dissertation when making comparisons across disparate spatial scales: 1) the definition of terms is universal, consistent across countries, cultures and historic time periods; 2) data are available, solid and comparable; and 3) assessment is standardized to allow parallel comparisons across space and time.

The logic linking the research to the case study research design is essentially based on pattern matching established in the resource availability framework. The main set of questions for individual case studies is also applied to the cross comparison. The five elements of resource availability framework are thus extracted from individual case studies into one category and
compared against each other to give further insights into resource availability in a post-disaster situation.

4.3.2 Selection of mixed research method
Creswell (2003) suggested quantitative, qualitative, or mixed method in a research study, and that the knowledge claims, the strategies, and the method contribute to a research approach that tends to be one of them. The following definitions of the three methods can be helpful in selecting an appropriate approach for a research.

1) **Quantitative approach**: is one in which the investigator primarily uses post-positivist claims for developing knowledge (i.e., cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation, and the test of theories), employs strategies of inquiry such as experiments and surveys, and collects data on predetermined instruments that yield statistical data. Quantitative research involves either identifying the characteristics of an observed phenomenon or exploring possible correlations among two or more phenomena (Leedy and Ormrod, 2010).

2) Alternatively, **qualitative approach**: is one in which the inquirer often makes knowledge claims based primarily on constructivist perspectives (i.e., the multiple meanings of individual experiences, meanings socially and historically constructed, with an intent of developing a theory or pattern) or advocacy/participatory perspective (i.e., political, issue-oriented, collaborative, or change oriented) or both. It also uses strategies of inquiry such as narratives, phenomenologies, ethnographies, grounded theory studies, or case studies. The researcher collects open-ended, emerging data with the primary intent of developing themes from the data.

3) **Mixed methods approach**: is one in which the researcher tends to base knowledge claims on pragmatic grounds (e.g., consequence-oriented, problem-centered, and pluralistic). It employs strategies of inquiry that involve collecting data either simultaneously or sequentially to best understand research problems. The data collection also involves gathering both numeric information (e.g., on instruments) as well as text information (e.g., on interviews) so that the final database represents both quantitative and qualitative information (Creswell, 2003).
The above definitions show that either quantitative or qualitative research approach can enhance the unique qualities of the other and result in opportunities for reciprocal advantages at each stage in the research process. The mixed research approach seems to combine the credits of these two approaches. This study dictates a mixed method research design to address the research problem. Table 4.3 and Table 4.4 present how the mixed methods are used to address the research questions and objectives in this study. The following section explains why the mixed method approach is adopted in this study.

Table 4.3 below summarizes the research methods required in line with different research questions and objectives in this study. Table 4.3 shows that a multi-method approach which embraces a range of possible means and operations that best attain each individual case study objectives. Within each individual case study, the advantages of collecting both close-ended quantitative data and open-ended qualitative data prove advantageous to best understand a research problem (Creswell, 2003). Table 4.4 also demonstrates that by an in-depth cross comparison of resourcing conditions, difficulties and challenges inherent in a post-disaster recovery process, the insights into the requirements for a sustainable reconstruction practice can be provided. The comparative approach recognizes the differences between the situations and cultures of various cases (Yin, 2003). An understanding of variations in resource availability determinants in different recovery environments can also help create a knowledge base from which to draw commonalities and disparities across cases and extend research findings into other similar situations.
Table 4.3 Multiple research methods to address research questions 1-5

<table>
<thead>
<tr>
<th>Overarching method</th>
<th>Single case</th>
<th>Single case study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple cases</strong></td>
<td><strong>Research questions in single case study</strong></td>
<td><strong>Research objectives</strong></td>
</tr>
<tr>
<td><strong>Q1. What is recovery and reconstruction environment like after a major disaster?</strong></td>
<td>(a) To identify post-disaster institutional arrangements, policies, programmes, and practices for disaster recovery and reconstruction. (b) To identify specific contextual elements that affect the way in which housing recovery is organized and managed.</td>
<td>Literature review</td>
</tr>
<tr>
<td><strong>Q2. What approach is adopted for post-disaster housing recovery?</strong></td>
<td>(a) To recognize the predominant issues for housing recovery after a disaster. (b) To identify housing recovery approach and methods applied to rebuild houses for communities.</td>
<td>Literature review Field visits Questionnaire survey On-site observations Interviews</td>
</tr>
<tr>
<td><strong>Q3. Who are the principal stakeholders involved in resourcing for disaster housing projects?</strong></td>
<td>(a) To undertake stakeholder analysis with respect to principal stakeholders involved in resourcing practice in post-disaster recovery operations and their relationships.</td>
<td>Literature review Field visits Questionnaire survey Interviews</td>
</tr>
<tr>
<td><strong>Q4. What are ‘indicator resources’ in the wake of a disaster that hinder the housing reconstruction?</strong></td>
<td>(a) To identify ‘indicator resources’ for housing recovery projects. (b) To assess the availability of these identified ‘indicator resources’</td>
<td>Questionnaire survey On-site observations Interviews</td>
</tr>
<tr>
<td><strong>Comparative analysis</strong></td>
<td><strong>Q5. What are the critical factors that affect resource availability for housing recovery?</strong></td>
<td>(a) To identify critical factors that affect post-disaster resource availability (b) To identify the relationships between these resource availability determinants</td>
</tr>
</tbody>
</table>
Table 4.4 Research methods to address the research question 6

<table>
<thead>
<tr>
<th>Research question for multiple case studies</th>
<th>Research objectives</th>
<th>Research methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q6. How does the resource availability for disaster housing recovery vary across different recovery environment?</td>
<td>(a) To compare the above identified resource availability elements across the case studies (b) To identify the commonalities and disparities with respect to resourcing for disaster recovery projects across the examined case studies</td>
<td>Comparative analysis Narrative presentation Interviews Expert judgement justification</td>
</tr>
</tbody>
</table>

According to Chang (2010), basic quantitative descriptions can provide a valuable baseline description that can help to identify issues for a more in-depth, qualitative or quantitative study for a particular event. In hazard research, Oliver-Smith (1996) also proposed that dialogue and open-ended methods are ethically and methodologically more appropriate for conducting disaster related research. Therefore, the quantitative approach, namely questionnaires with the aid of statistical analysis was employed in this study to identify the critical factors affecting resource availability for post-disaster housing reconstruction. By undertaking the research field visits to the case study site, qualitative observations and interviews, and audiovisual records are used to 1) address the research questions 1-4, 2) to clarify and reinforce conclusions yielded in the questionnaire session, and 3) to enhance the internal validity of the research. Therefore, the implementation of interviews runs through the entire case study research process to enhance the understanding of the five elements in the resource availability analytical framework.

Therefore, by answering the six research questions in Table 4.3 and Table 4.4, the data collected include both quantitative information such as questionnaire survey results, and qualitative information such as text information (e.g., on interviews and observations). It can be concluded that such database can be only developed if a mixed methods approach is used. The following section will specify these multiple research methods. The sources of evidence that are most commonly used in doing case studies include: documentation, archival records, interviews, direct observations, participant observation, and physical materials. To build up a solid database for each case, apart from those six qualitative methods, this research also applies questionnaire survey in each individual case. Documentary evidence was collected during field trips. This information included local government plans and documents, local newspapers and photographs.
showing the recovery and reconstruction progress and facts. Documents and archival records supplement the data collected by the researcher from the other four sources including observations, interviews, questionnaire, and audiovisual materials. A complete list of data sources are summarized in the Table 4.5, in line with (Creswell, 2003, p.186), (Yin, 2003, p.86) and (Leedy and Ormrod, 2010). The following section will specify the use of each research method.
## Table 4.5 Data collection types, advantages and limitations

<table>
<thead>
<tr>
<th>Data collection types</th>
<th>Options within types</th>
<th>Advantages of the type</th>
<th>Limitations of the type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observations</strong></td>
<td>Direct observation</td>
<td>• Reality – covers events in real time</td>
<td>• Time and cost consuming</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Contextual – covers context of event</td>
<td>• Selectivity and reflexivity</td>
</tr>
<tr>
<td></td>
<td>Participant observation</td>
<td>• (Same as above for direct observation)</td>
<td>• (Same as above for direct observation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Insightful into interpersonal behaviour and motives</td>
<td>• Bias due to investigator’s manipulation of events</td>
</tr>
<tr>
<td><strong>Interviews</strong></td>
<td>• Face to face interview</td>
<td>• Targeted – focuses directly on case study topic</td>
<td>• Bias due to poorly constructed questions</td>
</tr>
<tr>
<td></td>
<td>• Telephone interview</td>
<td>• Insightful – provides perceived causal inferences</td>
<td>• Response bias</td>
</tr>
<tr>
<td></td>
<td>• Focus group interview</td>
<td></td>
<td>• reflexivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Less representativeness of interviewees</td>
</tr>
<tr>
<td><strong>Questionnaire survey</strong></td>
<td>• Post/email questionnaire</td>
<td>• Anonymous responses</td>
<td>• Potential of a low response rate</td>
</tr>
<tr>
<td></td>
<td>• Online questionnaire</td>
<td>• Avoiding sensitive or controversial issues</td>
<td>• Sample size and representativeness</td>
</tr>
<tr>
<td></td>
<td>• On-site questionnaire</td>
<td>• More finding generalizability</td>
<td>• Bias due to respondents’ misinterpretation of questions</td>
</tr>
<tr>
<td><strong>Documents</strong></td>
<td>Documentation</td>
<td>• Easy access and time convenience of access</td>
<td>• Retrievability – can be low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Broad coverage</td>
<td>• Biased selectivity if collection is incomplete</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Saving time and cost of transcribing</td>
<td>• Bias due to author(s)’ reporting</td>
</tr>
<tr>
<td></td>
<td>Archival records</td>
<td>• (Same as above for documentation)</td>
<td>• (Same as above for documentation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Precise and quantitative</td>
<td>• Accessibility due to privacy reasons</td>
</tr>
<tr>
<td><strong>Audiovisual materials</strong></td>
<td>• Photographs</td>
<td>• Presentation of reality</td>
<td>• Difficult to interpret</td>
</tr>
<tr>
<td></td>
<td>• Videotapes and films</td>
<td>• Capturing attention visually</td>
<td>• May not accessible publicly or privately</td>
</tr>
<tr>
<td></td>
<td>• Art objects</td>
<td>• May be an unobtrusive method of collecting data</td>
<td>• Selectivity</td>
</tr>
<tr>
<td></td>
<td>• Database or software</td>
<td></td>
<td>• Investigator’s interruptions</td>
</tr>
</tbody>
</table>
4.4 Research methods

This section describes the individual research methods that were used in accomplishing the objectives of the research study. These research methods include: literature review, case studies, questionnaire survey within case studies, field-based observations and interviews, research workshops, conferences, and seminars, and other field trips.

4.4.1 Literature review

The literature review forms the foundation for the research proper (Hart, 1998). By conducting thorough literature review, as presented in Chapter One, Chapter Two and Chapter Three in this dissertation, the knowledge gap with regard to resource availability for disaster recovery projects has been identified. In addition, existing knowledge base in past research also helps develop an analytical framework to understand post-disaster reconstruction resource availability. Therefore, the literature review plays a two-fold role in this research — topic development and analytical framework development, as illustrated in Figure 4.4.

![Diagram of Literature Review and Knowledge Gap](image)

Figure 4.4 Two-fold role of the literature review in the research

Within this research, the literature review is divided into two parts, presented in Chapter Two and Three respectively. The review in the first part is on post-disaster recovery and reconstruction framework and issues emerging in disaster management. A progressive understanding from disasters, disaster management, disaster recovery, and housing recovery and reconstruction has been developed by reviewing and comparing the predominant ideas and thoughts in literature. Apart from the theoretical paradigms, practices of disaster management and recovery across varied jurisdictions were also reviewed and assessed in international
contexts. A number of issues that challenge disaster decision makers and practitioners are identified, including resource availability for post-disaster housing reconstruction.

The second knowledge base is concerned with resource management from project management perspective. The second part of literature review therefore adopted a similar ‘review-compare-assess’ method to summarize the existing resource management methods and techniques in conventional construction projects, as well as resourcing-related concepts in the field of post-disaster reconstruction. By taking a closer look at disaster recovery experience in the past, this research calls for a special attention on ‘indicator resources’ and their availability for disaster housing recovery. The literature review in Chapter Three, however, not only identified the knowledge gap in-depth, but also developed an analytical framework based on which this research study can be undertaken. The focus of the research is then concentrated on the five elements of the analytical framework for understanding resource availability in post-disaster situations, namely: post-disaster recovery and reconstruction environment, housing recovery approach, resourcing stakeholders, ‘indicator resources’ and availability, critical factors affecting resource availability for housing recovery.

In all, the literature review in this research consists of three different forms including theoretical review, methodological review, and integrative review, which is in line with Cooper (1984)’s suggestion for writing literature review in a dissertation. A combination of using three forms of reviews above, however, may provide not only a summary of studies but also an actual critique of the strengths and weaknesses of the method sections (Creswell, 2003). In the present study, integrative review is adopted to summarize broad themes in the disaster management literature, including disaster paradigms, disaster management frameworks and theories, and also in Chapter Three the resource management methods and techniques in construction projects. Literature review in Chapter Three is focused on extant theory such as resourcing approach, stakeholders and factors that relate to the problem under study. This form is called theoretical review. Finally, the methodological review is also applied in the study, focusing on methods and definitions of key concepts in both Chapter Two and Three. It can thus be concluded that the literature review of this research is pivotal to provide a knowledge basis for progressing research activities in achieving the overall research objective.
4.4.2 Case studies

The following sections explain the procedures and methods of using case study method in this research in terms of selection of cases, and the arrangement of case study chapters.

4.4.2.1 Case selection

The objective of this research dictates multiple case studies. According to Stake (2006), conducting the multiple case studies is a means of examining how the program or phenomenon performs in different environment. Yin (2003) suggested that the logic underlying the use of multi-case studies requires that each case must be carefully selected so that it either predicts similar results (a literal replication), or predicts contrasting results but for predictable reasons (a theoretical replication). In selecting cases, George and Bennett (2005) proposed three criteria as a general rule — first, the cases should be relevant to the research objectives and principal research questions; second, the cases should provide diversity across contexts; and third, the cases should provide opportunity to study about the complexity of the contexts.

In the context of this research, disasters are low probability and high consequence events. Major disasters such as the 2004 Indian Ocean tsunami, the 2008 Wenchuan earthquake, and the 2009 Victorian bushfires represent a situation of extreme and unique conditions. Thus it is impossible to fully plan or to be perfectly prepared for these infrequent events (Wu and Lindell, 2004). The three disaster events provided the researcher with opportunities to study the complexity inherent in their specific post-disaster recovery environment. In addition, variations in political, social and economic systems in the disaster-impacted countries of Indonesia, China and Australia provide diversity across contexts. Between 2008 and 2010, following each of the above events, the researcher conducted a series of research field visits to the disaster-impacted areas. The researcher observed that in the aftermath of the three events, the reconstruction practitioners in Indonesia, China and Australia had undergone difficulties in procuring resources for post-disaster reconstruction. Therefore, according to George and Bennett (2005)’s first criterion, the three cases were selected due to their distinct resourcing issues that are relevant to the research problem this study aims to examine.

During the field visits, the researcher obtained intimate access to, conducted research survey on, and thus generated a detailed understanding of, the specific resourcing issue in the three
countries. Therefore, apart from the above three general rules for selecting multiple cases, data accessibility and case generalizability were also considered in this research. Yin (2003) prescribed that selection of multiple cases should follow a ‘replication’ logic. The analytical framework developed in this research can be considered as a replicative format the investigation or interpretation of case studies ought to conform to. With all these criterion and considerations in mind, the three case studies are summarized in the following Table 4.6.
## Table 4.6 Selection of multiple case studies

<table>
<thead>
<tr>
<th>Country</th>
<th>Event</th>
<th>Fields visited</th>
<th>Field visit time</th>
<th>Research objectives</th>
<th>Case characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indonesia</strong></td>
<td>2004 Indian Ocean tsunami</td>
<td>Aceh Province: Banda Aceh Case site: Banda Aceh</td>
<td>March-June 2008</td>
<td>Research objectives</td>
<td><em>Specific political, and cultural context</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>In each case:</em></td>
<td><em>More donor-driven disaster recovery and reconstruction</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Recovery &amp; reconstruction environment</td>
<td><em>Modern concrete housing reconstruction</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Housing recovery approach</td>
<td><em>More prominent pre-event issues</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Housing resourcing stakeholders</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• ‘Indicator resources’ and availability</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Critical factors that affect resource availability for housing recovery</td>
<td></td>
</tr>
<tr>
<td><strong>China</strong></td>
<td>2008 Wenchuan earthquake</td>
<td>Sichuan Province:</td>
<td>• July 2008</td>
<td>• Variations regarding resource availability for housing recovery across different disaster recovery environments</td>
<td><em>Specific political, economic and cultural context</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mianzhu • Dujiangyan • Beichuan Case site:</td>
<td>• Dec. 2008 – Feb. 2009</td>
<td>• Representative of relatively developed countries</td>
<td><em>More government-driven disaster recovery</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mianzhu</td>
<td>• June - July 2009</td>
<td><em>Seismic resistant concrete and brick housing rebuilding</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• February 2010</td>
<td><em>2008 financial crisis effect</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Multiple cases:</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Variations regarding resource availability for housing reconstruction across different disaster recovery environments</td>
<td><em>Representative of relatively developed countries</em></td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td>2009 Victorian ‘Black Saturday’ bushfires</td>
<td>State of Victoria:</td>
<td>• August 2009</td>
<td><em>More market-led disaster recovery and reconstruction</em></td>
<td><em>Fire-resistance timber frame house rebuilding</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Marysville • Kinglake • Flowerdale Case site:</td>
<td>• July 2010</td>
<td><em>Speedy urbanisation progress</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marysville</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1) Case 1: The 2004 Indian Ocean tsunami in Aceh, Indonesia

The Indian Ocean tsunami occurred on the Boxing Day of 2004 and is one of the most devastating disasters in the world. The tsunami directly affected 11 countries, killing up to 300,000 people and displacing over one million people. The closest land mass to the earthquake epicentre was the Province of Aceh, the northern part of the Indonesian island of Sumatra. Aceh experienced the full force of the tsunami. The scale of the devastation prompted an unparalleled outpouring of global sympathy, leading to unprecedented donor commitments of over US$13 billion to assist the reconstruction effort (Telford et al., 2006; World Bank, 2007). There has been a diversity of different agents for housing reconstruction, including communities, political actors, government authorities, representative of religious groups, local NGOs and international NGOs. The rebuilding of houses and neighbourhoods has been a major reconstruction effort, led by large-scale NGOs.

Between March and June 2008, as part of a structural consultancy team to CARE International, the researcher was tasked with post-tsunami housing seismic assessment in Banda Aceh, Indonesia. The researcher therefore gained the opportunity to interact with a range of key recovery stakeholders such as governmental officials, construction professionals and donor representatives engaged in post-Indian Ocean tsunami housing reconstruction in Aceh. An in-depth investigation of the resourcing for post-tsunami housing recovery was conducted. Despite the particularities of the Aceh housing rebuilding, there are numerous lessons that are applicable to responses to future complex humanitarian emergencies.

2) Case 2: The 2008 Wenchuan earthquake in Sichuan, China

A magnitude (M) 8.0 earthquake struck the Province of Sichuan of China and its neighbours on May 12, 2008. The Wenchuan earthquake, as it is commonly known, killed 69,266 people, injured 374,643 people and left 17,923 people missing, and led to widespread destruction of buildings and infrastructure. 417 counties including cities and districts in China’s ten provinces were affected. In the aftermath of the earthquake, the civil society organizations and INGOs

---

4 M 8.0 represents surface wave magnitude (Ms), the national standard used by the Government of China. M7.9 in United States Geological Survey (USGS) reports represents moment magnitude (Mw).

5 As of noon on 11 September 2008
played a role in relief and reconstruction for the first time in China’s disaster reconstruction history (Teets, 2009). However, as also observed by a few scholars such as Dunford and Li (2011), the reconstruction program in China remains government-driven, reflecting the nature of a centralized administrative system.

The openness in China in the wake of the earthquake, however, allowed the researcher to undertake a series of field trips to the earthquake impacted areas. With vast assistance from the local government and universities, the researcher was able to access grounded information and conduct a substantial investigation on resourcing for post-earthquake housing recovery in China. The case study of the Wenchuan earthquake highlighted the resourcing problems that confront disaster reconstruction planners and practitioners following a major disaster. Examination of the Wenchuan earthquake housing recovery process can also help extend many of these findings in a way that is relevant to the perspectives of planners and project managers operating in the built environment.

3) Case 3: The 2009 ‘Black Saturday’ bushfires in Victoria, Australia

On Saturday February 7, 2009, the State of Victoria experienced deadly bushfires. This ‘Black Saturday’ disaster devastated approximately 80 communities, affected 6000 households, destroyed more than 2000 homes, and damaged 430,000 hectares of land across the State. By the time the fires were contained, 173 people had died and many others were seriously injured (VBBRA, 2009). While the emergency response and relief services were activated immediately after the fires, the task of recovery and reconstruction was complex.

Despite the institutions and procedures set up in place for expediting community recovery, housing reconstruction proceeded slowly, particularly in the worst affected Shire of Murrindindi. Difficulties in sourcing building materials and professionals were impediments to rebuilding across the Murrindindi shire. This event, therefore, offered an unusual opportunity for the researcher to assess the resourcing approach in Australia during its recovery from the bushfires. In August 2009 and July 2010 respectively, the researcher undertook field trips to the bushfire zone in Victoria. The researcher undertook a ground survey, assessing the resourcing problems by using the same research instruments as used in Indonesia and China. The research findings
from this case study, however, can also translate into lessons for the communities in other countries with similar contexts when they attempt to recover from disasters.

It is against this backdrop that the three disaster events were purposefully selected as cases under study in this research. The sample is not random but reflects the selection of specific cases to extend the theory to a broader range of contexts. Resource availability is dynamic and changing over time during a recovery period. Anecdotal evidence shows that resourcing difficulties often emerge immediately after a major disaster when the reconstruction demands exceed existing capacity of resource supply. As recovery proceeds, resourcing may not be an issue when an increased resource supply catches up with decreased demand. Therefore, the research data in each examined case study were collected by the time when there was a ‘resource crisis’ following a disaster. This research is intimately tied with ongoing evidence in the field and directed toward the development of generalizable lessons and experiences across settings.

4.4.2.2 Case study chapter structure

The organization of multiple case study chapters will be in line with the five key elements in the resource availability analytical framework, namely: post-disaster recovery and reconstruction environment, housing recovery approach, resourcing stakeholders for housing recovery, ‘indicator resources’ and their availability, critical factors that affect resource availability for housing recovery projects. The presentation of the case study research findings against those five areas are structured into the following three chapters: Chapter Five, Chapter Six and Chapter Seven. The literature review regarding disaster management framework in countries of Indonesia, China and Australia in Chapter two will also be referred to as background data included in the element of post-disaster recovery and reconstruction environment. The linkages between the predominant disaster theories and concepts such as ‘vulnerability’ and ‘resilience’, ‘build back better’, as shown in the literature review chapters and the relevant case descriptions will also be presented in the case study chapters.

The resource availability analytical framework also serves as a basis for conducting comparative discussion across three cases in Chapter Eight. By comparing the five elements, the focus of Chapter Eight is on illustrating the variations and similarities with respect to resource availability for post-disaster housing reconstruction. Therefore, a feedback loop is needed, as shown with the
dotted lines in the following Figure 4.5, with a review to refining and validating the original resource availability framework. Based on resource availability framework, the way of arranging individual case study chapters, along with a chapter for holistic cross comparison, is presented in Figure 4.5.

Figure 4.5 Case study chapter structure in the research, in line with Yin (2003, p.50)

4.4.3 Questionnaire survey within case studies

The questionnaire survey in this research study was used for the purpose of identifying specific housing recovery approach, ‘indicator resources’, and critical factors that affected resource availability in housing recovery projects in each single case. A survey design provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell, 2003). The questionnaire in this study was designed as an opinion survey with the majority of the questions in the form of Ordinal and Likert scales to identify the critical resource availability factors. There were also open ended questions which
permitted the participants to give opinions on types of housing recovery approach, the perceived ‘indicator resources’, and their availability. The following sections outline how the questionnaire survey was designed and conducted in three cases.

4.4.3.1 Design of questionnaire instrument

Questionnaire design can take many different forms. However, the concept behind the development of a questionnaire is that all respondents should have a comparable understanding of the questions so that the responses accurately reflect the views of all the respondents to a particular issue (McMurray et al., 2004). Through literature review in Chapter Three, a catalogue of 33 attributes in Table 3.10 that are likely to have an impact on resource availability was presented in form of a questionnaire. By using the content analysis method\(^6\) (Krippendorff, 1980), these factors were grouped into five major headings: construction market-related factors, transportation-related factors, reconstruction project-related factors, project stakeholders’ related factors and operational environment-related factors. Reliability of the preliminary questionnaire was achieved by conducting a pilot test of the questionnaire.

1) Pilot study

Prior to any questionnaire survey, a pilot study was conducted in each case to supplement the catalogue of factors in the questionnaire and enhance its suitability to the targeted survey area. The summary of pilot study details is tabulated in Table 4.7. A pilot study was first conducted in March 2008 in Banda Aceh, Indonesia. The researcher consulted with three experienced construction coordinators involved in post-tsunami housing reconstruction. Four additional factors, including pre-existing market structure, contractor inventory, supplier inventory, and community influence and participation were proposed by the informants to be incorporated in the questionnaire. A total of 37 factors extracted from both literature and the pilot study were designed into the questionnaire and minor amendments were made to remove any discrepancies. The revised questionnaire was then provided to the former pilot study participants and a concerted approval was gained for the use of questionnaire.

\(^6\) Content analysis consists of the examination of textual materials such as articles, memos, transcripts of discussions, and business documents, as well as audio and videotaped recordings of interactions. Content analysis in this research is used to categorize themes.
Table 4.7 Summary of pilot study details in three case studies

<table>
<thead>
<tr>
<th>Pilot study site</th>
<th>Time</th>
<th>Form</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banda Aceh, Indonesia</td>
<td>March 2008</td>
<td>Face to face interviews</td>
<td>3 experienced construction coordinators in tsunami reconstruction involved NGOs</td>
</tr>
<tr>
<td>Chengdu, China</td>
<td>December 2008</td>
<td>Face to face interviews</td>
<td>2 academic researchers at Sichuan University, 3 project managers in resource procurement for earthquake rebuilding</td>
</tr>
<tr>
<td>Melbourne, Australia</td>
<td>May 2010</td>
<td>Telephone interviews Email correspondence</td>
<td>4 project managers from VBRRA 1 researcher from the Bushfire Cooperative Research Centre</td>
</tr>
</tbody>
</table>

A pilot survey in the case of the Wenchuan earthquake was conducted in December 2008 by consulting two academic researchers in reconstruction procurement at Sichuan University, and three project managers involved in post-Wenchuan earthquake rebuilding projects. The Chinese translation of the questionnaire used in the case of the 2004 Indian Ocean tsunami was provided to these five informants for comments. Given China’s specific context, the respondents recommended the removal of two factors, namely, ‘social and political stability’, and ‘local housing culture and customs’ from the questionnaire, and the addition of one factor ‘social public attitude’. The factor ‘community participation and influence’ was also suggested to be replaced with ‘community influence’. Other wordings were also modified accordingly. A total of 37 factors generated from the literature and pilot study were included into the questionnaire to be used in the case study.

In a similar manner, the questionnaire used for the case of the 2004 Indian Ocean tsunami in Indonesia was tested in pilot study in Australia. In May 2010, via telephones and emails, the researcher consulted four experienced project managers from the Victorian Bushfire Recovery and Reconstruction Authority (VBRRA) involved in post-bushfire housing reconstruction and one researcher from the Bushfire Cooperative Research Centre (CRC) in Australia. Variations were made to the questionnaire as some of the questions apply to the specific post-bushfire
situation in Australia. A total of 32 factors extracted from both previous literature and the pilot study were incorporated into the final questionnaire protocol to be used in the bushfire case study.

2) **Components of the questionnaire**

The survey instrument in the present research contains three main components: background questions, open questions, and closed questions. The questionnaires used for the three cases are presented in Appendix 2. The questionnaire was designed in each case as a generic instrument so that the same questionnaire was administered to all irrespective of the different types of participants. It was therefore necessary to collect demographic data and other useful information to assist with categorizing the responses. The questionnaire in each case begins with background questions to gather demographic data on the participants.

Open format questions are those that ask for unprompted opinions (Leedy and Ormrod, 2010). In other words, there are no predetermined set of responses, and the participant is free to answer however he/she chooses. Open format questions are used in research questionnaire for soliciting subjective data on housing recovery and reconstruction approach and ‘indicator resources’ because the range of responses is not tightly defined. This increases the likelihood of receiving unexpected and insightful perceptions and perspectives to increase the full range of opinion. The questionnaire also ends with the open format questions asking the respondent for opinions of improvements with respect to resourcing issue in each case.

The majority of the questionnaire contains the closed format questions in the form of a Likert scale in Chinese questionnaire or ranking scale in Indonesian and Australian questionnaire. This type of questions allows the researcher to filter out useless or extreme answers that might occur in an open format question (Sekaran, 2003). In the questionnaires used for examining cases of Indonesia and Australia, the respondents were asked to rank the top 5 factors under each category. In the questionnaire for use in China, the design of closed questions in this regards was different. 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’. In spite of the difference in design and layout of questionnaires used in the three studied cases, the way of organizing these questions still served for the same purpose — statistically calculating the perceived importance of each factor. By restricting the answer set in
closed format, it is easy to calculate percentages and other statistical data over the whole group of participants.

4.4.3.3 Sample selection

There are three options for sample selection in a research survey — random, non-probability, and purposive sample. According to Creswell (2003), with randomization, a representative sample from a population provides the ability to generalize to a population. Less desirable is a non-probability sample or convenience sample, in which respondents are chosen based on their convenience and availability (Babbie, 1990). However, in this research, the sample selection is in accordance with the informants’ experience and knowledge in project resourcing and their role in disaster recovery. Therefore, the samples selected can be seen as purposive samples which are between randomization and non-probability. The reasons for non-random selection of survey populations lie in the following three aspects.

1) **Varied resourcing stakeholders in each case**: as shown in Chapter Three, resourcing stakeholders may play different roles across varied the disaster recovery and reconstruction environments. It is likely that the resourcing issues and solutions in the three countries may be contextually specific. Therefore, it is impossible to apply a generic sample design and selection to three cases. The identification of key resourcing stakeholders in each disaster recovery context is therefore important. In this sense, the survey needs to be targeted to capture the empirical insights of those who involved in disaster recovery resourcing practice.

2) **Exploratory nature of the research**: with purposive samples, the sampling units are selected subjectively by the researcher to obtain a sample that appears to be representative of the population (Frankfort-Nachmias and Nachmias, 1992). The major reason for this purposive sample selection is that the current research is exploratory. Each disaster is unique, as well as its recovery and reconstruction environment after the disaster. Therefore, the resourcing issue in a disaster recovery situation can be only understood when the researcher approaches the issue-involved informants. The sample selection strategy adopted by the researcher was to approach the main disaster recovery
and reconstruction agency in each examined case. The snow ball sample can be developed through the recommendation and facilitation of these responsible agencies.

3) **Limited sample size for the examined topic**: The sample size in this research is determined by the representativeness of the selected population. Data accessibility in disaster fields, however, as mentioned earlier, has constrained the likelihood of obtaining a large sampling unit. The essential requirement of any sample is that it is as representative as possible of the population from which it is drawn (Punch, 1998; Neuman, 2000). Therefore, by consulting the local recovery and reconstruction agency, the sample size in this research, although limited, but contribute to the representativeness of the main resourcing stakeholders in each studied recovery situation.

Following the 2004 Indian Ocean tsunami, the international donors had played a large part in housing recovery and reconstruction in Aceh, Indonesia. Therefore, the researcher first interacted with a number of representatives from NGOs involved tsunami reconstruction and obtained a preliminary list of potential sample population. Subsequently, by consulting the local recovery and reconstruction authority BRR, the selected sample for questionnaire was confirmed comprising 16 participants representing the international aid agencies and 4 recovery managers from BRR office in Banda Aceh.

In China, the construction professionals such as contractors and builders were charged with rebuilding houses for earthquake affected communities. Through assistance from the local university, the researcher gained opportunity to approach the Construction Bureau of People’s Government of Mianzhu which was in charge of post-earthquake reconstruction work in the affected Mianzhu administrative region. A potential sample list was recommended, including 16 building professionals registered with Construction Bureau of People’s Government of Mianzhu and 5 government officials from other relevant departments. In addition, five academic personnel in construction sustainability and procurement were also selected into the questionnaire sample, given their extensive knowledge and involvement in the Wenchuan earthquake reconstruction.

A snowball sample of 22 questionnaire informants was developed by consulting the VBRRRA in Victoria, Australia. A total of 4 rebuilding advisors and 1 rebuilding manager in VBRRRA were involved in bushfire housing recovery and reconstruction. These 5 key informants suggested
other potential informants who could be included in the sample. Apart from the representatives from the local government, the development and regulatory agencies, and the professional bodies, the selected sample in Australia also included representatives from trade associations and the relevant trade unions, who had participated in the Victorian bushfire recovery and reconstruction. The following Table 4.8 outlines the basic profile of the respondents who participated in the questionnaire surveys.

Table 4.8 Summary of the information on questionnaire respondents

<table>
<thead>
<tr>
<th>Country</th>
<th>Survey time</th>
<th>City</th>
<th>Questionnaire respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>March-May 2008</td>
<td>Banda Aceh</td>
<td>• 12 project managers from 6 NGOs(^1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 4 donor representatives/reconstruction coordinators</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 4 governmental officials from BRR(^2)</td>
</tr>
<tr>
<td>China</td>
<td>Dec.2008-Feb. 2009</td>
<td>Mianzhu</td>
<td>• 16 construction managers and project managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 5 academic researchers in construction sustainability and procurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 5 governmental officials in disaster recovery</td>
</tr>
<tr>
<td>Australia</td>
<td>June-July 2010</td>
<td>Marysville</td>
<td>• 1 rebuilding manager and 4 rebuilding advisors from VBRA(^3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kinglake</td>
<td>• 5 governmental officials from VBRA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 6 volume builders</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 4 construction material and product manufacturers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 officials from Building Commission</td>
</tr>
</tbody>
</table>

Note: 1. IFRC, CARE, Canadian Red Cross, UNDP, Australian Red Cross, and British Red Cross
2. BRR is the Agency for Rehabilitation and Reconstruction for Aceh and Nias in Indonesia
3. VBRA is the Victorian Bushfires Recovery and Reconstruction Authority in Australia

The questionnaires were sent by personal delivery during the field trip or by email and post prior to or after the field trips, together with a covering letter explaining the purpose of the study and informing the anonymity. 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 May 2008. Similarly, 26 questionnaire surveys in China were conducted between December 2008 and February 2009 with the professionals engaged in post-Wenchuan earthquake reconstruction in Sichuan Province. The questionnaire survey in Australia was
conducted with 18 respondents between June and July 2010. Prior to the survey, each potential participant was advised by the researchers to subscribe the Participant Consent Form through which a number of the interviewees chose to be unidentified by the name, gender, position and status.

4.4.3.4 Questionnaire data analysis

Based on the questionnaire responses, statistical analysis was used to determine the key factors affecting resource availability in post-disaster reconstruction situations. The mean ranking techniques and descriptive methods (Triola, 2008), were used to analyze the questionnaire responses. When analyzing the survey data collected from the Indonesian and Australian 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.

In comparison, the data processing in China’s case was undertaken by using descriptive t-test in SPSS, due to the varied questionnaire design. The significance of factors was ranked in terms of their respective mean. The results of data analysis in terms of the significance of factors generated from the questionnaire surveys in the three cases are tabulated in Appendix 3. The questionnaire results and discussion in the three cases will be presented in the case study chapters respectively.

4.4.4 Field-based observations and interviews

As mentioned earlier, field-based observations and interviews are the major data collection methods in carrying out case studies. Due to their empirical nature, on-site observations and interviews are important for disaster recovery-related research. These two methods were also used to supplement and validate the questionnaire results. This is the essence of triangulation that consistent findings among different data collection methods increase the credibility of research findings (Frankfort-Nachmias and Nachmias, 1992). This section outlines the use of field-based observations and interviews.
4.4.4.1 Field observation

Social science is rooted in observation (Neuman, 2000). According to Yin (2003), direct observations can partially overcome the deficiencies of artificiality that other interactive research methods such as interviews and questionnaire introduced. By making a series of field visits to the case study site, this research has created considerable opportunities for direct observations. An observational protocol was used to examine post-disaster reconstruction and recovery environment, housing recovery approach, resourcing stakeholders, and ‘indicator resources’ and their availability. These observational evidences, however, were captured with assistance of photographs. Other tools such as diary, notes, and narrative records, videotape and audio records were used under a varied circumstance during the observational process.

In addition to the direct observations in Banda Aceh, participant observation was also applied by the researcher between March and June 2008. By working with CARE International in Banda Aceh, the researcher was able to access the rebuilding sites and other implementing agencies for a ‘real-world’ resourcing investigation. A solid database for the case study of the Indian Ocean tsunami housing recovery and reconstruction was thus established, incorporating both direct observations and participant observations. A more precise understanding of the post-tsunami housing recovery and reconstruction in Indonesia was developed over the three month time.

4.4.4.2 Interviews within case studies

In this present research, interview serves as the most fundamental tool in gathering data within case studies. In line with Wilson (1996)’s classification, there are three major interview techniques, namely, face to face interview, telephone interview, focus group interview. Face to face interview method was used in this research during each field visit. A focus group interview was adopted in the case of the Wenchuan earthquake in China. The Figure 4.6 below shows how the interview method was applied to complement other main research methods such as field observation and questionnaire survey in this research.
1) **Design of interview instruments**

Interviewing acts as a valuable way of gaining an in-depth description of actions and events in this research. According to Maxwell (2005), interviews can provide additional information that was missed in observation, and can be used to check the accuracy of the observations and validity of questionnaire responses. Therefore, the interviews in this research were used for three main purposes: 1) to increase the understanding of the elements in resource availability analytical framework through gaining perspectives from the main resourcing stakeholders; 2) to identify the relationships between recognized critical factors that affected resource availability in disaster housing recovery, and validate questionnaire findings; and 3) to derive insights on possible solutions for improvement in the resourcing practice in varied recovery environments. Due to different purposes, the interview questions used for three cases also vary.

Generally, the interview questions were developed based on the research questions and objectives. Therefore, the question list in this research comprises five themes as presented in the resource availability analytical framework, including post-disaster recovery and reconstruction environment, housing recovery approach, resourcing stakeholders, ‘indicator resources’ and their availability, and critical factors that affected resource availability in housing recovery. The
interview instruments included both unstructured and semi-structured questions, and were intended to elicit views and opinions from the participants. The interview instruments used in the three case studies are included in Appendix 4.

Significant variations were applied to different interview instruments that took place at different times in each case study. The interview questions for the case studies were first tested in Auckland with ‘Resilient Organisations’ post-disaster reconstruction researchers in February 2008. Based on the feedback, the questions were modified and adapted to the Banda Aceh housing recovery case study. The questions were asked during the field trip in Indonesia between March and June of 2008, and were modified slightly, depending on the position and perspective of each respondent. For instance, some questions were made more specific about particular housing stakeholders, such as BRR and NGOs, or particular housing programs in which the respondent might be involved. The questions were modified and adapted for the use in case study in China and Australia. Table 4.9 lists the purposes, time, and data collected in interviews within three case studies. The main themes of questions in Table 4.9 are the basic and generic questions, modified somewhat depending on the person being interviewed and the amount of information already collected prior to the interview.
<table>
<thead>
<tr>
<th>Time and place</th>
<th>Interviewees</th>
<th>Themes of data collected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case study 1: 2004 Indian Ocean tsunami in Indonesia</strong></td>
<td><strong>March-June 2008 Banda Aceh</strong>&lt;br&gt;• 12 project managers from 6 NGOs (P1-P12)&lt;br&gt;• 4 donor representatives/reconstruction coordinators (Co1-Co4)&lt;br&gt;• 4 governmental officials from BRR (BRR1-4)</td>
<td>• Comments and explanation of the questionnaire response  &lt;br&gt;• Pre-existing and post-disaster problems and challenges to resource procurement  &lt;br&gt;• Initiatives adopted to improve resource availability for reconstruction projects  &lt;br&gt;• Likely measures and alternatives to address the resourcing constraints</td>
</tr>
<tr>
<td><strong>Case study 2: 2008 Wenchuan earthquake in China</strong></td>
<td><strong>June, 2008 Mianzhu, Chengdu</strong>&lt;br&gt;• 4 academic researchers from Sichuan University (RSU1-4)&lt;br&gt;• 2 governmental officials from Wenchuan earthquake Relief Headquarters (WRH1-2)&lt;br&gt;• 8 Earthquake relief officers (ER 1-22)</td>
<td>• Disaster impacts and resilience of the affected communities  &lt;br&gt;• Post-disaster recovery policies and government measures  &lt;br&gt;• Expectations from the involved agencies regarding housing recovery</td>
</tr>
<tr>
<td></td>
<td><strong>Dec. 08-Jan. 09 Dujiangyan, Chengdu, Mianzhu, Beichuan</strong>&lt;br&gt;• 16 construction contractors (C1-C16)&lt;br&gt;• 5 academic researchers (R1-R5)&lt;br&gt;• 5 governmental officials (G1-G5)</td>
<td><strong>Same as the case of Indonesia</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Jun.-Jul. 2009 Mianzhu</strong>&lt;br&gt;• 4 governmental officials (GO1-4)&lt;br&gt;• 6 earthquake housing rebuilding contractors (RC1-6)&lt;br&gt;• 2 academic researchers (AR1-2)&lt;br&gt;• 6 community representatives (CR1-6)</td>
<td>• Housing recovery and reconstruction progress  &lt;br&gt;• Issues emerging during the recovery process</td>
</tr>
<tr>
<td>Date</td>
<td>Location</td>
<td>Participants</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Feb. 2010  | Wenchuan, Mianzhu, Lixian         | • 10 governmental officials from three counties (GC1-10)                    | • Assessment of post-earthquake housing rebuilding performance  
• Retrospective review of effectiveness of measures that were applied to solve the resourcing issues and challenges  
• Overall expert judgement of the research findings within Chinese case study |
|            |                                   | • 4 academic researchers (A1-4)                                              |                                                                                                                                           |
|            |                                   | • 2 large retailers for building materials and products (BM1-2)               |                                                                                                                                           |
|            |                                   | • 4 earthquake housing rebuilding contractors (EB1-4)                        |                                                                                                                                           |
| Case study 3: 2009 Victorian ‘Black Saturday’ bushfires in Australia |                                   |                                                                                                                                           |
| August 2009| Melbourne, Marysville, Flowerdale, Kinglake | • 8 governmental officials (V1-V8)                                          | • Pre-existing and post-disaster problems and challenges to resource procurement  
• Initiatives adopted to improve resource availability for reconstruction projects  
• Emerging issues that are likely to affect post-bushfire housing recovery |
|            |                                   | • 2 academics from CRC and 2 researchers from RMIT (A1-A4)                  |                                                                                                                                           |
|            |                                   | • 3 contractor company representatives (Cr1-Cr3)                            |                                                                                                                                           |
| July 2010  | Melbourne, Marysville, Kinglake   | • 1 rebuilding manager (Rm1) and 4 rebuilding advisors from VBRRRA (Ra1-Ra4) | • Comments and explanation of the questionnaire response  
• Examples of resourcing problems and difficulties  
• Assessment of housing recovery progress and performance  
• Suggestions about possible solutions for addressing the resource constraints found in the Australia’s bushfire housing recovery |
|            |                                   | • 5 governmental officials from VBRRRA (Vo1-Vo5)                            |                                                                                                                                           |
|            |                                   | • 6 volume builders (B1-B6)                                                 |                                                                                                                                           |
|            |                                   | • 2 officials from DHS (D1-D2)                                               |                                                                                                                                           |
|            |                                   | • 1 official from Murrindindi Shire Council (C1)                             |                                                                                                                                           |
|            |                                   | • 4 construction material and product manufacturers (M1-M4)                 |                                                                                                                                           |
|            |                                   | • 2 officials from Building Commission (Bc1-Bc2)                            |                                                                                                                                           |
|            |                                   | • 2 Community representative (Cr1-Cr2)                                      |                                                                                                                                           |
2) Selection of interview participants

The selection of the participants to the interviews is similar to the way of selecting respondents to the questionnaire survey. The potential participant’s relevant knowledge, experience and roles in the resourcing practice in disaster recovery are the major considerations in selecting the interviewees. Well-informed respondents can provide important insights into a situation under investigation (Yin, 2003). Creswell (2003) proposed that the idea behind a qualitative research is to purposefully select participants or sites that will best help the researcher understand the problem and the research questions. Apart from the above considerations, in this research, the selection of interviewees was also determined by the willingness and availability of the potential interviewees, which was indicated when they participated in the questionnaire survey.

The majority of the questionnaire respondents, therefore, constituted the sample of the following interviews. There were also a number of interviews that took place without the application of questionnaires. During interviews, the researcher mainly recorded information using handwritten notes, and digital audio recording. Specifically, as alluded to earlier, a focus group of twelve contractor representatives in Mianzhu city was also conducted in December 2008 in China. Focus group is a small group discussion focused on a particular topic (Seale, 2004). Equal to the method of interviews, this focus group helped validate the questionnaire findings. The basic profile of the interviewees in this research is also listed in Table 4.9. Each interviewee was allocated a code for the purpose of convenience of quotation in this dissertation.

3) Interview data analysis

The data collected in the interviews are independently sampled, it rules out correlations across different observations and time periods when pooling data of multiple time points (Wooldridge, 2003). The first step of interview data analysis is reading the interview notes and transcribing the audio records into texted information (Emerson et al., 1995). Following each interview, the transcription of all the audio data was undertaken by the researcher. After the systematic transcription, at this point, according to Maxwell (2005), there are a number of analytical options which fall into three main groups: 1) memos, 2) categorizing strategies such as coding and thematic analysis, and 3) connecting strategies such as narrative analysis.
In this research, all the transcribed interview data, along with other qualitative data such as observational notes, and audiovisual data were coded and analyzed by using NVivo 8 qualitative data analysis software. NVivo is computer software for qualitative data analysis, produced by QSR International. It is designed for researchers to work with rich text-based and/or multimedia information, where deep levels of analysis on small or large volumes of data are required (QSR International, 2007). Due to the distinctive benefits of using NVivo, in the end of 2009, the researcher participated in two workshops on the application of this qualitative data analysis software. Through NVivo 8 coding comparison of queries, similar comments and quotations from interviewees under the same question were analyzed and synthesized on computer. A NVivo qualitative database for this research was established.

4.4.5 Research workshops and conferences events

Apart from the main research methods used for data gathering, as discussed in the preceding sections, the researcher attended a number of workshop and conference events that were related to the research problem. This section summarizes these research efforts made to facilitate the accomplishment of this dissertation.

4.4.5.1 Research-related conference events and presentation

During the period of PhD study, the researcher had taken part in a wide variety of research-related activities such as seminars, workshops, and conferences, all of which provided the valuable opportunity to advance the research progress. Meanwhile, information provided by other event attendees helped guide the focus of the research, inspire the possible research methods, and develop research directions. The list of main research events the researcher had attended is tabulated in Table 4.10.

Following the first field trip to the Wenchuan earthquake zone, the researcher presented the research findings with respect to the earthquake response and recovery in China to the related practitioners from MCDEM in Wellington in September 2008. During the conference, however, a few practitioners posed questions with regard to the relevance of the lessons learned from China to the context of New Zealand and some other countries. Those questions and concerns, to a great extent, helped the researcher to develop a comparative analysis across multiple cases, and also helped to justify the generalizability of the findings in this research.
Table 4.10 Research related conference events and presentations

<table>
<thead>
<tr>
<th>Date</th>
<th>Conference</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 18, 2008</td>
<td>Joint Workshop on Community Resilience between the ‘Ministry of Civil Defence and Emergency Management’ (MCDEM) and ‘Resilient Organisations’</td>
<td>Overview of Policies on Post-Wenchuan Earthquake Relief and Reconstruction</td>
</tr>
<tr>
<td>November 26-28, 2008</td>
<td>The 3rd Asia-Oceania Top University League on Engineering (AOTULE) Postgraduate Conference, The University of Auckland, New Zealand</td>
<td>Resource Availability for Post-disaster Reconstruction</td>
</tr>
<tr>
<td>December 9, 2009</td>
<td>‘Resilient Organisations’ Steering Committee Annual Meeting</td>
<td>Longitudinal field work in China: Post-Wenchuan earthquake reconstruction</td>
</tr>
<tr>
<td>January 19, 2010</td>
<td>Joint Workshop on Research Summary between OPUS New Zealand and ‘Resilient Organisations’</td>
<td>Wenchuan Earthquake Reconstruction in China</td>
</tr>
<tr>
<td>May 10-13, 2010</td>
<td>CIB World Congress 2010 ‘Building a Better World’. Manchester, UK.</td>
<td>Paper: ‘Interpreting resourcing bottlenecks of post-earthquake reconstruction in China’ was included in the CIB proceedings</td>
</tr>
<tr>
<td>September 2-3, 2010</td>
<td>COBRA2010, RICS International Research Conference, Paris, France</td>
<td>Resources and capacity: lessons learned from post-disaster reconstruction resourcing in Indonesia, China and Australia (This presentation was given by the research leader from the Resilient Organisations)</td>
</tr>
</tbody>
</table>

In November 2008, the literature review regarding the post-disaster resource availability framework was presented by the researcher in AOTULE Conference during the first year of this research. Responses from the conference audience suggested other relevant literature and documents which were subsequently included into the current thesis. By presenting the research findings from both Indonesian and Chinese case studies, comments from the conference attendees allowed the researcher to frame research strategies and methods more suitable for the
176 case of Australia. The insights provided by a number of the event attendees helped guide the following field trips for data collection and analysis.

4.4.5.2 Disaster and hazard related workshops and seminars

Besides the conference events the researcher had participated in, there were a number of beneficial workshops and seminars organized by the government and industry. The full list of these workshops and seminars the researcher had attended is presented below in Table 4.11.

Table 4.11 Workshops and seminars attended by the researcher during the research

<table>
<thead>
<tr>
<th>Date</th>
<th>Venue</th>
<th>Workshop &amp; Seminar</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 30, 2008</td>
<td>Changsha, China</td>
<td>Joint Seminar on Engineering Management and Disaster Management (University of Auckland, New Zealand and Central South University, China)</td>
</tr>
<tr>
<td>October 7, 2008</td>
<td>Wellington, NZ</td>
<td>New Zealand National Lifelines Forum 2008</td>
</tr>
<tr>
<td>February 16-18, 2009</td>
<td>Flock Hill, Canterbury, NZ</td>
<td>‘Resilient Organisations’ research retreat</td>
</tr>
<tr>
<td>April 28, 2009</td>
<td>Auckland, NZ</td>
<td>New Zealand Society for Earthquake Engineering Learning from Earthquakes: The Wenchuan Earthquake in China</td>
</tr>
<tr>
<td>May 1, 2009</td>
<td>Auckland, NZ</td>
<td>Auckland Engineering Lifelines Group Breakfast Seminar</td>
</tr>
<tr>
<td>July 13-22, 2009</td>
<td>Beijing, China</td>
<td>Summer School of International Project Management at Tsinghua University</td>
</tr>
<tr>
<td>August 5-7, 2009</td>
<td>Melbourne, Australia</td>
<td>3rd Australasian Hazards Management Workshop Series 2009: From warnings to effective response and recovery</td>
</tr>
<tr>
<td>July 14-16, 2010</td>
<td>Melbourne, Australia</td>
<td>Australasian Universities Building Education Association (AUBEA) 35th Annual Conference: Construction Management</td>
</tr>
<tr>
<td>August 17, 2010</td>
<td>Auckland, NZ</td>
<td>New Zealand Society for Risk Management lunchtime seminar series: Regional infrastructure resilience in floods &amp; earthquakes - A scenario-based approach</td>
</tr>
<tr>
<td>September 28, 2010</td>
<td>Christchurch, NZ</td>
<td>Recovery best practice: A national and international perspective – Seminar for those involved in the recovery effort</td>
</tr>
<tr>
<td>November 10, 2010</td>
<td>Christchurch, NZ</td>
<td>‘Resilient Organisations’ Research Strategy Workshop</td>
</tr>
</tbody>
</table>
At the beginning of this study, the researcher attended the New Zealand National Lifelines Forum in October 2008. The issues regarding the vulnerabilities of infrastructure facilities to natural disasters that were discussed at the forum helped guide the research direction. The forum brought together experts and practitioners from various agencies across New Zealand. The brainstorming discussion during the sessions identified the recovery challenges that decision makers and practitioners may face if a large-scale natural disaster strikes. Potential resource constraints following a major disaster were touched on during the forum. This intrigued the researcher to look at the resourcing issue for post-disaster recovery and reconstruction in the current research.

The workshops and seminars held in New Zealand and offshore in Australia, as shown in Table 4.11, covered extensive issues in disaster theory and practice. For instance, the third Australasian Hazards Management Workshop Series 2009 workshops in Melbourne raised two globally significant challenges/themes in disaster-prone countries, namely 1) enhancing community’s resilience, and 2) disaster risk reduction. The insights and perspectives from practitioners in these areas were valuable inputs that contributed to the present research. Other seminar series that were held in New Zealand also served as a platform bringing together emergency managers, planners, natural hazards researchers and scientists. The issues raised during the seminar sessions had enabled the researcher to identify the knowledge gap between the research and industry and consider potential future research directions.

Moreover, the ‘Resilient Organisations’ research retreat helped trigger thought and provoking discussion about what resilience is and how best to achieve it during post-disaster recovery and reconstruction. The Summer School of International Project Management at Tsinghua University in 2009 provided an unusual opportunity for the researcher to learn about the state-of-the-art knowledge on construction project management. The reconstruction challenges that a large-scale disaster is likely to pose to the project managers were also recognized through the school sessions. All the thoughts and ideas from a variety of research events in forms of workshops and seminars, to a large extent, contributed to the knowledge base presented in this dissertation.
4.5 Relevant issues with research design

The research study has involved a diversity of research methods and procedures. There are two concerns emerged during the design of the research: 1) the reliability and validity of the research, 2) limitations of using case study methods, and 3) cross cultural comparison. Although validation of findings occurs throughout the steps in the process of research, this section singles it out in order to emphasize the importance of validation in this research. The following outlines the strategies applied to address the above two issues for arriving at a robust research design.

4.5.1 Reliability and validity of research

4.5.1.1 The quality of case study design

Bryman (2008) proposed four tests to establish the quality of a empirical social research: construct validity, internal validity, external validity, and reliability. Kidder and Judd (1986, p.26-29) defined the four tests to social science methods as follows.

1) Construct validity: establishing correct operational measures for the concepts being studied.

2) Internal validity: establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.

3) External validity: establishing the domain to which a study’s findings can be generated.

4) Reliability: demonstrating that the operations of a study — such as the data collection procedures — can be repeated, with the same results.

By drawing on these four tests, Yin (2003, p.34) proposed a list, as shown in Table 4.12 below, to judge the quality of case study research design. This research can also use these four tests to assess the quality of case study research design. Table 4.12 illustrates how the four tests were used in this research to ensure validity.
Table 4.12 Case study tactics for four design tests in the research

<table>
<thead>
<tr>
<th>Tests</th>
<th>Case study tactic</th>
<th>Phase of research in which tactic occurs</th>
<th>Links to the current research</th>
</tr>
</thead>
</table>
| **Construct validity** | Use multiple sources of evidence                          | Data collection                          | • Section 4.3.2 Data gathering for case studies  
• Multiple sources used as summarized in Table 4.3 and Table 4.4 |
|                    | Establish chain of evidence                               | Data collection                          | Chain of evidence established on a basis of research questions and objectives, as summarized in Table 4.3 and Table 4.4 |
|                    | Have key informants review draft case study report         | Composition                              | Individual case study report reviewed by key informants and published in papers |
| **Internal validity** | Do pattern-matching                                       | Data analysis                            | Matching with five elements of the resource availability framework                        |
|                    | Do explanation-building                                   | Data analysis                            | Combining observations, interviews and documents to explain the researched topic, as summarized in Table 4.3 |
|                    | Address rival explanations                                | Data analysis                            | Involvement of key informants in justification of the research findings |
|                    | Use logic models                                          | Data analysis                            | Using NVivo qualitative data analysis with the logic structure from the resource availability framework |
| **External validity** | Use theory in single-case studies                         | Research design                          | Resource availability framework guiding the development of individual case study as summarized in Table 4.6 |
|                    | Use replication logic in multiple-case studies            | Research design                          | Replicated design for multiple cases, as summarized in Figure 4.5                      |
| **Reliability**    | Use case study protocol                                  | Data collection                          | Protocols of data collection, as summarized in Figure 4.6                              |
|                    | Develop case study database                               | Data collection                          | • Statistical questionnaire result  
• NVivo library for qualitative data  
• Endnote library for literature |

According to Creswell (2003), validity in qualitative research does not carry the same connotation as it does in quantitative research, nor is it a companion of reliability or generalizability. Designing and conducting case studies in this research involve various tactics to deal with these tests. Some of the tactics occur during the data collection, data analysis, or
reporting phases of the research. Therefore, the following sections describe these different tactics used for validating both qualitative and quantitative methods and findings in this research.

4.5.1.2 Validity of quantitative method and data

For the questionnaire-based data, reliability is the consistency of a response that has been obtained (McMurray et al., 2004). There are two methods that were used in this research to test the reliability of data generated from questionnaires, namely, 1) by relying on the inter validity of the statistical tool, and 2) by gaining the consistent feedback from the questionnaire respondents. In the case of the Wenchuan earthquake in China, for instance, statistical analysis was applied to determine the key factors affecting resource availability in post-disaster reconstruction situations. One sample t-test of the mean was conducted using SPSS, based on the sample’s ratings, to check if the factors identified within the questionnaire were important in affecting project resource availability in post-disaster reconstruction situations. Other descriptive statistics like mean calculation were used in the questionnaire data analysis in the case of the 2004 tsunami in Indonesia and the 2009 bushfires in Australia. All these statistical data analysis tools contain inter-validity in regard to the correlation between the sample and the population where the sample is drawn.

The sample for questionnaire survey in this research, as mentioned in the earlier sections, is not random, but was selected purposefully by the researcher. For this reason, the questionnaire results were validated in the subsequent interviewees with those who had participated in the questionnaire survey. By doing so, a justification mechanism was formed through the participants’ judgments, comments and further explanations. This justification process helped eliminate the possible extraneous threats caused by the purposive selection of relatively small samples in this research.

4.5.1.3 Validity of the qualitative method and data

In line with Creswell (2003)’s validating strategies, this section summarizes the five main tactics used to validate the qualitative method and data in this research. For instance, in terms of assessment of the resource availability framework, there are concerns about translation and representation. The study relies upon multiple lines of inquiry, various scales of analysis, and diversified sources of evidence to address these concerns.
1) Intensive, long-term involvement

Becker and Geer (1957) claimed that long-term participant observation provides more complete data about specific situations and events than any other method. In this study, as demonstrated earlier, the researcher had participated in a series of research field visits to the case study sites. The researcher, as a participant observer, spent three month intensive time in the field of Banda Aceh. The researcher was more likely to be able to develop an in-depth understanding of the phenomenon under study. In the case of the Wenchuan earthquake in China, a longitudinal study through a sequential set of site visits during a period of two years, however, ensured repeated observations and interviews for data collection and findings validation. Similarly, two field visits were conducted to the bushfire affected areas in Australia. The follow-up field visits to the disaster-affected areas in China and Australia helped rule out spurious associations and premature theories that had come up from the preceding site visit. Follow-up field trips also allowed a greater opportunity to develop research findings in a more accurate manner.

2) ‘Rich’ data

‘Rich’ data can provide ‘thick’ description to convey the findings (Creswell, 2003). In this present research, both long-term involvement and the intensive interviews enabled the researcher to collect rich data of varied types. Becker (1970) claimed that data that are detailed and varied enough can provide a full and revealing picture of what is going on. There is a diversity of data sets in this study, including interview notes, recording, observational scripts, videotapes, photo-type images, along with quantitative data. The varied types of data help their justification against one another. These datasets also provided a rich, and detailed grounding for, and test of, the conclusions.

3) Respondent validation

Respondent validation was systematically used in this research to solicit feedback about the data collected and conclusions from the data analysis. It is also called member checking (Lincoln and Guba, 1985; Bryman, 1988). Maxwell (2005) spoke highly of this method by saying that member checking is the single most important way of ruling out the possibility of misinterpreting the meaning of what participants say and do and the perspective they have on what is going on. It is also an important way of identifying the researcher’s own biases and misunderstanding.
During the discourse of this research, the qualitative data from each field visit was presented in the form of field trip report and submitted to the interviewed participants who had indicated the willingness to conduct member checking for data validation. Member checking was undertaken in forms of follow-up telephone calls and e-mail and mail correspondence with a number of interviewees.

4) **Triangulation**

By using different data sources of information, both quantitative and qualitative in this research, a coherent justification can be built. Fielding and Fielding (1986) emphasized that triangulation may not automatically increase validity because the validity threats are mainly ruled by evidence, not methods. However, this strategy can reduce the risk of chance associations and of systematic biases due to a specific method, and allows a better assessment of the generality of explanations (Maxwell, 2005). For instance, in the present research, observations, literature review, documentation, questionnaires and interviews were used for creating a solid database in accordance with the resource availability framework. Figure 4.5 also shows how the interview method was used to compliment other research methods. Therefore, triangulation research method in the research study appears to allow for a diversity of data sources to ensure the potential validity of datasets.

5) **Comparison**

Explicit comparison for the purpose of assessing validity threats are useful in qualitative studies, particularly in multi-case or multi-site studies (Maxwell, 2005). In this research — five elements of the resource availability framework have provided a comparative baseline for the three examined cases. It is also worth mentioning that one key informant in the case of Australia had experience with post-tsunami recovery and reconstruction in Indonesia. This research participant was able to draw on his experience in both studied settings to identify the commonalities and disparities between the different situations. Through a comparison across the three cases, the relevant characteristics and processes in one case can be identified, along with their significance. Lessons learned from the varied cases have implications for other similar contexts. This research is concerned with three international cases. The comparability of the cases with contrasting
social, economic and cultural differences is therefore worthy of questioning and study. The following section will address this concern.

4.5.2 Limitations of using case study research methods

As described in previous sections, this study uses a combination of data sources. The unique strength of case study is its ability to deal with a full variety of evidence – documents, arti-facts, interviews, and observations (Yin, 2003). This chapter has identified the features and situations in which case study strategy has a distinct advantage. This section provides some reflections on the limitations of using case study methods.

The first disadvantage of using case study in this research relates with self and/or participant manipulation. Researcher’s self-observation is one of the main tools for data collection in this study. It provides certain unusual opportunities for collecting qualitative data, but it also involves problems such as lack of ability to perceive reality from the viewpoint of the researcher ‘inside’ this topic rather than external to it. Therefore, self-perspective is unlikely to produce an ‘accurate’ portrayal of a case study phenomenon (Yin, 2003, p.94). Likewise, the researcher may also have the ability to manipulate minor events such as influencing the interviewees during a meeting by narrowing down the questions investigated or producing potential biases. Both the researcher and interview participants are likely to follow a commonly known phenomenon and become a supporter of the group or organization being studies (Maxwell, 2005).

The second limitation lies in the sample of surveys and interviews within case studies. ‘Matching’ is a way of acquiring decent and quality data from the most relevant people. This philosophy has determined the profession and position of survey participants and interviewees required. The selection of participants, particularly in the interviews, may pose a threat to the internal validity of the study. In designing the questionnaire, there were controls for variables that were known to the investigator through literature review and pilot study. Therefore, the questionnaire, although incorporating comments and feedbacks from different perspectives, may still carry a certain degree of manipulation from the researcher.

The third drawback in case study method lies in the difficulty in predicting the case study procedures before any research operations, and in comprehending the implications of investigated topic in a complex social environment. Most phenomena investigated by social
scientists call for the assessment of the effects of several independent variables on one or more dependent variables (Frankfort-Nachmias and Nachmias, 1992). This also happens in this study due to the inherent complexities in the disaster recovery. The language and cultural differences between the ‘informant’ and the researcher did not seem to be a barrier since only the case study in Sichuan following the Wenchuan earthquake requires translation. However, as an ‘outsider’ or ‘observer’, the challenge lies in how the research findings can add value to the region’s wider social context, without deeply understanding their rooted cultural and historical background.

Bearing these in mind, a range of solutions which are summarized in this chapter allow for the triangulation of data sources to enhance validity and reliability. The nature of the studied topic dictates case study methods with appropriate justification under some circumstances. The intrinsic limitations of case study research, as summarized in this section, are closely related to factors such as the topic studied, the investigator, the data source, and their interactions. Therefore, through a careful design of case studies, triangulation of data, and evidence-based justification, the limitations of using case study methods can be effectively minimized.

4.5.3 Cross culture and country comparison

International comparisons require articulated conceptual framework (Inam, 2005). The three selected jurisdictions in case studies differ in various aspects such as their political, social, economic, and cultural dimensions. However, according to Dogan and Pelassy (1990), for a comparative study, it is a matter of how we compare rather than what we compare. In order to create insights, comparison in this research is centred rightly on the resource availability analytical framework including the following five elements: post-disaster recovery and reconstruction environment, housing recovery approach, resourcing stakeholders, ‘indicator resources’ and their availability, and critical factors that affect resource availability in housing recovery projects.

Apparently, comparative analysis in this research is between developing countries of Indonesia and China context, and a developed country context of Australia. The political system varies significantly in the three countries — more politically centralized country of China, and more politically demographic country of Australia, and Indonesia lies between the two. The community-related cultural features such as traditions, religions and customs also highly vary
across the three case sites. For instance, Aceh has a reputation as the most devoutly Islamic region of Indonesia. The key stakeholders involved in Aceh’s reconstruction include the international and foreign humanitarian agencies, Indonesian government, former Free Aceh Movement (GAM) revels, and local NGOs and civil society organizations (Miller, 2010). Given this composition, the implementation of Islamic law within Aceh’s post-tsunami and post-conflict environment played a certain part in the rebuilding of Aceh. Likewise, a more government-dominant environment in China is likely to perform differently in response to the community recovery from the Wenchuan earthquake. Therefore, one aspect of cross culture and country comparison is the recognition of these variations and their likely effects on the studied topic.

Moreover, on one hand, it is clear that the systematic frameworks of post-disaster recovery and reconstruction — the policies, institutions, resources, capacities, participants, and roles and responsibilities of the government — all vary as they do between developing and developed countries in general. The same applies to the culture-related activities and their effects on the implementation of disaster recovery. On the other hand, the institutional decision making process — the constraints, policy innovation, and the tendency for policy to have unanticipated consequences — appears to display regularities that transcend the categories of developing or developed country (Horowitz, 1989). In designing the research instruments that will be applied to the different contexts, the researcher also considered these variations into questionnaire and interview questions. For instance, the potential contextual factors that are likely to impinge upon resource availability for housing recovery projects were also included in the questionnaire.

Three case studies in the research study serve to assess the analytical framework of resource availability in post-disaster recovery projects, but do not go as far as to represent their contextual variations and the related effects. The analytical framework, however articulates the overall comparability and diversity of the three cases. Based on this framework, comparison in this research looks at both the variations and similarities with regard resource availability for post-disaster housing reconstruction. Therefore, the validity threat concerned with the cross culture and country comparison in this research is likely to be ruled out by the way in which the cases are compared.
4.6 Ethical considerations

The research design contains significant interactive methods such as questionnaire and interviews which involve the participation of people. Ethical issues were therefore considered at all stages of the research design and execution process. Potential ethical issues that may arise during the development of this research include data collection, data analysis and interpretation and disseminating the research findings. An application was made to the University of Auckland Human Participants Ethics Committee, prior to the conducting of any research surveys. This research was granted permission by the committee with Reference Number 2009/029. The approved supporting documents such as the Participant Information Sheet and Consent Form are attached in Appendix 5. The following outlines the tactics used in this research in considering ethical issues.

1) **Informed consent**: the research subjects must be informed that their participation is voluntary (McMurray et al., 2004). All participants were made informed of this research through the initial email/phone request for questionnaire or interview participation. Depending upon the response from potential participants, the Participant Information Sheet was emailed or posted to inform the nature of this research and the rights held by the participant. Before a survey commenced, each potential participant was provided with the Participant Information Sheet and advised to complete the Consent Form in order to confirm their decision to participate in this research.

2) **Personal privacy and confidentiality**: There may be three privacy issues involved in the research process: sensitivity of information, settings in which data is collected, and the dissemination of information (Creswell, 2003). These issues were considered in the research design of this study. For instance, the Consent Form indicates the choices of whether to disclose the basic personal information or not. Questionnaire in this research is anonymous. A number of the interviewees chose to remain anonymous, unidentified by the name, gender, position and status. In this dissertation, only the coding number denoting the relevant interviewee will be used when citing the interview information. In the case of a quote being issued to substantiate a point, the informant will be quoted by position and organization. All use of names is avoided to maintain confidentiality. The
same applied to the publication of a research report based on the interview data derived from a respondent.

3) **Ethics in data analysis and interpretation**: Creswell (2003) suggested that investigator should discard data after analysis so that it will not be misused for other purposes. In this research, according to the university ethics guidelines and principles, all types of data will be kept only with the researcher for a period of six years to guard against sharing the data with others. In addition, as alluded to earlier, to provide an accurate account of the information, member checking validation method was adopted with a number of key informants. By doing so, the possibility of producing language or words that might be biased against persons or organizations in this research is significantly reduced.

4.7 Summary

This chapter provides an overview of the research framework, research process, research design, research methods, and issues that were considered into the research design. In selecting an appropriate research design to articulate the whole research process, an overhaul of research questions and objectives was conducted to align with the relevant research methods. By such a matching, case study research design was selected embracing the method of multiple case studies and a comparative analysis. The research design shows the process of developing each case study and the specific tactics of data collection, analysis, and validation. The main research methods described in this chapter include: literature review, case studies, questionnaire survey, field-based observations and interviews, research-related workshops, conferences, seminars and other field trips. The rationale for selecting each method to be used in the current research is explained when compared with other available options.

To fulfil the research objectives, the quantitative evidence was collected to indicate critical factors that impinged upon resource availability in disaster recovery projects. The qualitative data was captured to understand the underlying relationships revealed in the quantitative data and to assess the post-disaster recovery and reconstruction environment, housing recovery approach, and resourcing rationale or theory within each context. In response to two differing types of data, statistical analytical techniques were utilized to deal with questionnaire data, whereas the
specialized NVivo software was used to analyze qualitative data. A series of validation methods were used to ensure the internal and external validity of research methods and findings. Finally, this chapter illustrates the implications of the cross-cultural comparison as well as the ethical considerations in this research.

In the following chapters, namely Chapters Five, Six, Seven and Eight, the research findings will be presented in accordance with the analytical framework for understanding resource availability in disaster recovery projects. A synthesis of the research findings extracting from both the quantitative and qualitative data will be presented in a narrative format.
Chapter 5 Resourcing housing recovery following the 2004 Indian Ocean tsunami in Indonesia

5.0 Overview

This chapter presents research findings from the case study of the 2004 Indian Ocean tsunami in Indonesia. The focus of this case study is to address the five elements in the resource availability framework within the context of post-tsunami housing recovery in Aceh, Indonesia. These five elements are:

1) Post-tsunami recovery and reconstruction environment,
2) Post-tsunami housing recovery approach,
3) Resourcing stakeholders for tsunami housing reconstruction,
4) ‘Indicator resources’ and their availability, and
5) Critical factors that affect resource availability in post-tsunami housing recovery.

The case will be described in a narrative format, based on a synthesis of data from interviews, observations, documentation, and other audiovisual materials. In addition, existing literature will be used to present background findings and to discuss the findings with respect to the critical factors that affected resource availability in post-tsunami housing reconstruction. Finally, recommendations tackle the resourcing problems encountered by those resourcing stakeholders in undertaking post-tsunami housing recovery in Aceh, Indonesia.

5.1 Post-tsunami recovery and reconstruction environment

This section will reflect upon the recovery and reconstruction in Aceh following the 2004 Indian Ocean tsunami. Examining the reconstruction response immediately after the event is likely to enhance the depth of comprehension and the lessons that can be learned. Therefore, this section looks at the circumstances where the post-tsunami response and recovery took place, with a focus on examining the fundamental recovery decision-making and institutional arrangements.
5.1.1 The tsunami and the city of Banda Aceh

5.1.1.1 The 2004 Indian Ocean earthquakes and the tsunami

As described in Chapter Two, Indonesia is located in the ‘Ring of Fire’ consisting of volcanic arcs and oceanic trenches partly encircling the Pacific Basin. On December 26, 2004, Boxing Day, an earthquake with a magnitude measuring 9.0 on the Richter scale occurred and was centered about 30 kilometres off the west coast of Sumatra Island, Indonesia. The epicentre was right at the extreme western end of the ‘Ring of Fire’. The powerful quake produced a major undersea movement along Sumatra’s western fault line which, in turn, caused tsunami waves to strike the coastal areas of northern Indonesia, Thailand, and reaching further to India, Sri Lanka, The Maldives, and some parts of the coast of Somalia in Africa. The location of the earthquake and the tsunami affected countries are shown in Figure 5.1.

This event claimed 220,000 lives in total, and left 10,000 people injured (Steinberg, 2007). The impacts of the Indian Ocean tsunami are summarized in the following Table 5.1. At a UN press conference on 1 June 20057, the Secretary General of the United Nations, Kofi Annan, described this catastrophe as ‘the largest natural disaster the organization has had to respond to on behalf of the world community, in the 60 years of our existence’.

Figure 5.1 Areas affected by the 2004 Indian Ocean tsunami, source: ReliefWeb Map Centre (2005)

Table 5.1 Impacts of the 2004 Indian Ocean tsunami\(^8\) (Athukorala and Resosudarmo, 2005, p. 5)

<table>
<thead>
<tr>
<th>Country</th>
<th>Areas affected</th>
<th>Damage</th>
<th>Displaced</th>
<th>Deaths</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>2,200 km of coastal land; 300 m to 3km inland; 3 million people</td>
<td>897 villages; 157,393 dwelling units; 11,827 ha of cropland; US$1.56 billion in assets</td>
<td>647,556</td>
<td>10,872</td>
<td>5,551</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Aceh, 14 out of 21 districts; 1 million people</td>
<td>172 sub-districts; 1,550 villages; 21,659 houses</td>
<td>811,409</td>
<td>166,760</td>
<td>127,749</td>
</tr>
<tr>
<td>Malaysia</td>
<td>North-western states of Penang and Kedah</td>
<td></td>
<td>8,000</td>
<td>68</td>
<td>6</td>
</tr>
<tr>
<td>Maldives</td>
<td>20 atolls</td>
<td>100,000 people</td>
<td>10,578</td>
<td>82</td>
<td>26</td>
</tr>
<tr>
<td>Myanmar</td>
<td>23 villages</td>
<td>592 houses of 17 villages</td>
<td>2,591</td>
<td>At least 2,500</td>
<td>n.a.</td>
</tr>
<tr>
<td>Somalia</td>
<td>Puntland region worst hit; 650 km coastline</td>
<td>600 families have lost properties; 2,600 fishing boats destroyed</td>
<td>4,000</td>
<td>At least 150</td>
<td>n.a.</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>1,720 km of coastal land; 300m to 3km inland; 103 families</td>
<td>78,529 fully damaged houses; 41,097 partly damaged houses</td>
<td>502,668</td>
<td>30,959</td>
<td>5,644</td>
</tr>
<tr>
<td>Thailand</td>
<td>6 provinces on the west coast</td>
<td>6.85m baht have been provided to assist victims</td>
<td>N/A</td>
<td>5,392</td>
<td>3,100</td>
</tr>
</tbody>
</table>

\(^8\) by end of February 2005
5.1.1.2 The city of Banda Aceh and the tsunami impacts

Indonesia was one of the countries worst affected by the tsunami. The locations of the tsunami-affected areas of Aceh and Nias in Indonesia are shown in Figure 5.2 below. The official death toll in Aceh and Nias reached approximately 167,000 and more than 500,000 people were displaced. The devastation to infrastructure included the loss of over 110,000 houses, 3,000 kilometres of roads, 14 seaports, 11 airports and air strips, 120 arterial bridges, 2,000 school buildings, and 8 hospitals (BRR and Partners, 2006).

Figure 5.2 Map of Aceh and Nias in Indonesia and city of Banda Aceh

The epicentre of the 2004 Indian Ocean earthquake was 250 kilometres off the coast of the city of Banda Aceh, the capital city of Indonesia’s Aceh Province. Banda Aceh suffered severe damage during the tsunami with 61,065 people killed (Nurdin, 2006). The tsunami and its impacts, however, had to a great extent helped the ceasefire between the Indonesian Government and the independence forces of the Free Aceh Movement (FAM). Before the tsunami,

---

9 From the Aceh and Nias Mapframe, the electronic copy was provided by BRR when the researcher was in the field.

10 GAM: Gerkan Aceh Mardeka
according to ADB (2010), nearly a half-century of conflict killed more than 15,000 soldiers and citizens of Banda Aceh. The Indonesian Government placed the city under martial law, limiting the number of foreign visitors.

In addition, the geographic distance between Banda Aceh and capital city Jakarta, combined with its political problems, meant that it received less development work before the tsunami. Demographically, the city had a population of 264,618 in 9 sub-districts and 89 villages. The annual population growth was 2.87% before the tsunami. This coastal city covers an area of 6.136 hectares\(^\text{11}\). The residential area in Banda Aceh extends around 64 km\(^2\), with the Grand Mosque\(^\text{12}\) at the centre, which is a significant symbol of Acehnese religion and culture. Table 5.2 shows a brief summary of the characteristics of Banda Aceh before the tsunami.

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political situation</td>
<td>Civil war between the Indonesian Government and FAM</td>
</tr>
<tr>
<td>Geography/Topography</td>
<td>Coast city</td>
</tr>
<tr>
<td></td>
<td>9 Sub-districts and 89 villages</td>
</tr>
<tr>
<td></td>
<td>Covering area: 6.136 Ha</td>
</tr>
<tr>
<td></td>
<td>Residential area: 64 km(^2)</td>
</tr>
<tr>
<td>Demography</td>
<td>Population: 264,618</td>
</tr>
<tr>
<td></td>
<td>Population growth: 2.87%</td>
</tr>
<tr>
<td></td>
<td>9 Sub-districts and 89 villages</td>
</tr>
<tr>
<td>Landmark</td>
<td>Grand mosque</td>
</tr>
</tbody>
</table>

Of the nine sub-districts, the 2004 Indian Ocean tsunami destroyed three and damaged three. The other three districts were not affected. With 61,065 people killed by the tsunami, the population of the city decreased to 203,553. Across the city, 17,219 housing units were heavily damaged and 4,193 partly damaged. The tsunami destroyed 56 schools and damaged 119, leaving 110 not affected. The impacts of the tsunami on the city of Banda Aceh are summarized in Table 5.3. The photos in Figure 5.3 also illustrate the tsunami impact on the city.

\(^{11}\) Ha, or hectare, is a unit of area defined as 10,000 m\(^2\).
\(^{12}\) Also known as the Mesjid Raya Baiturrahman Mosque
Table 5.3 Impacts of the tsunami on Banda Aceh (Nurdin, 2006)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Affected area</strong></td>
<td>6 sub-districts are damaged</td>
</tr>
<tr>
<td></td>
<td>3 others are not affected at all</td>
</tr>
<tr>
<td><strong>Tsunami’s effect on population</strong></td>
<td>Before: 264,618</td>
</tr>
<tr>
<td></td>
<td>Killed: 61,065</td>
</tr>
<tr>
<td></td>
<td>After: 203,553</td>
</tr>
<tr>
<td><strong>Damaged houses (units)</strong></td>
<td>Heavy damage: 17,219</td>
</tr>
<tr>
<td></td>
<td>Medium damage: 4,193</td>
</tr>
<tr>
<td></td>
<td>Total: 21,412</td>
</tr>
<tr>
<td><strong>School buildings (units)</strong></td>
<td>Not affected: 110</td>
</tr>
<tr>
<td></td>
<td>Damaged: 56</td>
</tr>
<tr>
<td></td>
<td>Destroyed: 119</td>
</tr>
</tbody>
</table>

Banda Aceh before the tsunami

Banda Aceh after the tsunami

![Comparative photos of Banda Aceh before and after the tsunami](image)

*Figure 5.3 Comparative photos of Banda Aceh before and after the tsunami*13

---

13 The photos were provided by one interviewee from UNDP when the researcher was in the field.
5.1.2 Multi-stakeholder responses to the tsunami

The 2004 Indian Ocean tsunami drew a significant global attention. The response of international donors was remarkably quick and overwhelming. The United Nations, NGOs and INGOs mobilized emergency assistance on a massive scale. As of February 2005, the total financial pledge and commitments to post-tsunami recovery and reconstruction to Indonesia alone reached US$800 million (OCHA, 2005). In 2006, there were approximately 290 NGOs and donor organizations in Aceh and Nias, managing 828 recovery and reconstruction projects (BRR, 2006). The well known tsunami recovery slogan within the aid agencies ‘Build Back Better’ was proposed by the former president of the United States, Bill Clinton, as the United Nations Secretary-General’s Special Envoy for Tsunami Recovery. As a watchword to overarch the overall post-tsunami recovery efforts, ‘Build Back Better’ was defined by ten propositions shown in Table 5.4.

Table 5.4 Ten propositions for defining post-tsunami ‘Build Back Better’

<table>
<thead>
<tr>
<th>Ten propositions for defining post-tsunami “Build Back Better”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Governments, donors, and aid agencies must recognize that families and communities drive their own recovery.</td>
</tr>
<tr>
<td>2 Recovery must promote fairness and equity.</td>
</tr>
<tr>
<td>3 Governments must enhance preparedness for future disasters.</td>
</tr>
<tr>
<td>4 Local governments must be empowered to manage recovery efforts, and donors must devote greater resources to strengthening government recovery institutions, especially at the local level.</td>
</tr>
<tr>
<td>5 Good recovery planning and effective coordination depend on good information.</td>
</tr>
<tr>
<td>6 The UN, World Bank, and other multilateral agencies must clarify their roles and relationships, especially in addressing the early stage of a recovery process.</td>
</tr>
<tr>
<td>7 The expanding role of NGOs and the Red Cross/Red Crescent Movement carries greater responsibilities for quality in recovery efforts.</td>
</tr>
<tr>
<td>8 From the start of recovery operations, governments and aid agencies must create the conditions for entrepreneurs to flourish.</td>
</tr>
<tr>
<td>9 Beneficiaries deserve the kind of agency partnerships that move beyond rivalry and unhealthy competition.</td>
</tr>
<tr>
<td>10 Good recovery must leave communities safer by reducing risks and building resilience.</td>
</tr>
</tbody>
</table>
Apart from the outside aid agencies, the Indonesian Government prompted the response and relief quickly after the tsunami. In December 2004, the Government announced its commitment of $5 million in support of tsunami relief and recovery (BRR, 2006). The Government also committed support in three phases: 1) emergency rescue and relief operations, 2) rehabilitation and reconstruction of basic socioeconomic infrastructure and restoration of law and order, and 3) reconstruction of the economy and government system. The composition of funding commitment (2005-2009) from both the internal and external sources for post-tsunami rehabilitation and reconstruction is shown in Table 5.5. By the end of 2005, USD $ 4.4 billion had been allocated to specific projects. This financial commitment, however, according to Nazara and Resosudarmo (2007), was indicative of an intention of all involved tsunami recovery practitioners to build Aceh back better.

Table 5.5 Funding commitments to post-tsunami reconstruction (BRR and Partners, 2005)

<table>
<thead>
<tr>
<th>Tsunami recovery assistance</th>
<th>US $ billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic sources through the government budget</td>
<td>3.0</td>
</tr>
<tr>
<td>Foreign governments</td>
<td>3.6</td>
</tr>
<tr>
<td>Private sector and NGOs</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>9.1</td>
</tr>
</tbody>
</table>

5.1.3 Institutional arrangements for post-tsunami recovery

5.1.3.1 BAPPENAS, Mater Plan and BRR

The second phase of post-tsunami recovery — housing rehabilitation, resettlement of displaced people, and restoration of basic utilities — commenced in May 2005. However, with the significant involvement of the international aid agencies, the Indonesian Government had three concerns regarding reconstruction operations: 1) the need to coordinate the activities of the large number of NGOs; 2) security conditions in Aceh and 3) the need to ensure that commitments pledged by international donors would materialize in a timely manner (Nazara and Resosudarmo, 2007). To address the coordination problem, the National Development Planning Agency (BAPPENAS) was appointed as the central agency, working with the Ministry of Public Works (MPW), to develop the overall recovery planning for tsunami-affected communities.
BAPPENAS commenced intensive consultations in March 2005 with local communities and political leaders as well as recovery-involved NGOs, with a view to formulating a Master Plan for guiding the overall tsunami recovery operation.

In April 2005, the Master Plan was released through the President Regulation (Perpres) No. 34/2005. A number of researchers such as Steinberg (2007) and Kennedy et al. (2008) claimed that the Plan was comprehensive, and had outlined regulations for zoning, mandatory setbacks from the sea, and relocation of local markets. In spite of its full coverage, the Master Plan received a ‘cold welcome’ from many local communities and NGOs. Some communities suggested that their aspirations had not been properly reflected in the Plan, while some NGOs and local governments claimed that the reconstruction planning process was not inclusive.

Another administrative crisis took place nearly at the same time. In May 2005, the disagreement between the central government line departments and BAPPENAS had led to the establishment of an independent authority, BRR, for coordinating the reconstruction operations of aid agencies. BRR was formulated by Presidential Decree No. 63/2005, comprising an Advisory Board, a Supervisory Board, and an Executing Agency. In post-tsunami recovery and reconstruction, BRR served as a one-stop shop for liaising all agencies and donors in Aceh and Nias. The stated mission for BRR was to restore livelihoods and strengthening communities in Aceh and Nias by overseeing a coordinated community-driven reconstruction and development programme (Nazara and Resosudarmo, 2007). Apart from its primary role of being a coordinator, by the end of 2005 BRR was empowered by a cabinet decision to receive an additional mandate to build about 120,000 houses in Aceh and Nias. Since then, BRR has become a housing recovery agency and a kind of ‘super ministry’, completely taking over the rehabilitation and reconstruction responsibilities from all line ministries in Aceh and Nias (Steinberg, 2007).

In response to the Master Plan, however, BRR adopted a conciliatory manner. The Master Plan was used as a reference document and replaced by a range of recovery plans set out by BRR. A seemingly more community-participatory approach was shown in BRR’s recovery plans. According to the new plans, the Indonesian Government was tasked with the provision of principal infrastructure facilities such as roads, electricity and water sanitation structures. The rebuilding of housing for local communities was primarily charged to the relief agencies.
5.1.3.2 Post-tsunami recovery plans and policies

At the beginning of its implementation, BRR developed a diversity of recovery and reconstruction plans and policies, as well as the relevant operational procedures to enable coordination, leadership and quality control of the recovery process. The most prominent policies and guidelines for tsunami recovery are summarized in Table 5.6.

*Table 5.6 Policies and guidelines for tsunami recovery*

<table>
<thead>
<tr>
<th>Policy/Guideline</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| BRR Policy Guidelines for the Provision of Resettlements Assistance to Victims of the NAD/Nias Tsunami and Earthquakes | • Stipulate the right of return and housing based on Master Plan  
• Emphasize earlier BRR Guidelines on land mapping, village recovery planning and house rebuilding |
| BRR Guidelines for Infrastructure Redevelopment in Tsunami Affected Areas  
BRR Infrastructure Implementation Plan | • Provide the basic guidelines for village reconstruction and dimensions and price limits for construction of the main house and repairs  
• Set up practical scenario for the implementation of infrastructure with different involvement levels from various agencies |
| Village Planning Guidelines | Provide a detailed elaboration on a range of individual guidelines set out by BRR in June 2005, known as ‘BRR General Guidelines for Planning and Construction of Villages’ |

At the core of the BRR reconstruction strategy was the paradigm that the people of Aceh and Nias serve as the main contributor rather than bystanders to the rehabilitation and reconstruction of their communities. A continuum of recovery priorities were also identified by BRR for a period of reconstruction from 2005 to 2009. Housing reconstruction and rehabilitation was considered to be the first priority for the recovery of communities (BRR, 2006). The other five main areas with high priority were the recovery of land, infrastructure, education and health, social institution and human resource, and business and economy. Within the recovery timeframe set out by BRR, as shown in Figure 5.4, housing, land, education and health infrastructure were planned to be completed by the end of 2007. The associated infrastructure facilities connecting to the housing system were planned to be completed in 2008. The local government capacity
building were planned to be developed throughout the whole period of reconstruction until 2009 when the handover of power and authorities of BRR to local government takes place (BRR, 2006, p.44).

Figure 5.4 shows that the overall implementation of rehabilitation and reconstruction in Aceh and Nias encompasses five main stages, which will be outlined below, in line with BRR (2006).

1) **Stage One (Year 2005)**: includes rescue and recovery, and the revitalization of the social, economic and political life of the community. The main purpose of this stage was to provide infrastructure support for supplying access, clean water and the construction of sanitation facilities, tents, temporary shelters and houses for refugees. Apart from that, a program of providing temporary work was a primary objective of this stage through the cash-for-work initiative. It was also during this stage that BRR was established as the coordinator and implementer of the rehabilitation and reconstruction program for Aceh and Nias.

2) **Stage Two (Year 2006)**: the recovery period. The main priority in this stage is the construction of housing and the continuation of infrastructure development to support logistics. Other programs include the construction of temporary shelters, transportation
and communication systems, energy and electricity installation and support for increasing economic activities for community livelihoods and the long-term sustainability of infrastructure development. The strengthening of BRR institutional capacity and the upgrading of provincial and regional governments in Aceh and Nias is also a part of this stage.

3) **Stage Three (Year 2007):** All housing requirements are targeted to be completed during this stage. The reconstruction of the physical infrastructure such as roads, bridges, sea and air ports as well as infrastructure to support capital investment and the development of the local economy will be approaching completion. It is also expected that improvements to the quality of transportation, communications, and energy and electricity networks will also be reaching a final stage of development. A distinct role division is also expected to take place between BRR and the local rehabilitation and reconstruction implementers such as the provincial, district and city governments.

4) **Stage Four (Year 2008):** This stage is a continuation of the development of the physical infrastructure such as roads, bridges, sea and air ports, the infrastructure for developing local economy. An increased effort will also be made to develop tourism. By focusing on the development of energy and telecommunications sectors during this stage, it is expected that greater support can be leveraged towards the industry and services sections in Aceh and Nias. Capacity of the local government is also increased to achieve a smooth hand-over in 2009.

5) **Stage Five: (Year 2009):** It is expected that all major development and reconstruction of the physical infrastructure and its facilities will be completed. In the first half of 2009, all efforts will be directed towards capacity building. The process of handing-over, including handing over the rehabilitation and reconstruction programs and other administrative tasks can be finalized at this stage.

In general, rehabilitation and reconstruction in Aceh and Nias covered a broad range of projects, which were pertinent to the four components of community recovery, as presented in Chapter Two. With a focus on housing recovery and reconstruction in this present study, the following section elaborates on the process of housing rebuilding in Aceh and Nias after the tsunami.
5.2 Post-tsunami housing recovery approach

There was an agreed objective among the involved donors for housing reconstruction. According to Steinberg (2007), the implementing agencies aimed to rebuild houses that are socially and politically acceptable, economically affordable, technically sound and institutionally manageable. Housing reconstruction in Aceh, as observed by the researcher, was driven by the international aid agencies. This section examines this donor-driven approach to housing reconstruction.

5.2.1 Housing culture and type in Aceh

5.2.1.1 Traditional housing type in Aceh

Housing in Banda Aceh is a culturally-sensitive and highly localized process with strong links to the local livelihoods and social activities. The traditional Acehnese house is well documented in literature such as (Collier and Collier, 1997; Nas, 2003; O'Brien et al., 2008). A traditional house in Aceh is built entirely from organic building materials such as timber, bamboo and thatch. As shown in Figure 5.5, the house is held above the ground on timber posts that rest on flattened stone blocks. The elevated floor is made of bamboo slats and supported by a system of timber joists and bearers. Walls are made of timber planks with decoratively carved skirting boards and panels. Upper wall components have latticed screens of bamboo or rattan that enable cross ventilation while doors and windows commonly have decorated wooden shutters. The thatch roof, usually made with palm fronds, is supported by a system of timber and bamboo battens, major and minor rafters, and carved king posts. According to O’Brien et al. (2008), the space under the house is utilized for various household activities such as relaxation, rearing of animals and storage.
5.2.1.2 Changes in housing type after the tsunami

After the tsunami, there were changes in housing type from traditional timber houses to masonry houses. The new houses in Aceh rebuilt by the aid agencies post-tsunami typically consisted of reinforced concrete frame structures in-filled with brick walls, timber truss roofs and corrugated iron roofing with the reinforced concrete frames providing the seismic bracing. However, the western-style concrete structure was seen by the local communities as being representative of ‘development’ and ‘progress’ although they were less built to Aceh’s climate and traditional culture. This section summarizes the factors that contributed to the preference of ‘modern dwellings’ made of industrialized construction materials such as concrete, cement, brick, and steel following the tsunami.

1) **Expectations from communities**: Before the tsunami, a series of economic and cultural shifts had taken place in Aceh. The masonry bungalow, a typical housing model promoted by the media, has become commonplace throughout Southeast Asia. Nas (2003) argued that the reasons for choosing bungalow housing types in Aceh include diminished access to suitable timber suppliers, lack of craft persons skilled in traditional construction techniques, and the notion that the traditional house is less practical than its contemporary
alternative. O’Brien et al. (2008) added that changes to the housing culture were also fuelled by a desire from the communities for modernity that can emanate from industrialized houses. This desire was prominent in the aftermath of the 2004 tsunami for the newly built dwellings. According to Kennedy et al. (2008), the local communities in Aceh expected their houses to be built with masonry structures which represent affluence and modernity, despite the housing safety and quality concerns.

2) **Available funding and the involvement of international NGOs:** Available funding from the outside aid agencies exacerbated the changes to the Acehnese housing culture (Kennedy et al., 2008). Many agencies for house rebuilding in Aceh brought in the concrete and masonry housing type in order to suit the local aspirations. There was a wide variety of derivatives with building materials such as reinforced concrete, masonry components like concrete block and brick, steel framing, and corrugated iron sheets. There were also variations in external components of a house, such as colour and decorations, to cater for the house owners’ personal preferences. Figure 5.6 illustrates some houses built by different aid agencies in Aceh.

3) **Environmental concerns over timber use:** Dauvergne (1997) and UNFAO (2001) revealed that the high timber price in Aceh even before the tsunami was linked with local deforestation, industrialization, urbanization, overpopulation, and corruption. During the post-tsunami reconstruction, aid agencies were subject to difficulties in procuring quality construction timber from Indonesia nationwide. Large demands for the temporary shelters to accommodate tsunami victims, however, already consumed considerable amounts of local timber resources. The local timber supply was unable to meet larger demand for rebuilding permanent houses. There was an environmental concern over the exploitation of natural resources. This concern, to some extent, reinforced the tendency to build modern masonry, rather than timber, dwellings.

Therefore, it can be concluded that the lack of sustainable timber supply in Aceh, coupled with the local demand for westernized ‘modern’ housing, required post-tsunami housing reconstruction to be reliant on external aid agencies, with imported industrialized materials such as cement, steel, concrete and mass-produced products. The changes to the local approach to housing construction, however, dictated the use of different building materials and skills. The
issues related to sourcing these resources for housing reconstruction will be detailed in the following sections.

1. House rebuilt by Emergency Architects (EA)  
2. House rebuilt by the Canadian Red Cross (CRC)  
3. House rebuilt by Care International  
4. House rebuilt by UNDP

Figure 5.6 Masonry houses rebuilt by the international aid agencies in Aceh

5.2.2 Post-tsunami housing reconstruction actors

As observed by the researcher, in the aftermath of the 2004 Indian Ocean tsunami, the ‘infusion of aid’ housing reconstruction model was applied to most housing recovery projects. A large

---

14 Photo 1 and 3 were taken by the researcher in the field of Banda Aceh, photo 2 and 4 were provided by the interviewees from CRC and UNDP respectively.
number of humanitarian aid agencies had expanded their emergency response to longer-term reconstruction. The reason, according to Steinberg (2007), was due to an unprecedented flow of grant funds from the public or their governments. Depending on the housing reconstruction approach adopted, the degree of involvement of these aid agencies varied across housing projects.

There was a range of housing implementation approaches observed by the researcher on site, such as cash grants, contractor-build reconstruction *in situ* or *ex nihilo*, and self-rebuild. The focus of this case study is placed on the contractor-build housing recovery projects, managed by aid agencies in Aceh, Indonesia. The major actors involved in this type of rebuilding projects were identified: 1) Local beneficiaries; 2) Recovery authority BRR; 3) Recovery implementing agency NGOs; 4) Construction contractors. This section presents the research findings with respect to the roles and responsibilities of these actors and their relationships in undertaking a house rebuilding project in Aceh.

### 5.2.2.1 Local tsunami-affected communities

In BRR’s recovery plans, the community was expected to be an important participant in all areas of the rehabilitation and reconstruction program. Within the contractor-build recovery projects, however, the participation of local communities in the reconstruction process was represented by the Village Development Committee (VDC). The direct participation of the affected populations only happened during the initial planning stage to determine individual housing requirements. Most often, VDC took a lead role in recovery effort. VDC bore most tasks as a client to execute on-site supervision and liaisons with the responsible NGO. In turn, the implementing NGO collaborated with its VDC to deal with the communities and identify their needs.

A VDC comprised a headman and other elected committee members, providing a stable, consistent contact for aid agencies and facilitating the process of rebuilding. With the assistance from VDCs at the initial stage of recovery, many implementing NGOs undertook an on-site assessment of the recovery needs in housing and livelihoods. In general, the responsibilities of the tsunami-affected community represented by VDC are summarized as follows.

1) To conduct independent monitoring of recovery housing projects and ensure that the needs of the disadvantaged or other vulnerable groups within the community have been met;
2) To actively engage in liaisons between the community and all agencies such as BRR and the donor agency involved in the recovery process at the community level;

3) To inform the communities about the challenges, difficulties, progress and quality in terms of the recovery housing program; and

4) To manage the community’s expectations and voices, and tackle relevant problems during the reconstruction through proper regulatory channels and mechanisms.

5.2.2.2 Government agency through BRR

The purpose of establishing BRR, and its mission and functions with regard to the rehabilitation and reconstruction of Aceh and Nias, was detailed in the previous section. This section aims to present the roles and responsibility of BRR in the donor-driven and contractor-build housing recovery projects. Field observations and interviews suggested that the Indonesian Government through BRR played a two-fold role in the housing rehabilitation and reconstruction of Aceh: a coordinator and a facilitator.

1) **Housing recovery program coordinator**: Before the commencement of any reconstruction project, BRR adopted a mechanism called ‘concept notes’ to coordinate the allocation of reconstruction works. The concept notes were used as a template for elucidating the issues and questions from the international agencies that wished to be involved in housing reconstruction programs in Aceh. Once BRR approved the NGO’s concept notes/housing program proposal, the proposed housing projects would be allocated to the organization for implementation. During the housing reconstruction stage, BRR bore the responsibility of monitoring donor-driven housing programs. All relevant information regarding the housing reconstruction NGOs was included in BRR’s RAND database. This information was used to assist BRR in decision-making and publication to the local and international community.

2) **Housing recovery facilitator**: In addition to its coordinating function, BRR played a role of facilitator in helping the NGOs solve problems in the construction fields. BRR, along with the Ministry of Home Affairs and Ministry of Public Works provided policy guidance and planning assistance to the implementing NGOs in housing reconstruction.
BRR also worked with local governments to oversee donor-managed housing projects. Further, BRR’s facilitating role encompassed the overall recovery process, such as land tenure ownership, housing need assessment, village spatial planning, supervision of quality and progress of the housing projects, supervision of the delivery process of timber products, and setting up the cost ceilings for housing units and habitat infrastructure.

5.2.2.3 Aid agencies

As observed in the field by the researcher, a large number of the NGOs was in favour of the contractor-build approach and subcontracted the construction of houses to external construction contractors. The beneficiaries who were to receive assistance were essentially excluded from the house construction process. Instead of being a housing recovery facilitator, the aid agencies acted as a project manager overseeing the reconstruction of housing projects which were conducted by the building contractors. However, field observations suggested that in most cases the contracts were being sub-contracted, sometimes up to four to five tiers.

A number of site engineers and short-term consultants were employed from both Indonesia and overseas by the implementing NGOs to serve as supervisors for different types of construction management. These capacities were brought in to be mainly in charge of the management of project quality, cost and timeliness. Some of the NGOs, as observed by the researcher, also employed a number of facilitators to provide the training of labour to participate in the rebuilding work of housing projects.

5.2.2.4 Reconstruction builder – Local construction contractors

Local construction contractors acted as the main builder for tsunami housing reconstruction. Masonry housing type for reconstruction, however, required a variety of professional workers such as carpenters and masons. As could be expected, without adequate training, the contracted skills were unable to meet the quality standard required for earthquake-resistant buildings. Figure 5.7 illustrates examples of housing projects that were suspended due to poor workmanship. The participative observation between March and June 2008 showed that a number of houses managed by the aid agencies and constructed by contracted skills, were rebuilt below the quality standards, and as a result, had to be demolished or retrofit strengthened.
A number of local contractors were also tasked with the procurement of suitable building materials for rebuilding houses. However, on-site observations and interviews suggested that most of these construction professionals failed to procure good quality of essential resources required for seismic-resistant houses. Significant resourcing problems surfaced during the housing reconstruction and the implementing aid agencies had to deal with this challenge. The resourcing related issues will be discussed in detail in the following sections.

5.2.3 Characteristics of the housing recovery in Aceh

In general, housing recovery in Aceh following the tsunami was characterized by massive monetary assistance; largely from the international aid agencies and donor countries. With the involvement of the international aid agencies in physical house rebuilding, the conventional institutional structure for project management changed. Post-tsunami reconstruction, particularly in the housing sector, became a globalized disaster relief effort. This section looks at the prominent issues that featured the housing recovery in Aceh and contributed to the outcome of donor-driven house reconstruction.

---

15 The photos were taken by the researcher during the field trip in Banda Aceh.
5.2.3.1 Peace agreement between the Indonesian Government and GAM

The political situation in Aceh before the tsunami provides important contextualization for post-tsunami relief and rebuilding. As mentioned earlier, Aceh had been experiencing half a century of secessionist rebellion of the Free Aceh Movement (GAM). The tsunami encouraged the political disputing parties to cease military hostilities and begin dialogues with the Indonesian Government. The peace agreement between the Government of Indonesia and GAM signed in August 2005, known as the Memorandum of Understanding (MoU), was an essential part of a successful reconstruction process in Aceh.

Field interviews suggested that the particular relevance of this political reconstruction within the context of wider post-tsunami reconstruction was two-fold. First, the peace status after this agreement in Aceh proved crucial to allow international aid organizations to enter Aceh after the tsunami. The peace agreement also allowed material post-tsunami relief and reconstruction to proceed unhindered. Second, MoU established many of the normative criteria of political development. The tsunami wiped away the pre-existing political barriers in Aceh and allowed the construction of a new political framework. The newly formed stable governance in Aceh, as observed by the researcher in the field, provided a secure operational environment for the international aid agencies, and also underpinned other forms of post-tsunami community development in Aceh.

5.2.3.2 NGOs’ competence for housing reconstruction

The NGOs’ competence to undertake the implementation and management of housing construction projects was a major concern after the tsunami. This concern emerged as a real problem as the rebuilding process advanced. As described earlier, most NGOs were not specialized in physical infrastructure reconstruction. Field observations and interviews suggest that while some NGOs successfully adapted to these new construction tasks, many others failed to provide quality housing. The housing project failures included low quality construction materials, less seismic-resistant structures, and absence of amenities connecting to the housing system. Consequently, a number of completed houses were abandoned by the communities or remained empty. Construction of a large number of houses was also suspended due to low quality of existing structures or a sudden stop of fund flow.
Field interviews suggest that low quality of these housing projects managed by the aid agencies was attributable to various reasons such as lack of quality control, weaknesses in supervision, and a low level of employment of the qualified construction specialists within NGOs. These reasons raised a fundamental question about the competence of aid agencies in physical housing reconstruction. It has to be noted that the Code of Conduct for the humanitarian aid agencies, such as ‘Code of Conduct for the International Red Cross and Red Crescent Movement and NGOs in Disaster Relief’ and Sphere Project standards, only address issues in humanitarian development. The requirements for capacity to conduct construction works were not taken into account by the aid agencies at the early recovery stage.

The role shift from a recovery facilitator to a construction project manager in post-tsunami reconstruction posed unexpected challenges to those involved aid agencies in Aceh. Without prior experience in construction of housing, the reconstruction process was significantly affected by numerous bottlenecks and was much slower than intended, particularly in the case of procurement of quality resources including competent trades people, contractors, skilled labour and building materials. This will be discussed in detail further in this chapter.

5.2.3.3 Housing recovery outcome in Aceh —Quality? Vs. Speed?

This section takes a closer look at the donor-driven approach to housing reconstruction in Aceh. The influx of international aid to the tsunami-affected areas was inflationary in the construction sector (Steinberg, 2007). The way these international aid agencies organized their interventions in housing recovery can be gleaned from the following quotes during interviews.

‘Most of NGOs’ housing interventions were planned and implemented rapidly, and in isolation from the local political, economic and social environments’ (synthesis of views from BRR1, P3-5 and P11).

As a result, ‘local skills, preferences and needs tended to be marginalized in preference for speed, and little effort was made in knowledge management during the reconstruction process’ (Co3).
In addition, ‘pressures for housing numbers from government and donors caused aid agencies to rush the procurement of resources regardless of their limited capability, shortages of qualified staff, and inadequate development plan for long term projects’ (P8).

Field observations and interviews suggest that donor-driven housing reconstruction in Aceh was not in line with BRR’s recovery plan, as described in the preceding section. More than three years after the tsunami, many households continued to live in temporary shelters or tents and struggled to rebuild their homes. In 2005, BRR encouraged Universitas Syiah Kuala (UNSYIAH), the Banda Aceh based State University, to provide third party monitoring and evaluation on housing reconstruction. The survey, which was conducted between 2005 and 2006, monitored settlement recovery of 805 homes of about 61 organizations in 161 locations in Aceh. Three key indicators to benchmark the success of each project were used: construction quality index (0 to 4), satisfaction index (-9 to 9), and accountability index (0 to 10). The accountability index and satisfaction index are based on the beneficiaries’ opinions of their benefactor, whereas the construction quality is measured through direct on-site observation with a building inspector, architect and civil engineers. The quality was measured by the Aceh Building Code standard. The average result was that the construction quality index scored 2.58, satisfaction index was 1.2 and accountability index was 6.0 (UNSYIAH and UN-Habitat, 2006).

The above survey results, along with the researcher’s field observations, suggest that most donor-driven and contractor-build housing projects in Aceh had faced serious problems in construction quality, satisfaction and accountability. The most poignant was the satisfaction index. Since the satisfaction index is closely related to community participation, it means that the reconstruction failed to meet the beneficiaries’ needs with less participation by the community. In addition, the difficulties contractors faced in terms of procuring building expertise and materials were shifted to NGOs who had little construction experience in housing, and eventually had to turn to international construction professionals for remedial solutions. Aid agencies overlooked the time these specialists would need to become established locally and to familiarize themselves with reconstruction activities. Inevitable project failure and the resultant construction delays and rework thus took place. The following section presents the research findings with respect to resourcing for housing reconstruction under this donor-driven approach.
5.3 Resourcing stakeholders for housing recovery in Aceh

As mentioned in Chapter Three, resourcing stakeholders under different post-disaster recovery and reconstruction environments may play a varied role in securing resources for housing projects. This section examines the role of the involved resourcing stakeholders in the case of post-tsunami housing reconstruction in Aceh.

5.3.1 Resourcing facilitator: BRR, multilateral agencies, and NGOs

Field observations and interviews show that the increased housing demands and lack of construction resources had generated a competition for available resources among the implementing aid agencies. In response to the resource pressures, the Indonesian Government through BRR, along with a number of multilateral organizations and NGOs adopted various measures. This section outlines these measures.

5.3.1.1 Measures adopted by BRR

In response to the resource shortages after the tsunami for housing reconstruction, BRR adopted a series of regulatory measures as follows.

1) **Cost ceiling for housing reconstruction**: In early 2005, BRR issued cost ceilings of $3000 for housing units and $500 for habitat-related infrastructure. Field interviews suggest that most recovery implementing NGOs were reluctant to follow the cost ceilings. The reason was partly because these aid agencies considered the maximum cost limits for house rebuilding were not realistic, given the inflationary chaos in Aceh following the tsunami. In early 2006, BRR doubled cost ceilings for housing projects. However, most organizations still ignored this mandate. BRR loosened its mandated control on housing price and turned a ‘blind’ eye to the cost escalation of rebuilt houses.

2) **New timber administration rules**: In light of the tsunami impact on the natural environment, in 2006, the Government reviewed its timber administration rules. ‘Green Aceh’ vision was conceived and proposed by the Aceh Governor for no-logging movements during the period of post-tsunami reconstruction. On January 1, 2007, the new timber administration rules Penatausahaan Hasil Hutan (PUHH) were officially issued and implemented in Indonesia. These rules imposed strict requirements on the
utilization of domestic forest products. The World Wildlife Fund (WWF) and other conservation NGO programs also promoted the use of imported timber from sustainably managed forests for post-tsunami reconstruction in Aceh. The regulatory changes, however, significantly affected donors’ timber procurement for reconstruction and rehabilitation. The detailed discussion with respect to availability of timber resources for housing reconstruction will be presented in the following sections.

3) **Supervision for the transportation of timber resources**: As could be expected, the new timber administration rules reduced the possibility for donors to procure local timber in Indonesia. A number of NGOs had to resort to donor countries or other countries for timber resources, such as Canada, New Zealand and Australia. However, once landed in Indonesia, lengthy procedures for customs and inspections were likely to hold up the delivery of these imports to construction sites, as did road bandits in northern Sumatra. BRR thus took an additional role in assisting the aid agencies in supervising the shipment and transportation of the timber resources.

5.3.1.2 **Facilitation and support from the multilateral agencies and NGOs**

During the reconstruction period between 2005 and 2007, many construction materials such as timber, bricks, and cement had to be brought in from outside Aceh and even further afield. In response to this situation, multilateral agencies such as the World Bank and the Asian Development Bank, initiated a number of support programs to increase the local production capacity of these materials. Examples that were representative of this facilitation are outlined below.

1) **UNDP construction boom analysis**: In 2005, UNDP (2005a) funded AustCARE to re-establish sustainable, income-generating brick production businesses in three villages of Aceh Besar, a sub-district of Banda Aceh. In 2006 UNDP conducted a widespread survey across the construction sector on brick supply and demand for housing reconstruction in Aceh and Nias. To address the shortage of bricks for house rebuilding, UNDP proposed the use of concrete blocks as a substitute to bricks and provided finance to local small-scale brick enterprises for engaging new production technologies.
2) **ADB loan for rebuilding cement production facilities**: Between 2007 and 2008, the Asian Development Bank (2008b) provided an Indonesian rupiah-denominated loan of up to US$45 million for rebuilding PT Semen Andalas Indonesia’s (SAI) cement facility destroyed by the tsunami. The reconstruction of this cement facility in Aceh, to a great extent, increased the supply of cement for both housing and infrastructure rebuilding projects. The project also helped revive the local economy in Aceh, especially in construction associated industries through employment generation and promotion of related businesses.

3) **ILO skills training and education**: Between 2005 and 2008, the International Labour Office (ILO) initiated the ILO Aceh-Nias Tsunami Response Programme in Aceh as part of its post-tsunami reconstruction effort. The Programme was aimed towards supporting youth employment in Aceh, including the Education and Skills Training Project and labour intensive work with the Local Resource-based Road Works in Aceh and Nias project. The implementation of these activities helped increase the provision of local skilled labour and trades people for the recovery and reconstruction in Indonesia. Furthermore, by embedding community participatory approach in the training programs, ILO successfully transformed a large number of tsunami-affected people into skilled workers for rebuilding their own houses.

### 5.3.2 Resourcing manager: NGOs and local construction contractors

Field observations and interviews suggest that in managing housing reconstruction projects, aid agencies had been subject to various resourcing pressures posed by the local construction industry in Aceh. During decades of civil war, construction and development activities in Aceh had been very limited. In-field interviews show that even the local contractors were unable to access the quality stuff and building materials required for their construction projects. As some interviewees claimed:

‘*The construction industry in Banda Aceh, particularly after decades of civil conflict, was insufficient for large-scale reconstruction. Nearly 95% contractors, solutions, materials and expertise were imported from outside Banda Aceh, mainly from Java*’ (synthesis of views from P4, P6-8, Co2, and Co4).
Therefore, the implementing aid agencies who had little procurement experience and skills had to deal with the shortages of resources to ensure the smooth reconstruction of housing projects. The resourcing difficulty that confronted these aid agencies was compounded by competition for available resources in the market. As a number of interviewees stressed:

‘The fact, that the ‘window of opportunity’ of post-tsunami reconstruction turned out to be a ‘competition arena’ for NGOs to showcase their capability and competencies in the humanitarian course, is however, a major contributor to resource shortages during post-tsunami housing reconstruction’ (synthesis of views from P2, P5, P10, and Co2).

The difficulty in procuring timber resources for housing reconstruction was particularly prominent in Aceh. According to Dercon (2006), in the short run, no aid organization was big enough to get its feet into the oligopolistic timber business and the interests controlling timber transport. Most aid agencies ended up paying a higher price for timber resources. Despite the advocacy for alternative, wood-free construction, using metallic or aluminum structures, only a few aid agencies changed their design for alternative housing types. The majority of NGOs suffered construction delays and cost overruns due to the bottleneck to procuring timber resources.

5.4 ‘Indicator resources’ and their availability for post-tsunami housing recovery

Having discussed the key resourcing stakeholders and their interrelationships in resourcing for housing recovery in Aceh, this section presents the research findings with respect to ‘indicator resources’ during the post-tsunami housing recovery process and their availability. Between 2005 and 2006, Nazara and Resosudarmo (2007) conducted a longitudinal monitoring of the prices of the most common building materials and wages of labour. The cost escalation of these resources is shown in Table 5.7. Field interviews and observations identified the ‘indicator resources’ that were subject to shortages during the tsunami reconstruction and had a persistent impact on the housing recovery projects. These ‘indicator resources’ were construction timber, cement, brick and labour. The case study in this chapter is therefore focused on analyzing the availability of these four types of ‘indicator resources’.

215
Table 5.7 Cost of resources in Aceh, from 2004 to 2006 (Nazara and Resosudarmo, 2007, p. 40)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Unit¹</th>
<th>End 2004</th>
<th>Mid-2005</th>
<th>Early 2006</th>
<th>Oct 2006</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>labour</td>
<td>Rp 000/day</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>50</td>
<td>67</td>
</tr>
<tr>
<td>wood</td>
<td>Rp million/m³</td>
<td>1.0</td>
<td>1.5</td>
<td>1.9</td>
<td>2.2</td>
<td>120</td>
</tr>
<tr>
<td>cement</td>
<td>Rp 000/50kg</td>
<td>20</td>
<td>26</td>
<td>34</td>
<td>37</td>
<td>85</td>
</tr>
<tr>
<td>sand</td>
<td>Rp 000/3m³</td>
<td>150</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>brick</td>
<td>Rp each</td>
<td>250</td>
<td>580</td>
<td>700</td>
<td>700</td>
<td>180</td>
</tr>
</tbody>
</table>

Note 1: Rp is Indonesian currency symbol.

5.4.1 Availability of construction timber for housing recovery

During the interviews in Banda Aceh, all the interviewed participants agreed that one of the major resourcing obstacles they had faced during the recovery process was lack of sustainable timber supply. Initially, BRR estimated that the masonry-based housing reconstruction in Aceh and Nias would need 1.5 million cubic meters of timber. Both BRR and many aid agencies expected the timber demands to be met by normal domestic timber production, along with a small amount of imported timber and supplies from the donor countries.

Meanwhile, there was a consensus among the BRR, donors, and NGOs that reconstruction activities in Aceh and Nias would only use legal timber, and where possible would only use timber available locally or from elsewhere in Indonesia (Jawa Post, December 27, 2006). Therefore, from the outset, these legal and administrative constraints had, to a certain extent, restricted the supply of timber for post-tsunami reconstruction. For instance, there were large stocks of seized illegal timbers in Aceh and some NGOs were waiting for these stocks to be released for use. However, field interviews suggest that the Indonesian Government did not effect this release with a concern that the legalization of illegal timber might encourage further illegal logging.

Domestic timber supply in support of tsunami reconstruction was further exacerbated by the timber administration rules issued by the Indonesian government on January 1, 2007. These rules, as described earlier, reduced the possibility for donors to procure domestic timber in Indonesia. Field observations show that a large number of NGOs turned to procure timber resources from donor countries or other producing countries. However, the requirement for timber imports
introduced additional pressures to these NGOs. They were confronted with difficulties in purchasing quality construction timber with suitable guidelines from donor countries, and the logistical challenges of importing timber from overseas. Lengthy lead time of imports also affected the construction of houses on site. As the following quotes indicate that:

‘The lead time of imported timber from overseas, such as Australia, Canada and New Zealand, was three to four months.’ (P11). As a result, ‘some NGOs ended up with new houses that incurred cost and time overruns’ (synthesis of views from P6 and Co4).

Field interviews also suggest that between 2006 and 2008, the difficulties in accessing the stocks of seized illegal timber, couple with the need for importing timbers from overseas, had led to a large increase in timber prices, imposing extra financial burdens on the aid agencies. The assessment of timber availability for post-tsunami housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 5.8.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Large stocks of seized illegal timber resources  
• Low capacity of local timber supply  
• Significant impact of increased cost on the implementing agencies |
| **Usability** | • Quality concerns about both local procured and overseas imported timber  
• Lack of substitutes for timber resources |
| **Accessibility** | • Lack of access to the illegal timber stocks in Indonesia  
• Legal constraint on accessibility of domestic forest product since 2007  
• Concerns about secure transportation and other infrastructural capacity  
• Complex logistics from overseas donor countries |

5.4.2 Availability of cement for housing recovery

As could be expected, the changes in the housing approach from timber-based construction to masonry-based structure would increase the demands on the local cement supply. According to ADB (2007), in 2005, there were nine cement companies in Indonesia operating fifteen cement plants with a total installed production capacity of 46.1 million metric tons. Among these nine
companies, PT Semen Gresik, PT Semen Padang, and PT Semen Tonasa were part of the Semen Gresik Group that was 51% owned by the Government and held the largest market share of 45.3%. The next top two and top three companies were subsidiaries from international companies in Germany and Switzerland respectively. These top three companies had 73% capacity in Java. The other four small cement producers operated in Sumatra and elsewhere in Indonesia.

Field interviews suggest that the increased demand for housing reconstruction in Aceh and Nias had significantly pushed up the domestic cement prices. These companies had to progressively shift their sales from exports to the domestic market to meet reconstruction needs. The material of cement, however, has a low value-to-weight ratio. The geographic coverage of cement facilities can also have an effect on the price of cement materials. Therefore, each of the above producers had adopted a geographic focus for its sales and distribution network. In Aceh, for instance, the PT Semen Andalas Indonesia (SAI)’s cement production facility was the only one near Banda Aceh. However, this facility suffered major damage during the tsunami and ceased production. During the post-tsunami reconstruction, housing projects in Banda Aceh experienced a shortage of cement which, coupled with price speculation, drove up cement prices. According to the statistics of ADB (2008b), the cement price increased by 63%; from Rp 25,500 per bag in 2004 to an average of Rp 41,600 in 2005. The cement price in Aceh was about 8.7% higher than prices in Sumatra and 10% higher than in Indonesia as a whole. A significant portion of this price gap was due to increased transportation cost when importing cement from other regions of Indonesia and even from Malaysia.

When the researcher conducted the field trip in 2008, Aceh was still facing a crisis of cement shortages. The construction-related facilities, such as tsunami-damaged production facilities, the road linking the city of Medan with Banda Aceh, and a loading port in Padang, were still under construction. The manufacturers had to ration their supplies to match the excessive cement demand. However, field interviews suggest that in pursuing rebuilding speed, some NGOs in Aceh turned to importing cement from India and Malaysia with a high price. Lack of quality inspections meant that the quality of the imported cement materials may not be guaranteed. Consequently, a few NGOs had to re-purchase cement from domestic producers. Such a procurement process had been time-and cost-consuming.
Profiteering was also observed by the researcher in Banda Aceh as some traders were selling cement at a black market price with questionable quality. One housing recovery coordinator also made this point during the interviews.

‘The properties of cement entail risks of hardening within the supply chain process unless proper logistics and infrastructure facilities are available during transportation and storage. However, unreliable supply from both domestic and overseas companies hampered the progress of construction. In many cases, the half-completed concrete structure had to be demolished due to the disrupted cement supply’. (Co2)

The overall assessment of cement availability for post-tsunami housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 5.9.

Table 5.9 Availability of cement for tsunami housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Reduced production capacity due to the impact of tsunami  
• Limited number of cement producers in Aceh  
• Significant impact of increased cost on the implementing agencies |
| **Usability** | • Quality concerns about overseas imported cement from Indian and Malaysia  
• Easily hardening property requires proper logistics and infrastructure facilities |
| **Accessibility** | • Damaged transport networks  
• Sparse geographic coverage of cement production in Indonesia  
• Lengthy lead time from the domestic cement manufacturers |

5.4.3 Availability of bricks for housing recovery

Following the tsunami, both BRR and a number of aid agencies such as IOM and the World Bank conducted individual damage and needs assessment for post-tsunami recovery and reconstruction. According to UNDP (2006a), there were 1,412 small brick businesses in Aceh in 2005, that produce approximately 1.38 billion bricks per year. Based on this figure, the potential brick supply for a recovery period of 2005-2009 can be 6.85 billion. However, BRR’s survey had
put forward a requirement for 3 billion bricks for the reconstruction of Aceh and Nias during the recovery period. The United Nations Joint Logistics Centre (UNJLC) had a different number — approximately 1.5 billion bricks were needed for housing reconstruction. There was significant variance in these estimates for tsunami reconstruction. However, by comparing the supply estimate with the demand of bricks for reconstruction, instead of being shortage, there was likely to be a surplus of bricks during the construction boom.

This was not the case during the post-tsunami reconstruction. According to the Aceh Central Bureau of Statistics (BPS) and World Bank calculations (2005), there had been a 100% increase in the price of bricks between December 2004 and October 2005. The inflation caused by the shortages of bricks had casted doubt on the accuracy of the above demands assessments. Field interviews suggest that there was no coordinated approach to damage assessment and there was no reliable demand and supply assessment that could truly indicate the efforts and resources needed for recovery and reconstruction. In 2008, more than three years after the tsunami, there was still a significant shortfall of bricks for housing recovery in Aceh and some NGOs’ housing building works were delayed due to the shortage of bricks. Some interviewees mentioned that their organizations imported high quality bricks from Medan with expensive transport costs.

According to the interviewees P3, P7, and Co3, the large number of brick businesses in Aceh and their seemingly full operation status after the tsunami, had paradoxically helped to mask imbalances in the production of quality bricks for housing reconstruction. The interviewee Co 3 estimated that only 20-30% of local brick supplies in Aceh were high quality. The seemingly easy procurement of bricks with low quality from the local supply chains, to a great extent, frustrated many reconstruction agencies. Some interviewees such as P3, P4, and P7 stressed that this situation had continued for a long time between 2006 and 2008.

Field interviews suggest that low quality of bricks was attributed to the poor quality of raw materials for making bricks, such as clay and sand, poor quality of timber in brick kilns, and flawed operation of machines. The difficulty in procuring sustainable timber, as described earlier, also had an impact on the quality of brick kilns, and thus the final quality of bricks. Some of aid agencies such as UNDP, Mercy Corps and Architecture Clinic proposed to develop concrete blocks as substitute for bricks. However, field interviews suggest that there was widespread reluctance among the local beneficiaries to accept this alternative. Many aid agencies tended to
import quality bricks from outside Banda Aceh, especially from Medan. However, high transportation costs, and poor infrastructure for brick dispersal and delivery greatly contributed to its inflation in Aceh. The overall assessment of brick availability for post-tsunami housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 5.10.

Table 5.10 Availability of bricks for tsunami housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Seemingly oversupply capacity in Aceh, but salient inflation of brick price  
• 20-30% production capacity associated with good quality of bricks  
• Significant impact of increased cost on the implementing agencies |
| **Usability** | • Quality concerns of the local brick supply  
• Quality of raw materials and skilled labour operating machines  
• Quality of timber brick kilns |
| **Accessibility** | • Poor infrastructure for dispersal and delivery of imported bricks  
• High transportation costs  
• Beneficiaries’ unwillingness to use concrete blocks as a substitute for bricks |

5.4.4 Availability of skilled labour for housing recovery

The construction boom in Aceh after the tsunami caused an inflationary impact on the labour force required for housing recovery projects. The increase in housing construction costs was also driven by higher wages for skilled labour such as carpenters, painters and masons. Field observations and interviews suggest that skilled construction labour was in scarce supply in the tsunami-affected Banda Aceh due to the pre-tsunami existing industry problem, as described earlier. The tsunami destroyed the livelihoods of many people and created local unemployment. Most of the unemployed people such as local fisherman, farmers and small traders with little or no construction skills became involved in a series of skill-training programs to support housing reconstruction. However, both these affected and the training providers had overlooked the fact that substantial skill development for the specialized type of labour requires a certain length of
time. Short-term skill training and education after the tsunami was unlikely to meet the large-scale demand for housing and infrastructure reconstruction in Aceh.

In response to this, both BRR and the implementing aid agencies encouraged the import of skilled labour from outside Aceh, mainly from Java. The extra expenditure from both imported skilled labour and locally employed labour lifted overall demand in the local economy. In line with the study conducted by Jayasuriya and McCawley (2008), field interviews suggest that over time, more skilled workers were recruited to ease the shortages, and in the medium term, increasing numbers of unskilled workers had learned specialized construction skills and expanded the supply of skilled labour available. The major challenge most aid agencies confronted in sourcing skilled labour for reconstruction, however, concerned the workmanship of these workers. Another difficulty in employing competent labour was related to their mobility. The researcher’s participative observation verified this situation. The following statement presents the researcher’s experience as an example.

In April 2008, serving as a structural consultant, the researcher needed to employ a few labourers for a short time in the field. By approaching the head of a construction management team, the researcher was referred to the community liaison officer who was able to provide required labour resources from the local community. The labour wage was agreed by the responsible financial officer, the construction manager, and the researcher at a rate of Rp. $ 60,000 per day for six hours. Among the eight labour personnel, on the third day of the work, two did not turn up on the construction site, and on the following day, another four quit. The construction work under the supervision of the researcher was therefore delayed. The researcher was told by the community liaison that those resigned labourers had found jobs with higher wages provided by other reconstruction aid agencies. Interviews with a few project managers show that this was common. Rp. $ 60,000 was a market average rate of labour payment. The implementing aid agencies could set the price freely across the region.

Further field interviews revealed that there was a standard set by IFRC in Banda Aceh office to regulate the payment for labour. However, this standard was practically ignored by the aid agencies when sourcing skills. There was no other mechanism for coordinating the construction practice of those aid organizations in Aceh. The competition for qualified labour personnel had persisted over the housing recovery and reconstruction time. The extra expenditure for recruiting
skills for housing reconstruction not only contributed to an increase in overall construction cost but also created a vicious cycle that exacerbated the shortage of skilled labour. The overall assessment of skilled labour availability for post-tsunami housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 5.11.

**Table 5.11 Availability of skilled labour for tsunami housing reconstruction**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| Attainability | • Low local supply capacity due to the pre-existing industry problem  
• Lengthy skill development time  
• Significant impact of increased cost on the implementing agencies |
| Usability | • Workmanship concern with specialized labour such as carpenters and masons  
• Effective skill training for unemployed local tsunami survivors was required |
| Accessibility | • Imported from outside of Aceh, mainly from Java, and North Sumatra  
• Less accessibility to local qualified labour force  
• Unstable supply due to the competition among aid agencies |

### 5.4.5 Impacts of low resource availability on housing recovery projects

There were other specific building materials, such as steel and sand, identified by a few questionnaire respondents as causing procurement bottlenecks. However, the issue of procuring resources like sand and steel was not as prominent as the ‘indicator resources’ described earlier. These resources are therefore not dealt with by the current case study. Field interviews highlighted the impact of changes in fuel prices on the transportation of building materials and equipment for housing recovery since 2005. According to interviewee Co2, in the second half of 2005, the average fuel prices increased by 29% since March 1. The fuel price hike was due to the influence of the world oil prices and the fact that the government cut the fuel subsidy on March 1, 2005 based on Presidential regulation 22/2005. Escalating fuel prices had put more pressure on procuring resources required for housing recovery and reconstruction. The previous sections have described the impacts of low availability of ‘indicator resources’ on the housing recovery
projects. This section demonstrates these impacts with an example of ADB’s Earthquake and Tsunami Emergency Support Project (ETESP) in Aceh.

Between 2005 and 2006, increases of 200-250% in the cost of construction materials were observed in Aceh. Field interviews and observations suggest that significant cost escalation of building materials resulted in shortfalls between donor funding and actual requirements for housing. To reduce the funding pressure, some aid agencies had to compromise their housing number commitment to the local government and beneficiaries. In 2006, ADB reduced the targeted number of its ETESP housing units from 14,000 to 8,000 and from 10,000 units to be repaired and rehabilitated to 2,000 units.

Table 5.12 documents the ADB’s actual ETESP on-budget house price increase during 2005-2008 and the main reasons. The average cost of an on-budget concrete and brick house rose to about Rp 52-58 million in 2006 according to BRR guidelines and recommendations, in order to accommodate this price inflation. In remote locations, price increases were more pronounced as mainly experienced by the off-budget partners. The main operational problems related to on-budget and off-budget procurement alike were related to the limited human and material resources of the construction industry in Aceh and Nias. Construction materials such as steel, cement, and even timber came from Medan or from Java. Lack of local skilled labour in areas of reconstruction had caused delays and cost increases before, during and at the completion of construction. To avoid illegal logging, the use of certified legal timber had been enforced, which caused further delays. In consequence, BRR recommended the external agencies including ADB to use profiles of light steel for roof construction, especially for truss and purling. In 2008 most roofs had been built using the new technology of light steel. However, the high prices associated with using steel trusses as replacements for timber placed extra financial pressure on ADB.

As presented earlier, alternatives to limited timber and brick supply and other options for sourcing materials for construction were sought and reviewed by many organizations involved in Aceh reconstruction. The alternatives to timber products include such as steel trusses and roofs, windows, doors or coconut tresses as structural components. Despite their merits, such initiatives were unable to address the resourcing problems and reduce their impacts on housing project implementation in Aceh. The following section will present research findings with respect to critical factors that had an impact on resource availability for housing recovery in this case study.
Table 5.12 Cost of an ETESP house in Aceh (Asian Development Bank, 2009)

<table>
<thead>
<tr>
<th>Construction batch</th>
<th>Contract awarded</th>
<th>Unit cost (Rp. million)</th>
<th>% change</th>
<th>Factors driving price increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADB’s appraisal estimate</td>
<td>Estimate April 2005</td>
<td>28.8</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>SPAR estimate by PPC</td>
<td>Estimates of early 2006</td>
<td>60.0</td>
<td>—</td>
<td>Fuel price increase by 100% on 1 Oct 2005, ETESP house design modified from RSS on account of earthquake resistance requirements</td>
</tr>
<tr>
<td>Batch 1</td>
<td>April 2006</td>
<td>59.9</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Batch 2</td>
<td>July 2006</td>
<td>59.8</td>
<td>0.2</td>
<td>—</td>
</tr>
<tr>
<td>Batch 3</td>
<td>September 2006</td>
<td>59.8</td>
<td>0.1</td>
<td>—</td>
</tr>
<tr>
<td>Batch 4</td>
<td>April 2007</td>
<td>67.0</td>
<td>11.9</td>
<td>• Fuel price increase by 13% on 1 June 2006, • Huge demand for construction materials and labour influenced market price, • Design modifications to sanitation facilities, • Material of roof truss was changed from timber to light metal</td>
</tr>
<tr>
<td>Batch 5</td>
<td>April 2008</td>
<td>76.7</td>
<td>14.4</td>
<td>• Fuel price increase by 6% on 1 Nov 07, • Huge demand for construction materials and labour influenced market price, Design was improved to add room for kitchen</td>
</tr>
<tr>
<td>Batch 6</td>
<td>August 2008</td>
<td>89.6</td>
<td>16.8</td>
<td>• Fuel price increase by 28% on 24 May 2008, • Price of reinforcing steel increased by 56%, • Price of cement increased by approximately 20%</td>
</tr>
</tbody>
</table>
5.5 Critical factors that affected resource availability in tsunami housing recovery

Based on statistical techniques, the questionnaire survey result with respect to the critical factors that affected resource availability in housing recovery in the case study of the 2004 Indian Ocean tsunami is shown in Appendix 3. Among the five categories of factors, reconstruction stakeholder-related factors and environment-related factors were seen as being more significant than the other three groups. Table 5.13 presents the top ten variables perceived by the Indonesian respondents as being most significant in affecting resource availability in post-tsunami housing reconstruction. These ten factors are: competition for resources among aid agencies, local transportation capacity, project type, resource procurement lead time, local housing culture and customs, community influence and participation, local government support and assistance, competence of contractor, NGOs competency in resource procurement, and local production capacity.

<table>
<thead>
<tr>
<th>Factors affecting resource availability in post-tsunami reconstruction</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition for resources among aid agencies</td>
<td>1</td>
</tr>
<tr>
<td>Local transportation capacity</td>
<td>2</td>
</tr>
<tr>
<td>Project type</td>
<td>3</td>
</tr>
<tr>
<td>Resource procurement lead time</td>
<td>4</td>
</tr>
<tr>
<td>Local housing culture and customs</td>
<td>5</td>
</tr>
<tr>
<td>Community influence and participation</td>
<td>6</td>
</tr>
<tr>
<td>Local government support and assistance</td>
<td>7</td>
</tr>
<tr>
<td>Competence of contractor</td>
<td>8</td>
</tr>
<tr>
<td>NGOs competency of resource procurement</td>
<td>9</td>
</tr>
<tr>
<td>Local production capacity</td>
<td>10</td>
</tr>
</tbody>
</table>

With the use of content analysis, the identified ten key determinants can be classified into three categories for discussion: 1) NGOs-related factors including NGOs competency of resource procurement, and competition for resources among aid agencies; 2) external hurdles in the NGO implementing environment including: local transportation capacity, resource procurement lead
time, competence of contractor, local government support and assistance, and local production capacity; and 3) community-related factors including project type, local housing culture and customs, and community influence and participation.

5.5.1 NGOs-related factors

5.5.1.1 Competition for resources among aid agencies

Competition among NGOs for available construction resources was ranked highest by the questionnaire respondents. This result relates to the importance of coordination among the implementing agencies involved in Aceh’s post-tsunami reconstruction and the need to seek a collaborative procurement strategy for post-disaster resourcing. The reality, as mentioned in the last section, was that with the funding available at the initial stage of reconstruction, the potential threat of resource shortage for long-term rebuilding was largely overlooked by the NGOs. The field observations and interviews show that the quantity and schedule pressure of housing programs from off-site donors, along with the lack of coordination, had intensified the competition for high quality resources among the aid agencies.

For instance, as learned from the interviews, IFRC was tasked with the overall coordination for recovery activities among other National Red Cross and Red Crescent Societies in Aceh. However, due to varying local knowledge and expertise, varying access to communities and local governments, the IFRC national auxiliaries had a tendency to showcase their respective capabilities and competencies in humanitarian aid. The lack of adequate execution ability and the absence of a coordinating mechanism within the IFRC also contributed to this co-ordination failure. As a result, the role and responsibility for NGOs in post-disaster housing practice was undercut by this resource competition.

5.5.1.2 NGOs competency of resource procurement

NGOs’ competency of resource procurement was regarded by the questionnaire respondents as being the ninth most important factor in affecting resource availability. Field observations suggest that the resourcing approaches some of the NGOs adopted were largely dependent on tacit knowledge and improvisation at the operational level, leading to inefficient procurement practices and material shortages. Interview participants Co2 and P8 indicated that changes to the preliminary house design, such as replacing timber windows with the steel framed windows, had
resulted in large scale inventories of imported construction products within their agencies, causing material waste. The interviews suggest that the lack of sufficient construction professionals can account for the changes in design. At the initial stage of housing reconstruction, interviewee Co4 said there was only a limited number of trained staff to conduct comprehensive inspections of building designs. Furthermore, at the outset of reconstruction, the NGOs also underestimated the difficulty in resource procurement, as summarized by interviewee Co2:

‘Without qualified procurement personnel, suitable facilities and database systems, basic knowledge and technology regarding resource management in place within the aid agency, the resourcing difficulties escalated to a level that significantly impeded the development of housing programs’ (Co2).

Furthermore, local knowledge (Thanurjan and Seneviratne, 2009), in-house capability (Meding et al., 2008), and social networks (Winchester, 2000) are important components for the successful resourcing of international NGOs. According to the interviewees from BRR and the international NGOs in Aceh:

‘Apart from basic historical, social and economic stories, the necessary local knowledge for NGOs’ resourcing includes the traditional construction materials and techniques, construction knowledge and disaster mitigation technologies, local traditions and housing cultures, physical resource conditions, productivity, and other social development issues’ (synthesis of views from BRR1, BRR3, P6, P11, and Co1).

5.5.2 External hurdles in NGOs implementing environment

5.5.2.1 Local transportation capacity

Second highest ranking was given to ‘local transportation capacity’ in the questionnaire response. The significance of the transport network has been confirmed in previous studies with respect to post-disaster reconstruction, especially in regard to the high cost of resource transportation (Limoncu and Celebioglu, 2006), and lack of access (Singh, 2007). The impact of the poor infrastructure for resource dispersal and delivery was also discussed in earlier sections in this chapter. The resource transportation difficulty encountered by the NGOs in Banda Aceh was due to the lack of key requirements for infrastructure, such as roading connected to the housing system and slow development of critical facilities by the Indonesian Government.
The interviewee P10 stressed that in Aceh there was an over-investment in housing by the NGOs in ignorance of infrastructure connections. Apart from a few infrastructure rehabilitation works conducted by the local government, the United States Agency for International Development (USAID) was the sole agency tasked with the reconstruction of the road from Banda Aceh to Meulaboh which linked Aceh Province with the rest of North Sumatra and Indonesia. Field observations show that a number of houses in the field were built as being a stand-alone structure without sanitation fittings and drainage connections. Less development of local infrastructure, particularly transport networks linking the affected areas with other material production facilities, had added more difficulties for the aid agencies in sourcing resources for housing reconstruction.

5.5.2.2 Resource procurement lead time

The lead time for materials and supplies was perceived by the questionnaire respondents as being the fourth most important factor that had an impact on the productivity and performance of resource procurement. This result is consistent with the study by Singh (2007) who concluded that lead time associated with acquiring resources in post-disaster situations can be detrimental to the availability of these resources, especially in a construction industry which relies heavily on “just-in-time” delivery. The procurement lead time was contingent on a broader post-tsunami recovery environment. For instance, due to the new timber administration policy in 2007, the possibility for the donor community to procure large amounts of domestic timber resources was reduced. Evidence from the observations and interviews showed that the lead time for procuring timber off-shore was unpredictable, especially when negotiating and obtaining approvals from Indonesian authorities or encountering road bandits during transportation in northern Sumatra. Specifically, as the interviewees P1, P5 and Co3 reported, their agency’s importing of legal timber from countries such as Australia, Canada and New Zealand with lead times of three to four months led to consequences such as the suspension of construction and resources idle.

As described earlier, there was also a likely lengthy lead time for importing other ‘indicator resources’ such as cement and bricks from outside Aceh. Interviewee P10 mentioned that the international aid agencies were new to the area and had no good knowledge of the local production market. It was thus difficult for them to find a reliable and consistent materials supplier in both the Aceh region and further afield. The process of resource procurement for housing projects, as one project manager P4 reported, was quite different from the normal times,
fraught with a set of unexpected complexities and uncertainties, which led to long lead time and construction delays.

5.5.2.3 Local government support and assistance

Government support and assistance received a high score in the questionnaire survey. During our interviews, the need to increase involvement of local authorities in donor-driven resource procurement was stressed by all the interviewed representatives of NGOs. According to the interviewees P3 and Co1, some issues such as transportation safety, inspection of imported cargo and material inflation control, could only be properly addressed with the support of the BRR or local government. However, the paucity of tactical support from local government for resource procurement can be traced back to the beginning of housing recovery and reconstruction in Aceh. The representative BRR 1 stressed that:

‘Due to the limitations on Indonesia’s ability to absorb and utilize local capacities, BRR ended up fully relying on assumed support from NGOs’ (BRR1).

The limited local government capacity in the immediate aftermath of the tsunami seemed to give the external NGOs a ‘free hand’ at the housing design and planning stages. On the other hand, NGOs initially failed to seek close partnership with local institutions. The interviewee BRR3 pointed out that:

‘Initially it even took a long time for BRR to decide on the allocation of rebuilding tasks in the affected areas to a wide variety of NGOs’ (BRR3).

Both interviewees P7 and P10 from NGOs and BRR3 and BRR4 from BRR acknowledged:

‘At the start of the rebuilding, both sides (BRR and aid organizations) had different, even sometimes quite conflicting, rebuilding priorities and interests’ (Quoted from P7).

The differing recovery objectives between NGOs and the local government to some extent hindered effective collaboration at a later stage of reconstruction. In addition, it was true that, according to BRR2, the recovery and reconstruction on such a large scale was new to the Indonesian government. BRR was also an initiative of the Indonesian Government and there was
lack of the proper institutional arrangement for providing procurement assistance to the implementing NGOs.

5.2.2.4 Competence of contractor

The low competency level of contractors was regarded by the questionnaire respondent as a key constraint to housing project resource availability. Both the interview respondents P3 and P6 revealed that local contractors employed by NGOs were unable to meet the reconstruction requirements, especially in terms of procuring qualified building expertise and materials, and ensuring construction quality. As discussed earlier, contractor competence in Aceh was largely restricted pre-tsunami because of a decade of conflict. Some interviewees reported that:

‘The construction industry in Banda Aceh, particularly after decades of civil conflict, was insufficient for large-scale reconstruction. Nearly 95% contractors, solutions, materials and expertise were imported from outside Banda Aceh, mainly from Java’ (synthesis of views from P4, P6-8, Co2, and Co4).

Poor construction capability impaired the donors’ ability to complete housing reconstruction work. As a result, NGOs had to change their role in housing construction from a facilitator to a project manager with respect to resource procurement. The resultant large amount of outsourcing responsibilities had highly affected the donors’ financial and technical commitment and capacity to housing recovery and reconstruction.

5.2.2.5 Local production capacity

In the tsunami, the local manufacturing and production facilities in Aceh were widely damaged. Some development agencies like the UNDP (2006a), the Asian Development Bank (2007) and the World Bank (2008) were engaged in financing the development of small and medium sized enterprises (SME) fostering production recovery to assist with physical reconstruction and community redevelopment. Despite a number of material production plants being rebuilt, the overall supply capacity was still unable to satisfy the demands for large scale reconstruction and rehabilitation. The reason, according to the interviewee BRR2 was that:

‘These international NGOs brought in designs for the modernized houses which were very different from what the local people had before, but the materials were not out there and you
cannot expect the construction and operation of manufacturing facilities to happen overnight’ (BRR2).

However, field observations in 2008 in Aceh suggest that the business climate included a limited amount of accurate information on Aceh’s prospects, the lack of investment incentives provided by the government, and the impact of past conflict on social stability, hindering potential civic and external investments for Aceh’s economic redevelopment. Both the local government and the reconstruction practitioners overlooked the importance of a robust economic recovery to the success of physical housing reconstruction. The respondent Co3 commented:

‘The conditions in Aceh were not conducive for NGOs to maximize the utilization of local resources and even complicated and reduced the effectiveness of NGOs’ reconstruction endeavours’ (Co3).

5.5.3 Community-related factors

5.5.3.1 Project type and housing culture and customs

Project type, in this case namely housing type, is closely connected with indigenous housing culture and customs. Both factors were regarded as being important in the questionnaire survey. Therefore, this section will discuss these two factors together. As revealed at the beginning of section 5.2.1, the housing culture of Aceh traditionally utilized organic building materials such as timber, thatched grasses and bamboo. Field observations and interviews confirmed that a number of beneficiaries in Banda Aceh expressed their preference for a ‘modern’ westernized house which symbolizes solidity and social status. The new housing types introduced by the international aid agencies matched this local aspiration.

The cultural preference to housing type, however, placed extra resourcing burdens on the NGOs. As alluded to earlier, local capacity for producing the industrialized materials with high quality, such as cement, steel, concrete and mass-produced products, was unable to meet the large-scale requirements for masonry and concrete construction. Low local supply capacity made a number of NGOs procure these resources from outside Aceh with a significant increase in transport costs and a longer lead time. Interviewee P4 pointed out that the influence and participation of communities in early decision-making, such as selecting construction materials and techniques,
reflects donor sensitivity to community needs. However, in this regard, the interviewee P9 also made the following comment:

‘The community consultation on housing type in the tsunami-stricken areas in Indonesia was prominent. However, it also caused a whole lot of issues including resource availability and the resultant delays of housing delivery’ (P9).

5.5.3.2 Community influence and participation

Community influence and participation is seen by the questionnaire participants as being the sixth important factor affecting resource availability post-tsunami. A number of aid agencies such as the UNDP and UN-Habitat (2007) recognized that communities can bring in skills, networking, resources and capabilities which can facilitate donor-driven reconstruction activities. This result is also implied in the above discussion of the last factor ‘housing culture and customs’. However, despite the BRR’s community-driven recovery vision, in the examined case in this chapter, community participation in donor-driven and contractor-build reconstruction was limited and in certain affected areas NGOs failed to work closely with community groups in coordinating the relief effort. The reasons can be attributed to the NGOs’ lack of understanding, experience and knowledge of the way in which community-based reconstruction can be organized (Dercon, 2007).

Additionally, one interviewee reported:

‘In order to maximize community input, we set up a liaison team employing people from the local communities. However, without a community engagement mechanism in place in our organization, the information and feedback from the local communities were put aside by our key decision makers and then the liaison team became a mere formality’ (Co3).

Another interviewee stated:

‘The expectation of local communities for NGO assistance with rebuilding was very high whereas the awareness of local engagement and real participation was very low’ (P6).
Therefore, it can be concluded that under a donor-driven and contractor-build reconstruction mode, the potential for the affected local community to contribute to rebuilding their houses largely depends upon the readiness of both the aid agencies and the local communities concerned.

5.6 Conclusions and recommendations

The major aim of this chapter was to review and analyze the five elements in the resource availability framework within the context of post-tsunami housing recovery. This chapter started with a description of the 2004 Indian Ocean tsunami and its impact on Indonesia, particularly the city of Banda Aceh where the case study was conducted. The tsunami recovery and reconstruction-related institutional arrangements and policies were reviewed. Stakeholders involved in post-tsunami housing recovery were introduced, with a focus on their role and responsibilities in reconstruction. Characteristics of the post-tsunami housing reconstruction approach were also discussed.

In the second half of the chapter, the resourcing stakeholders for tsunami housing recovery projects were identified. There were four ‘indicator resources’, including timber, cement, brick and labour. The availability of these ‘indicator resources’ were discussed in terms of their attainability, usability, accessibility. The impacts of the low availability of building materials and labour on the housing reconstruction in Aceh were illustrated with an example of the ADB’s ETESP project. The research surveys concluded that the resource availability for donor-driven post-tsunami housing reconstruction in Aceh was connected with the internal context of the aid agency itself, including the mandate, capacity and skills to procure resources for reconstruction programs. On the other hand, resourcing difficulties in Aceh were also external to the implementing aid agencies and lay within the specific local context. In Aceh, insufficient reconstruction capability in the local construction industry, lack of an effective transport system and the intervention of government institutions all handicapped resource provision and supply after the catastrophe and also inhibited the ability of the donor community to acquire available resources.

Indonesia’s case raises concerns about whether the international aid agencies and donor society are adequately prepared for post-disaster reconstruction and, in particular, for resource
procurement in a post-disaster situation. Donor-driven resourcing, with available funding and the commitment of NGOs could be more effective if these aspects are sufficiently understood, resolved and blended into an organizational culture. The overall case study, however, points to the importance of continuous capacity building amongst NGOs, proactive resource assessment and planning, the strengthening of relationships with local community and institutions, together with a collaborative resourcing approach to addressing the resourcing constraints faced by NGOs when rebuilding communities following a disaster.

The emphasis of the government authorities in Indonesia on the alleviation of NGOs’ resourcing constraints should be on enhancing local capacity and legitimacy, strengthening infrastructure, and facilitating closer communication and coordination with aid agencies. The focus of the NGOs should be on extensively mapping construction capability and local material supply capacity at the early recovery stage, and be based on contextual reality, formulating resourcing strategies for longer term recovery and reconstruction. Both local government and NGOs, by improving local economic circumstances for business investment, could make an effort towards a development for enhancing the capacity of local institutions and market supply. To overcome both institutional weakness in NGOs and external complexities during the resourcing process, the recommendations outlined below are suggested for the involved stakeholders to consider and incorporate into their operations for improving NGOs’ resourcing performance:

1) In order to fully develop their capacity to procure external resources and manage their supply chains, NGOs need to develop better construction knowledge and understanding. Of conditions. Desired resource procurement requires dedicated procurement staff, the competence to implement all aspects of resourcing including: resource assessment, planning, purchase, delivery and management. NGOs should employ staff with professional expertise, such as architects, engineers and consultants who have a direct influence in the selection of appropriate housing type and resources. Involvement of the construction experts at an early stage can reduce problems of design iterations, poor construction management and re-working.

2) Resource availability for construction projects especially in a post-disaster situation requires proactive resource mapping, assessment and planning. Before commencing a reconstruction project, an assessment of local construction capability is likely to be able
to identify the extent of the resource need for housing reconstruction programs, and inform the selection of housing types in terms of building materials and techniques. Resource assessment can also help the aid agency to identify the key stakeholders, how to tackle potential resource constraints, what additional assistance and facilitation is needed from stakeholders, and what kind of partnerships and coordination structures are required.

3) It is important for NGOs to create a partnership environment with local communities and institutions to facilitate their procuring operations. Developing potential partner relationships at the initial recovery stage with local institutes or communities can help to form operational links between NGOs and local potential resources and capacities. Partnering connections can be established by twinning NGOs’ recovery and resource mapping, assessment and planning activities with government recovery plans and community redevelopment programs such as skills training and education. NGOs should involve government agencies and representatives from the affected community in the development of their reconstruction resourcing plans.

4) A collaborative resourcing approach between the various aid agencies is required. Materials sourced from outside of Indonesia such as timber and steel, if procured together among the aid agencies, can significantly reduce lead time and transaction costs. This advanced level of resource procurement requires networking across institutional boundaries, which leverage on and link together the critical capacities of other stakeholders. Continuous improvement to remove resourcing bottlenecks during post-disaster reconstruction also requires all the stakeholders to establish a culture of communication, coordination and collaboration.
Chapter 6 Resourcing housing recovery following the 2008 Wenchuan earthquake in China

6.0 Overview

This chapter presents research findings from the case study of the 2008 Wenchuan earthquake in China. The focus of this case study is to address the five elements in the resource availability framework within the context of post-Wenchuan earthquake housing recovery in Sichuan, China. These five elements are:

1) Post-Wenchuan earthquake recovery and reconstruction environment,
2) Post-earthquake housing recovery approach,
3) Resourcing stakeholders for earthquake housing reconstruction,
4) ‘Indicator resources’ and their availability, and
5) Critical factors that affect resource availability for post-earthquake housing recovery.

The documentary data was derived from official reports and documents published by the Chinese Government, NGOs and a variety of databases. Other qualitative data, including observational and interview records and audiovisual materials, were collected through a series of field visits to the earthquake-affected areas at the different stages of earthquake reconstruction. Based on a synthesis of data, the longitudinal case study in China provides a comprehensive understanding of the resourcing issues in Wenchuan earthquake recovery.

6.1 Post-earthquake recovery and reconstruction environment

This section sets the scene for the case study by providing an overview of recovery and reconstruction circumstances in China after the 2008 Wenchuan earthquake.
6.1.1 The Wenchuan earthquake and the city of Mianzhu

6.1.1.1 The 2008 Wenchuan earthquake in China

On May 12, 2008, an earthquake measuring 8.0 on the Richter scale struck Western China’s Sichuan Province and its neighbouring provinces, causing significant human losses and widespread destruction to buildings and infrastructure. The earthquake was commonly known as Wenchuan earthquake, as the epicentre was in Wenchuan County, a rural and mountainous region in Sichuan Province. The earthquake affected 417 counties (cities and districts) in ten provinces across the country. The locations of the quake-affected areas are shown in Figure 6.1.

According to the China Earthquake Administration (2008), the earthquake originated on the Longmenshan fault. The energy source of the Wenchuan earthquake came from the crush of the Indian Plate onto the Eurasian Plate and its northward push. The inter-plate relative motion caused large scale structural deformation in the Asian continent, resulting in a thinning crust of the Qinghai-Tibet Plateau, the uplift of its landscape and an eastward extrude. Near the Sichuan Basin, Qinghai-Tibet Plateau's east-northward movement met strong resistance from the South China Block, causing a high degree of stress accumulation in the Longmenshan thrust formation. This caused a sudden dislocation in the Yingxiu-Beichuan fracture, leading to the violent earthquake of M 8.0.
As of September 11, 2008, the earthquake death toll reached 69,266, with 374,643 people injured and 17,923 missing. Approximately 34,125 kilometres of roads, 1,263 reservoirs, 7,444 schools, 11,028 medical institutions and numerous urban and rural residences and factories were devastated by the earthquake (State Planning Group, 2008). The direct economic losses reached RMB$843.77 billion. Housing was the single greatest component of all losses in terms of economic value and buildings damaged. Around 7,789,000 housing units collapsed and 24,590,000 were damaged during the earthquake (Paterson et al., 2008). The impacts of the Wenchuan earthquake are summarized in Table 6.1.

Table 6.1 Impacts of the 2008 Wenchuan earthquake

<table>
<thead>
<tr>
<th>Life impacts</th>
<th>Infrastructural damage</th>
<th>Housing sector (units)</th>
<th>Economic loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death 69,266</td>
<td>Roads 34,125 km</td>
<td>Collapsed 7,789,100</td>
<td>RMB$ 843.77 billion16</td>
</tr>
<tr>
<td>Injured 374,643</td>
<td>Reservoirs 1,263</td>
<td>Damaged 24,590,000</td>
<td></td>
</tr>
<tr>
<td>Missing 17,923</td>
<td>Schools 7,444</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medical institutions 11,028</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16 Approximately US$ 123.66 billion
Following the earthquake, the affected areas were subject to persistent heavy rains and numerous aftershocks, which compounded the post-quake situation, leading to a large number of secondary hazards such as landslides, landslips, mud-rock flows and "quake lakes". The Asian Development Bank (2008a) described the Wenchuan earthquake as being a natural disaster that featured the strongest destruction, the widest impact range and the hardest rescue and relief efforts in China since the establishment of the People’s Republic of China. The following section further looks at the earthquake impact on the case study site — City of Mianzhu, one of the severely damaged jurisdictions in China.

6.1.1.2 The city of Mianzhu and earthquake impacts

During the earthquake, Sichuan Province was worst stricken with an area of 28,000 km² land affected, 1,295,000 ha farmland damaged, and 114.5 ha construction land and 101,000 ha forests destroyed (Reconstruction Planning Team, 2008). The case study of the Wenchuan earthquake took place in Mianzhu City, 30 kilometres from the earthquake epicentre of Wenchuan County. Situated in the northwest Sichuan Basin, Mianzhu is a county-level city administered by Deyang Prefecture. It covers an area of 1,245 km², and had a population of 513,859 17 in 19 towns and 2 townships. Figure 6.2 shows the location of Mianzhu City in Sichuan Province.

17 as of 2006
Before the 2008 Wenchuan earthquake, the city of Mianzhu was well known as ‘shining pearl’ of western Sichuan due to its rapid economic development in recent decades. It had been ranked as one of the top 10 industrial counties in Sichuan for a decade. Food processing, machinery, chemicals and building materials formed the pillars of Mianzhu's economy. Mianzhu is also the home to Jiannanchun, one of the country's top 10 liquor brands, being recorded in the national intangible cultural heritage list. The county has 40 mineral resources, including limestone, natural gas, coal, and phosphate.

Apart from the above credits, Mianzhu is renowned for its woodblock New Year paintings, which originated in the Ming Dynasty (1368-1644). The themes of paintings range from historic stories and fairy tales, to opera and dramas. Before the earthquake, there were more than 300 painting factories across the city with an annual production of 12 million items. The exportation of New Year paintings to domestic and overseas markets, including India, Japan and Vietnam, greatly contributed to the local economy. A summary of main characteristics of Mianzhu City before the earthquake is listed in Table 6.2.
Table 6.2 Characteristics of City of Mianzhu before the earthquake

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covering Area</td>
<td>1,245 km²</td>
</tr>
<tr>
<td>Topography/Geography</td>
<td>Located in the northwest Sichuan Basin</td>
</tr>
<tr>
<td></td>
<td>Inland industrial city</td>
</tr>
<tr>
<td>Demography</td>
<td>Population: 513,859</td>
</tr>
<tr>
<td>Governmental aspect</td>
<td>19 towns and 2 townships</td>
</tr>
<tr>
<td>Main economy</td>
<td>The Mianzhu City factory of Jiannanchun Group, a key alcohol manufacturer</td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
</tr>
<tr>
<td></td>
<td>New Year paintings production</td>
</tr>
<tr>
<td></td>
<td>Ranked amongst &quot;the top ten counties/cities&quot; of Sichuan</td>
</tr>
</tbody>
</table>

Mianzhu was severely damaged during the Wenchuan earthquake, with 11,117 people killed, 38,000 injured, and 258 missing\(^\text{18}\). In rural areas, approximately 133,800 house units were damaged or collapsed in the earthquake. In urban areas, however, 61,000 housing units were damaged or destroyed. Only 8% of housing units cross the city remained habitable after the earthquake. Infrastructure facilities including telecommunication, gas, and pipelines were subject to varying degrees of damage. The economic cost of the earthquake in Mianzhu reached RMB $142.3 billion. The impacts of the earthquake on Mianzhu City are tabulated in Table 6.3.

Table 6.3 Impacts of the earthquake on Mianzhu City

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected area</td>
<td>Nearly all</td>
</tr>
<tr>
<td>Earthquake impact on population</td>
<td>Before: 513,859</td>
</tr>
<tr>
<td></td>
<td>Killed: 11,117</td>
</tr>
<tr>
<td></td>
<td>After: 502,742 with 258 missing</td>
</tr>
<tr>
<td>Damaged or destroyed houses (units)</td>
<td>Rural: 133,800</td>
</tr>
<tr>
<td></td>
<td>Urban: 61,000</td>
</tr>
<tr>
<td></td>
<td>Total: 194,800</td>
</tr>
<tr>
<td>Economic cost</td>
<td>RMB $142.3 billion</td>
</tr>
</tbody>
</table>

\(^{18}\) As of June 19, 2008
In particular, the town of Hanwang in Mianzhu City, where the fault runs across the edge of the town, was struck hardest and experienced extensive damage. The photos in Figure 6.3 illustrate the earthquake impact on the town of Hanwang.

Hanwang town of Mianzhu before the earthquake, source: (Mianzhu Government, 2008)

1. Clock tower with all side clocks ceased at the time of 14:28 when the earthquake struck
2. East Turbine production plant after the quake
3. Collapsed and damaged buildings in residential areas
The emergency response to the Wenchuan earthquake was impressively rapid and decisive with enormous effort focused on rescue and resettlement. Contrary to the conventions, other agencies such as Chinese society and overseas aid agencies were actively engaged in assisting the local government in earthquake response. This section gives an overview of the response from different agencies and groups.

6.1.2.1 Response from the Chinese Government

As usual, following the Wenchuan earthquake, the People’s Liberation Army (PLA) played a significant role in searching, rescuing, repairing access and maintaining order. Other institutions were also set up in response to the earthquake, including the following:

1) **Earthquake Rescue and Relief Headquarters**: The State Council established the Earthquake Rescue and Relief Headquarters immediately after the earthquake, providing the fundamental principles and priorities for earthquake response and recovery in 51 affected counties. A three-month emergency period target was established to meet the basic needs of survivors. The Headquarters also set an overarching goal for a three-year recovery and reconstruction period. The outcomes would be that every family has a house,
every household has employment, every person has social and medical care, and the infrastructure, economy, and environment are all improved.

2) **Reconstruction planning team**: On May 16, four days after the earthquake, the Ministry of Housing and Urban-Rural Development of China formed a special team on reconstruction planning. Major urban planning and design institutes, along with a number of universities in China, participated in the reconstruction planning work. Between May and June, the planning team investigated the earthquake areas and checked desirable sites for temporary shelters, tents, prefabricated houses and permanent residential areas. A Master Plan, called the ‘State Overall Plan’, was developed for a three-year reconstruction period from 2008 to 2010 and a ten year development period. The State Plan will be discussed in the following section.

3) **General Coordinating Office for Earthquake Relief**: At the local level, the General Coordinating Office for Earthquake Relief was established in each affected municipality to organize and coordinate the relief work of army, police, medical staff, nongovernmental agencies and other social assistant individuals or groups. On June 11, the State Council approved ‘One-on-one Assistance Program for Wenchuan Post-earthquake Restoration and Reconstruction’. Under this program, 20 non-affected provinces cross China were paired with one of the quake-affected towns or townships. The sponsoring province was required to provide assistance to its earthquake-affected counterpart in terms of reconstruction planning, public infrastructure restoration, farmlands rearrangement, volunteer teachers, medical doctors and other in-kind supports. This pairing program will be specified in the following section in greater detail.

6.1.2.2 **Response from the civil society**

Field observations and interviews in June 2008 suggest that a heightened level of nongovernmental involvement was seen in the rescue and relief operations following the Wenchuan earthquake. For instance, the Chinese Red Cross was able to rapidly organize an action plan and receive government approval to implement their relief assistance to the earthquake-affected people. Other civil society organizations including NGOs, community groups and volunteers played a significant role in emergency response, particularly during the
early days for survivor search and rescue. Prior to formal assistance, many initial search and rescue efforts were provided by family members, neighbours, colleagues and local groups. In addition, a large number of civil groups from unaffected areas came to the earthquake areas, providing voluntary assistance. Field observations suggest that the outside human resources included school teachers, psychological counsellors and medical expertise and assistants. Interviews show that provision of psychological support services and interventions to affected people was new in China, and this had featured in the emergency response after the Wenchuan earthquake.

It has to be noted that it is the openness after the quake that provided a significant chance for those civil society groups to participate in relief efforts. However, many NGOs and INGOs failed to operate their programs in coordination with other organizations and local governments. This was possibly due to having less experience in delivering assistance and lack of coordinating mechanism to work with communities, government and other agencies in China. The Wenchuan earthquake, however, essentially provided an opportunity for these agencies to strengthen their capacities within China’s specific context.

6.1.2.3 Technical assistance from overseas experts

Immediately after the earthquake event, many scientific and engineering societies from overseas organized reconnaissance trips to the earthquake-affected areas. There were various types of mutual cooperation and information-sharing between these foreign consultants and their counterparts such as the local governments, research institutes and universities. The external agencies provided technical supports to local researchers, engineers and practitioners in aspects such as damage assessment, structural restoration and community rehabilitation. Furthermore, a number of INGOs, such as Build Change and Emergency Architects, set up their recovery office in the earthquake-affected areas. With expertise in building disaster-resistant houses, these organizations were actively involved in the post-earthquake reconstruction by providing technical support for the local affected populations.

In all, unlike the usual stance the Chinese government adopted in response to a natural disaster, in the case of Wenchuan earthquake, the openness and willingness of the Government to work with civil society and foreign technical agencies was significant. The Wenchuan earthquake
posed a great challenge for the Chinese government and its disaster management system. With more involvement of local communities and different types of NGOs, the earthquake recovery was still led and managed by the Government. Its substantial effort in responding to the earthquake, according to the Asian Development Bank (2008a), had gained praise from both within and outside the country.

6.1.3 Institutional arrangements for post-earthquake recovery

6.1.3.1 Post-earthquake recovery and reconstruction legislation

Following the earthquake, the State Council took swift legislative action to establish a multi-governmental management framework for the recovery endeavour. On June 8, 2008, ‘Regulations on Post-Wenchuan Earthquake Restoration and Reconstruction’ (The Regulations) came into effect to guarantee the standards of post-disaster reconstruction work. This law set guidelines for the reconstruction and provided an important legal basis for various departments and government agencies, both inside and outside the quake-hit region, to assist with recovery and reconstruction. The guiding principles specified in The Regulations encompass areas such as damage assessment, temporary housing, reconstruction planning, financing, implementation and management.

The Regulations were formulated on a basis of the existing laws, including the Emergency Response Law of the People’s Republic of China, and the Law of the People’s Republic of China on Earthquake Preparedness and Disaster Reduction. The Regulations stipulate that the post-Wenchuan earthquake recovery and reconstruction conform to six principles, listed in Table 6.4.

Table 6.4 Principles for post-Wenchuan earthquake reconstruction

<table>
<thead>
<tr>
<th>Principles for post-Wenchuan earthquake reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Self-reliance and self-help production in disaster-stricken areas combined with state support and one-on-one assistance</td>
</tr>
<tr>
<td>2 Government dominance combined with social participation</td>
</tr>
<tr>
<td>3 In-situ rehabilitation and reconstruction combined with ex-situ new construction</td>
</tr>
<tr>
<td>4 Quality guarantee combined with efficiency enhancement</td>
</tr>
</tbody>
</table>

20 Also known as ‘Wenchuan Earthquake Disaster Recovery and Reconstruction Act’
5 | Short-term considerations combined with long-term considerations
6 | Economic and social development combined with protection of ecological environment and resources.

The Regulations set out that the National Development and Reform Commission (NDRC) is responsible for arrangements of the overall planning; providing policies and suggestions, and implementation plans; organization and coordination and rebuilding major infrastructure projects. With regard to the implementation of Wenchuan earthquake rehabilitation and reconstruction at the local level, The Regulations define the structure of involved reconstruction agencies in which the provincial government takes a lead role to organize and implement the post-earthquake reconstruction. The relevant departments under the State Council are required to provide support, assistance and guidance for the work of recovery and reconstruction in the earthquake-affected areas. The governance structure for post-Wenchuan earthquake recovery and reconstruction is shown in Figure 6.4.

Figure 6.4 illustrates that instead of having one centralized recovery authority to manage the overall post-earthquake recovery and reconstruction, the government at different levels played an important part in disaster reconstruction planning and implementation. The line ministries and their provincial and sub-provincial governments were also permitted to adjust their own budgetary expenditure structure in favour of the disaster areas (Dunford and Li, 2011). This structure diagram is also indicative of the way the Chinese Government mobilized administrative, human and material resources at different levels to assist with the reconstruction of earthquake affected communities.

The Regulations was the first law formulated for post-disaster recovery and reconstruction in China. The principles stipulated in The Regulations ensure that post-Wenchuan earthquake reconstruction work will be implemented in a legislated way. ‘The Work Scheme for Post-Wenchuan Earthquake Reconstruction Planning’ was approved by the State Council on June 13, 2008. This Scheme combined with The Regulations placed a solid guiding basis for planning earthquake recovery and reconstruction.
6.1.3.2 The Overall Plan for Wenchuan earthquake reconstruction

On August 12, 2008, three months after the earthquake, a comprehensive reconstruction plan ‘The State Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction’ (The State Overall Plan/Master Plan) was released for public review. This Master Plan included ten specific plans, covering urban systems, rural development, urban-rural housing, infrastructure, public service facilities, productivity distribution and industrial restructuring, market service system, disaster prevention and mitigation, ecological rehabilitation, and land use. In the Master Plan, the guarantee of people’s well-being was deemed the fundamental issue in post-Wenchuan earthquake restoration and reconstruction. The top recovery priority was given to repairing and
rebuilding the urban and rural residential houses, restoring public facilities and infrastructures, to ensure the resettlement, stability and reassurance of the affected population.

The State Overall Plan, however, was confined to seriously-affected areas and divided the 51 disaster-affected counties into three categories: 1) areas suitable for reconstruction, 2) areas suitable for appropriate reconstruction, and 3) ecological reconstruction areas; as shown in Table 6.5. Following the Plan, between August and November 2008, ten more specific reconstruction plans were formulated. On October 14, 2008, the State Council established the ‘Group for Coordinating Restoration and Reconstruction’, replacing the Earthquake Rescue and Relief Headquarters. This Group, however, was merely an administrative office reporting the recovery progress to the State Council. The provincial governments in the stricken provinces were primarily tasked with overall reconstruction.

<table>
<thead>
<tr>
<th>Type</th>
<th>Area (sq.km)</th>
<th>Proportion in the planned areas (%)</th>
<th>Population (ten thousands)</th>
<th>Proportion in the planned areas (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas suitable for reconstruction</td>
<td>10,077</td>
<td>7.6</td>
<td>772.8</td>
<td>38.9</td>
</tr>
<tr>
<td>Areas suitable for appropriate reconstruction</td>
<td>38,320</td>
<td>28.9</td>
<td>1,180.1</td>
<td>59.4</td>
</tr>
<tr>
<td>Ecological reconstruction</td>
<td>84,199</td>
<td>63.5</td>
<td>33.8</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Table 6.5 Reconstruction divisions in the earthquake affected areas

The Master Plan set guidelines for funding allocations in each category of the recovery areas. The Central Government established the Central Post-Wenchuan Earthquake Restoration and Reconstruction Fund (CPERRF). The reconstruction budget stipulated in the Master Plan was estimated to be approximately RMB$1 trillion (US$ 147 billion). The Central Government committed RMB$ 300 billion to post-earthquake recovery and reconstruction through CPERRF. Other funding assistance came from sources such as RMB$ 76 billion from other provinces, RMB 75 billion cash donations, RMB 100 billion contribution from the three earthquake affected provincial governments, and RMB 400 billion from the financial market such as bank loans. As the earthquake-affected areas entered an overall rebuilding stage in August 2008, the role and responsibilities of the Chinese government shifted from earthquake response and coordination to
technical support and supervision of reconstruction implementation, with less administrative intervention.

6.1.3.3 One-on-one Assistance Program for Wenchuan earthquake reconstruction

A central element of China’s post-earthquake recovery management was a pairing of the earthquake-affected areas with unaffected regions to help provide the resources and funds for recovery and reconstruction. This innovative policy was materialized through ‘One-on-one Assistance Program for Wenchuan Post-earthquake Restoration and Reconstruction’ (The ‘One-on-one Program’). This Program was released by the State Council on June 11, 2008, as a supplementary policy to aid the full implementation of The Regulations. According to the policy, the earthquake-stricken areas of Sichuan, Gansu and Shaanxi provinces were divided into 24 districts and twinned with 24 relatively developed localities across China. For instance, the historical tourist city Dujiangyan was sponsored by Shanghai municipality and the industrial city of Mianzhu was assisted by Jiangsu Province in China’s developed east coast. Sister localities had been tasked over the next three years after the earthquake with funding 1% of their GDP, provision of human resources and temporary housing units, and in-kind support from planning institutions and other departments in association with disaster reconstruction.

The ‘One-on-one Program’ featured prominently in the Wenchuan earthquake reconstruction. In the first three months after the earthquake, more than 500,000 temporary houses were constructed in part as a result of the partner support program. At the recovery and reconstruction stage, field observations between December 2008 and February 2009, in July 2009 and in February 2010 suggest that with available funding and human resources, sponsoring localities had been achieving the reconstruction target progressively. Significant reconstruction progress was made by the sponsoring partners by providing assistance in rebuilding infrastructure such as roads, water and sewage, electricity, and broadcasting, public buildings such as schools, hospitals, clinics, and key sectors of the economy, such as tourism and production facilities. Many sponsoring recovery programs at the local level that aimed specifically at livelihood issues were effective in addressing employment needs. Enhanced community capacity with restored living conditions in the stricken areas was also witnessed by the researcher during a series of field visits.
6.2 Post-earthquake housing recovery approach

The Overall State Plan (2008) estimated the housing reconstruction scale in the earthquake-affected rural areas and urban areas, as shown in Table 6.6 and Table 6.7 respectively.

Table 6.6 Retrofit and rebuilding housing units in rural areas

<table>
<thead>
<tr>
<th>Unit: household (1,000)</th>
<th>Total</th>
<th>Sichuan</th>
<th>Gansu</th>
<th>Shaanxi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengthening</td>
<td>2141.1</td>
<td>1904.2</td>
<td>125.5</td>
<td>111.4</td>
</tr>
<tr>
<td>New construction</td>
<td>3289.7</td>
<td>2984.9</td>
<td>260.4</td>
<td>44.4</td>
</tr>
</tbody>
</table>

Table 6.7 Retrofit and rebuilding housing area in urban areas

<table>
<thead>
<tr>
<th>Unit: area (1,000 sq. m.)</th>
<th>Total</th>
<th>Sichuan</th>
<th>Gansu</th>
<th>Shaanxi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengthening</td>
<td>58,070.9</td>
<td>55,177</td>
<td>2,204.7</td>
<td>689.2</td>
</tr>
<tr>
<td>New construction</td>
<td>66,201</td>
<td>64,900.3</td>
<td>98.5</td>
<td>315.7</td>
</tr>
</tbody>
</table>

Under the Master Plan, a range of initiatives at the community level were launched to facilitate the implementation of housing recovery policies and regulations. However, field observations and interviews suggest that post-Wenchuan earthquake housing reconstruction was largely undertaken by the construction professionals, such as contractors and builders, in a government-dominated recovery environment. This section presents the research findings with respect to post-earthquake housing recovery approach in Sichuan.

6.2.1 Housing culture and type in Sichuan

6.2.1.1 Housing type before the earthquake

The damage experienced by housing structures in the Wenchuan earthquake was largely contingent on the housing construction type\(^{21}\). Brick masonry, with the advantage of easy manufacture and low cost, is the predominant type of construction in Sichuan Province. However,

---

\(^{21}\) A selection of the survey publications on the Wenchuan Earthquake is available from the website of the organizations: Earthquake Engineering Field Investigation Team, US Earthquake Engineering Research Institute (EERI), Multidisciplinary Center for Earthquake Engineering Research (MCEER), United States Geological Survey (USGS), and US National Center for Research on Earthquake Engineering.
this type of construction posed the greatest risk of structural collapse during the Wenchuan earthquake. The brittleness of the brick masonry material, combined with weak seismic resistance, inducted severe building damage. In line with the US Earthquake Engineering Research Institute (EERI) (2008)’s report, three types of unreinforced masonry (URM) buildings were observed in the affected areas: 1) pure unreinforced masonry bearing wall buildings of 1-3 storeys with timber and shingle roof structure; 2) reinforced concrete storefront on first storey with 2-3 of pure URM bearing wall above; and 3) 3-7 storey mixed brick-concrete system.

Most housing structures in Sichuan’s rural areas fell into the first two housing types built with URM bearing walls composed of bricks or concrete block that did not possess seismic-resistant elements. There were also a few wood buildings, primarily limited to distant rural areas. The third type of structures — multi-storey restrained brick apartment buildings — were most commonly seen in the urban areas of Sichuan. Field observations suggest that in the affected towns and cities in the mountain foothills on the edge of the Chengdu Plain, such as Dujiangyan, Mianzhu, Pengzhou, and Shifang, most buildings had not been properly designed nor built with sufficient provision to withstand earthquakes and thus suffered varying degrees of damage. Construction defects, including poor quality of cement and brick, improper concrete-making operation, insufficient drawings, scant attention to building codes, and lack of seismic-resistant structure and qualified skilled construction staff, were primarily responsible for structural collapses and damage of these masonry buildings during the earthquake. In addition, poor location, weak design and inappropriate building technology adopted into the structure were critical in the collapse of multi-storey buildings in the Wenchuan earthquake.

Sichuan is one of the multi-ethnic provinces in China. The Qiang ethnic group mostly inhabits in the mountainous areas of the Maowen County in the Aba Tibetan Qiang Autonomous Prefecture in western Sichuan. During the Wenchuan earthquake, the Qiang area was hardest hit. The Qiang people usually build their villages on the flat areas half-way up the mountain. The houses are connected by a long corridor and form a village. Their traditional houses, known as Zhuangfang, or Diaolou are square in shape with walls and flat roofs with the materials of stone and clay (Hays, 2008).

This traditional house usually has two or three storeys with the second floor serving as the living area for the family, while the ground floor is used for storage and provides accommodation for
the livestock. The third floor, if there is one, can be used not only to dry and husk cereals, but also gives room for people to rest, children to play, and for women to do knitting. Built entirely of broken stones and yellow mud, many of the Qiang houses had withstood the earthquake. During the field trip to the earthquake-affected Aba Tibetan Qiang Autonomous Prefecture in February 2010, the researcher came across traditional Qiang houses which had only suffered minor damage during the 2008 Wenchuan earthquake, as shown in Figure 6.5 below.

![Figure 6.5 Traditional Qiang ethnic house in Aba Tibetan-Qiang Autonomous Prefecture](image)

6.2.1.2 Housing type after the earthquake

After the earthquake, however, the masonry and concrete system continued to be the most predominant housing type for communities to rebuild their houses. The challenge for rebuilding such housing, therefore, was to ensure higher seismic standards and construction quality in order to minimize vulnerability to future disasters. Timber structured housing and Qiang people’s stone houses were also observed by the researcher. This section summarizes the reasons why the masonry housing type was still popular among communities after the Wenchuan earthquake.

1) **Rooted masonry housing culture in communities**: Field interviews with a number of affected house owners between December 2008 and February 2009 suggested an agreed reason for rebuilding their houses with masonry construction type and materials — brick construction is relatively simple and cheap. Brick masonry buildings have been used in China for thousands of years. The concept of masonry housing, with brick walls in particular, was well rooted as a tradition in local architecture. Some community members
mentioned that from an architectural point of view, brick construction is flexible, allowing substantial freedom in the layout of internal spaces and the distribution of openings. In some cases, local communities perceived the masonry walls of a building as being the only construction element that symbolizes a house with security and comfort.

2) **Locally available construction materials and skills**: The brick masonry housing construction allows self-build reconstruction in the earthquake-affected rural areas. Some households pointed out that bricks can be procured locally and so are the raw materials for making mortar such as sand and water. In addition, the basic technology of constructing this type of house in Sichuan has minor geographical variations and has changed little over time. Mortar is subject to greater variation across the region, however, only depending on availability of the bonding agents, mud, clay, or cement. For building a one or two storeyed house in rural areas, bricklaying requires average-level skilled labour. Therefore, this type of construction can be performed by small building contractors/builders or house owners themselves.

3) **Stringent quality control for house rebuilding**: Field interviews in December 2008 suggest that for rebuilding seismic-resistant houses, the governmental authorities imposed a stringent quality control system. Quality inspections, however, were combined with staged subsidy allocation initiatives. For instance, RMB$16,000 (USD $2,336) subsidies were only granted to a rural household on the premise of their compliance with construction standards. This money was allocated to the house owners when a certain major structure was built to the standard. Likewise, in urban areas, a ‘filing system’ was launched by local government. Only when drawings and schemes for rebuilding or retrofit were provided and approved by the surveyors, were subsidies varying from RMB$1,000 (USD $146) to RMB$8,000 (USD $1168) allocated to the household. In addition, various forms of public education were initiated to ensure construction quality. These quality control initiatives to a great extent assured the local communities of using masonry structure for housing reconstruction after the earthquake.

4) **Technical support from the NGOs**: As alluded to earlier, a number of NGOs that specialize in disaster resistant construction were involved in Wenchuan earthquake reconstruction, providing technical support to local communities. The representatives
from Build Change said that they had employed over 30 Chinese professionals, working on a daily basis with homeowners, builders, and government officials to build safer houses. Build Change provided hands-on training courses for local communities and engineers. The employed construction professionals organized one-on-one meeting with homeowners and tailored house designs for individual families. Build Change also assigned a number of site engineers to supervise the rebuilding operations in the field to make sure the brick masonry of new houses was reinforced properly.

Apart from masonry buildings, timber housing type was advocated in the earthquake recovery areas by the local government, in conjunction with a number of local research institutions. Interviewee R4 from the local university reported that the Sichuan Provincial Government had organized a Science and Technology Consultancy Team comprising construction experts from different research institutes across Sichuan. The main focus was to develop alternative seismic-resistant materials in the construction of new houses. The team launched a range of research activities and community initiatives to encourage the use of timber housing. Xiaoyudong village in Pengzhou city was selected as a timber house demonstration site. Field interviews in February 2010 in Pengzhou suggest that timber houses were popular and spoken highly of by local communities. The newly rebuilt houses after the Wenchuan earthquake are shown in Figure 6.6.
Field observations and interviews show that reconstruction efforts in the earthquake-affected areas were carried out in a culturally sensitive way, especially in ethnic minority communities. Cultural heritage for Qiang ethnics, introduced in the previous section, includes not only traditional historic sites, but historic housing, cultural landscapes, and aesthetic assets such as the architectural style of housing. In Lixian town of Aba Tibetan Qiang Autonomous Prefecture, retaining cultural heritage for those Qiang people was one of priorities of the local government and sponsoring partner Hunan Province. Field interviews with the Hunan province reconstruction sponsoring team in February 2010 show consideration was given to integrating the cultural assets conservation into larger community reconstruction projects. For instance, in rebuilding some
earthquake-damaged Qiang villages, the Hunan sponsoring team adopted the building codes compatible with local cultural concepts. The photos in Figure 6.7 demonstrate newly rebuilt houses with integration of the ethnic cultural elements.

1. Traditional Qiang cultural features integrated into the reconstruction design and building in Beichuan town (Photo taken in Dec. 2008)

2. Newly rebuilt Tibetan house in Lixian town in Aba Tibetan Qiang Autonomous Prefecture (Photo taken in Feb. 2010)

![Figure 6.7 Rebuilt houses of Qiang and Tibetan ethnics in Sichuan Province](image)

6.2.2 Post-earthquake housing reconstruction actors and methods

Government-dominance featured post-Wenchuan earthquake housing recovery. This was first embodied in the second principle prescribed in the earthquake reconstruction ‘Regulations’, — government dominance combined with social participation had indicated a specific way of organizing post-earthquake housing reconstruction in China. Field observations and interviews identified four groups of actors in housing reconstruction: 1) Local communities; 2) Government authorities; 3) Civil society organizations and 4) Construction contractors. This section discusses the roles of these actors in terms of rural housing reconstruction and urban housing reconstruction.

6.2.2.1 Rural housing reconstruction in Sichuan

An owner-organized reconstruction approach, utilizing a combination of governmental subsidies, partnership assistance and social help and support, was commonly seen in rural affected areas in Sichuan. Owner self-build approach was only seen in some counties where they had tradition for self-build. In some other rural areas, accessible education and training was provided by the local
government for farmers, not only in the technical specifics of building codes but also in the basic reasoning that underlies them, and linked the provision of subsidies to inspection and monitoring at each construction stage. For house owners who did not possess the capacity to rebuild their houses, the rebuilding work was mainly contracted to the construction professionals.

In the self-organized rebuilding process, the affected communities set up a community recovery committee (CRC) to organize and manage the rebuilding of their own houses. Field interviews suggest that CRC consisted of representatives of families who were recognized as being trustworthy and devoted to the community. With all the available assistance in place, such as technical and financial support from the local government or other aid agencies, the CRC communicated with the families and decided on the construction technique and materials that would be applied in new construction. As observed by the researcher on a construction site, Habitat for Humanity got involved in housing reconstruction for local communities in terms of providing cash subsidies and coordinating hands-on volunteers from South Korea. The CRC organized families to supervise the operations of builders and coordinate on site with these volunteers.

Field interviews with CRC members in Pengzhou suggest that the above housing reconstruction approach provided a fulfilling exercise for both parties — communities through CRC, and Habitat for Humanity. The volunteers and donors were likely to gain a better understanding about how they could improve their participation in assisting disaster-affected communities. The local communities not only participated in the decision-making stage but also organized and managed the whole housing construction process. Working with the involved NGOs, volunteers, advisory consultants and local government, the capacity of communities increased.

**6.2.2.2 Urban housing reconstruction in Sichuan**

The urban housing reconstruction, however, was more complicated than rural housing. The intense and heterogeneous externalities among urban residents due to high density aggregation underscore the importance of collective action, which tended to be difficult. Field observations and interviews suggest that urban infrastructure and housing suffered relatively minor damage during the earthquake, in comparison with that in rural areas. The housing repair and rebuilding work was taken in varied forms.
In Beichuan and Wenchuan, where the entire town was severely devastated in the earthquake, a centralized planning and construction took place. The local government, in conjunction with the sponsoring counterparts took over urban planning and overall reconstruction. In other places such as Dujiangyan, as observed by the researcher in July 2009, self-organized construction with centralized planning was adopted in quake-affected areas. Two options were available for the earthquake-affected residents: 1) each household is provided a flat of 70 m² constructed by the local government, 2) taking RMB $140,000 in cash. Regardless of choices of either ‘cash’ or ‘house’ from the government, housing reconstruction was mainly organized by house owners and carried out by professional building contractors. House owners were, to different degrees, involved in house design and planning at the upfront stage, and control and monitoring responsibilities at the later stage of reconstruction.

Similar to housing reconstruction in rural areas, a self-organized approach in urban areas was conducted through a CRC or a households association (HA). CRC representing communities was responsible for finding a developer or contractor to undertake construction work. For instance, in Mianzhu City, field interviews in December 2008 suggest that the house owners’ affiliated state-owned organizations such as Jiannanchuan and East Turbine established their own project teams to manage the overall housing rebuilding process for their employees. The reconstruction work was managed by this project team, which was equal to CRC.

6.2.3 Characteristics of the housing recovery in Sichuan

Field observations and interviews suggest that housing reconstruction in Sichuan after the 2008 Wenchuan earthquake was characterized by government dominance and social participation. The government played a greater role with increased involvement from local communities and external NGOs. With additional contributions from sponsoring regions, the reconstruction process manifested a number of political and economic features specific to the China context. This section aims to shed light on these features.

6.2.3.1 Political openness in the aftermath of the earthquake

As mentioned earlier, in the wake of the Wenchuan earthquake, contrary to convention, China’s openness allowed foreign media and agencies to visit quake areas. After the quake, at least 545
foreign reporters from 30 countries were allowed access to the earthquake zone. This new level of transparency facilitated, in some way, the unanticipated foreign relief effort. A large number of international organizations became involved in the subsequent earthquake recovery and rebuilding practice. This situation, however, was reflective of an opening stance of the Chinese Government and its willingness for international engagement. As one interviewee stated,

‘The Wenchuan earthquake created an opportunity for Chinese government to showcase their governance competence and ability to cope with a large-scale crisis. This is important especially when China was busy preparing for the Summer Olympic Games.’ (Gc6)

Field interviews suggest that the openness demonstrated during the earthquake recovery had, to a great extent, facilitated many international agencies to access local self-organized rebuilding programs for providing technical assistance. It has to be recognized that post-earthquake relief posed a great challenge to the local government in terms if disaster preparedness and mitigation. This had given greater policy relevance to disaster recovery decision-makers and managers. Field interviews suggest that the Wenchuan earthquake highlighted the weaknesses in China’s disaster management system, as reviewed in Chapter Two. By close cooperation with a number of consultancy agencies such as the Asian Development Bank and World Bank after the Wenchuan earthquake, the Chinese government had recognized a need to adopt a more comprehensive approach to disaster risk management in the future.

6.2.3.2 Centralized mobilization of funding resources

The financing of Wenchuan earthquake reconstruction was pooled through the organization of solidarity, with government assuming a major responsibility. A particular element contributing to the organized solidarity was the ‘One-on-one’ pairing program. Field observations and interviews in February 2010 focused mainly on evaluation on the effectiveness of this assistance program. The characteristics and implications of this policy innovation for disaster recovery can be summarized as follows.

1) The twinning partnership serves as a facilitating instrument of mutual friendship and cultural exchange at the local level, and even at the project level. For instance, in Lixian where Hunan Province acted as sponsoring partner, the sponsoring team not only brought

---

22 China Daily, June 12, 2008
in the resources such as funding, manpower and in-kind materials, but also brought in the intangible assets such as advanced construction technology, management skills and expertise in social, economic development and urban planning.

2) This partnership serves as a powerful tool for capacity building and community learning in the earthquake-affected areas in China. Field observations and interviews suggest that the affected populations, ranging from the local government officials, the public services and the private sectors to the local communities, were to a varied degree involved in this reconstruction assistance system. By interacting with the sponsoring expertise, this program provided them with a hands-on learning opportunity to increase their capacity.

3) The potential funding gap for earthquake recovery and rebuilding was filled through this specific funding channel, especially in infrastructure and housing sectors. One local government official in Lixian, Ge9, commented that the financial and economic strength of the sponsoring locality had contributed to a smooth and rapid reconstruction progress. In this instance, interregional co-operation played a positive role in reconstruction activities and served as a catalyst to the speed and quality of response to the earthquake.

6.2.3.3 Housing recovery outcome in Sichuan – scale, quality and speed

A number of observations made across the four field studies suggest that the scale, speed and quality of the reconstruction of housing following the Wenchuan earthquake were impressive. The post-disaster reconstruction progress on each timescale over the observed reconstruction period in Mianzhu is shown in Table 6.8.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Disaster response</td>
<td>Reconstruction peak time</td>
<td>80% housing rebuilt in the affected rural areas</td>
<td>98% housing rebuilt in the affected rural areas</td>
</tr>
<tr>
<td>Transition to recovery</td>
<td>Rural housing reconstruction commenced</td>
<td>10% housing rebuilt in the affected urban areas</td>
<td>60% housing rebuilt in the affected urban areas</td>
</tr>
</tbody>
</table>

Field interviews between December 2008 and February 2009 suggest that housing reconstruction work was accelerated in some quake-hit areas where local officials had promised that no people
in the quake-hit area would live in the makeshift tents during the wintertime. The time pressure had been best met before Chinese traditional New Year through partnership between government institutions and communities. A year after the earthquake, as shown in Table 6.8, 80% housing units in rural areas were rebuilt and occupied by the house owners. In comparison, 10% housing was reconstructed in urban areas. A large number of residents in Mianzhu still stayed with unaffected family members or in temporary prefabricated accommodation. In February 2010, twenty months after the quake, Mianzhu had accomplished only 60% housing reconstruction in urban areas. The three-year housing reconstruction objective in the Master Plan seemed ambitious, particularly when this objective was shortened to two years in 2009, in part due to a reflection of the progress made in the first year.

By releasing the progress report of the partnership program, the Central Government aimed to encourage the sponsoring provinces to act promptly through competing with each other. Field interviews with sponsoring governmental officials in February 2010 suggest that the active engagement of the sponsoring localities into post-Wenchuan earthquake reconstruction was partly due to the political incentive for the sponsoring governmental officials. Physical reconstruction with visible outcomes was seen as changes for the sponsoring counterpart to demonstrate their competency and capabilities in regional development. Putting aside this political reason, the generous nature of the sponsoring localities in terms of funding and human resources was a big help in rebuilding earthquake-affected areas in Sichuan. Most significantly, a mutual help ethos was established and became a valuable asset for both sides in the future.

In conclusion, the overall housing recovery and reconstruction, from planning to implementation, was managed by a powerful top-bottom administrative system. The centralized recovery leadership in China provided an effective way in promoting and coordinating earthquake recovery efforts. Under the centralized framework, other stakeholders, including communities, civil society and private sectors, worked together to rebuild lives from the earthquake. In line with the study conducted by Dunford and Li (2011), the longitudinal study in the quake-affected areas in Sichuan suggested three factors that contributed to the effectiveness of post-earthquake reconstruction activities. These three factors are: 1) a rapid and reliable assessment of needs; 2) a selection of priorities which reflected the urgency of the needs of rural households, along with a clear, detailed, holistic Master Plan embracing physical, social, and psychological reconstruction
and 3) a consistent and effective co-ordination and integration of the activities of different departments and organizations involved in reconstruction activities.

The above analysis shows that, on one hand, the Wenchuan earthquake reconstruction demonstrated the capabilities of Chinese model of governance and development. However, on the other hand, field observations show that attempting to complete all reconstruction projects in a short time had resulted in skyrocketing prices of construction materials and of the labour force. Shortages of essential building resources greatly hindered housing recovery. The local construction capability and market environment were largely overlooked in the Master Plan and local planning for reconstruction activities. The following section presents the research findings with respect to resourcing for housing reconstruction under the government-dominant recovery environment in Sichuan.

6.3 Resourcing stakeholders for housing recovery in Sichuan

Questionnaire surveys and focus group discussions identified the principal stakeholders who assumed responsibility for resourcing for post-earthquake housing reconstruction. These stakeholders were: 1) policymakers, notably reconstruction planners and local authorities; 2) construction contractors/builders and 3) scientific or research institutions. This section discusses the role and responsibilities of these resourcing stakeholders.

6.3.1 Reconstruction planners and local authorities

Field observations between December 2008 and February 2009 suggest that difficulties in procuring suitable building materials and a labour force had greatly hindered the reconstruction from proceeding as intended during this period. In response to resource shortages and subsequent inflationary chaos after the earthquake, since December 2008 the Chinese government at different levels had introduced a series of administrative interventions to the construction market. These interventions included the following.

1) A range of temporary price restrictions: In December 2008, temporary price ceilings were enforced by the local government in the earthquake-affected areas. The government had fixed the maximum price for some of the most commonly used building materials to
guard against profiteering. For instance, in Mianzhu City, the maximum selling price of brick was limited to RMB 0.36 per brick. For concrete materials, the maximum price for C15 concrete\(^\text{23}\) was RMB 315 per cubic metre including the transportation fee, and the maximum price for C20 concrete\(^\text{24}\) was RMB 345 per cubic metre. The profit for selling construction glass was required to be fewer than 20% and for construction steel to be fewer than 3%.

2) **Diverting resource supply to the worst earthquake-stricken areas**: In line with the top priority of reconstruction, a material supply diversion program was set up across Sichuan Province. Available building materials in the market or directly from the manufacturing factories were required to be sent to the worst hit areas to meet their reconstruction needs. For instance, the local government of Mianzhu had designated a number of region-wide brick factories to supply their products to the prioritized jurisdictions where the effects of the earthquake were relatively larger than other places.

3) **Assigning inspectors to monitor suppliers’ selling prices**: A supplementary ‘price monitoring system’ was set up by the local government in a number of material production factories to control their sale prices. This intervention was focused on the supply side to contain profiteering-induced inflation in the construction market. However, field observations and interviews suggest that these measures had discouraged material suppliers to engage actively in material provision for post-disaster reconstruction.

4) **Financial subsidies for resource transportation**: Between August and December 2008, the Provincial Government of Sichuan initiated supportive subsidies for drivers who were in charge of transporting construction materials to support recovery in the earthquake-affected areas. The tolls these drivers need to pay for using highways, if necessary, were also exempted. In total, the Provincial Government of Sichuan granted RMB 0.1 billion (approximately USD 14.65 million) in support of businesses tasked with specific material production and delivery to designated areas.

\(^\text{23}\) C15 concrete is a type of mixing concrete with a compressive strength of 15 Newton per square millimetre (N/mm\(^2\)). C is the compressive strength grade.

\(^\text{24}\) C20 concrete is a type of mixing concrete with a compressive strength of 20 N/mm\(^2\). C is the compressive strength grade.
5) *Streamlining the consenting process for material manufacturers*: Since August 2008, the Provincial Government of Sichuan had streamlined the consent process for materials manufacturers who applied for building new production plants. For instance, in August 2008, the Provincial Government sanctioned the building of 75 cement production plants, 760 brick factories and two large-scale, high-performance steelworks to meet reconstruction demand over the next three years (2009 to 2011). In addition, an information management system was set up within the local governments to monitor and publish the price of building materials on a daily basis. This system included a range of sub-databases such as information on demand for construction materials, directories of 95 cement and steel production companies in neighbouring provinces, and the details on the reconstruction progress.

While the researcher was in the field, there were a wide variety of programs and initiatives launched by the local government at different levels. The main purpose of these initiatives was to control inflation and guarantee the availability of resources for the communities of high priority. However, field observations and interviews show that in general, shortage of resources posed a salient obstacle to the housing reconstruction for the vast majority of the affected population.

6.3.2 *Resourcing procurer: construction contractors*

As mentioned in the preceding section, housing recovery and reconstruction in the affected regions was largely undertaken by construction professionals, such as contractors and specialized builders. There were variations in resource purchase and procurement between the rural areas and urban areas. In rural areas, depending on the choice of house owners, resource procurement for rebuilding houses was managed by the community recovery committee (CRC) or was contracted to building contractors. In contrast, rebuilding multi-storey apartment buildings in urban areas dictated a more complex supply chain. Procurement of construction resources was mainly charged to professional contractors.

When interviewed, some construction professionals (C2–6, C8 and C12) involved in housing recovery and reconstruction in Mianzhu highlighted the difference in project management between the conventional construction and post-disaster rebuilding. C2 stated:
‘In comparison with pre-event construction, project managers working on post-disaster projects need to abide by local reality of limited resources and constraints, of lack of access to resources, and of the chaos originated by the disastrous event’ (C2).

Focus group discussions with twelve construction professionals suggested a common view that in the aspect of resourcing, the construction industry in Mianzhu seemed to purely rely on supportive policies and interventions from government authorities. There was a general misunderstanding that the government is the most significant institution the nation can utilize and rely upon for dealing with disasters. The construction industry, however, was not sufficiently prepared for, or involved in the large-scale reconstruction work following the Wenchuan earthquake. In other words, the construction sector’s awareness of the need to engage in disaster prevention and management was absent even during the earthquake reconstruction stage. As some interviewees claimed:

‘We just do what we normally need to do in the construction process according to the requirements of the regulatory agencies and house owners’ (C3); ‘We really didn’t realize we are contributing to reducing the vulnerability of potential disaster risks’ (synthesis of views from C7, C10, and C14); both C12 and C15 mentioned ‘Even if we knew our significant role in future disaster prevention, disaster management and construction still appear to be separate subjects’ (synthesis of views from C12 and C15).

However, some interviewees (C1–3, C5–14, R4 and G1) suggested that construction contractors/builders should take a lead role in physical reconstruction and contribute to resilience enhancement of those affected communities. Government officials G3 and G4 advocated that contractors/builders could be more proactive, given their expertise and skills, in becoming engaged in technology transformation for rebuilding earthquake-resistant buildings. This perspective concurs with the findings of the Max Lock Centre (2006) that property and construction skills can add value to disaster management and recovery in areas of sourcing construction materials and equipment, procurement and project management, and aiding logistical planning. It is also in line with the study of Zuo et al. (2006) who assert that construction contractors provide a critical boost to resource availability in post-disaster reconstruction.
During the interviews between December 2008 and February 2009, interviewees C1–4 and C9 stressed that the organizational weaknesses underlying a construction business would emerge in a post-disaster reconstruction situation. For instance, when confronted with challenges such as a disruptive supply chain and logistical barriers following the Wenchuan earthquake, some large construction companies reviewed their procurement strategies and operations. Therefore, by becoming involved in helping communities to recover from the earthquake, the building organizations had an opportunity to review and enhance their own resilience to adverse crises. As C2 claimed:

‘Post-disaster reconstruction could enable the construction industry to become more resilient and capable and consolidate the relationships among project stakeholders, thus ensuring collaborative resourcing practices when facing resource unavailability and improving quality of the rebuilding projects’ (C2).

6.3.3 Resourcing facilitator: research institutions

During the interviews in December 2008, interviewees C5, C16, R2–3, R5 and G2 underlined the important role of scientific or research institutions in material-related research and application. They suggested that more research on developing alternatives to seismic-resistant building structures, materials, and components should be undertaken with funding support from the government. Researcher R2 particularly proposed the need to launch a widespread ‘wooden house campaign’ across Sichuan Province and even nationwide. Plentiful forestry resources in the mountainous terrain in Sichuan Province indicate the high likelihood of utilizing local available timber resources for rebuilding seismic-resistant houses or for use in newly constructing houses. The only concern, according to R3, was that there was no existing law in China that could justify the proper use of this natural resource without detriment to the natural environment.

In addition, interviewees R2 and G2 stressed their concern about local acceptance of new construction materials. R2 suggested that the local governments should introduce initiatives to promote widespread application of new materials and construction methods in earthquake prone areas. Meanwhile research institutions need to base themselves on the ground to solicit ‘grassroots’ opinions’. There were various arguments in the interviews regarding the appropriate role the research institute should assume in resourcing for post-disaster reconstruction. However,
an agreed view was that the research institutes take a lead role in construction innovation for advocacy of safe buildings. The quality of construction is not only contingent upon what materials can be used, but also upon how the builders craft these materials into structures with high quality. Therefore, advocating new construction materials or technology should be accompanied by training construction workers and educating the public and manufacturers to raise their awareness of producing safe building products.

A multi-stakeholder, cooperative approach was recommended by the focus group participants for resourcing for post-disaster housing and infrastructure reconstruction. Involvement by local government and construction industry representatives is vital for translating the lessons learned from the Wenchuan earthquake into practice by increasing the overall resourcing capability. In addition, the involvement of national government and related research institutions is essential for linking resourcing issues to the legislative and policy system. As one respondent suggested:

‘The process of reconstruction should have strict planning controls. The planning of reconstruction projects at both national and local levels should take account of the actual construction capabilities. The government should guide and control the prices of construction materials by finding a trade-off between ‘hard’ interventions and more flexible market mechanisms’ (R1).

The review of key stakeholders and their involvement in the resourcing for post-Wenchuan earthquake reconstruction reveals that the resourcing efforts in Sichuan were mainly government-driven and focussed on containing inflationary chaos caused by shortages of resources for reconstruction. The key aspects of a successful resourcing approach, including market linkages, infrastructure settings, and interactions with other principal stakeholders, were not being addressed well.

6.4 ‘Indicator resources’ and their availability for post-earthquake housing recovery

Resourcing issues observed on each timescale over the reconstruction period in Mianzhu are summarized in Table 6.9.
Field observations and interviews suggest that resourcing difficulties only became apparent in August 2008, three months after the earthquake, when the major housing reconstruction and restoration commenced. Large-scale reconstruction demands for masonry-based houses, however, were incommensurate in scale with the available resources, especially the most commonly-used building materials such as brick, cement, aggregate and steel. In October 2008, the Provincial Government of Sichuan announced the estimated supply shortfalls of cement, brick and steel in the earthquake-stricken areas (Table 6.10).

Table 6.10 Estimated supply shortfalls of cement, brick and steel in Sichuan

<table>
<thead>
<tr>
<th>Items</th>
<th>2008-2009</th>
<th>2009-2010</th>
<th>2010-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement (million tons)</td>
<td>53</td>
<td>39</td>
<td>31</td>
</tr>
<tr>
<td>Brick (billion pieces)</td>
<td>35.5</td>
<td>17.8</td>
<td>3</td>
</tr>
<tr>
<td>Steel (million tons)</td>
<td>3-3.6</td>
<td>3-3.6</td>
<td>3-3.6</td>
</tr>
</tbody>
</table>

Source: http://www.sc.gov.cn/zwgk/gggs/jm/

During the peak of housing reconstruction in Mianzhu between the end of 2008 and early 2009, the most needed construction materials in the quake-affected areas of Sichuan Province were brick, aggregate, cement with 127%, 125%, and 30% price increases respectively, and steel with 30% price fall\(^{25}\), compared with the pre-event level in the middle of 2008. Precipitous wage increases of local labour also served to undermine the sustainability of the reconstruction trade market. However, as shown in Table 6.11 below, the cost escalation of cement and steel was less

\(^{25}\) Price fluctuation rate is based on the contrast between April 2008 and December 2008. Data was obtained through the researchers’ personal communication with officers in Price Bureau of People’s Government of Mianzhu City, Sichuan Province and field-based market investigation.

270
prominent in comparison with that of labour, brick, and aggregate. Therefore, cement and steel are not dealt with in this case study. The case study of this chapter is focused on analyzing the availability of the identified ‘indicator resources’, including brick, aggregate and labour, that were subject to shortages and had a great inflationary impact on housing recovery projects.

Table 6.11 Cost of labour and materials in rural areas between 2008 and 2009

<table>
<thead>
<tr>
<th>Resource</th>
<th>unit</th>
<th>Mid 2008</th>
<th>End 2008</th>
<th>Early 2009</th>
<th>Mid 2009</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>labour</td>
<td>RMB /day</td>
<td>30</td>
<td>60</td>
<td>100</td>
<td>80</td>
<td>167</td>
</tr>
<tr>
<td>brick</td>
<td>RMB each</td>
<td>0.33</td>
<td>0.53</td>
<td>0.55</td>
<td>0.35</td>
<td>6</td>
</tr>
<tr>
<td>cement</td>
<td>RMB/ton</td>
<td>390</td>
<td>460</td>
<td>550</td>
<td>480</td>
<td>23.1</td>
</tr>
<tr>
<td>aggregate</td>
<td>RMB/ m³</td>
<td>25</td>
<td>50</td>
<td>55</td>
<td>75</td>
<td>200</td>
</tr>
<tr>
<td>steel</td>
<td>RMB/ton</td>
<td>5400</td>
<td>3800</td>
<td>3600</td>
<td>4200</td>
<td>22.2</td>
</tr>
</tbody>
</table>

6.4.1 Availability of bricks for housing recovery

Field interviews show that rebuilding masonry houses for both rural and urban areas affected by the earthquake required a considerable volume of bricks. The shortage of bricks was a major bottleneck to proceeding with housing reconstruction. Figure 6.8 portrays the observed changes in brick prices over the reconstruction period between the middle of 2008 and early 2010. Market investigations by the researcher in Mianzhu suggest that from April 2008 to December 2008, the price of bricks had gone up by 127%, in comparison with the pre-event level. Many house owners were unable to afford the purchase of the available bricks. Field observations in December 2008 show that, with limited options, many quake-affected people went back to the collapsed or severely destroyed building sites to reclaim brick materials that may be usable.
Interviews between December 2008 and February 2009 highlighted four issues that contribute to the short supply of brick materials for housing reconstruction in Mianzhu. These four issues are: 1) significant damage to local brick production facilities in the earthquake, 2) nationwide price escalation of oil and coal, 3) political will to precipitate recovery process, especially in rural areas, and 4) aspiration of the affected communities to move into new houses for Chinese New Year. As mentioned in the previous section, before the winter time of the end of 2008, housing reconstruction works were accelerated in some quake-hit areas of Mianzhu as local governmental officials had promised that no earthquake-affected person would live in tents during the wintertime. This was done by promising an extra subsidy of RMB $5,000 to each household on the precondition that they would commence rebuilding their house before 12 May 2009. This political will from local authorities was in line with communities’ aspiration to celebrate their forthcoming lunar New Year in new homes. The shortage of brick materials in the quake-affected areas was exacerbated by competition among house owners for local limited resources. This situation further added to the difficulty for house owners in purchasing bricks for rebuilding their houses. A vicious cycle between house owners’ competition and brick shortage in the market thus arose.

The effect of local authorities’ ‘hard’ interventions, as described earlier, was most prominent regarding the supply of bricks. Field interviews suggest that the ‘hard’ interventions directly into the manufacturing industry of brick materials had eased the inflationary chaos in a short time. Diversion of supply through Government Orders had ensured the resource provision for the top prioritized communities that were affected severely by the earthquake. However, the majority of
house owners in other quake-affected areas had to bear the adverse effect of these interventions. A number of half-constructed houses in Mianzhu were observed in the field in December 2008 due to the brick supply disruptions caused by this resource diversion program.

To alleviate the brick supply pressure, in early 2009, Mianzhu government and some aid agencies advocated the use of concrete blocks as an alternative to brick material. Field observations in June 2009 in Mianzhu show that concrete blocks were applied only to a few houses across the entire Mianzhu jurisdiction. The total cost for a house rebuilt with concrete block was a third less than that of a brick masonry house. Despite its cost-effectiveness, this type of material was not popular among communities. House owners would rather defer the rebuilding of their houses until the price of bricks dropped. The assessment of brick availability for post-earthquake housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 6.12.

### Table 6.12 Availability of bricks for earthquake housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attainability</td>
<td>• Reduced production capacity due to the impact of the earthquake</td>
</tr>
<tr>
<td></td>
<td>• Effect of Government ‘hard’ interventions into market and supply systems</td>
</tr>
<tr>
<td></td>
<td>• Significant impact of inflationary brick price on affected house owners</td>
</tr>
<tr>
<td>Usability</td>
<td>• Lack of social acceptance of using concrete blocks as a substitute to bricks</td>
</tr>
<tr>
<td></td>
<td>• Quality concern about concrete blocks</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Lack of access to local available resources in the market</td>
</tr>
<tr>
<td></td>
<td>• Government’s supply redirection limited local access to available bricks</td>
</tr>
</tbody>
</table>

#### 6.4.2 Availability of aggregate for housing recovery

Field observations show that the aggregates industry in Mianzhu was fragmented and markets were localized. The main composite materials for aggregate include gravel, sand, and crushed stone. These particles were used in their raw form or were combined with other materials to produce concrete. Interviews with government officials GO2 and GO4 suggest that the landscape of Sichuan with vast number of mountains and rivers provides a multiplicity of aggregate materials. Therefore, from the outset of housing reconstruction, the Provincial Government of Sichuan had held positive prospects for aggregate supply to meet post-earthquake reconstruction
requirements. But in December of 2008, the shortages of aggregate materials and cost inflation with 125% price increase, compared with the pre-event level in the middle of 2008, had drawn attention from the local government. The changes in aggregate price over the observed housing reconstruction period are shown in Figure 6.9.

![Figure 6.9 Change in price of aggregate between 2008 and 2010](image)

Following the Wenchuan earthquake, the Provincial Government of Sichuan imposed stringent quality control for rebuilding brick masonry houses. The quality control system required basic seismic solutions in relation to ring beams, ductile reinforcement detailing and ties between elements to be included into the construction practice. Performance of concrete structures and components, therefore, contributes to the resilience of a building to earthquakes. During the interviews in December 2008, one community representative commented:

‘Before the earthquake, there was a general lack of awareness to conform to codes and standards promoted by the government, and most houses constructed by house owners themselves or contracted professionals failed to include the basic good seismic design practice, and consequently failed to withstand the impacts of the earthquake. After the earthquake, however, there was a growing realization of importance of safe construction practices in rebuilding a masonry house’ (CR4).

The seismic-resistant requirements for rebuilding houses, such as concrete reinforced ring beam, concrete reinforced column, and concrete foundation, imposed a large demand on the composite materials including aggregate, cement, and steel. The quality and quantity of any of these materials are likely to influence the performance of the engineered fill of concrete structure. The
availability of any of these materials thus had an effect on the availability of concrete components required for a housing recovery project.

The causes for price escalation of aggregate, according to field interviews in June 2009, can be grouped into three factors: 1) restrictions on mining mineral aggregate deposits, including sand, gravel, and stone; 2) increased cost for transporting different composite materials to the construction site; 3) competition for aggregate materials between housing reconstruction and infrastructure restoration, particularly restoring earthquake damaged roads. The large demands for aggregate materials after the earthquake placed pressures on existing manufacturers which, according to the interviewed local government official G2 in December 2008, could only cope with pre-event construction levels. Field observations between December 2008 and February 2009 suggest an increased competition for aggregate materials among house owners who attempted to commence rebuilding their house before May 12, 2009, the first anniversary of the quake.

To stabilize the price of aggregate materials, the local government, apart from the ‘hard’ interventions alluded to earlier, assembled a community-based concrete recycling team. This team was charged with sorting out useable particles after old buildings had been demolished or concrete blocks had been broken down. These aggregates were then recycled and transported to different construction sites for further refinement and usage. Recycling aggregate materials for a recovery purpose became a seemingly prospective resourcing channel for local communities. However, a quality concern for using these recycled materials emerged during reconstruction. The interviewed contractor representative RC5 in June 2009 reported that the technique of recycling and refining aggregate materials was not mature in China. The recycled aggregate materials could be treated only as specialty lightweight aggregates to be used in non-bearing structures.

At the end of 2008, Mianzhu’s sponsoring counterpart Jiangsu Province started restoration of inter-regional roading networks in the affected regions. Field interviews suggest that demands for aggregates as a base material to rebuild roads and a composite material for making asphalt, were even larger than that for housing reconstruction. Funding availability, however, rendered the sponsoring province better able to procure a large amount of aggregate materials at a higher price to cater for their rebuilding requirements. A flow of aggregate resources from the housing
recovery sector towards infrastructure restoration was thus not surprising. This left the house owners in a ‘cold’ situation; not being able to bug affordable aggregate materials for rebuilding their houses.

Despite a steady price increase after the earthquake, as shown in Figure 6.9, the cost of aggregate experienced a pronounced boost in the middle of 2009. Field interviews in June 2009 suggest that this temporary boost was due to strict control on the exploitation of raw materials such as sand and gravel, which was implemented by the government authorities in early 2009. There was an enhanced standard for environmental conservation in association with the use of natural resources such as mineral materials. There were restrictions on quarrying and mining in the affected areas. The price of local available aggregate materials had thus gone up. A number of house owners tended to import aggregate from outside of Mianzhu or further afield with doubled transportation costs. With a significant progress made in housing reconstruction in the second half of 2009, aggregate price began falling to pre-event levels. The assessment of aggregate availability for post-earthquake housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 6.13.

Table 6.13 Availability of aggregate for earthquake housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Limited existing aggregate manufacturing capacity  
• Government underestimation of the reconstruction demand for aggregate  
• Significant impact of inflationary aggregate price on affected house owners |
| **Usability** | • Quality concern of recycled aggregate materials  
• Increased environmental concerns regarding aggregate exploitation |
| **Accessibility** | • House owners’ lack of access to local available aggregate resources for housing reconstruction due to large demands in infrastructure restoration  
• High transportation cost for aggregate materials  
• Reduced accessibility to aggregate sources due to environmental concerns |

6.4.3 Availability of skilled labour for housing recovery

Prior to the earthquake, skill promotion constituted an important part of Mianzhu’s development strategies. As mentioned in the preceding section, production of building materials was one of
the main industries in Mianzhu. A construction boom caused by massive rebuilding needs following the earthquake had not only overstretched the material supply capacity, but also the availability of mason, concreter, and other construction expertise in Mianzhu. The average daily wage for labour workers in Mianzhu soared by 233% from RMB $30 in mid-2008 to RMB $100 in early 2009. The changes in labour wages over the observed housing reconstruction timeframe are shown in Figure 6.10. Field interviews suggest that escalation of payment for employing labour in the region was partly a reflection of a high-cost economy and partly a result of the reconstruction boom after the earthquake. Interviews explained three factors that contributed to wage escalation of these workers: 1) lack of local skill base; 2) high competition for skilled labour among house owners and 3) dispute issues between house owners and the contracted labour workers.

![Figure 6.10 Change in wage of labour between 2008 and 2010](image)

The difficulty in acquiring labour in Mianzhu was mainly concerned with the lack of specialized skills for essential seismic-resistant structures, such as concreters and foundation makers. As explained by interviewee GO3 from the local construction department, before the earthquake, some training programs had been set up for young people to teach them basic building techniques. However, most of these qualified candidates had migrated to places outside of Sichuan Province, such as Guangdong, Jiangsu, and Zhejiang Provinces, where more jobs and high payment could be guaranteed. GO3 commented:

‘Out migration is an important pathway for young work force with equipped knowledge and expertise. These skills had been pulled out of Mianzhu, and even the entire Sichuan Province and into other parts of the country, relatively developed coastal provinces in particular’ (GO3).
The 2008 global financial crisis happened when Sichuan was coping with post-earthquake rebuilding and recovery. Many migrant workers who were originally from Sichuan province returned home to assist with reconstruction work. Rough statistics from the local construction department show that the number of these returned migrant workers was low in comparison with the number of in-flowed labour force from other places. Instead, inward migration from other places contributed to the local labour market after the earthquake. However, increased wages in the earthquake-affected areas had also attracted low-skilled workers from outside. By offering a much lower quote, many outside contractors won the rebuilding work when competing with local contractors. ‘Cowboy’ phenomena were thus observed by the researcher in the quake-affected areas such as cheating on house owners, doing shoddy work and using inferior materials.

In some earthquake-hit areas where engineering technical assistance was less accessible, some NGOs became active providers of skill training for house owners. Field observations and interviews suggest that many aid agencies, in partnership with the local civil society, provided funding to support localized educational activities and skill training projects. However, there was a lack of trust between the house owners and employed construction workers. Thinking that the contractors may cheat on the price of material procurement, house owners tended to purchase materials for themselves. As could be expected, without assistance from construction professionals, CRCs were unlikely to purchase materials with a reasonable price. The interviewee RC2 gave this example:

‘Due to the lack of appropriate understanding and knowledge of construction and building, most house owners had an incorrect perception about building materials, such as they perceived that the thicker the steel bar is, the better quality it has. So they changed the design drawings on their own without consulting design professionals. They do not trust the construction team as there is a preoccupation in their mind that the construction team always take dishonest behaviours and cheat on them such as purchasing the poor-quality of materials, not following the specifications, etc’ (RC2).

There were also instances, as observed by the researcher in June 2009, that construction professionals left half-constructed houses on the construction site because of house owners’ delays in making payment. The reason, in part, can be gleaned from one quote from the interviewee RC4.
Some of them (house owners) were too much dependent on the government for funding, delayed to pay the construction team, waiting for the prospective additional funding from the government’ (RC4).

In some other areas, attracted by the government monetary incentive to expedite housing reconstruction process, a number of house owners turned to low skilled workers. Defects of poorly supervised or rushed reconstruction buildings were observed by the researcher in these places. In addition, difficulties in recruiting qualified labour also posed a challenge to local construction authorities. According to the interviewee GO2, Mianzhu Government was considering how to manage, supervise and regulate the behaviours of both the industry players and house owners during reconstruction. How to educate the public to raise their legal, contractual and quality requirements without affecting their participation in housing recovery was another issue they need to take on board. The assessment of labour availability for post-earthquake housing reconstruction in terms of the three dimensions of resource availability is summarized in Table 6.14.

Table 6.14 Availability of labour for earthquake housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Limited local skill base  
| | • Increased labour flow by returning migrant workers and from other regions  
| | • Lower skill from outside the quake affected areas  
| | • Significant impact of inflationary labour wage on affected house owners |
| **Usability** | • Concerns about labour reliability and liability  
| | • Workmanship concern with specialized labour for seismic resistant structures, such as carpenters and masons  
| | • Code of Conduct is required for both house owners and construction professionals |
| **Accessibility** | • In flux of labour from areas outside Mianzhu  
| | • Less accessibility to local qualified labour |
6.4.4 Impacts of low resource availability on housing recovery projects

A longitudinal study in Mianzhu suggests that the earthquake-affected areas were exposed to inflationary effects of the above ‘indicator resources’ from the end of 2008 to mid 2009. During this period, the impacts of low level of resource availability on the housing reconstruction in terms of construction cost, time and quality were significant. This section aims to reveal these impacts by providing an example of rebuilding a single house in Penghua Village of Mianzhu. The field investigation of this example took place in June 2009.

The average duration for rebuilding a confined masonry house, as shown in Photo 1 in Figure 6.6, was three to four months. The average cost for rebuilding this house was RMB $ 700-800 yuan/m², consisting of labour cost and the cost of building materials such as brick, concrete, steel rebar and timber. Therefore, the total construction cost for such a house with an area of 60-70 m² was RMB $ 50,000. From the end of 2008 to mid 2009, the construction cost of housing was higher than the pre-event levels due to cost escalation of the ‘indicator resources’ identified in this case study. In comparison, the average construction cost for a concrete block house was RMB $ 640-650 yuan/m². The construction cost for a wooden house was nearly the same as a confined masonry house. Field interviews with the local communities in Penghua Village show that construction of a wooden house, however, requires more building procedures and a variety of workmanship, especially carpenters. The lack of these building specialists meant that in spite of its superior seismic properties, the construction of a wooden structure house in Mianzhu was still limited.

The funding sources for rebuilding such a house in the earthquake-affected rural areas in Mianzhu included:

- national government subsidies RMB$16,000,
- bank loan maximum $RMB 20,000,
- local government subsidies of RMB $5,000 for a household that started rebuilding before 12 May 2009,
- varied financial assistance from the sponsoring locality depending on the level of income, and
- monetary or material donations from NGOs.

280
The shortfalls of the funding were usually covered by

- house owners’ personal savings, or
- money borrowed from families, relatives or friends.

Field interviews with local communities in Penghua Village show that cost escalation of the ‘indicator resources’, such as brick and aggregate, and the increased wages for employing labour or contractor professionals, had imposed financial burdens on the affected house owners. The overall cost for rebuilding a house containing four people had increased twice in comparing with pre-event levels. Community representative CR5 reported:

‘The financial incentives from the local government to try to expedite the whole housing rebuilding process in Mianzhu, however, to some extent put the house owners in a dilemma. On one hand, house owners were willing to get the RMB $5,000 funding from the local government, while they had to start rebuilding their house before the one year anniversary (May 12, 2009); on the other hand, this was the time duration that the level of resource availability in the market was low and it was very difficult to procure construction materials and labour for undertaking and even smoothly proceeding with their house rebuilding’ (CR5).

In particular, the inflationary effect of rebuilding a house was felt more strongly by those who lost jobs due to the earthquake and struggled to rebuild livelihoods. There was also a psychological barrier among those less-established communities. As one house owner CR1 highlighted:

‘Although we could access the bank loan for a maximum of RMB$20,000 for rebuilding our house and had loans from our relatives and friends in the unaffected areas, since then we have been burdened about how we are going to return the money back to them’ (CR1).

It can be concluded that the impact of low availability of resources for housing reconstruction in this case study was pertinent to affordability by the affected house owners. In spite of a number of initiatives and measures adopted by the related resourcing stakeholders, the financial impact of resourcing bottlenecks was prominent in the housing sector over the observed period. To reduce these impacts and gain further insights, the following section presents findings from a
questionnaire survey and interviews with regard to critical factors that affected resource availability for housing recovery in the earthquake-affected areas.

6.5 Critical factors that affected resource availability in earthquake housing recovery

By using statistical techniques, the questionnaire result with respect to the critical factors that affected resource availability in housing recovery in this case study of the 2008 Wenchuan earthquake is shown in Appendix 3. The results in Appendix 3 show that only 2 factors, namely competition for resources from other industries (sig. 0.115) and public social attitude (sig. 0.281) have a greater significance level than 0.05. These factors are thus not statistically important with regard to resourcing while the other 35 factors identified have an influence on project resource availability in post-disaster reconstruction.

Table 6.15 illustrates the top ten variables that were perceived by the Chinese respondents as being most significant in influencing resource availability in post-earthquake housing reconstruction.

<table>
<thead>
<tr>
<th>Factors affecting resource availability in post-earthquake reconstruction</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislation and policy</td>
<td>1</td>
</tr>
<tr>
<td>Project schedule/urgency</td>
<td>2</td>
</tr>
<tr>
<td>Competency of resourcing manager</td>
<td>3</td>
</tr>
<tr>
<td>Competence of contractor</td>
<td>4</td>
</tr>
<tr>
<td>Project resourcing plan</td>
<td>5</td>
</tr>
<tr>
<td>Quantity of resources required</td>
<td>6</td>
</tr>
<tr>
<td>Resource procurement lead time</td>
<td>7</td>
</tr>
<tr>
<td>General economic environment</td>
<td>8</td>
</tr>
<tr>
<td>Transportation cost</td>
<td>9</td>
</tr>
<tr>
<td>Transportation method</td>
<td>10</td>
</tr>
</tbody>
</table>
By using content analysis, the identified ten key determinants can be classified into three categories: (1) project-related factors including quantity of resources required, project schedule/urgency, project resourcing plan, and resource procurement lead time; (2) factors related to the reconstruction practitioners, including competency of resourcing manager and competence of contractor; and (3) factors external to reconstruction projects including legislation and policy, general economic environment and resource transportation cost and method. A discussion follows concerning the three main categories, incorporating the past studies, field observations, and interviews made during a series of field trips to Mianzhu.

6.5.1 Project-related factors

6.5.1.1 Project schedule/urgency

Project schedule/urgency was ranked as being the second most significant factor that influenced resource availability during post-earthquake reconstruction. This result is in line with Belassi and Tukel’s study (1996) which showed that the urgency of a project, being one of a project’s attributes, plays an important role in post-disaster reconstruction. In the current case study, much of the urgency came from livelihood recovery, notably from residential reconstruction which was the top priority for disaster-affected communities. However, the role that reconstruction plays in long-term community redevelopment is often overlooked (Jha et al., 2010).

Similar to the case of Mianzhu, there was an imperative to complete rebuilding of permanent residences before winter for people affected by the 2005 Great Pakistan Earthquake in North Pakistan (Mumtaz et al., 2008). Following a large-scale disaster, time needs to be allocated for reconstruction planning and scheduling (Schwab 1998) and normal planning procedures and construction legislation cannot be bypassed (Silva, 2007). If this happens, the project is more likely to suffer resourcing bottlenecks (Resilient Organisations, 2006a), exceed budgets (Davidson et al., 2008) and overrun schedules (Steinberg, 2007). In this respect, project schedule/urgency, as reflected in this case study, was not well considered in the State Overall Plan. Consequently, regardless of low level resource availability, the housing recovery urgency was compounded by the political will of the local government during post-disaster reconstruction.
6.5.1.2 Project resourcing plan

Project resourcing plan was regarded as the fifth most important factor that affected resource availability in this case study. Apart from basic plans, project resourcing plans involve proactive and preventive schemes to address potential resource bottlenecks. The significance of this variable suggests that a well-organized plan rooted in good factual detail can make the process manageable (Schwab et al., 1998). In a disastrous situation, resourcing plans are essential and will depend on the knowledge of available resources for an initial response to the emergency and for the subsequent restoration phases (Alexander, 2002). However, field observations suggest that resourcing for housing reconstruction in China was decided upon after the earthquake. This gave the construction sector little time to cope with disasters, in terms of resources.

Barenstein (2006a) advocated that the affected community could contribute to improving the implementing agencies’ planning efficiency by providing local resources and knowledge inputs into the resourcing plan. In addition, planning attention should be focused on critical resources in consideration of the anticipated long lead times (Zuo et al., 2006). In this case, the focus group discussions in December 2008 with twelve contractor representatives show that without access to the regional resource availability database (normally managed by the local construction authorities), it was impossible for them to conduct detailed resource planning due to the volatile market situation. One interviewee revealed:

‘The fact was that the production capacity was unlikely to cope with such a large demand for reconstruction. Therefore the resourcing difficulty was directly related to the market situation; no matter how well-established you were before the earthquake. In this case it should be us, but the government to undertake a detailed resource planning for the overall recovery and reconstruction’ (C2).

6.5.1.3 Quantity of resources required

The quantity of resources required, as interpreted by the interviewees as being rebuilding demand for resources, was seen by the questionnaire respondents as being significant. Hopkins (1995) pointed out that the total resources needed for full reinstatement is a starting point for assessing the implications for reconstruction timing, resource availability and supply/demand. As observed by the researchers after the Wenchuan earthquake, the reconstruction tasks were
incommensurate in scale with the available resources and caused a number of problems undermining the construction market, such as profiteering, inflation and precipitous wage increases for local labour.

The estimated supply shortfalls for main construction materials for the three-year reconstruction in China’s Sichuan Province in Table 6.10 indicate the quantity of resources required for post-earthquake rebuilding. Field interviews all agreed that the resource shortages were mostly induced by widespread and intensive rebuilding work. However, the focus group discussion also reached the conclusion that the quantity of resources depends upon a number of variables such as the physical impacts of the disaster, construction type and method, and the requirements of building owners, all of which deserves proper consideration for both project procurement managers and reconstruction planners.

6.5.1.4 Resource procurement lead time

In our research, one of the top ten factors leading to resource shortage was found to be resource procurement lead time, which concerns the interval between the initiation of resource procurement and the receipt of the resource into the project construction system. This result conforms to the findings of the study carried out by Singh (2007) who concluded that the lead time associated with the acquisition of resources in post-disaster situations can be detrimental to the availability of these resources, especially in a construction industry which relies heavily on “just-in-time” delivery. In the aftermath of Wenchuan earthquake, however, the lead time of cement was the most prominent issue that was encountered by the rebuilding contractors.

Focus group discussions and interviews proposed some examples of project failure and rework because of the long lead time of cement for making in-cast concrete. The impact can be gleaned from the following quote from one contractor representative.

‘According to the construction schedule, for instance, the needed cement would be delivered to the site at a certain time. House owners were unable to ensure its timely delivery because the manufacturers were unable to guarantee their consistent supply. As a result, some of the ongoing work such as constructing concrete foundations and columns had to cease and the quality of these structures was also affected’ (C7).
6.5.2 Factors related to the reconstruction practitioners

6.5.2.1 Competency of resourcing manager

Third highest ranking was given to the factor ‘competency of resourcing manager’ in the questionnaire responses. The resourcing manager in this case refers to either the house owners or community recovery committee (CRC) if they chose to procure resources or construction professionals who were charged with resource procurement for house rebuilding projects. Regardless of the construction procurement type, resourcing managers need to procure resources for project construction in a timely and economical way. The case study in this research highlighted the role of the communities in resource procurement within a house construction process. Field observations suggest that most cases in relation to resource procurement failure for reconstruction work were concerned with house owner-procured resourcing mode.

Due to the lack of trust in the contracted professionals, most CRCs formed their own resource procurement team. Interviews with community representatives (CR2-CR5) in June 2009 show that by purchasing in a large volume, they could gain a lower rate for essential materials such as bricks and cement, in comparison with the market price. However, without prior experience and proper knowledge about suitable resources for construction, there were a number of cases where the building products or materials purchased by the CRC members were not in line with the specifications and the requirements of house construction. The technical support, according to one interviewee (CR2), was mainly focused on the inclusion of seismic features into house construction. There was a lack of targeted education and technical assistance programs for the local communities and construction practitioners with respect to resource procurement. One academic researcher pointed out:

‘In the aftermath of the earthquake, the government adopted a series of initiatives to encourage the self-build housing reconstruction. However, it should be noted that any initiative should be facilitated by the back-up supporting mechanism. For instance, without systematic training for those who aimed to procure resources themselves, a self-procure resourcing approach is unlikely to be successful’ (AR1).
6.5.2.2 Competence of contractor

Competence of contractor was perceived by the questionnaire respondents as being the fourth important factor that had an impact on resource availability post-earthquake. In the contractor build reconstruction cases in Mianzhu, the contractor’s capability was regarded as a key element to pool and source resources required for rebuilding a house. It was observed that large-scale contractors were more involved in high-rise apartment building and more likely to procure resources needed for housing reconstruction. One of the reasons may be that many large contractors maintain long-term relationships with their subcontractors and suppliers, and it is these relationships that determine the position of large contractors in post-disaster reconstruction (Masurier et al., 2006b). In contrast, in rural areas of Mianzhu, relatively simple house construction required more small contractors, builders and trades people involved. The experience and social network of these small size businesses seemed to be important in securing resources for construction.

Field interviews also reveal that the superior resourcing ability of large contractors in urban areas in Mianzhu had pooled the resources needed for urban housing rebuilding, especially the masonry products such as bricks and construction labour. This had a subsequent impact on the housing reconstruction in rural areas. One construction contractor in June 2009 claimed:

‘There was a tendency in the earthquake-affected areas that the resources and skills with high quality were likely to flow into the well-established construction contractors who mainly operating a large housing project in urban areas, whereas house owners could only tend to lower skills and resources of low quality’ (RC5).

Capacity building for small and medium size construction businesses was proposed by a number of interviewees in June 2009. The first step, according to interviewee RC2, should come from the local government to encourage and enable the small contractors to effectively handle the resourcing tasks confronting them in post-disaster situations.
**6.5.3 Factors external to reconstruction projects**

**6.5.3.1 Legislation and policy**

Legislation and policy was ranked highest by the questionnaire respondents. This result in this case study relates to the significance of the legislative measures adopted by the Chinese government to facilitate the overall recovery and reconstruction, and the implications of a series of ‘hard’ interventions into the construction market. China’s post-disaster resourcing strategies are in line with the findings of Hirshleifer (1956) who found that in order to deal with market disorder, profiteering and inflation, regulatory authorities normally turn to ‘hard interventions’ by directly interfering in manufacturing, supply and transaction. The cornerstone of this philosophy is that legislation and policy decisions can have positive consequences in a complex post-disaster system. As McGee (2008, p. 547) explained, ‘government officials often succumb to public pressure to place controls on the very goods and services that are most needed after a natural disaster’.

Within the specific context of China, the market regulations after the earthquake enabled public institutions to orient resource production and supply for the most vulnerable communities. The following quotations highlight the views from a range of interviewees on the effectiveness of such a government-driven resourcing approach:

‘*China’s efforts to improve resource availability and to ensure the priority needs in the most vulnerable communities provided the government with the credibility to ‘campaign’ for long term reconstruction nationwide*’ (synthesis of views from Focus Group with C1-C12).

However, as the post-earthquake reconstruction proceeded, some underlying problems surfaced, as the interviewed reconstruction practitioners C12, R3 and G1 reported:

‘*These government-driven resourcing actions, focusing on the supply side to stimulate the construction market, to some degree, eased the temporary tension of inflation in the earthquake-affected areas*’ (C12). ‘*However, the generic restrictions also posed a major disincentive to other suppliers to actively get engaged in post-disaster reconstruction resource supply*’ (R3).
‘Another problem with these mandates is that the superficial ease of inflationary tension in the short term would make authorities underestimate the disaster-economic impacts without a careful assessment of community needs’ (G1).

In addition, in light of the author’s longitudinal research, the on-going activities of housing reconstruction in China showed a restricted market mechanism for balancing reconstruction demand and supply. Additional vulnerabilities in the local economy were created as a result. As an interviewee commented in June 2009:

‘As could be seen in the field, the majority of housing reconstruction (80%) in rural areas was completed one year after the earthquake; the local brick production industry had already suffered a ‘crisis of excessive production’ (G2).

These comments reinforced the point raised by McGee (2008, p. 551), who claimed that any sort of price controls would cause resources to be allocated inefficiently and could only serve to delay disaster relief. Any input into the construction market and material production needs to be grounded in an understanding and continual monitoring of community needs during reconstruction process. Local government should pay attention to the evolution of the local economy and the social requirements for resource availability in post-disaster situations. As two interviewees proposed:

‘Policy makers should understand the resource supply vulnerabilities from the demand side’ (C14); ‘The public rules should not aim for settling different and conflicting interests of stakeholders but for what can be improved to facilitate resource supply in a given context’ (R1).

6.5.3.2 General economic environment

The general economic environment, globally, nationally and locally, played a prominent role in post-earthquake reconstruction work in China. The global economic crisis in 2008 had an impact on China’s construction market and in particular, a huge impact on the steel industry. 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 continuing nationwide reduction in the demand for steel products. Nevertheless, most of these manufacturers were reluctant to supply their steel stocks at a lower price to the needy population for earthquake recovery and reconstruction. This
profit-driven and somewhat risk-averse behaviour of Chinese steelmakers made supply a problem in disaster-affected areas.

One positive effect of the 2008 global financial crisis on post-Wenchuan earthquake recovery and reconstruction was that some earthquake affected cities had seen a cycle of reverse migration. Under the harsher economic conditions in China’s relatively developed east coast, many able-bodied migrants who had left rural villages in Sichuan Province and adjacent regions returned home and constituted a part as labour force in housing recovery and reconstruction.

6.5.3.3 Resource transportation cost and method

Resource transportation cost is closely related with the transportation method. Both these factors were regarded by the questionnaire respondents as being important in influencing resource availability. Therefore, this section will discuss these two factors together. Transportation systems such as roads, airports and railways serve as lifeline access to available resources for a country’s successful recovery. The significance of transportation has been confirmed in previous research. Some studies looking into post-disaster reconstruction logistics have shown that high cost of resource transportation (Limoncu and Celebioglu, 2006) and lack of access alternatives (Singh, 2007) are a major concern for overall reconstruction. As observed in China by the researcher in the field, the unavoidable costs related to logistics, such as the costs incurred by lack of consistency in delivery and by volatile price fluctuations of fuel and physical distribution, accounted for a large fraction of resource sourcing costs.

The location of the construction site in association with distance, method and cost of resource delivery is also recognized by the respondents as a key factor impacting on rebuilding project resource availability. Particularly in the remote mountainous areas where quake damage was severe, resourcing for rebuilding houses was principally restricted by the lack of any transport system. According to the researcher’s observation in Mianzhu City in December 2008, all modes of transport including human and pack-animal carrying methods were applied for delivering building materials to construction sites in the affected areas which were both remote and mountainous and where road access had been disrupted.

In December 2008, the Ministry of Transport in China approved four river–land joint routes for large cargo delivery, capitalising on a comprehensive national transport system. One of the four
lines ran from Shanghai via Chongqing to Chengdu. The recovery and reconstruction resources were shipped from Shanghai to Chongqing using the Yangtze River and then transferred to the earthquake-affected areas via the Chongqing–Suining highway (295 kilometres), the Chengdu–Chongqing highway (339 kilometres) and the Yuling highway (413 kilometres). However, as interviewee G5 noted, these ad hoc post-event strategies for extending transport capacity have the potential to generate transportation conflicts between existing delivery activities and reconstruction needs and to some extent increase the difficulty of overall coordination and deployment of resources nationwide.

6.6 Conclusions and recommendations

The case study of the Wenchuan earthquake in this chapter serves as an example of house recovery organized by affected communities, implemented by construction professionals under a government-dominant environment. By reviewing the post-earthquake recovery and reconstruction operations from different involved stakeholders, the resourcing challenges that confronted decision makers, construction practitioners, and house owners were identified. Characteristics of the post-Wenchuan earthquake housing reconstruction were analyzed.

In the second half of the chapter, the roles and responsibilities of the resourcing stakeholders were discussed. Three main ‘indicator resources’ were identified: brick, aggregate, and labour, followed by a discussion of their availability. The impacts of the low resource availability of building materials and construction professionals on housing reconstruction in Mianzhu were illustrated with an example of a house rebuilt in Penghua village in Mianzhu. In general, resourcing problems caused by the ‘indicator resources’ challenged house owners’ affordability to rebuild their houses. Findings from the questionnaire survey and interviews show that resource availability for China’s Wenchuan earthquake reconstruction was a function of the rebuilding project and the individual capability of contractors, along with other issues in the external built environment such as legislation and policy, economic and transportation conditions. However, these factors were not fully recognized and addressed by Chinese reconstruction teams during their resourcing operations.
The analysis of the resourcing challenges encountered by Chinese authorities during the post-Wenchuan earthquake reconstruction period demonstrated that while government intervention in the market could cater for reconstruction requirements of the most vulnerable communities in the short term, it also undermined the longer-term sustainable development of the local economy. The sense of urgency led to the rushing of housing recovery planning at the local level. Given China’s specific social system, in order to improve resourcing post-disaster in China, the following features should be addressed.

1) The reconstruction planning by decision makers should be made through a proactive approach that is cognizant of the actual resource availability. Having a planned procurement strategy would effectively reduce the risks of long lead time and at the same time enhance procurement capability of the resourcing professionals. It is important for resourcing managers to incorporate as much resource-associated information into the plan as possible, by building networks with stakeholders and material suppliers in particular.

2) Large-scale construction companies, as the leading players in the construction industry, should provide procurement expertise to assist small and medium-size corporations with training in resourcing procedures, assessing quantities of resources required and procurement skills to reduce lead time and cost. Local governmental agencies and construction associations play a coordination role in facilitating technical assistance by providing financial or in-kind support to launch a series of training initiatives. A range of ‘fit-for-purpose’ contractual relations and well-tailored resourcing strategies, when appropriate, could be linked with measures to foster resourcing capability of small or medium size contractors.

3) To be more certain of fulfilling resourcing needs of post-disaster reconstruction, a specific legislative and regulatory system is required. Legislation and policy needs to be revamped prior to disasters in order to facilitate effective resource acquisition and utilization for long-term sustainability in disaster-prone areas. Effective, enforceable legislation and policy is essential to the formulation of an overall resourcing system and its outcomes after a disaster.
4) The general economic environment is the most uncontrollable yet influential factor impinging on resource availability after a disaster. Its facilitation function for post-disaster reconstruction resourcing can only be realized by policy makers through a policy of robust and extensive program of global economic integration and domestic deregulation, as well as sound macro-economic and local economic management.

5) Given the importance of transportation in post-disaster resourcing, transport capacity extending strategies should be integrated into the pre-disaster mitigation program and be targeted at transport alternatives to enhance the resilience of the overall transportation system. Planning for infrastructure reconstruction of transport should also be in line with industrialization and urbanization in disaster-impacted areas taking account of natural environmental conditions.

Post-disaster resource planning requires commitment from decision-makers and practitioners in a multi-sector approach. Understanding and communication among stakeholders can make it possible to develop a collaborative reconstruction approach. To achieve this, systematic data collection, information systems and communication and coordination mechanisms are required. An enabling international environment is vital to develop the knowledge, capabilities and motivation needed to build disaster-resilient nations and communities in China. Developing specific mechanisms to introduce human and material resources into China through both bilateral and multilateral channels for post-disaster reconstruction should also be considered.
Chapter 7 Resourcing housing recovery following the 2009 ‘Black Saturday’ bushfires in Australia

7.0 Overview

This chapter presents research findings from the case study of the 2009 ‘Black Saturday’ bushfires in Victoria, Australia. Analogous to the preceding chapters of case studies of Indonesia and China, the structure of this chapter is arranged on a basis of the five elements in the resource availability analytical framework. These five elements in the context of post-bushfire recovery and reconstruction in Australia are:

1) Post-bushfire recovery and reconstruction environment,
2) Post-bushfire housing recovery approach,
3) Resourcing stakeholders for bushfire housing reconstruction,
4) ‘Indicator resources’ and their availability, and
5) Critical factors that affect resource availability for post-bushfire housing recovery.

Several recommendations are made in the conclusion in addressing the resourcing constraints identified during the process of bushfire housing recovery in Australia.

7.1 Post-bushfires recovery and reconstruction environment

This section sets out to provide an overview of the aftermath of the bushfires in Victoria, as well as the overall recovery and reconstruction settings. It begins with presenting the impacts of the bushfires on the case study site examined in this research. The response to the bushfires from the government at different levels and from various agencies will be presented on a basis of the field observations and interviews in August 2009, six months after the bushfires. This section then presents a view of the institutional arrangements such as recovery legislation, policies, agencies and services that were put in place after the bushfires, with a view to helping communities recover from the bushfires.
7.1.1 The ‘Black Saturday’ bushfires and the town of Marysville

7.1.1.1 The 2009 Victorian ‘Black Saturday’ bushfires

On Saturday February 7, 2009, the State of Victoria experienced devastating bushfires. The fires started and were widely spread across the State by severe drought conditions, high temperatures and strong winds. The fires affected 80 communities, destroyed more than 2000 homes and damaged 430,000 hectares of land. The locations of the ‘Black Saturday’ fires are shown in Figure 7.1 below. By the time the fires were contained, 173 people had died and many others were seriously injured (VBBRA, 2009). A summary of the bushfire impacts is presented in Table 7.1.

![Figure 7.1 Areas affected by the ‘Black Saturday’ fires in the State of Victoria (CFA, 2009a)](image)

Among all the affected areas in Victoria, the Shire of Murrindindi was seriously affected by the bushfires. The field trips to the fire-affected areas took place in Murrindindi, with a focus on the most devastated towns of Marysville, Kinglake and Flowerdale. The following section presents an overview of the case study site, Marysville, and the bushfire impacts.
Table 7.1 Impacts of the 2009 Victorian ‘Black Saturday’ bushfires

<table>
<thead>
<tr>
<th>Fire areas</th>
<th>Estimated no. of houses within fire perimeter¹</th>
<th>Houses destroyed²</th>
<th>Houses with minor damage²</th>
<th>Houses with no damage</th>
<th>Death</th>
<th>Forest area burnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunyip</td>
<td>240</td>
<td>35</td>
<td>21</td>
<td>184</td>
<td>0</td>
<td>180,000+ha</td>
</tr>
<tr>
<td>Churchill</td>
<td>359</td>
<td>133</td>
<td>86</td>
<td>140</td>
<td>11</td>
<td>150,000+ha</td>
</tr>
<tr>
<td>Kilmore East</td>
<td>3540</td>
<td>1244</td>
<td>530</td>
<td>1766</td>
<td>121</td>
<td>32,800+ha</td>
</tr>
<tr>
<td>Maiden Gully</td>
<td>172</td>
<td>48</td>
<td>21</td>
<td>103</td>
<td>1</td>
<td>500+ha</td>
</tr>
<tr>
<td>Murrindindi</td>
<td>1064</td>
<td>590</td>
<td>74</td>
<td>400</td>
<td>40</td>
<td>24,500+ha</td>
</tr>
<tr>
<td>Total</td>
<td>5375</td>
<td>2118</td>
<td>832</td>
<td>2593</td>
<td>173</td>
<td>390,000+ha</td>
</tr>
</tbody>
</table>

Note: 1: Based on National Exposure Information System (NEXIS) (G-NAF) address identifiers, assuming one residence per address, and some extra added points identified from aerial imagery without address.
2: Assessment from aerial imagery by Geoscience Australia
Source: Adapted from (Bushfire CRC and Geoscience Australia, 2009, p. 147)

7.1.1.2 Town of Marysville and bushfire impacts

The Shire of Murrindindi is located north east of Melbourne, the capital city of the State of Victoria. Murrindindi encompasses townships and villages such as Alexandra, Buxton, Eildon, Flowerdale, Highlands, Kinglake, Marysville, Lake Mountain, Narbethong, Strath Creek, Taggerty, Thornton, Toolangi, Yea and Yarck. The Murrindindi fire started at 14:55 on Saturday afternoon in Wilhelmina Falls Road, Murrindindi. It travelled rapidly and by 16:30 it reached Narbethong. Following a wind change that arrived at about 18:15, the fire swept through the communities of Marysville, Buxton and Taggerty. The locations of the bushfire-affected areas in Murrindindi and field-visited towns of Marysville, Kinglake, and Flowerdale are shown in Figure 7.2.
Half of the shire of Murrindindi was severely damaged by the fires in terms of loss of life, houses or property. Statistics from the Murrindindi Shire Council (2009) in Table 7.2 provide a grim picture of the enormous losses to the Murrindindi residents and businesses.

Table 7.2 Statistics of damage from bushfires in the Shire of Murrindindi

<table>
<thead>
<tr>
<th>Items</th>
<th>Statistics of bushfire damage in the Shire of Murrindindi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>95</td>
</tr>
<tr>
<td>Area burnt</td>
<td>1,539 km², 40% of shire area</td>
</tr>
<tr>
<td>Structures destroyed</td>
<td>• Businesses/shops: 75</td>
</tr>
<tr>
<td></td>
<td>• Community/government facilities: 16 total losses and 9 partial losses</td>
</tr>
<tr>
<td></td>
<td>• Houses: 1,397</td>
</tr>
<tr>
<td></td>
<td>• Others (sheds only on vacant land): 234</td>
</tr>
<tr>
<td>Fencing destroyed</td>
<td>3,533 km (a straight line from Alexandra to Perth)</td>
</tr>
<tr>
<td>Relief centers</td>
<td>• Alexandra 2: Alexandra Leisure Centre &amp; Alexandra Secondary College</td>
</tr>
<tr>
<td>Staffed</td>
<td>• Yea 1: Yea Recreation Reserve</td>
</tr>
<tr>
<td>Rate revenue</td>
<td>• $375,000 – total loss of revenue 2008/2009</td>
</tr>
<tr>
<td></td>
<td>• Potential full year impact going into 2009/2010 could exceed $1 million in loss of rate revenue</td>
</tr>
</tbody>
</table>
The town of Marysville in Murrindindi Shire is less than two hours travel distance from Melbourne. About 12 km further east of Marysville is Lake Mountain which is a popular destination for cross-country skiing and bushwalking. Before the ‘Black Saturday’ fires, population in Marysville was approximately 500, with half the residents living as holiday makers. Tourism, agriculture and forestry were pillar industries underpinning local economy. Tourism was centered on the accommodation hub and food services of the town. All these services contributed more than 40% business activity.

The fires on Saturday February 7, 2009, however, devastated the entire township of Marysville. Statistics from VBRRA show that 34 people were killed in the fires in Marysville. The fires also destroyed 530 properties, including 95% of the retail businesses and 400 homes. An estimated 50% of employment in Marysville was lost, which was mainly associated with hospitality and tourism. Moreover, public infrastructure including the primary school, retirement village, community centre, post office, medical centre and police station were destroyed (VBRRA, 2010b). A summary of bushfire impacts on Marysville is tabulated in Table 7.3, supplemented by photos in Figure 7.3 illustrating the devastation.

<table>
<thead>
<tr>
<th>Features before the bushfires</th>
<th>Impact of the bushfires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population: 500 residents</td>
<td>Death toll: 34</td>
</tr>
<tr>
<td>Tourism, agriculture and forest industry</td>
<td>• 50% tourism and service jobs lost</td>
</tr>
<tr>
<td></td>
<td>• DSE office damaged, surrounding forest devastated</td>
</tr>
<tr>
<td>Property: 530</td>
<td>95% of retail businesses destroyed</td>
</tr>
<tr>
<td></td>
<td>400 homes and buildings destroyed</td>
</tr>
<tr>
<td>Public infrastructure</td>
<td>The primary school, retirement village, community centre, post office, medical centre and police station destroyed</td>
</tr>
</tbody>
</table>
Emergency services in Victoria were activated immediately. The emergency response was concentrated on fire fighting, evacuation, setting up community welfare centres and restoration of damaged critical infrastructure. On ‘Black Saturday’, more than 12,000 personnel from Country Fire Authority (CFA) were actively engaged in fighting the fires. The Metropolitan Fire and Emergency Services Board also contributed crews, as did interstate and international fire fighting services and the State Emergency Services. The Australian Defence Force was involved in fire fighting and also worked to create fire breaks and clear roads.

26 The photos were derived from the Age webpage of Australia.
The PPRR emergency management framework in Australia, as reviewed in Chapter Two, was applied in the overall emergency response to the bushfires. The day after the bushfires, the Australian Government Disaster Response Plan was activated. The Response Plan prescribed the management arrangements, responsibilities and procedures for State Government agencies and organizations involved in the bushfire prevention, preparedness, response and recovery (PPRR). Under the Response Plan, the Australian and Victorian governments, community organizations and volunteers groups took a varied role in emergency relief, including areas such as temporary accommodation, financial assistance, health care, and food aid.

Meanwhile, the State Government of Victoria, in partnership with the Federal Government and Australian Red Cross, established the Victorian Bushfire Appeal Fund on February 8. The fund was to support the affected communities to recover from the bushfires. The Australian Government Disaster Recovery Payment Program was initiated on February 9 to provide financial assistance for individual families. On February 10, the Commonwealth and Victorian Governments established the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA) to oversee and coordinate bushfire recovery and rebuilding programs. On February 14, the Victorian Bushfire Case Management Service, comprising over 360 case managers from the Australian and Victorian governments and other agencies, was set up, providing the affected populations with personalized support, information and advice (DHS, 2010). The 2009 Victorian Bushfires Royal Commission was established on February 16 to investigate the causes and responses to the February bushfires in the State of Victoria, as well as make recommendations about improving fire preparedness. The above immediate responses to the ‘Black Saturday’ bushfires are summarized in Table 7.4.

<table>
<thead>
<tr>
<th>Date</th>
<th>Response (agencies or institutions)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 7</td>
<td>Country Fire Authority (CFA), Metropolitan Fire and Emergency Services Board, interstate and international fire fighting services, the State Emergency Services, and the Australian Defence Force</td>
<td>Fire fighting and emergency rescue</td>
</tr>
<tr>
<td>February 8</td>
<td>The Australian Government Disaster</td>
<td>To define the management arrangements, responsibilities and procedures for State Government</td>
</tr>
<tr>
<td>Date</td>
<td>Agency/Service</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>February 8</td>
<td>The Victorian Bushfire Appeal Fund</td>
<td>To support individuals and communities in towns and suburbs affected by the 2009 Victorian bushfires</td>
</tr>
<tr>
<td>February 10</td>
<td>Victorian Bushfire Reconstruction and Recovery Authority (VBRRA)</td>
<td>To oversee and coordinate bushfire recovery and rebuilding programs</td>
</tr>
<tr>
<td>February 14</td>
<td>Victorian Bushfire Case Management Service</td>
<td>To help with accessing the practical assistance and services needed for recovery till end of February 2011.</td>
</tr>
<tr>
<td>February 16</td>
<td>The 2009 Victorian Bushfires Royal Commission</td>
<td>To investigate the causes and responses to the February bushfires in the State of Victoria, as well as make recommendations about improving fire preparedness</td>
</tr>
</tbody>
</table>

Table 7.4 shows that the responses to the bushfires from both the government agencies and emergency services were considerable and rapid. However, field interviews suggest that many affected communities, especially those who lost family members or friends in the fires, attributed their loss to the government’s failure to respond effectively. The deficiencies in the emergency response during the ‘Black Saturday’ fires were further revealed the Victorian Bushfires Royal Commission (VBRC) in their interim report. According to VBRC (2009), during the fires, public information and warning systems in particular, were found to be inadequate. In addition, delayed warnings and overloaded information, along with the ‘stay or go’ policy, received criticism because the degree of risk in staying and defending were not fully understood by the public.

7.1.3 Institutional arrangements for post-bushfire recovery

7.1.3.1 Bushfire Recovery Assistance Package

To facilitate post-bushfire recovery and reconstruction, the Australian Government announced a $465 million Recovery Assistance Package. A multiplicity of assistance was provided in the Package for individuals, families, communities, businesses, primary producers and local governments affected by the bushfires. In addition, there were a number of initiatives and

---

27 The currency unit in this case study is the Australian currency dollars AUD
programs put in place to help various individuals and organizations recover from bushfires. Major initiatives in the Package are summarized in Table 7.5 and outlined below.

Table 7.5 Initiatives under the Bushfire Recovery Assistance Package (Disaster Assist, 2011)

<table>
<thead>
<tr>
<th>Assistance</th>
<th>Initiatives included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial assistance to the affected individuals</td>
<td>• The Australian Government Disaster Recovery Payment (AGDRP)</td>
</tr>
<tr>
<td></td>
<td>• Income Recovery Subsidy</td>
</tr>
<tr>
<td></td>
<td>• Natural Disaster Relief and Recovery Arrangements (NDRRA): Temporary Living Expense &amp; Grant Re-establishment Grant</td>
</tr>
<tr>
<td>Other assistance to the affected individuals</td>
<td>• Victorian Bushfire Case Management Service</td>
</tr>
<tr>
<td></td>
<td>• Psychological Counselling support</td>
</tr>
<tr>
<td></td>
<td>• Clean-up and demolition (Grocon)</td>
</tr>
<tr>
<td></td>
<td>• Relaxation of new-start requirements</td>
</tr>
<tr>
<td></td>
<td>• Support for elderly people</td>
</tr>
<tr>
<td>Assistance to community, business and local government</td>
<td>• Natural Disaster Relief and Recovery Arrangements (NDRRA) grant to small businesses</td>
</tr>
<tr>
<td></td>
<td>• Community Recovery Fund</td>
</tr>
<tr>
<td></td>
<td>• Tourism Industry Support Package</td>
</tr>
<tr>
<td></td>
<td>• Emergency Relief Funding</td>
</tr>
<tr>
<td></td>
<td>• Social Housing Initiative</td>
</tr>
<tr>
<td></td>
<td>• Regional and Local Community Infrastructure Program to support local councils</td>
</tr>
</tbody>
</table>

1) **Financial assistance to the affected individuals**: The Australian Government Disaster Recovery Payment (AGDRP), as alluded to earlier, provided a one-off, immediate payment of $1000 per adult and $400 per child to the bushfire-affected population. In addition, the Income Recovery Subsidy program was set up to provide assistance to employees, small business operators, and farmers who lost income as a result of bushfires. Under the Natural Disaster Relief and Recovery Arrangements (NDRRA), the Victorian Department of Human Services (DHS) was responsible for delivering temporary accommodation and re-establishing grants to the bushfire-affected people in 25 identified local government areas. The Re-establishment Grant consisted of a maximum payment of up to $8,650 for repairs for a property and up to the same amount to replace essential
household contents such as furnishings and electrical goods. A Temporary Living Expense Grant up to a maximum of $8,650 was also available for each household.

2) **Other assistance to the affected individuals:** As mentioned in the preceding section, the Victorian Bushfire Case Management Service was established a few days after the fires to support people affected by the bushfires. The case managers provided advice on issues such as accommodation, finance, employment, education, counselling, health and legal services, and other personal assistance. The Package allocated $7.5 million funding to provide counselling services for mental health support to affected individuals. Following the bushfires, the Australian and Victorian Governments contracted Grocon to help communities with site clean-up and demolition. There was also a relaxation of new-start requirements for job seekers impacted by the bushfires. For elderly people affected by bushfires, the Australian Government provided an additional $1.5 million in emergency funding to help cover costs of emergency nursing home care and mechanical aids/personal care items lost in the bushfires. The Australian Government provided up to $500,000 to the Victorian Government to provide additional Home and Community Care services.

3) **Assistance to community, business and local government:** Under the Natural Disaster Relief and Recovery Arrangements (NDRRA), the Australian and Victorian Governments provided a $51 million joint package to support the small businesses affected by the bushfires. A $10 million Community Recovery Fund was also established to help community recovery and development, with a focus on addressing longer-term recovery of social networks, functioning and community facilities. The Fund covers a range of projects such as the restoration of community infrastructure, community preparedness and resilience building activities. Other funding assistance to the affected communities include a $10 million Tourism Industry Support Package, $80.4 million Emergency Relief Funding, and $2.4 million Social Housing Initiative. To enable the local governments to better meet the recovery need of communities, the Australian Government provided local councils in the affected areas with the opportunity to reprioritize their projects under its $250 million Regional and Local Community Infrastructure Program.
7.1.3.2 Victorian Bushfire Reconstruction and Recovery Agency (VBRRA)

The scale and urgency of the 2009 ‘Black Saturday’ bushfires recovery task created an imperative to establish a new government agency. As alluded to earlier, on February 10, 2009, three days after the fires, the Victorian Government established the recovery agency — the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA). VBRRA was responsible for coordinating the restoration and recovery of regions, towns and communities affected by the ‘Black Saturday’ bushfires across Victoria.

In the early days after the bushfires, VBRRA worked alongside the emergency response, recovery and relief agencies. Its operation was mainly characterized by rapid organizational activities such as convening decision-making and advisory groups, meeting local governments, engaging local communities and establishing a media presence (State Services Authority, 2010). Field interviews in August 2009 suggest that, apart from being a recovery coordinator, VBRRA also undertook operational responsibilities. The role and tasks VBRRA had taken on are summarized as follows.

1) **Clean-up program:** Three weeks after the bushfires, VBRRA contracted a private company, Grocon, to clear debris from fire-damaged properties for the affected households. Grocon engaged local contractors, with 69% of work undertaken by non-metropolitan contractors located within or close to affected areas. In four and a half months, Grocon cleared 3,053 properties and removed 400,000 tons of materials from the sites (VBRRA, 2010a). At its peak time in March 2009, around 300 properties were cleared each week. Field interviews show that cleanup workers had received psychological training before they conducted the clearing job for communities. The training was to make them prepared to deal with traumatized people. The clean-up task was undertaken by Grocon in a sensitive and respectful manner, and spoken of highly among communities.

2) **Material aid and donations management:** Following the bushfires, there was an unprecedented volume of donations to the affected people from both Australia and overseas. Field interviews in August 2009 show that considerable donations offered within days of the bushfires posed a major challenge for emergency relief operations.

304
donations coordination system within VBRRA, including a warehousing and distribution service, was put in place to manage in-kind donations. Moreover, VBRRA attempted to align the material aids with the needs of the affected people. For this purpose, a needs-based donations management system and a ‘matching service’ for high-value donations were established consecutively.

3) **Temporary villages**: To accommodate displaced individuals and families in the hardest hit areas, VBRRA, working with the Department of Human Services (DHS), established three temporary villages in Marysville, Kinglake, and Flowerdale, as well as smaller housing arrangements in Whittlesea. Field interviews suggest that there was no precedent for this kind of project in the State of Victoria. VBRRA was therefore confronted with a unique challenge to help those displaced rebuild their permanent houses. Field observations in July 2010 suggest that DHS managed the tenancies for about 253 temporary dwellings, while VBRRA arranged the access to land for locating the temporary villages. In addition to single, double and family accommodation units, the temporary villages also included a variety of facilities such as communal cooking and dining facilities, recreation space, laundries, storage, and pet facilities. Photos in Figure 7.4 show these types of units in the Marysville Temporary Village.

1. Single unit in Marysville Temporary Village  
2. Two bed room family units

*Figure 7.4 Temporary accommodation for displaced people in Marysville Temporary Village*²⁸

²⁸ The photos were taken by the researcher during the field trip to Marysville in July 2010.
Apart from the above specific rebuilding tasks, VBRRA operated across jurisdictions, portfolios, sectors and geographically dispersed communities, as an administrative office of the Department of Premier and Cabinet. Field interviews suggest that VBRRA served as an institutional agency that can be established rapidly but did not necessarily come with legislative powers and functions. Most work had to be done through partnerships and negotiation to achieve consensus and coordination. However, field trips to the affected areas show that over the reconstruction period, VBRRA played a significant role in facilitating the community to recover from bushfires, especially rebuilding their houses and communities. The efforts and operations made by VBRRA in housing recovery will be specified in greater detail in the following section.

7.1.3.2 Post-bushfire recovery and reconstruction framework and plan

For post-bushfire community recovery, VBRRA adopted a recovery and reconstruction framework in Figure 7.5, as described in Chapter Two.

![Figure 7.5 Bushfire recovery and reconstruction framework](image)

The framework encompasses four elements: people, reconstruction, economy and environment; and recognizes the interdependencies of local community recovery with each of these four elements. Field interviews show that the reconstruction framework provided a structured and interactive approach to recovery and reconstruction, keeping the needs and aspirations of local
communities at its centre. As a starting point, VBRRRA set out the guiding principles within the framework that underpinned VBRRRA’s activities through the recovery process. These principles are presented in Table 7.6.

Table 7.6 VBRRRA principles for post-bushfire recovery and reconstruction

<table>
<thead>
<tr>
<th></th>
<th>Principles for post-bushfire recovery and reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Welfare</strong>: The safety and welfare of people in the local community including householders, volunteers and workers will be the top level priority and will not be compromised.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Meeting needs</strong>: Resources for recovery will be focused on areas of greatest need in each community.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Community engagement</strong>: Community involvement is key and will be pursued through all activities with management at local level empowered to deliver results.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Integrity</strong>: Provision of services and resources will be governed by the principles of fairness and equity.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Tailored solutions</strong>: The needs of each community affected by the fires are different and the recovery solutions will be tailored to the specific needs of each community.</td>
</tr>
</tbody>
</table>

Both the framework and VBRRRA’s main tasks described in the preceding section involved working with communities, government agencies, and other organizations to develop coordinated plans for recovery and reconstruction. The recovery plans included community recovery plans at a local level, as well as a state-wide plan for post-bushfire reconstruction and recovery across Victoria. The following describes these two sets of plans for bushfire community recovery.

1) The Rebuilding Together Plan

In October 2009, the Australian and Victorian Governments jointly launched The Rebuilding Together Plan (VBBRA, 2009). The Plan represented the framework for community recovery and the restoration of core services and infrastructure following the 2009 Victorian bushfires. The Rebuilding Together Plan set out the steps for the recovery and rebuilding of the fire-affected communities. It served as an overarching guideline for delivering initiatives and projects to support people as they rebuild their homes. It also provided guidance on the restoration of critical community facilities and infrastructure over a two-year recovery period. The Plan
stipulated that VBRRA continue to take a lead role in overseeing and coordinating the recovery and rebuilding programs until January 2011. The recovery would then be handed over to the Victorian Government and local governments in the affected areas.

The Rebuilding Together Plan had committed $193 million to deliver a range of recovery projects. The composition of this funding was $117 million from the Australian and Victorian Governments, $56 million from the Victorian Bushfire Appeal Fund, and $20 million from philanthropic and corporate donations. This financial commitment was targeted for rebuilding major community facilities, including schools damaged or destroyed in the fires and for supporting people as they rebuilt their lives and their homes. A National Partnership Agreement between the Australian and Victorian Governments was put in place to facilitate the Australian Government’s contribution towards the Rebuilding Together Plan.

The Rebuilding Together Plan was based on the disaster recovery and reconstruction framework shown in Figure 7.5. This framework acknowledged that communities and individuals recover best when they are supported to manage their own recovery. Under the Rebuilding Together Plan, a community-led recovery approach was adopted across the affected areas in Victoria. Local communities were supported by the Victorian Government through VBRRA to identify issues of local concern and develop plans to address these issues. Under Victoria’s Emergency Management Act 1986, Community Recovery Committees (CRCs) were set up in the affected regions to lead and manage community recovery activities. 33 CRCs were established. CRCs worked alongside other agencies, including regional recovery committees, VBRRA, local councils, government departments, and other local groups. The structure of the recovery agencies involved in the Murrindindi bushfire recovery and reconstruction is shown in Figure 7.6.
2) Community Recovery Plan

Guided by the Rebuilding Together Plan, VBRA worked with local councils and communities to establish CRCs and to develop long-term Community Recovery Plans. Through extensive consultation with local communities, the CRCs considered the views of local residents and businesses by identifying their needs. The Community Recovery Plan then listed specific needs, prioritized projects and initiatives, and set out a vision for the future for each community. The proposed projects covered all aspects of recovery such as personal health and wellbeing, built environment, business and economy, natural environment, and community strength and wellbeing. Priorities identified in the Community Recovery Plans included restoring facilities such as local halls, community centres and sports grounds, rebuilding infrastructure such as roads and bridges, and initiatives to help small businesses to recover.

Field interviews in August 2009 suggested that each CRC set its own priorities and retained complete authorship over its plans. Community Engagement Teams were established
accordingly within VBRRA to work with CRCs to identify alternative options for developing, funding and delivering projects that could be further incorporated into the Rebuilding Together Plan. However, VBRRA’s commitment to community-led recovery at the local level was not without its challenges. Field observations in both August 2009 and July 2010 found that community participation incurred time and resource costs. Decision-making via community consensus entailed a slower process. By August 2009, six months after the fires, very little reconstruction had commenced and by July 2010, one and half years after the bushfires, housing reconstruction proceeded slowly, particularly in the worst-affected areas of Kinglake and Marysville. The following section sets out to amplify the process of housing rebuilding in Murrindindi, with a focus on post-bushfire housing recovery in Marysville.

7.2 Post-bushfires housing recovery approach
VBRRAs emphasis on community-led recovery and local decision making had an impact on the post-bushfire housing recovery and reconstruction which was organized by the affected house owners themselves. This section aims to explore the emerging issues and elements that constituted the characteristics of the post-bushfire housing recovery in this case study.

7.2.1 Building controls for housing construction before the bushfires
The predominant housing type in Australia is a timber-frame structure with a variety of materials for other supporting elements such as floors, roofs, and external walls. Field interviews show that in bushfires, brick houses were likely to perform significantly better than other structures such as cellulose cement, timber and mud brick-clad houses. Prior to the 2009 ‘Black Saturday’ bushfires, there was an integrated control system for constructing bushfire-proof houses in Victoria. This section details the pre-existing building controls for bushfire safety.

7.2.1.1 House vulnerability to bushfires
The causes of house losses in bushfires are complex and involve many aspects such as weather conditions, forest fuels, local topography, house design, house materials, landscape objects and brigade and occupant behaviour (Blanchi et al., 2006). Previous research conducted by the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia has shown that the predominant causes of house ignition are from ember attack, or as a result of radiant heat
or flames from surrounding burning objects and/or surface fuels leading to house ignition (Ramsay and McArthur, 1995; Leonard and McArthur, 1999; Leonard and Blanchi, 2005). House vulnerability is defined in terms of the susceptibility to the bushfire attack mechanisms: ember entry, ember accumulation, radiant heat and flame (Bushfire CRC and Geoscience Australia, 2009). As for the building alone, according to Ramsay et al. (1994), different parts of the building have been identified as vulnerable to fires, such as gaps in the building envelope, glazing systems (window and frame), external doors, timber decks, roof cavities, eaves, fascias, and subfloor.

In 2003, a Bushfire Co-operative Research Centre (CRC) was established after the 2003 Canberra bushfires in Australia. In response to the 2009 ‘Black Saturday’ bushfires, the Bushfire CRC established a research taskforce to undertake data collection and analysis in the aftermath of the fires. This section presents the research findings with respect to design elements that contributed to the property loss during the 2009 ‘Black Saturday’ bushfires:

1) **Cladding material**: Among the different cladding materials, bricks performed well in comparison with all other forms of construction. It was found that mud brick, cellulose cement and timber-clad structures all performed similarly to each other. The worst performer was cellulose cement, indicating either higher vulnerability or poor building integrity associated with this cladding type, or the associated light construction approach for these dwellings. Mud brick was considered as a heavy non-combustible wall material. CRC assumed that the poor performance of mud brick constructions during the bushfires, however, may be due to the other structural design details.

2) **Window glass type**: The physical characteristics of glass and framing performance in bushfires were well presented in the study of glazing performance (Bowditch et al., 2006). Glass selection and framework are key components that have a great effect on the performance of a window during fires. Generally, in comparison with toughened and laminated glasses, plain glass is considered as the most vulnerable glass type to fires. The Bushfire CRC (2009)’s survey showed that the large majority of damaged houses in bushfires had plain glass. However, the relatively small sample of houses with toughened or laminated glasses made it unsuitable to compare their contribution to house survival when comparing with plain glass.
3) **Roof types:** Two types of roof systems were dominant in the survey dataset by the Bushfire CRC after the Black Saturday bushfires. These two roof systems were a simple roof with one ridge and no valleys, and a roof with complex ridge. The predominant roof materials include corrugated iron and metal deck. The valleys in a complex ridge roof were areas where accumulation of embers and windborne debris can occur and increase the likelihood of roof ignition during ember attack. The housing damage survey showed that there was no statistical significance between house loss and roof material type.

4) **Flooring system:** Across all the houses surveyed by the Bushfire CRC after the 2009 bushfires, 35% fell into slab-on-ground construction, 30% of houses had floors supported by concrete stumps and 12% of houses had floors supported by timber stumps. Houses involving raised flooring were more likely to be destroyed than slab-on-ground construction. Houses with raised floors supported by stumps had a great chance of being ignited and destroyed by fires. However, the type of stump material did not seem to influence the likelihood of house loss.

5) **Deck and veranda:** Different types of attachments were recorded in the house damage survey by the Bushfire CRC, including decks, stairs and veranda. Of the deck attachment, however, 87% were identified as combustible, though the decking material varied from tongue board, gapped board treated pine, to gapped board other timber. The Bushfire CRC house damage survey showed that of the deck attachments, 46% were undamaged and 35% were completely burnt. However, any significant correlation between the type of these attachments and the house loss was not conclusive in this survey.

### 7.2.1.2 Bushfire building controls

Prior to the ‘Black Saturday’ bushfires, the County Fire Authority (CFA) classified the key phases in the fight against wildfires as being prevention, preparedness, response and recovery. Prevention and preparedness techniques have been developed on the basis that buildings burn as a result of three different methods: direct flame contact, radiant heat and burning embers. Building in bushfire areas in Victoria requires careful planning and must be designed to meet bushfire controls. In general, the bushfire building controls for residential properties in Victoria are mainly focused on two processes of building and planning and their interaction.
1) **Legislative framework for construction of buildings:** In the State of Victoria, there is a legislative framework that governs the construction of buildings (Building Commission Victoria, 2004). The framework comprises the Building Act 1993, Building Regulations, and the Building Code of Australia (BCA). Bushfire building requirements are set out in the BCA and the Australian Standard ‘Construction of buildings in bushfire-prone areas’ (AS3959-1999). Ramsay and Rudolph (2003) also specified the building design and materials used into a house construction system in bushfire areas. The Building Standards AS3959-1999 specifies the categories of bushfire attack as 1) low bushfire attack, 2) medium bushfire attack, 3) high bushfire attack, 4) extreme bushfire attack. According to Hughes and Mercer (2009), the Australian Standards 3959-1999, implemented through the building regulations alone, failed to provide adequate protection from radiant heat and flame contact. It only focused on maximizing the performance of buildings subject to bushfire attack by means of construction and design requirements for buildings.

2) **Wildfire Management Overlays (WMO):** As a supplement to the construction control, planning guidelines exercise significant controls on the level of bushfire damage to residential buildings in Victoria. The Wildfire Management Overlay (WMO) and planning controls form part of the prevention and preparedness component of wildfire management, with a focus on mitigation against radiant heat and flame contact in new residential developments. Therefore, to complement the Building Standards 3959-1999, as discussed above, direct flame contact and radiant heat can be best managed through site layout and vegetation management which, in turn, is best achieved through the WMO and CFA’s education programs like ‘Community Fireguard’ and ‘Bushfire Blitz’ (Maughan and Krusel, 2004). The purpose of a WMO is to ensure that building development in areas subject to high fire risks will include appropriate fire protection measures such as adequate water supply, access, building sitting design and fuel-reduced areas around buildings.

3) **Interaction of WMO and bushfire building controls:** Where the WMO applies, buildings need to comply with both planning and building controls. The CFA published ‘Building in a Wildfire Management Overlay – Applicants Kits’ which was designed to assist house owners to seek planning permits for building in a WMO area. The Kit sets
out an alternative site assessment process to that specified in AS3959-1999. In addition, the Kit specifies the vegetation management conditions and proposes an installation of an external water spray system (EWSS) as part of an entire property fire management plan. In an area covered by a WMO, the planning permit will specify the category of bushfire attack in accordance with AS3959-1999. The relevant building surveyor must ensure that the building construction is consistent with this category of bushfire attack and with the planning permit generally.

Field interviews in July 2010 suggest that Murrindindi Shire Council was the first local government to introduce the WMO into their planning scheme. While CFA in Victoria had provided considerable support to local governments to formulate and adopt the WMO, some local governments in Victoria were slow to implement the WMO. The integration of WMO into the local planning was reliant on the strength of local policies or guidelines. However, in examining the implementation of WMO in Victoria, Hughes and Mercer (2009) attributed the weakness of local planning policies to a lack of a solid and comprehensive base for planning and the lack of consideration of strategic direction in the local governments. The 2009 ‘Black Saturday’ bushfires and its significant impacts on residential properties, however, brought to the fore the importance of adopting WMO and aligning it with the Building Regulations to guard buildings against fires. The following section will detail the changes made to building controls for constructing new houses in Victoria after the 2009 ‘Black Saturday’ bushfires.

### 7.2.2 Changes in building controls for housing reconstruction after the bushfires

On March 11, 2009, the Victorian Government introduced updated Building Standards AS3959-2009 for bushfire-prone areas to facilitate the rebuilding process. The Standards increased the construction requirements on residential buildings for better fire protection. The new Australian Standard applies to the whole State. Under the new Standards, construction sites are defined into six Bushfire Attack Level (BAL) categories, with increased construction requirements ranging from ember protection to direct flame contact protection. These six BALs have replaced the four levels in the preceding version of AS3959-1999. The new BAL takes into account a number of factors including the Fire Danger Index, the slope of the land, types of surrounding vegetation.

---

29 The WMO was incorporated into the Murrindindi Planning Scheme on April 6, 2004.
and its proximity to any building. Table 7.7 outlines the construction requirements in accordance with different BALs.

Table 7.7 BALs within the new building standards (Building Commission Victoria, 2009)

<table>
<thead>
<tr>
<th>BAL</th>
<th>Description of predicted bushfire attack and levels of exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAL-Low</td>
<td>There is insufficient risk to warrant specific construction requirements</td>
</tr>
<tr>
<td>BAL-12.5</td>
<td>Ember attack</td>
</tr>
<tr>
<td>BAL-19</td>
<td>Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux between 12.5 and 19 kW m²</td>
</tr>
<tr>
<td>BAL-29</td>
<td>Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux between 19 and 29 kW m²</td>
</tr>
<tr>
<td>BAL-40</td>
<td>Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames</td>
</tr>
<tr>
<td>BAL-FZ</td>
<td>Direct exposure to flames from fire front in addition to heat flux and ember attack</td>
</tr>
</tbody>
</table>

The new Standards stipulated that every new home built in Victoria will undergo a BAL site assessment as part of the application for a building permit to determine which method of construction is to be used. The new Standards were to be used to guide the rebuilding process for communities affected by the 2009 bushfires. However, in places where there is no rebuilding as a result of the recent fires, WMO requirements apply as usual. The construction must be in accordance with AS3959-2009 or as directed by the CFA as a note on the relevant planning permit. Field observations and interviews suggest that the accelerated adoption of the updated Standards in response to the ‘Black Saturday’ bushfires raised a number of issues for land use planners and CFA in particular.

Before the bushfires, the site assessment set out in the WMO kit met the requirements of a site bushfire attack assessment required under the previous AS3959-1999. In situations where the WMO applies, at the planning permit stage a site assessment under WMO needs to be completed, and at the subsequent building permit stage, the relevant building surveyor does not need to re-assess the site. After the bushfires, the new BALs assessment method in new Building Standards AS3959-2009 is not in line with the one under WMO. Therefore, the introduction of AS3959-2009 required an amendment to the WMO Applicant’s Kit to reflect the revised construction requirements. Moreover, field interviews with representative Bc1 from the Building Commission.
suggest that construction in the BAL-flame zone was a fundamental concern because the safety of building occupants relies solely on the construction of the building if WMO does not apply. There were challenges to the integration of the Victorian land use planning and building control solutions after the bushfires. This integration also required knowledge transfer and behaviour change through widespread community education. The current Victorian planning and building legislative regime in relation to wildfires is shown in Figure 7.7.

*Figure 7.7 Victorian planning and building legislation in relation to wildfire (Bushfire CRC, 2009)*

### 7.2.3 Post-bushfires housing recovery actors

As discussed in the preceding section, Victoria adopted a community-led approach to the bushfire recovery and reconstruction. The local communities were supported by the State Government through VBRRA, other government departments and local councils. Field observations and interviews suggest that house rebuilding in the fire-affected areas in Victoria generally conformed to the traditional ‘client, contractor, consultant’ triangle structure. Under this structure, house owners acted as clients and the design and construction were contracted to the qualified consultants and builders/contractors respectively. The case study in this chapter
looks at the contractor-build housing reconstruction, organized by the affected house owners. Questionnaire survey and field interviews identified three major groups of actors in post-bushfire housing rebuilding projects, namely: 1) Government authorities, including the Department of Human Services (DHS), Building Commission, the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA) and the local government Murrindindi Shire Council; 2) House owners and 3) Construction professionals. This section details the roles and responsibilities of these actors and their relationships in undertaking a house recovery project.

7.2.3.1 Government authorities at different levels

Apart from the legislative changes and swift establishment of VBRRA, a range of fast-track solutions was initiated by the Victorian Government to accelerate housing reconstruction. These solutions included an exemption for a planning permit if a house was to be rebuilt on the original site, streamlining the building permit, and a government-funded clean-up program. Furthermore, a number of agencies and services were set up for the worst-affected towns, such as Marysville and Kinglake, to assist affected house owners with rebuilding their homes. These included such things as the provision of temporary villages, provision of the Rebuilding Advisory Service, provision of the Voluntary BAL Assessment, and establishing two Rebuilding Advisory Centres in Marysville and Kinglake. Four government bodies that played an important part in facilitating housing recovery in Marysville and Kinglake are mentioned.

1) Department of Human Services (DHS): The Department of Human Services assisted people who had lost their homes to find temporary accommodation while homes and communities were rebuilt. The interviewees D1 and D2 from the DHS reported that the temporary housing options were: (1) temporary villages in Flowerdale, Marysville and Kinglake, (2) public housing across the State, (3) 200 caravans on sites and (4) other rental options. 95% chose to rebuild on their own land. Interviewee D1 suggested that among the temporary housing options, using sheds was considered to be most cost-effective. On-site sheds can help people to get back to their own land and rebuild homes. Option for caravans was limited by size and quality. Some people had to wait for three months before they moved into caravans on their own land. In comparison, temporary villages were costly. The fire-affected people had to be distributed across the whole State for public housing. Therefore, the best solution is to build on-site sheds to encourage
people to go back to their own blocks and start permanent housing rebuilding. Apart from
the temporary housing assistance, DHS established Community Service Hubs in a
number of areas such as Marysville, Kinglake, and Flowerdale, as a ‘one-stop shop’ for a
range of recovery services. The main services included financial support, housing
assistance and counselling assistance. It also functioned as a ‘drop in centre’ that
facilitated interaction amongst community members and allowed for the development of
support networks and establishment of locally relevant ‘recovery’ activities.

2) **Building Commission**: The Building Commission is a statutory authority that oversees
the building control system in Victoria. Four statutory bodies were established by the
Building Act 1993, namely: Building Advisory Council, Building Appeals Board,
Building Practitioners Board and Building Regulations Advisory Committee. The
Building Commission works closely with these four statutory bodies to provide industry
leadership and to regulate building quality (Building Commission, 2004). Field
interviews show that the Building Commission was actively involved in the housing
recovery following the introduction of the new Building Standards AS3959-2009. To
ensure the right building measures were in place and complied with the building
legislation, the Building Commission initiated a series of programs to communicate
building legislation changes to the public. For instance, the Building Commission
published a series of guides for house owners including “A guide to a safe return to the
bushfire damaged property”, “A guide to assessing property’s BAL”, “A guide to
temporary housing options for people affected by the bushfires”, and “A guide to
building in Victoria after the bushfires”. In addition, by working with the construction
industry and other sectors, the Building Commission made considerable efforts, as an
advisor and ‘public educator’, to provide compliant building solutions for house owners,
as well as a variety of training programs for construction practitioners.

3) **Victorian Bushfire Reconstruction and Recovery Authority (VBRRA)**: A free mobile
Rebuilding Advisory service was set up within VBRRA and played a significant role in
assisting house owners while rebuilding their residences. Information, advice and
assistance on all aspects of rebuilding were available through this service operating
across all affected areas. Four rebuilding advisors Ra1-Ra4 during the interviews in July
2010 mentioned that the Rebuilding Advisory Service visited affected communities to provide face-to-face assistance in order to guide residents through the building process. However, by the time the field trip took place in July 2010, there were only four building advisory officers operating across all affected areas. This service, along with other assistance, was expected to be strengthened by establishing two Rebuilding Advisory Centres in Marysville and Kinglake. Interviews with these four rebuilding advisors suggest that there were instances where a number of house owners were unable to rebuild their homes due to expensive contract alterations and other problems with their builders who raced to cash in without delivering satisfactory work. Accordingly, the Rebuilding Advisory team organized a series of professional workshops and programs offering tactics for house owners on contractual issues.

4) **Murrindindi Shire Council**: During housing reconstruction, the Murrindindi Shire Council implemented and administered building legislation at a local level. Through the municipal building surveyor and other building professionals, the Council was mainly responsible for delivering building services and providing technical expertise and experiences to house owners. The interviewed representative C1 from the Murrindindi Shire Council suggested that while the Council served as a significant provider of building services for communities, it also worked as part of a team within the complete emergency management system. For instance, the building service unit in the Shire of Murrindindi has a wide range of technical and operational responsibilities in emergency management and house construction, including hazard mapping, issuing building and occupancy permits, maintaining registers of building permits, and undertaking construction inspections and approvals. However, field interviews suggest that the Murrindindi Shire Council faced significant challenges as it was overwhelmed by the post-bushfire recovery work, while it still had to maintain its normal services.

7.2.3.2 **Bushfire-affected house owner**

Field interviews in July 2010 suggest that the community recovery committee (CRC) established in the affected areas was in charge of community rebuilding and re-development work such as rebuilding infrastructure and public facilities. Rebuilding houses, however, was organized by the house owners. The entire rebuilding process, according to the rebuilding advisor Ra4, was in line
with the conventional construction process in Victoria. In July 2010 field interviews with representatives Bc1 and Bc2 from the Building Commission suggest that the major difference between the conventional construction and post-bushfire reconstruction resided with the application of new BAL assessment under Building Standards AS3959-2009. Generally, the housing rebuilding process followed four construction steps as follows.

1) **The design phase**: The BAL assessment could be undertaken by house owners or a free BAL voluntary service. House owners who would rebuild their house on the original site were not required to obtain planning permits. Therefore, after the BAL assessment, the house owners only sought the advice from the building designer and architect on how to apply the construction methods most appropriate to meet their needs.

2) **Appointing a builder**: When the design plans were complete, the house owners needed to appoint a builder. The Building Commission provided information for house owners to select a Registered Building Practitioner (RBP). House owners needed to make their own decision on the selection of suitable building workers and to arrange the contract.

3) **Applying for a building permit**: House owners needed to check with the local council regarding whether their building work required a building permit. If so, the house owners needed to obtain the building permit before the commencement of any building work. Building permits are issued by the Council’s Municipal Building Surveyor or a Private Building Surveyor who ensures that the plans comply with the new Building Standards AS3959-2009. Applications for the building permits were streamlined for the affected house owners by the Murrindindi Council.

4) **The rebuild process**: The overall reconstruction process is the same as the traditional house construction. The builder or architect appointed by the house owner oversees the entire building process to make sure the building construction complies with the Building Standards. The building surveyor carries out building inspections throughout the construction process. House owners need to seek an occupancy permit or a certificate of final inspection from the building surveyor on completion of the construction work.
7.2.2.3 Construction professionals

Field observations and interviews in August 2009 and July 2010 suggest that the construction industry in Victoria played an important role in the bushfire response and recovery. The efforts made by a wide variety of construction professionals in the industry can be summarized as follows.

1) **Clean-up and BAL site assessment**: As mentioned in the preceding section, the private construction company Grocon was the successful tenderer for the clean-up process. Grocon successfully linked with local communities and local licensed contractors to deliver the bushfire clean-up and demolition program in a coordinated way. Interviewee V4 commented that with a record of rebuilding homes for communities affected by 1974 Cyclone Tracey in Darwin, Grocon was well placed to deliver the clean-up operation sensitively, safely and as quickly as possible. At the end of June 2009, a voluntary BAL assessment was organized by the Building Commission for the affected house owners in preparation for their design and rebuild process. The industry volunteers involved in this program included engineers, builders and other building expertise. This program provided initial support for the house owners, especially those who were traumatized and unable to conduct BAL assessment on their own.

2) **Architects Bushfire Homes Service**: Field interviews in August 2009 revealed that a number of house owners had an issue with the house design under the new Building Standards. In response to this situation, in mid 2009, the Architects Bushfire Homes Service was established by the Office of the Victorian Government Architect and the Australian Institute of Architects. The service offered house owners access to a range of house designs and one free consultation with an architect. Based on the house owner’s requirements, house designs were tailored to comply with the new Australian Standard for residential buildings in bushfire-prone areas.

3) **Housing construction builder/contractor**: Field observations in August 2009 and July 2010 showed that there were a few cases where house rebuilding was conducted by house owners themselves, but the vast majority of house rebuilding was carried out by local contractors or from the Melbourne metropolitan region. Rebuilding advisory officers Ra2
and Ra3 advised that many house owners had good experiences with their builders and got on well with rebuilding their homes and lives. However, others experienced real problems in maintaining a good relationship with their builders. In addition, the construction requirements under the new Building Standards were new to building practitioners during the recovery process. The impact of the legislative changes on the construction practitioners will be discussed in greater detail in the following sections.

The roles of three main reconstruction actors during the housing recovery in Victoria are summarized in Table 7.8.

### Table 7.8 Summary of roles and responsibilities of housing reconstruction stakeholders in Victoria

<table>
<thead>
<tr>
<th>Actors</th>
<th>Roles/responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Governmental authorities</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Department of Human Services (DHS) | • Providing temporary accommodation for affected people while rebuilding their permanent houses  
   • Community Services Hubs – one-stop shop, drop-in centre  
   • Assistance to rebuilding lives                                                                 |
| Building Commission                 | • Communicating legislation changes to public  
   • Providing information and training to both communities and construction industry           |
| VBRRA                               | Providing affected people with information, advice and assistance on all aspects of rebuilding:  
   - Mobile Rebuilding Advisory Service  
   - Rebuilding Advisory Centre in Marysville and Kinglake  
   - Rebuilding workshops and programs for communities |
| Murrindindi Shire Council           | • Implementing and administering building legislation at local level  
   • Delivering building services and providing technical expertise and experiences  
   • Emergency management operations                                                        |
| Owner-build construction            | Decision-maker and main constructor                                                     |
| House owners                        | Decision-maker  
   - Selecting, appointing construction professionals  
   - Complying with building regulations and other                                          |
Table 7.8 demonstrates that in assisting housing recovery, the State Government of Victoria, local governments, and other public and private entities had made considerable efforts. Despite these endeavours, housing reconstruction proceeded slowly, especially in the worst-affected Shire of Murrindindi. By the time the researcher conducted the second research trip in July 2010, 18 months after the bushfires, many households in Marysville, Kinglake and Flowerdale were still struggling towards housing recovery and little reconstruction activity had taken place. In Marysville, for instance, fewer than 300 rebuilding permits had been issued for houses, sheds, and commercial properties. As few as 50 houses were actually being rebuilt while many of the permits that had been granted were probably for sheds. Field interviews in July 2010 suggest that resource shortages for house rebuilding and difficulties in sourcing building materials and professionals were principal impediments to housing reconstruction. The following sections present research findings with regard to resourcing for bushfire housing reconstruction.

### 7.3 Resourcing stakeholders for housing recovery in Victoria

As alluded to earlier, new building site assessment has six levels of risk based on the Bushfire Attack Level (BAL), with increasing construction requirements ranging from ember protection at the low levels (BAL-12.5) to fire-rated construction at the highest (BAL-FZ [Flame Zone]). According to the Building Commission (2009), of the building permits issued for new homes in 2008, around 80% would fall into the lowest category (BAL-LOW), requiring no special construction requirements. Only 10% of building permits issued would fall into the higher BAL categories – BAL 29, BAL 40, and BAL-FZ. Field interviews show that in Marysville and Kinglake, however, most of the rebuilding houses fell into the higher BAL categories. The construction requirements for houses in these areas posed a great challenge with respect to
selecting compliant materials and suitable building professionals. This section presents research findings of main resourcing stakeholders.

### 7.3.1 Resourcing facilitator: VBRRA and Building Commission

Field interviews suggest that the major influence of the changed legislative control for buildings in Victoria was on the selection of materials, especially for houses in higher BAL categories. VBRRA through the Rebuilding Advisory Service played a role as an advisor to help with selection of suitable materials for house reconstruction. The Building Commission was also seen as a facilitator in developing specifications to the new building products.

#### 7.3.1.1 Measures adopted by VBRRA

To help the affected communities to solve the resourcing difficulties, VBRRA adopted a series of facilitating measures.

1) **Providing advice on the selection of compliant building materials**: Through the Rebuilding Advisory Service (RAS) and Rebuilding Advisory Centres (RACs) in Marysville and Kinglake, VBRRA provided advice on the selection of compliant building materials under the new Building Standards. During the interviews in July 2010, rebuilding manager Rm1 reported that along with the mobile RAS, VBRRA built two RACs in Marysville and Kinglake. The RACs would accommodate a range of building professionals such as Building Commission staff, council building surveyors and town planners, legal advisory services, consumer affairs, and other professionals from Sustainability Victoria and CFA. In the long term, the two buildings would be handed over to the local community to be used as permanent community facilities.

2) **Providing information on available resources**: According to the rebuilding advisor Ra4, at the beginning of the recovery, the rebuilding advisory team in VBRRA established a database incorporating information on existing local construction capacity. Information on available construction materials, designers, draftsmen and builders was categorized into individual databases. In addition, by developing relationships with the building product manufacturers and the Building Commission, VBRRA resumed the responsibility of communicating product innovations to the needy house owners through rebuilding services in both RAS and RACs.
7.3.1.2 Facilitation provided by the Building Commission

The Victorian Building Commission acted as a ‘building controller’ to ensure that the rebuilding work complied with the new Building Standards. In resourcing for post-bushfire housing recovery and reconstruction, the Building Commission played an important facilitating role.

1) **Specifying new compliant products**: For building products required for houses in higher BAL categories and yet not on the market, the Building Commission designed the specifications for these compliant elements. This was done by collaborating with a large number of specialist suppliers and manufacturers. For instance, to facilitate the production of compliant window systems for rebuilding houses in BAL-FZ, the Building Commission developed specific research design criteria for such window products. By involving fire experts and product manufacturers, a combined window and screen system manufactured for use in BAL-FZ was tested by the Building Commission to the Australian Standard AS1530.8.2 and released onto the market in early 2010. The Building Commission also engaged other stakeholders in the process of manufacturing roof systems for BAL-FZ houses under the new Building Standards.

2) **Providing training for the construction industry**: As mentioned in the preceding section, the Building Commission organized a series of industry seminars to inform building practitioners on the technical aspects of the new residential Building Standards. Interviewee Bc 2 noted that in order to improve the overall industry capacity, the Building Commission took a lead role in developing a central database of built environment volunteers for bushfire recovery and reconstruction. In addition, the Commission initiated a number of training projects to enhance the skills of volunteers to meet the long-term demand for contractors or builders.

7.3.2 Resourcing procurer: construction contractors/builders

Field observations and interviews in July 2010 suggest that the role of contractors and builders in housing rebuilding was not confined to only undertaking construction work. Many contractors were seen taking greater responsibility for house design and specification decisions or becoming involved with the design team in the design process. Those construction professionals were often
in a position to select appropriate products for house owners who were not familiar with construction requirements under the new Building Standards. As suggested by interviewee Ra3:

“The selection of the building products or materials that will comply with the current building standards is most likely to be a decision-making thing for the already traumatized house owners. We used to see a lot of cases in which house owners choose and purchase materials on their own. After the bushfires, however, the changed regulations had confused house owners and increased uncertainties regarding the selection of suitable construction products’ (Ra3).

In most cases after the bushfires, the contractors/builders acted as actual purchaser of building products for house owners. The volume builder representatives B3 and B5 explained that usually contractors and sub-contractors have accounts with some regular merchants and by placing their orders they can obtain some financial discount. With this advantage, most house owners were inclined to contract the material procurement to these contractors.

When questioned on the procurement of building materials, the builder representatives stated they preferred to select products they were familiar with. Architects also preferred the use of standard designs that were applied to house construction before the bushfires. The selected design would be altered if necessary to suit the specific criteria of the house rebuilding after the bushfires. However, interviewee B2 stated that if a product required in the design was new to the construction contractor or builder, it would only be procured with guarantees, such as a certificate by a registered fire safety engineer and/or conformity to Australian Standards. Manufacturers’ guarantees were seen to be essential in reducing the potential risk of using a new non-specified product in a construction system. Field interviews show that there were a number of building products available in the construction market. However, these products could only be used after the institutionalized fire test for houses constructed in higher BAL categories. The testing process, taking a long time, had contributed to the subsequent housing recovery delays.

7.3.3 Resourcing driver: building product manufacturers

Field interviews in July 2010 suggest that innovation in building materials in Victoria was influenced by the desire of the manufacturers to hold and extend their markets, rather than in response to particular rebuilding demands. In other words, development and application of new building products for rebuilding fire-resistant houses was largely determined by market push
rather than demand pull. According to interviewee B4, the cost of developing new building products was hard to calculate since the price of a product was rarely known at the development and specification stage. Therefore, manufacturers were reluctant to disclose the price of the new products until they were released onto the market.

In the context of changed building standards in Victoria, manufacturers seemed to lose interest in the design of new products for rebuilding in the BAL higher categories. The reason was possibly because of insufficient assistance from the government. Manufacturers M1-M4 suggested that they would only consider their investment on producing new building materials or components designed for their tenth or hundredth use, rather than for a single use. Mass manufacturing not only ensures greater efficiency but also guarantees the reduction of transaction cost. According to M2:

‘Small manufacturing businesses may need funding assistance regarding the tests from the government. If government can justify the size of the market against the cost of tests, and take a more responsible approach to help with house owners in the extreme zones such as providing grants for large manufacturing businesses with testing, the housing rebuilding in BAL-FZ could’ve gained a good start’ (M2).

However, field interviews show that by merely changing the building standards, the government assumed that bushfire rebuilding may present multiple opportunities for material manufacturing businesses to conduct building and construction innovation. The fact that the technological advances were dependent upon the projected size of the prospective market for new products was largely overlooked. Furthermore, as described earlier, the Building Commission suggested that across Victoria, 80% of building applications are low risk, 10% are in the two categories of BAL-12.5 and BAL-19, 7% are in the high risk levels of BAL-29 and BAL-40, and only 3% are in the highest risk category of BAL-FZ. Only 10% house rebuilding may require new construction materials or products for fire-resistant compliance. Therefore, a conservative rather than positive attitude was adopted by many manufacturers with respect to the investment on new building products. There was a general concern that the new products may fail to achieve a seemingly small market share.
7.4 ‘Indicator resources’ and their availability for post-bushfire housing recovery

Field observations and interviews show that resourcing for housing recovery was more dominated by the construction market and less intervened by government authorities. However, in this market-driven recovery environment, house owners in the Shire of Murrindindi, especially in Marysville and Kinglake, faced significant resourcing problems, such as shortages of building materials, lack of qualified builders and increased costs for rebuilding. These resourcing problems, as observed by the researcher, had translated into frustration for the communities as they attempted to recover. This section presents the research findings with respect to the ‘indicator resources’ and their availability, and the impacts of low resource availability on housing recovery projects in Murrindindi.

As alluded to earlier, the new Building Standards set out suitable materials and construction methods appropriate to bushfire risk. When asked about the main differences in construction requirements between the preceding Building Standards AS3959-1999 and new AS3959-2009, interviewees V2 and V6 in August 2009 suggested that under AS3959-2009, new homes at risk of bushfire may have specific requirements including: 1) roofs, verandas and decking made from non-combustible materials; 2) wall and roof joints sealed against ember attacks; 3) windows protected by non-combustible shutters or made using 4 to 5 mm toughened glass and 4) door frames made from fire resistant timber and tightly fitted, with a weather trip at the base. Following the introduction of AS3959-2009, the Building Commission (2009) estimated the additional costs in relation to a double brick single level home built under the new standard. The estimated elementary costs of the entire structure are tabulated in Table 7.9 below.

Table 7.9 Additional cost of building a single storey house under AS3959-2009 (Building Commission Victoria, 2009)

<table>
<thead>
<tr>
<th>Base house cost</th>
<th>BAL</th>
<th>Cost under new standard</th>
<th>Cost increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>$280,000</td>
<td>12.5</td>
<td>$11,535</td>
<td>4.1%</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>$11,535</td>
<td>4.1%</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>$16,783</td>
<td>6.0%</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>$17,615</td>
<td>6.1%</td>
</tr>
<tr>
<td></td>
<td>FZ</td>
<td>$22,108</td>
<td>7.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construction components</th>
<th>Cost under new standard</th>
<th>Construction requirements under new standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>Cost</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Roof</td>
<td>$1749</td>
<td>Non-combustible covering, Roof/wall junction sealed, Openings fitted with non-combustible ember guards, Roof to be fully sarked.</td>
</tr>
<tr>
<td>Windows</td>
<td>$5999</td>
<td>Protected by bushfire shutters or completely screened with steel, bronze or aluminum mesh or 4mm Grade A safety glass or glass blocks within 400mm of ground.</td>
</tr>
<tr>
<td>External doors</td>
<td>$2700</td>
<td>Protected by bushfire shutters or completely screened with steel, bronze or aluminum mesh or non-combustible or 35mm solid timber for 400mm above threshold glazed with 4mm Grade A safety glass, Door framing to be natural fire resistant, tight fitting with weather strip at base.</td>
</tr>
<tr>
<td>External walls</td>
<td>$787</td>
<td>Parts less than 400mm above ground or decks to be of a non-combustible material.</td>
</tr>
<tr>
<td>Vents and Weepholes</td>
<td>$300</td>
<td>To be screened with 2mm corrosion-resistant steel, bronze or aluminum mesh.</td>
</tr>
</tbody>
</table>

Of the five types of construction components listed in Table 7.9, windows and roofing system were identified in this case study as the most critical ‘indicator resources’ that had an impact on housing recovery in Marysville and Kinglake. The actual costs for such new products used in rebuilding houses, however, had greatly exceeded the Building Commission’s estimate. Moreover, builders and tradespeople were also identified in the questionnaire survey and interviews as being another ‘indicator resource’. Low availability of qualified construction professionals compounded the material shortages in the worst-affected Marysville and Kinglake. The availability of these ‘indicator resources’ including windows, roofs and builders are analyzed as follows.

### 7.4.1 Availability of windows for housing recovery

The new Building Standards AS3959-2009 require optional fire shutters on windows of buildings at high risk of bushfires, and improved fire resistance for windows to protect them from direct flame and radiant heat. Interviews in July 2010 suggest that the issues relating to the unavailability of building materials had been most prominent in terms of requirements to install fire-proof shutters or fire-rated window systems in BAL-FZ situations. Field observations in July 2010 in Marysville and Kinglake confirmed that lack of fireproof shutters and window panels on the market for houses in BAL-FZ caused housing rebuilding delays.
Following the introduction of the AS3959-2009, the Building Commission suggested a few companies nationwide that may be able to provide required window components for building BAL-FZ houses. However, cost was a major concern for house owners seeking to rebuild their homes in BAL-FZ. According to interviewee V2,

‘The quote from the suggested companies for the type of windows that were required for BAL-FZ houses was around between $3,000 and $3,500 each, with a total of more than $20,000 to install 7 windows for a house. This item alone, however, constituted a big portion to the total cost for rebuilding a house’ (V2).

Alternatively, there were other types of window panels on the market that may be usable for BAL-FZ houses. However, these available products were not specified for BAL-FZ houses at the time of housing recovery. Without specification, no one could guarantee their compliance with AS3959-2009. House rebuilding in BAL-FZ in both Marysville and Kinglake was hindered due to the lack of compliant window materials. Field observations in July 2010 show that a number of house owners with houses in BAL-FZ had to change the location of their houses or remove surrounding vegetation to lower the BAL category. By reducing their house’s BAL, they could access the available resources for lower BALs on the market for house rebuilding.

The above situation lasted until March 2010 when a combined window and screen system manufactured for use in BAL-FZ was released onto the market. As explained by interviewees Bc1 and M3, the fact was that there was only a small number of homes located in the highest BAL-FZ category. It was not financially viable for manufacturing companies to test and produce new window products for such a small market. The Building Commission, being a catalyst for building regulatory changes, however, had to take a lead role in testing new products. Since the introduction of AS3959-2009, Building Commission had been working with other industry participants to seek solutions for compliant windows and screens to be used in BAL-FZ. The following quote from interviewee Bc1 highlighted the important role of the Building Commission in resourcing for bushfire housing recovery.

‘After the bushfires, it became an imperative for the Building Commission to develop a collaborative approach to promoting the role it can play in helping businesses respond to demand for new fire-resistant products for use in high BAL categories’ (Bc1).
Field interviews show that there were reservations about test methods for determining the performance of components under bushfire conditions. According to manufacturer representative M2, the uncertainty about the test methods under BAL-FZ conditions was considered as a potential risk with respect to liability. Consequently, it was the governmental authorities, particularly the Building Commission, who played a lead role in facilitating the window solutions for rebuilding houses in BAL-FZ category. The assessment of window availability for housing reconstruction in terms of the three dimensions of resource availability can be summarized in Table 7.10.

Table 7.10 Availability of windows for bushfire housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Little fire-proof shutters or fire-rated window systems in BAL-FZ situations on the market after the fires  
• Product innovation took place with considerable facilitation from the Building Commission  
• Significant impact of window prices on affected house owners |
| **Usability** | • Lack of alternative window solutions for houses in BAL-FZ category  
• Reservations in the building standards with respect to test methods increased uncertainty of product testing  
• Manufacturers’ reluctance to test and release new products to market |
| **Accessibility** | • Lack of access to available window systems in the market  
• Building Commission’s facilitation increased local access to available combined window and screen systems |

7.4.2 Availability of roofing systems for housing recovery

There was also a lack of compliant roofing products under AS3959-2009. Field interviews in August 2009 suggest that, similar to window systems, the available materials for a roofing system in the market had not been fire-tested. In May 2009, the State Government relaxed the building permit process for house owners to ensure the fire testing of roofing materials for use in BAL-FZ would not obstruct house rebuilding. According to interviewee Bc1, house owners were allowed to submit plans without specific roofing material specifications so that manufacturers would have time to complete their fire testing processes.
In response to the shortages of roofing systems for houses in BAL-FZ, the Building Commission initiated the collaboration with industry participants in support of provision for the compliant roof products. The testing of the composite roofing materials was complicated and time-consuming due to the large number of roofing components. According to representative Bc1 from the Building Commission, the basic roof test described in the Australian Standard AS1530.8.2 had to be first conducted. The structural and fixing components of a roof system were also required to be tested, which covers battens, trusses, valleys, barges, hips and gables. Following the test, since all roof systems need to be installed in accordance with the certified specifications, the information sessions such as construction and installation instructions were also required to be undertaken in a speedy manner. Interviewee B2 stated:

‘The test for a comprehensive roofing system required a wide collaboration across the whole construction material industry. It is a system; therefore, the time and cost for the test of any component would have an impact on the application of the entire roof’ (B2).

In July 2009, the first roofing systems for houses in BAL-FZ were tested by the Building Commission and then released onto market. The overall development of new roof products was jointly funded by main product manufacturers, such as Forest and Wood Products Australia Ltd, BlueScope Steel Ltd, and Promat Australia Pty Ltd. The test of steel roof systems against AS1530.8.2 for the BAL-FZ zone was conducted by the manufacturers providing steel construction solutions. In October 2009, five more roof systems were made available on the market in BAL-FZ category. Apart from the steel roofing systems, interviewee M3 reported that the Roofing Tile Association of Australia (RTAA) had conducted independent fire-testing of tiled roofs, which was funded by Australian roof tile manufacturers. The multiple options available for new roof systems at the end of 2009 seemed to bring a glimpse of hope for house owners. However, the expensive cost of these roof products still hindered house owners in BAL-FZ zone from rebuilding their homes as intended. Rebuilding advisor Ra2 described:

‘Many house owners in BAL higher categories, particularly in BAL-FZ, were expecting the subsidies from the government or payout from the insurance companies to cover the extra expenses for the new building products under the new standards. However, there was no decision made by the State Government to commit the Victorian Bushfire Appeal Fund to
meeting all the extra costs relating to the achievement of the additional construction requirements of AS3959-2009’ (Ra2).

The assessment of roofing system availability for housing reconstruction in terms of the three dimensions of resource availability is summarized in Table 7.11.

*Table 7.11 Availability of roofing systems for bushfire housing reconstruction*

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Attainability** | • Few options for roofing systems in BAL-FZ zone on the market within a few months after the bushfires  
• Roofing system testing took place in a collaborative approach among the product manufacturers  
• Significant impact of roof price on affected house owners |
| **Usability** | • The property of a comprehensive roof system depends on all the components which were required to be tested independently  
• The information session to the construction industry influenced the application of the products |
| **Accessibility** | • Lack of access to available tested roof systems in the market  
• The industry manufacturers and trade associations played a major role in testing and introducing the new roofing systems to houses in BAL-FZ zone |

**7.4.3 Availability of builders and trades people for housing recovery**

Research findings from both questionnaire survey and interviews show that lack of qualified builders, and difficulty in finding builders or tradespeople with a reasonable quoted price for construction were prominent issues during reconstruction. The recovery, according to interviewee Rm1, was expected to provide a potential ‘construction boom’ for the building industry. However, reconstruction demands in affected regions failed to attract a large number of construction professionals. Instead, the housing rebuilding had encountered shortages of skills and expertise, particularly in the worst-affected Marysville and Kinglake. The following quote from interviewee Bc1 is indicative of the reasons for this situation.

‘Resourcing builders for post-disaster reconstruction doesn’t seem to be a simple supply chain issue but more of relativity of risk and profit margin between reconstruction in bushfire
areas and construction in the fast growing fringe suburbs, particularly of Melbourne. Without appropriate incentives from the government or industry, engaging these construction professionals in bushfire recovery turned out to be very difficult’ (Bc1).

Field interviews in July 2010 suggest that the Victorian construction market demonstrated considerable volatility compared with the pre-event level. Apart from legislative changes, this volatility was caused by escalated housing market outside the bushfire regions. Rapid urbanization in recent years had increased demand for new housing in the metropolitan areas. The construction boom in these new urban areas absorbed resources from the existing construction market. Resource flows took place from the high demanding fire-affected areas to the less risky and more profitable new urban areas of Melbourne. Interviewee Vo5 reported:

‘Victoria is in the middle of a very active home building cycle fed by migration and the Government’s economic stimulus package, especially the first home owner’s grant. This is soaking up much of the labour capacity in the industry. The fringe areas are flat and large volume project home markets, while in the bushfire area, are often more remote with sloping topology, which demand more custom building and together increases the build time and costs’ (Vo5).

Evidence from interviews also showed that although the ‘Black Saturday’ bushfires were labelled as the worst natural disaster in Australia, only a relatively small number of houses was damaged by fire. According to interviewee M4, approximately 2000 houses were destroyed in the bushfires which, even if they were all rebuilt in one year, would make up less than 1.5% of the 130,000 to 170,000 houses that are built in Australia each year. Therefore, it was not surprising that the small volume of rebuilding work in the bushfire areas failed to warrant attention and interest from outside construction professionals.

Interviews with representatives of builders show that logistics-related issues, such as long travel distance and lack of accommodation in the bushfire-affected areas, were also major considerations when builders choose construction works. In the fire-impacted communities, it was difficult for building workers to find accommodation with satisfactory living conditions. Although temporary villages had been set up in Marysville and Kinglake, when empty, this accommodation was not being used to house builders and contractors from outside the region. It
was for the use of bushfire-affected people only. Temporary housing for a rebuilding workforce was generally lacking. Volume builder representatives B1-B3, and B6 expressed their common expectations that the government provides incentives and logistical support for the construction practitioners. As alluded to earlier, there were also instances where builders failed to fit the correct materials to bushfire safety standards. Other issues between house owners and builders with respect to contract and payment were also observed in the field. A number of house owners complained about, and were frustrated with, difficulty in finding qualified contractors or builders. The assessment of builder availability for housing reconstruction in terms of the three dimensions of resource availability is summarized in Table 7.12.

Table 7.12 Availability of builders and tradespeople for bushfire housing reconstruction

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attainability</td>
<td>• Low interest of construction builders and tradespeople in house rebuilding</td>
</tr>
<tr>
<td></td>
<td>• Skills pulled out to the Melbourne metropolitan region</td>
</tr>
<tr>
<td></td>
<td>• Impact of increased quoted price on affected house owners</td>
</tr>
<tr>
<td>Usability</td>
<td>• House owners’ concerns about builders’ reliability and liability</td>
</tr>
<tr>
<td></td>
<td>• Contract and payment issues between house owners and builders</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Less accessibility to qualified builders with reasonable quote</td>
</tr>
<tr>
<td></td>
<td>• Logistical barriers of the builders and tradespeople to providing building services</td>
</tr>
</tbody>
</table>

7.4.4 Impacts of low resource availability on housing recovery projects

Issues in relation to resource shortages due to the regulatory changes translated into delays for house rebuilding, particularly in the BAL-FZ zone in Marysville and Kinglake. Field interviews suggest that the adoption of the new building standards AS3959-2009 was subject to criticism from different organizations. The slow rebuilding in the fire-affected areas was primarily attributed to the continued disagreement of how to deal with houses identified being in BAL-FZ under the new standards. Field observations in August 2009 and July 2010 suggest that legislative changes in the Building Standards had greatly affected house owners’ ability to finance the repair or reconstruction of their houses. Shortages of compliant building materials
had resulted in shortfalls of funding, especially for those who were uninsured or underinsured before the fires.

At the initial stage of bushfire reconstruction, as observed by the researcher in August 2009, the changes in the Building Standards caused an increase in rebuilding costs in terms of building products and materials for BAL-40 and BAL-FZ. Interviewee V3 estimated:

‘The construction cost for a house in compliance with the new building rules would be five times higher than that of the original one’ (V3).

With the old standards, the costs of building depended on the type of construction and the property’s level of bushfire risk. With the introduction of new residential building standards involving enhanced risk assessment, the construction requirements addressed the level of exposure that a building could face under bushfire conditions. Apart from the resourcing problem caused by the ‘indicator resources’ identified and described in the preceding section, the following quote demonstrates other resourcing concerns.

‘When the housing rebuilding commenced in May 2009, the non-combustible materials, such as masonry, brick veneer and aerated concrete, for constructing a new house located at BAL-29, BAL-40 and BAL-FZ level (flame zone) were not available in the market, and material suppliers had not tested some of the materials for window and roof systems’ (V3).

The new standard did not allow for cost-effective selection of building materials when the affected residents commenced rebuilding and, rather, forced a number of house owners to purchase the available, but expensive, fire-resistant products, thus pushing up construction cost. Meanwhile, as interviewees V6 and V8 during the interview in August 2009 and Vo4 during the interview in July 2010 pointed out:

‘VBRRRA had to dedicate a lot of time to getting the reconstruction technology and methodology correct and to advising house owners to make decisions’ (V6). And ‘It also took long time for social organizations to understand the vulnerabilities and to assess local capacities before commencing a project’ (V8).

‘Shortage of materials to comply with the new Bushfire Attack Level requirements including appropriately rated windows, screens, and roofing systems. As I understand it, the products had
Field observations and interviews show that the impact of legislative changes on resource availability for housing reconstruction was profound and lasted for a long time. By the time the researcher conducted the second field trip in July 2010, there were few solutions of window and roof systems in the market that house owners could afford. Lack of funding for housing rebuilding became a fundamental deterrent to housing recovery. The heavy concentration on compliance with building requirements and the resultant cost escalation discouraged many uninsured and under-insured house owners from commencing rebuilding and caused significant delays in housing recovery. This is indicated from the following quote from interviewee Bc 1:

‘There are delays for BAL-FZ because people have got the building permit but they couldn’t afford to buy these new products. Even for other BAL areas, some people couldn’t afford to get a qualified builder with a reasonable quoted price. So they are just stuck’ (Bc1).

In conclusion, there was likely to be an ‘impact chain’, induced by the changes to the Building Standards, on the whole building construction system, and ultimately had an impact on resource availability in the fire-affected areas. Lack of ‘indicator resources’ had resulted in housing rebuilding delays and cost escalation. During the second field trip in July 2010, however, there were few rebuilding activities observed by the researcher in the worst-affected areas such as Marysville and Kinglake. To gain a better understanding of the resourcing issues, the following section presents findings from questionnaire survey and interviews with regard to critical factors that affected resource availability for housing recovery.

7.5 Critical factors that affected resource availability in bushfire housing recovery

Based on statistical techniques, the questionnaire survey result with respect to the critical factors that affected resource availability in housing recovery in this case study is shown in Appendix 6. Among the five categories of factors, reconstruction market-related factors and environment-related factors were seen as more significant than the other three groups. Table 7.13 provides a summary of the statistical rankings of the top ten critical factors that were identified by the
Australian respondents as being most significant in affecting resource availability during the bushfire housing rebuilding.

Table 7.13 Determinants affecting resource availability in housing recovery in Victoria

<table>
<thead>
<tr>
<th>Factors affecting resource availability in post-bushfire reconstruction</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance with new building codes</td>
<td>1</td>
</tr>
<tr>
<td>Legislation and policy</td>
<td>2</td>
</tr>
<tr>
<td>Government support and assistance</td>
<td>3</td>
</tr>
<tr>
<td>Competition for resources from other existing construction projects</td>
<td>4</td>
</tr>
<tr>
<td>Competition for resources from other rebuilding projects</td>
<td>5</td>
</tr>
<tr>
<td>Local production capacity</td>
<td>6</td>
</tr>
<tr>
<td>Decision making ability of the affected people</td>
<td>7</td>
</tr>
<tr>
<td>Competence of contractor/builder</td>
<td>8</td>
</tr>
<tr>
<td>Resource price fluctuation in market</td>
<td>9</td>
</tr>
<tr>
<td>Project budget/construction funding</td>
<td>10</td>
</tr>
<tr>
<td>Project location</td>
<td>10</td>
</tr>
</tbody>
</table>

By using content analysis, the identified key determinants can be classified into three groups for discussion: 1) market-related factors including competition for resources from other existing construction projects, competition for resources from other rebuilding projects, local production capacity, and resource price fluctuation in market; 2) external factors in the bushfire recovery environment including: compliance with new building codes, legislation and policy, government support and assistance, and competence of contractor/builder and 3) local contextual factors including project budget/construction funding, decision making ability of the affected people, and project location.

7.5.1 Market-related factors

7.5.1.1 Increased housing market outside of the bushfire regions

The questionnaire results show that the market-related factors including competition for resources from other existing construction projects and competition for resources from other
rebuilding projects were viewed as significant by respondents with respect to housing resource availability. Further interviews clarified that the competition that existed in the market was targeted at the essential construction services such as builders, contractors and other building professionals.

In-field interviews suggest that the post-bushfire construction market in Victoria demonstrated considerable volatility and adjustment when compared with the pre-event levels of construction. The reason, apart from legislative changes, was attributed to the escalated housing market outside the bushfire regions due to rapid urbanization. As discussed in the previous section of this chapter, the demand for new housing in the metropolitan areas called for more resource requirements from the existing construction market. The relatively small volume of rebuilding work in the bushfire areas failed to warrant attention and interest from outside construction professionals. As a result, there were considerable resource flows from the high-demanding fire-affected areas to the less risky and more profitable new urban areas of Melbourne.

In addition, the industry pointed out that, apart from some workshops and seminars organized by VBRRA and the Building Commission to encourage building professionals to actively engage in bushfire reconstruction, there were few incentives from the government for tradesmen and building professionals to travel long distances to help with rebuilding. Field interviews in July 2010 suggest that the shortage of builders in the bushfire-affected areas was closely associated with the profit-driven business behaviour of builders, which can be attributed to their reluctance to deal with traumatized bushfire victims, inconvenience of travelling to, and being accommodated in, the affected areas and lack of government incentives.

7.5.1.2 Local production capacity

In the questionnaire, local production capacity was ranked as the sixth important resource availability determinant. The follow-up interviews suggest that for the houses located in the under BAL-40 areas, the production of materials within the industry seemed to be stable. The construction requirements for BAL levels lower than 40 are analogous with those of the previous standards. Field observations confirmed that the rebuilding houses where resource shortage did, and still does, occur twenty months after the bushfires are in the BAL-FZ zone. Some of the required fire-resistant products to this level need to be re-tested.
The reason for limited production capacity for BAL-FZ, according to manufacturers M1 and M2, was due to the abrupt change in building codes after the bushfires, which caused many uncertainties. For instance, as M2 stated:

‘We expected 12 months before the new building code was issued, so we could have enough time to conduct testing especially for external fabrics, like roof and windows. However, the Victorian Government adopted the upgraded building standards a year earlier’ (M2).

Additionally, M1 raised the point that houses in the most extreme flame zone require external cladding materials to be tested and certified to comply with a new set of tests that had been defined in the code. This certification had taken many manufacturing companies some time to obtain, and it had the corresponding flow-on effect of delays in construction approval. When asked how long it takes for product testing, interviewee M1 responded:

‘It’s taken... even to get the basic test done... the quickest test came out in about 6-9 months. We had our testing done last year but we haven’t released our testing yet. So 18 months later, we haven’t released it because we have got legal issues with the testing body which we are trying to sort out before we release our tests’ (M1).

The uncertainty about the number of houses in the BAL-FZ zone was another major concern for building product manufacturers. As we learned from interviewee Ra4:

‘They (The Victorian Government) brought in this legislation to these higher standards, anticipating manufacturers would then go and see an opportunity for a place for market, perhaps for these new materials, new products. Manufacturers calculated only a small number of houses would need new products and didn’t want to take a risk of pouring money into research and development for these products’ (Ra4).

7.5.1.3 Resource price fluctuation in market

Resource price fluctuation was perceived by the questionnaire respondents as being the ninth most important factor with regard to its influence on resource availability. The interviews with these respondents in July 2010 indicated that the significant variation in resource price in the aftermath of the bushfires mainly occurred for houses in the higher BAL levels such as BAL40 and FZ. Interviewed representatives Bc1 and Bc2 from the Building Commission raised a
common concern that whether BAL-FZ is significantly different from BAL-40 is still questionable. When evaluating the cost variations for rebuilding a house in the bushfire-prone areas, interviewee Bc1 said:

‘It’s a big issue at the moment about cost for products for use in BAL-FZ. The national RIS suggested that building a standard 3 bedroom house, the upgrade to BAL-FZ will cost around $20,000. We have done our own research which shows that using the cheapest materials available, that actually cost $99,000, and using more expensive materials it’s over 130,000 dollars. So the actual cost for BAL-FZ is way outside the scope the RIS suggested’ (Bc1).

On the other hand, the following quote from interviewee M5 highlighted the construction cost implications for house owners who attempted to recover from bushfires.

‘For people living in high BAL, the new building standards put indirectly a real financial strain with some not being able to afford to build. For people who live in BAL-FZ, they can either not afford to build and if they sell their land it is devalued by the cost of what it would cost to build to a BAL-FZ. BAL-40 is not far behind but does not quite have the same cost implications.’ (M5)

Field observations and interviews further revealed that the building regulatory changes helped to make future construction safer in the bushfire-prone areas, but it also created a range of uncertainties and disruptions in the existing social functions. Rebuilding manager Rm1 suggested that:

‘Community rebuilding is an integrated social system which cannot be achieved by solely increasing the physical building standards without consideration of the impacts of this legislation change on other aspects of community recovery, particularly their economical circumstances in the fire-affected areas’ (Rm1).

7.5.2 External factors in bushfire recovery environment

7.5.2.1 Bushfire recovery legislative environment

The compliance with new building codes, and legislation and policy were perceived by the questionnaire respondents as being the first and second important variables respectively that
leveraged over resource availability after bushfires. This result is consistent with Blong’s (2004) findings in analyzing residential building damage and natural perils in Australia. He pointed out that land use planning and building codes play a large role in reducing building vulnerability to bushfires. Field interviews and observations in July 2010 reinforced this result. A number of comments from the respondents highlighted the implications of the legislative changes for the selection of suitable construction materials among the affected house owners. For instance, according to the manufacturer M1,

‘BAL requirements are new so there is uncertainty around house owners select which products that are best value for money’ (M1).

The immediate changes in the building regulations after the bushfires, however, not only had an impact on the construction capability to rebuild, it also caused longer-term repercussions on the communities. Bc2 said:

‘There was inconsistency with regard to the regulations and people’s understanding of the regulations. Even six to twelve months on, there was still inconsistency with people’s understanding and knowledge of rebuilding to regulations, and delays of rebuilding thus occurred’ (Bc2).

Apart from the above effects, according to the interviews, building designers and builders, as well as the rebuilding advisors from VBRRA, had to familiarize themselves with the new building standards to assist and advise communities to rebuild their homes. Project Manager Ra1 reported:

‘That’s been one of the difficulties. This (Building Standards AS3959:2009) is so new for everyone. The architects were not sure of the plans they were presenting. They often have to go back to building surveyors for the building permit. The builders were trying to learn these new things as well.’ (Ra1).

The following quote from the rebuilding advisor Ra4 in VBRRA highlighted the repercussions of this legislative change on their recovery practice.

‘When we first started, we had no idea about what we can start with. So basically for a couple of weeks, we just looked up the availability of draftsmen and builders, made up a list,
researching what materials were out there, setting up our own database. It took a considerable
amount of time’ (Ra4).

This experience is in line with the conclusion made by Spence (2004) who claimed that, where
they are implemented, the rate at which the introduction of new building codes and planning
rules has an impact on the overall vulnerability of the built environment. The post-bushfire
recovery and reconstruction practice served as another notable example in this regard. The likely
impacts of the new codes or regulatory changes need to be carefully considered and reduced,
especially in a post-disaster situation, to ensure the introduction of these changes align with the
social and economic circumstances.

7.5.2.2 Government support and assistance

Government support and assistance was ranked as the third most important variable in
determining post-bushfire resource availability. Interviews with construction industry
practitioners B1-B6 and manufacturer representatives M1-M4 in July 2010 suggested that
government support and assistance in Australia for the building and manufacturing industry in
understanding and adjustment to the changed built environment had been inadequate. There were
few incentives from the government for tradesmen and building professionals in the industry to
help with rebuilding houses. There were few incentives in the bushfire housing market of such a
small size for manufacturers to engage in providing products required in BAL-FZ zone. Trade
representative M2 in July 2010 stated:

‘Small manufacturing businesses may need funding assistance regarding the tests from the
government. .... If government can justify the size of the market against the cost of test, and take
a more responsible approach to help house owners in the extreme zone such as providing grants
for large manufacturing businesses with testing, the housing rebuilding in BAL-FZ could’ve
gained a good start’ (M2).

This finding aligns with previous research, such as (Rubin and Popkin, 1990; Schwab et al., 1998;
Comerio, 2004; Zhang and Peacock, 2010), concerning the government role in market-driven
housing recovery. These researchers suggested that local government work with industries and
provide collaborative mechanisms that will best match the needs of participating practitioners
when engaging in a housing rebuilding activity. However, the capacity of the local government
and of other agencies was also affected by the legislative changes which, according to Rm1, largely influenced the entire government administration and coordination systems. The capacity of the governmental authorities had to be renewed and strengthened to adapt to the related changes. Field observatory evidence suggests that legal changes were complex. And the government had be involved over a long period in the development of these changes. The political will and technical solutions were also needed to develop incentives for the engineering community to be involved.

7.5.2.3 Competence of contractor/builder

The competence of builders/contractors in construction was recognized in the questionnaire as an important factor affecting resource availability for housing reconstruction. A number of disputes regarding material selection and procurement were recorded by the researchers due to contractual problems between the house owners and builders. Furthermore, the competence of contractors/builders for bushfire recovery and rebuilding was found to be mainly contingent upon their ability to understand the needs of traumatized bushfire victims.

The interviews show that the affected communities had undergone trauma and failed to take on a home rebuilding task or to address construction issues during recovery. This situation was compounded by lack of understanding from construction professionals for dealing with the disaster-affected population, leading to further impediments to reconstruction progress. Volume builder representative B2 explained:

‘...Because all the builders are already under a fair amount of stress to cover all bases during a construction work. So the whole situation has been difficult then to deal with people up in the mountains as well and their situation would be more complicated because they are affected and traumatized’ (B2).

This point was supplemented by another volume builder representative B1, when commenting on the complexity of post-bushfire rebuilding situations.

‘It becomes a complex business in which you’ve got lots of stakeholders with lots to say. You’ve got this traumatized person in their middle of all these and they added personality to it. You then get a situation where there is something you cannot finalize because the government decided on
the legislation under which the poor suppliers have to try to come up with product that complies. Then the product takes a long time to come out and it costs maybe thousands more’ (B1).

In the meantime, there were some instances where opportunistic builders seized on housing rebuilding and caused some problems for house owners during the reconstruction process. Rebuilding manager Rm1 from VBRRRA summarized the situation.

‘Owners were generally unaware of contractual requirements, signing themselves into dangerous positions. People need more upfront support when it comes to contracts’ (Rm1).

The majority of participating builders who were spoken highly of by the affected communities in Marysville were country businesses with a strong, long history of association with the affected communities. The sense of community and the close ties provided motivation for these builders to take greater care in housing rebuilding. Rebuilding advisor Ba3 suggested:

‘A key element for such a relationship between the affected house owners and industry practitioners is to find ways in which to encourage and increase the involvement of builders. The raising of awareness of engagement and cooperation, the training of a sufficient number of professionals to undertake the task of housing rebuilding are of greater importance than solely improving building codes and creating regulations regarding their application and enforcement’ (Ba3).

Given the post-bushfire situations, a high priority needed to be given to the minority of the bushfire affected people for obtaining the services of qualified construction professionals.

7.5.3 Local contextual factors

7.5.3.1 Project budget/construction funding

The questionnaire survey results show that availability of construction funding had a large impact on the housing rebuilding rate and speed in the Victorian bushfire areas. In-field observations and interviews confirmed that the disaster impacts were felt particularly strongly within the housing sector in some areas where properties were uninsured or under insured. Even for the insured houses, the owners also faced financial difficulties with significant insurance payment shortfalls as a result of changed building standards for reconstruction.
More than half interviewees suggested that inadequate insurance was a significant threat to the community’s rebuilding ability. According to the VBRRA (2009, p. 14, 15), at the end of September 2009, insurance assessments had been completed for 99% of damaged residential properties and commercial properties and 80% of claims for destroyed homes had been settled. For some fully-insured house owners, the insurance company provided a year’s rental free of charge as well as replacement value for house rebuilding. However, for the uninsured people the funding for housing rebuilding was a major concern. As Rm 1 and Bc1 reported:

‘The major problem of rebuilding is for those uninsured and under-insured households. Around 300-400 house owners need extensive help since they belong to low-income groups and their houses were under-insured’ (Rm1).

‘There are some delays for BAL-FZ because people have got the building permit but they couldn’t afford to buy these new products. Even for other BAL areas, some people couldn’t afford to get a qualified builder with a reasonable quoted price. So they are just stuck’ (Bc1).

Lack of funding for housing rebuilding became a fundamental deterrent to recovery. The way in which the project budget affected resource availability for the reconstruction was governed by the house owner’s ability to afford to procure resources for house rebuilding. It is, therefore, the house owner’s affordability that oriented housing reconstruction related activities. Meanwhile, the heavy concentration on compliance with building requirements and the resultant cost escalation discouraged many uninsured and under-insured house owners from commencing rebuilding and caused significant delays in housing recovery.

7.5.3.2 Decision making ability of the affected people

House owners’ decision-making ability was perceived by the questionnaire respondents as being a significant factor affecting resource availability for housing recovery. When faced with great distress, it was difficult for house owners to make a decision about whether to stay and rebuild or move to another place. Field evidence in July 2010 in this research suggested that a series of social vulnerabilities within the affected populations to a great extent constrained their ability to carry on housing recovery. As described by B2:
‘Everybody takes a different time to heal and certainly it’s difficult to deal with people in a different psychological state and also the economic state. The reality is quite often people who live in those communities are not as wealthy as those living in the city. There’s a whole adjustment into that’ (B2).

In addition, according to the interviews in July 2010, deadlock occurred in the affected areas between the recovery of local economy and housing. For instance, around 530 properties, 95% of the retail businesses and the commercial centre of Marysville were destroyed (VBRRRA, 2010c). The bushfire-affected people looked to economic recovery as evidence of the revival of the communities whereas the business owners expected residents to return and rebuild before starting up their businesses. Bc1 said:

‘Homeowners don’t want to rebuild, they want to see shops there, but shopkeepers don’t want to rebuild because there’s no one there to buy their products. The return of the businesses also depends on how many consumers there are in the town. It’s a real vicious cycle. The delay of housing rebuilding also lies in the house owners’ waiting for economy revival and then making a decision’ (Bc1).

Another aspect of the social vulnerability of those affected is associated with their demographic changes. For example, the town of Marysville had 400-500 residents prior to the bushfires and usually doubled in population during the summer and winter seasons for tourist events such as skiing and bushwalking. At the time of the bushfires, 34 residents died, and an estimated 50% of employment in Marysville was lost, including most of the hospitality and tourism jobs (VBRRRA, 2010c). According to the Marysville community representatives, by the time our field visit took place in July 2010, 30% of the remaining population chose to not come back to the township and in the next 12 months, 20% would decide not to come back. Thus, 50% of the population in Marysville would be lost after the fires. Psychological impacts on the house owners, including trauma and depression, were still seen by the researchers during the field trip in July 2010, especially those who had lost families and friends. These social vulnerabilities inherent in the bushfire-affected communities undermined opportunities for housing recovery. As Vo4 commented:
‘Mostly the material or labour resource problems have been well secondary to the locals deciding whether they wanted to stay or rebuild in the town and design decision making and difficulty with understanding the rebuilding or any building process because most of the people affected were not experienced in that area’ (Vo4).

7.5.3.3 Project location

The location of the housing projects involved the conditions of the site context including climate, topology and local living patterns. This factor, together with the project budget was ranked equally in the questionnaire as the tenth most important factors impinging on resource availability for bushfire rebuilding. A number of researchers such as Reddy (2000), Cole (2003) and Kamel (2004) have suggested the same linkage between the localized conditions and successful recovery outcomes. They advocated that an understanding of the socio-economic composition of the households and the housing characteristics of places helps to address the wide range of housing needs that result from a disaster. Field interviews in July 2010 revealed that this situation did occur in the bushfire-affected areas.

The location of the destroyed houses was a significant factor that had been taken into account by those builders when they decided on business choices. As reported by Vo5:

‘Victoria is in the middle of a very active home building cycle, fed by migration and the Government’s economic stimulus package, especially the first home owner’s grant. This is soaking up much of the labour capacity in the industry. The fringe areas are flat and large volume project home markets, while in the bushfire area, are often more remote with sloping topology, which demand more custom building and together increases the build time and costs’ (Vo5).

With business opportunities available in the Melbourne region, the benefits of taking on reconstruction works in the bushfire affected areas were less clear. The likely solution to offsetting this physical barrier, according to a number of interviewees, was to stimulate rebuilding priorities by providing potential practitioners with in-kind support such as free accommodation, travel vouchers, and monetary incentives such as tax reduction and subsidies for the reconstruction of residential buildings.
7.6 Conclusions and recommendations

Housing recovery and reconstruction after the 2009 Victorian ‘Black Saturday’ bushfires shed light on the market-driven housing reconstruction environment in Australia. In accordance with the resource availability analytical framework, the case study in this chapter presents the research findings in terms of the five elements. By examining the post-bushfire housing recovery process, the resourcing challenges that confronted Australian recovery authorities, industry practitioners, and communities were identified.

In analyzing the resourcing issue during the bushfire housing recovery, the roles and responsibilities of main resourcing stakeholders were discussed. Three ‘indicator resources’, including windows, roof systems, and builders/tradespeople, were identified and their availability in bushfire housing recovery was discussed. The impacts of the low resource availability of building materials and construction professionals on housing reconstruction in Victoria were illustrated. The shortage of construction materials for houses rebuilt in the BAL-FZ zone was due to the changes in the Building Standards, and the extent to which people were ready to rebuild their homes. The lack of builders for rebuilding houses for the bushfire affected communities was attributed to the elements inherent in a market-oriented economy. In essence, legislative changes played a large role in resourcing for post-bushfire housing reconstruction.

This case study demonstrates that while post-disaster legislation helps effective implementation of disaster mitigation solutions in construction, it is also important to consider how the uncertainties created by legislative changes can impact on the reconstruction ability of market, government, industry, and house owners. The research findings in this chapter provide insights into the complex manifestation of a market-driven resourcing process during recovery. Such results enrich the knowledge base in post-disaster housing recovery and provide policy implications on how the decision makers and the construction industry can take action to reduce the impact of resourcing on the success of housing recovery. Legal changes in the built environment after a disaster should take place along with capacity augmentation of all the agencies involved to cope with post-disaster recovery.
Furthermore, successful resourcing in the wake of a catastrophe requires a robust market base, and solid facilitation from both governments and construction professionals. It is important for governments to forge strategies, tools and mechanisms in the market to ensure that the built environment and communities can respond better to a future disaster and its aftermath. To reduce the impacts of the identified resource availability critical factors on housing recovery in Australia, the following issues should be addressed.

1) Adaptation of management strategies from the government authorities and other institutions should be made to provide dynamic local conditions. Resourcing facilitation tactics for housing recovery, such as resourcing the registered builders and other building professionals, should reflect the typical geographic setting of the affected areas. This could enable the reconstruction authority (VBRRA in this case) and the local institutions to clearly identify the underlying resource constraints and accordingly mould solutions to address these constraints to suit the variations of the locality.

2) Regulations must be reviewed to suit the particular economy and society at which they are aimed. Formulating new regulations takes time, and therefore needs a long-term commitment from policy makers. Technically feasible strategies such as careful cost-benefit analyses are required to determine the BAL level at which more affordable fire-resistant materials can be economically justified. Housing recovery should not be considered to be simply a short-term emergency issue nor simply left to the market; it needs to be regarded as a critical component of a long-term community recovery strategy.

3) Community capacity assessment should be carried out along with damage and needs assessment at the initial stage of disaster recovery. A detailed housing condition assessment is necessary in order to estimate the total cost of reconstruction and to allocate resources. Assessment should focus not just on bricks and mortar, but also on the social conditions of the people such as their work ethos, their willingness to participate, and their cultural values.

4) Sustainable design ideas should be encouraged and applied to permanent housing. The conditions of the site context including climate, topography, local material, construction technology, labour skill and local living patterns are very important considerations that
need to be incorporated into design solutions. The training program in the construction industry should target the network of local builders, incorporating their informal education through interpersonal training and apprenticeship in accordance with their learning patterns and the skills and abilities required to deal with disaster-traumatized clients.

5) Finally, it has to be recognized that rebuilding homes in heavily-timbered rural and urban residential areas increases risk to and impact on both cost-driven builders and on manufacturers, which requires a variety of planning and building mechanisms to encourage their involvement. This recognition would assist local government in taking responsibility for motivating these market forces while providing rebuilding advisory services to communities. Therefore, in order for government authorities to expedite housing recovery progress under a market-driven economy, there is a requirement for practical incentives combined with an understanding of the specifics of a particular post-disaster situation and an assessment of the practitioner needs.
Chapter 8 Cross case comparative discussion

8.0 Overview

This chapter sets out to discuss the research findings from the case study chapters in a comparative perspective. The cross case comparison is in accordance with the five elements in the resource availability framework. Post-disaster recovery and reconstruction environment, housing recovery approach, resourcing stakeholders for housing recovery, ‘indicator resources’ and their availability, along with critical factors that affected resource availability in each case will be collectively discussed and compared. By such a systematic comparison, this chapter explains the differences and similarities between the three case studies. Implications of this comparative analysis with respect to resourcing for post-disaster housing reconstruction will be illustrated.

8.1 Post-disaster recovery and reconstruction environment

This section compares and contrasts the three elements in the post-disaster recovery and reconstruction environment in each case — 1) case study city and its disaster impact, 2) responses of various agencies to disaster, and 3) institutional arrangements for post-disaster recovery.

8.1.1 Banda Aceh, Mianzhu and Marysville

Why are Banda Aceh, Mianzhu and Marysville appropriate contexts to study the resourcing of post-disaster housing reconstruction? The three jurisdictions are disaster-prone areas confronting complex resourcing challenges in the aftermath of a major disaster. These common challenges, as presented in the three case study chapters, include resource shortages, cost inflation and difficulties in procuring available resources for housing recovery projects. Invariably, these challenges posed further impediments to post-disaster recovery and reconstruction in the three cases. The ability to tackle resourcing problems following a disaster therefore becomes a critical component to successful housing recovery.
The three jurisdictions, namely Banda Aceh, Mianzhu and Marysville, had suffered significant impacts of a large-scale natural disaster. The scale of post-disaster housing programs was intimately associated with the impact of each event. As described in the research methodology chapter, these three case studies were selected partly because of data access opportunities provided after each event. Furthermore, the three case studies presented a unique opportunity for comparing resourcing practices for housing recovery in a developing versus a developed country context.

The city of Banda Aceh experienced problems different from the City of Mianzhu and Marysville due to its specific political settings before the 2004 Indian Ocean tsunami. A decade of civil conflicts as a result of the ‘Free Aceh Movement’ featured the ‘image’ of pre-tsunami Banda Aceh. Lack of development in the region had affected the local ability to recover from the tsunami. In contrast, Mianzhu, as a renowned industrial base in Sichuan Province, carried more economic characteristics of a medium-sized city in developing countries. Similarly, Marysville, with its unique scenery and resources, served as a tourism destination before the 2009 devastating bushfires. The three contrasting characterizations of Banda Aceh, Mianzhu and Marysville are fraught with policy implications for the post-disaster recovery and reconstruction.

Many issues are linked with city demographic and economic features in several ways. Banda Aceh and Mianzhu had a larger population before the disaster. The sheer size of disaster damage to both cities, in terms of human loss, infrastructure damage and economic cost, along with the challenges that had confronted their recovery authorities in sheltering and displacing the affected people were significant. However, the unprecedented assistance from outside Indonesia had contributed resources, infrastructure, and institutions to Banda Aceh when the tsunami impact overburdened the region and even the entire country. By comparison, Mianzhu within China’s specific political context received similarly considerable assistance from the counterpart provinces through the ‘One-on-one program’. Recovery in Marysville was different since there was much smaller population with nearly half of residents associated with tourism, retailing businesses and rental properties. With the losses largely associated with these tourism assets, changes in demographic and economic conditions in Marysville as a result of the 2009 bushfires required more strategic endeavours in order to rebuild the town.
Banda Aceh and Mianzhu share a number of critical similarities. Both cities exhibit characteristics of developing countries such as disparity of financial circumstances in the population, a relatively poor infrastructure and environmental concerns. At the national level, the political system in Australia is considered to be more democratic than most developing countries like China and Indonesia. Therefore, the difference in political regimes in the three case studies means that the different combinations of governmental interventions at various levels will be observed over the periods of disaster recovery and reconstruction to influence the post-disaster recovery outcome. Policy and institutional changes were introduced in each case study to deal with a large-scale disaster. The comparative profiles of the three case study cities are shown in Table 8.1. The remainder of this section presents the comparative results across three case studies in terms of the various aspects of post-disaster recovery institutional arrangements from post-event response to disaster recovery programs.

### Table 8.1 Comparative profiles of the three cities

<table>
<thead>
<tr>
<th>Profile</th>
<th>Banda Aceh</th>
<th>Mianzhu</th>
<th>Marysville</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-event</td>
<td>264,618</td>
<td>513,859</td>
<td>500</td>
</tr>
<tr>
<td>Post-event</td>
<td>203,553</td>
<td>502,742</td>
<td>34 deaths, and 1/3 population left the town</td>
</tr>
<tr>
<td>Housing damage</td>
<td>21,412 units damaged</td>
<td>194,800 units damaged</td>
<td>400 units destroyed</td>
</tr>
<tr>
<td>Infrastructure damage</td>
<td>Severely damaged infrastructure facilities especially ports and schools</td>
<td>Telecommunication, gas and pipelines were subject to varied degrees of damage</td>
<td>The primary school, retirement village, community centre, post office, medical centre, police station destroyed</td>
</tr>
<tr>
<td>Economic loss</td>
<td>Large loss of livelihoods in fishery and agricultural sector</td>
<td>Large industrial and manufacturing factories closed</td>
<td>50% tourism and services jobs lost, 95% retail businesses destroyed</td>
</tr>
</tbody>
</table>

#### 8.1.2 Multi-stakeholder responses to the disaster event

Emergency response to a major disaster in each case is reflective of the degree of its disaster preparedness, and of the ability to cope with the event and its aftermath. In this section,
comparing responses to the disaster event in different political-economic contexts provides a basis for understanding the similarities and differences in strategies of the subsequent recovery. By drawing the research results from the preceding case study chapters, the different involvement of government authorities, industry and other agencies during the response stages is summarized in Table 8.2 below.

Table 8.2 Comparative responses to the disaster event

<table>
<thead>
<tr>
<th>Response</th>
<th>04 Indian Ocean tsunami</th>
<th>08 Wenchuan earthquake</th>
<th>09 Victorian bushfires</th>
</tr>
</thead>
</table>
| **Government**     | • Immediate search and rescue  
                     • Funding pledge  
                     • Peace Agreement between GAM and the Indonesian Government  
                     • Earthquake Rescue and Relief Headquarters  
                     • State Overall planning  
                     • General Coordinating Office for Earthquake Relief at local level  
                     • One-on-one Assistance Program  
                     • Firefighting of CFA, and fire and emergency services  
                     • Australian Government Disaster Response Plan activated  
                     • Victorian Bushfire Appeal Fund  
                     • VBRRA  
                     • 2009 Victorian Bushfires Royal Commission |
| **Local society**  | • Local NGOs’ emergency assistance  
                     • Local emergency services  
                     • Increased involvement local civil society organizations  
                     • Affected and unaffected communities’ search and rescue  
                     • Local emergency services  
                     • NGOs’ emergency assistance |
| **International agencies** | • A massive scale of international emergency assistance  
                     • UN’s involvement and ‘Build Back Better’ vision  
                     • Increased involvement of International NGOs’ assistance  
                     • Technical support provided by overseas institutions  
                     • Donations  
                     • Others |

The three cases were acclaimed for their uniquely institutional actions in response to disasters. Field observations and interviews suggest that the emergency response in the three cases contained common outputs that were present to different degrees and in different forms — rapid
action, massive funding, involvement of civil organizations, and institutional coordination. However, there are differences in institutional actions between the studied cases, which will be analyzed in detail.

Both case studies of the 2004 Indian Ocean tsunami and the 2008 Wenchuan earthquake dealt with areas of concentrated residential devastation and represented a relatively large-scale of efforts and interventions required from domestic authorities and agencies. Particularly, the response to the Indian Ocean tsunami in Indonesia was a global operation. ‘Build Back Better’ proposed by Bill Clinton, the UN Secretary-General’s Special Envoy for Tsunami Recovery became a watchword for the overall recovery undertaken by the international aid community. However, due to lack of pre-event planning and preparedness in their disaster management practice, government responses to the tsunami and the Wenchuan earthquake took an ‘ad hoc’ form. This result is in line with the literature review presented in Chapter Two, with respect to the disaster management systems in the two countries.

Following the Wenchuan earthquake, by comparison, the government’s approach to post-earthquake recovery and reconstruction was different in political terms. The Chinese government tightly controlled the emergency response. External aid agencies were not involved as heavily in China. As presented in case study Chapter Five, the openness following the Wenchuan earthquake and the willingness of the Chinese Government to work with civil society and overseas institutions for post-earthquake recovery and reconstruction was significant. Increased involvement of civil society and international cooperation were observed by the researcher over the longitudinal study period following the Wenchuan earthquake. The provision of psychological assistance from both the local civil groups and international aid agencies was new in China, and thus largely featured the post-Wenchuan earthquake response.

The response to the 2009 ‘Black Saturday’ bushfires in Victoria, unlike that of the 2004 tsunami and of the 2008 Wenchuan earthquake, was more targeted and strategic. The main reason is possibly due to the pre-existing, well-established ‘PPRR’ emergency management framework in Australia. The Australian Government Disaster Response Plan activated immediately had also contributed to a more coordinated approach to emergency response. Under the Plan, the government, community organizations and volunteer groups were able to take institutionalized norms and practices. The efficiency of the bushfire response depended, to a large extent, on
existing institutional routines. In this regard, it is likely that the government authorities, agencies, and communities in Australia were more prepared for dealing with a disaster than those in China and Indonesia. This comparison result, however, is in line with the critique of the different approaches to disaster management presented in Chapter Two.

8.1.3 Institutional arrangements for post-disaster recovery

One of the purposes of a comparative analysis of the three case studies in Indonesia, China and Australia is to study the effects of different post-disaster recovery institutions in different contexts; that is, to understand what works under what conditions in a post-disaster situation. These institutional arrangements are likely to have an effect on the undertaking of any reconstruction activities including resourcing for housing recovery. Institutions for post-disaster recovery and reconstruction, in theory, encompass such elements as legislation, establishment of national and local institutions, formulation of national policies implemented at local level, mobilization and utilization of resources and capacities, and implementation of national programs which are particular to each political-economic context and set of specific local conditions (Inam, 1997). In this section, a comparison of post-disaster recovery institutional arrangements across the three case studies will be undertaken on four levels: 1) post-disaster legislation; 2) recovery authority; 3) recovery plan and 4) programs in relation to disaster recovery. By drawing on the case study research findings, a summary of comparative institutional arrangements in terms of these four elements is tabulated in Table 8.3 below.
<table>
<thead>
<tr>
<th>Institutional arrangement</th>
<th>04 Indian Ocean tsunami</th>
<th>08 Wenchuan earthquake</th>
<th>09 Victorian bushfires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-disaster legislation</td>
<td>President Regulations</td>
<td>‘Regulations on Post-</td>
<td>Victoria’s Emergency</td>
</tr>
<tr>
<td></td>
<td>• The Master Plan</td>
<td>Wenchuan Earthquake</td>
<td>Management Act 1986</td>
</tr>
<tr>
<td></td>
<td>• BRR establishment</td>
<td>Restoration and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reconstruction’</td>
<td></td>
</tr>
<tr>
<td>Recovery authority</td>
<td>BRR (legislated)</td>
<td>Provincial Government</td>
<td>• VBRRRA (administrative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(legislated)</td>
<td>office)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Special committees</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(legislated)</td>
</tr>
<tr>
<td>Recovery plan</td>
<td>• Master Plan</td>
<td>• The State Overall Plan</td>
<td>• The Rebuilding</td>
</tr>
<tr>
<td></td>
<td>• BRR’s Mandate</td>
<td>• Local government plans</td>
<td>Together Plan</td>
</tr>
<tr>
<td></td>
<td>• Community recovery</td>
<td></td>
<td>• Community recovery</td>
</tr>
<tr>
<td></td>
<td>plans</td>
<td></td>
<td>plans</td>
</tr>
<tr>
<td>Programs in relation to</td>
<td>Donor-funded &amp; driven</td>
<td>‘One-on-one Assistance</td>
<td>Bushfire Recovery</td>
</tr>
<tr>
<td>disaster recovery</td>
<td>housing recovery, and</td>
<td>Program’</td>
<td>Assistance Package</td>
</tr>
<tr>
<td></td>
<td>government-led</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>infrastructure recovery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 8.1.3.1 Legislative and regulatory arrangements

According to Inam (2005), crisis situations may give rise to institutional coordination which not only ensures smoother operations but also enables the creation of ideas and programs that may not been considered under normal circumstances. This was manifested well in the aftermath of the Wenchuan earthquake. As presented in the case study Chapter Six, less than a month after the devastating earthquake, China’s Central Government established the ‘Regulations on Post-Wenchuan Earthquake Restoration and Reconstruction’ which stipulated the roles and responsibilities of various departments and governmental agencies for recovery planning and implementation. The Regulations became the first law in China for coping with post-disaster situations and laid a legal foundation for the earthquake reconstruction work. In addition, the Ministry of Housing and Urban-Rural Development assembled an *ad hoc* reconstruction planning team that included experts from urban planning and design institutes and universities across China. The reconstruction planning team functioned as a national ‘think tank’ to enable the development of a comprehensive State Overall Plan issued in October 2008.
The public legislative behaviour in Indonesia with respect to post-tsunami recovery was different from the case of the Wenchuan earthquake. The institutional actions including releasing the Master Plan and establishment of BRR, along with their legitimacy were bonded by President Regulations. However, the enactment force behind these regulatory designs was generally lacking. Without the legislative regulations that govern the implementation of the Master Plan, such as institutional rules that control the recovery planning and implementation actions, the involvement of large aid agencies, and the implementation of the Master Plan at the local level, the Master Plan ended being put aside as a ‘reference book’.

Within BRR there were few rules to govern the relations between individuals and between groups involved in post-tsunami recovery and reconstruction. Consequently, as presented in the case study Chapter Five, following the tsunami a large number of NGOs operated their relief and recovery efforts with little consultation and coordination with BRR, local Acehnese government agencies or community organizations. This is a key insight in a globalized disaster relief context where NGOs, with growing strength and presence, gained a legitimacy of authority over the local government. This situation is exacerbated in post-disaster scenarios in which immediate injections of international aid are needed to address the complex and urgent needs of affected populations (Pandya, 2006). To manage NGOs’ private authority and their accountability in disaster recovery projects, a robust governance mechanism in Indonesia was needed for the coordination with involved recovery agencies, and for the resolution of any organizational problems.

By contrast, in Australia the 2009 bushfires of a relatively small scale failed to warrant legislative changes to guide the overall recovery and reconstruction. The relevant recovery policy actions and programs in the fire-affected areas across Victoria were based on existing law, Victoria’s Emergency Management Act 1986. Furthermore, risk management-based PPRR model prescribed in the Emergency Management Act 2006 was extensively applied to the bushfire recovery in Victoria. Under the Local Government Act 1993, the councils in the bushfire-affected areas took the corresponding responsibilities. A community-led recovery approach was adopted and Community Recovery Committees (CRCs) were established through Victoria’s Emergency Management Act 1986. There were legislative changes in relation to
building controls on reconstruction of houses in the bushfire-prone areas. The following section will discuss these changes in greater detail.

8.1.3.2 Post-disaster recovery authority

According to Inam (2005), in most developing countries, administrative traditions are characterized by highly centralized, control-oriented management systems and institutional structures. This was the case in the aftermath of the Wenchuan earthquake. By relying on a centralized administrative system, the Central Government of China was able to mobilize resources and capacities nationwide in support of the earthquake-affected people in Sichuan. However, as revealed in the literature review Chapter Two, governmental agencies in China that are in a position to respond to disaster response and recovery tend to react individually without a specific agency managing the overall recovery work. This had also occurred after the Wenchuan earthquake. The Regulations defined the structure of involved reconstruction agencies in which the Provincial Government took a lead role in managing earthquake recovery. However, instead of having one centralized recovery authority, the government at different levels played a varied part in reconstruction planning and implementation.

In contrast to that in China, post-tsunami recovery and reconstruction in Indonesia was overwhelmingly the responsibility of the international donor society. All levels of the Indonesian government played roles of varying importance in determining recovery plans and ways of implementation. Initially, the National Development Planning Agency (BAPPENAS) and the Ministry of Public Works (MPW) were tasked with developing an overarching Master Plan for the tsunami-affected areas. The case study chapter referred to disagreements between line departments and BAPPENAS that resulted in the establishment of an independent recovery authority, BRR, in April 2005. By the end of 2005, post-tsunami recovery and reconstruction expanded with BRR becoming an implementing agency for housing reconstruction and a ‘super ministry’ for coordination of all rehabilitation and reconstruction activities.

The establishment of BRR for managing reconstruction can be considered to be a successful policy innovation in Indonesia. However, as also illustrated in the case study chapter, BRR failed to take the leadership and to fulfil its coordinating role in the reconstruction work. A conciliatory manner was adopted by BRR to bypass the Master Plan. With the public and private parallel
systems of relief and recovery operating, BRR relaxed the mandated control over NGOs’ recovery and reconstruction operations in the tsunami-affected areas. This raised long-term issues of accountability and efficacy of these aid agencies for all parties involved in post-tsunami recovery in Aceh.

By comparison, unlike the Provincial Government in China and BRR in Indonesia, the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA) functioned as an administrative office of the Department of Premier and Cabinet, coordinating recovery actions for the bushfire-affected communities. The Victorian State Services Authority (2010) summarized four key factors that enabled VBRRA to operate effectively without statutory powers: purpose and goodwill, authorizing environment, leadership and budget. Strong working relationships are essential for VBRRA to manage complex governance environments. This means that in the absence of legislated functions, VBRRA needed an institutional mechanism to oversee recovery and reconstruction, in conjunction with local governments affected by the bushfires.

However, apart from VBRRA being a coordinator, as presented in the case study Chapter Seven, the bushfire reconstruction and recovery in Victoria was mainly managed by special committees established within individual councils. Under the Local Government Act 1989, for instance, Murrindindin Shire’s Special Committee of Murrindindi Shire Council had the delegated powers and tasks with respect to bushfire recovery. The Committee provided a governance structure to coordinate and align policy, planning, community engagement, service delivery and reconstruction projects (State Services Authority, 2010). This is similar to the case of the Wenchuan earthquake in which the Provincial Government bore principal responsibility of managing the entire reconstruction work.

In conclusion, post-disaster recovery operational environment in the three cases was commonly complex, involving cross jurisdictions, portfolios, sectors and geographically dispersed locations. A well-designed and executed recovery authority is dictated in each case to sustain improvement in the quality, effectiveness and efficiency of post-disaster recovery and reconstruction. Without an institutional mechanism in place, the mandates of BRR in Aceh were not sufficient to meet the challenges posed by NGOs’ increased private authority. Likewise, in the absence of legislative empowerment, VBRRA in Victoria was unlikely to be able to provide adequate governance and leadership in recovery and reconstruction. In China, the lack of a centralized
leading authority seemed to add extra works to already-overloaded local governments, particularly the Provincial Government of Sichuan. In addition, the longitudinal study in China suggests that coordination problems between the local governments and the sponsoring counterparts surfaced as the recovery and reconstruction proceeded. Therefore, a legally empowered authority, independent of all line departments and government authorities, with institutional mechanisms in place, is needed for effectively managing recovery and reconstruction after a disaster.

8.1.3.3 Post-disaster recovery plan

While the political-economic and urban planning contexts of Aceh, Sichuan and Victoria are quite different, there are substantial similarities between the post-disaster recovery planning processes. The overarching principle manifested in recovery plans in the three cases was to adopt a community-centred and community-led approach to disaster recovery. Extensive consultations with communities and involved agencies in the disaster-affected areas commonly took place. In comparison with that of Australia, the relatively speedy development of the Master Plan in Indonesia and China depended, to a large extent, on their more straightforward decision-making procedures. Consultation with local affected communities in Australia, for instance, was a more technical and legal necessity on the part of the government. As revealed in the case study Chapter Seven, community participation incurred time and resource costs. Decision-making via community consensus therefore entailed a slower planning process in Victoria than that in Aceh and in Sichuan.

In examining the planning process in Aceh, the case study of the tsunami demonstrated that the Master Plan was mistreated due to disagreements between stakeholders, although it was comprehensive and encompassed various aspects of post-tsunami recovery and reconstruction. A series of subsequent recovery plans developed by BRR were claimed to include a more community participation approach, especially in the decision-making of housing reconstruction. However, as presented in the case study Chapter Seven, NGOs involved in the post-tsunami recovery in Aceh tended to build their own interests, preferences, and plans into their operating procedures and practices. Aceh’s experience also shows that less organized, legislated Master planning and implementation had reduced the level of cooperation and coordination between the private sector and public authority.
In China, after the Wenchuan earthquake, there was a growing interest in mobilizing China’s civil society and other community groups, and in involving communities in the overall planning procedure. The Wenchuan earthquake became a catalyst for the landmark ‘State Overall Planning’ which was confined to seriously-affected areas. One characteristic of this planning system was participant interaction among the planning team and the local governments and communities. The fundamental goal of this Plan, presented in the case study Chapter Six, was to restore basic living conditions and a level of economic development to reach or exceed pre-disaster levels. The targeted duration of infrastructural reconstruction was three years. However, this short-term timeframe was shortened to two years by the Central Government due to a reflection of the progress made in the first year. This is not surprising, given the highly centralized administrative system in China. As scrutinized by the researcher over the longitudinal study period, the rush of earthquake reconstruction in China consequently raised a series of concerns over the quality of recovery projects. This will be further discussed in the following sections.

With an emphasis on individual initiative and decision-making, bushfire-affected communities in Victoria were expected to provide input into the overall Master Plan. However, in comparison, it took longer time to formulate the state-wide ‘Rebuilding Together Plan’ in Victoria than those Master Plans in both Indonesia and China. The reason was that the community, due to various degrees of traumas suffered and poor levels of cooperation within itself, was unable to take the collective initiative in planning for recovery and reconstruction. Another factor contributing to the long duration of recovery planning at the local level in Victoria was the disparities in views from different households and community members. For instance, it was not until November 2009, nearly ten months after the bushfires, that the Marysville and Triangle Urban Design Framework was formulated by VBRRA and the Murrindindi Shire Council to guide reconstruction priorities for funding and attracting investment to the Marysville and Triangle communities. Slow process to attain this plan was largely because a number of community members held different opinions on how the rebuilding of communities should be conducted.

In all, the recovery planning process and subsequent implementation in the three cases carries features specific to each case context. A community-led recovery principle was commonly inherent in the initial aspiration of the public authority in the three countries. However, lack of
policy consistency within the Indonesian government system had led to an abandonment of a well-formulated Master Plan. The recovery and reconstruction operations by NGOs were also diverted to suit their own interests and plans. In China, a rapid and decisive planning process was seen in its highly centralized administrative system. However, the subsequent earthquake recovery implementation was not in line with the Master Plan due to its absence of planning controls. Victorian bushfire recovery planning process, in comparison, was featured with its time-consuming consultation with local communities and their lengthy decision-making process.

8.1.3.4 Programs in relation to disaster recovery

To gain further insights into the institutional innovation across case studies, this section compares the initiated programs that were instrumental to the recovery of communities in disaster-affected Aceh, Sichuan and Victoria. In Aceh, where resources were generally in short supply and capacity of the local government and communities were low, housing recovery programs were primarily managed by the aid agencies. The Indonesian Government made a commitment to furnish capital to assist in the restoration and rebuilding of public infrastructure. Over time, however, the government through BRR had also taken on an additional role of providing supplementary assistance to the housing rebuilding program. The existence of financing for housing reconstruction from outside donors was the key feature in the case of post-tsunami recovery.

The highly centralized administrative and political structure in China, in contrast, transformed a local disaster — the earthquake in Sichuan — into a national phenomenon. This was clearly evident in the ‘One-on-one Assistance Program’ pairing the earthquake-affected areas with relatively economically developed regions across the country. Undoubtedly, this program made a significant contribution to the affected communities, with funding of 1% GDP from the sponsoring localities, and other types of intelligenital and in-kind support. Differing from the case of Aceh where the recovery resources required for massive recovery came mainly from the international community, the case of Sichuan shows that the Wenchuan earthquake provided an opportunity to deploy, optimize and reconfigure available resources from other parts of the country to the earthquake-affected regions. Such a twinning effort represented an innovation of public assistance after a large-scale disaster when reconstruction work overwhelmed local capacity.
Unlike Indonesia and China, in Australia where standards of living and personal wealth are relatively higher, no one would expect an outside entity to rebuild communities after a natural disaster. Australian federal government and State government provided an infusion of capital to assist in the recovery and restoration of public infrastructure. To address the psycho-social, economic, infrastructure, and environmental impacts on the affected communities, a comprehensive Bushfire Recovery Assistance Package from the Australian Government was indicative of the role played by the government. A more integrated assistance approach to disaster-affected communities was seen in Australia than in Indonesia or China. This is possibly due to the substantial availability of insurance and availability of public assistance for disaster recovery in Australia.

In all, evidence in the case of post-tsunami reconstruction in Aceh indicates that post-tsunami recovery and reconstruction, particularly in the housing sector, was reliant on outside assistance provided by aid agencies. In China, with the strength of a centralized system, unaffected regions across the country assisted the affected areas with financing and technical assistance to rebuilding through the ‘One-on-one Assistance Program’. The Australian federal government and the Victorian State Government committed funding and expertise to rebuilding communities in a relatively integrated way. These distinctive institutional practices were expressed well in particular contexts in the three cases. The implications of this comparative analysis of institutional arrangements for post-disaster recovery are summarized in the following section.

8.1.3.5 Summary of comparison of institutional arrangements in case studies

From the comparison of the four aspects of institutional arrangements described above, it can be concluded that in three cases, the disaster served as an opportunity for policy changes and institutional adaption. This is in line with the conclusion in the literature review Chapter Two that each disaster functioned as a renewed attention to change emergency management to a new level of significance. Moreover, the disaster event also tested the institutional effectiveness in terms of the institutions’ ability to promote a return to normalcy, or even attain improved conditions through post-disaster recovery and reconstruction. In both China and Indonesia, the decision-making for post-disaster institutional development was exceptional, yet on an ‘ad hoc’ basis. Due to a more centralized administrative structure, the Chinese government was likely to be able to adopt more creative and effective measures to manage disaster recovery and
reconstruction, such as mobilization of national resources and capacities, formulation of a legislative base, and initiating a Central government-led, local government-implemented ‘top-down’ approach to managing community recovery.

However, less consistency of the government-led institutional development for disaster recovery in Indonesia was seen in the wake of the 2004 tsunami. For Aceh, the recovery rules through legislative and regulatory arrangements should be in place and reinforced and policed by means of either an external authority or a coercive legal system. In comparison with that of Indonesia and China, the actual formulation of policies, programs, and practices in response to the devastating situation after the bushfires in Australia, however, seemed to be based on pre-existing institutional routines and procedures. Apart from establishing a single recovery agency, VBRRA, the overall recovery work in terms of both planning and implementation aligned with the existing ‘PPRR’ framework. However, it has to be noted that, unlike the legislated formulation of BRR in Indonesia and stipulated roles of the Provincial Government under China’s ‘Regulations’, VBRRA served as an administrative office without legislated powers. The recovery decision-making and leadership fell to the affected communities and was delegated by the community recovery committees (CRCs) at the local level.

There are several implications of the above comparative analysis among Aceh, Sichuan and Victoria, and among Indonesia, China and Australia, also more generally for disaster recovery planning and policy-making between developing countries and developed countries. The major institutional difference between Indonesia and China, and Australia derives from the fact that recovery planning and implementation in Australia was more institutionalized. The powers within government for post-bushfire recovery through well-formulated legislative and regulatory regimes offered more formal access for the local communities to decision-making and recovery participation. This result is indicative of the findings of Inam (2005) that a number of agencies and groups may play an identifiable and significant role in articulating citizens and organizational interests in most developed counties. In Indonesia and China, in contrast, the link between local interests and the decision-making process is more elusive.

Furthermore, disparate degrees of governance structure, disparate legislative systems, disparate access to resources, disparate levels of economic development, and disparate social patterns in the three cases account for varied impacts of their institutional arrangements on recovery and
reconstruction outcome. The Banda Aceh case study illustrates an institutional environment marked by inconsistent process of policy-making and decision-making, and the vulnerability of administrative regimes. For these reasons, the preferences and interests of the outside NGOs played a role dominating the post-disaster recovery decision-making process.

In comparison, the institutional response to the Wenchuan earthquake recovery in China was shaped by new legislation and policy innovations. The Central Government, however, as usual, held positions in decision- and policy-making and played a role of institutional leader. In China’s specific context, this centralized institutional manner was instrumental in mobilizing resources and capacity to increase public assistance to the earthquake-affected areas. Actions by recovery agencies in Victoria in response to the bushfire were in line with its institutional routines. The establishment of VBRRA for overseeing the overall recovery work helped shape the way information and relations among different stakeholders were dealt with. The community interests are, therefore, more likely to be represented through these formalized channels.

8.2 Post-disaster housing recovery approach

After examining the overall post-disaster recovery and reconstruction environment, this section aims to scrutinize the similarities and differences in housing reconstruction approach between the case studies. The comparative analysis of post-disaster housing recovery approaches is divided into three parts: 1) housing culture and type, 2) housing reconstruction actors, and 3) characteristics of housing recovery approach.

8.2.1 Housing culture and type

Housing, invariably, was placed as a top priority in post-disaster recovery agenda in the three cases. Banda Aceh and Mianzhu share a similarity that they were both two of the worst-affected cities. In both places, damage was attributed largely to the quality of housing construction. The number of housing units lost or destroyed posed a significant challenge to the local communities. In Marysville, however, most of the lost housing units were either inhabited by homeowners or by renters. This difference is important because to a large extent the residential composition of a community contributes to the different approach to the housing recovery process (Mukherji, 2008).
To better understand housing reconstruction processes and the resulting difference in outcomes they produced, this section will compare the predominant housing types in Aceh, Sichuan and Victoria, and its changes after the disaster. The comparative elements in the three cases are tabulated in Table 8.4, by drawing the results from the preceding case studies.

Table 8.4 Comparative housing type and culture in case studies

<table>
<thead>
<tr>
<th>Cases</th>
<th>Main housing type (pre-event)</th>
<th>Main housing type (post-event)</th>
<th>Catalyst for changes in housing system/reasons for retaining the previous housing system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aceh</td>
<td>• Timber house&lt;br&gt;• Organic building materials such as timber, bamboo &amp; thatch</td>
<td>• Masonry house&lt;br&gt;• Industrialized materials such as brick, concrete, cement, steel</td>
<td>• Expectations from communities&lt;br&gt;• Available funding and NGOs’ participation&lt;br&gt;• Environmental concerns over timber use</td>
</tr>
<tr>
<td>Sichuan</td>
<td>• Brick masonry house in rural areas&lt;br&gt;• Brick masonry multi-storey buildings in urban areas&lt;br&gt;• Building materials such as brick, concrete, cement, steel</td>
<td>• Brick masonry type of residential buildings in both rural and urban areas&lt;br&gt;• Higher construction requirements for workmanship, technique &amp; materials</td>
<td>• Rooted masonry housing culture in communities&lt;br&gt;• Locally available construction materials and skills&lt;br&gt;• Stringent quality control during house rebuilding&lt;br&gt;• Technical support from NGOs</td>
</tr>
<tr>
<td>Victoria</td>
<td>• Timber-frame structure&lt;br&gt;• A variety of materials for other supporting elements</td>
<td>• Timber-frame/steel-frame&lt;br&gt;• Higher construction requirements for fire-resistant materials &amp; components</td>
<td>• Intention of reducing building vulnerability to wildfires&lt;br&gt;• Legislative changes to building standards</td>
</tr>
</tbody>
</table>

8.2.1.1 Housing types before and after the disaster

Housing type and construction techniques are intimately associated with the local climate, topology and culture (Manley et al., 2009). The literature review Chapter Three indicated that to a certain degree, housing culture and traditions embody significantly higher levels of use of building techniques and according materials and products. In the case of Aceh, a fundamental
change in housing type took place after the tsunami, moving away from ‘organic’ timber structure towards ‘brick and mortar’ solutions. Changes in communities’ understanding of a home as not only a physical structure, but more a socio-economic symbol, had helped further this shift. However, in the cases of Sichuan and Victoria, the predominant housing type was retained during recovery and reconstruction with more stringent construction requirements imposed.

In the case of Sichuan, housing damage was primarily seen in non-engineered houses made of load-bearing masonry walls. Construction defects such as poor quality of cement and brick, improper concrete producing technique, and poor structural design, along with lack of seismic-resistant structures were responsible for housing damage and collapse. There was a growing realization after the earthquake that the structural vulnerabilities of buildings need to be reduced in order to reduce losses of life and property. Therefore, the only change made to the post-earthquake recovery housing projects in Sichuan resided with more strict technical requirements from the local government in terms of workmanship and materials.

In Victoria, a series of bushfire-related research initiatives and event investigations had taken place before and after the 2009 bushfires. Generally, there was a good understanding of the performance of a housing system against bushfires, such as the properties of building materials, related design and construction specifications, surroundings, and house owners’ behaviours. In comparison with that of in Indonesia and China, the housing type and construction requirements in Australia were associated more with the pre-existing building controls. This concurs with Blong (2004)’s observations that land use planning and building codes play a large role in reducing building vulnerability to bushfires in Australia. The following section will discuss the reasons behind the choices of housing type in Aceh, Sichuan, Victoria after the disasters.

8.2.1.2 Catalyst for changes in housing system/reasons for retaining the preceding housing system

The three case studies show that, generically, there was an augmentation regarding construction requirements to improve the overall building performance against natural disasters. In Table 8.4, a summary of factors that contributed to the choice of certain housing types indicates that in Aceh and Sichuan, house owners’ selection of housing type for recovery and reconstruction was largely influenced by the local culture and cultural evolution in terms of social trend, and
perception and understanding of communities about a house. Quality concerns, however, seemed secondary to these housing cultural patterns. This was particularly demonstrated in the case study of Aceh. The 2004 tsunami and the subsequent NGO involvement brought about a cultural shift in housing reconstruction. In contrast, house construction in Victoria was essentially connected with requirements stipulated in building legislation.

Furthermore, cases of post-tsunami reconstruction in Aceh and of earthquake rebuilding in Sichuan share similarities in that the application of masonry type of building after the disasters was also linked with availability of technical and financial resources. The houses in Aceh rebuilt by aid agencies typically consisted of reinforced concrete frame structures in-filled with brick walls, timber truss roofs and corrugated iron roofing with the reinforced concrete frames providing the seismic bracing. As described in the case study Chapter Five, with available funding for a large-scale housing program, NGOs, particularly the international agencies, had introduced masonry-based construction for housing projects in Aceh. This matched the local aspirations for rebuilding a perceived ‘modern’ house.

In the case study of the Wenchuan earthquake, the relatively lower cost of, and simple techniques required for, building brick masonry houses were major factors considered by the local communities in choosing a housing construction type. In addition, extensive technical support from both the local government and aid agencies in Sichuan, ranging from seismic design to construction, also assured the house owners of the use of masonry structure after the earthquake. Both cases of Aceh and Sichuan point to the importance of quality control throughout the post-disaster housing reconstruction process. Quality control with regard to a specific type of housing was an emerging issue in most disaster-affected developing counties (Potangaroa et al., 2010). Apart from justifying seismic resilience for masonry type of construction in countries like Indonesia and China, additional measures from the government to address cost-prohibitive limitations and reconstruction timescales are also required. Analogous to the physical resources, time, cost and quality can also be articulated by recovery managers and planners through effective planning, serving as intangible ‘inputs’ into disaster housing recovery projects.

In the case of the Victorian bushfires, there had been an integration of the Victorian land use planning and building control solutions to guide the overall construction of residential buildings
against wildfires. Following the 2009 bushfires, however, the Victorian government introduced updated Building Standards AS3959-2009 for housing reconstruction across the bushfire affected areas in Victoria. This legislative change, however, was aimed to reduce building vulnerabilities to future wildfire events. Different from Indonesia and China, housing construction in Australia was more in compliance with institutional regulations. This is possibly due to its more regulated construction process and building services provided by the governmental agencies at different levels. The following section aims to compare and contrast the main housing reconstruction actors in the three cases in terms of their respective roles and responsibilities.

8.2.2 Post-disaster housing reconstruction actors

In order to understand the housing recovery process in the different contexts, the literature review Chapter Two categorized housing recovery operational environments into three categories: market-dominant, government-dominant, and donor-dominant post-disaster recovery circumstances. In either environment, stakeholders take part in housing recovery projects. The method of reconstruction implementation includes self-build and contractor-build (Barakat, 2003). Since self-build housing reconstruction was rarely seen in the three case studies, the emphasis of this research was placed on contractor-build housing reconstruction mode. Four types of reconstruction actors, namely government authorities, communities/house owners, NGOs, and professional contractors, were identified and discussed in each case study. Variations in roles and responsibilities of these actors are summarized in Table 8.5. This section draws the findings from the case study chapters with respect to post-disaster housing reconstruction actors and makes a comparison.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Aceh</th>
<th>Sichuan</th>
<th>Victoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actors</td>
<td>Donor-driven, contractor-build</td>
<td>Government-driven, contractor-build</td>
<td>Market-driven, contractor-build</td>
</tr>
<tr>
<td>Community</td>
<td>• Bystander</td>
<td>• Supervisor</td>
<td>• Decision maker</td>
</tr>
<tr>
<td></td>
<td>• Only participated in the housing design stage</td>
<td>• Community recovery committee (CRC) for managing and organizing house rebuilding</td>
<td>• Managing and organizing construction services individually</td>
</tr>
<tr>
<td></td>
<td>• Liaison and supervision tasks by VDC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.5 Comparative roles and responsibilities of housing reconstruction stakeholders
8.2.2.1 Community

The Ache case study represents a contractor-build housing recovery approach under a donor-dominant operational environment. Communities had little influence on the overall procurement and delivery of their housing projects. Community participation was largely limited to a few village meetings with the Village Development Committee (VDC) aimed at approving the housing designs and settlement layouts. VDC’s supervision over the building work turned out to be a difficult task due to their lack of experience in construction management and little knowledge about constructing masonry houses. Community participation in this case study falls into the bottom end of Davidson et al. (2007)’s ladder of community participation, where beneficiaries may be consulted about their needs and wants, merely informed about the shape the housing project will take or even manipulated into taking apart in the project. However, Choguill (1996) argued that this cannot really be classified as ‘participation’ because the users have little or no control over decision making. As discussed in the case study, under the donor-driven and contractor-build reconstruction approach, recipient beneficiaries became bystanders with little contribution to their housing recovery implementation.

By contrast, in Sichuan, the creation of new community organizations such as Community Recovery Committee (CRC) was innovative and greatly nurtured the interactions of local
communities with other main recovery actors. With varied degrees of technical, financial and material assistance from the government and aid agencies, this collective action provided an effective way to mitigate some of the risks of contractor-build housing reconstruction. CRC was empowered with particular roles such as a decision-making body and project manager to manage and supervise the entire construction work. This initiative was fully in line with the principles prescribed in China’s ‘Regulations on Post-Wenchuan Earthquake Restoration and Reconstruction’ and was successfully translated into practice at the local level. It also concurs with a management-related project organization pattern in which the owner takes charge of, and manages, design and construction activities carried out by a number of construction professionals (Masterman, 2002). Most importantly, representing all community members, CRC was able to make a decisive response to any reconstruction problems, especially for those who lost family members and suffered trauma after the earthquake.

An owner-driven and contractor-build approach was pursued in Victoria during the post-bushfire housing recovery and reconstruction. The bushfire-affected communities organized rebuilding houses with access to a range of technical, material, and financial assistance. House owners’ participation in the bushfire housing recovery, was the same as at normal construction times. According to (Mukherji, 2008), under this construction pattern, households have direct control and supervision over construction of their house, with local artisans, building contractors or contract labourers doing the actual construction work.

As opposed to the case of post-tsunami housing reconstruction, the highly owner-participatory approach in Victoria is similar to that in Sichuan. The only difference in community participation between Sichuan and Victoria lies in that community participation in China took the form of a collective community organization, CRC, whereas in Australia it was conducted on an individual-household basis. In spite of this difference, housing reconstruction in both cases gave complete decision-making powers to homeowners regarding the choice of building materials and professionals, the construction process, and the house design. Based on Davidson et al. (2007)’s ladder of community participation, the comparative scope of community participation in the housing recovery projects in the three cases is portrayed in Figure 8.1.
8.2.2.2 Government authorities

The major institutional actor at the national level for housing recovery in Aceh was the Indonesian government through BRR. Although fully empowered, BRR failed to fulfil its role as being a regulator, overseer and coordinator, due to complex issues after the tsunami and its institutional deficiencies. Aceh’s experience was also the first time in history that a centralized ‘super ministry’ was established to coordinate post-disaster recovery and reconstruction activities on such a large scale. In essence, similar to housing projects after the earthquake event in Gujarat (Barenstein, 2006a), the Indonesian Government, NGOs and private sector organizations took part in housing recovery under a ‘public-private’ partnership arrangement. In Aceh’s case, however, lack of coordination over the main recovery actors of aid agencies, and particularly the absence of regulatory mechanisms within BRR, undermined the effectiveness of this ‘public-private’ partnership in housing reconstruction. As a result, BRR’s responsibilities for housing recovery were substantially reduced.

In China, while the Central Government created basic legislative settings for housing reconstruction, the Sichuan Provincial Government provided administrative mechanism for the regulation and control of house rebuilding at the local level. Housing reconstruction examined in the case study concurs with observations of Dunford and Li (2011) that the Chinese government
played a significant role in leading, controlling and financing reconstruction after the 2008 earthquake. Apart from being a regulator through a highly centralized administrative system, governmental authorities at different levels in the affected areas, in conjunction with those in the non-affected regions across China, had provided considerable facilitation to the quake-affected communities in terms of financial, technical and material aid. This ‘paternalistic role’ of the Chinese government is in line with the category of government-dominant operational environment, as summarized in the literature review Chapter Two.

The government interventions in Australia adopted a different approach. According to the institutional routines, the government at different levels undertook various responsibilities prescribed in legislation. The Victorian State Government took a lead role in managing the regionally disastrous event. The State Government introduced the building standards, and the local councils ensured that the actual house reconstruction complied with those regulations. Unlike that in China, the government interventions in Victoria were less controlling but were more facilitating and responsive to different sets of needs and income groups. This is possibly because housing in most developed countries is considered a product for private consumption through private market mechanisms (Mukherji, 2008). This case study shows that the bushfire-affected house owners were directly assisted by a number of government agencies. In addition to socio-economic assistance from other government departments and social groups, a range of rebuilding services such as mobile Rebuilding Advisory Service and Rebuilding Centres were specifically established to attend to housing recovery needs of house owners in the worst affected areas.

8.2.2.3 NGOs/civil society

In the case study of the 2004 tsunami, NGOs and, especially the large INGOs, played a lead role in post-tsunami housing recovery in Aceh. Aid agencies opted for contractor-build reconstruction and in most cases, community participation was minimal. The involvement of NGOs in the actual housing recovery implementation also challenged the Indonesian government’s top-down reconstruction approach. According to Davidson (2010), in traditional contexts, where shared know-how is available nationally or regionally, the global environment has little recognized impact on the building project; in reconstruction projects, the contrary is the case and the impacts of global influences are all pervading and difficult to cope with. This was well exemplified in the
case of the Indian Ocean tsunami housing reconstruction. Due to lack of coordination, the centralized governance from BRR was essentially replaced by decentralized decision-making of the individual aid agencies. Unlike the 2008 and 2009 disasters, NGOs in post-tsunami Aceh became a decision-maker regarding the choice of building materials and professionals, the construction process, and of the house design.

Analogous to the CRCs in the Wenchuan earthquake housing recovery, the aid agencies in housing reconstruction after the tsunami concurs to Masterman (2002)’s project management pattern. Rather than empowering and enabling local communities to take charge of and manage the building work, the implementing NGOs acted as a chief project manager for housing reconstruction projects. The outcome of donor-driven housing reconstruction programs in terms of time, cost and quality was undesired. There were a number of factors contributing to this unfavourable housing recovery result. The following sections will unveil these factors in a comparative perspective.

Indeed, NGOs’ involvement in post-disaster housing recovery projects was not new to disaster-affected areas. In examining and comparing housing reconstruction approaches in post-earthquake Gujarat, Barenstein (2006b) suggested that funding agencies and NGOs should reconsider their role in post-disaster housing reconstruction and support people’s own initiative, rather than providing them with what outside agencies believe is good for them. The case study of the 2004 tsunami in this research shows a common concern shared by other researchers such as Steinberg (2007), Kennedy et al. (2008) and Jayasuriya and McCawley (2008), that the capacity and capability of these humanitarian aid organizations was insufficient in undertaking physical construction work post-disaster.

In contrast, the engagement of civil society, particularly the international NGOs in housing reconstruction after the Wenchuan earthquake was new in China’s disaster recovery history. In Sichuan, the involvement of aid agencies in housing reconstruction was limited under the Chinese governance structure. NGOs in Sichuan adopted a facilitative role, providing additional material and technical aid to the communities who attempted to rebuild their houses. Their participation is in line with Barenstein (2006b)’s subsidiary housing approach in which aid agencies do not engage directly in housing reconstruction. Instead, they assumed a subsidiary
role, complementing government compensation with additional material and technical assistance required by the house owners.

The engagement of aid agencies in housing reconstruction after the 2009 bushfires was not observed by the researcher. However, the case study shows that, apart from organizing and distributing considerable donations to the affected communities, the aid agencies or social groups in Victoria were active in livelihood programs targeting vulnerable communities to provide socio-economic assistance. Their participation in housing recovery projects was less than that of in Aceh and in Sichuan. This situation, however, was common in most developed countries such as the U.S. (Comerio, 1997, 2004) and Japan (Olshansky et al., 2006) where aid agencies were inclined to respond to house owners’ housing needs and preferences by helping increase the capacity of the affected in terms of financial, technical and material support.

8.2.2.4 Construction professionals

The literature on post-disaster housing reconstruction reveals a preference for contextualized community participatory approaches; but it has largely overlooked the role of the construction industry, especially the role of participant builders/contractors in reconstruction. This lack of attention is somewhat surprising given that the construction industry is not only a critical component of the nation’s economy but is also a fundamental contributor to disaster management and mitigation (Spence and Kelman, 2004; Pheng, Raphael and Kit, 2006; Zuo et al., 2006). Until recently, scholars such as Ofori (2002), Page (2004), Haigh et al. (2006), and Bosher et al. (2007) have proposed that more attention should be paid to the construction sector and its role in disaster management. The three case studies were concerned with the actual construction work being undertaken by construction professionals. There were also common concerns about the relations between clients, namely, house owners in Sichuan and Victoria, NGOs in Aceh, and those industry practitioners.

According to Barenstein (2006b), many humanitarian organizations assume that the quickest and most effective way to rebuild houses after a disaster is to employ professional construction companies. However, as shown in the case study in Aceh, the general inadequacy of construction capacity in the industry prior to the tsunami was unable to cope with large-scale housing recovery after the tsunami. Reconstruction after the tsunami was entrusted to a general contractor
who subcontracted the numerous specialized tasks to trades people. The profit imperative may also compromise the quality of the work. Despite quality concerns and frustrations experienced by the aid agencies in dealing with their contractors, housing reconstruction with poor workmanship and inferior materials continued. As a result, in line with observations of Dercon (2007) and Boen (2008), the bulk of the reconstruction work carried out by Indonesian contractors failed to meet seismic-resistant quality and had to be demolished or retrofitted with bracing.

It was found that in both contexts of Sichuan and Victoria, there was a relatively higher building capacity in comparison with Aceh. The government authorities in both China and Australia had also recognized and built upon this capacity by supporting owner-organized housing reconstruction. The local construction professionals undertook the actual building work. Quality control over the construction work, however, in both cases was significant through a wide variety of rebuilding services from the government. Particularly, other forms of construction sector’s involvement in response to the bushfires were suggested, such as Grocon’s clean-up program, industry voluntary BAL-assessment, and housing design assistance.

In traditional, relatively stable environments, according to Davidson (2010), industry participants in a building project team rely upon their own knowledge and capacity. However, in a context of reconstruction after natural disasters, the importance of skills that are required for carrying out rebuilding work is likely to play out through the overall rebuilding process. Both the earthquake and the bushfires highlighted this point since the unexpected contractual problems pertaining to the relationship between house owners and building contractors emerged during reconstruction. Lack of mutual trust and understanding between the two sides was a prominent issue that had an impact on the post-disaster housing recovery in Sichuan and Victoria. In this regard, the motivations of these construction professionals to participate in housing reconstruction in a post-disaster situation have to be recognized.

8.2.3 Characteristics of housing recovery approach

In this research, the case study of the tsunami placed a focus on donor-driven, contractor-build housing projects, whereas the case study of the earthquake looked at contractor-build housing recovery under a government-dominant environment; and the case study of the 2009 Victorian bushfires looked at contractor-build housing recovery under a market-dominant environment.
Housing reconstruction actors in all three cases fell into similar categories, but assumed different degrees of roles and responsibilities. This section compares the characteristics of the housing recovery approaches applied at two levels: funding mechanism and reconstruction organization.

8.2.3.1 Funding sources: Government, NGOs, market?

Housing recovery can be commonly seen as a process where communities or individual households rebuild, repair, and replace their damaged or destroyed houses by using a combination of technical, financial, and materials assistance from government or other social groups. Among many factors that contribute to a community’s capacity to successfully rebuild after a disaster, Comerio (1998) advocated that the most important factor is the system of finance for housing repairs and rebuilding. Across the three cases, the funding sources encompass personal funds, private loans, insurance payouts, funding from external aid agencies, or public financial assistance from the government.

Models of donor-driven housing reconstruction, as employed in Aceh after the tsunami, generated opportunities for introducing novel techniques and available funding. Similar to other developing countries, according to Bhattacharya (1994), the problem of providing affordable housing is aggravated by limited allocations of budgetary resources by the governments. The 2004 tsunami emerged as a focal point for global humanitarian assistance. Various international aid organizations assisted the Indonesian Government with financing to build replacement housing. Although the Indonesian Government had injected capitals into housing reconstruction through BRR, the vast majority of funding composition was monetary donations from the outside donors and aid agencies. The financial availability from external organizations and donor countries, to some extent, affected the way NGOs were involved in the housing recovery and reconstruction (Freeman, 2004). In the case of the post-tsunami reconstruction in this research, however, funding availability involves the fact that NGOs became an exclusive decision-maker to manage their own housing programs.

In China, the house owners’ major funding sources were government subsidies, public loans and their personal savings. The public financial assistance from non-affected regions also accounted for a large proportion. Funding from external aid agencies used for housing recovery and reconstruction, however, was limited. There is an absence of the property insurance against
natural disasters in China. Following the 1998 Yangze River flooding, flood insurance was initiated and encouraged by the Chinese government, and several pilot projects were implemented (Zhang, 2003). However these were not very successful, mainly due to the fact that the poor rural people in flood-prone areas were reluctant to pay the insurance premium since they traditionally rely on relief from the government after flood disasters (Zhou, 2009). Therefore, instead of relying on external financial assistance from aid agencies, the Chinese government took a lead role in establishing a combined financing system for compensating earthquake losses for the affected communities.

As with many other developed countries such as the U.S. (Oliver-Smith, 1990; Comerio, 1998), in Australia where the country embraces free market economy and the privatization of the housing market, owner-organized housing recovery could only allow limited public interventions. Most public funding is targeted towards community redevelopment. Households are expected to insure their investments against catastrophic losses or borrow from banks to finance property reconstruction (Wu and Lindell, 2004). Market economy provides a mechanism for house owners to finance, build, own and insure houses. As presented in the case study of the Victorian bushfires, a series of financial packages from the government at different levels were available to the bushfire-affected populations. However, house owners ultimately had to rely on private sources such as personal savings, insurance and commercial loans for rebuilding houses. The funding sources in the three case studies are summarized in Table 8.6.
### Table 8.6 Comparative funding sources for post-disaster housing reconstruction

<table>
<thead>
<tr>
<th>Funding sources</th>
<th>Housing recovery in Aceh</th>
<th>Housing recovery in Sichuan</th>
<th>Housing recovery in Victoria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market forces</strong></td>
<td>N/A</td>
<td>Bank loans</td>
<td>• Insurance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Bank loans</td>
</tr>
<tr>
<td><strong>Public assistance</strong></td>
<td>Government subsidies</td>
<td>• Central government subsidies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local government subsidies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Financial support from Sponsoring government</td>
<td>Government financial support package</td>
</tr>
<tr>
<td><strong>Aid agencies/Donors</strong></td>
<td>Fully rely on the funding support from aid agencies</td>
<td>Monetary donations account for small section</td>
<td>Limited monetary donations used for housing reconstruction</td>
</tr>
<tr>
<td><strong>Personal savings</strong></td>
<td>N/A</td>
<td>Personal savings in part compensate for the rebuilding of houses</td>
<td>Personal savings in part compensate for the rebuilding of houses</td>
</tr>
</tbody>
</table>

### 8.2.3.2 Housing reconstruction organization

The tsunami case study shows that the involvement of the international aid agencies, to some extent, exacerbated developmental problems due to their lack of technical assistance and coordination mechanism. The past reconstruction experience in Gujarat after the 2001 earthquake (Barenstein, 2006a), presents a good example where NGOs played a role in strengthening local housing culture and building capacity by empowering communities through financial and technical assistance to manage for themselves the reconstruction of their houses. Additionally, one favourable model of NGOs’ involvement in post-disaster housing reconstruction is that agencies should make an informed and contextually appropriate technological choice and pay more attention to preserve the design, material, and construction practices related to local housing (Barenstein and Pittet, 2007).

The primary lesson to be taken from the tsunami case study is not that donor-driven approach is fundamentally flawed but rather that it must be drawn up in the presence of certain conditions. As alluded to earlier in this chapter, the Indonesian government through a centralized recovery
authority, BRR, should inject administrative and technical inputs into donors’ housing recovery efforts. Donor-driven reconstruction requires powerful and mandatory coordination structures within the recipient government institutions, and through their involvement, may develop capacities and legitimacy (Ackerman, 2003; Zetter, 2005).

The way Chinese government organized the post-earthquake housing reconstruction was similar to its usual government-led response to natural disasters. However, advocacy of self-help reconstruction under the overarching post-earthquake legislation and Master Plan had enabled greater empowerment of affected communities to implement housing recovery at the local level. The research findings in the case study of the Wenchuan earthquake are consistent with the study by Prater and Wu (2002) that a centralized government would facilitate emergency response, and perhaps disaster recovery. Under the government-led regulatory and administrative framework, instead of being directly involved in housing recovery, aid agencies in the post-earthquake reconstruction in Sichuan played a facilitative role complementing the technical and material assistance from the Chinese government.

In comparison, the government facilitation features for owner-driven reconstruction in Victoria were prominent, and directly related to the provision of technical assistance. Housing is a critical component of the overall economic recovery of a community after disasters (Mukherji, 2008). According to Comerio (1998, p.161), timely housing recovery is a component of economic recovery. For communities who failed to rebuild their houses after the bushfires, it is likely that they will fall back economically. As the literature has indicated, owner-driven methods are best purposed only where their implementation is joined by substantial technical assistance, clear building codes and rigorous enforcement regimes to monitor and evaluate structural quality (Twigg, 2006). The case study of the 2009 Victorian bushfires shows that, apart from these requirements, socio-economic vulnerabilities of the disaster-affected populations played a significant part in an owner-driven housing recovery approach. Therefore, the theoretical ideal of government involvement needs to be adapted more in post-disaster recovery governance and leadership to allow owner-driven housing approach to succeed.

Despite the differences inherent in the specific context of post-disaster reconstruction, the approaches in the three cases shared many similarities. Post-disaster reconstruction programs in the three cases evolved over time in response to the disaster conditions. In both Sichuan and
Victoria, the hardest-hit areas were targeted for special attention and required larger amounts of technical and financial assistance. The experience following the Wenchuan earthquake and the Victorian bushfires illustrates the importance of empowering the local affected and enabling their full participation in rebuilding their houses. The pre-conditions for attaining a successful owner-driven approach lie in coupling the provision of technical, financial and material support with local flexibility. Varied decision-making and funding provision from the dominant actors in housing recovery projects — government, NGOs, communities, along with market mechanisms, provide insight into how different stakeholders can leverage their power and authority into collective reconstruction solutions. Similarly, the following section attempts to compare and discuss the roles and responsibilities of resourcing stakeholders in their housing recovery projects.

8.3 Resourcing stakeholders for housing recovery

Potential resourcing participants for post-disaster reconstruction have been identified in the literature review Chapter Three, including policy makers, house owners/communities, construction contractors, aid agencies, scientific or research institutions, and manufacturers and trade associations. The reconstruction model, as discussed in the above sections, has an influence on the relationships, roles and responsibilities of these resourcing stakeholders. This section compares the roles and responsibilities of different stakeholders pertaining to resourcing for post-disaster housing recovery projects. A summary of research results with respect to resourcing stakeholders for housing recovery in the three case studies is presented in Table 8.7.

<table>
<thead>
<tr>
<th>Resourcing stakeholders</th>
<th>04 Indian Ocean tsunami</th>
<th>08 Wenchuan earthquake</th>
<th>09 Victorian ‘Black Saturday’ bushfires</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy makers</strong></td>
<td><strong>BRR</strong>: A series of regulatory measures in response to resource shortages</td>
<td>• Government interventions into resource production and market • Facilitation to resource production and logistical support for delivery</td>
<td>Resourcing facilitators: • VBRRRA • Building Commission</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>A limited ability of sourcing resources locally</td>
<td>Procurement of resources for house owners in some</td>
<td>Material and product selection and purchase for</td>
</tr>
</tbody>
</table>

Table 8.7 Comparative roles and responsibilities of resourcing stakeholders
<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>contractors</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Aid agencies</strong></td>
<td>• Infrastructural investment in production facilities</td>
</tr>
<tr>
<td></td>
<td>• Resource procurement by implementing agencies</td>
</tr>
<tr>
<td></td>
<td>Material assistance</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Scientific &amp; research institutions</strong></td>
<td>• Development and advocacy of alternatives to building materials</td>
</tr>
<tr>
<td></td>
<td>• Communicating new construction technology to public</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Manufacturers &amp; trade associations</strong></td>
<td>Expanded production capacity with assistance from the government</td>
</tr>
<tr>
<td></td>
<td>Investment in manufacturing products required for houses in BAL-FZ</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Communities</strong></td>
<td>Bystander</td>
</tr>
<tr>
<td></td>
<td><strong>CRCs:</strong></td>
</tr>
<tr>
<td></td>
<td>• Decision making on selection of materials</td>
</tr>
<tr>
<td></td>
<td>• Resource procurement</td>
</tr>
<tr>
<td></td>
<td>Decision making on selection of building resources and services</td>
</tr>
</tbody>
</table>

### 8.3.1 Roles and responsibilities of resourcing stakeholders for housing recovery

The Chinese authority’s way of resourcing for reconstruction was characterized by its ‘hard’ interventions into the production and circulation of building materials. These interventions were aimed to contain inflation and meet the reconstruction requirements in the worst-impacted areas. The administrative interventions were effective in meeting the rebuilding objectives in Master Plan, although it gave rise to an adverse impact on the local economic development. The remedial NGO-procured alternatives presented in the case of the 2004 Indian Ocean tsunami are preferable in countries such as Indonesia where natural resources are lacking and the local institutions are unable to play a lead role in post-disaster reconstruction. The local market and infrastructure settings in Indonesia failed to assist the poorly-managed international aid agencies in coping with the logistical requirements for large-scale housing development. Australia’s case is in line with a common concern expressed by Spence (2004) that in developed countries, the
disaster mitigation measures and building standards introduced post-disaster could cause unexpected resourcing problems for a market-driven housing recovery.

The mandated legislation and policies of the Chinese government provided a powerful vehicle which articulated both the outcomes of the stakeholders resourcing efforts and the manner in which the resourcing activities were carried out. However, government-driven measures can misguide people into improvised and ad hoc tactics and handicap the sustainability and development of the local economy and market (McGee, 2008). Thus, it has been difficult for authorities to impose regulations of such a kind in countries like Australia where the market economy is dominant. Instead, in the mature market economy in Australia, mandated regulations and legislation with regard to building construction largely impacted upon market forces which eventually drove the customer-oriented changes to resourcing. The legislative changes to the Building Standards after the bushfires had an impact on the manufacturing industry in producing products required for rebuilding houses.

In Indonesia’s case, there was an absence of a political and operational space in which local recovery efforts could take strong hold. The role of the national government through BRR was limited to information sharing, implementation capability, and communication with aid agencies. As presented in the case study, the regulatory measures adopted by BRR such as cost ceilings and new timber administration rules failed to address cost inflation of essential building materials for housing reconstruction. In Aceh, the varied and inconsistent objectives between aid agencies and BRR posed obstacles to coordinated resourcing efforts during reconstruction. This resourcing approach conducted by aid agencies, however, necessitates thinking ahead (Kennedy et al., 2008) and an ethos of trust and commitment from governments (Pandya, 2006).

**8.3.2 Resourcing approaches for housing recovery**

The assessments on roles and responsibilities of the resourcing stakeholders presented in the preceding case study chapters show differences and similarities between the three different post-disaster resourcing models. The examination and comparison of the way in which resources were procured has illustrated that a government-led strategy is the most effective method in the case of resource management, whereas a commercial market system remains more efficient for the provision of resources to disaster-affected communities. In essence, government policy plays an
important part in the actions of resourcing during the rebuilding process. This can be seen as a difference between the case of China and the cases of Australia and Indonesia.

Both resourcing approaches in China and Indonesia are representative of situations in many developing countries where socio-economic and political conditions play a dominant role in shaping the nature of reconstruction programs. The absence of an insurance culture in these two countries is a possible reason for their dependence on the assistance from the government or aid agencies. Additionally, China’s and Indonesia’s cases also suggest that the local construction sector in these countries fell short of their resourcing duties in the wake of the disasters. Particularly in the case of the Wenchuan earthquake, community organizations CRCs assumed the main responsibility of selecting and procuring resources for rebuilding houses in rural areas. The manufacturing industry in both cases was purely reliant upon outside assistance from either aid agencies or the government.

In contrast, in Australia where the government’s major role was the restoration of services and public infrastructure, the reconstruction of private housing was conducted by the affected house owners. The resource shortages were attributed mainly to the more stringent construction requirements under the improved Building Standards, and people’s readiness to face rebuilding at their personal level. Thus, the success of market-driven resourcing relies on a mechanism for capitalizing on the market leverage for providing low-cost houses for disaster-affected people. A realistic assessment and justification of market prospects for new products required for rebuilding houses at higher BALs, combined with government facilitation, might help solve the resourcing difficulties the communities had faced.

In this research, evidence shows that post-disaster reconstruction ideology has an impact on the selection and application of resourcing interventions for disaster recovery. The practical implication is that the designers and planners of post-disaster recovery should take this ideology into account when designing programs to assist communities in recovering from disaster. Given the varied capacities of the affected nations and communities, designers of a disaster recovery system should appropriate the most effective reconstruction approach. The resourcing capacity under each approach is closely related to the economic, political, and socio-demographic disparities between groups, especially disparities in the perceptions of the affected people. The substantive differences in tsunami, earthquake and bushfire hazards, along with the nature of
policy-making authority to deal with those hazards, also show widely differing coping dynamics in the affected local communities.

Variations in resourcing processes and outcomes in the three cases were also associated with the variations in their pre-existing social and material conditions, the differences in local and state institutional arrangements, and in the level of community organization and local leadership. Different groups of surveyed populations varied in the three case studies because of the differing resourcing approach employed. Under a relatively mature market economy, Australia is expected to have significantly different concerns than those of China and Indonesia. Reconstruction practitioners such as consultants, suppliers, and specialist contractors from the construction industry are likely to be subjected to a different set of problems and challenges within the different contexts. The research findings, however, discerned these expected differences and also revealed the resourcing constraints that commonly face the post-disaster reconstruction policy makers and practitioners.

It should be noted that the bushfire event in Australia, in terms of human loss and economic impact, was smaller than either the earthquake in China or the tsunami in Indonesia. It still makes a compelling case that, to a significant degree, reveals the dysfunctions of the infrastructure and services in response to community housing recovery. In addition, resourcing for housing projects in the bushfire damaged areas was less influenced by the capacity of the building professionals, than by the influence of the broader environment on the activities of recovery.

Therefore, it can be concluded that all the examined resourcing approaches can provide benefits and also impediments. It is important to keep in mind the fundamentally different challenges that these contexts present and, consequently, the different efforts they require. Both government-driven and donor-driven resourcing can be further enhanced by the government fostering an enabling environment and the facilitating of the procurement and development of resources. The materialization of potential benefits of a market-driven resourcing approach will depend on the particular design of the implementing mechanisms, and on the legal and governance context. Therefore, the resourcing focus for post-disaster housing reconstruction should not be on finding suitable overarching frameworks, but on understanding the opportunities and pitfalls of different
resourcing approaches and understanding what can realistically be achieved within a given context.

The comparison taken here responds to the reasons why problem identification and learnings sharing are important for improving the understanding and practice of disaster recovery, rather than sticking to any particular nominal category of what should or should not be included in a disaster management framework. Ultimately, whichever resourcing approach is adopted after a major disaster, resource availability faces the challenges structured by its relations with the key decision makers. The success of resourcing depends on multi-stakeholder’s collaboration and the development of policies, plans and tools to allow market flexibility, donor management and government intervention. Establishing closer relationships between the relevant stakeholders means that more effective dialogues will result.

8.4 ‘Indicator resources’ and their availability for post-disaster housing recovery

Research findings in the preceding case study chapters suggest that the resourcing of the various ‘indicator resources’ had an impact on the housing recovery projects after the disasters. As shown in individual case studies, it is crucial to pay more attention to these ‘indicator resources’ because their availability profoundly affected the manner in which the post-disaster recovery projects were procured, and the ultimate project outcomes. The ‘indicator resources’ and their resource availability in housing reconstruction across the case studies are comparatively demonstrated in Table 8.8 and will be compared in this section.
### Table 8.8 Comparative 'indicator resources' (IRs) and their availability in housing recovery

<table>
<thead>
<tr>
<th>IRs</th>
<th>04 Indian Ocean tsunami</th>
<th>08 Wenchuan earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timber</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attainability</td>
<td>• Large stocks of seized illegal timber resources</td>
<td>• Reduced production capacity due to the impact of the earthquake</td>
</tr>
<tr>
<td></td>
<td>• Low capacity of local timber supply</td>
<td>• Effect of Government ‘hard’ interventions into market</td>
</tr>
<tr>
<td></td>
<td>• Significant impact of increased cost</td>
<td>• Significant impact of inflationary brick price on affected house owners</td>
</tr>
<tr>
<td>Usability</td>
<td>• Quality concerns about both local procured and overseas imported timber</td>
<td>• Lack of social acceptance of using concrete blocks as a substitute to bricks</td>
</tr>
<tr>
<td></td>
<td>• Lack of substitutes for timber resources</td>
<td>• Quality concern about concrete blocks</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Lack of access to the illegal timber stocks</td>
<td>• Lack of access to local available resources in the market</td>
</tr>
<tr>
<td></td>
<td>• Legal constraint on accessibility of domestic forest product since 2007</td>
<td>• Government’s supply redirection limited local access to available bricks</td>
</tr>
<tr>
<td></td>
<td>• Concerns about secure transportation and other infrastructural capacity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Complex logistics from overseas imports</td>
<td></td>
</tr>
<tr>
<td><strong>Cement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attainability</td>
<td>• Reduced production capacity due to the impact of tsunami</td>
<td>• Reduced production capacity due to the impact of the earthquake</td>
</tr>
<tr>
<td></td>
<td>• Limited number of cement producers</td>
<td>• Effect of Government ‘hard’ interventions into market</td>
</tr>
<tr>
<td></td>
<td>• Significant impact of increased cost</td>
<td>• Significant impact of inflationary brick price on affected house owners</td>
</tr>
<tr>
<td>Usability</td>
<td>• Quality concerns about overseas imported cement from Indian and Malaysia</td>
<td>• Lack of social acceptance of using concrete blocks as a substitute to bricks</td>
</tr>
<tr>
<td></td>
<td>• Easily hardening property requires proper logistics and infrastructure facilities</td>
<td>• Quality concern about concrete blocks</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Damaged transport networks</td>
<td>• Lack of access to local available resources in the market</td>
</tr>
<tr>
<td></td>
<td>• Sparse geographic coverage of cement production in Indonesia</td>
<td>• Government’s supply redirection limited local access to available bricks</td>
</tr>
<tr>
<td></td>
<td>• Lengthy procurement lead time of cement</td>
<td></td>
</tr>
<tr>
<td><strong>Brick</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attainability</td>
<td>• Salient inflation of brick price</td>
<td>• Reduced production capacity due to the impact of the earthquake</td>
</tr>
<tr>
<td></td>
<td>• 20-30% production capacity associated with good quality of bricks</td>
<td>• Effect of Government ‘hard’ interventions into market</td>
</tr>
<tr>
<td></td>
<td>• Significant impact of increased cost</td>
<td>• Significant impact of inflationary brick price on affected house owners</td>
</tr>
<tr>
<td>Usability</td>
<td>• Quality concerns of the local brick supply</td>
<td>• Lack of social acceptance of using concrete blocks as a substitute to bricks</td>
</tr>
<tr>
<td></td>
<td>• Quality of raw materials and skilled labour operating machines</td>
<td>• Quality concern about concrete blocks</td>
</tr>
<tr>
<td></td>
<td>• Quality of timber brick kilns</td>
<td>• Lack of access to local available resources in the market</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Poor infrastructure for dispersal and delivery of imported bricks</td>
<td>• Government’s supply redirection limited local access to available bricks</td>
</tr>
<tr>
<td></td>
<td>• High transportation costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Beneficiaries’ unwillingness to use concrete blocks as a substitute for bricks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lack of social acceptance of using concrete blocks as a substitute to bricks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Quality concern about concrete blocks</td>
<td></td>
</tr>
<tr>
<td><strong>Skilled labour</strong></td>
<td>• Low local supply capacity due to the pre-existing industry problem</td>
<td>• Reduced production capacity due to the impact of the earthquake</td>
</tr>
<tr>
<td></td>
<td>• Lengthy skill development time</td>
<td>• Effect of Government ‘hard’ interventions into market</td>
</tr>
<tr>
<td></td>
<td>• Significant impact of increased cost on the implementing agencies</td>
<td>• Significant impact of inflationary brick price on affected house owners</td>
</tr>
<tr>
<td>Usability</td>
<td>• Workmanship concern with specialized labour such as carpenters and masons</td>
<td>• Lack of social acceptance of using concrete blocks as a substitute to bricks</td>
</tr>
<tr>
<td></td>
<td>• Effective skill training for unemployed local tsunami survivors was required</td>
<td>• Quality concern about concrete blocks</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Imported from outside of Aceh, mainly from Java, and North Sumatra</td>
<td>• Lack of access to local available resources in the market</td>
</tr>
<tr>
<td></td>
<td>• Less accessibility to local qualified labour</td>
<td>• Government’s supply redirection limited local access to available bricks</td>
</tr>
<tr>
<td></td>
<td>• Unstable supply due to the competition among aid agencies</td>
<td></td>
</tr>
<tr>
<td>Aggregate</td>
<td>Labour</td>
<td>09 Victorian bushfires</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>------------------------</td>
</tr>
</tbody>
</table>
| • Limited existing aggregate manufacturing capacity  
• Government underestimation of the reconstruction demand for aggregate  
• Significant impact of inflationary aggregate price on affected house owners | • Limited local skill base  
• Increased labour flow by returning migrant workers and from other regions  
• Lower skill from outside the quake affected areas  
• Impact of inflationary labour wage | • Limited interest of construction builders and tradespeople in house rebuilding  
• Skills pulled out to Melbourne region  
• Impact of increased quoted price on affected house owners  
• Low interest of construction builders and tradespeople in house rebuilding  
• Skills pulled out to Melbourne region  
• Impact of increased quoted price on affected house owners  
• Low interest of construction builders and tradespeople in house rebuilding  
• Skills pulled out to Melbourne region  
• Impact of increased quoted price on affected house owners |
| • Quality concern of recycled aggregate materials  
• Increased environmental concerns regarding aggregate exploitation | • Concerns about labour reliability and liability  
• Workmanship concerned with specialized labour for seismic resistant structures, such as carpenters and masons  
• Code of Conduct is required for both house owners and construction professionals | • Low interest of construction builders and tradespeople in house rebuilding  
• Skills pulled out to Melbourne region  
• Impact of increased quoted price on affected house owners  
• Low interest of construction builders and tradespeople in house rebuilding  
• Skills pulled out to Melbourne region  
• Impact of increased quoted price on affected house owners  
• Low interest of construction builders and tradespeople in house rebuilding  
• Skills pulled out to Melbourne region  
• Impact of increased quoted price on affected house owners |
| • House owners’ lack of access to local available aggregate resources due to large demands in infrastructure restoration  
• High transportation cost  
• Reduced accessibility to aggregate sources due to environmental concerns | • Influx of labour from areas outside Mianzhu  
• Less accessibility to local qualified labour | • Lack of alternative window solutions for houses in BAL-FZ category  
• 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  
• Impact of window price on recovery  
• Lack of access to available window systems in the market  
• Building Commission’s facilitation increased local access to available combined window and screen systems  
• Impact of window price on recovery |
| • The property of a comprehensive roof system depends on all the components which were required to be tested independently  
• The information session to the construction industry influenced the application of the products  
• Lack of access to available tested roof systems in the market  
• The industry manufacturers and trade associations played a major role in testing and introducing the new roofing systems to houses in BAL-FZ zone | • Influx of labour from areas outside Mianzhu  
• Less accessibility to local qualified labour | • Lack of alternative window solutions for houses in BAL-FZ category  
• 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  
• Impact of window price on recovery  
• Lack of access to available window systems in the market  
• Building Commission’s facilitation increased local access to available combined window and screen systems  
• Impact of window price on recovery |
| • Influx of labour from areas outside Mianzhu  
• Less accessibility to local qualified labour | • Limitation of local skill base  
• Increased labour flow by returning migrant workers and from other regions  
• Lower skill from outside the quake affected areas  
• Impact of inflationary labour wage | • Influx of labour from areas outside Mianzhu  
• Less accessibility to local qualified labour  
• Limitation of local skill base  
• Increased labour flow by returning migrant workers and from other regions  
• Lower skill from outside the quake affected areas  
• Impact of inflationary labour wage |
The discussion in the previous case study chapters shows that following the devastating disasters in Aceh, Sichuan and Victoria, the resourcing stakeholders faced complex resourcing issues for post-disaster housing reconstruction. In line with the implications of resource availability for post-disaster recovery in the literature review, lack of, or absence of resource availability in the three cases had affected the rebuilding project performance in terms of construction cost, quality, and schedule. Furthermore, these impacts also extended to a larger recovery context, to some extent, had reinforced economic, social and environmental vulnerabilities of local communities. The research findings in the case study chapters show that some aspects of the Aceh, Sichuan and Victoria’s resourcing experience hold lessons of wider relevance for other contexts. The primary objective of this section is to compare availability of the identified ‘indicator resources’ for housing recovery projects across the three cases.

The research shows that three dimensions which constitute to resource availability — attainability, usability, and accessibility, cannot be disentangled from one another to represent the actual ability to achieve the acquisition and use of resources for post-disaster reconstruction. The manufacturing capacity from the supply side in both Aceh and Sichuan was affected by the disasters. The decision makers in all three cases took the varied form of regulatory or facilitative measures to alleviate the impact of cost escalation as a result of resource shortages. However, affordability of house owners in Sichuan and Victoria and of international aid agencies in Aceh for housing reconstruction became a critical factor that influenced the attainability of the available resources. This result suggests cost implications of resource availability for both house owners and implementing agencies who seek to rebuild disaster-damaged houses in previous research (Steinberg, 2007; McGee, 2008; Pathiraja and Tombesi, 2009).

In line with observations of Barakat and Zyck (2011), the case studies show that individuals who were socio-economically better off were able to dedicate monetary resources to the process of housing reconstruction, and were able to contract skilled labours and engineers. In contrast, those with fewer resources, as shown in the case of China and Australia, commonly lacked access to technical expertise and skilled builders. Those economically vulnerable house owners were most likely to be affected by inflation in the price of construction materials. As a result, for instance in Sichuan, house owners with less affordability were inclined to either use lower-grade materials, or higher-cost materials available on the market. In Victoria, there were instances where house
owners had to remove the vegetation in their house surroundings to lower the bushfire attack levels in order to obtain available resources for reconstruction. In Aceh, however, cost inflation of the ‘indicator resources’ also had constituted a major part in influencing aid agencies’ housing reconstruction implementation for local beneficiaries.

The results in the three case studies underscored the various impacts of legal constraints on the manifestation of resource availability in the post-disaster market (McGee, 2008). The effect of ‘Green Aceh’ environmental movement advocated by the Aceh Government for timber conservation, however, bears a resemblance to that of regulatory adjustment by the Sichuan Provincial Government to reduce local aggregate exploitation. Both environmental-concerned administrative actions had reduced the accessibility by aid agencies in Aceh and of house owners in Sichuan to available materials for rebuilding houses. In contrast, the introduction of new Building Standards to increase building resilience to wildfires in Victoria had caused house owners in higher BALs being unable to access compliant products for housing reconstruction.

In the literature review Chapter Three, this study argued that the selection of building materials for house construction was partly contingent upon housing culture and tradition. The comparative analysis in the previous sections shows that social acceptance of alternatives to brick materials such as concrete blocks in both Aceh and Sichuan played an important role in housing reconstruction. The brick production crisis in Aceh and Sichuan highlighted the need for an expanded role of government with regard to encouraging innovation and application of alternatives. However, the local government, research institutes, and manufacturers actually played a limited role in this effort in Aceh and Sichuan. Any input into the construction market and production circulation needs to be grounded in an understanding of resource demand evolution in the reconstruction process (Jha et al., 2010). This was well exemplified in the case study of Victorian bushfires in which it was the government in post-bushfire market who initiated product designing, specifying and testing to help the industry to meet the needs and capacities of the targeted communities. The integration of stakeholders in resource innovation for housing construction between demand and supply is needed.

The case study findings also suggest that special attention in disaster recovery planning should be paid to the sourcing bottlenecks of the common ‘indicator resources’ for housing reconstruction; for example, bricks, cement, aggregate, labour, specialized builders and
tradespeople, as identified in this research and those with long lead time. As argued above, to address the issue of low resource availability, one promising solution is to strengthen the collaboration among the government, the industry, and the research institutes for developing resource and construction alternatives. Training builders to use new building materials and techniques is also required. Apart from good workmanship required, three case studies commonly pointed to the importance to nurture a healthy, conducive building environment where mutual trust, liability and understanding between house owners/implementing agencies and the construction professionals are achieved. A substantial time investment and legislative assistance in pre-event planning and preparedness by considering these issues can pay off in the long run.

The three case studies also show that there was a competition for common resources between house owners, between aid agencies, and between housing reconstruction projects and infrastructural restoration projects, and also resource flows between disaster-affected areas and wider construction markets in non-affected regions. Therefore, the possible resourcing solutions have to be backed by a reasonably-phased reconstruction schedule at both strategic national and local levels. For instance, the slower start of urban housing rebuilding than in the rural areas in China is likely to offer some thoughts into arranging reconstruction phases and priorities for permanent homes. Interests and needs of construction professionals in practice should also be considered when planning for post-disaster recovery.

The comparative analysis reveals that resource availability varies widely during the post-disaster rebuilding period. However, resourcing issues, like many other challenges after a disaster, can be anticipated and measures can be taken to reduce resource vulnerability. Research findings in the three case studies suggest that merely increasing the investment in building material production without extensive resource mapping is unlikely to solve resource shortages after a disaster; rather, it might bring about adverse impacts on the local economy. A detailed understanding of the trends in resource requirement based on empirical or nationally statistical data, as well as of the underlying factors that drive changes in resource demand over time is needed.

Moreover, the case studies indicate that competence of construction professionals, and government response and intervention in resource management, had commonly played a large role in dictating resource availability for housing reconstruction following large events.
Therefore, systematic awareness of constraints and opportunities with respect to resource availability following a major disaster will play a valuable role in shaping feasible plans for increasing the coping ability of resourcing stakeholders in future. The succeeding section aims to provide insights by comparing and discussing questionnaire and interview results with respect to critical factors affecting resource availability for housing reconstruction.

8.5 Critical factors that affected resource availability for housing recovery

The interrelated factors affecting resource availability in three examined cases are presented in Figure 8.2 below. Those factors that were identified as very important by the respondents are discussed in this section. In Figure 8.2, legislation and policy as a leading factor in China and Australia, together with government support and assistance recognized as being significant in Indonesia and Australia fall into one factor: government response and intervention.

![Figure 8.2 Factors that affected resource availability for housing reconstruction](image)

Figure 8.2 demonstrates that the factors that affected resource availability in disaster recovery projects vary. In general, apart from NGOs competence of resource procurement, community-related housing features in Aceh, including housing type, housing culture and customs, and community influence and participation, played a predominant role in resource procurement. Factors relating to project control and management including project schedule, project resourcing...
plan, competence of construction professionals and resource procurement lead time, were more
dominant for resourcing management in China, whereas, market-related factors including
material price fluctuation, material production capacity, competition for resources from existing
construction projects, and competition for resources among rebuilding projects largely affected
resource availability in bushfire recovery in Australia. The generic factors identified include
competence of contractor/builder, and government response and intervention. Moreover,
Indonesia and China share similarity in two factors, namely resource procurement lead time and
transportation; whereas the cases of Indonesia and Australia overlap in two factors: competition
for resources among recovery projects and production capacity.

By using the content analysis technique, the parallels and disparities in these resource availability
determinants between the studied countries are discussed around five aspects: (1) government
response and intervention; (2) the construction market; (3) transportation system; (4)
construction professionals; and (5) specific local conditions. Figure 8.2 shows how each factor
falls into the five categories.

8.5.1 Government response and intervention

Government response and intervention is critical to recovery with respect to resource availability
and management. In Indonesia, local government assistance and support was important for
reconstruction resource availability, whereas legislation and policy played a significant role in
determining recovery resourcing success in China. Likewise, compliance with building code,
legislation and policy, as well as government support and assistance were regarded as the first
three most important factors in affecting post-bushfire resource availability for recovery projects
in Australia.

Field observations and interviews explain that China’s post-quake mandates and policies were
primarily constituted by the deployment of available resources for recovery priority at a macro-
level and ‘hard’ market interventions for containing inflation at a micro-level. These mandatory
measures, according to Wang and Dong (2009), had a great impact on resource supply and flow
in the earthquake-stricken areas. The ‘hard’ interventions focused on the supply side to contain
directly material prices, placing a major disincentive to other suppliers to engage actively in
earthquake recovery resource supply. Therefore, the trade-off between levels of directive control
and market self-regulation posed a challenge to Chinese policymakers to satisfy the different and conflicting interests of stakeholders in the disaster-affected region.

A similar high degree of mandating, to expedite bushfire recovery-related activities and decisions, was also observed in Australia. New building standards were introduced immediately after the bushfires for rebuilding fire-resistant houses. In response to the amendments to the building standards, as our interviews revealed, the practitioners in the construction sector including consultants, suppliers and specialist builders were subjected to a different set of problems and challenges. For instance, the new standards require the houses in the most extreme flame zone to use upgraded external cladding materials. Prolonged lead time to manufacture, test, certify and release these new materials into market had a significant corresponding flow-on effect of delays in housing reconstruction.

In contrast, however, this seems to be not the case in Indonesia. The reason, according to our interviews, can be traced back to the lack of consistency of mandates, operations and leadership from the Indonesian authorities during tsunami recovery. Without adequate government response and intervention, the donor society and aid agencies played a lead role in resourcing for their rebuilding housing projects (Pandya, 2006). The importance of NGO’s competence for resource procurement thus came to the fore as shown in the survey. These results and field observations reinforce the argument in studies of (Masurier et al., 2008; Rotimi et al., 2009) that regardless of country context, the regulatory framework of the recovery process is a cornerstone to successful post-disaster project procurement. The impact of mandates on the various aspects of reconstruction in a post-disaster situation should be well considered by concerned decision makers and recovery managers at a national level before commencement of recovery. Other institutional changes should be promoted within the government to prepare themselves in response to disasters and recovery. These facilitative initiatives could include revising legislative and regulatory systems, optimizing market coping mechanisms, and partnerships with recovery participants.

8.5.2 The 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 key determinants in recovery resourcing in Aceh. A significant correlation between market-related
factors and project resource availability was also found in questionnaire responses in Australia. By comparison, market conditions were less problematic due to China’s government-led recovery operations. One prominent issue emerged after the Wenchuan earthquake was the 2008 global financial crisis which came during the earthquake recovery phase and impacted on the supply of non-localized materials such as cement and steel to the disaster areas. According to the China Iron and Steel Association (2009), in the second half of 2008, steel manufacturers in China were cutting production due to declining demand for steel and falling prices nationwide. Nonetheless, most of these manufacturers were reluctant to supply their steel stocks at a lower price to the population for earthquake recovery and reconstruction. This made steel supply a problem in the earthquake-affected areas.

In a more developed country like Australia, however, it is the construction market that generally directs the balance between resource demand and supply (Comerio, 1998; Zhang, 2006). The market in Australia generated competition between reconstruction projects in the bushfire-affected areas and other construction work outside the recovery region. Our interviews show that resource availability for bushfire rebuilding houses seemed to be determined by relativity of risk and profit margin between reconstruction in bushfire areas and construction in the fast growing fringe suburbs of Melbourne. Contractors/builders preferred more profitable alteration and extension projects in the established areas. This added difficulty to the bushfire-affected house owners in finding qualified builders. The inconvenience of travelling to, and being accommodated in, the affected areas, and lack of government incentives to do so, were also contributory factors to the shortfall of building services for bushfire recovery.

In comparison with the Australian case, competition among the recovery aid agencies had a great impact on resource shortage in the Indonesian construction market. This result relates to the importance of coordination among the implementing agencies involved in Aceh’s post-tsunami reconstruction and the need to seek a collaborative procurement strategy for post-disaster resourcing. The reality, according to our interviews, was that with available funding at the initial stage of reconstruction, the potential threat of resource shortages for long term rebuilding was largely overlooked by the involved NGOs. As also observed by the researchers, the quantity and schedule pressure of housing programs from off-site donors intensified the resource competition among those recovery projects. Barenstein (2006b) and Bailey and Pavanello (2009) suggested
that more fundamental resource mapping and assessment across the market in a disaster country be encouraged and undertaken during the ‘early recovery’ stage. This input should be integrated into broader national or regional recovery plans for medium and longer-term reconstruction. To reduce the likelihood of competition for resources in Indonesia, a collaborative approach should be advocated with recovery aid agencies and incorporated into their organization culture, together with effective dialogs between them. In Australia, incentives from government agencies or industry associations are needed to increase participation of construction professionals in post-disaster recovery and reconstruction.

8.5.3 Transportation system

Transportation for post-disaster resourcing was identified in Indonesia and China as being significant factors. In the Australian case, however, transportation capacity was not seen as important in relation to resource availability for bushfire recovery. A possible explanation, according to the interviews, could be the relative robustness of transport networks in Australia. Critical roading systems only suffered minor damage in the bushfires without causing major transport disruption during the recovery.

The resource transportation bottleneck encountered by NGOs in Banda Aceh, as observed by the researchers, rested with its poor infrastructure before the tsunami and lack of key requirements for infrastructure such as roading connected to the housing system after the event. NGOs appeared to over-invest in post-tsunami housing reconstruction and overlook infrastructure development. As observed by the researchers, apart from a few infrastructure rehabilitation works conducted by the local government, the United States Agency for International Development (USAID) was the sole agency tasked with the reconstruction of the Banda Aceh to Meulaboh road linking Aceh Province with the rest of North Sumatra and Indonesia.

Moreover, the lead time of timber resource for housing reconstruction also had an impact on the performance of post-tsunami reconstruction projects in Indonesia. The ‘Green Aceh’ timber administration rules issued by the Indonesian government (2007) reduced the possibility for donors to procure timber locally in Indonesia. According to our interviews, importing legal timber from donor countries such as Australia, Canada and New Zealand with lead times of three to four months had consequences such as construction suspension and idle resources.
In contrast, the transportation problems in China were related to a large number of secondary hazards such as landslides, landslips, mud-rock flow and ‘quake lakes’ after the Wenchuan earthquake. Due to the lack of access, delivery of required resources to earthquake recovery projects was, to a large extent, delayed. The unavoidable costs related to logistics because of lack of consistency in delivery and price fluctuations of fuel, accounted for a large fraction of resource sourcing expenses. As observed by the researchers in Mianzhu City, all kinds of transport including human and pack-animal carrying methods were applied for delivering building materials to construction sites in the remote mountainous areas where road access was severely disrupted by the earthquake. This research finding warrants attention from the national recovery planners. Rapid restoration and recovery of critical infrastructure systems is a priority. A more integrated reconstruction approach with priority given to the overall development of the built environment is required. To increase the resilience of transport systems, vulnerabilities in transport networks and their potential impact on local communities and on post-disaster recovery should be identified through pre-event scenarios and accordingly considered in urban development plans.

8.5.4 Construction professionals

In spite of the varied resourcing approaches in Indonesia, China and Australia, competence of contractors was generally regarded in three cases as being significant in deciding on project resource availability. One observation in Indonesia was that, during the tsunami recovery period, nearly 95% of contractors, materials and expertise were imported, mainly from Java. Interviews in Aceh revealed that decades of civil conflict\(^\text{30}\) largely contributed to the poor competence and capacity of local construction sector. The low level of construction capacity in Indonesia, combined with such issues within the recovery aid agencies as lack of procurement expertise and lack of adequate construction planning made recovery resourcing especially difficult in tsunami housing programs (Pheng et al., 2006; Lakshmi and Bau, 2007). In comparison, the Chinese participants gave similar significance to the credentials of construction contractors with respect to project resource availability. In China, building professionals were inclined to rely on public policies for resource deployment. Moreover, in a fragmented and competitive sector environment,

\(^{30}\text{Known as ‘Free Aceh Movement’}\)
there were few strategic alliances spanning the industry or in co-operation with other stakeholders.

In Australia, however, the primary industry issue linked to resource availability in bushfire recovery projects was the cooperation of parties in construction. A number of disputes regarding material selection and procurement was recorded by the researchers due to contractual problems between the house owners and builders. The competence of contractors/builders for bushfire recovery and rebuilding was found to be mainly contingent upon their ability to deal with traumatized bushfire victims. The interviews show that, in the wake of the bushfires, the affected population was traumatised and unable to take on home rebuilding tasks or to address construction issues during recovery. This situation was compounded by lack of understanding from construction professionals the population’s needs, leading to further impediments to reconstruction progress. Participating builders with country businesses had a stronger association with communities. The sense of community and close ties with the country people provided assurance for these builders to take more sensitive approaches in engaging in housing reconstruction.

Apart from the concern about construction capability for recovery projects, the interviews also showed that the construction industry in the three countries was highly marginalized from the course of disaster management. The lack of industry engagement in disaster events is also found in many other countries, such as UK (Bosher et al., 2007; Haigh et al., 2007) and Singapore (Dulaimi et al., 2001; Ofori, 2002). There should be effective integration of the construction industry into disaster risk management, preparedness and planning. Engagement and cooperation, understanding the local conditions, as well as adequate training for professionals with regard to housing rebuilding are important for post-disaster recovery and future resilience.

8.5.5 Specific local conditions

Figure 8.2 demonstrates that the factors associated with the local disaster-affected community played a dominant role in Indonesia and Australia, but this was not the case in China. Housing culture and community characteristics were perceived as being key factors contributing to resourcing outcomes in post-tsunami Indonesia. The housing culture of Aceh traditionally utilized organic building materials such as timber, thatched grasses and bamboo (O’Brien et al., 2008). Community influence and participation in early decisions, such as selecting construction
materials and techniques, had a major influence in the final resourcing practice in Indonesia. As recorded by the researchers, most beneficiaries in Banda Aceh expressed their preference for a ‘modern’ westernized house which symbolizes solidity and social status. The new housing types introduced by the international aid agencies matched this local aspiration. Local capacity for producing the industrialized materials, such as cement, steel, concrete and mass-produced products, however, was unable to meet the large-scale requirements for masonry and concrete construction. A variety of resourcing problems during post-tsunami reconstruction thus arose.

By contrast, in Australia, the house owner’s ability and resilience seemed to determine the pace of recovery. One of the main reasons for housing reconstruction delays in Australia concerned the house owners’ decision of whether to stay and rebuild, or leave. This is consistent with the findings by Comerio (1998) who recognized that housing repair and reconstruction in developed nations is fundamentally concerned with the ability of house owners to undertake the repairs/reconstruction. Evidence in this research suggested that the socio-psychological aspect of the affected populations was a significant factor that slowed the progress of housing recovery in Australia. When faced with great distress after bushfires, people habitually looked to economic recovery for the potential of revival and the prosperity of the communities. However, a ‘deadlock’ was observed in the affected areas between economic recovery and housing recovery. In Marysville for instance, without seeing household rebuilding and recovery, businesses delayed their recovery; conversely, without seeing recovery progress of business sectors, households hesitated about rebuilding their houses.

8.6 Summary

In accordance with the articulated resource availability analytical framework, this chapter provides a comparative discussion on research findings across three case studies. By comparing five elements, namely: post-disaster recovery and reconstruction environment, housing recovery approach, resourcing stakeholders, ‘indicator resources’ and their availability, as well as the critical factors affecting resource availability in housing recovery, this chapter sheds light on how some common process and initiatives produced varied results in different places, and why different processes produced similar outcomes. Such international comparisons in this chapter
involved a number of tasks such as identifying underlying patterns and explanations, specifying particular similarities and differences, and understanding the effect of the underlying institutional framework, for instance, the structure and role of relevant stakeholders in the provision of housing and building services.

Acknowledging the differences in resourcing approach between the three cases, this chapter has focused on comparing the identified resource availability determinants in order to gain insights into how they vary between different disaster environments. The research findings show that the variations in resourcing problems and outcomes exist in their differing socio-economic environment, culture, and overall political agenda in the three countries. Despite disparities, two factors, namely competence of construction professionals (contractors and builders), and government response and intervention, in terms of legislation and policy, and government support and assistance, were identified as common determinants to the resourcing of disaster recovery projects. Moreover, the cases of Indonesia and China share similarities in two factors of resource procurement lead time, and transportation; whereas the cases of Indonesia and Australia bear resemblance in two factors, competition for resources among recovery projects and production capacity.

Comparative discussions in this chapter help to better understand similar resourcing problems with respect to supply, demand, cost escalation and quality under different approaches in Aceh, Sichuan and Victoria. Drawing on the resourcing evidence of the three jurisdictions during their recovery from disaster, this chapter confirmed the analytical typology of post-disaster resource availability presented in the literature review. The substantive information with which the comparative analysis is provided allows for an in-depth understanding of how and why resourcing after a natural disaster remains consistently difficult for reconstruction decision makers and practitioners. While the focus is on the three disasters, it is informative to consider how the basic premise of each their approaches can be translated to the setting of a similar country.
Chapter 9 Conclusions and recommendations

9.0 Overview

The extensive literature review presented in the first two chapters of this thesis helped develop an analytical framework to understand resource availability in a post-disaster reconstruction environment. The research methodology chapter described how the selected theories, tools, and methods fulfill the research objectives presented in the introduction chapter. Three case study chapters have shown research findings in terms of the five elements in the resource availability analytical framework. In the previous chapter of this study, Chapter Eight, a comparative analysis was presented, also at the five elemental levels in the resource availability analytical framework, to understand similarities and differences in their resourcing practice post-disaster across cases. This final chapter presents the main findings of this research and its contributions to the existing knowledge base.

The chapter is divided into four sections. The first section provides a summary review of the major research findings. These findings are synthesized into recommendations to address the research questions in the second section. The third section of the chapter describes how these findings contribute to the scholarships of disaster management, post-disaster recovery, and construction management, and, in particular, to the housing reconstruction literature. The third section also evaluates the research outputs by showing how research findings in this thesis addressed the research gaps identified in the literature review chapter. A discussion of the limitations of the study and suggestions for future research directions is presented. The fourth section summarizes the practical implications of this research, followed by a brief postscript.

9.1 Resourcing for post-disaster housing reconstruction: A Synthesis

This dissertation has compared the five elements in the resource availability analytical framework in Aceh of Indonesia, Sichuan of China, and Victoria of Australia with the goal of understanding the resourcing issues found, as well as similarities and differences across jurisdictions. The research finds that there are similar resourcing problems that exist in different
post-disaster recovery environments. There are also different and common factors in varied post-disaster environments, which impacted on resource availability for housing recovery projects. This section revisits these key issues and factors.

9.1.1 Recovery governance and Institutional arrangements for housing recovery

Research findings presented in the case studies and the comparative discussion show that the institutional differences such as disparate degrees of governance structure, legislative systems, levels of economic development, and social patterns in the three cases account for their overall difference in recovery and reconstruction outcome. The recovery of Banda Aceh, as described in the case study Chapter Five, is comparable to the capital infusion model of recovery governance. It mixes the provision of housing recovery by local and outside contractors with NGO-managed building programs. The case study of the 2004 Indian Ocean tsunami illustrates an institutional environment marked by inconsistent process of policy and decision making, and vulnerability of administrative regimes. For these reasons, the preferences and interests of the outside NGOs played a role in dominating post-disaster housing recovery.

In contrast, the institutional response to the Wenchuan earthquake in China was shaped by new legislation and policy innovations. The Central Government, however, as usual, held decision and policy making positions and played the role of institutional leader. Although the post-quake recovery has seen increasing participation of communities, social groups, and international organizations, in general, it still follows the paternalistic model of recovery governance. In China centralized institutional arrangements played a large part in mobilizing resources and capacity to increase public assistance to the earthquake affected areas. Conversely, actions by recovery agencies in Victoria in response to bushfire recovery and reconstruction were in line with its institutional routines, particularly community-centred ‘PPRR’ emergency management model in Australia. The community interests were, therefore, more likely to be represented through these institutionalized channels. The governance structure adopted in Victoria for recovery and reconstruction can be seen as a market-led approach with the private sector and markets playing a dominant role in bushfire rebuilding efforts.

The case study of the 2004 Indian Ocean tsunami focused on donor-driven, contractor-build housing projects, whereas the case study of the 2008 Wenchuan earthquake looked at contractor-build housing recovery under a government-dominant environment; and the case study of the
2009 Victorian bushfires looked at contractor-build housing recovery under a market-dominant environment. The housing reconstruction players in the three cases fall into similar categories, however, they assumed varying degrees of responsibility. Housing recovery in both Sichuan and Victoria can be seen as a process where communities or individual households rebuilt, repaired, and replaced their damaged or destroyed houses by using a varied combination of technical, financial, and materials assistance from government or other social groups. In contrast, aid agencies, particularly international NGOs became the primary player in housing reconstruction in Aceh with little input from community participation and public assistance.

Generally, the case study of the 2004 Indian Ocean tsunami shows that although the involvement of international aid agencies had brought considerable funding resources to Aceh, such an approach also exacerbated developmental problems due to lack of technical assistance and lack of coordination mechanism from the local government. The way the Chinese government organized housing reconstruction after the 2008 Wenchuan earthquake was similar to the usual government-led response to natural disasters. However, the openness after the earthquake, and advocacy of a self-help reconstruction approach manifested in both the post-earthquake Legislations and the Master Plan to enable greater empowerment of affected communities to implement housing recovery at the local level. Under the government-led regulatory and administrative framework, aid agencies played a facilitative role complimenting the technical and material assistance in the post-earthquake reconstruction. The case study of the 2009 Victorian bushfires shows that the government facilitative features for owner-driven reconstruction in Victoria were prominent, and directly related to the provision of technical assistance. However, socio-economic vulnerabilities of the disaster-affected populations played a significant part in determining the success of housing recovery.

The Chinese authority’s way of resourcing for the Wenchuan earthquake housing reconstruction was characterized by its ‘hard’ interventions into the production and circulation of building materials, with a view to containing price inflation and profiteering, as well as assisting the reconstruction of the worst affected areas. These administrative interventions were effective in meeting their rebuilding objectives, although it exacerbated resource shortages and gave rise to a longer-term impact on the local economy. The remedial NGO-procured alternatives presented in the case of the 2004 Indian Ocean tsunami was preferable in Indonesia where natural resources
were lacking and the local institutions were unable to play a lead role in post-disaster reconstruction. In addition, the local market and infrastructure settings in Indonesia were lacking in the ability to assist poorly-managed international aid agencies in coping with large-scale logistical requirements for recovery. However, the case of the 2009 Victorian bushfires in Australia shows that changes in the Building Standards following the bushfires as part of disaster mitigation measures had caused unexpected impacts on resource availability for housing recovery, particularly in the worst affected areas.

9.1.2 Revisiting resource availability for housing recovery

Cross comparison of the availability of ‘indicator resources’ that impacted post-disaster housing recovery projects highlighted several short-term as well as longer-term issues that need to be addressed by relevant stakeholders. Some aspects of the resourcing experiences in Aceh, Sichuan and Victoria show lessons of general relevance. In the three case studies, commonly, lack of, or absence of essential ‘indicator resources’ for rebuilding houses post-disaster had impinged upon the recovery project performance in terms of construction cost, quality, and schedule. Furthermore, these impacts also reinforced economic, social and environmental vulnerabilities of the local affected populations.

The analysis shows that although the factors that affected resource availability in a post-disaster circumstance varied across the three studied jurisdictions, the problems and challenges facing post-disaster reconstruction decision makers and practitioners were fundamentally consistent. The essential difference in terms of resource availability topology depends mainly on legal arrangements for recovery, and post-disaster housing reconstruction approach. A comparative analysis shows that specific factors such as cultural elements, socio-economic environment and political agenda influenced the manifestation of the resourcing problems and solutions in the three cases. Despite different resourcing approaches, competence of construction professionals, and government response and intervention were identified as common determinants to resourcing disaster recovery projects.

Other critical factors that affected resource availability in disaster recovery projects vary from case to case. In general, apart from NGOs competence of resource procurement, it was community-related housing features in Aceh, Indonesia, including housing type, housing culture and local customs, and community influence and participation, which played a predominant role
in resource procurement. Factors relating to project control and management including project schedule, project resourcing plan, competence of construction professionals and resource procurement lead time, were more dominant for resourcing management in China, whereas, market-related factors including material price fluctuation, material production capacity, competition for resources from existing construction projects, and competition for resources among rebuilding projects largely affected resource availability in bushfire recovery in Australia. The cases of Indonesia and China share similarity in two factors namely resource procurement lead time and transportation; whereas the cases of Indonesia and Australia are similar in competition for resources among recovery projects and production capacity.

9.1.3 Evaluation of research findings

The findings of the research cover three main parts. The first part establishes principles and recommendations for improved reconstruction resourcing in the disaster-impacted areas studied. In this sense, it translates the insights gained into practical solutions. It proposes a way of learning from the initiatives and policies across cases and aligning these lessons with the available resources and capacities in each case to solve existing problems and improve conditions. The second part confirms that the resource availability analytical framework suggested in this research can be used more generically. This framework has a generalized basis upon which the resourcing issues inherent in a complex post-disaster recovery and reconstruction process can be identified, evaluated and addressed. Finally, by presenting what is likely to happen to resource price, supply and demand in a post-disaster reconstruction situation, this research formulates theoretical perspectives to inform the planning and preparedness of construction professionals, decision makers and communities in resourcing reconstruction after a disaster, as well as a multi-stakeholder integrated planning at a national level.

The main objective of this PhD research is to understand resource availability for housing recovery projects in a post-disaster situation, with a view to assisting disaster related stakeholders in resourcing for housing reconstruction. In accordance with the five elements identified in the resource availability analytical framework, this main objective is divided into a set of sub-objectives. In order to fulfil each objective, a variety of research methods including literature review, case studies, questionnaire survey, field-based observations and interviews, research workshops, conferences and seminars, along with field trips were applied in this
research. Table 9.1 below illustrates how each part of the current thesis addressed the relevant research questions and fulfilled research objectives.

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Research objectives</th>
<th>Relevant thesis sections</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q1. What is recovery and reconstruction environment like after a major disaster?</strong></td>
<td>(a) To identify post-disaster institutional arrangements, policies, programs, and practices for disaster recovery and reconstruction</td>
<td>s5.1, s6.1, s7.1.</td>
</tr>
<tr>
<td></td>
<td>(b) To identify specific contextual elements that affect the way the housing recovery is organized and managed</td>
<td>s5.1.1, s6.1.1, s7.1.1.</td>
</tr>
<tr>
<td><strong>Q2. What approach is adopted for post-disaster housing recovery?</strong></td>
<td>(a) To recognize the predominant issues for housing recovery after a disaster</td>
<td>s5.2.1 &amp; s5.2.3; s6.2.1 &amp; s6.2.3; s7.2.1 &amp; s7.2.2.</td>
</tr>
<tr>
<td></td>
<td>(b) To identify housing recovery approach and methods applied to rebuilding houses for communities</td>
<td>s5.2.2, s6.2.2, s7.2.3.</td>
</tr>
<tr>
<td><strong>Q3. Who are the principal stakeholders involved in resourcing for disaster housing projects?</strong></td>
<td>(a) To undertake stakeholder analysis with respect to principal stakeholders involved in resourcing practice in post-disaster recovery operations and their relationships</td>
<td>s5.3, s6.3, s7.3.</td>
</tr>
<tr>
<td><strong>Q4. What are ‘indicator resources’ in the wake of a disaster that hinder housing reconstruction?</strong></td>
<td>(a) To identify ‘indicator resources’ for housing recovery projects</td>
<td>s5.4, s6.4, s7.4</td>
</tr>
<tr>
<td></td>
<td>(b) To assess the availability of these identified ‘indicator resources’</td>
<td></td>
</tr>
<tr>
<td><strong>Q5. What are the critical factors that affect resource availability for housing recovery?</strong></td>
<td>(a) To identify critical factors that affect resource availability for post-disaster housing reconstruction</td>
<td>s5.5, s6.5, s7.5</td>
</tr>
<tr>
<td></td>
<td>(b) To identify the relationships between these resource availability determinants</td>
<td></td>
</tr>
<tr>
<td><strong>Q6. How does the resource availability for disaster housing recovery vary across different recovery environments?</strong></td>
<td>(a) To compare the resource availability elements across different recovery environments</td>
<td>s8.5</td>
</tr>
<tr>
<td></td>
<td>(b) To identify the commonalities and disparities with respect to resourcing for disaster recovery projects across different recovery environments</td>
<td>Chapter 8</td>
</tr>
</tbody>
</table>
9.2 Research recommendations

Individual case study chapters suggested specific recommendations for those involved agencies and stakeholders so that they could be incorporated into the current resourcing approaches for a potential reduction in their vulnerabilities. A comparative analysis of three case studies provides a multi-perspective view of the resourcing issues in a post-disaster situation. As many recovery problems faced in disaster-impacted areas that relate to housing, resource availability intrinsically links to long standing chronic conditions of vulnerability in existence prior to the disaster. Most significantly, the fundamental resourcing challenges that faced the disaster-impacted countries are not unique but universal.

The Chinese resourcing initiative was part of a national action agenda to deploy and mobilize resources nationwide for the Wenchuan earthquake recovery and reconstruction. The interventions from the Chinese authorities into the earthquake rebuilding operations paradoxically helped to mask the pre-existing macroeconomic imbalances in the construction market for a time. However, inflation chaos and resourcing problems still persisted, hindering the housing reconstruction process and adversely affecting the rehabilitation and development of local economy. The inadequate resourcing capability of the NGOs involved in post-tsunami housing reconstruction, along with complexities inherent in Indonesia, caused significant resourcing frustrations. The key reason why the affected communities in Australia struggled to recover was due to the variation in appropriateness of public mandates to match community needs and market capacities. Without facilitation and support from other stakeholders such as the government and the local construction sector, a better outcome is unlikely to be attained under a market-driven resourcing method.

By drawing on research findings generated from such a comparison, this section therefore proposes an integrated planning framework, as shown in Figure 9.1, incorporating generic problems identified across three cases, and thus makes recommendations. The framework will have the potential to guide recovery decision makers and practitioners to understand, visualize, coordinate and effectively manage post-disaster housing resourcing issues.
9.2.1 Legislation and policy revamping

The three varied disaster events of the 2004 Indian Ocean tsunami, the 2008 Wenchuan earthquake, and the 2009 Victorian bushfires are good illustrations of legislation and policy being introduced post-disaster. The impact of post-disaster legislation and policy on the community/agency’s ability to procure resources needs to be considered in the pre-planning and preparation stages of a disaster cycle. Efforts should be made to develop a specific legislative portfolio compatible with resourcing needs. To reduce the likely impact of competition for commonly used resources, there is a need for a major prioritization of resource planning for both housing recovery and infrastructural restoration. Local government may have to formulate strategic legal plans for phasing housing rebuilding and infrastructural reconstruction. There is also a need for the decision makers involved at higher levels to give due consideration to real rebuilding needs and local capacity of material production in disaster-hit areas in order to align resources more closely to markets and to the requirements of the people affected.

Central Government should take steps to reinforce local government commitment to planning and implementation. For instance, it would be appropriate to promote specific provisions for housing insurance as a preliminary step towards an environment that encourages a culture of insurance in China and Indonesia. Devising a multi-hazards insurance program for low-income
social groups in Australia is also needed. Furthermore, when looking at Indonesia and China, there is a need for these countries to develop a law for logging and reforestation to make local wood resources accessible for people affected without detriment to the natural environment; and by changing buildings codes to promote upgraded materials for post-disaster reconstruction projects.

It is also clear that an effective enforceable mechanism of legislation and policy pertaining to post-disaster recovery and reconstruction is needed especially for less mandated countries like Indonesia and China. This could be achieved through the establishment of a special institution/agency fully empowered by the Central or State Government. Such establishment of capable institutions has universal appeal for improving disaster recovery outcomes.

9.2.2 Construction industry capability enhancement

The construction industry capacity to cope with a major disaster is critical to disaster recovery success. When planning for post-disaster recovery, the construction industry can play its part in enhancing capability for physical reconstruction, especially in skill and technique upgrading, thus incorporating risk reduction and disaster prevention elements into construction work. To enhance this ability, practitioners need to adapt to the changing post-disaster environment by relying on knowledge and skills acquired through experience training provided by the industry. Such training should address information collecting, communication, purchasing strategy, negotiation skills, etc., and has considerable relevance not only for developing future managers, but more importantly, for the kind of management and procurement that construction organizations can adopt. There is also a need within the construction industry to design innovative programs to heighten the awareness of these industry players to proactively engage in disaster management and prevention.

A well-conceived resourcing plan for a possible rebuilding project in a disaster stricken environment conveys the meaning that the contracting organization is aware and prepared for the resourcing issues arising in a recovery process. Furthermore, by involving and consulting with suppliers and sub-contractors in all phases of resource planning, construction contractors can develop a resource database system, which is the core of a pre-disaster resource plan that helps to create a systematic procurement strategy with the continuous input of timely and accurate information.
An inventory of procurement methods and partnerships is also crucial for providing a basis for designing appropriate resourcing strategies based on variations in organizational capacity and experience with planning. Volume building might be a preferable option for resourcing for home rebuilding across an affected community. Furthermore, the systematic mapping of the needs and capacities of the construction professionals and provision of training and education to deal with disaster-affected households could help the formulation of construction relationships during post-disaster reconstruction.

9.2.3 Market re-measurement and re-structuring

Effective post-disaster reconstruction relies on efficient market planning to ensure resource supply. In most cases of post-disaster reconstruction, resource attainability was supplemented either by the construction of a large number of new production facilities or by the reallocation of resources from existing uses to reconstruction projects. However, the case of the 2009 Victorian bushfires shows that partnerships between businesses and local authorities may offer a significant opportunity for better market and economic planning and improving the market function and mechanisms. Thus, improvements to post-disaster markets ability to resource the recovery environment include:

1) Strengthening the market flexibility to explore resourcing channels nationwide;
2) Adoption of cost-effective technology in the development and production of construction products and materials; and
3) Assessment of the local productivity and construction industry capability.

There is a need for construction authorities, in conjunction with the related sectors, to design a variety of motivation, education, training and assistance programs in the market to initiate construction innovations for coping with potential future disasters. This could be addressed by:

1) large-scale construction companies providing procurement expertise to assist small and medium-size corporations with the details of resourcing procedures, strengthening supply chain relationships; assessing quantities of resources required and offering strategic procurement skills to reduce lead time and cost;
2) local government construction departments playing an important role in facilitating technical assistance by providing financial or in-kind support for research and development (R&D), and to launch a series of training initiatives;

3) local authorities, in conjunction with the related recovery governmental departments and the construction industry, providing incentives and logistical assistance for prospective building professionals and tradesmen to increase their involvement in post-disaster reconstruction; and

4) local authorities, being put in charge of the construction market for local communities, launching regular training and recruitment activities in pre-event situations. This would be done in order to attract and absorb more skilled human resources, to encourage local communities to be prepared and equipped for a future disaster and the subsequent reconstruction and thus also provide a ‘personnel reserve buffer’.

9.2.4 Transportation planning for capacity development

Given the importance of transportation in the post-disaster resourcing process, particularly in the case of the 2004 Indian Ocean tsunami and the 2008 Wenchuan earthquake, the strategies for transport capacity development should:

1) be integrated into the pre-disaster mitigation programs and local redevelopment planning;
2) be targeted at transport alternatives to enhance the resistance and resilience of the transportation system in disaster-prone areas; and
3) be in line with industrialization and urbanization in disaster-impacted areas taking account of natural environmental conditions and capacity.

In accordance with specific characteristics of topography and geology in disaster prone areas, to reduce vulnerability to future hazards, more disaster risk reduction approaches should be integrated into post-disaster lifeline reconstruction. A robust transportation network, if developed along with communication facilities, will make the management and coordination of relief and reconstruction resources more streamlined and will furthermore allow for improvement of post-disaster reconstruction performance.
9.2.5 Consideration of local conditions into overall planning

An understanding of the links between disasters and the natural environment, as well as of the relationship between resourcing for disaster recovery and local conditions, should be promoted and fused into the overall planning system to avoid, minimize, and resolve potential environmental and socio-economic issues. The emphasis of government, however, should be on understanding local conditions to ensure targeted reconstruction assistance. This entails local socio-economic considerations be linked to wider public policies. Furthermore, environment conservation, as a ‘code of conduct’, should be incorporated into the resource utilization, production and waste disposal activities of players in the construction industry and market. Consideration of the cultural and social status of an area should also be incorporated as a top priority in disaster recovery. Particular attention should be given to three issues:

1) an interactive cycle between physical housing reconstruction and economic recovery and especially the post-disaster recovery of small businesses
2) the impact of local government land use and development management programs on rebuilding and on local involvement in the protection of the natural environment
3) community development programs with a focus on agency leadership and the facilitation of local decision making

9.2.6 A synthesis vision for integrated resource planning

In spite of variations in the recovery contexts of the three jurisdictions and the resourcing approaches adopted for post-disaster housing reconstruction, the planning framework shown in Figure 9.1 provides a common vision which synthesizes areas where stakeholders could improve resource availability for housing rebuilding projects. As concluded in the literature review chapter, and presented in the case studies, three dimensions — attainability, usability, accessibility cannot be disentangled from one another, but are interconnected for resource availability. Planning for resource availability in a disaster situation does not mean simply finding more sources of resources for housing reconstruction; it involves finding strategies to limit the cost of resource provision and enhance the quality of resources, whilst increasing accessibility to available resources for meeting a variety of local conditions. It is from this perspective that this planning model offers a view for reconstruction decision makers to facilitate reconstruction work and to reinforce policy capability. The research also sets the basic steps for
ameliorating resourcing operations and enhancing the resourcing performance of the construction industry.

The need for an integrated planning framework with performance targets for resource availability in housing reconstruction is identified. The framework encompasses effective planning for resource availability in post-disaster reconstruction. Table 9.2 below presents a summary of suggested planning working areas in which stakeholders can achieve a superior resourcing performance. Understanding and communication between stakeholders can make it possible to develop a collaborative planning process. To achieve this, high quality, systematic data collection, information systems and communication and coordination mechanisms should be introduced. Regular communication between the identified agencies — for example, by means of meetings, workshops and seminars organized by the government, could provide a collaborative platform. Governments need to take a lead role in coordination and facilitation to fully support inclusive planning processes both before and after the occurrence of a disaster.

Albeit that each country has the primary responsibility for its own post-disaster reconstruction and recovery, an enabling international environment is vital to stimulate and contribute towards the development of the knowledge, capabilities and motivation needed to build disaster resilient nations and communities; developing specific mechanisms to engage the active introduction of outside human and material resources into a disaster-impacted country through both bilateral and multilateral channels.

It is clear that the encouragement of dialogue between a wide range of stakeholders at different levels, the establishment of mutual assistance mechanisms and the need to focus on community needs should be at the top of the reconstruction strategy agendas, and would have been beneficial in the three countries studies. The discussion of resourcing, reflected in this research, following the 2004 Indian Ocean tsunami, the 2008 Wenchuan earthquake and the 2009 Victorian bushfires — created political and social openings in which longer-term housing development issues could be addressed by the integration of various well prepared and equipped stakeholders.
<table>
<thead>
<tr>
<th>Planning</th>
<th>Objective</th>
<th>Specified working areas</th>
</tr>
</thead>
</table>
| Legislation and policy | To review and revamp the existing legislation and policy, thereby linking the legal framework and agendas with the long term post-disaster reconstruction | • incorporating housing reconstruction into a sustainable recovery process  
• assessment of reconstruction needs and local industry capacity  
• development of specific mechanisms at both national and local level to maximize resource utilization  
• adaptation of market regulations based on climatic context-specific features  
• supporting local studies on alternatives to housing resources and structures  
• Upgrading the policy portfolio to cater for different aspects of resourcing in post-disaster situations such as innovative insurance scheme, consistent education and training programs for involved stakeholders, enforcement of environmental protection into resourcing operations  
• Establishment of a single-lead agency for regulation enforcement with sufficient authority empowerment |
| Construction industry | To integrate the construction industry into disaster management and post-disaster resourcing process | • Awareness enhancement of the construction practitioners to engage in disaster risk reduction in physical reconstruction  
• Establishment of horizontal and vertical partnership with resource suppliers and relevant research institutions  
• Improving procurement skills through training and learning programs  
• Formulation of resource management and preparedness plans within the organization  
• Updating resource database by constant consultations in the construction market  
• Development of cooperative resourcing strategies in the industry |
| Construction market | To map and re-structure the local construction market for a robust resource supply | • Establishment of partnerships between businesses and local authorities  
• Linking market capacity with local reconstruction planning  
• Providing sufficient education and assistance programs for resourcing stakeholders  
• Inclusion of scientific communities into the community-based development and application of resource alternatives  
• Improving international, national and local resource allocation through market-driven mechanism |
| --- | --- | --- |
| Transportation | To enhance the resource accessibility through transportation network development | • Reducing the vulnerabilities of transportation system with disaster mitigation measures in terms of local topology and seismicity  
• Promotion of environmental elements within transportation planning sector  
• Integrating transportation development programs into local social and economic planning  
• Building transportation network in line with other infrastructure facilities |
| Local conditions | To set up an contextual mapping mechanism in disaster-affected areas by integrating community recovery elements – socio-economic, cultural and environmental, into the overall planning | • Empowerment of decision making as a priority in the community development agenda  
• Establishing a legal ground for solving socio-economic vulnerabilities in post-disaster recovery and reconstruction process  
• Incorporating environmental factors into stakeholders’ regular business plan and implementation  
• Innovation of sustainable and disaster-resistant construction materials and techniques |
9.3 Contribution to knowledge base

Based on the findings of this study, this part of the chapter discusses the main contributions of this research to the disaster management, post-disaster housing reconstruction, and resource management for construction projects scholarships. Research limitations and future directions will be outlined.

9.3.1 Research theoretical contributions

This research builds on the literature review with regard to disaster management, post-disaster recovery and reconstruction, housing reconstruction, and resource management for construction projects. The research findings are intimately linked with five elements presented in the resource availability analytical framework, which encompasses the above scholarships. Table 9.3 illustrates how the current research addressed the knowledge gaps identified in the literature review Chapter Three. The research theoretical contributions are summarized into four points which will be discussed in details below.

Table 9.3 Knowledge gaps fulfilled by relevant thesis sections

<table>
<thead>
<tr>
<th>Knowledge gap</th>
<th>Relevant thesis sections</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General knowledge gap</strong></td>
<td></td>
</tr>
<tr>
<td>Lack of understanding of the factors in the resourcing operations that</td>
<td>s5.5, s6.5, s7.5</td>
</tr>
<tr>
<td>creating bottlenecks to disaster recovery projects</td>
<td></td>
</tr>
<tr>
<td>Limited suggestion of the appropriate interventions and solutions to</td>
<td>s5.6, s6.6, s7.6, s9.1.2</td>
</tr>
<tr>
<td>address resourcing issues</td>
<td></td>
</tr>
<tr>
<td><strong>Project resource management</strong></td>
<td></td>
</tr>
<tr>
<td>Potential causes for resourcing bottlenecks to project construction has</td>
<td>s5.5, s6.5, s7.5</td>
</tr>
<tr>
<td>been historically neglected</td>
<td></td>
</tr>
<tr>
<td>Resource availability is singled out in project resource management framework</td>
<td>s3.1.2</td>
</tr>
<tr>
<td>Lack of a holistic view of resource procurement environment</td>
<td>s3.2</td>
</tr>
<tr>
<td>Lack of understanding the likely constraints hindering resource procurement</td>
<td>s3.3.3, s5.5, s6.5, s7.5, s8.5</td>
</tr>
<tr>
<td>Lack of understanding the likely opportunities for project managers to</td>
<td>s3.3.3, s5.5, s6.5, s7.5, s8.5</td>
</tr>
<tr>
<td>enhance their resource procurement capability</td>
<td></td>
</tr>
</tbody>
</table>
Resourcing construction projects and resourcing post-disaster reconstruction

<table>
<thead>
<tr>
<th>Lack of analysis of project resource procurement from a wider disaster recovery stakeholders perspective</th>
<th>s5.3, s6.3, s7.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of resourcing stakeholder analysis for disaster recovery projects</td>
<td>s5.3, s6.3, s7.3, s8.3</td>
</tr>
</tbody>
</table>

Resource availability for post-disaster recovery projects

| Limited knowledge on ‘indicator resources’ that are likely to subject to shortages during construction and thus have an impact on the delivery of a house construction project | s5.4, s6.4, s7.4, s8.4 |
| Limited understanding on resource availability in a post-disaster context | s5.4, s6.4, s7.4, s8.4 |
| Limited understanding on critical factors that impinge upon resource availability in disaster recovery projects | s5.5, s6.5, s7.5, s8.5 |

9.3.1.1 Critical role of post-disaster recovery governance and leadership

The research challenges the current emergency management models such as capability-based MPPRR model in the U.S. (Congressional Research Service, 2006), PPRR model in Australia (EMA, 2004), and ‘4R’ model in New Zealand (MCDEM, 2002), which emphasize community-led disaster recovery and reconstruction with assistance from public, private and non-profit sectors. This research argues that although the components in a comprehensive disaster management framework seem to cover every aspect of community recovery — physical/built, social, economic, and natural — with a view to addressing both vulnerability and resilience issues, the framework has overlooked the importance of an institutionalized leadership to help communities recover from disasters. Based on findings from its comparative analysis, the study argues that it was due to the difference in the post-disaster institutional arrangements designed to meet the needs and capacities of the targeted community that dictated the difference in post-disaster recovery outcomes.

There is a plethora of literature which has identified the factors that contribute to a community’s capacity to successfully rebuild after a disaster — community’s socio-economic position which is related to their access to resources (Blaikie et al., 1994; Comerio, 1998), community’s internal and external capacities (Siembieda, 2002; Kenny, 2005; Pathiraja and Tombesi, 2009), and external factors such as political and economic conditions (Wu and Lindell, 2004; Zhang and...
Peacock, 2010), role of the government (Lindell, 1994), regulatory system (Spence, 2004; Lorch, 2005) and disaster management system (Sullivan, 2003; Mitchell, 2004). An increased recognition of the importance of according public assistance, private sector engagement, and also community participation was seen in the literature. However, the literature does not show, as in this research, that the cornerstone of the community capacity resides with their decision making ability. And in a post-disaster situation, an institutionalized leadership from the government plays a significant role in facilitating the decisions that communities need to make.

The response to the 2004 Indian Ocean tsunami in Indonesia was largely reliant upon the external aid agencies. The legislated role of BRR, however, was substantially reduced due to its lack of administrative capabilities and lack of coordination mechanism in place. China’s centralized administrative system allowed mobilization of resources and capacity in a rapid and efficient manner. However, at the local level, the management of post-Wenchuan earthquake reconstruction was shared by the fragmented ministries and local government departments. In Victoria, the institutionalized routines were instrumental in activating public and private assistance to help with bushfire response and recovery. VBRRA established as policy innovation, did play a part in coordinating recovery activities, but its role was limited due to the absence of legal power and leadership.

The above examples show the different characteristics in terms of post-disaster institutional arrangements in three cases. Among the three cases, whether they are developed countries, or developing countries, or whether they are considered to be more democratic or less, there was a lack of recovery governance and leadership from the government authorities to strengthen community capability to achieve housing recovery. Narrowly defined public assistance without a legally empowered leadership may failed to fully understand the needs of the targeted groups and address these needs, as seen in Indonesia, China and Australia. Thus, this research argues for a need for establishing an institutionalized leadership framework under which public and private assistance along with community participation can be integrated.

9.3.1.2 Critical role of the construction industry

A second contribution this research makes to improving disaster management knowledge concerns the critical role of the construction industry in housing recovery following disasters.
The research argues that while increased involvement of the private sectors, such as the construction industry, can help community recovery efforts, meanwhile it is important to understand the needs and capacities of these industry practitioners, as well as how their vulnerabilities and resilience during the reconstruction would affect community/agency’s ability to rebuild houses. The comparative study findings demonstrate that competence of construction professionals affect overall recovery project performance. This dissertation suggests that mapping the capability of the construction industry and understanding the needs and reactions of the involved practitioners in disaster recovery should be integrated in the post-disaster recovery and reconstruction planning.

The research findings in the three case studies show that an absence of this mapping led to policies and programs that fail to take the local capacities and needs into account. This failure was a key reason that skilled human resources flowed from the disaster-affected areas to the non-affected areas, while under-skilled forces from outside flowed into post-disaster reconstruction. Lack of qualified construction professionals for housing reconstruction compounded recovery problems of aid agencies in Aceh, and of households in Sichuan and Victoria. This situation, however, was further complicated by a lack of understanding from construction professionals of the population’s needs, leading to further impediments to reconstruction progress.

Recent studies in the disaster fields have argued that the construction industry has a much broader role in disaster recovery, such as to anticipate, assess, prevent, prepare, respond and recover from disruptive challenges (Haigh et al., 2006), and construction professions are in the best position to frame the discussion on a systematic risk management process (Coles, 2004). The built environment, at each stage of the disaster management process, has invaluable expertise and a key role to play in the development of society's resilience to disasters (Haigh and Amaratunga, 2010). Bosher et al. (2007) also argue that disaster risk management should be integrated into the construction industry in order to achieve a resilient and sustainable built environment. Further, Bosher (2011a) proposed a set of guiding principles in construction practice in order to create a more resilient built environment.

The above literature recognized the multi-disciplinary nature of disaster management, and the need to involve the construction industry into disaster management. However, these studies do not empirically examine the interaction between the built environment, its disciplines, and the
disaster management process. Using the findings from comparative analyses of construction sector’s involvement in housing recovery, the current research argues that the construction industry in the three countries was highly marginalized from disaster management. The research shows that local construction capability for recovery projects in Aceh was largely overlooked by the outside aid agencies before they commenced housing recovery projects. In contrast, although the resource shortfalls were estimated by the Chinese government, this was not taken into account in the overall post-Wenchuan earthquake recovery and reconstruction planning. In other words, the role and capacity the construction industry could offer in disaster management, particularly post-disaster reconstruction was limited.

The competence of construction professionals in post-disaster housing recovery in Aceh, Sichuan and Victoria was connected to two primary factors: their ability to produce quality work and their ability to deal with disaster-affected households. Invariably, behind these two factors lay their cost-driven motivation to participate in the reconstruction work. These findings align with the study of Ofori (2002) who called for the development of the construction industry to prevent and respond to disasters. However, according to Haigh and Amaratunga (2010), when searching for emergent theory, a conceptual framework is important for situating further study in the relevant knowledge base to lay the foundation for effective integration of the construction industry into disaster risk management. This current study argues that the integrated planning framework developed in this research, as shown in Figure 9.1, can help inform the development of this conceptual framework.

Furthermore, the lack of previous literature also limited the understanding of the critical role of the construction industry in disaster management. This research enhances the existing knowledge by suggesting that engagement and cooperation, understanding the local conditions, as well as adequate training for professionals with regard to housing rebuilding are important for the construction industry in post-disaster reconstruction. From the government or agency’s perspective, as discussed earlier, without understanding the needs and capacities of construction practitioners, it is difficult to design policies and programs that can increase and facilitate their involvement in housing reconstruction.
9.3.1.3 Resourcing, ‘indicator resources’ and resource availability

A third contribution this research makes is that it challenges the current paradigm in resource management literature. The literature on resource management, as shown in the literature review Chapter Three, has largely overlooked resource availability in project management, in preference for resource planning and optimization within one project or concurrent projects. Furthermore, in normal construction practice, resource availability for project construction is often construed as a procurement responsibility of the resourcing professionals. This research argues that resource management should incorporate resourcing capability and resource availability to its theoretical framework.

Post-disaster reconstruction researchers such as Rotimi et al. (2006), Masurier et al. (2006a), and ‘Resilient Organisations’ (2006a) have argued that conventional resource management for reconstruction is unlikely to be sufficient to deal with recovery projects following a large-scale disaster. Zuo and Wilkinson (2008) examined the timber procurement difficulties encountered by the aid agencies following the 2004 Indian Ocean tsunami, however, it did not identify the factors that affected the availability of timber resources in housing reconstruction. Based on the findings from the comparative analysis, this study contends that resource pressures including shortages of materials, components, specialized skills, and professionals are likely to play out in reconstruction pricing, quality and timeliness after a major event. There is a need to identify ‘indicator resources’ and to reduce the impacts of their low availability on housing recovery projects.

Furthermore, competence of construction professionals, and government response and intervention in resource management often become significant factors in the successful resourcing for the reconstruction of large events. By presenting post-disaster rebuilding experiences in Indonesia, China and Australia, this research suggests a shift from the focus on resourcing a project itself to linkages of resource availability in post-disaster economic, social and environmental settings.

The integrated planning framework provides a basis for tapping into the overlooked components of resourcing for post-disaster reconstruction in order to contribute to a systematic, comparative knowledge base on disaster recovery. The baseline assessment of resource availability and
resourcing practice in Indonesia, China and Australia provides a useful vantage point from which to consider recovery from events in other countries. The planning framework could be tailored to local conditions and be designed to ensure reliability and accessibility by the affected population for both the collection and review of data. The single case study approach with the aid of a triangulation data collection method has the benefit of understanding the nature of the obstacles that hinder resourcing housing reconstruction and the extent of their impact on reconstruction performance. The resource planning framework developed in this research helps the related stakeholders, especially disaster recovery planners, to prioritize activities and to facilitate effective resourcing practice. The research argues for a paradigm shift required in the purpose, process, and mindset of resourcing post disaster as shown in Table 9.4.

Table 9.4 Required paradigm shift in resourcing for post-disaster reconstruction

<table>
<thead>
<tr>
<th>Current paradigm</th>
<th>New paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Ad hoc’ reacting to disaster recovery in terms of mandates</td>
<td>➢ Proactive policy design and legislation formulation</td>
</tr>
<tr>
<td></td>
<td>➢ Incentive mechanism to increase the involvement of construction industry and market forces</td>
</tr>
<tr>
<td>Segmentated structure in the industry or among donor societies</td>
<td>➢ Strategic collaborative resourcing approach</td>
</tr>
<tr>
<td>Cost-driven resource supply in the market</td>
<td>➢ Capacity building through systematic education and training</td>
</tr>
<tr>
<td>Segregated stakeholders’ activities</td>
<td>➢ Integrated process</td>
</tr>
<tr>
<td>Segmented development of infrastructure and housing</td>
<td>➢ Improvement of the technical support infrastructure</td>
</tr>
<tr>
<td>Market-oriented resource availability</td>
<td>➢ Market-driven agenda with inputs from the government and industry</td>
</tr>
</tbody>
</table>

9.3.1.4 Reinforcing existing theories in literature

The research in this thesis confirms many of the issues from previous studies associated with government-driven resourcing and the problems existing in a market-driven resourcing approach and a donor-driven reconstruction process; it highlights the importance of a legal framework, the engagement of construction practitioners, market linkage, a robust transportation system as well as the consideration of local and environmental conditions and the importance of the
collaboration of multi-stakeholders and policy innovations. However, through extensive case studies in three post-disaster countries China, Indonesia and Australia along with a comparative analysis, this thesis has also explored the differences and similarities between the developed nations and developing counties with respect to disaster management. This thesis extends many of these findings in a way that is relevant to the perspective of planners and project managers operating in the built environment.

The research is located at the intersection of scholarship in the areas of disasters, construction management, and housing policy. According to Inam (2005), a common risk of conducting international comparative analyses is to expect to apply lessons from developed countries to developing counties, rather than being open to the possibility of mutual learning, or even policy lessons which flow from the developing world to the developed world. The cross-cultural comparative study in this research encourages policy makers and practitioners to exchange experiences in recent recovery operations. The lessons will inform the industry and government in other similar countries in planning for and responding to any future events.

Apart from the main research questions addressed, the thesis has answered such basic questions as: ‘what are likely vulnerable resources following a disaster?’, and ‘where do the potential resourcing bottlenecks exist during post-disaster reconstruction?’ This type of knowledge is important for developing reasonable expectations that can inform planning and decision making for pre-event planning and preparedness for post-disaster recovery.

9.3.2 Research limitations

Disasters are unique events which take on their own characteristics. Post-disaster environments are so complex and dynamic that no single group of stakeholders is likely to independently create and maintain a comprehensive understanding and knowledge concerning the overall recovery effort. In addition, the challenge of transforming the experience gained from one devastating event into improved performance in response to the next threat is not easy. While comparative analysis of resource availability for post-disaster housing reconstruction holds promise for enhancing the knowledge base on disaster recovery and construction management, there are also inherent limitations of this research.
The research data in each disaster-affected jurisdiction were collected at a specific time point where the resourcing issue was salient during the housing recovery of the affected area. Time and budget constraints are unlikely to allow the researcher to conduct a longitudinal research of resource availability over the entire disaster recovery process. Furthermore, understanding of the changes in availability of the identified ‘indicator resources’ or other resources that may become ‘indicator resources’ at a later stage, the changes in critical factors that affect resource availability, changes in resourcing issues over the housing recovery process requires more in-depth ‘forensic’ study. This longitudinal understanding of resource availability for post-disaster housing recovery, however, was, unfortunately, not dealt with by this research.

Since the research method is a comparative case study, the results of the comparison need to be interpreted carefully. Apart from the varied political systems, there are varied cultural influences, as well as different economies across the three selected disaster sites. These and other varying elements such as differences in disaster types, and in physical damage rates may have an influence on resourcing process and outcomes after a disaster but these are not recognized in this research. However, a comparison of recovery in different study areas which accounts for these potential elements will assist in a meaningful comparison of units on very different scales and in communities affected by different disasters.

To develop comparative insights on disaster recovery, the proposed planning framework should be tested and applied to a larger set of disasters. Limitations or deficiencies in the interconnected areas between components in the framework were not identified in this research. Furthermore, instead of using statistical techniques to identify the correlations between factors in the questionnaire, in-depth interviews were capitalized upon in this research for further clarification and interpretation. The interview method of data collection also helped to reveal the complexities and uncertainties inherent in a post-disaster situation. However, the scientific accuracy of this method is unknown. Furthermore, validation of the research findings and the proposed framework mainly depends on the expert judgment in the form of two-way communication and face-to-face feedback discussions with certain interviewees. Likewise, the reliability and rigour of this expert judgment method is sometimes uncertain.
9.3.3 Future research directions

This research opens up broad channels for future research. First, the case study has focused on the contractor-build housing reconstruction under the government-led, donor-led, and market-oriented operational environments in three countries. Further case studies in other disaster-affected countries are needed to examine the applicability of the findings in this research. Future studies regarding resourcing for infrastructure reconstruction and commercial buildings reconstruction are also needed. Since there was competition for the resources required between infrastructure facilities and housing reconstruction in the case study of this research. Successful resourcing practices should be explored.

A longitudinal case study in a disaster-impacted country can assist in discerning the effects of the disaster over time and offer important insights into the practical struggles of getting specific materials. This type of information can rationally inform key policy decisions. Furthermore, the proposed conceptual planning framework directs attention to improving the resourcing performance of the involved stakeholders. It is primarily concerned with two related issues — the coordination of organizations charged with response and recovery, and ensuring that proper resources are available when needed in the aftermath of a disaster. The related operative measures and coordination initiatives for achieving this framework are critical issues for future research.

By nature of the subject matter, research on post-disaster reconstruction contains a significant degree of direct and practical implications for policy. It is very important to recognize that disaster intensity and occurrence has been increasing and it is useful to consider what issues researchers concern themselves with in the near future. For instance, climate change, as an important concern of the present, is likely to draw attention from both politicians and academicians. A systematic dynamic approach to better understand the complexities in hazard-prone areas is a promising tool that can be used in the natural hazards community.

9.3.4 Reflective comments on the research process

Alfred North Whitehead said that: ‘Learning preserves the errors of the past, as well as its wisdom’. It is true that the whole process of accomplishing this thesis is a ‘learning curve’. The thesis not only contains a portfolio of research plans, methods, and empirical results, but it is also
a principal mechanism by which the actions of the researcher are assessed. This section provides some reflective comments on the techniques used and the research process.

9.3.4.1 What worked well?

As indicated in the Chapter Four, disasters are low probability events, and thus it is impossible to fully plan or to be perfectly prepared for research-related activities. Over the research period, immediate actions following a disaster have proved to be a living part of this research program. The reconnaissance trip to Sichuan, which took place six weeks after the Wenchuan earthquake, enabled the researcher to capture the ‘perishable’ data on disaster response. The first hand information in this regard provided much background and insights around the recovery governance and management system in China. This is also the case in Australia following the Victorian bushfire event.

While the cases may lack sufficient scope for statistical generalization due to a relatively small sample, the comparative analysis provides for a depth of description that is impossible in quantitative analyses. The goal of comparison is to search for similarity and variance, and identify underlying processes of resourcing across different geographical areas and their post-disaster contexts. As discussed in Chapter Four, cross-cultural interpretation of cases requires extra caution. With this in mind, comparative analysis makes the learning from different cases more informative and insightful; and it is certainly worth using in the future research.

9.3.4.2 What did not work well?

This study was not planned as a longitudinal study. Whilst the issues of housing reconstruction in the wake of the 2004 tsunami, 2008 earthquake, and 2009 bushfires have been discussed, there is a dearth of longitudinal research looking at changes over the post-disaster period. Case studies in this thesis successfully captured a snapshot of resource availability at time. However, the changes of resourcing processes and dynamics that caused these changes over time were beyond the scope of thesis. Lorch (2005) highlighted this problem and advocated longitudinal research for evidence-based recovery decision-making. A longitudinal study is needed for each case and requires significant funding, time and field-work commitment.
Another challenge is actually for us, as postgraduate researchers, to get across messages to those practitioners and stakeholders who are working ‘on the ground’, informing their practice. Quite often there is a gap between research and practice, particularly in the field of post-disaster recovery. Simply using the Participant Information Sheet in which the benefits of participation are listed is inadequate to attract key industry players to engage in a research program. The potential opportunities to continuously maintain an interactive relationship with the survey and interview participants are worth considering from the beginning. Moreover, the practical implications of this research project need to be planned for as a continued process throughout the whole doctoral period. An impact statement with industry inputs should be added into the provisional research proposal as a goal to achieve. It should continuously guide the researcher as the study proceeds.

9.4 Practical implications

Findings from this research suggest a number of planning and policy implications. The understanding of disasters, understanding of recovery, understanding of housing reconstruction, and understanding of resource availability in a post-disaster situation, as presented in this research, can no longer be excluded from the practices of disaster planning and preparedness. The recognition of resourcing-related dynamics following a major disaster, and in particular of the implications for housing recovery, provides insights into what might likely happen with respect to resource availability for housing rebuilding. By examining how post-disaster recovery factors and reconstruction housing approaches affect resource availability, planners should become more aware of the effect of institutional arrangements, governance and leadership, as well as approach to organizing and managing recovery projects, and of the importance of the strategic policies, practices, and tools associated with resourcing to mitigate the undesired resource pressures for post-disaster reconstruction.

The research findings show that post-disaster reconstruction provides valuable opportunities for institutions, industries, and communities to enhance capacity and resilience. Resourcing a post disaster environment places significant risks on many different stakeholders, government, construction industry and communities. Careful resource planning contributes to the success of
post-disaster recovery projects. By understanding what happens to resource prices, supply and demand as reconstruction continues and the strategies which can be put in place to manage resource competition and cost escalation, the disaster-impacted region will be better informed for the next event. Therefore, disaster recovery planners should anticipate and monitor potential volatility in the market following a major disaster. Planning departments should implement policies in advance that will support the affected house owners, communities and reconstruction practitioners to procure materials required for housing reconstruction. To expedite recovery and reconstruction following a major disaster, national and local governments should establish and formalize procurement procedures to speed up the acquisition of construction resources for disaster-stricken areas.

Clearly, the nature of resourcing practice during post-disaster reconstruction requires systematic thinking of how best to achieve resource availability. The research provides a means to understand and enhance this practice. It is anticipated that the research constitutes a means for understanding and adapting to resource uncertainties and sets up a baseline for a longitudinal cross-country, multi-disaster study. In this regard, a continuous improvement is required for the removal of bottlenecks or constraints during the resourcing process. There is no doubt that the impacts of future disasters will not be the same as previous ones but lessons from the past can be very helpful for improving knowledge about disasters and providing better response programs for local and international organizations (Eshghi and Larson, 2008). Risks and challenges during post-disaster reconstruction process identified in the research can be anticipated and measured. This begins with establishing the integration of a culture of disaster management into the construction industry.

In conclusion, in large and complex disaster recovery operations, the availability of resources is bound to be limited. Identified resourcing problems are likely to be universal and can be anticipated and pre-planned for irrespective of where a disaster happens. From this research, decision makers and construction practitioners can have clearer direction for improving their resourcing effort in a post-disaster situation. It is suggested that successful resourcing implementation in disaster recovery projects requires a multi-stakeholder approach, incorporating capacity building in the construction sector and facilitation from government. The
research results highlighted the importance of capacity building in the construction industry and of government response and intervention to disaster recovery and reconstruction.

The challenge for researchers and practitioners is to design bespoke solutions that can adapt to the changing physical, social, economic and political environment and the evolving institutional changes. To make informed land use decisions and to build disaster resilient communities, disaster planners and policy makers should understand the economics of a disaster. More research is needed to understand fundamental questions such as how local economies react and adjust to shocks associated with disasters, whether there are long-term negative economic impacts, and how businesses and households recover from natural disasters. Last but not the least, the problem that remains open is to identify the factors that inhibit the lessons and knowledge learned from the past events from being translated into policy adoption. Only by addressing these impediments, can the implications and insights gained from this research be transformed into practice.

9.5 Postscript

While I was working on this thesis, the world was not peaceful. On Tuesday, February 22, 2011, a magnitude 6.3 earthquake struck Christchurch, New Zealand’s garden city. The quake has claimed too many lives and caused extensive damage to homes, businesses and infrastructure. On March 11, a magnitude 9.0 earthquake struck the northeast coast of Japan near the city of Sendai. The earthquake generated a massive tsunami, destroyed infrastructural facilities, buildings and lives. Thousands of people are dead or still missing, and homes and towns have been destroyed by flooding. The two events raised disturbing questions about existing disaster management in both New Zealand and Japan that had been regarded as among the most effective and comprehensive in the world.

Despite considerable attention to these two events globally, silence greeted my queries about the resilience of communities facing major, destructive, and uncontrollable disasters. Phrases like vulnerability reduction, disaster risk mitigation, community resilience, and comprehensive disaster management which appeared in this dissertation seemed to be so pale and weak before on-the-ground realities the disasters had exposed us to. I, therefore, asked myself, what is left
behind by these devastating disasters? — tears, grieves, fears, traumas, memories? Or — hope? Such a question had led me to the very theme that has weaved through this dissertation — the hope that effective post-disaster recovery can bring to the affected communities.

It seems clear that the community’s unrelenting desire to rebuild lives following a disaster has contributed towards resilience improvements during recovery. It has to be acknowledged that to some extent a shift in disaster recovery responsibility from the public to the private has been taking place with an increased advocacy and implementation of community-participatory recovery and reconstruction, as the whole thesis and the three case studies illustrated. Moreover, ideas such as community resilience and capacity building are embedded in the culture, momentum and trends of disaster recovery scholarship. While the according scholarly and practical initiatives have offered a multiplicity of tools to conceptualize these ideas, the need to bring a true meaning of recovery back to the affected people becomes of paramount significance.

This thesis acknowledges the diligence and devotions of those who had participated in post-disaster recovery around the world and those who had contributed intelligence, knowledge, experience and insights to the understanding of post-disaster recovery and reconstruction following a disaster. Simultaneously, it involves a request for a down-to-earth thinking about what ‘better’ lives would be after recovery from a disaster, and how best to rebuild these lives. Only by deep thinking about these issues, could the disasters become opportunities to enhance resilience. Ultimately, these questions will be best answered if decision makers view these disasters as unique opportunities to bring change. Otherwise, as this study illustrates, part of community recovery efforts would be in vain.
Bibliography


Barenstein, J. D., and D. Pittet (2007) Post-disaster housing reconstruction current trends and sustainable alternatives for tsunami-affected communities in coastal Tamil Nadu, ISAAC.


Dercon, B. (2006) Housing damage and reconstruction needs in Nias and Nias Selatan: Evaluation of the Aceh MapFrame 3 Data, UN-HABITAT.

Dercon, B. (2007) Two years of settlement recovery in Aceh and Nias: what should the planners have learned? *43rd ISOCARP Congress 'Urban Trialogues - Co-productive ways to relate visioning and strategic urban projects'*. Antwerp, Belgium.


Dunford, M., and L. Li (2011) "Earthquake reconstruction in Wenchuan: Assessing the state overall plan and addressing the 'forgotten phase'". *Applied Geography* 31(3): 998-1009.


EMA (2004a) Emergency Management Arrangements. EMA. Canberra, Commonwealth Australia


FEMA (2000a) Planning for a Sustainable Future: the Link Between Hazard Mitigation and Liveability. FEMA. Washington, DC.


Freeman, P. K., M. Keen, and M. Mani (2003) "Being prepared: Natural disasters are becoming more frequent, more destructive, and deadlier, and poor countries are being hit the hardest". *Finance and Development* 40(3): 42-45.


Inam, A. (1997) Institutions, routines, and crises: Post-earthquake housing recovery in Mexico City and Los Angeles, University of Southern California. Ph.D.


Murrindindi Shire Council (2009) Bushfire Damage Statistics. Alexandra, Murrindindi Shire Council.,


Quarantelli, E. (1982) Sheltering and housing after major community disasters: Case studies and general observations. Columbus, Ohio State University.


460


Todd, D. J. (1979) "Mixing Qualitative and Quantitative Methods: Triangulation in Action". *Administrative Science Quarterly* 24: 602-611.


UNDP (2005b) Survivors of The Tsunami: One Year Later, United Nations Development Programme (UNDP).


UNDP (2006b) Local governance in tsunami recovery: Lessons learned and emerging principles. Geneva, UNDP.


