The CERA Spatial Data Infrastructure

A model for government ICT delivery

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Unprecedented Disruption

“The Public Sector holds large amounts of data but it is not being shared effectively and that there is a lack of knowledge as to what data are available where, and how one can access them.”

_Spatial Information in the New Zealand Economy Report 2009 cf_

Unprecedented is the phrase often used to describe the situation which Christchurch New Zealand encountered following the magnitude 7.1 and 6.3 earthquakes of September 2010 and February 2011 and their associated aftershocks.

Not only was the Christchurch City CBD virtually destroyed, the on-going aftermath included the removal of more than 200,000 tonnes of liquefaction silt, more than 1,000 km of roads requiring rebuild or repair and more than 500 km of sewer pipe needing replacement.

Over 100,000 houses were damaged and required repair or rebuilding. The Earthquake Commission (EQC) received over 400,000 claims and more than 8,000 residential properties were declared “Red Zoned” as they were unable to be redeveloped in the short to medium-term due to serious land damage.

Individuals, companies, NGOs and government agencies found themselves trying to glean information to respond and coordinate activities with an information infrastructure that was barely adequate in a peace-time situation, but was unable to meet the demands this crisis presented.
The Great Data Hunt

This setting provided the catalyst for the creation and on-going governance of a world-class spatial data infrastructure (SDI) by a collaborative group of local and national organisations from the Public and Private sectors in New Zealand.

The 2009 report; ‘Spatial Information in the New Zealand Economy’ stated that the Public Sector “holds large amounts of data [but it is] not being shared effectively and there is a lack of knowledge as to what data are available where, and how one can access them”1. This proved to be the greatest initial challenge. The team tasked with implementing the SDI knew that much of the data they required resided within local and national organisations with interests in Christchurch but most of those organisations were not accustomed to sharing their data with the Public or each other in a coordinated way. This underscored the policy, political, organisational and people challenges which far outweighed any technical challenges in implementing the SDI. The focus was therefore on building relationships, partnerships and trust with data stewards and custodians within those organisations. The partnerships and trust across the recovery partners remains the most important and enduring legacy of the CERA SDI.

Partnership & Trust

Land Information NZ (LINZ) took a remarkable leadership decision by initially funding a cloud-hosted geographical information system (GIS) from prominent New Zealand company NorthSouth GIS Ltd2. This GIS, which can be more accurately called a spatial data infrastructure (SDI), initiated a Public/Private partnership at the core of the on-going governance of the SDI. This immediately began to expand and evolve to meet the changing demands of various stakeholder agencies and organisations through the response and recovery phases.

In 2011, little was known and much was assumed yet in that climate of uncertainty, this ‘partnership of the willing’ between Public and Private Sector recovery agencies took its practical form in the shape of a “GIS roundtable” tasked with the Governance and Strategic direction of the SDI. Those recovery partners included: SCIRT3, Christchurch City Council, Land Information New Zealand (LINZ), Selwyn District Council, Waimakariri District Council, CERA, NorthSouthGIS Ltd.

Some agencies were often represented at the table by Private Sector organisations acting as agents for Government and Local Authorities, so business and government formed a strong bond where priorities and resources were shared and aligned between agencies.

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2 Named Explorer Graphics Ltd at the time and subsequently renamed as NorthSouth GIS

3 Stronger Christchurch Infrastructure Rebuild Team (SCIRT) is a partnership between Government and Private Sector infrastructure companies tasked with rebuilding horizontal infrastructure in Christchurch following the earthquakes of 2010 and 2011.
The CERA SDI is a practical demonstration of Government Policy, Guidelines and Declarations all working in concert.

Connecting the pieces
There are several theoretical or academic accounts of what an SDI might look like and how one might go about creating such an infrastructure, but very few, if any, actual working examples anywhere in the world. While the SDI embraces and validates current New Zealand Government strategy and indeed influenced some international thinking, not all of that guidance existed in 2011.

The CERA SDI Governance and Implementation model is a template for delivering Government initiatives that require multi-agency; Public/Private collaboration to achieve objectives as set out in the Govt ICT Strategy and Action Plan⁴, and to support the 10 challenging objectives the Government has set the Public Sector to achieve over the next five years⁵.

Govt ICT Strategy and Action Plan
“Delivering this plan requires a new operating model that provides system-wide coordination of investment, resources and capabilities, and develops business leaders across the system that can harness the full potential of technology and leverage information assets for transformative gains. This will not be a fully centralised model, but rather one that increases capability sharing”

⁵ http://www.ssc.govt.nz/bps-results-for-nzers
The SDI Cookbook

In the geospatial world, the CERA SDI is the real life expression of the LINZ SDI Cookbook\(^6\) published by the NZ Geospatial Office. The roles (geospatial custodian, geospatial steward) and standards prescribed in that series of documents can be observed successfully operating in the CERA SDI which can be considered complimentary to other government initiatives such as the LINZ Data Service [www.data.linz.govt.nz](http://www.linz.govt.nz/about-linz/our-location-strategy/connecting-and-sharing-geospatial-data) and the Government Data Portal [www.data.govt.nz](https://www.ict.govt.nz/programmes-and-initiatives/open-and-transparent-government/).

Declaration on Open and Transparent Government

The principles of the NZ Declaration on Open and Transparent Government\(^7\) can be found expressed in the CERA SDI, enabling citizens to engage with authoritative Government data. That encompasses the NZ Government Data Portal [www.data.govt.nz](https://www.ict.govt.nz/programmes-and-initiatives/open-and-transparent-government/) integrated into core SDI processes with all CERA-authored data discoverable on the data.govt.nz site linked from the CERA SDI landing page [www.cera.govt.nz/maps](http://creativecommons.org/licenses/by/3.0/nz/). The discovery and use component of the wider infrastructure is completed with CERA data licensed under Creative Commons by attribution (CC-BY 3.0 (NZ))\(^8\).

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\(\text{6} \quad \text{http://www.linz.govt.nz/about-linz/our-location-strategy/connecting-and-sharing-geospatial-data}\)

\(\text{7} \quad \text{https://www.ict.govt.nz/programmes-and-initiatives/open-and-transparent-government/}\)

\(\text{8} \quad \text{http://creativecommons.org/licenses/by/3.0/nz/}\)
Security AND flexibility

Within a single web-based tool access to specific data layers, layer attributes or geographies (location) can be controlled by role based credentials. Rather than multiple applications for multiple teams, a single application can be deployed with a security model allowing specific access.

Spatial information - the currency of disaster response

Within the SDI architecture (below) customer focused tools deliver over 4,000 datasets, from 80 secure and public data services including 10 separate imagery services from 14 public and private sector organisations.

CERA staff have an array of customised secure web viewers at their disposal, as well as bureau access to ad-hoc analysis and visualisation services commonly delivered on a just-in-time basis.

Non-technical users can view and query ‘packaged’ datasets in web-based viewers on industry standard platforms including Silverlight and HTML5. HTML5 is an open industry standard allowing device and browser agnostic delivery to any platform or device the user should choose.

Expert users can access the spatial data in a range of OGC standard formats9 directly from a central service catalogue; enforcing a single source of truth for CERA authored data.

9 Open GIS Consortium (OGC - http://www.opengeospatial.org/) and industry standard formats are available including: JavaScript Object Notation (JSON), Simple Object Access Protocol (SOAP), representational state transfer (REST), Web Map Service (WMS), Web Feature Service (WFS) and Keyhole Mark-up language (KML)
Responding to continuous change

Today the CERA spatial data infrastructure is mature, embedded and utilised throughout CERA and many organisations and agencies involved in the recovery. While comprised of the technical, data, policy and organisational elements one might expect in any SDI; what it delivers is an agile framework for successfully responding to continuous change. The CERA SDI is a fully cloud-hosted, service-oriented-architecture (SOA) utilising an Infrastructure as a Service (IaaS)/Software as a Service (SaaS) model. Loosely coupled components allow for minimal dependency and agile development to occur in the constantly changing Christchurch recovery environment.

During one of the more significant landzone announcements of 2012 the SDI supported in excess of 4,000 map requests a minute sustained for several hours.

Learning to Fail Fast

Some technologies are either not available or simply do not work. An example is the (OGC standard) web feature service transactional (WFS-T\(^\text{11}\)) which allows querying and retrieval of geospatial features between different software platforms. In 2011/12 WFS-T; while published and available within leading GIS software solutions, simply did not work. In consultation with two of the world’s leading GIS software developers; Esri\(^\text{12}\) and Intergraph\(^\text{13}\), it was revealed that the WFS-T standard had never been implemented in a production environment anywhere in the world. The CERA SDI was the first to try to do so. This necessitated developing a technical workaround for integration across the platforms while acting as a test-bed for advanced on-going WFS-T development within Esri, Intergraph and the wider OGC community.

\(^{10}\) Loose coupling is an approach to interconnecting the components in a SDI so that those components depend on each other to the least extent practicable. Coupling refers to the degree of direct knowledge that one element has of another.

\(^{11}\) http://www.ogcnetwork.net/taxonomy/term/170

\(^{12}\) http://www.esri.com/

\(^{13}\) http://www.intergraph.com/
Measure to manage
Web analytics offer powerful insights into audience and user behaviour.

Below we see a highly repeatable pattern of weekday use of CERA public map viewers. The two spikes in early-May and mid-June 2014 represent significant flooding events affecting many citizens in the heavily damaged eastern suburbs of the city of Christchurch. Timely access to accurate data was invaluable to affected people and responding agencies alike.

Show me the data!
Property owners in Christchurch have been faced with significant challenges in insurance, town planning, property remediation and flooding issues. This in turn complicated the areas of residential construction (particularly foundation design), insurance and re-insurance. Property owners, developers, builders and insurance companies needed timely access to data to quantify risk, enable mitigation strategies, and lower foundation and insurance costs so that rebuilding could commence.

One of the simple solutions to this challenge is the Christchurch City Council (CCC) Flood Levels Viewer (http://maps.cera.govt.nz/advanced-viewer/?Viewer=Ccc-Floor-Leve) which is hosted on the CERA SDI on behalf of CCC. This is a simple viewer with land-zones, flood-extent models and floor level parameters. Built in a week on HTML5, it will run on any device. It was first deployed on 10 April 2012 and by the end of October 2012 had recorded 580,000 individual browser sessions. It remains one of the most-used sites for CERA with an average of over 300 unique user visits per day.
Heuristics and thinking outside the square

Through 2011 and into 2012 various CERA teams and supporting agencies from Infrastructure to Community Wellbeing were struggling to understand the scope and nature of population movement. While there was considerable anecdotal evidence indicating significant population movement; there was no available data even approaching a level sufficient for meaningful decision-making or policy development. The SDI Team began thinking about data that might indicate property occupancy or vacancy and came up with a heuristics-based\(^{14}\) approach using postal redirection and power usage data. Both NZ Post and local power companies had property (address) level data.

While not definitive at an individual property level, when combined with Statistics NZ population data these simple maps and underlying data presented a clear, suburb-level view of population movement that was invaluable to CERA and agencies involved in the recovery.

Fit for purpose in a changing world

There is no doubt that the CERA SDI remains one of the success stories to rise from the ruins of a significant natural disaster. In many ways the business of CERA has been that of a conglomerate of government agencies on speed. Because of this, the effects of some business problems present in inter alia insurance and town planning processes have been magnified to disproportionate levels compared to “peacetime”.

The earthquakes presented unparalleled challenges for everyone from responding agencies to residents in Christchurch. Indeed, while many people at work were

\(^{14}\) A heuristic technique is an approach to problem solving, learning, or discovery that employs a practical method not guaranteed to be optimal or perfect, but sufficient to achieve the immediate goals, particularly where finding an optimal solution is impossible, impractical to too time-consuming.
dealing with the challenges their organisations faced in responding to the crisis, many were also dealing with personal challenges at home.

The provision of a best of breed spatial data infrastructure has enabled the region to respond with timely and decisive evidence based policy, planning and projects to meet the unprecedented challenges of five years of earthquake recovery in Canterbury. While focused on a natural disaster recovery in a specific geography; the overarching framework could be applied to any Government context in any town, region or at a National level and as such is a model for ICT Service delivery across Government in New Zealand.
About the authors

The Canterbury Earthquake Recovery Authority (CERA) is the New Zealand Government agency established in April 2011 to lead and coordinate the response and recovery from the Canterbury Earthquake Sequence for a period of five years.

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Stephen is the Data & GIS Manager at CERA who has overseen the on-going development of the CERA Spatial Data Infrastructure (SDI) and its support to the wider stakeholder community. Stephen is a location information and SDI specialist with a background in surveying and GIS, who has worked across the public and private sectors. Outcomes focussed and agile-thinking, Stephen delivers results in a dynamic discovery based environment.

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Martin has a broad background across the spectrum of knowledge management disciplines ranging from; spatial data infrastructure (SDI) and GIS; programme and project management, document and content management, agile and discovery-based methodologies and information architecture design. That experience spans 30 plus years across the New Zealand public and private sectors including central and local government. Martin is an active writer, blogger and thought leader in knowledge management communities with several published whitepapers and articles.

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¹⁵ http://creativecommons.org/licenses/by/3.0/nz/