The Canterbury Earthquake Recovery Authority Spatial Data Infrastructure

A model for government information and communications technology delivery

Stephen Ferriss, Martin Erasmuson

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CERA
Canterbury Earthquake Recovery Authority
Te Mana Haumanu ki Waitaha

A business whitepaper

Not Government policy

Contents

Unprecedented disruption

"The Public Sector holds large amounts of data [but they are] not being shared effectively and 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, 2009

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

The Christchurch city centre was virtually destroyed. Moreover, in the ongoing aftermath it was necessary to remove more than 200,000 tonnes of liquefaction silt, rebuild or repair more than 1,000 km of roads and replace more than 500 km of sewer pipes.

Over 100,000 houses were damaged and required repair or rebuilding. The Earthquake Commission (EQC) received over 400,000 claims. 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.

Central and local government and businesses alike found themselves trying to glean information to respond to the disaster and coordinate activities with an information infrastructure that was barely adequate for business as usual, and was certainly unable to meet the demands this crisis presented.

The great data hunt

This unprecedented setting provided the catalyst for the creation and ongoing 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 they are] 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 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 established across the recovery partners remain the most important and enduring legacy of the Canterbury Earthquake Recovery Authority (CERA) SDI.

Partnerships and trust

Land Information New Zealand (LINZ) took a remarkable leadership decision by initially funding a cloud-hosted geographical information system (GIS) from prominent New Zealand company NorthSouth GIS Ltd.[2] This GIS, which can be more accurately called a spatial data infrastructure, initiated a public–private partnership at the core of the ongoing 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 providing the governance and strategic direction of the SDI. The recovery partners involved included the Stronger Christchurch Infrastructure Rebuild Team (SCIRT),[3] Christchurch City Council, LINZ, Selwyn District Council, Waimakariri District Council, Environment Canterbury and CERA.

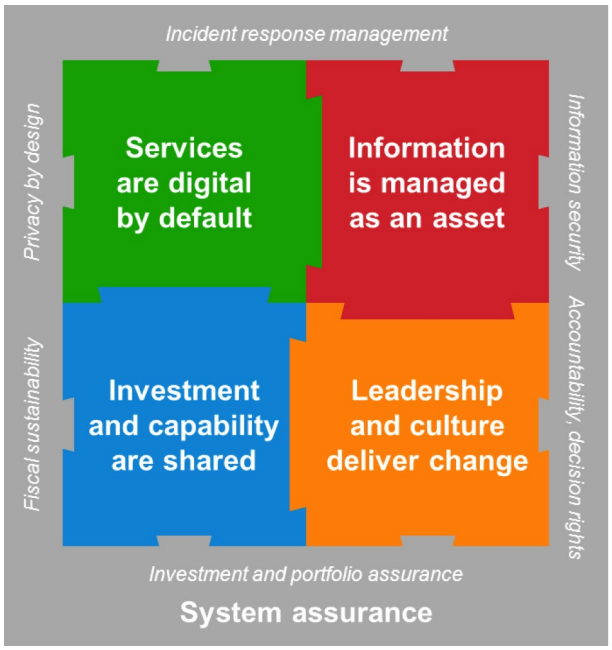
Some agencies were often represented at the table by private sector organisations acting as agents for government and local authorities, so business and government formed a strong bond where priorities and resources were shared and aligned between partners.

[1] *Section 3.1.2, Spatial Information in the New Zealand Economy: http://www.linz.govt.nz/about-linz/our-location-strategy/geospatial-projects/spatial-information-new-zealand-economy*

[2] *Named Explorer Graphics Ltd at the time and subsequently renamed as NorthSouth GIS.*

[3] *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 to create such an infrastructure. However, very few, if any, actual working examples exist 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 **Government ICT Strategy and Action Plan**[4] and to support the 10 challenging objectives the Government has set the public sector to achieve over the next five years.[5]

Government 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."

[4] https://www.ict.govt.nz/strategy-and-action-plan/strategy/

[5] http://www.ssc.govt.nz/bps-results-for-nzers

Integrated

The SDI Cookbook

In the geospatial world, the CERA SDI is the real-life expression of the **LINZ SDI Cookbook**[6] published by the New Zealand 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 complementary to other government initiatives such as the LINZ Data Service (www.data.linz.govt.nz) and the Government Data Portal (www.data.govt.nz).

Declaration on Open and Transparent Government

The principles of the **New Zealand Declaration on Open and Transparent Government**[7] are expressed in the CERA SDI, enabling citizens to engage with authoritative government data. That encompasses integrating the New Zealand Government Data Portal (www.data.govt.nz) into core SDI processes so that all CERA-authored data can be discovered on the Government Data Portal, which is linked from the CERA SDI landing page (www.cera.govt.nz/maps). 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]

[6] http://www.linz.govt.nz/about-linz/our-location-strategy/connecting-and-sharing-geospatial-data

[7] https://www.ict.govt.nz/programmes-and-initiatives/open-and-transparent-government/

[8] 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 having multiple applications for multiple teams, a single application can be deployed with a security model allowing specific access.

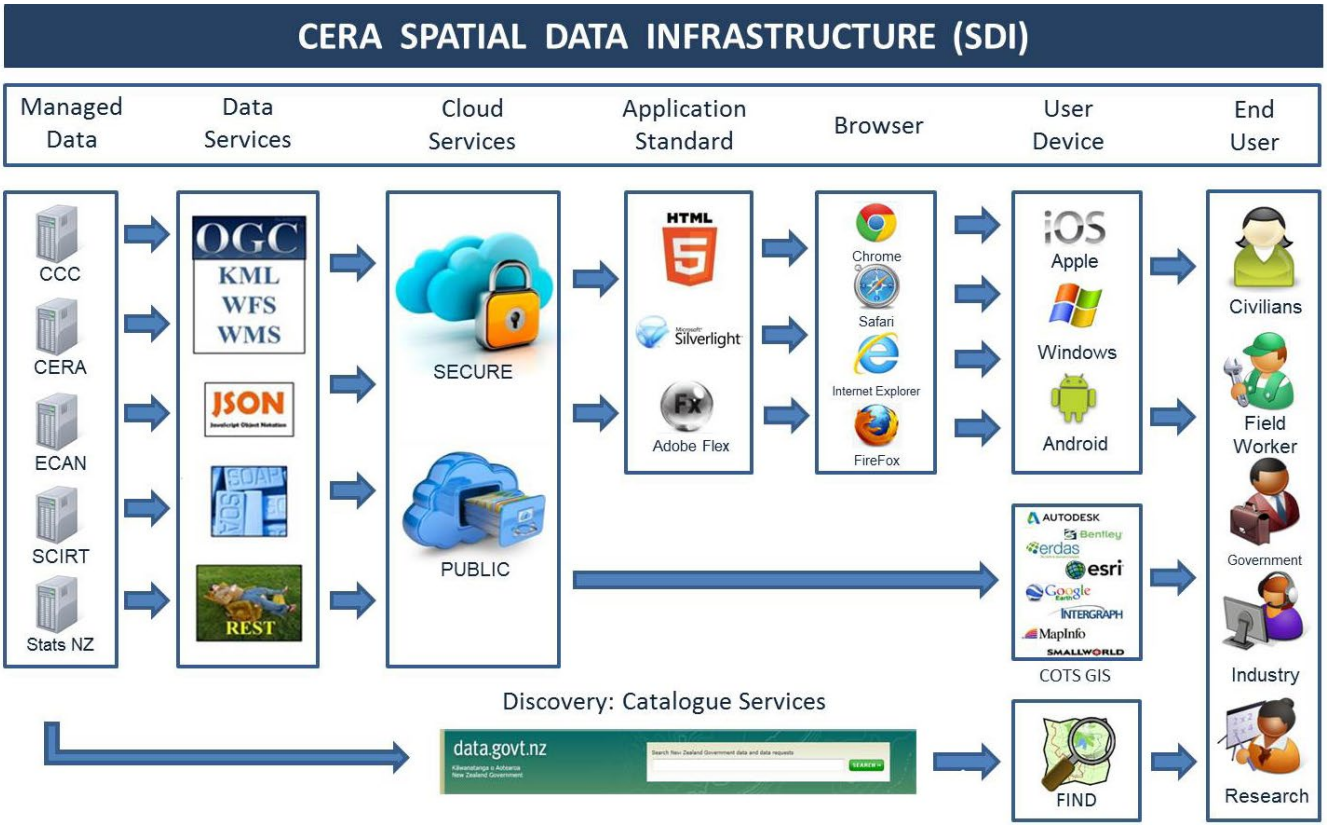
Spatial information – the currency of disaster response

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 available, as well as bureau access to 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 delivery to any browser, platform or device the user chooses.

Expert users can access the spatial data in a range of OGC standard formats[9] directly from a central service catalogue, so that CERA-authored data comes from a single source of truth.



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

The CERA SDI became a test-bed for the OGC Web Feature Service – Transaction (WFS-T) standard and advanced its development with the world's leading GIS software developers.

Responding to continuous change

Today the CERA spatial data infrastructure is mature, embedded and used throughout CERA and many other organisations and agencies involved in the recovery. While comprised of the technical, data, policy and organisational elements one might expect in any SDI, it delivers 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[10] components allow for minimal dependency and agile development to occur in the constantly changing Christchurch recovery environment.

During one of the more significant land-zone announcements of 2012, the SDI supported in excess of 4,000 map requests a minute over several hours.

Learning to fail fast

Some technologies are either not available or do not work. An example is the (OGC standard) Web Feature Service – Transaction (WFS-T[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. Consultation with two of the world's leading GIS software developers, Esri[12] and Intergraph[13], 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. To do so, it was necessary to develop a technical workaround for integration across the platforms while acting as a test-bed for advanced ongoing WFS-T development within Esri, Intergraph and the wider OGC community.

[10] *Loose coupling is an approach to interconnecting the components in an 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

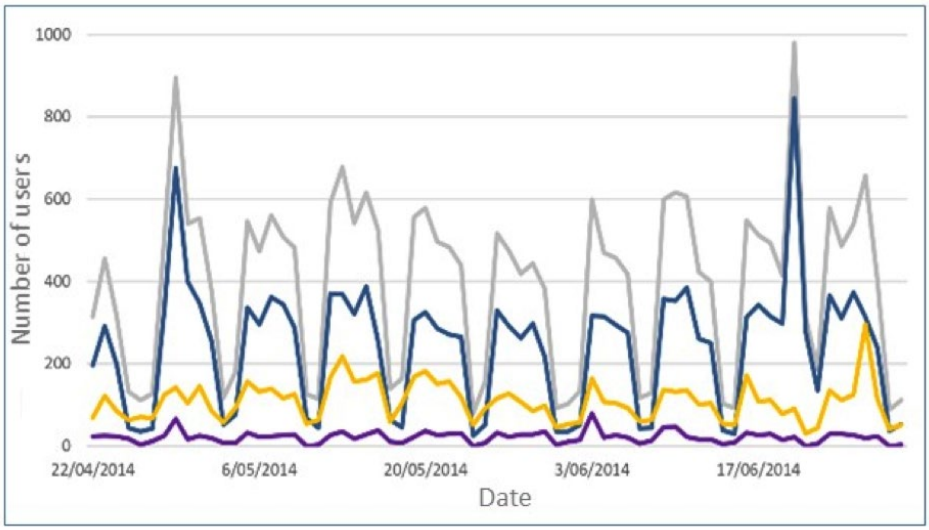
Web analytics offer powerful insights into audience and user behaviour.

In the graph below we see a highly repeatable pattern of how people viewed CERA's public maps on weekdays. The two spikes in early May and mid June 2014 coincide with 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!

roperty owners in Christchurch have been faced with significant challenges related to insurance, town planning, property remediation and flooding. These issues in turn complicated residential construction (particularly foundation design), settling insurance claims and re-insurance. Property owners, developers, builders and insurance companies needed timely access to data to quantify risk, develop 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 Floor Levels Viewer (http://maps.cera.govt.nzadvanced-viewer/?Viewer=Ccc-Floor-Levels), which is hosted on the CERA SDI on behalf of the Council. 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 CERA's most-used sites, 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 working in areas from infrastructure to community wellbeing were struggling to understand the scope and nature of population movement. While considerable anecdotal evidence indicated population movement was significant, no available data even approached 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 New Zealand Post and local power companies had data available at property (address) level.

Once the two sources of data were combined, where a property had both a postal redirection and a zero electricity meter reading, it indicated it was 'potentially vacant'.

While not providing definitive information on individual properties, when also combined with Statistics New Zealand population data these simple maps and underlying data presented a clear, suburb-level view of population movement that was invaluable to CERA and other 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 emerge from a significant natural disaster. In many ways the business of CERA has been to work intensively on the tasks of a conglomerate of government agencies. Because of this, the effects of some business problems present in insurance and town planning processes, among others, have been magnified to levels disproportionate to what might be expected from business as usual.

The earthquakes presented unparalleled challenges for everyone – from responding agencies to the residents of Christchurch. Indeed, while many people at work were dealing with the challenges their organisations faced in responding to the crisis, they were also dealing with personal challenges at home.

With the provision of a best-of-breed spatial data infrastructure, the region has been able 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. As such, it is a model for ICT service delivery across government in New Zealand.

[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.

About the authors

The Canterbury Earthquake Recovery Authority (CERA) is the New Zealand government agency established on 29 March 2011 to lead and coordinate the response and recovery from the Canterbury earthquake sequence for five years. It ended on 18 April 2016.

Stephen Ferriss

Data & GIS Manager
Canterbury Earthquake Recovery Authority

https://www.linkedin.com/in/steve-ferriss-04432144

Stephen is the Data & GIS Manager at CERA who has overseen the ongoing development of the CERA spatial data infrastructure 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.

Martin Erasmuson

Managing Director
StratSim Ltd.

https://nz.linkedin.com/in/martinerasmuson

Martin has a broad background across the spectrum of knowledge management disciplines, encompassing spatial data infrastructure 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 and has published several white papers and articles.

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