7th i-Rec Conference 2015: **Reconstruction and Recovery in Urban Contexts**

Planning and design in the recovery of infrastructure networks – a study of Christchurch's post-earthquake reconstruction

Kristen MacAskill, Centre for Sustainable Development, Department of Engineering, University of Cambridge
Email: kam71@cam.ac.uk

Peter Guthrie, Centre for Sustainable Development, Department of Engineering, University of Cambridge
Email: pmg31@cam.ac.uk

Abstract

Infrastructure networks provide essential services such as water supply, wastewater collection, transport and flood protection. After a disaster, there is pressure to reinstate these services to pre-disaster levels as quickly as possible, helping to restore some form of 'normality' to urban life. Reconstruction programmes thus commence in highly uncertain decision-making environments and necessarily react to perceived, immediate needs. The extent and nature of the work is then re-evaluated and clarified as projects progress. This context of post-disaster response presents unique challenges to infrastructure design and delivery.

Such challenges are examined here through a case study of the reconstruction of infrastructure networks following a series of major earthquakes in 2010/11 in Christchurch, New Zealand. This is a longitudinal study, providing insights into the process of decision making as the recovery has evolved over time. It is informed by a series of semi-structured interviews with engineers and executives working on infrastructure recovery. These interviews were conducted from 2013 to 2015. Supplementary data includes direct project-related reports and broader documentation associated with the rebuild such as the recovery plans, audits and media reports.

A construction alliance, SCIRT, was created to lead the reconstruction of the local council's infrastructure networks in Christchurch. Despite a goal to "create resilient infrastructure that gives people security and confidence in the future of Christchurch" (SCIRT *c*.2011), there were limitations in SCIRT's ability to adopt this philosophy and reduce future risk of damage. A key factor is that there has been significant ongoing debate between local government and central government – and between local government and their insurers – over what work is eligible for recovery funding. There was a general remit to rebuild infrastructure using 'modern-equivalent standards', for example replacing damaged asbestos cement pipes (added to the network from the 1950s to 1980s) with plastic pipes that are more resilient to earthquake damage (Curbrinovski et al. 2014). However, adding extra pipe capacity, seismically reinforcing a pump

station or proposing alternative wastewater pipe technology often required greater justification. Either the local government needed to source extra funding or the 'more resilient' proposals needed to be cost-neutral compared to a straight replacement option (see MacAskill and Guthrie, 2015 for more detailed discussion).

While some resilience has been introduced to the infrastructure networks as part of the reconstruction process, it has proven difficult to return levels of service that existed prior to the earthquakes – particularly as time has moved on. During the earlier phases of the recovery, alternative technology was adopted in some areas where wastewater infrastructure sustained significant damage. However, as focus moved onto less damaged areas over time, the reality of the constrained funding environment became a more critical factor. With the local council facing a significant funding shortfall, a process of 'capital rationing' was introduced whereby some projects originally identified for the reconstruction programme were removed from the schedule (Law 2015). There have also been clear messages reported in the local paper since 2013 that there is not enough funding to completely rehabilitate road pavements (Yardley 2013).

In terms of 'building back better' (a concept related to resilience), it is important to reflect on SCIRT's role in the recovery. There has been a significant trend in recovery literature that criticises a focus on physical recovery, which has been done in the past without sufficient consideration of communities and social capital (Aldrich, 2010). The two are inherently linked where – particularly in a developed city like Christchurch – infrastructure services are a critical aspect of community recovery. While SCIRT is an organisation that focuses on physical infrastructure, there is awareness of the broader community impact. Although the extent of engagement on significant projects has been subject to some criticism (there has been a court case where a resident opposed the proposed new wastewater system for his community), SCIRT has conducted a substantial communication campaign to keep residents informed of projects in their communities. Another important point is that the Canterbury Earthquake Reconstruction Authority (CERA) is one of SCIRT's clients and provides direction to the infrastructure recovery. It is CERA's role to oversee the broader needs of the communities and coordinate this with the physical reconstruction of the city – providing a critical link between SCIRT's physical infrastructure focus and the more social concerns of recovery (discussed in MacAskill and Guthrie, In Press).

The SCIRT alliance is generally considered to be a successful model for delivering the infrastructure reconstruction programme, albeit with clear limits in its ability to reconstruct with added resilience. Working within clear limitations, the infrastructure design process maintained flexibility over time and responded to a changing decision context. Rules guiding key design decisions were continuously updated in response to a combination of factors, including: increased pressure to limit spending; an improved understanding of the exact nature of the damage and appropriate solutions to remedy it; and a shift in focus from highly damaged to less damaged areas of the city.

The Christchurch recovery provides useful lessons for network owners and managers facing recovery in the future. A quest to turn disaster into opportunity is a noble goal, but ultimately trade-offs are needed in determining how to effectively and efficiently spend available funds.

Keywords: post-disaster, infrastructure reconstruction, governance

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Roundtable theme

- ❑ **Disasters in urban context**

Author's Biography

Photo here (optional)	Beyond her academic pursuits, Kristen has worked for several years as a consulting engineer in both the water and transport sectors. Her experience covers diverse areas of infrastructure development, including: strategic level options assessment, post-earthquake damage assessment, infrastructure design, project management and sustainability assessment. In her research, Kristen is particularly interested in urban reconstruction, where there are opportunities to "build back better" and advance the sustainability/resilience agenda for infrastructure development. This has led Kristen to focus her PhD research on exploring decision making in post-disaster urban infrastructure reconstruction activities, with an aim to understand the extent to which sustainability, resilience and uncertainty influence the outcome of reconstruction programmes.