



**Resilient Organisations Research Report – 2008/01**

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# **Post-Disaster Reconstruction Research in New Zealand**

*An Industry Update*

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## **Resilient Organisations**

The Resilient Organisations research programme aims to improve the resilience of New Zealand organisations to major hazard events. Organisations manage, maintain and operate our infrastructure, create our economy and contribute to our society. The ability of organisations to respond effectively following a hazard event will have a large influence on the length of time that essential services are unavailable, and ultimately how well our communities cope with major disaster.

Particular aspects of organisational response and recovery focused on by the research team include: how organisations plan for hazard events, their ability to direct resources effectively during crises, and the legal and contractual frameworks within which they will need to operate.

The Resilient Organisations research programme is funded by the Foundation for Research Science and Technology (FRST) of New Zealand.

# Executive Summary

This report reviews the key learnings and application possibilities of research completed as part of the Resilient Organisations Objective 3 (Legal and Contractual Frameworks for Post-Disaster Reconstruction) Programme over the past three years. Where appropriate, comments have been made regarding pre-disaster planning considerations. Alternatives that need to be incorporated into the thinking and planning of those who are involved in post disaster reconstruction have been highlighted. Several areas have also been identified that require further research or additional planning for a smoother, co-ordinated process of reconstruction.

Resilient Organisations Objective 3 (Legal and Contractual Frameworks for Post-Disaster Reconstruction) Programme of research covers four main areas of focus; each area is being or has been researched within the following Programme structure:

Lead Researchers:

- o Associate Professor Suzanne Wilkinson, Auckland University
- o Associate Professor Regan Potangaroa, Unitec
- o Jason Le Masurier, University of Canterbury

Legislation	Co-ordination	Contractual	Resourcing / new research focus
James Rotimi (Ph.D student)	John Hewitt (Ph.D student)  Felicity Glennie (past project student)	Kelvin Zuo, (Ph.D student)  Jetske van der Zon (past project student)	Beshram Singh (completed Masters Thesis),  Alice Chang (new Ph.D student)

The task of reconstruction after a major event requires deliberate and coordinated efforts of all stakeholders for effective and efficient recovery of the affected community. Key lessons for New Zealand in planning to be more resilient in post-disaster reconstruction include:

- ***Existing New Zealand legislation does not provide adequately for the facilitation of reconstruction projects following a major disaster***
- ***During recovery, specific provisions are needed in regulations and legislation that apply to routine construction, such as the Building Act.***
- ***The processing of building consents at the early stages of reconstruction and recovery after an event has been identified as a potential bottleneck.***
- ***Whilst the New Zealand construction industry would most likely cope with a medium sized disaster if the base work load was at an average***

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*level, a large scale disaster coinciding with a high base load could require up to 180,000 additional construction industry workers*

- *Revisions made to vulnerable natural disaster zones maps following an event may have significant ramifications for property owners, impacting their ability to be compensated or to re-insure.*
- *Territorial Local Authorities and other agencies need to lobby government to align and simplify legislation to introduce more flexibility for post-disaster reconstruction processes.*
- *Urban Planners and Recovery Managers should include the concept of levels and an urban change hierarchy in their reconstruction planning processes*
- *There is an urgent need for a well-developed and understood protocol or stipulated procedure for procurement in the event of disasters.*
- *When rapid rebuild is required and financial resources are limited, calculated trade-offs may need to be made between reduced time and cost on the one hand and higher quality that may facilitate community resilience.*
- *There are distinct pros and cons of different forms of procurement contracts, including design and build, alliancing and partnering during a reconstruction effort. Ultimately, relationships will be the key factor underpinning successful contractual arrangements.*
- *International experience demonstrates the effectiveness of reflecting the cost of 'downtime' by linking performance payments with the speed of reconstruction.*
- *The National Recovery Plan should place a greater focus on the reconstruction process, including advice on procurement process and related contractual arrangements.*
- *Shortages of construction materials and price inflation are likely to be key features in any large-scale NZ reconstruction effort.*
- *The prioritisation of construction works in other regions versus post-disaster works is likely to become a major issue for the construction sector over a lengthy reconstruction period.*

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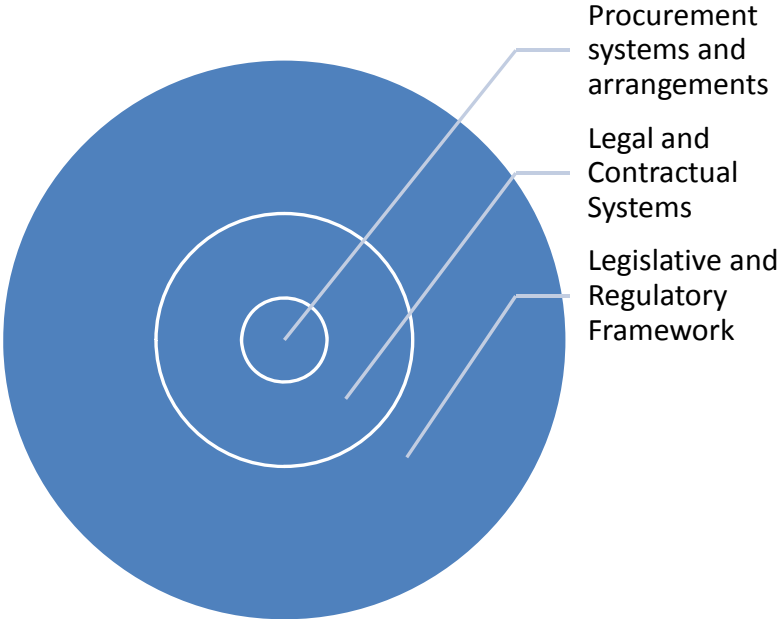
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## Introduction

The legal and contractual systems post-disaster can have a significant impact on the long-term recovery from an event. Following a disaster, one of the requirements for reconstruction is the establishment of a comprehensive procurement framework for reconstruction. Post-disaster, there also needs to be an understanding of the effects the disaster has on the legislative and regulatory system of the country experiencing the disaster. Without developed frameworks, reconstruction and new development will be carried out on an ad-hoc basis with little regard for the needs of the society.

Figure 1 below provides a view of the context for and factors that have an influence on organisational resilience; these need to be aligned and strengthened to support organisations in building their capacity and capability for post-disaster reconstruction.



**Figure 1: Context for and Factors Influencing Organisational Resilience**

Each of the following sections provides a summary of the main areas of research and related themes and findings; in each section, a summary relating the application of these research findings to pre-disaster preparedness activities is provided in order to guide organisations in their planning and co-ordination of recovery and reconstruction efforts.

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# 1. Regulatory and Legislative Frameworks

The Resilient Organisations Objective 3 (Legal and Contractual Frameworks for Post-Disaster Reconstruction) Programme has used case studies from New Zealand (Le Masurier, Rotimi and Wilkinson, 2005) to compare routine construction and post-disaster reconstruction. It has been confirmed that existing New Zealand legislation does not provide adequately for the facilitation of reconstruction projects following a major disaster.

Extrapolation of the main issues that arose in these case studies to larger scale disasters has highlighted the need to review reconstruction policy and legislation to achieve a greater degree of co-ordination for programmes following a disaster.

## 2.1 The Need for Special Legislative Provisions for Recovery and Reconstruction

There is little provision in legislation to cater for post-disaster reconstruction processes as part of recovery. The special powers available during a declared state of emergency and circumvention of routine statutory processes need to also be applied to the recovery and reconstruction process. The designated Recovery Manager has no statutory power to direct resources for recovery once the declaration of the state of emergency has been lifted. Without such special powers, recovery process may become a protracted process, lasting several years.

While the Ministry of Civil Defence Emergency Management (MCDEM) in New Zealand follows a holistic approach, public policies for mitigation, response and recovery need to be integrated and robust. Research into disaster management in New Zealand suggests that there is a relatively poor understanding of recovery and little consideration given to the role that regulatory frameworks should play in recovery and reconstruction in New Zealand. Whilst the scale of a disaster will dictate the responsibility for co-ordination of recovery, clear lines of responsibility are needed to facilitate the management of recovery at central, regional and local levels of government.

During recovery, specific provisions are needed in regulations and legislation that apply to routine construction. Without these, co-ordination and management of a major programme of reconstruction could become cumbersome and inefficient. It is also expected that shortfalls in experienced personnel will restrict the coping ability of co-ordinating authorities and regulatory bodies.

Whilst regulatory provisions exist for routine construction, there is little provision in several areas of legislation to cater for the post-disaster reconstruction processes. Following a major disaster it is unlikely that coordinating authorities and regulatory bodies would be able to cope with the volume of work due to shortfalls in experienced personnel, thus the coordination and management of a major programme of reconstruction could become cumbersome and inefficient.

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## 2.2 The Recovery Framework

Recovery requires a concerted approach that will support the foundations of community sustainability and capacity building and which will eventually reduce risks and vulnerabilities to future disasters. Examples where sustainable recovery interventions were poorly planned and implemented (e.g. the Latur 1993 earthquake in India) highlight the value of having identified institutions responsible for formulating public policies for recovery.

New Zealand's recovery planning and management arrangements are contained in the National Civil Defence Emergency Management Strategy (MCDEM 2004) where recovery is intended to be delivered through a continuum of central, regional, community and personal structures. All of these need to be strengthened if the continuum is to be effective.

While Government cannot legislate for all eventualities, there appears to be little provision in several areas of legislation to facilitate reconstruction projects. The following pieces of legislation make reference to building work but include very little reference to recovery:

- Building Act 1991 and 2004
- Resource Management Act 1992
- Housing Improvement Regulations 1947
- Historic Places Act 1993

## 2.3 The Recovery Process

Recovery, an integral part of the comprehensive emergency management process, refers to all activities that are carried out immediately after the initial response to a disaster situation. This will usually extend until the community's capacity for self-help has been restored.

Issues related to recovery from disasters may present an opportunity for improvement in the functioning of the community, so that risks from future events can be reduced while the community becomes more resilient. The effectiveness of the process will depend on how much planning has been carried out and what contingencies are put in place prior to the disaster. It is expected that recovery and reconstruction works will restore the affected community in all aspects of its natural, built, social and economic environment.

If it is to be an enabling process, recovery requires community participation. Consultation and communication is encouraged especially in identifying community needs and for collective decision making and commitment amongst all stakeholders. Typical stakeholders will include:

- Asset owners (may be private or public and the business community)
- Lifeline Agencies
- CDEM groups (national, territorial and local government departments, police, fire brigade, relief and welfare agencies, health and safety personnel etc)
- Insurance companies
- Non-governmental agencies (charities, funding organisations etc.)
- Construction and reinstatement organisations

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## 2.4 The Building Act (2004) and Reconstruction Resources

The processing of building consents at the early stages of reconstruction and recovery after an event has been identified as a potential bottleneck. The high volume of consent applications after a major disaster, shortages of qualified people to handle impact assessments and the time taken for normal processing of building consents will require a more flexible approach.

There is an opportunity to address the skills required by Building Officials during the period to 2013 when quality assurance of processes and professional development will receive attention as part of the accreditation of Building Authorities.

It is generally believed that the New Zealand construction industry would cope with a medium sized disaster if the base work load was at an average level, but Le Masurier, Rotimi and Wilkinson (2005) highlight the human resources requirements as a cause for concern and pro-active planning; they reference Page's work (2004), indicating that a large scale disaster coinciding with a high base load could require up to 180,000 additional construction industry workers (this is based on an event causing \$10billion worth of damage in the Wellington region and with a base work load 7% higher than current levels).

The National Civil Defence Emergency Management Plan (July 2006), acknowledges New Zealand may need to mobilise all nationally available resources because it has finite capacity and capability for response and recovery. Sourcing and co-ordinating the use of these resources will be a major challenge and needs to be planned in advance.

The Building Act (2004) has placed new requirements on Territorial Authorities regarding the granting of building consents on land subjected to natural hazards. In the absence of protection from the identified hazards and / or clearly indicating the risk exposure of the natural hazards, the Earthquake Commission Act (EQC) has indicated that it is not liable to settle any claim where there is an identified large risk. Revisions to the mapping of vulnerable natural disaster zones may influence the ability of property owners to be compensated.

The CDEM Act is the only piece of legislation that requires specific identification of hazards by councils. However, because hazard identification can only be inferred from other pieces of legislation (e.g. the Building Act and RMA), Councils have a limited ability to gather information on hazards. The implication of not being able to apply the provisions of the various acts is that development control outside recognised hazard zones may be limited.

Routine regulatory and legislative processes would not facilitate regulatory bodies coping with the volume of work associated with the reconstruction effort following a large scale disaster. Figure 2 on the next page highlights the need for clarity in roles and responsibilities of the various CDEM agencies and other stakeholders. The need to address conflicts in the interpretation of the different pieces of legislation also needs to be addressed; Territorial Local Authorities and other agencies need to lobby government to align and simplify the legislation, thus introducing more flexibility for post-disaster reconstruction processes.

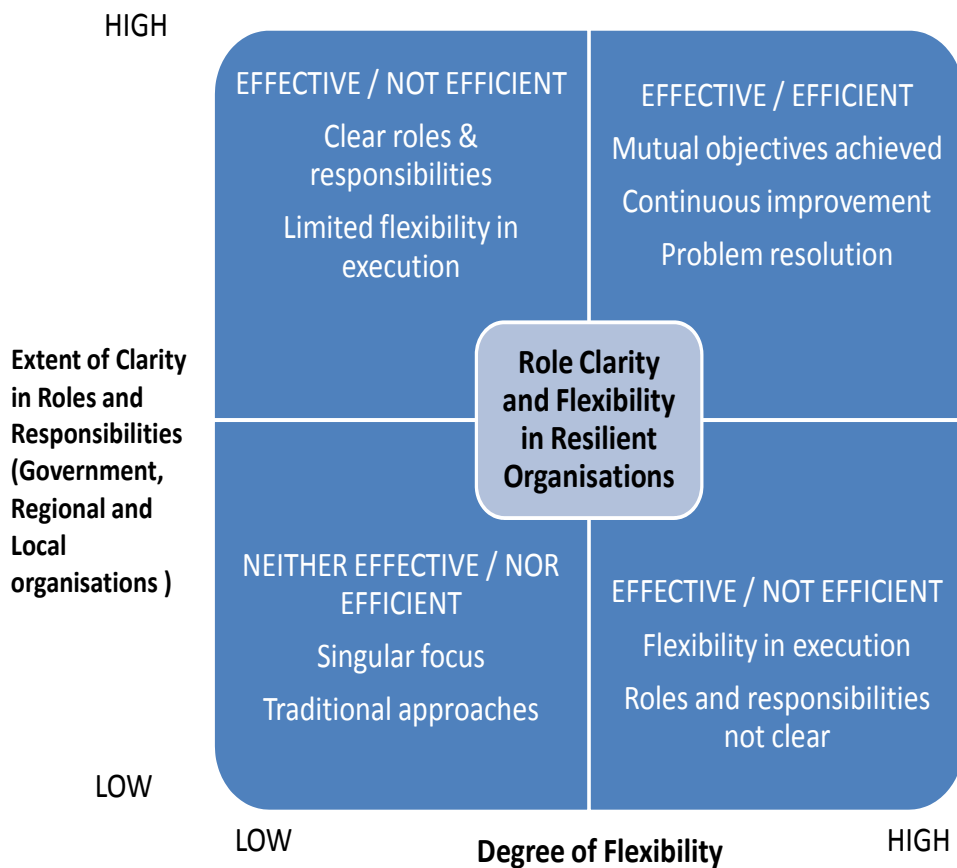


Figure 2: Role Clarity and Flexibility in achieving Resilience Outcomes in Post-Disaster Reconstruction

## 2.5 Challenges for Larger Scale Disasters

Whilst relying on routine processes proves adequate in many ways for small-scale disasters, a higher level of coordination and management would be needed for programmes of reconstruction following a larger disaster.

Should the routine regulatory and legislative processes be followed after a major disaster it is unlikely that regulatory bodies would be able to cope with the volume of work. The conflicts in the interpretation of the different pieces of legislation need to be removed, whilst the roles and responsibilities of the various CDEM agencies and other stakeholders need to be made clear. The apparent division between those who, in practice, take responsibility for reconstruction and those who set policy and legislation create barriers that need to be overcome. Failing this, implementation of reconstruction works will be cumbersome in the event of a major disaster.

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## 2.6 Key Lessons

### ***Pro-active planning and understanding of legislative constraints***

*The effectiveness of the recovery process post-disaster will depend on how much planning has been carried out and what contingencies are put in place prior to the disaster. Simply modifying routine construction processes on an ad hoc basis will not be appropriate or effective in larger scale disasters. To allow effective co-ordination and delivery of reconstruction works, a modification of the legislative and regulatory framework will be required; the focus needs to be on permitting implementation of appropriate systems in advance.*

### ***Facilitating recovery of the built environment and community sustainability***

*The regulatory and legislative framework for recovery needs to facilitate the community's ability to carry out a number of activities immediately after the initial response to a disaster situation. The built environment is of particular interest in the recovery process since it supports the foundations of community sustainability and capacity building.*

### ***Lobbying for more legislative powers and flexibility in regulatory and legislative frameworks***

*Organisations, including Territorial Local Authorities, need to lobby for more powers and / or flexibility in the application of regulatory and legislative frameworks. Without such changes or flexibility, organisations will, in any event, need to implement plans and develop relationships to enhance their resilience and preparedness to deal with post-disaster recovery and reconstruction.*

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### **3. Co-ordination and Prioritisation**

The application of knowledge about post-disaster sequencing and prioritisation of reconstruction efforts has not received sufficient attention. Recent research into the application of a model for reconstruction prioritisation has highlighted the need to consider a number of issues in this process and cautioned against making assumptions about “what comes first”.

#### **3.1. The role of urban change hierarchies in the planning of disaster responses**

Although there is general agreement that a collaborative and coordinated response and recovery programme is necessary, little agreement exists regarding its means of achievement (Hewitt, Potangaroa and Wilkinson, 2006).

Research has focused on the relevance of restoring and reconstructing the affected urban area using a hierarchical model that describes the role of the agents of change. Levels are identified within the physical structure of the built environment, decreasing in scale from major transport networks, through local street patterns, the urban block and buildings, to the rooms within the building and the furniture within the room.

The aftermath of a disaster is an extreme example of the collapse of the hierarchy into a single level. Within the collapsed hierarchy it becomes important that reconstruction of the order or hierarchy and associated levels takes place. The relationship between the levels of built form and agents acting within them is not fixed. Often change within the scalar hierarchy of form needs to be introduced to offer a degree of flexibility and potential to adapt to unpredictable circumstances.

#### **3.3 Convergence in disaster management and urban planning fields**

Overviews of current directions in both the disaster management and the urban planning fields offer new insights into the inherent “patterns” of disasters, and increased understanding of operational and management aspects such as community resilience.

Urban planning research highlights the importance of urban design control. In disaster management, research has highlighted the importance of community involvement in the recovery process.

Surveys have detected evidence of the recognition of the concept of levels, and of convergence between the two bodies of knowledge. One such study was a pilot study carried out in Banda Aceh some six months after the tsunami disaster of December 2004, and designed to discover to what extent, if any, the survivors of a disaster (i.e. potential users of any proposed recovery system) recognize the concept of levels of urban form. A significant degree of recognition was discovered, and indicates an intuitive understanding of the concept, and of its relevance in post-disaster situations.

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Habraken's model (1998) describes two interdependent yet distinct hierarchies or "orders"—of physical form ("Form") and of territory ("Place"). Resilient Organisations research has focused on the order of form as a way of addressing change and reconstruction following a disaster. The Model promotes discussion about the emergence of a new, post-disaster, everyday environment that will emerge from the recovery process; the collapsed hierarchy will be reassembled in a modified form from the former hierarchy.

The concept of levels referred to in Habraken's Model has been recognised in a number of recent publications including "A Design Guide for Urban New Zealand" published by the Ministry for The Environment in 2002.

### **3.4 Banda Aceh Pilot Study**

A pilot study was conducted to test the feasibility of a combined approach to post-disaster physical recovery, involving the bodies of knowledge (theoretical and operational) of the urban planning and disaster management disciplines. The study took the form of a survey, based on a questionnaire including Habraken's (1998) hierarchy of urban form.

The survey was conducted in June-July 2005, by conducting interviews with the assistance of with post-graduate students of law from Syiah Kuala University in Banda Aceh acting as interviewers. Ninety survivors of the Boxing Day 2004 tsunami in Indonesia were interviewed and the results of those interviews indicate:

- A significant prioritisation (by 76% of respondents) of higher-level components of the hierarchy in the response phase, mainly major arteries and roads in the first 3 months following the disaster
- In the 3 months to 2 year recovery phase, a shift in priority and emphasis to lower level priorities (49% indicated buildings), while major arteries still feature as a priority (34%)
- In the 2 to 15 year rehabilitation phase, the priorities continue to shift downwards to personal space (35%); however 50% still retaining major arteries / city structure / neighbourhood as a second priority

The results of the survey therefore show a high degree of correlation between the phases of the post-disaster reconstruction process and the levels of the urban hierarchy.

The prioritization of the rebuilding of specific elements of the physical infrastructure (e.g. major arteries and roads) indicates a need for major agencies (i.e. Government) to take a leading role in the initial Response phase. The debate regarding the expediency with which this occurred after Hurricane Katrina (New Orleans, 2005) continues; there is a consensus that this was not done well.

During the Recovery phase the priorities move down the urban scale, and become focused on the rebuilding of housing and communal facilities such as schools and hospitals. Traditional levels of community involvement – those associated with local building production – achieve the highest priority in the recovery phase (that is, from three months after the disaster).

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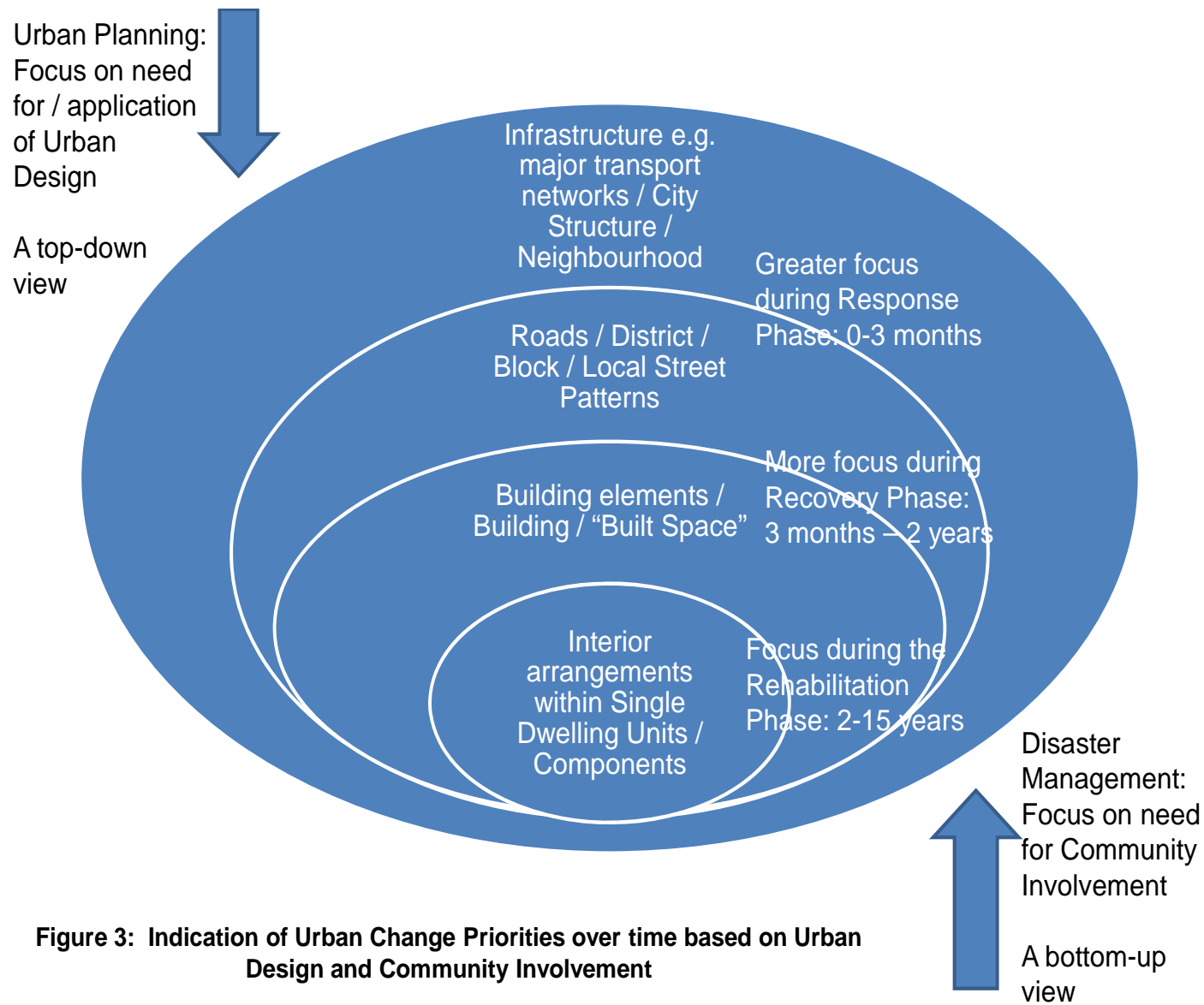
This research confirms the multi-level emphasis during the recovery phase (3 months to 2 years) and the need for rapid action planning and implementation. There is a focus not only on reconstruction of major arteries, roads and buildings, but also on personal space (“place”). The community’s degree of resilience may be measured in terms of the time taken in its reestablishment.

### **3.5 Top-down and Bottom-up Approaches to Post-disaster Reconstruction**

Trends in the development of the knowledge base of urban planning and disaster management indicate a focus on urban design control and community participation respectively. Urban planning favours a top-down approach, while disaster management favours a bottom-up approach. A common operational framework may, however, be achieved.

According to Hewitt, Potangaroa and Wilkinson (2006), the post-Kobe earthquake reconstruction in Japan (post 1995) provides a good example of the convergence of many agents of change (normally exerting control within separate levels) into a single collapsed level of the control hierarchy. This example together with the Banda Aceh example illustrates an implicit understanding of the hierarchy of levels and of its capacity for simultaneous operations. The role of community involvement in the process of incremental change in urban systems is highlighted.

Figure 3 on the following page indicates how the emphasis and urban change priority may shift over time and the need to take both a top-down and bottom-up view to confirm priorities during different phases.



**Figure 3: Indication of Urban Change Priorities over time based on Urban Design and Community Involvement**

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## 3.6 Key Lessons

### ***The Concept of levels and an urban change hierarchy needs to be considered in reconstruction planning processes***

*The relevance of the concept of levels in a post-disaster context has been confirmed. It appears in disaster management and urban planning theory and has been acknowledged as highly relevant in recent post disaster research.*

### ***The need for further research and understanding of hierarchies and cross-impacts***

*Significant cross-disciplinary influences have been revealed through related research. Further research into typology and patterns may facilitate a better understanding of urban hierarchies in different cultures. Another area within this research into the order of form is the extent of overlaps between levels and the extent to which these are helpful to or hinder post-disaster reconstruction.*

*Further research is needed to understand how urban planning, urban design and other aspects related to disaster planning and disaster management may be brought together to better engage in pre-disaster planning processes. Learning from the recovery and reconstruction phases following disasters will better prepare organisations and communities for post-disaster implementation of co-ordinated, more integrated and aligned plans.*

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## 4. Contractual Arrangements

Appropriate contractual arrangements between suppliers and key players in the reconstruction effort are essential to facilitate a smooth process post-disaster. Organisations have an opportunity to complete much of this work in advance of the disaster to ensure this.

### 4.1 Post-disaster reconstruction procurement systems – what works and what needs to be improved?

Zuo, Wilkinson, Le Masurier and Van der Zon (2006) used the 2004 Manawatu Flood Reconstruction experience as a case study focusing on the current reconstruction system and its' contractual arrangements and procurement plans. What becomes apparent is that the use of well established and developed models of procurement (traditional, design and build, and project management) and a variety of contractual relationships to procure construction projects are critical in the rapid recovery of damaged communities.

The study highlighted a number of aspects related to facilitation of post-disaster reconstruction, including the need for:

- a comprehensive reconstruction procurement framework
- development of a fast and efficient contractual system

New forms of relationship-based contractual systems (partnering, alliancing and joint ventures) are increasingly being used together with transaction-based contracts in the New Zealand construction sector; both forms of contracts present challenges to the smooth and effective functioning of post-disaster processes.

Several existing procurement guidelines are in use in New Zealand for Government agencies (central or local) for procurement in normal situations. However, there is an urgent need for a well-developed and understood protocol or stipulated procedure in the event of disasters. Following a large scale disaster, the form and nature of these protocols and procedures, together with a strong relationship-centred contractual framework(s) will be key considerations. The following aspects deserve special attention:

- guidelines for 'abnormal' situations (in particular, guidance on processes for securing suppliers of large construction and/or building contracts)
- the quality and value consideration in the actual selection step in the procurement process
- special legislative provisions (where applicable)
- flexible contractual arrangements.

While a number of Recovery-related publications have been prepared by the New Zealand Ministry of Civil Defence & Emergency Management (MCDEM), there are a number of gaps in reconstruction procurement aspects of recovery from disasters:

- 
- a lack of understanding of how construction works will be procured
  - how the industry will facilitate reconstruction
  - who (in the construction industry) will be involved in procuring and constructing such reconstructed facilities.

The Civil Defence Emergency Management Act (2002) clearly indicates that Central government would become involved only when recovery is beyond the ability of the community to manage. Both CDEM Groups and reconstruction agencies and organisations need to prepare robust regional and local plans to address post disaster recovery and reconstruction.

## **4.2 Procurement Options for Post-Disaster Reconstruction**

Procurement systems are important in the reconstruction process after a natural disaster. They determine the overall framework embracing the structure of responsibilities and authority for participants within the building process and are therefore critical. Clear structures need to be determined and responsibilities and authority for rebuilding established.

Not all procurement systems will be suitable post-disaster, so the governing organisations need to be advised of the best system to meet their needs. Traditional procurement systems, with separated design and construction organisation, are usually associated with longer time periods and higher cost; clearly a disadvantage in a disaster reconstruction situation. In an integrated procurement system, design and construction are integrated and became the responsibility of one organisation. Design and build and variations thereof have gained popularity because of claims by contractors of greater efficiency and lower cost.

Although recovery in New Zealand is funded to a significant level by insurers, when rapid rebuild is required and additional financial resources are limited, calculated trade-offs may need to be made; these may include trade-offs between reduced time and cost on the one hand and higher quality that may facilitate community resilience. Inevitably organisations and communities need to make trade-offs between time, cost and quality.

Depending on the scale and nature of the disaster, design and build procurement could be suitable because of the short time and low cost focus. Le Masurier, Wilkinson, Zuo and Rotimi (2008) suggest that these systems can more readily respond to the client's needs, especially accelerated commencement and completion. Appointing a project manager with increased knowledge of project planning may also facilitate rapid rebuild using existing communication links between the parties.

Partnering used together with the procurement frameworks in operation, facilitates achievement of mutual objectives, continuous improvement and problem resolution; together with long-term relationships based on trust, it may provide a vehicle for reconstruction. When faced with the common objective of rebuilding communities, it can be quickly learnt.

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Project alliancing, typically used on larger and more complex projects with high levels of uncertainty, would also be useful in an emergency situation. However, the size and duration of the project has to justify the investment in setting it up, both commercially and culturally.

Contracts for freeway reconstruction following the 1994 Northridge earthquake took two weeks rather than three months and there is evidence that the contractor has developed long and lasting relationships with the agency responsible for overseeing the reconstruction. This experience demonstrates the effectiveness of reflecting the cost of 'downtime' by linking performance payments with the speed of reconstruction

### **4.3 Effective Relationships for Reconstruction following a disaster**

The use of alliancing does necessitate pre-planning and detailed preparation. Parties need to understand how the relationship will work and the benefits will need to be transparent to each party. This may require an investment of time preparing for an alliance relationship in anticipation of a future event.

Preparation that should be carried out by agencies responsible for delivering reconstruction projects (such as major public utility and highway infrastructure owners) need to include:

- Identifying construction supply chain companies with similar values and commercial culture to that of the owner
- Identifying facilitators who could be called upon to accelerate and maintain the culture
- Developing alliancing agreements that are provisionally agreed to in advance by potential alliance parties, including commercial and legal frameworks and dispute resolution procedures
- Developing procedures for establishing target costs and pain / gain share.

Figure 4 indicates how effective and efficient procurement frameworks are developed using integrated approaches (design and build), partnering and alliancing as well as joint criteria in the management of performance. Effective and efficient reconstruction will not necessarily be achieved using traditional approaches (this does, however, depend on the scale of the disaster), nor will some (limited) performance criteria or familiarity with the local industry be sufficient. To be effective and efficient, the procurement frameworks and systems need to embrace new dynamic ways of supporting the achievement of performance-based post-disaster reconstruction programmes.

The following lessons learnt from the New Zealand flooding events of 2004 and 2005 offer opportunities for improved processes to be incorporated into future procurement models:

- During the Manawatu flood event, utilities became frustrated with the process of developing an understanding with the Regional Council about emergency actions that would cover all situations under the Resource Management Act, rather than require a formal process for each activity; however, a more pragmatic approach was followed subsequently which meant that slip material could be moved and redeposited locally.
- The road funding authority, Transfund, needed to become involved earlier since Transfund has direct access to government funds. Following the Manawatu floods

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more could have been done to secure certainty over funding in the early stages of recovery which would have helped with the physical works prioritisation process.

- Recovery at Matata relied heavily on Central Government funding that took some time to come through causing frustration for the local population.
- Overall there was little difference between the routine construction process and the reconstruction process, due to the fact that the disasters were of a relatively small scale.
- Using existing relationships involving the parties normally involved during routine construction projects during the reconstruction facilitated the process.
- National scale contractors were a valuable source of resources, since they were able to use their networks to mobilise resources from the whole country.

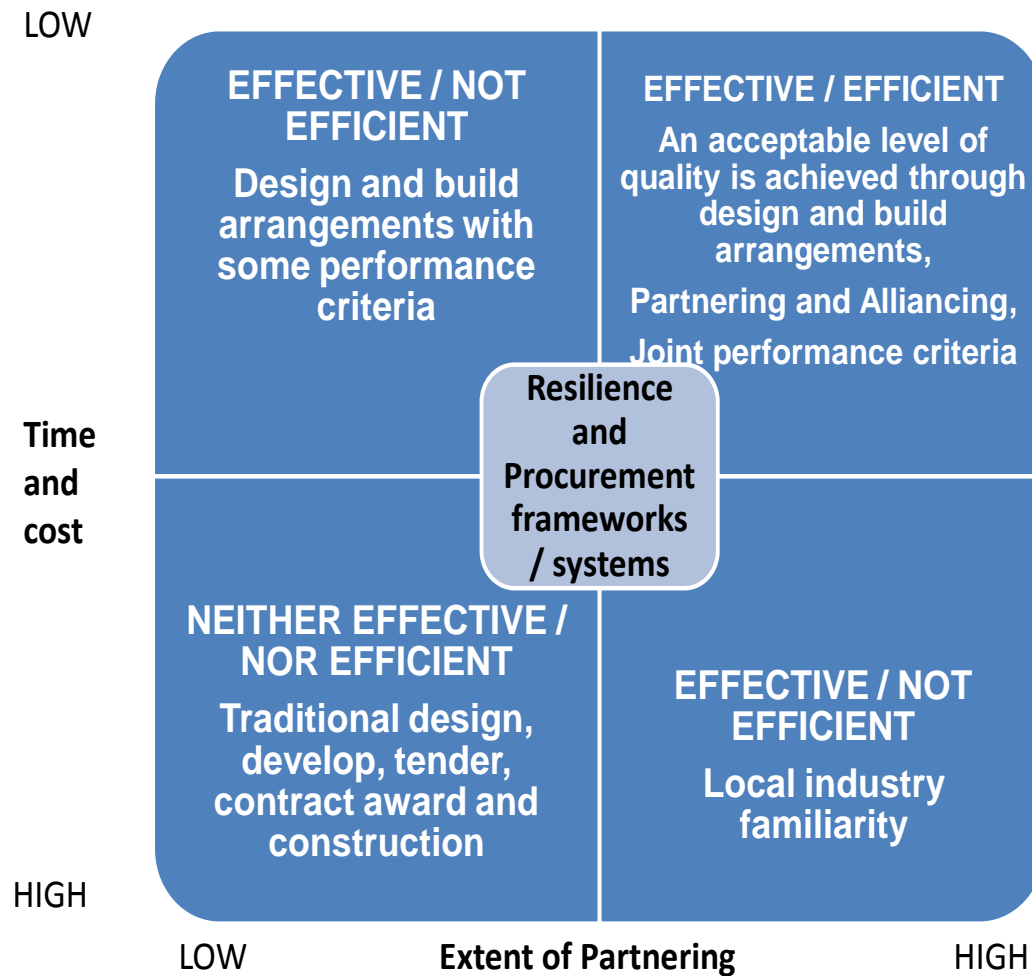
Both events, although significant in terms of negative impacts on the local communities, were of a smaller scale relative to large-scale world disasters. This allowed for the use of existing contracts in the post-disaster reconstruction process and relationship-based contracts (drawing on the locally-available resources) were found to be very effective.

#### **4.4 Government Guidelines for Procurement**

Zuo, Wilkinson, Le Masurier and Van der Zon (2006) comment that, whilst useful, current Guidelines for Procurement that have been drafted and issued by Government bodies (e.g. The Ministry of Economic Development's Regulatory and Competition Policy branch - 'Government Procurement in New Zealand – Policy Guide for Purchaser' (July 2002) , the ACENZ & IPENZ 'Guideline on the Briefing and Engagement for Consulting Engineering Services' (January 2004) and the Office of Controller and Auditor-General - 'Procurement – A Statement of Good Practice' (June 2001)) are somewhat limited in their applicability in post-disaster scenarios; these limitations are mainly that they do not provide (1) significant guidance on processes for securing suppliers of large construction and/or building contract, and (2) guidance on how to embody the quality and value consideration in the actual selection step.

Procurement planning should form part of any reconstruction planning for major disasters. However, this appears to be lacking in New Zealand. Recovery Management - Director's Guidelines for CDEM Groups (DGL 4/05) (part of a series of documents produced by MCDEM), does not directly concern itself with the reconstruction procurement process or related contractual arrangements. These Guidelines focus more on the general aspects of recovery activities, the resilience of the whole community and aspects that relate to financial matters and insurance arrangements.

The lack of understanding of how construction works will be procured, how the industry will facilitate reconstruction, and who, in the construction industry, will be involved in procuring, and constructing such reconstructed facilities indicates an urgent need to enhance these processes.



**Figure 4: Procurement Frameworks for Achieving Resilience Outcomes in Post-Disaster Reconstruction**

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## 4.5 Future development of post-disaster reconstruction contractual systems

Examples of contracts applied in the recovery / reconstruction following the Manawatu floods indicate a mix of use of traditional contracts and some special arrangements; these special arrangements involved stepping outside of existing arrangements and where necessary, tendering in the open market for parts of the restoration work.

Further research is required to examine the most effective forms of contract in disaster scenarios. The need for a flexible, fast, efficient, relationship-centred contractual system and a comprehensive reconstruction procurement framework(s) is apparent.

Guidelines need to be developed for 'abnormal' situations (in particular, guidance on processes for securing suppliers of large construction and/or building contracts). Quality and value considerations need to be built into the actual selection step in the procurement process.

A higher level of coordination and management would be needed for programmes of reconstruction following a larger disaster. It has been suggested that, in the event of a major disaster, the EQC should award bulk reconstruction contracts to relieve house owners from sourcing and managing the process. A co-ordinated response used by the EQC to the Te Anau earthquake of 2003, allowed a large single contractor to co-ordinate and manage the recovery works on its behalf. Whilst inconclusive, coordination was clearly an improvement on the situation where individual property owners competed for the services of a limited number of building contractors.

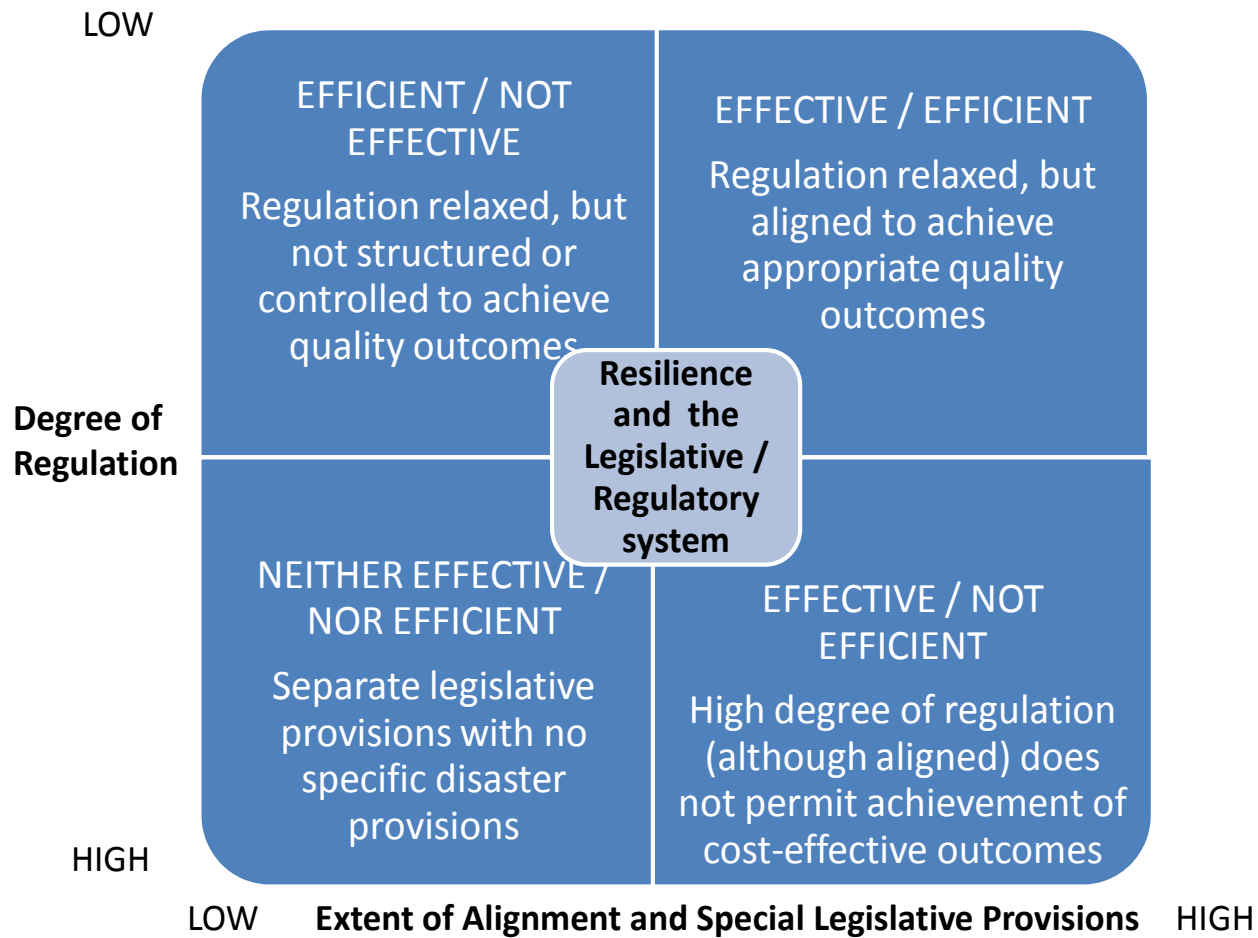
The setting up of task groups and sub-groups to achieve recovery objectives is recommended in the MCDEM Director's Guidelines. The role of the 'Residential Housing Subtask Group' under the 'Built Environment Task Group' is described as follows:

*'repair, reconstruct or relocate buildings – obtaining fast-track building and other consents, sufficient builders and materials, coordinating skilled trades and their work standards'*

Legislative and other constraints may prove too challenging for such a task force unless special provisions are enacted to facilitate fast-tracking of processes related to recovery and reconstruction. Further investigation is recommended to scope the extent of special legislative provisions that may need to be applied in disaster / post-disaster scenarios.

Figure 5 below shows how legislative and regulatory aspects influence the achievement of resilience outcomes.

While informal, relationship-based contracting has played a significant role in post disaster reconstruction in smaller-scale disasters, more consideration needs to be given to developing supplementary, pre-planned contractual relationships that may be required to give effect to post-disaster reconstruction following larger-scale events.



**Figure 5: The Legislative and Regulatory System for achieving Resilience Outcomes**

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## **4.6 Case Study: Supply chain and material procurement experiences in the Banda Aceh Tsunami reconstruction**

Zuo, Potangaroa and Wilkinson (2007) examined the Boxing Day 2004 tsunami reconstruction experience to learn more about the effectiveness of supply chain and material procurement for post disaster reconstruction.

Following the tsunami, the procurement and supply of sustainable and legal construction material for the reconstruction become the first priority of almost every organisation involved in this process in Indonesia. Competition for limited resources and the lack of effective coordination between reconstruction agencies has nearly tripled the cost of a standard house and leaving thousands of people in transit living conditions years after the disaster.

A review of supply chain management (SCM) in Banda Aceh, the worst affected area, has been completed to understand the future development and adoption of an integrated SCM concept in post disaster reconstruction.

### **Relationships with Suppliers and Communication**

Suppliers have a profound and direct impact on cost, quality, time and responsiveness of the buying firms. Poor communication is often a fundamental weakness in the interface between a buying firm and its supplier, which undermines the buying firm's efforts to achieve increased levels of supplier performance.

This is a major problem experienced by various agencies involved in Aceh reconstruction embodied in competition for resources and increased difficulty in materials procurement.

### **Long-term Relationships with Fewer Suppliers**

Traditional practices of supply chain management tend to contract with multiple suppliers even for the same material or components. However, reduction of the supplier base is a unique characteristic of contemporary buyer–supplier relationships. This became important in the Aceh reconstruction, given the limited availability of construction materials and often inadequate administrative abilities of reconstruction agencies. Many firms are reducing the number of primary suppliers and allocating a majority of the purchased material requirements to a single source; the benefits attributed to this practice often exceed those achieved through traditional bidding from multiple sources, which often emphasizes low price at the expense of performance.

Long-term relationships between supplier and buyer have become a crucial characteristic of modern supply chain relationship

- Through close relationships supply chain partners are willing to share risks and reward and maintain the relationship over a longer period of time
- Through a long-term relationship, the supplier will become part of a well-managed chain and will have a lasting effect on the competitiveness of the entire supply chain

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A recent trend of supplier certification provides a potential solution to a number of procurement problems, including:

- enhanced buyer–supplier trust and communication
- improved supplier product quality
- reduced communication errors
- reduced inspection and inventory costs for the buyer

### **Supplier and Logistic Integration**

Supplier involvement has been found to be an important part of the strategy in reducing new product development time. Effective integration of suppliers into new product development can yield such benefits as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology.

Recently there has been a trend involving logistics integration across firm boundaries termed 'external integration'; the approach underlines the needs of mutual completion of procurement, production planning and distribution in order to carry out a unitary process.

Enterprise logistics integration is the extent to which a firm implements both internal and external integration. It can be characterized by integration of logistics activities across functional departments within the firm, as well as integration of the firm's logistics activities with the logistics activities of other supply chain members.

### **Challenges for the Banda Aceh tsunami reconstruction**

Almost every organization involved in Aceh reconstruction has been faced with issues related to the supply and procurement of legal and sustainable construction materials, especially the massive needs of timber.

Timber procurement has been faced with delays and the quality in some cases has been questionable. Following the tsunami, 70% of mainland Aceh is still covered by natural tropical forests. These resources are now open for exploitation since extensive illegal logging is currently taking place in Aceh forests. Major problems have been experienced in getting legal and sustainable timber supply for reconstruction.

Other problems in timber procurement in Aceh include the legitimacy of importing timber and associated timber treatment methods. Reliability and legality are key considerations and NGOs have the responsibility to ensure the legality of procurement from suppliers.

Obvious disadvantages include higher prices and longer delivery schedule (at least 4-6 weeks, but generally believed as long as 10 weeks). This is mainly because of limited order amounts (per order) and the lack of overall supply chain management and communications between procurement and project teams.

Larger orders of timber could be streamlined and procured at a lower price before subdividing into required smaller packages. However, storage of large amounts of international timber is another problem associated with imported timber; it also needs to be kept dry and

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out of direct sunshine in warehouses and this adds to the overall cost. Amidst uncertainty regarding the legitimacy of timber supplies, timber procurement in Aceh remains complex.

Similar problems may arise in New Zealand, with a largely export-lead timber industry that may not be able to supply the quantities of timber that may be required due to supply contracts. A clear policy is needed for the supply of timber and other materials post-disaster. In addition, contracts supported by good relationships and performance measures will need to be developed to ensure resilience at a national.

New Zealand suppliers and users of timber for construction and reconstruction would benefit from securing supply of timber and other building material from sources outside of New Zealand ahead of any disaster events; the objective should be to build appropriate supply relationships and negotiate performance-based contracts that ensure short turn-around in delivery at competitive prices.

### **Lessons from Banda Aceh relevant to New Zealand**

Reconstruction agencies should seek every possible way to secure suitable materials for the reconstruction effort. In New Zealand, the availability and suitability of alternative materials should be researched, documented and arrangements for potential supply (in the event of a disaster) should be put in place to ensure that recovery and reconstruction efforts are structured and co-ordinated effectively and efficiently.

Both in New Zealand and in Banda Aceh, buyers and suppliers must commit a greater amount of information and be willing to share sensitive information to achieve increased levels of supplier performance. Reducing the supplier base will minimise the administrative or transaction costs associated with managing a large number of vendors. Simplification of checks and balances in an integrated supply chain management process (involving both supplier and logistics aspects) is another key consideration.

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## 4.7 Key Lessons

### **Partnering and alliancing arrangements and industry familiarity make a difference**

*Following the Manawatu and Matata floods, the New Zealand experience has been that industry familiarity and enhanced level of trust-based collaboration within existing relationships has lent itself towards partnering and alliancing arrangements.*

*The use of relationship-focused contracts or procurement methods (e.g. partnering or traditional ones with traits of partnering) should be encouraged in post-disaster reconstruction to ensure an appropriate level of collaboration among involved parties and a higher level of industry familiarity.*

*However, reliable relationships need to be developed in advance of any disaster in order to establish a stronger platform for recovery and reconstruction. Larger scale disasters will be more demanding in terms of prepared procurement protocols and plans as well as established working relationships.*

### **Smooth post-disaster reconstruction will require both existing contractual arrangements and the pre-planning and development of supplementary arrangements**

*Clearly more flexibility is required if quick, effective (and efficient) post-disaster rebuilding is to be achieved. This may require use of existing contractual relationships wherever possible (those with a proven track record and based on trust), together with other supplementary arrangements where resources, skills and/or capacity need to be augmented. Preferably, such arrangements should be pre-planned. Failure to do so will be costly in terms of time, cost and quality and hinder a smooth construction process.*

### **Lessons from Banda Aceh – specific planning for scarce resources in NZ**

*While these lessons learnt in Banda Aceh may be dismissed as being particular to that geographic area, similar issues may be faced by reconstruction agencies in New Zealand faced with larger scale disasters. Resources that may be available within New Zealand would still need to be transported to the disaster area and relationship-based contracts for supply should be put in place in advance to facilitate this. Resources that are known to be scarce require special arrangements.*

*The implications are that New Zealand reconstruction agencies would need to critically review their current procurement and supply chain arrangements and practices to confirm their readiness to meaningfully engage in recovery and reconstruction. Alternative relationship-based procurement and contractual arrangements, including partnering and alliancing, offer dynamic options that add to organisations' resilience and their ability to facilitate recovery and reconstruction.*

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## **5. Resource Availability**

Availability of resources for post-disaster reconstruction is a major issue that requires a critical assessment. In the New Zealand construction industry the availability of aggregates, reinforcing bars and merchant steel products; cement and concrete; fuel; asphalt pavers; human resources and funding for state highway reconstruction would, for example, be critical in the event of a large earthquake.

Successful reconstruction will ultimately depend on the level of resources available to execute the necessary activities, with the availability of finances as important as materials, plant and labour. Availability of resources is also governed by the policies and strategies put in place by the authorities to deal with the reconstruction phase.

Each of the factors that are identified as impinging upon the availability and capability of the sector needs to be addressed as part of disaster preparedness.

### **5.1 Access and resources for reinstating damaged infrastructure**

Singh and Wilkinson (2008) researched the availability of resources for post-disaster reconstruction of State Highways in the Wellington region following a large earthquake, with a focus on aggregates, cement and concrete. A benchmark of the resources required for reinstatement of the state highways was established using a resource estimation method uniquely designed to integrate the level of damage to the state highway.

The State Highway network forms the core of the transportation system in New Zealand. It is also highly vulnerable to disasters. The Wellington State Highway network in a post-earthquake situation is crucial in providing access for the recovery of other lifelines. Getting resources into a disaster area delivers a logistical dilemma to the availability of resources. Restoration of the state highways to allow access for reconstruction resources will be a major challenge for post-disaster reconstruction.

Early research (up to 1995) concluded that New Zealand's resources could adequately undertake reconstruction following a Wellington fault earthquake. However, changes in the construction industry locally and abroad have necessitated another evaluation of the situation and this research highlights vulnerabilities within the sector.

### **5.2 Medium-term focus for pre-planning and scheduling of resource utilisation**

The research indicated that, following a large Wellington fault earthquake, reconstruction of state highways in the Wellington region could take as long as 3 to 5 years.

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The greatest difficulties of mobilising resources (resource availability) will be at the initial stage but can be expected to normalise as time elapses. Proper scheduling of resource utilisation and pre-planning plays an important part in ensuring that resources are available.

### **5.3 Availability of Construction Materials**

This research examined the availability of materials within the industry and revealed that the unavailability of aggregate, cement and concrete, steel and fuel was the greatest threat to post-disaster reconstruction.

#### **Aggregate:**

Following a Wellington earthquake, aggregate quarries are likely to be subjected to damage. The quarries in Wellington will be severely challenged to meet the demands of state highway reconstruction within the area and this may warrant importation from other regions.

Competition by contracted parties for aggregates, including those associated with other lifelines and private reconstruction, is also likely to lead to cost inflation. The high level of competition envisaged in a post-disaster scenario reinforces the need to enter into pre-disaster arrangements to secure aggregate supply.

Depending on the scale of damage to the quarries in the Wellington area, alternative sources (from other parts of New Zealand) will have to be considered, particularly in the initial stages of the reconstruction period.

#### **Cement and concrete:**

Cement and concrete unavailability is likely to be due to inadequate local production and limited number of suppliers of pre-cast components, coupled with long lead times.

The New Zealand manufacturing industry has its production levels geared to meet domestic demands. On average, the construction industry consumes 910,000 tonnes of cement per annum, from an annual production of 1,040,000 tonnes. This shows that limited scope exists for increases in consumption before supplies become critical. In the context of supply capacity for post-disaster recovery, the estimated quantity of cement required for state highway/bridge reinstatement alone (2000 tonnes), is likely to prove beyond the local industry's capability.

The supply of cement in a post-disaster scenario will depend on:

- (1) the prioritisation of construction works versus post-disaster works; if damaged infrastructure is valued greater than developmental works, then by virtue, post-disaster works would have first preference to cement, and
- (2) the ability of the major suppliers to collaborate with their overseas counterparts for supply assistance. New Zealand subsidiaries of larger international cement-manufacturing

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groups are in the position to ascertain the necessary assistance. However, importation of cement will have additional costs attached and longer lead times for shipping.

Procurement and supply of pre-cast units was identified as posing difficulties post-disaster. Component pre-casting (pipes, bridge lengths, columns and site barriers) generally requires considerably more engineering input than other concrete works. Based on current trends, there are fluctuations in supply of these pre-cast components, along with product lines such as culverts, piles and slabs. The increasing demand for pre-casting, coupled with the supply limitations, has created this shortage. The increased demand may also account for lead time problems identified by contractors.

### **Alternative approaches to supply problems**

Alleviation of supply problems may require the involvement of national contractors in post-disaster re-design. This will ensure that available products (post-disaster) are utilised, as opposed to traditionally used pre-cast components. This method is also consistent with international experience.

Lengthy lead times for procuring of pre-cast components may require amendments to design specifications to accommodate changes in material; this requires flexibility in the project team approach to alternative solutions.

## **5.4 Logistics of Transporting Resources into the Damaged Region**

Transportation is the obvious impediment to sourcing aggregates due to the physical barriers that will be imposed by the earthquake. Damage to rail and the state highways would make it impossible to transport bulk resources into the area during the initial stages of reconstruction.

The best alternative identified by several research participants is the utilisation of barges; this alternative mode of transportation of bulk raw materials (like aggregates) warrants further investigation as part of emergency post-disaster arrangements.

From a logistical perspective, it will be necessary for the road network to be substantially accessible before cement and concrete components can be effectively transported. Structural pre-cast concrete is effectively transported in New Zealand by articulated trucks. The road network will also facilitate ready mix concrete for in-situ works on joints and other construction that requires the use of mixing trucks.

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## 5.5 Key Lessons

### ***Pro-active assessment of resource availability and alternative supply arrangements***

*Pre-disaster planning for reconstruction following a large Wellington earthquake needs to address the availability of resources and find alternatives to current supply arrangements. This will involve determining ways of assessing the prioritisation of works, the ability to pool resources, the procurement lead times, existing contractual relationships and transportation into and around the disaster zone.*

*Given that aggregate production at a (Wellington) regional level is likely to be insufficient and national production would provide the aggregate requirements, importation of aggregates from other parts of New Zealand using barges has been identified as a practical alternative. The “Just-in-time” delivery model used in the New Zealand manufacturing industry to meet local demand for cement and cement products will not meet the increased demand following a large Wellington earthquake. The anticipated intense competition from various sectors and poor transportation conditions into Wellington will need to be addressed pro-actively.*

### ***Importation, alternative design and comprehensive resource planning***

*Importation (from within New Zealand and abroad) is a viable option of meeting the demand of post-disaster reconstruction. A reduction in current export levels of some of these products following the disaster could also assist in mobilising resources. Manufacturers with international connections should ensure that these products are adequately supplied but also plan for long lead times in delivery. Where product lines are limited, alternative designs should be considered that are less reliant on those products.*

*Appropriate resource planning, including planning for the availability of skilled tradesmen and technical professionals, will engender more confidence in resource availability and capability in the post-disaster reconstruction process.*

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## 6. Conclusions

From the Resilient Organisations research completed as part of Objective 3 thus far, a number of challenges remain for building resilience and preparedness for post-disaster reconstruction. Some of these challenges involve efforts on the part of key organisations to rectify or improve internal arrangements; others involve developing relationships with external stakeholders (e.g. suppliers and the community). The need for further, on-going research into different aspects of organisation resilience (related to legal and contractual frameworks for reconstruction) has also been identified.

Organisations that aim to achieve a greater degree of resilience and play their part in post-disaster reconstruction efforts will need to focus on achieving (1) appropriate relationship-based contractual arrangements, (2) more flexibility in their procurement systems and arrangements, and (3) more alignment and integration of legislative provisions to facilitate their interpretation and application (4) better integration of the construction supply-chain. Such improvements will enable organisations to play their part and to meaningfully engage in post-disaster recovery and reconstruction.

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## FEEDBACK FORM

### Resilient Organisations Research Report – 2008/01

This Industry Report has, hopefully, been thought-provoking. Your feedback is very important to the Resilient Organisations Team, so we encourage you to share some of your own ideas and organisational requirements with the Resilient Organisations Steering Group. Please complete this Form and email or fax your response to:

[dean@8020options.com](mailto:dean@8020options.com) , or (09) 4798661(fax), attention Dr Dean Myburgh.

1. The report is useful and my organisation will use all / some of the ideas from the report.

(please circle the appropriate response or, alternatively, delete the response that does not apply if completing electronically)

**YES NO**

Comments:

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I found the following sections of the report particularly interesting or useful. (please circle the appropriate response or, alternatively, delete the response that does not apply if completing electronically):

<b>Regulatory and Legislative Frameworks</b>	<b>YES</b>	<b>NO</b>
<b>Co-ordination and Prioritisation</b>	<b>YES</b>	<b>NO</b>
<b>Contractual Arrangements</b>	<b>YES</b>	<b>NO</b>



