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e-Survey and Title in New Zealand-Land*online*

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INTRODUCTION

The purpose of this paper is to present some perspectives on the transition of the survey industry from a largely paper based system, serving a fairly specific market and need, to one that has the potential to be a major contributor to mainstream society and commerce – recognising that over 80% of all government information has a spatial component. There is also a mainstream or flood tide of a rapidly growing demand for information – with spatial having that key role of linking land and people. This is what **Land*online*** does.

I will do this by drawing on recent experiences with the automation of the New Zealand Survey and Title System – **Land*online.*** The presentation will be high level, not very technical – that is for others - and will provide an outline of the environment, drivers, goals and lessons learnt – and there were plenty of lessons to learn. I will provide some assessments of impacts on the business communities, and attempt to identify the system's future as a driver of further changes in land use activity.

I have noted that the theme of the Congress is 'e-future – into the mainstream' – where e may represent "emerging", "electronic", "exciting" - **Land*online*** is all of these and I can also add "exhilarating" – at times "exhausting" – but above all "enterprising".

THE LAND*ONLINE* STRAGEGY

The aims of the automation programme are to integrate all survey and title processes; to provide them in digital form; to reduce the costs of both provision and compliance; to utilise technological development, and to meet the growing community demand for improved quality and delivery of services and information.

A Strategy was developed that identified the vision, key components, its justification and the drivers.

The Vision

The three core components of the vision were:

- **Intelligent Record.** In contrast to the paper records and plans, information would be held as intelligent digital data to enable redesign and automation of processes with potential for significant efficiency gains.

- **Business Rules.** Institutional knowledge and expertise would be transformed (as far as practicable) into business rules managed by automated information systems, allowing also their use in transaction validation by surveyors and conveyancers.

- **Automated Transaction processing.** Information systems that automate data flows and processes and integrate the intelligent record and business rules.

Vision Building Blocks

A number of building blocks were identified that would be used to progress the vision. These included:

- Strategy and User Requirements
- Conceptual design of an electronic cadastral system
- Integration of survey and title information and processes
- Design and build of the integrated system
- Imaging of survey plans
- Introduction of a modern geodetic framework
- Conversion of the historical paper records to intelligent data
- Populating the spatial data base with numeric survey data

The Business Case

Government required LINZ to develop a business case to support the programme. The key benefits of the system, when fully implemented were:

- Lower LINZ costs through reduced staffing and closure of 7 of the 12 offices
- Simplifying surveyor lodgement processes and reducing requisitions
- Reducing transaction times, leading to savings for land developers
- Enabling the use of modern technology
- Improving access to land information
- Improving the integrity of LINZ records
- Standardising processes on a national basis

DRIVERS

A project of this magnitude obviously requires a high level of political support and strong leadership. In New Zealand the survey and land title functions had been in separate government agencies since 1876, although there was a comparatively high level of integration of manual processes at an operational level. For some years prior to 1996 both agencies had implemented a series of automation initiatives and strategies. There was also a small inter-agency government unit, set up to ensure co-ordination via a form of common indexing and linking, however this unit couldn't, by itself, achieve any significant degree of process integration or automation.

In 1995 Government decided that the two agencies, the then Department of Survey and Land Information and the Land and Deeds Division of the Department of Justice should be combined into one agency. This resulted in the establishment of Land Information New Zealand in 1996 with a clear mandate to integrate survey and title processes, and also to investigate and to recommend strategies and a business case to automate the survey and land title processes.

Other leading drivers were:

- Increasingly unwieldy nature of manual or paper processes, with 30 km of document shelving, increasing at a rate requiring an extra 1 km of shelving each year (survey plans, microfilms, field books, traverse sheets, reports, check sheets, notices, titles registrations, mortgages, transfers etc)

- Increasing use of automated or digital systems by land professionals and local authorities, leading to a demand for an equivalent government system. Here the technology was both the driver and the enabler.

- Concerns by surveyors and conveyancers at unacceptable delays in the manual process, typically 1-3 months for survey approval and issue of new titles.

- Demand, particularly from utility agencies and local authorities, for greater spatial accuracy or consistency in the cadastral or parcel map. While the DCDB was being used extensively it suffered from significant inaccuracies due to its derivation from digitising hard copy maps of varying scales and quality.

Since starting the project other drivers have emerged, arising from changes or developments in government policy, such as:

- Government policy of making its data and processes more readily available to citizens, remotely and digitally, leading also to a recognition of the need to spatially index government data.

- A principle that Government data should typically be provided at the cost (if any) of dissemination, leading to a rapid growth in added value applications by the private sector, and a consequent increased demand for the data.

These specific drivers should be seen in the light of the major drivers of change affecting our societies:

- Population growth and urbanisation.
- Environmental stresses.
- Resource depletion.
- Economic restructuring.
- Technological advances.
- Information and communications revolution.
- Democratisation and open access to information.
- Individual responsibility and self-determination

IMPLEMENTATION AND ACHIEVEMENTS

As well as the key technical building blocks already described, successful implementation required:

- Clear performance measures and leadership by the chief executive of LINZ
- Well specified contracts with sanctions for non-performance
- LINZ commitment of its best people to work with the developers
- Strong project and contract management
- Rigorous control over “scope creep”
- A comprehensive financial model with controlled contingency funding
- Comprehensive change management programme for staff and external users
- The support, consultation and involvement of professional representative bodies, i.e. the New Zealand Institute of Surveyors (NZIS) and the New Zealand Law Society (NZLS).
- The support and trust of key government control agencies including Treasury
- Best practice system-development methodology sourced from the private sector
  [PricewaterhouseCoopers played the leading role in the design and construction, with involvement also of other consultants such as Accenture and Equinox. Electronic Data Services designed and managed the survey and title conversion and are providing facilities management]
- A rigorous testing process, involving users (internal and external)
- Intensive training for staff and education for external users

A critical and fundamental component is obviously a survey system that has been well organised and managed over the years, such that it has a high level of accuracy. Strong technical and professional leadership is essential to ensure the design meets the necessary levels of performance and functionality – that provide the efficiency and capability for the future.

Land*online* was implemented in two main phases.

Phase 1 – Internal

- Establish user requirements
- Document and codify business rules
- Convert existing records (survey plans, titles, DCDB, geodetic database)
- Automate internal process and workflow
- Provide remote access to converted records (images) and structured digital data
- Convert new paper transactions to intelligent digital data (not just images) for automated processing

Phase 2 – External

- Remote extraction of structured data
- Electronic workspace for external users to create and manage work (eSurvey transactions)
- Remote certification and digital lodgement of data sets
- Ability for surveyors to prevalidate their surveys against business rules prior to digital lodgement
- Utilisation of LandXML data exchange format

Next Steps

- Online exchange of datasets with Territorial Authorities for digital certification
- Further incremental automation of transactions (eg digital lodgement of title subdivisional transactions to complement the eSurvey subdivisional transactions)
- Potential for major enhancements as new business benefits are identified.

Phase 1 is now fully implemented in all our offices as a single national system. There is still some settling in and performance improvement to come, but it is working, as designed. The next test is remote validation and digital lodgement, and that is due to be piloted in November this year.

LESSONS LEARNED

It can be expected that in a project of this size (some NZ$140m and 6 years) that lessons were learnt and, with the benefit of hindsight, some things could have been done better.

(a) Re-engineer the Process

It is important to utilise an independent methodology or analytical framework – this made us reassess the total process (from geodetic survey through cadastral survey to title systems), not just bits of it, to understand all of the components and relationships, initially at a conceptual level. This was the business process re-engineering or envisioning stage. This involved the rigorous analysis of often longstanding existing processes to see if these were still really necessary, and some sacred cows had to be killed. Having understood and modelled the total process we could then determine what components could be automated. In any system it is important to make a business judgement on which parts can be automated, and which are best left to human judgement or manual intervention (eg rare or highly complex transactions).

(b) Benefits

The grass roots analysis or envisioning of the process identified the need to create a survey accurate database, of observed vectors and points/nodes, to enable automation of survey validation and access to data. An outcome, but not a primary objective, of this was the generation of a Survey-accurate Digital Cadastral DataBase – more accurate, and with a more complete and coherent data model that the original DCDB. This generates its own benefits, but these were not all factored into the business case – in other words the business case was economically positive even without these flow on benefits. In the longer term the applications and benefits from a comprehensive survey accurate database, fully integrated within a geodetic framework, are likely to outstrip those from the purely cadastral applications.

We could therefore have taken a broader view of the users and benefits which are limited primarily to cadastral surveyors and conveyancers. The cost benefit analysis was fairly tightly focussed on the traditional uses. What we couldn't readily anticipate was the flow on benefits arising from the data becoming much more readily accessible, adaptable and useable, by virtue of becoming digital. A change in Government policy to reduce charges for Government data and to make government data more readily available via the web also had a significant impact.

(c) Costings and Risk Analysis

Similarly costs should be realistically estimated – what could go wrong probably will – and it is nigh impossible to anticipate a lot of the design quirks and difficulties in data or processes as complex as spatial, or in a project of this size and sophistication.

Initially, because of the fiscal model used in the business case, funding and time lines were very tight with no allowance for contingencies or slippage. This resulted in some rushed design, rework, and compromises, leading to a less than ideal implementation. Also there was little scope to introduce highly desirable enhancements identified in the course of design and testing. A more flexible financial and project model was introduced partway through which provided a more robust estimate of possible risks, contingencies and timelines, but still within a rigorous financial plan and performance measures. The project was funded at the lower end, to encourage careful management, but with agreed processes to access contingency funding if certain events occurred, e.g. a delay in one component. The risk modelling process used for the business case has since become a best practice example for other New Zealand government IT projects.

(d) Provision of Expertise

Outsourcing proved to be an effective means of designing and building the system, giving access to proven analytical systems, project management, and to highly skilled IT resources. This does however require very clear contracts, specification of deliverables and controls over scope "creep". In this approach it is critical that the very best technical business expertise (spatial, survey, title) you have is put into the project to work alongside the IT people. You also need to have other equally capable staff available to peer review and test the products. This means that an organisation has to give up its best operational and technical staff to the project, which of course gives other operational staff the opportunity to operate at a higher level, and they can. At any one time there were probably at least six top level survey staff (surveyors, technicians, DCDB) fully involved in design and construction, with many others having various support, review or testing roles. These LINZ business experts were not just over-viewing the work of the contractor building the system. They were seconded to work full time on the project and available to be directed day by day by the contractor's (PWC) project managers. However they retained responsibilities for reporting back to LINZ. This both required, and created, a high level of cooperation between the system development contractors and LINZ.

(e) Change Management and Stakeholders

This was a key component, involving organisation redesign, retraining, management of redundancies, consultation and communication. As well as relating to internal LINZ staff there was also a strong focus on customers and users, to ensure the design aligned with the reality of professional practice. The changes also had and will have a major impact on the way the practitioners organise and operate, and this external impact wasn't fully understood at first, either by LINZ or the NZIS or the NZLS.

Expert and experienced external users need to be involved, right in the detail of the project, and from the beginning, to ensure these user requirements are understood, and that users fully appreciate and can prepare for the changes being made. LINZ recruited, in consultation with the New Zealand Law Society and New Zealand Institute of Surveyors, experienced practitioners for this role in the second phase. In addition other stakeholder or user representatives were involved in reviews, testing, and advising senior management. However, with hindsight, these stakeholder representatives should have been brought into the project right at the beginning.

(f) Control vs Flexibility

An automated survey and title system necessarily has tightly structured independencies between data and business rules. This is in order to be able to validate the transactions and to minimise risks to the guarantee and public confidence in the data and its outputs. Accordingly the design and functionality has to be well controlled. The reality is that we have thousands of external users in the system who can't just do what they want or feel like in the process.

It is important to understand fully all the data and linkages and relationships to other functions. This is to enable flexibility to be built in where it can or needs to be, whilst still ensuring necessary controls over the functionality are in place. Too much flexibility in how business rules are applied and processes modified can be dangerous, and can reduce the integrity of the data and transactions.

(g) Standards – leading or following?

One key decision during the early stages of the project was the extent to which it would be based on existing survey data standards. The system design methodology used by the contractor required the early analysis to be based on the fundamental conceptual aspects of a survey system and not based on, or biased by, existing constraints and assumptions. At some point, such a design must be brought into the world of what is possible rather than what is ideal. However, it is important not to make this transition too soon or the design will have its long term future distorted by short term constraints.

At the stage when it became necessary and appropriate to realise or "physicalise" the **Land*online*** conceptual design and data model, it was also clear that the business requirements went well beyond any available survey data standard. It had not been the intention of the **Land*online*** designers to be at the leading edge of electronic survey system development but it became apparent that that is where we found ourselves. The leading edge can be an uncomfortable place to be but it does create interesting opportunities if you are ready for them. In the case of **Land*online***, the opportunity appeared in the form of a draft version of a survey data standard for internet based transactions – LandXML. XML is the new open and extensible format for internet based transactions in general. LandXML was intended to be a survey and land information based version of XML – originally growing out of roading and other survey engineering applications.

The **Land*online*** project team and Land Information NZ were able to make proposals to the LandXML developers for fundamental changes to the data to increase the utility of this format mainly to enable its application to the lodgement of cadastral surveys. These changes were accepted by the LandXML development group resulting in a high degree of compatibility between LandXML and the survey component of the **Land*online*** data model. If the **Land*online*** design had been constrained in the early days (1996 and 1997) by the data standards of the day, then it is unlikely that the development of LandXML 5 years later would have dovetailed so well with **Land*online*** requirements. Therefore the risk taken in not being a standards follower proved to be the correct one with **Land*online*** becoming a standards leader. An added feature and benefit to **Land*online*** is the international compatibility of LandXML.

(h) Other Lessons

Within all the emphasis on automation of processes and data it is easy for survey and title to overlook the importance of the field or real world business component, which is what the process is really about. External stakeholder involvement played an important role in maintaining this focus.

Some other impacts have been the closure of smaller offices, with loss of good expertise and local access, but offset by improved access to data by many others and improved access by all to the processes. Users can now access data from anywhere and lodge data in any office without having to visit an office.

In the conversion some infrequently used records were not imaged and some moved offsite. Subsequent experience suggests that offsite retrieval of non-converted records is not necessarily cost effective or efficient. This also adversely affected some peripheral uses of the records, e.g. for historical or cultural research and there was significant concern in some communities at the loss of what they saw as their local land history.

(i) Achievements

Land*online* has effectively fulfilled the key components of a modern cadastre, as expressed in the FIG Cadastre 2014 vision. It will fulfil many of the requirements of a multipurpose database, by virtue of it having survey accurate structured data, regular maintenance, vertical integration of core attributes and being readily accessible.

NEW CADASTRAL PROCESSES

With the ability of surveyors to prevalidate or test their survey data against a survey accurate database using automatic or manual business rules, is there any reason why a surveyor should not be able to, in effect, approve their own surveys in the database? This concept is of course subject to:

- Surveyors observing the principles and ethics of good survey practice, e.g. diligent search for old marks, independent checks, accurate measurements and through analysis of data and evidence.

- Provision for the efficient resolution of problems with existing survey data (errors, missing marks), possibly outside the automatic process.

- Original marks still being the primary evidence – even if they don't fit the database. This is particularly so in an environment subject to pervasive earth deformation resulting from tectonic processes.

- Surveyors' competency and compliance with non automated rules.

With competency and expertise assured by a sound regulatory regime for licensing and regular audits, with a well designed and managed infrastructure and efficient business rules, processes and standards, why shouldn't surveyors be able to interact directly with the data base and the process? In effect the system becomes the surveyors' in an operational sense, with the state's role being one of regulator - setting standards, providing the infrastructure, licensing and auditing or monitoring performance.

Another consequence is that the digital process and technology provides surveyors with a greatly enhanced opportunity to improve their management of the land development process. The emergence of the LandXML protocol enables a surveyor to construct a comprehensive digital data set, of all components of a design or a development, which can then be exchanged with or transferred to the various agencies. These agencies simply extract the data they need from the LandXML file. The surveyor is then able to interact digitally with other agencies involved, and so reinforce their role in the process.

A further important factor is that reliance on spatial data applications, increasingly by persons with little knowledge of the data, but complete trust in the results, will place greater expectations on data integrity. Cadastral data is somewhat unique in this respect, in that it is gathered, interpreted and processed by qualified individuals to known standards in response to transactions, validated in terms of the business rules and existing data; and well documented and integrated within a structured data model. It thus has a high level of known accuracy, consistency and currency in terms of key land transactions. It also creates or manages a lot of attribute data relating to land ownership or land use, and to the placement of structures or services relative to boundaries. It is increasingly being recognised as the data set that underpins and links other data, especially to people or property.

AN EMERGING RISK (AND OPPORTUNITY) – MATURITY OF THE CADASTRE

In recent years there has been a lot of debate and discussion about the maturity and need for reform of our cadastral and land administration systems. To be described as a mature system should be seen as a warning that rejuvenation or a new focus is needed. Automation provides this opportunity; it is generating its own demand for information and creating greater interdependencies with other data and processes. It is also enabling, or perhaps driving, an increase in the frequency of activity and complexity of transactions in response to real world activities. Land is still the key resource with more and more pressure, demands and constraints, requiring innovative ways of how to improve uses, including often multiple or competing demands. In this environment rights and interests, or more particularly the extent, adjacency or overlay of these, are becoming more critical. The community is also more demanding of professions, expecting better quality, improved performance and shorter transaction timelines.

The cadastre is often defined by its traditional role in relation to the land title functions. This can be a limiting perspective and fails to recognise the cadastre's role in defining and modelling a variety of land rights and interests relating to land use. Virtually all land development needs an expert understanding of the cadastral environment, both spatial and legal. The surveyors work in modelling all of these components needs to interface with the various agencies with responsibilities for land development. Of course it is necessary that these other agencies also develop digital capacities, but many are and some already have. The opportunity is to take the lead and influence other players in the land development and administration business.

FUTURE OPPORTUNITIES AND IMPACTS

These come principally from the transition, enabled by digital development of the spatial industry, from a niche sector to one that is recognised as a major and critical contributor to other mainstream information sectors, e.g. retail, transport, financial, health, law and order. In order to be more visible in the community, the survey profession needs to make spatial data more accessible and useful to the community -–this is what **Land*online*** can and is doing – it is repositioning the spatial cadastre in a way that improves its ability to meet the wider needs of government and society.

Digital data provides the ability to record or manage a much wider range of data and overlapping interests of different types in various land administration systems. There is growing interest and use of spatial data at the parcel level, for many other uses other than the traditional one of title registration. Some intensive research is being done on 3D topological systems, which we should anticipate becoming part of the system in the not too distant future. Modern land administration and resource management systems are going to need this functionality to manage the increasingly intensive demands on limited land resources.

The recent Queensland study on the Efficiency of Property Rights Administration identifies the problem of increasing complexity of the land administration regulatory framework, stemming from the increasing complexity of human interaction with land. Whilst there is no doubt some scope for streamlining or simplifying processes, it seems inevitable that other new processes will arise. Perhaps one answer is to model these relationships and rules within a comprehensive intelligent spatial reference system. Automation and digitisation can make the information more accessible and complete and understandable. This seems to present a singular opportunity to surveyors, who understand these issues and relationships and the data as well as anyone.

The digital revolution is making both the data and the GIS technology required to use it widely available and useful to all. The same advanced skills won't be required for routine uses. Some may see this as a threat, and it could be if we don't recognise the trend, the opportunities and our strengths, and what we need to do to prepare for the opportunities. Spatial data and the technology is complex – and, given the growing availability of data and the technology, there will be more innovative and complex ways found of using it. This is why surveyors should be ensuring a thorough understanding of the data and processes and how they model or represent the real world and how real world events can in turn be modelled.

The survey profession and spatial industry have to recognise the synergy between its traditional skills and mandates, the emerging capability of the new technologies and the spatial IT skills of new graduates. A key strategy is to bring these together to provide the public with the spatial data analysis and products needed for the e-enabled community.

It is difficult to predict with any certainty what future requirements and impacts or opportunities could be. But, given that spatial data underpins or pervades most business, social or environmental activity and that information technology is now all embracing, it can be predicted that opportunities to apply these skills will be almost unlimited. What we have to do, as experts in spatial systems, is to ensure we are prepared with the expertise and insights to identify, nurture and exploit these opportunities, for the benefit of our communities.

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I have said in this presentation that it is essential that you get the best brains and expertise you can get involved – I have followed my own advice in preparing this presentation, and acknowledgments are due to Don Grant and Anselm Haanen of my staff, and Jeff Needham, survey stakeholder representative from the **Land*online*** project team, for their insights, ideas and advice, which I have expressed in this presentation. A general appreciation is also due to those who have led and worked on the project.