

Lessons learned from one of New Zealand's most challenging civil engineering projects: rebuilding the earthquake damaged pipes, roads, bridges and retaining walls in the city of Christchurch 2011 - 2016.

## Collectively we are stronger: Engineers generating collaborative solutions to strengthen community resilience post-disaster – document

**Story:** The 10th Brunel International Lecture Series: Collectively we are Stronger

**Theme:** The SCIRT Model

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A document made available to people attending Duncan Gibb's Brunel lecture.

This document has been provided as an example of a tool that might be useful for other organisations undertaking complex disaster recovery or infrastructure rebuild programmes.

For more information about this document, visit [www.scirtlearninglegacy.org.nz](http://www.scirtlearninglegacy.org.nz)



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# Collectively we are stronger

Engineers generating collaborative solutions to strengthen community resilience post-disaster

10<sup>th</sup> ICE Brunel International Lecture

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## Introduction

# “Collectively we are stronger - engineers generating collaborative solutions to strengthen community resilience post-disaster”

The Institution of Civil Engineers (ICE) established the Brunel International Lecture in 1999 in memory of Isambard Kingdom Brunel. These lectures have discussed the role of the engineer in topics including infrastructure and technology, sustainable development, the alleviation of human suffering due to poverty, and the lack of basic needs including water and shelter. The role of the engineer has been considered in preparing for and responding to the changing conditions within our global environment in the context of climatic (natural) or social, political (manmade) circumstances.

The key theme of the Lectures is that of the engineer in service of people.

**The 10<sup>th</sup> ICE Brunel International Lecture - “Collectively we are stronger”** - presents a post-disaster in which engineers are delivering outcomes for people through leadership, innovation and collaboration.

This case study demonstrates the results that can be achieved through harnessing the skills and experience of engineers with other diverse professionals and communities. The learnings from this scenario are directly relevant to the role of engineers in the dynamic environment that is the world of the 21st century.

The Brunel International Lecture is the ICE’s touring prestige lecture, as such it will be taken around the world to various venues. Continual feedback, comment and input will be sought from the audiences addressed to ensure that the content evolves, adapts and captures new insights over time. ■



## Learning through adversity

The global community needs to improve at preventing, preparing for and recovering from unexpected events such as natural disasters, human conflict and large scale outbreaks of disease. Engineers are well placed to act as leaders of change in this challenge.

This paper describes a post-disaster collaborative recovery organisation [the Stronger Christchurch Infrastructure Rebuild Team - SCIRT] designed by engineers and organisational specialists. The role of this organisation is to meet the massive horizontal infrastructure (potable water supply, sewer/wastewater, stormwater/drainage and road network) challenges created by a series of devastating earthquakes that struck Christchurch, New Zealand in 2010 and continued into 2011.

The model for SCIRT intentionally builds collaboration across multiple parties drawn together by an unwavering commitment to shared vision, goals and objectives. It is underpinned by established commercial principles that are robust and flexible and empowered through: broad sets of relationships, community engagement, leadership training and a wellbeing plan to support workforce resilience. It provides clarity, certainty and a supportive workplace for the hundreds of team members that were 'pulled together' from multiple highly competitive parent organisations to create an 'instant' organisation capable of responding in an environment of uncertainty and change.

The leadership of the SCIRT organisation have been continuously challenged and surprised by the ability of engineers to work with others to create innovative solutions to engineering, social, economic and public health dilemmas faced in the midst and shadow of disaster. Innovative construction methodologies, engagement and planning have been designed in consultation with communities to support broader social and economic outcomes.

It is clear that the collective power of individuals is exponentially increased through the intentional generation of collaboration and leadership.

The experiences of this purpose built organisation offer lessons for establishing post-disaster collaborative models that are transferable to other contexts and sectors. ◀



## Engineers – social innovators

It is fair to say that engineers are recognised for getting things done, they deliver outcomes. Whether it is designing, constructing and maintaining buildings and infrastructure or creating new and better solutions to problems which improve the quality of life of people across the world - engineers get things done.

This view of engineering is epitomised by civil engineers such as Isambard Kingdom Brunel who continually sought new challenges throughout his career in the design and construction of tunnelling, bridges, railways and shipping projects.

His introduction to engineering practice and project management started early as he took on the responsibilities as resident engineer for the Thames Tunnel at the age of 20. Throughout his career he was a man of tremendous vision, persuasion and innovation. He got things done.

He was continually seeking better, faster, more efficient and resilient solutions. He wasn't constrained by conventions of engineering discipline, but turned his reasoning and logic to the solution of the current problem or challenge at hand. Brunel established civil engineers as social innovators and entrepreneurs.

In his ICE Presidential Address in November 2005<sup>1</sup>, Gordon Masterton reflected on the challenge of 'Sustaining our Future': "In its broadest sense we, as engineers, need to view the 'big picture' in all we do. Brunel addressed the big issues of his time – the growth of trade, and transportation's crucial role in this. If Brunel were alive now, his global vision and genius would be applied to the planet-sized problems of today. Solving these problems will require civil engineers working in partnership, crossing disciplines. We need to use our engineering know-how to help influence and educate decision-makers – including the public stakeholders."

**If Brunel were alive now, his global vision and genius would be applied to the planet-sized problems of today. Solving these problems will require civil engineers working in partnership, crossing disciplines.**

It is becoming increasingly clear that tomorrow's foundation investment and development drivers are more about environmental and social outcomes, rather than simply technological and economic development. It is also apparent that the interface between human/social demands and the application of technology is – as it always has been – the domain of the civil engineer.<sup>1</sup>

Brunel literally connected people through transportation networks. The frontier for today's engineers is to forge networks of a less tangible nature. These are networks of diverse intellectual capital, experience and worldviews that are brought together to explore non-traditional approaches to complex problems.

It is time to expand on the 'engineers get things done' reputation to something that better reflects the role that engineers have in society. We achieve social, or community outcomes through engineering.

In the current global context it seems more appropriate we champion the view that 'engineers lead collective action to deliver outcomes by involving multiple sectors and perspectives in innovative ways'.

In doing so, we will meet the extraordinary challenges and risks of the 21st century. ◀



## Broader NZ context

New Zealand has always been vulnerable to natural hazards. Given the diversity of the natural landscape (both geologically and meteorologically), and its relative geographic isolation, the people of New Zealand are, and will continue to be, at risk from a large range of hazards.

To effectively manage the impact of hazards on communities, New Zealand has a well-established emergency management framework. This framework is built around an all-hazards, all-risks, comprehensive, multi-agency, integrated and community-focused approach.

National legislation, through the Civil Defence and Emergency Management (CDEM) Act 2002, provides an overview of the hazards that New Zealand faces on a national, regional and local scale. Each region in New Zealand outlines and ranks the hazards from which they are most at risk and develops mitigation strategies.

This Act sets out the duties, functions and powers of central government, local government, emergency services, lifeline utilities and the general public, and outlines significant powers and authorities for some individuals. A planning framework to achieve this purpose is set out in the National CDEM Plan 2005.

Following destructive earthquakes in the regional centre of Napier in 1931, the government of New Zealand had created a national insurance scheme to provide support to the communities affected by significant natural events. Changes were also made to the national building codes to upgrade the standards of housing stock and commercial buildings.

The Earthquake Commission Act 1993 sets the legal framework for the Earthquake Commission (EQC) and the provision of publicly-funded insurance against natural disaster damage. EQC is a government-owned Crown entity that provides cover for residential homes, land and contents. This cover is automatically provided if the owner has a current private insurance policy that includes fire insurance. EQC cover insures against loss or damage to dwellings, contents and land from earthquakes, natural landslips, volcanic eruptions, hydrothermal activity, and tsunamis, and for land damage caused by storms and floods.

Cover entitles the holder to up to \$100,000 for each dwelling, with any amount above that being paid by the policyholder's insurance company. This cover is government guaranteed, which provides assurance to consumers that if EQC cannot cover its obligations from the Natural Disaster Fund and its reinsurance, then the Government will pay the shortfall.

This, along with high levels of private insurance, required to enact the EQC facility, provided a strong foundation for the funding of housing and business repair.

When considered against the backdrop of other global disaster events, the Christchurch event was highly insured and financially underwritten. ◀



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## Christchurch, New Zealand – the impact of earthquake

A relevant case study for the consideration of the role of the civil engineer in the interface between human/social demands and the application of technology is provided by the rebuilding of the horizontal infrastructure damaged by the earthquake events of 2010 to 2011 in Christchurch, New Zealand.

An initial magnitude 7.1 earthquake on September 4, 2010 caused major damage to the city's housing, business and commercial buildings and public infrastructure, with miraculously, no fatalities. The damage to horizontal infrastructure was significant although geographically limited to approximately 10% of the city.

On February 22, 2011 Christchurch experienced its second large earthquake (6.3 magnitude) in what became a prolonged series of approximately 13,000 earthquakes and aftershocks resulting in severe stress for individuals, families and communities.

**The following statements are provided to illustrate the many facets of impact and recovery associated with this series of earthquakes:**

- The February earthquake created additional complexity for reconstruction through changing ground levels, locations of damage and quantum of damage.
- Severe damage occurred in almost all buildings in the central business district, core infrastructure (water, sewer/wastewater, power and telecommunications) and housing in many areas. There was also significant land damage.

- There has been widespread population movement throughout the greater Christchurch region with increases in the smaller rural districts of Selwyn and Waimakariri, which border Christchurch City. This has impacted on the social fabric of communities with smaller rural communities growing at the expense of the damaged eastern suburbs of Christchurch.
- There is currently a housing shortage and large increases in costs across both rental and purchase markets in the surrounding areas. This is particularly felt at the low end of the rental market and puts pressure on vulnerable residents.
- Extensive liquefaction, generating 400,000t of ejected silts, resulted from across multiple earthquake events causing stress within the community and damage to housing stock and infrastructure. Land damage in greater Christchurch is significant and complex. There is still uncertainty regarding land decisions for many affected properties.
- There have been a large number of properties deemed uneconomic to repair due to land damage and an increased seismic and flooding risk profile. Many residents have accepted the Government's offer to purchase damaged land and have purchased or built elsewhere.

**The cost of the rebuild will be approximately 10% of New Zealand's GDP (a large proportion considering that Great Japan Earthquake and Tsunami was estimated at 2-3% of GDP).**

- The cost of the rebuild will be approximately 10% of New Zealand's GDP (a large proportion considering that Great Japan Earthquake and Tsunami was estimated at 2-3% of GDP).
  - Christchurch property owners had a high rate of insurance (90%), with coverage through both public (EQC – Earthquake Commission) and private insurance schemes.
  - In April 2011 legislation was implemented as a result of the earthquakes (the Canterbury Earthquake Recovery Act) and a new government agency was established under the State Services Act (the Canterbury Earthquake Recovery Authority (CERA)), based in Christchurch to lead, through partnership, the recovery of greater Christchurch.
  - Three years after the September 2010 earthquake, the pressures of long-term recovery are reported to have resulted in the 'rise of secondary stressors'<sup>2</sup>.
  - Increases in rates of domestic violence and demand for counselling have been attributed to the financial, social and psychosocial pressures that have resulted from the earthquakes.
  - The quantity and processing of information needed in the rebuilding, repair and resettlement process can be overwhelming for people affected by the trauma of the earthquakes.
  - Pre-existing vulnerabilities have been exacerbated particularly in relation to housing affordability and there is concern that this has contributed to health issues and overcrowding. The need for temporary accommodation (due to repair processes) has not yet peaked.
  - Despite the challenges created by the earthquakes, a strength and depth of community resilience has been displayed across the affected communities of greater Canterbury. From the initial response where people mobilised to work together to solve problems, bright spots of community activity have continued. Transitional projects, conversations, events and functions generated by both the community organisations and government agencies have been instrumental in maintaining community motivation and engagement in hard times.
- In the context of a response to disaster, it is clear that the ability to respond to the repair and/or rebuilding of damaged buildings and infrastructure is important in its own right, but a key underlying element is that infrastructure assists the rebuilding of people's lives and the communities in which they live.
- The issues relating to both challenges of rebuilding infrastructure and communities are inextricably linked and need to be considered together. ◀

## The response – on the ground

In Christchurch the Civil Defence organisation, responding to its obligations under the CDEM Act, rapidly mobilised to manage the initial response to the earthquakes of September 2010 and February 2011. The February event was declared a 'state of emergency' by central government and the military was mobilised to support the Civil Defence.

The emergency services and local government, utilising the incumbent utility maintenance contractors, worked under the direction of Civil Defence to address the initial 'humanitarian relief' priorities of making safe buildings, roads and structures and providing sources of potable water, ablution facilities and shelter.

The emergency response phase, following the initial humanitarian relief phase, was managed by local government - The Christchurch City Council (*hereafter referred to as Council*). Private sector utility providers managed the reinstatement of power and telecommunications networks.

Many agencies and utilities performed very well in the response to the earthquakes. Review of the response noted that organisations that were well prepared in advance responded much better than those who were not.<sup>2</sup>

In accordance with the CDEM Act, an assurance was given by the central government of a contribution to the cost of works associated with the initial emergency response associated with the event. This provided confidence for the community and Council.

To facilitate the longer term recovery, Council formed the infrastructure rebuild management office (IRMO) in December 2010 and mobilised construction contractors and designers to undertake rebuild works. However, days after the media event which celebrated the official commencement of the longer term horizontal rebuild, the second more devastating earthquake struck on February 22, 2011.

The earthquake occurred at a relatively shallow depth, it was located close to the central business district (CBD), and occurred at lunch time. It created significant damage causing 185 deaths, the subsequent demolition of over 1,000 buildings in the CBD, and damage or destruction of tens of thousands of homes.

The initial approach to rebuilding horizontal infrastructure was no longer applicable given the increase in scale of impact. Something much larger and more powerful was required to provide the ability to respond to the increased scale. ◀

**Review of the response noted that organisations that were well prepared in advance responded much better than those who were not.<sup>2</sup>**

## The thinking behind the new 'delivery vehicle'

In determining how to respond to the second major earthquake event in February 2011, the asset owners - Council and New Zealand Transport Agency (NZTA, which represented the national government), identified the need for the combined development of a plan for recovery. NZTA had significant experience in large scale infrastructure procurement and delivery and was instrumental in providing leadership in the consideration of non-traditional solutions.

A working party was formed to consider the broad range of issues arising from the event. It included specialists in the areas of procurement, project management, commercial management, cost estimation/valuation, asset management, human resources, resource management and commercial facilitation. The team was resourced from within central and local government and from external consultancies.

### The working party considered issues including:

#### 1. Defining the 'scope of work' - what needs to be done.

The main consideration was on reinstatement of infrastructure, utilising information from the appropriate network asset management and operations teams informed by performance data. A significant proportion of the pipe infrastructure had been damaged and substantially filled with fine silts of liquefaction ejecta, creating overflows of sewage and wastewater.

A strong focus was given to the minimisation of public health issues by restoring water supply and sanitation, and the prioritisation of infrastructure to support social recovery.

**2. Funding** – An initial estimate of the cost of recovery was made, based on the available operational data. Preliminary information was provided to central and local government agencies to inform a separate funding conversation. Issues of potential funding through sources such as insurance, existing capital programmes and emergency funding were considered.

The working party was advised to proceed and a further public commitment of funding by central government was made, which helped to underpin confidence and facilitate a rapid response.

**3. Management/control structure** – Alternative structures were considered, however it was rapidly determined that traditional options would be inadequate in dealing with issues including the uncertainty of scope, urgency of response and management of risk. The collaborative relationship approach encompassed in alliancing was recommended as being the most appropriate means of controlling cost, time, quality and risk whilst delivering measurable outcomes.

**4. Resources** – With the scale of the recovery defined at a preliminary level it became apparent that securing resources was critical. A review of key resources - plant, labour, materials - identified that resources were available within the country.

**5. Time frame** – After considering the global context of the recovery of Christchurch as a city/community, it was determined that the immediate needs - returning basic services to the community, protecting public health and opening transport networks – could be addressed whilst initiating a longer-term planned, prioritised recovery programme.

The rebuild of the horizontal infrastructure was identified as an enabling programme for the broader recovery of community, business and government. A rapid response and a condensed duration were required.

With a tenfold increase in damage between the first and second major earthquake, it was determined that no single public or private organisation had the capacity to undertake the required response. A number of conversations at both the central and local government level led to the recommendation for a non-traditional solution—the approach was to incorporate *multiple actors from both the public and private sectors in a collaborative relationship*.

The working group proceeded to develop a procurement process to engage with the private sector in the creation of a single, purpose-built organisation, to act as the 'delivery vehicle' to reinstate the city's horizontal infrastructure.

From the outset the working group recognised that this organisation and its people needed to be practical, outcomes-focused, agile and innovative in order to cope with the uncertainties inherent in working in a post-earthquake environment, where the full scope of work was not yet fully understood and could change at any time due to additional earthquake events. ◀

## Shaping the 'delivery vehicle'

### The principles adopted for the 'delivery vehicle' were defined as:

1. A 'partnership', relationship-style commercial agreement, engaging multiple organisations (local and central government, private sector) and multiple disciplines (engineering, construction, community and stakeholder engagement, human resources, health and wellbeing, commercial and economic);
2. A commercial framework that aims to drive aligned value outcomes;
3. An organisational structure with clear accountability and authority to respond to the demands of the environment, within the scope and specifications provided by the clients/funders;
4. Planned transition from emergency response/repair to recovery and finally reconstruction;
5. A 'programme management' focus to gain consistency and maximise value across the recovery response, and to prioritise design and construction across multiple work fronts concurrently;
6. Utilisation of local resources as a priority;
7. Intentional accelerated development of the organisation and its people.

## The disaster recovery backdrop

The approach that was developed to deliver the rebuild of the horizontal infrastructure networks in Christchurch was based on experience from within both the public and private sectors of the engineering construction industry within New Zealand.

It is appropriate to review the established global body of knowledge referring to Disaster Management as a means of providing a benchmark against which to compare this approach.

### Increasing impact of disasters, a call to action

There is international acknowledgement that disasters are increasingly impacting society globally, with the trend expected to continue due to population increase and rapid urbanisation.<sup>3</sup>

In January 2005 the World Conference on Disaster Reduction was held in Hyogo, Japan, resulting in an agreed commitment to the reduction of disaster risk and the development of the Framework for Action 2005 – 2015.

### Within this framework five Priorities for Action were articulated as:

1. Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
4. Reduce the underlying risk factors.
5. Strengthen disaster preparedness for effective response at all levels.

As discussed earlier, New Zealand had been proactive in addressing these actions and had responded to disaster events on numerous occasions. Despite this, it was not prepared to respond to the scale of events in Christchurch.

### The disaster management cycle, plan for early recovery

The representation of the Disaster Management Cycle as expressed in Figure 1 (below) is adapted from the United Nations Development Programme (UNDP) Policy on Early Recovery, Bureau for Crisis Prevention and Recovery, 2008.<sup>4</sup>

This policy identifies the distinct phases of disaster management from the Preparedness and Prevention phases prior to an event through to initial humanitarian Relief, Recovery and Reconstruction phases post-event. It highlights the importance of the initial period following the disaster event. It also contends that *"properly implemented, early recovery can stabilise a situation, prevent further deterioration in national capacity, as well as foreshorten the humanitarian phase. It can reduce the gap between humanitarian and full recovery programmes (and) represents an effective and indispensable component of the response to crises."*

<sup>3</sup> World Conference on Disaster Reduction 18-22 January 2005, Kobe, Hyogo, Japan: Hyogo Framework for Action 2005–2015 Building the Resilience of Nations and Communities to Disasters

<sup>4</sup> United Nations Development Programme: Policy on Early Recovery, February 2008

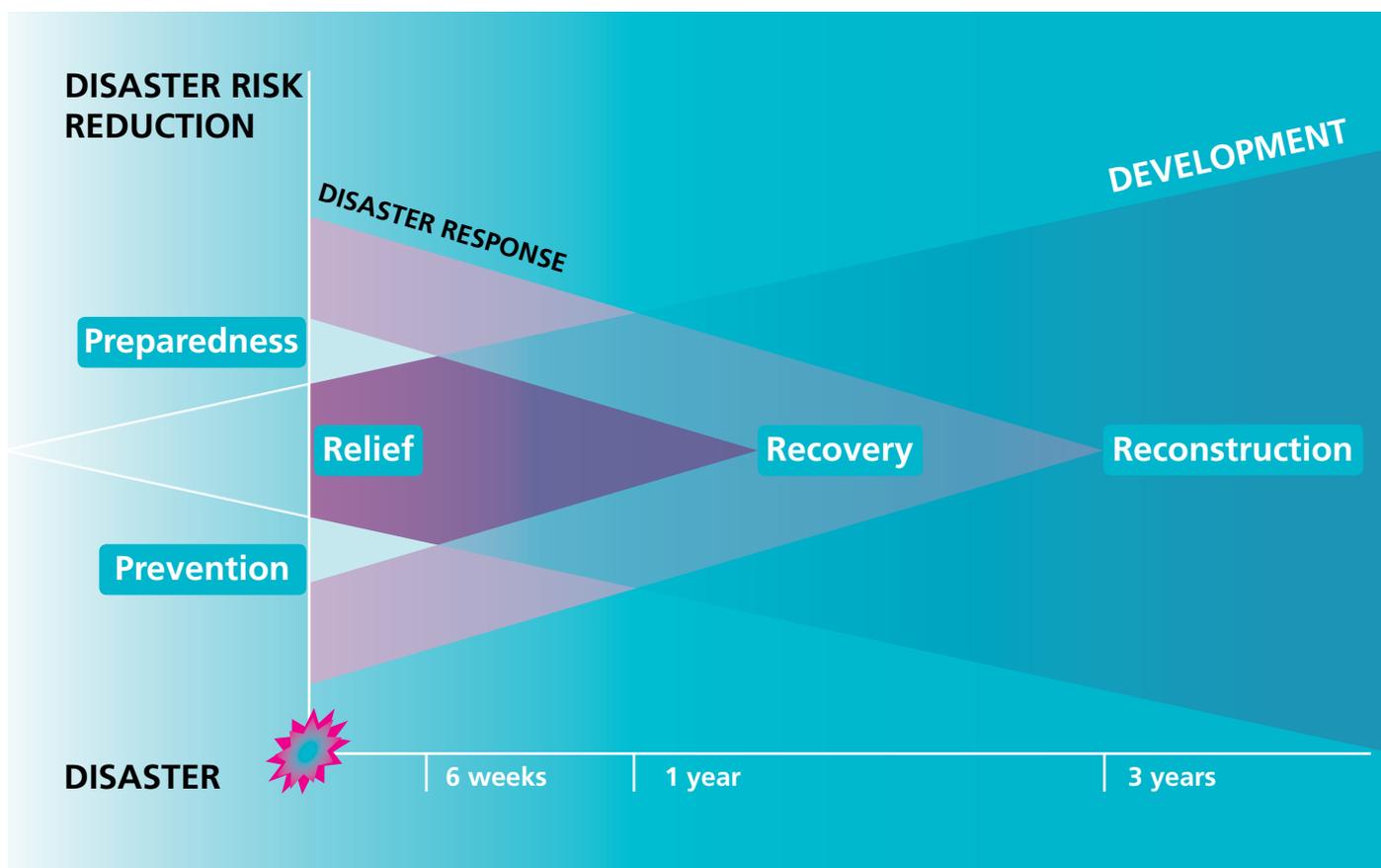


Figure 1: Disaster Management Cycle

The UNDP Policy on Early Recovery identifies the guiding development principles for early recovery activities as being:

**a) National ownership** - "is indispensable for the achievement of a more sustainable full recovery."

**b) National capacity utilisation and support** - "National ownership cannot fully materialise if national actors and institutions do not have the required capacities to lead, manage and implement the process. Early recovery programmes should develop the capacities of the state and other duty bearers to fulfil their main obligations and responsibilities towards the population."

**c) Community centred approach** - "This is the level at which some of the most meaningful early recovery activities are undertaken. Participation of communities and decision making, implementation and monitoring and evaluation of local programmes will increase the appropriateness of the early recovery interventions."

**d) Conflict prevention and risk reduction** - "A crisis can precipitate opportunities for improvements in conditions that resulted in the losses and instability in the first place. Building back better aims to promote the restoration of services, systems and institutions to a more advanced state than before the crises through the application of improved standards and policies."

**e) Promoting gender equality** - "The promotion of gender equality and women's empowerment should be integrated as a cross-cutting issue in all early activities and addressed from the initial assessment and planning stages of early recovery."

**f) Transparency and accountability** - "This comprises full accountability to beneficiaries, as well as to governments and donors. It includes a transparent recovery planning process, the sharing of good practises and rigorous monitoring and evaluation."

It is clear that New Zealand is relatively advanced in addressing these principles (with the institutional governance articulated in the preceding section, 'Broader New Zealand context'). The Christchurch response has a strong focus on improving resilience.

### More resilient communities

In the paper "Shifting agendas: response to resilience, The role of the engineer in disaster risk reduction"<sup>5</sup> Jo da Silva states that *"greater emphasis needs to be placed on the effectiveness of humanitarian response through better leadership, accountability, innovation and partnerships."*

The paper presents ideas that have strong links to the UNDP principle for early recovery activities. It talks about the need for a paradigm shift from response to resilience which *"requires action throughout the entirety of the disaster management cycle, including disaster risk reduction within development policy and programmes"*. This approach is aimed at creating *"safer and more resilient communities who are able to adapt to survive and recover from extreme events."*

The initial leadership in Christchurch was driven by central and local government with a focus on response. In the later recovery and reconstruction phases of the response cycle, a shift has occurred with local government leading a move towards greater understanding of, and action to develop, a community resilience focus.

It is important to consider that whilst the rebuild of the horizontal infrastructure is primarily increasing the reliability of the infrastructure networks, it also has positive secondary effects. With the rapid deployment of the rebuild team across the city, community confidence in the ongoing provision of essential services is increased. Community resilience is strengthened.

### Partnerships can aid recovery

The World Economic Forum's (WEF's) Engineering & Construction Disaster Resource Partnership, A New Private-Public Partnership Model for Disaster Response, 2010<sup>6</sup> acknowledges that traditionally the private sector has been looked on primarily as donors, but acknowledges that the *"emphasis has shifted from seeing the private sector's role as a donor to being more actively engaged in sharing expertise and capacity, both to reduce suffering and to help rebuild communities following a disaster, as well as to play a critical role in disaster risk reduction through prevention and preparedness."*

It has also been acknowledged that it is appropriate to fairly remunerate the private sector for expertise they bring to recovery.

The WEF paper further notes that *"several high profile failures and increasing competition between agencies have also lead to increasing pressure from within the humanitarian community and from donors for more professionalization and increased accountability to both donors and beneficiaries."* The private sector is well placed to contribute to increasing professionalism and accountability whilst collaborating with others to support the broader recovery vision.

The role of engineers in disaster response/recovery has until recently been limited to providing technical expertise in water and sanitation, shelter, logistics and communications and the rebuilding of roads and bridges. Engineering and construction resources are traditionally utilised through consultants employed by government and humanitarian agencies to enhance their capacity and through construction resources in the relief and reconstruction phases.

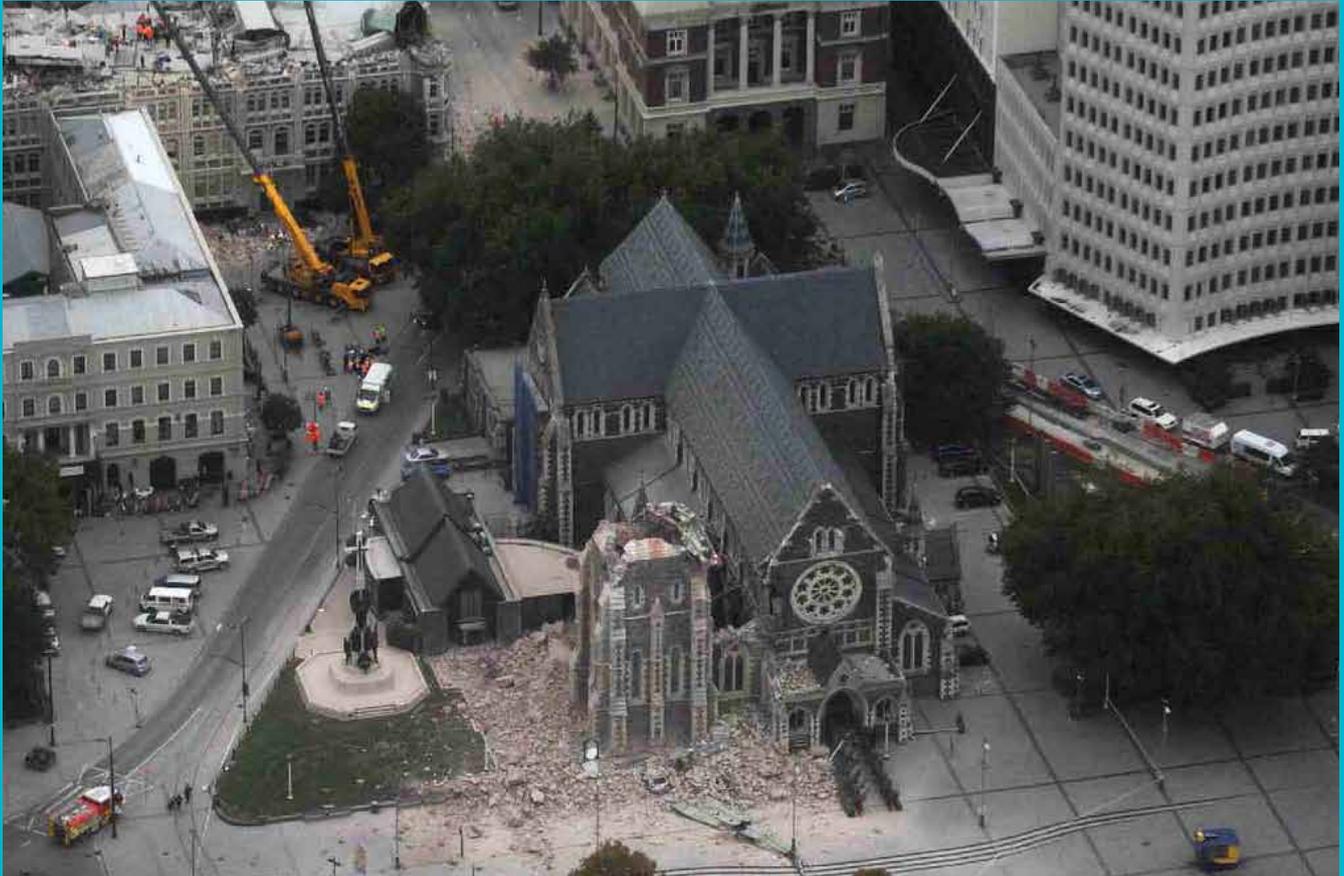
In the 2010 paper, the WEF discusses the engineering construction disaster resource partnerships (DRP), a tripartite model which brings together members of the engineering and construction industry with humanitarian and development agencies, and government. Importantly the DRP recognises that partnerships need to be created prior to a disaster and they need to exist at both national and international level. The capability of engineers as project managers and leaders working in partnership with other disciplines has been identified.

### Limited resources

The disaster management environment is inherently difficult. A myriad of actors are competing for limited resources and co-ordination is challenging within the local and international organisations focused on response. Greater levels of collaboration are required to optimise these limited resources. The increasing number of crises and the large number of actors involved in responding adds complexity.

Coordination and lack of collaboration are repeatedly cited as challenges in post-disaster recovery efforts. Agencies appear to operate as independent streams of effort and humanitarian aid agencies compete with each other for the 'donation' funding.

This section has described some key principles and ideas articulated throughout the global body of knowledge on disaster management and recovery. The Christchurch 'case study' can now be explored to determine whether it is a model that may have broader applications in meeting collaboration and coordination challenges of post-disaster and other contexts. ◀



**CASE STUDY:**

**THE CHRISTCHURCH 'CASE STUDY' - SCIRT**

**A 'partnership', relationship style contract**

In the SCIRT 'partnership', an Alliance Agreement is the overarching contractual arrangement. This involves three 'owner' public government participants (CCC, NZTA and CERA) and five 'non-owner' private contractor participants. An Alliance arrangement draws all participating organisations together to achieve agreed common goals and objectives within a framework that aligns commercial drivers and ensures that all participants either succeed or fail together.

**Commercial framework that aims to drive the best value outcomes**

This Alliance departs from a more traditional Alliance in that it requires the formation of a single united 'virtual organisation', whilst maintaining independent teams which are required to compete and collaborate.



An element of the commercial framework, a performance incentive or pain/gain, rewards those teams for excellent performance and encourages the stronger teams to collaborate with and assist the weaker performers. This creates a cycle of continuous improvement across the programme.

**An organisational structure with clear accountability and authority**

SCIRT's structure is represented in Figure 2 opposite.

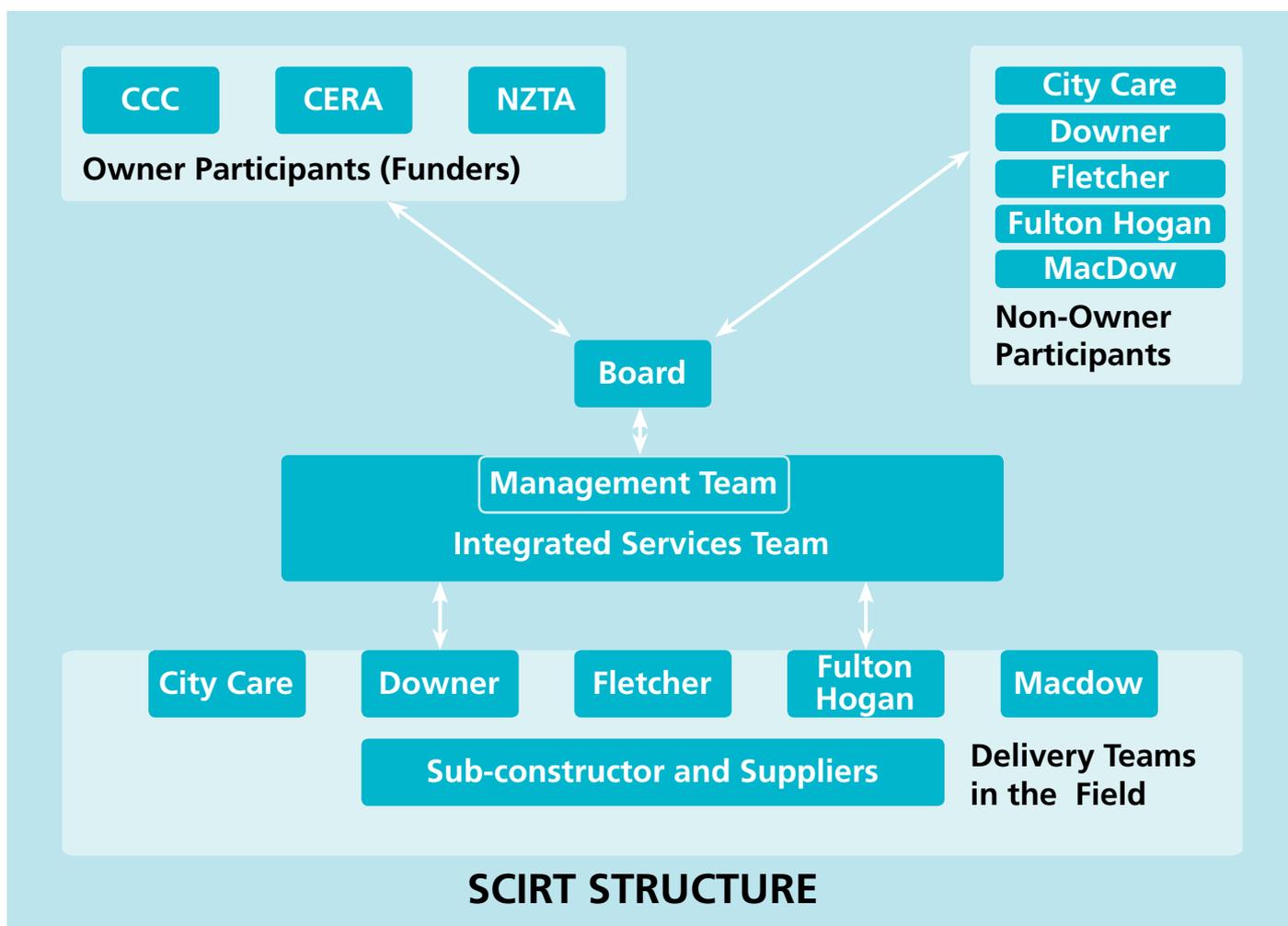


Figure 2: SCIRT Structure

Critical to the success of the collaborative approach is a clear understanding of the arrangement and total commitment to its success at the most senior level of each participant organisation.

The clients, recognising this at the outset, contracted an external facilitator to engage all parties in gaining a ‘shared understanding’ of, and commitment to, the chosen delivery model. Commitment to ongoing senior participation at the Board was also achieved.

External to the operational relationships of the SCIRT delivery vehicle, a separate client governance body, chaired by an external central government appointment, was subsequently created. This body is responsible for establishing a united client view in relation to areas of funding, strategy and scope definition for the horizontal infrastructure rebuild programme. In normal circumstances, i.e. not responding to a disaster, these functions

would be determined prior to the Alliance establishment. The client governance body operates in parallel with the SCIRT Board to provide policy and direction.

**‘Programme management’ focus to gain consistency and maximise value**

Under the SCIRT model the General Manager and a Management Team oversee a ‘corporate office’ known as the Integrated Services Team. The Integrated Services Team has the capacity to undertake the tasks of asset assessment, project definition and prioritisation, concept and detailed design, estimation and allocation of projects to Delivery Teams for construction. This team also provides programme consistency in the areas of community and stakeholder engagement, safety, quality, environmental, commercial and human resources performance.

Within the Integrated Services Team around 180 designers from 18 local consulting firms were engaged. A further 250 local technical personnel were engaged to undertake asset assessment of the hundreds of kilometres of water, sewer and wastewater and stormwater pipelines fractured and substantially filled with liquefaction ejecta. Refer to Figure 3 for summary of the damage estimate.

The use of local resource is a priority for SCIRT, providing the benefits of gaining the expertise of locals who understand the challenging geological conditions in terms of both design and construction. In addition, local resources attract a lower cost, and through their engagement in a meaningful recovery activity the psycho-social aspects of mental and social wellbeing of the community are in part addressed. All subcontractors and suppliers have been engaged from within New Zealand as a primary source supporting the local economy.

**Planned transition from emergency response to reconstruction**

The formation of SCIRT was undertaken in parallel with the emergency response works initiated after the first earthquake in September 2010. With emergency response works underway through the initial Council IRMO process, an intentional planning and preparation period was able to be implemented prior to commencement of work in the field. This process recognised the need for a transition between the initial emergency repair works and a longer-term planned, prioritised programme of infrastructure rebuild and reconstruction. There was a strategic plan to optimise the activities of the early recovery period in service of the final outcome or ‘end game’.

Estimated Damage			
Wastewater	Reticulation Pump Stations	km no.	659 86
Water Supply	Reticulation Pump Stations & Reservoirs	km no.	69 63
Stormwater	Reticulation Pump Stations	km no.	26 12
Roading	Carriageway Stormwater Bridges Retaining Walls	m2 km no. no.	1,320,375 135 152 244

Figure 3: Damage Estimate

## SCIRT - a disaster recovery solution

The SCIRT delivery vehicle was founded on a business management framework that was designed and developed to provide clarity and certainty for the hundreds of team members 'pulled together' from multiple parent organisations to create an 'instant' organisation.

Engineering, project and business management experience dictated that the traditional requirements for programme management be implemented, including:

### 1. The development and implementation of robust systems and procedures (programme management approach)

– including design and construction delivery, safety, quality, cost, environmental and risk and opportunity management;

2. 'Open book' data management and reporting – including specific reports to meet individual organisation requirements, and independent external audit/verification;

3. Process mapping – asset assessment / design / construction – solution development;

4. Engineering Solutions – inclusion of designers and constructors through early constructor involvement, safety in design, whole of life costing;

5. Collaboration – involvement of funders, asset owners, designers, constructors and technical experts - including local resources and organisations;

6. Innovation – a structured plan to generate and capture new resilient solutions;

7. Community Engagement – the people of Christchurch need to be informed and engaged.

The opportunity arose to develop specific 'tools' to service and enable the task at hand, starting with a 'blank canvas'. This enabled the scoping of each element of the information technology platform to best service the organisational and process architecture developed for the disaster response. The business systems were developed around the requirements of the Integrated Management Plans written to drive the organisation to achieve the agreed goals and objectives.

An organisation cannot function solely on systems and procedures – whether tailor made or not. The people who form the organisation must be aligned, motivated, engaged and empowered for success.

A crucial consideration for the successful creation of a united team of individuals, brought together from many separate organisations, is that of creating a single powerful culture. To enable this - the most challenging facet of the SCIRT organisation - it was acknowledged that assistance from specialist external service providers was required to assist the team to create and implement:

1. A plan to create an environment, or culture, that is focussed on the delivery of tangible outcomes (Peak Performance Plan) – the plan creates and builds on a foundation of a corporate Vision (or noble purpose), Values and Behaviours to facilitate the engagement and enrolment of team members. It is empowered through an intentional platform of collaboration.

2. A leadership programme – to build the capability of the team so they can 'lead from where they operate', identify and release potential leaders, to plan for intentional change of leaders for differing phases of recovery.

3. A training and development plan – to attract new entrants from the local community into the recovery, and provide training across all levels of the organisation.

4. An intentional wellbeing plan – to ensure that the team delivering the recovery remains resilient, whilst experiencing the impact of the disaster event on themselves and their families.

A significant strength of the delivery vehicle framework is the intentional planning of all aspects of the organisation prior to start up. The planning and development was undertaken over a four month period, enabling a structured approach to the identification and engagement of appropriate resources, provision of a purpose-built, efficient platform of systems, processes and procedures. The upfront planning and preparation enabled the team to optimise the effectiveness of the available resources as well as focus on ensuring the engagement and ongoing wellbeing of these resources. ◀

## What we have learned so far

In the context of repair and recovery from disaster, the Christchurch earthquake infrastructure rebuild undertaken through the SCIRT delivery vehicle is a useful case study. It demonstrates that the multiple party, public-private partnership model is an appropriate mechanism to consider, either before or after an event, or sequence of events. This model provides an effective framework for:

- 1. Collaboration** – between government agencies, humanitarian organisations, funders, designers, contractors and community organisations in service of a common agreed set of goals and objectives which are measured and monitored.
- 2. Intentional organisational development** – creating an environment to enable a high performance team focused on delivering outcomes, founded on a robust yet flexible contractual arrangement able to maintain certainty in an environment of uncertainty.
- 3. Intentional Leadership development** – with engagement, empowerment, outcomes focused training programmes targeted at building 'local resources' with the aim of the transition to a stage of 'local leadership' and the withdrawal of initial establishment resources.
- 4. Solution development** – providing practical, resilient engineering solutions including robust standard details for incorporation into existing specifications and utilisation of new materials and technologies. Construction methodologies to minimise the impact on the community, including traffic planning, community engagement and low impact construction are all examples of innovating for a better social outcome.

Throughout the rebuild, community and stakeholder engagement has been a central focus. With progress through the recovery cycle, it has become obvious that interaction with the affected community is crucial.

- 1.** In the operational communications the realisation that 'you cannot communicate too much' has been clear. Positive community support has been generated through open, honest, timely engagement. Maintaining integrity in all communications is critical.
- 2.** The attitude of the community changes markedly as the recovery progresses through phases. Where engagement or informing is suitable in the initial relief and early recovery phases, later recovery and reconstruction phases demand an increased level of consultation and two way involvement.

- 3.** An important piece of work is required in the consideration of 'cultural' aspects of communication. Don't be afraid to admit that you don't know what you don't know – engage with local community leaders across a number of organisations.

Examples of activities undertaken in Christchurch to enhance community resilience through intentional interaction include:

- Working closely with residents isolated from their homes by construction to provide alternative access.
- Working with businesses to minimise the disruption to trade.
- Sponsorship of the buskers festival, aimed at lifting community spirit.
- The teaming up of community engagement workers with Red Cross volunteers to support communities.

The Community Engagement Team interact closely with people impacted by the work in the field to keep them fully informed empowering them to make decisions. This approach reduces the 'secondary stressors' and aids in psycho-social recovery.

A complete suite of Integrated Programme Management Plans and a purpose-built, disaster recovery specific information technology platform have been created. The ability to 'start from scratch', without any requirement to utilise existing corporate systems or platforms, has been instrumental in enabling procurement of solutions that are best for the programme.

A business systems solution has been designed and developed to enable data from off-the-shelf information technology platforms (many donated by suppliers to the earthquake response) to be extracted and processed to respond to multiple reporting requirements from a single real-time data source.

An important component of reporting within the programme is a Value Report which identifies achievements of individual components of the programme measured against the business case established at the outset.

The processes, systems and procedures developed have been audited by multiple government agencies and external auditing companies to provide verification of performance and data security. The ability to provide confidence to stakeholders and external funders through visibility of information and operation is necessary. ◀

## Conclusion

My experience, the observations of experts consulted in the development of this paper, and published information regarding the response to disaster or crisis events, indicates that while response efforts are focused on serving the communities impacted, it would seem that they do so without an overarching intentional plan or framework that drives collaboration and effective coordination.

### The experience from SCIRT demonstrates that:

1. Implementation of a plan or collaborative 'framework for action' to combine the efforts and resources of organisations across phases of the disaster management cycle can deliver an optimised outcome, targeted at increasing the ability of the communities to survive and recover from crisis events.
2. Intentional involvement of potential stakeholder organisations through a structured process of engagement, held in the preparedness stages (prior to an event) will establish a foundation for early recovery, to achieve strategic goals guided by long term development planning.
3. The implementation of physical response, such as rebuilding infrastructure, can have a consequential effect of strengthening the resilience of communities and delivering recovery.
2. 'Model proforma' contractual/ commercial documentation, which can be modified for specific circumstances, to facilitate the activation of organisations previously identified for a rapid response post event.
3. A mechanism identifying key events and processes required to create an intentional collaborative response by the previously engaged organisations.
4. A suite of systems and procedures housed within appropriate software and hardware chosen for rapid deployment whilst providing robust and visible information.
5. A programme of activities to create a unique culture and environment for a specific 'delivery vehicle' targeting leadership skills development.
6. A model for the development of appropriate, enabling governance.
7. A plan for regular 'scenario playing' to facilitate operational preparedness.

The SCIRT organisation is delivering on its commitment to rebuild Christchurch's horizontal infrastructure. It is delivering results for Christchurch and New Zealand.

## Framework for action

The delivery vehicle developed for the Christchurch infrastructure rebuild forms the basis of a collaborative disaster recovery 'framework for action' that is scalable, robust, yet flexible enough for use in a number of situations.

The concept reflects and supports current international thinking in many areas and can be modified whilst maintaining the integrity of the approach.

The learnings from this case study identify that it is possible to provide a 'framework for action' which can provide :

1. A 'packaged solution', supported through a training programme for implementation as part of a Disaster Preparedness and Prevention process. A key component of training would include a plan for the facilitation of 'shared understanding' between organisations to ensure high level commitment to the fundamentals of the collaborative process.

It could be argued though, that the most important legacy is less tangible; that is the legacy of collaboration and competition, leadership and innovative behaviour that is imbued in those who have been involved in the horizontal infrastructure rebuild. The potential exists for this to filter through the industry, the country and into the international community. Engineers can lead collective action to deliver outcomes by involving multiple sectors and perspectives in innovative ways. Collectively we are stronger.

Our invitation is for you to consider our experience and adopt and adjust this framework to increase its power and effectiveness in your organisation and career.

## Notes

- <sup>1</sup> Engineering Civilisation from the Shadows, 6<sup>th</sup> ICE Brunel International Lecture by Professor Paul W Jowitt
- <sup>2</sup> New Zealand: Country Case Study Report – How Law and Regulation Supports Disaster Risk Reduction, E McNaughton paper supporting New Zealand legislation (draft 23 December 2013)
- <sup>3</sup> World Conference on Disaster Reduction 18-22 January 2005, Kobe, Hyogo, Japan: Hyogo Framework for Action 2005 – 2015 Building the Resilience of Nations and Communities to Disasters
- <sup>4</sup> United Nations Development Programme: Policy on Early Recovery, February 2008
- <sup>5</sup> Shifting Agendas – Response to resilience – The role of the engineer in disaster risk reduction, 9<sup>th</sup> ICE Brunel International Lecture by Jo da Silva OBE, Director Arup
- <sup>6</sup> World Economic Forum: Engineering & Construction Disaster Resource Partnership: A New Private-Public Partnership Model for Disaster Response, November 2010

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- <sup>7</sup> Margot Christellar, "Greater Christchurch's Future and the Recovery Functions", January 2014
- <sup>8</sup> Stanford Social Innovations Review, "Channeling Change: Making Collective Impact Work", [http://www.ssireview.org/blog/entry/channeling\\_change\\_making\\_collective\\_impact](http://www.ssireview.org/blog/entry/channeling_change_making_collective_impact)
- <sup>9</sup> Elisabeth McNaughton, "Leadership, wisdom and the post-disaster recovery process"
- <sup>10</sup> ALNAP, Margie Buchanan-Smith with Kim Scriven, "Leadership in Action: Leading effectively in humanitarian operations"
- <sup>11</sup> Cluster Working Group on Early Recovery in cooperation with the UNDG-ECHA Working Group, "Guidance Note on Early Recovery", April 2008
- <sup>12</sup> Resilient Organisations, A collaboration between research & industry, "Earthquakes, Floods, Snowstorms, Power outages, Equipment Break downs"
- <sup>13</sup> Rosemary Baird, Bernard Walker, Venkataraman Nilakant, "Building Resilient Infrastructure through Effective Leadership and Management of Infrastructure Organisations, Update on MBIE-funded Project"
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- <sup>15</sup> ICE, Institution of Civil Engineers, "Infrastructure impact and recovery following the 2010-2011 earthquakes in Christchurch, New Zealand", Terry Howes and Tim Cheesebrough, May 2013
- <sup>16</sup> Tenth U.S. National Conference on Earthquake Engineering, Frontiers of Earthquake Engineering, "Theorizing Community Resilience to Earthquakes", Scott B. Miles, July 2014

## Personal Perspective — everything in my career prepared me for this

### **In April 2011, with 30 years' engineering experience I found myself questioning why I had become an engineer.**

This followed an 'invitation' to lead the rebuild of horizontal infrastructure in Christchurch following the devastating series of earthquakes in 2010 and 2011. It meant moving overseas with my wife, away from our children, grandchildren, church, other support groups as well as a secure role managing a successful business in Australia.

I had had some exposure to disasters through witnessing bushfire decimating rural communities in southern Australia and also in responding to flooding in Queensland. I had, however, no formal insight into the current body of knowledge around disaster management. I had not before considered the opportunities for engineers to impact disaster recovery outside of the more obvious and traditional engineering role in the physical reconstruction work.

During the last half of my career I had been involved directly in 'relationship' or 'collaborative' contracting arrangements which had provided insight into a process of building high performance teams to deliver outstanding outcomes. This process had opened my eyes to the value that can be gained by engaging with other organisations and professional disciplines in service of achieving outcomes that I could not have imagined previously, let alone achieved.

What I enjoy about being an engineer is that we make things happen and get things done. Whether it is designing, constructing and maintaining buildings and infrastructure, or creating new and better solutions to problems which improve the quality of life of people across the world, engineers get things done. We achieve social, or community outcomes through engineering.

Since early 2010 I have been continuously challenged and surprised by the ability of engineers to work with others to create innovative solutions to engineering, social, economic and public health dilemma's faced in the midst and shadow of disaster. It has become clear to me that the collective power of individuals is exponentially increased through the intentional generation of collaboration and leadership.

After significant soul searching I have realised that I, and probably most engineers, do what we do to make a difference to people. As it turns out, everything in my professional career,

the good and the bad, had prepared me for this new challenge ..... and at the centre of it all, are people.

I recently took the time to review what had been accomplished in the rebuild of the horizontal infrastructure in Christchurch. This was prompted by the organisation receiving ad hoc acknowledgement for its work from international visitors, and by recognition received through a number of awards, including the ICE's Brunel Medal in 2013, an unexpected honour.

I wanted to explore how SCIRT was 'measuring up' in terms of disaster recovery and began to do some research. What I discovered is that SCIRT does have something to offer in terms of disaster recovery; our work is consistent with accepted practice and builds on this.

The Brunel International Lecture has provided two significant opportunities for me. The first is to encourage engineers to intentionally seek to identify that which we don't know that we don't know. I believe that we have become oblivious to the opportunities to learn from and collaborate with other professionals to enable us to unlock new more powerful opportunities to serve our communities.

Secondly I believe that when we look outside of our 'comfortable seat of experience' we can identify significant opportunities to use our skills and knowledge to benefit others in harnessing opportunities that they do not know how to deal with. This 'framework for action' developed out of engineering project management, and extended through collaboration with human resource, communications, economic, leadership development and humanitarian relief professionals has potential to unlock a significant improvement in both planning for, and response to, crises across the globe.

I agree with the view that engineers would gain from the development of modules in the engineering curriculum to enable the engineers of the future to be better equipped to deliver effective and holistic solutions to the real-world challenges society faces in the 21st century.

It is also clear that we cannot achieve the potential that stands before us on our own. It is through collaborating with others to harness our complementary skills and abilities that possibility will be unlocked.

**Collectively we are stronger!**



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