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Legislation for building back better of horizontal infrastructure

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Abstract

Purpose – The purpose of this paper is to determine how post-disaster legislation can be used to support building back better (BBB) in the horizontal infrastructure sector (roading, water, wastewater and stormwater networks).

Design/methodology/approach – A case study approach was taken looking at the rebuild following the Canterbury earthquakes in New Zealand. Data were collected through document analysis and semi-structured open-ended interviews with members of the organization responsible for implementing the horizontal infrastructure rebuild.

Findings – The results showed that the post-disaster legislative actions taken in Christchurch were comparable to existing findings on post-disaster legislative best practices in developed countries. This study confirmed that post-disaster legislation is an effective mechanism to support BBB through enforcing BBB concepts such as risk reduction and better implementation, and facilitating the recovery process to improve efficiency.

Research limitations/implications – It is recommended that this study is extended to conduct similar case studies in other countries to further explore legislative implications in different sectors as well as different legislative environments.

Originality/value – This paper makes a valuable contribution to existing research on how post-disaster legislation can be used to support BBB in the horizontal infrastructure sector. The findings also add to wider knowledge on the Canterbury earthquakes recovery process.

Keywords Build back better, Reconstruction, Post-disaster recovery, Canterbury earthquakes, Disasters and legislation, Infrastructure reconstruction

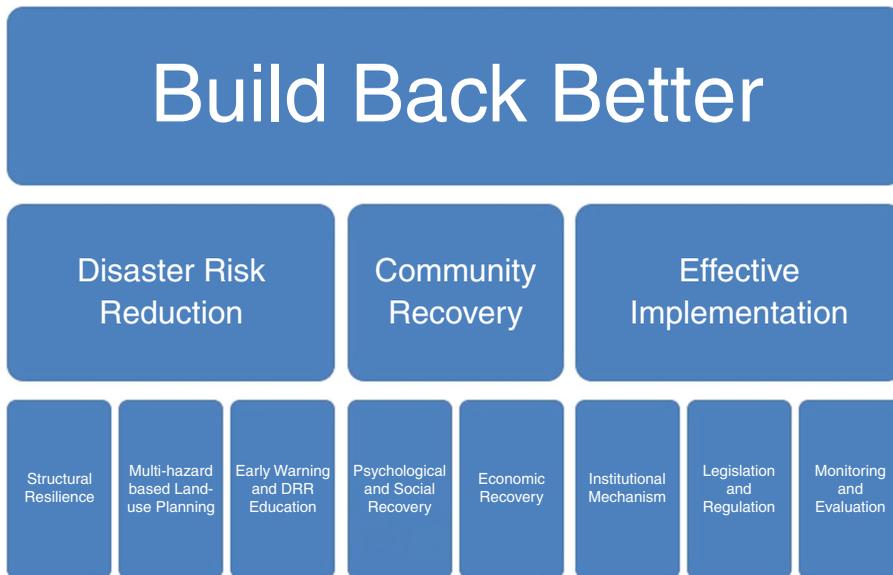
Paper type Research paper

Introduction

Building back better (BBB) is an important concept for resilience and has been recognized by the United Nations Sendai Framework for Disaster Risk Reduction (DRR) as a key global priority for action in the next 15 years (UNISDR, 2015). Despite having been recognized by the Sendai Framework, the phrase BBB is known to cause confusion where the definition of the word “better” is concerned. Some interpret “better” as modernization, while there is a strong argument that the term “Building Back Safer” is more appropriate to bring the focus towards increasing structural safety in rebuilds (Kennedy *et al.*, 2008). However, many authors and organizations including the United Nations and the World Bank use the term BBB widely recognizing it as a holistic concept where post-disaster reconstruction is used as an opportunity to improve the physical, social and economic conditions of vulnerable communities in a simultaneous manner (Clinton, 2006; Khasalamwa, 2009; Mannakkara, 2014; GFDRR *et al.*, 2015).

The BBB framework developed and modified by Mannakkara and Wilkinson (2014) (Figure 1) clarifies the scope of what the term BBB encapsulates, identifying BBB as a three-pronged approach to reconstruction and recovery including DRR, where measures are put in place to improve the structural resilience of the built environment, land-use planning based on multi-hazard analysis and DRR and early warning education for communities (Mannakkara and Wilkinson, 2012b, 2013a); community recovery, where the psycho-social recovery and economic recovery of affected communities is supported as a priority during the rebuild (Mannakkara and Wilkinson, 2012a, 2015); and effective implementation, where appropriate





Source: Mannakkara and Wilkinson (2014)

Figure 1.
BBB framework

institutional mechanisms, legislation and regulation and monitoring and evaluation is used to improve the effectiveness and efficiency of recovery as part of BBB (Mannakkara and Wilkinson, 2013c, 2016). The modified BBB framework is in use as a tool to assess and determine post-disaster recovery best practices internationally (Mannakkara and Wilkinson, 2013b; Bassett *et al.*, 2016; Mannakkara, 2016; Francis, 2016; Mannakkara and Wilkinson, 2014).

The objective of this paper is to understand how legislation can be used to support a BBB approach in the reconstruction of horizontal infrastructure (roading and water, wastewater and stormwater networks). This paper forms part of a wider study looking at identifying BBB best practices under Mannakkara and Wilkinson's BBB framework using the Canterbury earthquakes recovery as a case study. The experiences in Christchurch are used to determine best-practice recommendations that support efficient and effective reconstruction, which serve as BBB indicators for rebuilding in this sector.

Post-disaster legislation

Post-disaster reconstruction and recovery has traditionally been quite ad hoc, without any proper systems and processes in place to manage and guide the process (Le Masurier, 2015). The increasing number of disaster experiences recorded over recent years has led to more attention being placed on using legislative provisions to assist reconstruction and recovery efforts (Wilkinson *et al.*, 2015; Rotimi *et al.*, 2009; Birkland, 2007).

Emergency legislation put in place following disasters include special provisions for reconstruction and recovery such as the creation of recovery authorities to manage reconstruction. Examples include the Bureau of Rehabilitation and Recovery in Indonesia; Bam's Reconstruction Supreme Supervisory and Policymaking Association in Iran; and the Victorian Bushfire Reconstruction and Recovery Authority in Australia (Meigh, 2009; Omidvar *et al.*, 2010; VBBRA, 2009). Post-disaster legislation is used to enforce planning and design standards during reconstruction. In Sri Lanka following the 2004 Indian Ocean tsunami disaster, a planning provision called the coastal buffer zone was put in place to ban

construction along the coastal strip (GoSL, 2005). A similar no-build zone was also implemented in the Philippines following typhoon Haiyan (Thomas, 2015). In Australia, the building code for bushfire-prone areas was revised along with the implementation of new planning regulations to safeguard against bushfire risk (DPCD, 2013; Eco Logical Australia, 2010). Post-disaster legislation is also used to fast-track business-as-usual processes to prevent reconstruction bottle-necks (Meese *et al.*, 2005; Ingram *et al.*, 2006). Special post-disaster legislation facilitated the rebuilding efforts following disasters like the Northridge earthquake in San Francisco, Kashmir earthquake in Pakistan, the Kobe earthquake and the 2011 Great Eastern Japan earthquake and Tsunami (Bolin and Stanford, 1998; Halvorson and Hamilton, 2010; Ellsworth, 1995; Takeuchi, 2011).

Case studies conducted by Mannakkara and Wilkinson using the BBB framework as a tool have highlighted legislative provisions which support BBB for overall recovery (Table I) (Mannakkara and Wilkinson, 2013c; Mannakkara, 2014). The aim of this study is to use its findings to identify legislative best practices to support BBB in the horizontal infrastructure sector.

Case study: the Canterbury earthquakes

The Canterbury earthquakes sequence commenced with its first earthquake on 4 September 2010 which struck Christchurch with a magnitude of 7.1 Mw at a depth of 11 km (GeoNet, 2012b). This earthquake commonly called the Darfield earthquake, did not result in any fatalities but caused widespread damages due to soil liquefaction. The Canterbury earthquakes sequence continued with nearly 11,000 aftershocks within a period of 15 months, and another major earthquake on 22 February 2011 (GeoNet, 2012a; Turner, 2013). The February earthquake was the most devastating, leading to 185 deaths and extensive damages to buildings and infrastructure throughout Christchurch

Legislation for compliance	Legislation for building back better Legislation for facilitation
Provide legislative provisions to establish a recovery authority that is responsible for managing recovery	Provide legislative provisions to simplify and fast-track permit procedures for rebuilding
Provide legislative provisions to enforce (revised) building codes and building regulations	Provide legislative provisions to expedite release of state lands for temporary housing and resettlement operations
Provide legislative provisions to enforce (revised) planning regulations	Provide legislative provisions to expedite disbursement of funds
Provide legislative provisions to enforce risk management and retrofitting programmes for on-going management of hazard risks	Provide legislative provisions to assist business recovery (e.g.: providing subsidized office/shop spaces and equipment, low-interest business loans, and making special arrangements between businesses to support each other)
Provide legislative provisions to mandate community-inclusive and participatory recovery planning and implementation	Special facilitations should be made for businesses above what is normally provided for residential rebuilding
Provide legislative provisions to implement community support services	Flexibility with the end dates of legislative provisions
Provide legislative provisions to impose quality control specifications for stakeholder selection	Provide training and education for stakeholders and the community about new legislative changes
Provide legislative provisions to enforce standardized post-disaster building contracts for residential rebuilding	

Table I.
BBB indicators
for post-disaster
legislation

Source: Mannakkara (2014)

(Canterbury Earthquakes Royal Commission, 2012). The continuing aftershocks and two other big quakes on 13 June 2011 and 23 December 2011 exacerbated the situation. Soil liquefaction was a major factor which caused extensive damages to Christchurch's horizontal infrastructure (Christchurch City Council, 2013b; Cubrinovski *et al.*, 2014).

It was evident that Christchurch required a comprehensive rebuild, with particular attention needed for remediating damages from liquefied soils and repairing failed infrastructure networks. As with post-disaster reconstruction and recovery efforts worldwide, effective post-disaster legislation and regulation was necessary to carry out the rebuilding and recovery operations and ensure successful outcomes.

Implementing the horizontal infrastructure rebuild

One of the first actions taken by the New Zealand Government was to enforce the Canterbury Earthquake Recovery Act 2011 (CER Act). The CER Act legislated the creation of a separate body called the Canterbury Earthquake Recovery Authority (CERA) to lead and coordinate the recovery effort (CERA, 2011, 2013a). In light of the scale of the rebuild required and the need for fast reconstruction, an alliance called the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) was established to plan, design and execute the horizontal infrastructure rebuild (SCIRT, 2011; CERA, 2012). SCIRT's alliance included the Christchurch City Council (CCC), the CERA and the New Zealand Transport Agency (NZTA) as owner participants, and five of the country's major design and construction companies as non-owner participants (Hurley, 2013; SCIRT, 2011).

Research method

A case study approach was used to collect data for this paper. Maykut and Morehouse (1994) and Yin (2009) stated that case study research is suitable for exploring the nature of processes and allows for a deep understanding to be obtained. Since the objective of this study was to examine the use of post-disaster legislation and regulation in Christchurch to support BBB, adopting a case study approach was deemed most appropriate. The data for the study were collected from document analysis and semi-structured open-ended interviews.

Document analysis

Document analysis included a review of the pre- and post-disaster legislation and regulations relevant to horizontal infrastructure in Christchurch and post-disaster rebuilding and recovery. Key documents referred included relevant official legislation, recovery strategies, horizontal infrastructure policies and strategies, and physical construction and design standards used in the Christchurch rebuild as listed in Table II.

Semi-structured open-ended interviews

Interviews were the key research method used for this study. In total, 14 interviews were conducted with senior staff of SCIRT from each of the five delivery teams and four owner participants. The participants were selected based upon the structure of SCIRT to achieve an even representation across teams within the organization. Interviewees ranged from senior professional design engineers, senior on-site staff and senior management within the SCIRT alliance. The details of the interview participants are shown in Table III.

The interviews were semi-structured to ensure that common and comparable data could be obtained from each participant whilst also leaving scope and potential for spontaneous discussion to find more in-depth information regarding post-disaster legislation and regulation relevant to Christchurch's horizontal infrastructure rebuild. The interviews were approximately one hour in duration and were conducted in April and May of 2014, with follow-up interviews conducted in February 2015. The language of interviews was English,

DPM 26,1	Document name	Came into effect	Description
98	Infrastructure Rebuild Technical Standard and Guidelines (IRTSG)	Post-earthquakes	Provides the overall brief for rebuild projects associated with SCIRT
	Construction Standard Specifications (CSS)	Pre-earthquakes, adapted post-earthquakes	Guides construction of infrastructure within the Christchurch City Council (CCC) area
	Infrastructure Design Guidelines (IDS)	Pre-earthquakes, adapted post-earthquakes	Guides infrastructure design methods in the CCC area
Table II. Key documents used for document analysis	Canterbury Earthquake Recovery Act 2011	Post-earthquakes	Statute designed to assist the Canterbury earthquakes rebuild
	Recovery Strategy for Greater Christchurch	Post-earthquakes	Key reference document to guide and coordinate the programme of recovery work under the CER Act
Source: Author			

Role within SCIRT	Career duration	Experience levels		Participant identification
		Geographic location		
Delivery team project coordinators	Approx. 10 years (2), 20 years (2) and 30+years (1)	UK (1), Australia (1) and New Zealand (3)		P1 to P5
Delivery team site supervisors	Under 10 years (2), 30+years (1)	UK and Australia (1), New Zealand (2)		P6 to P8
Design team engineers	Under 10 years (2) and Approx. 20 years (2)	UK (1), Australia (1) and New Zealand (2)		P9 to P12
Senior managers	Approx. 20 years (1) and 30 +years (1)	UK (1) and New Zealand (1)		P13 and P14
Table III. Interview participant details				
Source: Author				

and the interviews were recorded with the permission of the participants. Each interviewee signed a consent form where anonymity and confidentiality was guaranteed unless otherwise specified by the participant.

Data analysis

The data analysis process began by transcribing the interviews. The transcribed data were then analysed using the “constant comparative analysis” method (Maykut and Morehouse, 1994), which is a process of coding data based on previous findings or collected data to form, enhance, confirm or discount theories. This process was used to identify the key post-disaster legislative decisions that assisted the horizontal infrastructure rebuild in Christchurch.

Reliability and validity of the data collected were ensured through using a number of sources to gain a wide perspective, ensuring that research outcomes fit with those observed with previous research, using the case study method which is used extensively for similar research, and establishing operational procedures early in the research to document and record the data collected for reliability.

Post-disaster legislative decisions in Christchurch’s horizontal infrastructure rebuild

The post-disaster recovery process in Christchurch followed many of the post-disaster legislative patterns in other countries such as Australia, USA, Haiti and Turkey where legislation was used for enforcement and also for facilitation of rebuilding (Meese *et al.*, 2005;

Bakir, 2004; Government of the Republic of Haiti, 2010; DPCD, 2013). The findings of this study are presented under: legislation for enforcement and legislation for facilitation.

Legislative provisions for enforcement were used to establish a recovery authority responsible for managing recovery, and to enforce building codes and revised building regulations. Legislative provisions for facilitation were used to simplify and fast-track permit procedures for rebuilding.

Legislation and regulation for enforcement

Establishing a recovery authority. The establishment of a recovery authority was one of the first legislative actions taken to support the rebuild in Christchurch. CERA, which was established to coordinate the overall rebuild, had legislative powers for five years, but had no fixed time frame for its lifespan (CERA, 2013a). When CERA was established, the New Zealand Government also passed the Canterbury Earthquake Recovery Act (CERA, 2011). P14 shared that “the CER Act gave CERA legal provisions to override the pre-disaster business-as-usual processes” (CERA, 2012). The provisions covered enabling community input into decision-making and cross-party forums, special powers granted to the minister and chief executive of CERA, guidance on the development and implementation of recovery planning instruments such as the Recovery Strategy, Recovery Plans and other aspects such as information gathering, reports and investigations.

The key reference document that guided and coordinated the programme of work was the Recovery Strategy for Greater Christchurch published by CERA (Recovery Strategy). The Recovery Strategy was also a legal document as defined by the CER Act and all rebuild associated activities were required to fit within the Recovery Strategy.

In terms of the horizontal infrastructure rebuild, SCIRT was responsible for rebuilding the affected road and water, wastewater and stormwater networks and fell under CERA’s umbrella (SCIRT, 2011; Hurley, 2013). P14 said that “CERA was also one of the three owner participants in the SCIRT alliance with a directive role in leading the projects undertaken by SCIRT’s delivery teams”. The interviewees confirmed that SCIRT did not have any legislative powers, and had to operate under the bounds of the CER Act and Recovery Strategy.

Enforcing building codes, revised building regulations and other legislation. P1-P12 said that many changes were made to the construction and design standards relevant to infrastructure construction during the progress of the Christchurch rebuild. Pre-earthquake guidelines for infrastructure construction implemented by the CCC such as the Civil Engineering Construction Standard Specifications and the Christchurch City Council Infrastructure Design Guidelines were modified for the rebuild based on the land-use changes and the structural enhancements required for BBB (Christchurch City Council, 2013a, 2014). The Infrastructure Recovery Technical Standards and Guidelines was created following the earthquakes by the CCC, CERA and the NZTA to identify the scope, objectives, intervention levels and defined standards for the rebuild (CERA, 2013b). P9-P12 shared that these construction and design standards were not enforced legally; but it was deemed unacceptable not to adhere to the modified standards unless separate approval had been specifically granted on a case by case basis. They confirmed that extensive checking and reviewing processes were in place during both construction and designs phases to ensure that regulations were being met and quality control processes were followed.

The Recovery Strategy stated that “resilience and improvement” or betterment in sectors including infrastructure were important objectives in the Christchurch rebuild. P9-P12 agreed that this effectively provided a directive to SCIRT and other organizations to consider and include betterment factors and make necessary changes in order to meet this requirement.

Further to infrastructure construction and design standards in Christchurch, wholesale changes to workplace health and safety legislation and management methods came into effect during the Christchurch rebuild, which were also applied nationally (New Zealand Government, 2013). These changes had a direct impact on SCIRT as a large proportion of their staff worked on live construction sites on a daily basis (P1-P8). P4 and P8 shared that the rebuild received a lot of media attention and therefore SCIRT had to be extra careful with issues regarding workplace health and safety.

P1-P8 and P10 said that a similar attitude was taken towards environmental management by SCIRT. There were no changes to environmental standards during this period, but SCIRT took extra care to prevent and minimize environmental failures (P1, P2, P4, P6, P7 and P10). P1-P4 and P6 stated that more effort was placed on environmental controls on sites, such as leachate and sediment control to reduce any discharges to waterways. P3 said that “Environmental Canterbury (ECan) also became more stringent in terms of environmental monitoring during the rebuild”.

Legislation and regulation for facilitation

Legislative facilitations were also a big part of the rebuild in Christchurch. Environmental legislation was relaxed significantly during the rebuild. P13 said, “for example untreated wastewater was allowed to be discharge to public waterways like rivers and streams over a short period of time until the wastewater networks were restored”. P4-P8 confirmed that close monitoring was conducted to ensure that there were no adverse effects on public health. They added that a concerted effort was put in place to inform the public about these legislation changes to reduce human interaction with waterways as much as possible.

The CER Act and Recovery Strategy together provided special legislative provisions which were available for horizontal infrastructure rebuild projects (CERA, 2011, 2012). The legislative provisions could override pre-disaster legislation to give precedence to repair, restoration and rebuilding activities. P13 said that “the New Zealand Government also made changes to the Resource Management Act to facilitate resource consenting and public consultation processes that also applied to the horizontal infrastructure sector” (Ministry for the Environment, 2010).

The results from this study showed that the post-disaster legislative decisions taken in Christchurch to support the horizontal infrastructure rebuild resembled other recovery efforts worldwide and were in-line with Mannakkara and Wilkinson’s BBB indicators from Table I. Legislation was used to enforce processes that contributed towards BBB such as revising technical design and construction guidelines to improve structural resilience of horizontal infrastructure and reduce future disaster risks consistent with international post-disaster recovery and BBB best practices (Mannakkara and Wilkinson, 2013c; Clinton, 2006). The establishment of recovery authorities like CERA and SCIRT to overlook the rebuild contributed to more effective and efficient implementation. Although other international recovery efforts including Sri Lanka following the Indian Ocean tsunami, Australia following the Victorian bushfires and America following hurricane Katrina followed the same template of establishing separate recovery authorities (Olshansky, 2005; Thiruppugazh, 2014; James Lee Witt Associates, 2005), the Christchurch case study displayed a positive example with SCIRT being established as an alliance including owner participants such as the CCC and CERA. SCIRT took on the responsibility of ensuring that their work was in-line with legislation as well as non-legislated regulations and standards to deliver improved, high quality horizontal infrastructure while being sensitive to the environment despite environmental regulations being relaxed during this period. Legislation was also used to facilitate systems and processes to improve the efficiency of the rebuild similar to the recovery effort in Victoria (DPCD, 2013).

The legislative decisions in Christchurch that supported BBB of horizontal infrastructure rebuild included:

- Establishing the Canterbury Earthquake Recovery Act to provide legislative provisions for enforcement and facilitation of reconstruction and recovery activities to improve efficiency and effectiveness.
- Establishing the CERA with legislative powers to manage the overall recovery process in a coordinated manner to BBB.
- Creating the Recovery Strategy for Greater Christchurch as a legislative document to guide the rebuild and recovery process. The Strategy being a legislative document gave it the power to implement projects that were beneficial to the long-term recovery of Christchurch.
- Establishing the SCIRT to plan and execute the horizontal infrastructure rebuild. SCIRT was a good example of BBB, where the local council, recovery authority, and design and construction companies all came together and displayed a concerted effort to solve the horizontal infrastructure issues in Christchurch and rebuild the roading and water networks in a sustainable manner.
- Modifying design and construction standards to reflect and address the changes that had arisen following the earthquakes.
- Modifying health and safety legislation to reflect and address the issues that arose as a result of the earthquakes and the rebuild.
- Simplifying permit procedures and prioritizing rebuild-related activities to facilitate the rebuilding process and improve recovery efficiency.
- Relaxing environmental legislation until wastewater networks were restored to facilitate the rebuild and prevent undue delays in reconstruction and restoration.
- Modifying the New Zealand Resource Management Act to facilitate resource consenting and public consultation processes to assist the rebuild.

Implementing legislative provisions that contributed to BBB was straightforward, and the stakeholders involved adhered to all requirements without hesitation. This can be attributed to the well-established legislative culture in New Zealand.

Conclusion

BBB has been recognized as an important concept in post-disaster environments to ensure that reconstruction and recovery contributes to creating communities that are resilient physically, socially and economically. Post-disaster legislation has been recognized as an effective way to support BBB by improving the efficiency and effectiveness of post-disaster recovery. Post-disaster legislation has been used to enforce reconstruction and recovery initiatives, as well as facilitate rebuilding and recovery by simplifying and fast-tracking existing legislative procedures. The post-disaster legislation implemented for the rebuilding of horizontal infrastructure including roading, water, wastewater and stormwater networks following the 2010/2011 Canterbury earthquakes was studied to identify legislative best practices that can support BBB.

This case study is able to back existing research that post-disaster legislation can be used to support BBB by enforcing principles related to BBB and improving the efficiency of the recovery process. The rebuild in Christchurch adopted many initiatives that contribute to BBB. Developing emergency legislation specifically to support the Canterbury earthquake rebuild and using this legislation to create recovery-specific authorities such as CERA and SCIRT

kick-started the rebuild and enabled recovery operations to be implemented in a coordinated manner. Construction guidelines, health and safety legislation and resource management, public consultation legislation and health and safety legislation were updated to suit new conditions following the earthquakes to enable reconstruction and recovery of horizontal infrastructure to take place without hindrance. Permit procedures and environmental regulations were relaxed to assist the rebuild. Apart from the effectiveness of the legislative actions taken to assist the rebuild, it is to be noted that New Zealand's culture of adherence to legislation and standards contributed to the success of initiatives that supported BBB in this case study.

This study did not explicitly consider political and cultural contexts that influenced legislation for BBB, therefore perhaps the specific influences and impacts of politics and culture in implementing legislation for BBB can be explored in future studies. Conducting further case studies looking at different sectors and different legislation is recommended to support the findings of this study and build on the knowledge base on how to successfully implement BBB practices.

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