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Canterbury SDI: lessons learned from post-earthquake recovery *

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Abstract

In the wake of the devastation caused to the Canterbury region of New Zealand in 2010 and 2011 by a series of earthquakes, a number of SDI-related projects were established to help assist and accelerate the rebuild process. This 3-year work programme is nearing completion. This paper discusses some of the key lessons that have emerged.

The paper is based on two recently published reports concerning the issues identified with property data and use, and how current practice could be improved to help solve a number of the problems associated with locating people, property and other assets that arose in the wake of the earthquakes. These reports are:

- *CSDI - Project Data Management Framework Summary of Problem Identification, by Mercury Project Solutions (http://www.mercuryps.com.au/) for LINZ, 2015*
- *Property Data Management Framework – Framework and Data Model Report, by e-Spatial (http://www.e-spatial.co.nz/) for LINZ, 2015,*

Both are available from the LINZ website:

http://www.linz.govt.nz/about-linz/our-location-strategy/canterbury-spatial-data-infrastructure-sdi-programme/canterbury-sdi-projects#property-data

It also draws extensively on a "Problem Identification" study undertaken by Vicinity Solutions (http://www.vicinitysolutions.co.nz/) for LINZ.

Much of the text of this paper is taken directly from these documents, and the author wishes to recognise fully the contributions of the above organisations, and their help in advancing the work around the Property Data Management Framework.

Introduction

Between September 2010 and February 2011 the Canterbury region of New Zealand's South Island was subject to a series of earthquakes.

The February 2011 earthquake severely damaged Christchurch, New Zealand's second-largest city, killing 185. The government declared a state of national emergency, which stayed in force until 30 April 2011.

The total cost to insurers of rebuilding has been estimated at NZ$20–30 billion, making it New Zealand's costliest natural disaster. (https://en.wikipedia.org/wiki/2011_Christchurch_earthquake , Wikipeda, last visited 1/10/2015)

In the immediate wake of the February 2011 event the use of geospatial information and associated technology became invaluable to the agencies and organisations involved in the response and recovery. They were also widely used by the public and volunteer groups to find out about what was happening where.

Recognising the utility and value of this, the New Zealand Government provided approximately $5 million funding to eight projects focused on the use of Spatial Data Infrastructure (SDI) concepts to help improve the planning and execution of the rebuild process. This “Canterbury SDI Programme” was managed by LINZ and concluded in 2015. LINZ are now in the process of transitioning some of the projects to business-as-usual operations and reviewing how lessons learned from the projects can help influence the development of New Zealand’s national SDI.

The eight projects were:

- GIS Interoperability
- Forward Works Planning
- 3D Enabled Cities
- Improved Sharing of Utilities Data
- Property Data Management Framework
- Canterbury Maps web portal enhancements
- Open Data and Open API support
- Geospatial Data Discovery

Details of each can be found at:

http://www.linz.govt.nz/about-linz/our-location-strategy/canterbury-spatial-data-infrastructure-sdi-programme

This paper focuses on the lessons that have emerged from the project that examined the problems using available address and property data effectively to support recovery and rebuild activities, the Property Data Management Framework (PDMF).

The problems with property data

During the response to, and recovery from, the 2011 and 2012 Canterbury Earthquakes, a number of significant issues arose in dealing with a myriad of property, address and building information sources, leading to significant delays and rework, reduced service to citizens, and loss of credibility for the response organisations.

Dealing with separate sources for addresses, property, ownership and building information proved to be challenging. Multiple databases were being used, often not being able to be reliably linked. Sharing data between agencies and organisations was difficult due to security, privacy and technical issues, and location and address data collected in the field did not make it back, or very slowly, make its way back into the source data stores.

As a result, much duplication of effort and data occurred, and the lack of integration between related datasets led to significant re-work, reduced quality of decision making, reduced quality of service to Canterbury citizens, loss of credibility among agencies and a significant cost burden.

At its outset, the PDMF project set out to identify the root causes of these problems, a process which involved interviewing many people across those agencies and organisations involved in the response and recovery activities. This research outlined four broad problem areas:

- **Preparedness**: a lack of preparation that inhibited data sharing and integration
- **Property Data Management**: the lack of a central, authoritative, reliable and maintained property data framework address register
- **Risk Management**: decisions made about data management and technology did not follow appropriate risk management procedures
- **Location Data**: there were significant gaps in the availability and capture of certain types of location data

Preparedness

When the events of 2011 and 2012 happened, the lack of preparedness meant that people had to improvise and invent on the spot to get the right, or use best available data under the circumstances. The lack of preparation manifested itself in difficulty discovering what data sources were available, a reluctance to share due to quality, privacy and licensing concerns and technical access constraints.

The root causes underlying these issues were identified as:

- The lack of data sharing agreements in place;
- No data sharing channels (such as web services), or standardisation of formats and data models
- No catalogue or registry of available data sources
- A lack of training or practice on how to pull together data sources

Problems manifested as:

- Inability to find key people who could supply data;
- Inability to access the data;
- Reluctance to supply data because of perceived poor quality;
- Reluctance to supply data because the requestor was perceived as not needing it;
- Reluctance to supply data because it was not known how the requestor might use it;
- Privacy issues;
- Supplying spatial data in unhelpful formats.

Problems related to integrating data from multiple agencies included:

- No plans on how to integrate data representing aspects such as people, places, things, events and concepts, from multiple agencies;
- No plans on how to integrate data from a single agency into a recipient's business system;
- Data-models were different and the attributes contained different data. Schemas were not available;
- Abstractions were different (e.g. mobile toilet delivery being recorded as a number against a street name by some people, and against an address by others);

- Geometry data types were different (whether the feature was stored as a point, a line, or a polygon);
- Datasets were at different levels of completion;
- Data was in different formats, e.g. WFS, ArcGIS, MS Access, Excel, CSV files, PDFs, paper forms and maps.

Getting expertise was also a problem:

- People were thrust into positions they were not equipped to deal with;
- Information was captured by people without experience of spatial data;
- Data was managed by people without experience of spatial data;
- No access to technical expertise;
- Out-of-town resources were unfamiliar with the city (e.g. common road names and place names);
- Out-of-town resources were unfamiliar with the systems they were working in.

Property Data Management

The most common feedback was that there needs to be a single centralised, authoritative, reliable, maintained address register with a unique ID. Such a register would link commonly used property reference datasets such as addresses, buildings, parcels, title and rating units.

Analysis of the issue shows that improved addressing would provide some benefit. However the root cause of this issue is the use of addresses as the primary or sole identifier for sharing property related data. However as no standardised agreed address schema with persistent identifiers exists, issues arose with data being unable to be matched due to different address strings used by different agencies. The development of an integrated property data framework which models the relationships between all property data elements would provide a more comprehensive solution being able to resolve multiple data issues, rather than just addressing. Such a framework would be seen as centralised, though practically it would be more likely to be a federation of linked data sets utilizing web services.

The key barriers, or root causes, that have prevented such a register to be available to date are identified as:

- The use of (unstructured) address strings as identifiers, making it almost impossible to consistently and reliable match datasets based upon on the address string as the lone identifier. This is in part due to multiple address datasets in the market focussed on meeting different needs in the market,
- A lack of overarching, standardised, shared information models for property related datasets
- A market driven approach, with a disincentive for coordination or standardisation among market players
- Lack of mechanisms for feed-back or data updates
- A general lack of reliable data sources for buildings or rating units

Factors contributing to the problems included inconsistent data and practices amongst various duplicate address datasets:

- Addressing practices vary across Territorial Authorities (TAs);

- It is difficult to determine if an address exists in the real world;
- Uncertainty with addresses means that imagery is needed to check for mistakes;
- In the absence of a unique identifier for an address, matching relies on the data describing the address being the same in both systems;
- Inconsistent methods for determining where an address point should be placed;
- Divergence in datasets makes them more difficult to match.

Useful ownership data did not exist:

- Confusion exists where buildings overlap several parcels in common ownership;
- The legal owner of a piece of land was difficult to identify and contact;
- Insurers have insufficient property-related data to process a claim.

Useful building data did not exist:

- There is no clear update path to capture or correct geospatial data of a building;
- There is no identifier for a building;
- There are multiple 2D and 3D representations of a building, but no linkages to them;
- As there is no building data there is nothing against which seismic ratings, heritage models and building information can be attached;
- TAs collect data about the building consent process, but not the building;
- Building footprints not being maintained, where they do exist;
- TAs have difficulty determining whether a building has been started, completed or demolished;
- Architects drawings are not easily converted to building spatial data;

People did not know what to do and were unable to do it efficiently:

- Inability to know what services were being delivered in the response;
- Inability to know where services needed to be delivered to next;
- Work was repeated many times, when there was the least capacity to do so;
- Professionals were tied up trying to integrate data;
- While property-related data sharing arrangements are in place, standardisation is difficult;
- People did not know what to do and were unable to do it efficiently.

Risk Management

There was inadequate risk management and mitigation planning around property data. In the disaster planning and preparation processes, data related risks were misrepresented, underestimated or not identified. Disaster planning had rehearsed for the physical response along with individual event data sharing but not long term large scale data access and sharing. As a result, risk identification and mitigation was often done on an individual, ad-hoc basis, resulting in risk adverse behaviour and temporary, ad-hoc mitigations.

The root causes identified were:

- A lack of planning and training around data management and technology
- Risk management was left to individuals on an ad-hoc basis
- Risk management only accounted for worst-case scenarios, and missed more ‘mundane’ scenarios such as lack of data integration

- Existing risk management plans did not account for the data needs of an event of such scale

Problem statements included:

- Some organisations were not prepared to share data until *not sharing* was creating more problems than *sharing*;
- Data was collected in formats that required triple-handling;
- Data was not collected in a way that enabled it to be delivered in time to make decisions;
- Temporary solutions became embedded.

Location Data

It was identified that there were significant gaps in the availability and capture of certain types of location data. This meant that much data about events or observations (such as the delivery of temporary toilet facilities) was recorded without a (reliable) location; business and tenancy location data was not current or available, informal building names could not be matched, and aggregated data such as building blocks was not reliably available.

The identified root causes were:

- Reliance on paper forms, rather than location-enabled applications, for in-field data capture
- Business location data was unavailable or out of date
- Building tenancy data was not available
- There was no data available depicting aggregated areas such as blocks or the CBD cordon

Problem statements included:

- Data about buildings using names couldn't be matched;
- Land parcel boundary was too granular a scale for broad brush response and rebuild planning activities;
- Various activities required various granularities of data, which wasn't available.

Conclusions and Recommendations

The lack of a unified Property Data Management Framework severely hampered the response to, and recovery from, the Canterbury earthquakes. There was no authoritative, reliable and maintained dataset that links properties, buildings, addresses and rating units, leading to significantly reduced decision making, service to citizens and a large dollar cost. This problem and its negative economic and social impacts are not unique to the Canterbury earthquakes, and extend to the entire New Zealand economy and domains beyond disaster management.

The Canterbury Spatial Data Infrastructure's PDMF project addressed some of the issues and root causes identified in the Problem Identification report. Following this report the project undertook:

- The design of a comprehensive Property Data Framework Model: an integrated, overarching, standards-based information model for property data that brings together addresses, parcel, titles, buildings and rating units (among others), and includes the registration of unique, persistent IDs (Figure 1)

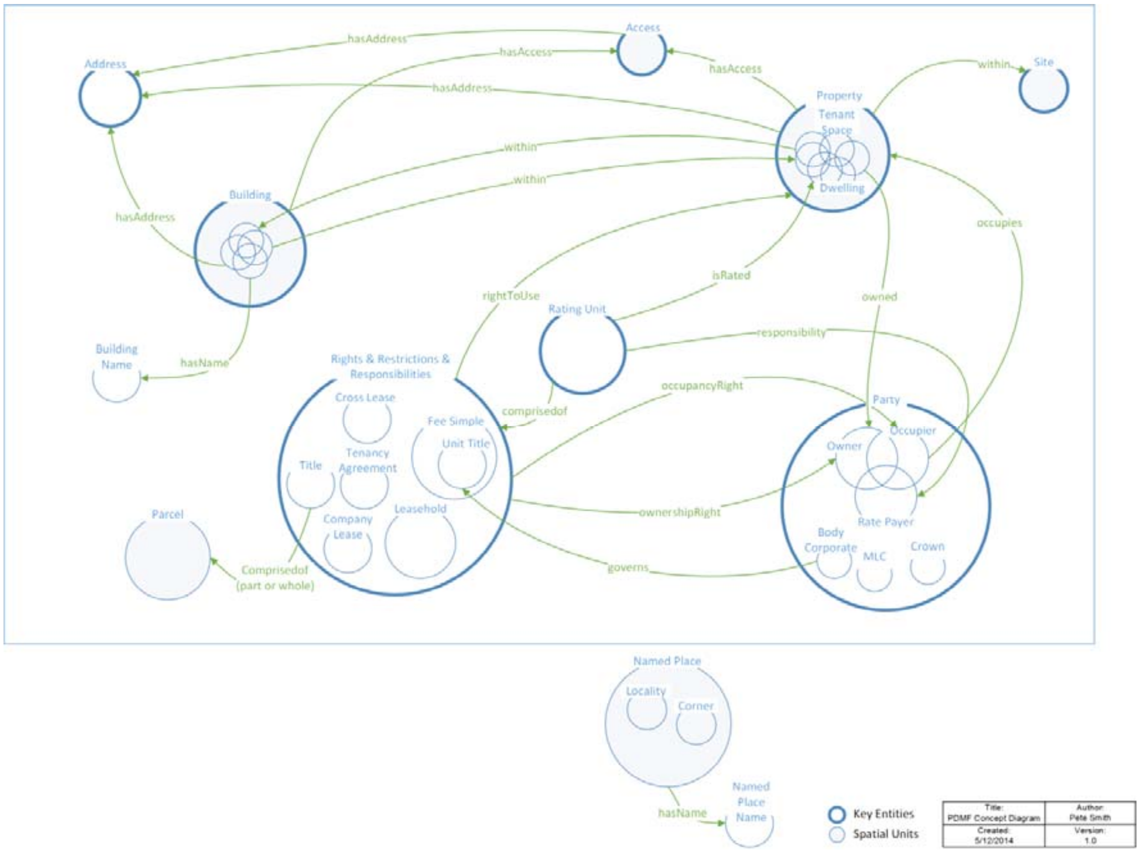

Figure 1: High-level conceptual model of the proposed Property Data Management Framework (Property Data Management Framework – Framework and Data Model Report, LINZ 2015)

Recommended next steps are to:

- Create a test and demonstration environment for the Framework Model
- Create a stakeholder engagement plan to ensure a wide adoption of the PDMF by users, industry and government.

The problem identification work highlighted that the normal commercial environment for property and address data supply, provides disincentives to coordination and standardisation. There is therefore a role for government to provide the enabling framework to make a PDMF available for the entire New Zealand economy to benefit from. At a minimum that would include the (open) data sharing agreements, standards, information models and ID register for PDMF data sets, as well as education and training resourced to assist implementation and adoption.

LINZ is now planning to take the data linking concepts developed through the PDMF project and implement them within a re-engineered land and title system, meaning that key lessons learned from the Canterbury SDI will be used to improve vital elements of

New Zealand's national property data management system, and contribute significantly to the development of its national SDI.

References

CSDI - Project Data Management Framework Summary of Problem Identification, Mercury Project Solutions for LINZ, 2015, http://www.linz.govt.nz/about-linz/our-location-strategy/canterbury-spatial-data-infrastructure-sdi-programme/canterbury-sdi-projects#property-data (last visited 1/10/2015)

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