Streamlining the Exchange of Geodetic Data in Australia and New Zealand

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Key words: eGeodesy, Geodetic Data, Positioning, Standards, ICSM

SUMMARY

The core function of the Australian and New Zealand Intergovernmental Committee on Surveying and Mapping (ICSM) is to coordinate and promote the development and maintenance of key national spatial data including geodetic data. The Geodesy Technical Sub-Committee (GTSC) of ICSM implements national geodesy policies developed by ICSM by coordinating geodetic activities between governmental agencies. For ICSM, Geodesy is the business of monitoring, maintaining and enhancing the horizontal and vertical working datum and their associated elements. It enables a diverse set of data to be brought together in terms of a common geospatial reference framework. In the modern environment of digital data management, the exchange of geodetic data has become more prevalent amongst industry members whose business concerns spatial datasets and databases.

The GTSC has commenced the *eGeodesy* project to develop a standard for the exchange of geodetic information. The main aims of the *eGeodesy* project are to standardise the exchange of geodetic data as well as standardise the publishing and delivery of results; standardise the recording of observations; enable the archival of observational data and results; streamline the process for generating adjustment files and interface seamlessly with vendor packages.

The *eGeodesy* project outlines the business processes and data of geodesy in Australia, New Zealand and their territories, including the modelling of current geodetic business and activities. The project will be built around best practice approaches such as the use of the Unified Modelling Language (UML) and the Extensible Mark-up Language (XML). This project also builds on the methodology being used in the ICSM *ePlan* Project, which is addressing the digital exchange of cadastral survey plan information.

This paper summarises the management and exchange geodetic information in Australia and New Zealand, and provides an overview of some current data exchange projects. The paper then describes the aims, methodology and current status of the *eGeodesy* project. Comments on the proposed design, development and implementation stages of the project are also provided in the paper.

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1. INTRODUCTION

The core function of the Australian and New Zealand Intergovernmental Committee on Surveying and Mapping (ICSM) is to coordinate and promote the development and maintenance of key national spatial data including geodetic data and to provide a consistent and modern approach to surveying, mapping and charting. There is a surveying and mapping agency within each Australian State and Territory and an Australian Government agency with specific national responsibilities. The Australian Defence Force and Land Information New Zealand (LINZ) are also ICSM members. ICSM is an important forum for the exchange of information and ideas in the Australian national interest and for Australian and New Zealand (commonly termed Trans-Tasman) matters.

The ICSM currently has ten working groups in areas of expertise including the Geodesy Technical Sub-Committee (GTSC) and the Electronic Lodgement and Transfer of Survey Data Working Group (*ePlan*). The GTSC membership has representatives from each ICSM jurisdiction and an invited academic representative. The GTSC of ICSM implements national geodesy policies developed by ICSM by coordinating geodetic activities between governmental agencies. The ICSM GTSC has a vision of a geodetic infrastructure supporting instantaneous, four-dimensional, sub-centimetre positioning anywhere in Australia and New Zealand. ICSM's Harmonised Data Framework is a high-level data model to enable the transfer of data between jurisdictions and to enable the development of national datasets and interoperability across the nations.

For the ICSM, geodesy is the business of monitoring, maintaining and enhancing the horizontal and vertical working datum and their associated elements. It enables a diverse set of data to be brought together in terms of a common geospatial reference framework. In the modern environment of digital data management, the exchange of geodetic data has become more prevalent amongst industry members whose business concerns spatial datasets and databases. The GTSC has commenced the *eGeodesy* project to develop a standard for the exchange of geodetic information.

2. CURRENT GEODESY ENVIRONMENT IN AUSTRALIA AND NEW ZEALAND

2.1 The size and shape of Australia and New Zealand

Australia is the world's sixth largest country and comprises approximately 5% of the world's land area. Australia is the lowest, flattest, and (apart from Antarctica) the driest of the continents (Geoscience Australia, 2005a). Australia experiences climatic extremes with highly variable rainfall. The tropics receive high intensity rain and several metres a year but

18% of the total mainland area is classified as desert and about 35% of the Australian continent receives so little rain it is effectively desert (Geoscience Australia, 2005a).

Australia is 7,617,930 km^2 in size (nearly 22 times larger than Germany or similar in size to the United States) and consists of many jurisdictions, States and Territories, which vary considerably in size. The State of Queensland (excluding the islands off the mainland) is 1,723,936 km^2, or nearly five times larger than Germany (Geoscience Australia, 2005a). Although Australia is situated well inside the Australian tectonic plate which is moving at a rate of approximately seven centimetres per year to the North-East.

Like Australia, New Zealand is an island nation. New Zealand is 268,021 km^2 in size (larger than the United Kingdom). Unlike Australia, only one body, LINZ, governs New Zealand's geodetic and mapping systems. New Zealand lies across the obliquely convergent boundary between the Pacific and Australian tectonic plates. To the north the Pacific plate is subducted beneath the Australian plate and to the south the Australian plate is subducted beneath the Pacific plate. In central New Zealand the oblique collision of continental material has resulted in a combination of uplift and strike slip motion. Motion of about 40-55mm/year occurs on the plate boundary through New Zealand and results in geological features such as active volcanoes and large earthquakes (Grant et al, 1999).

2.2 Geodesy Background in Australia and New Zealand

Geodesy involves measuring the size and shape of the earth's surface. This is achieved by creating a framework of positions that support all spatial activities. The frameworks currently consist of a network of survey control marks with positions on the accepted horizontal and vertical datum. Due to the size and complexity of the environments within Australia and New Zealand, geodesy plays a key role in the spatial data infrastructure, which underpins the economic, environmental and social development of the countries. This fundamental data supports key industries such as mining, agriculture, transport, tourism and telecommunications and is crucial to making informed decisions and setting strategic policy.

Australia and New Zealand each adopted a geocentric datum in 2000 to align with international applications and advances in Global Navigation Satellite Systems (GNSS). The Geocentric Datum of Australia 1994 (GDA94) is the current Australian standard coordinate set, aligned to the International Terrestrial Reference Frame 1992 (ITRF92) at epoch 1994.0 and the reference ellipsoid is Geodetic Reference System 1980 (GRS80) (Geoscience Australia, 2005b). The current Australian Grid Coordinate System is the Map Grid of Australia 1994 (MGA94), which is a Universal Transverse Mercator projection and using the GRS80 ellipsoid.

Australia has a single height datum, Australian Height Datum (AHD), based on mean sea level determination at thirty tide gauges around the Australian mainland. The adjustment was performed in 1971 and was based on 97,230 km of two-way levelling as well as supplementary networks (Luton and Johnston, 2001). The relationships between the AHD, geoid and ellipsoid models used in GNSS have been continually improving with AusGeoid models produced in 1991, 1993 and currently 1998 (which is being updated and a new model will be published shortly).

New Zealand Geocentric Datum 2000 (NZGD2000) is a semi-dynamic datum, aligned to International Terrestrial Reference Frame 1996 (ITRF96) at epoch 2000.0. To accommodate the motions due to plate tectonics a deformation model is incorporated in the datum to enable observations and coordinates to be determined at the reference epoch of 2000.0 (Blick, 2003). The model also allows coordinates to be determined at times than the reference epoch. New Zealand has 13 orthometric levelling datums, based on mean sea level at a number of standard port gauges. A project is currently under way to establish a national vertical datum based on ellipsoidal heights (Amos et al, 2003).

Geodesy within Australia and New Zealand is managed by government agencies to maintain a reliable and accurate positioning infrastructure using a coordinated approach from the local to national through to the international level (ICSM GTSC, 2000). The Australian Government agency, Geoscience Australia, manages the national geodetic framework within Australia, working in partnership with each State and Territory. The Government agency LINZ manages New Zealand's geodetic framework.

Both Australia and New Zealand have a network of continually operating geodetic quality Global Positioning System (GPS) receivers on geologically stable marks. The New Zealand network (PositioNZ) consists of thirty stations across New Zealand and the Chatham Islands. The Australian network has eight stations within Australia known as the Australian Fiducial Network (AFN). This is further densified with some sixty highly accurate ground marks, situated approximately 500km apart, known as the Australian National Network (ANN). The ANN is constrained to the AFN and they form the framework for the Geocentric Datum of Australia.

Also within some jurisdictions there are more dense networks of Continuously Operating Reference Stations (CORS) such as SunPOZ over South-East Queensland and VicNet covering the state of Victoria.

2.2.1 Geodetic Data Exchange and Storage in Australia

Geodetic processes, data and storage are similar throughout Australia but there is no single formalised process or database. Geoscience Australia is responsible for the National Geodetic Data Base (NGDB). The NGDB is a national archive of more than 25,000 geodetic survey marks in Australia and its external territories (including Antarctica). The database contains positions in terms of a number of datum and coordinate systems of national interest and historical importance. Each jurisdiction also maintains their own geodetic databases, which contain information on geodetic survey marks within that jurisdiction, and may not be held in the NGDB. The jurisdictions' resources and policies influence which geodetic data and metadata is stored, how the data is stored, how the data is accessed and exchanged. Most Australian jurisdictions have no formalised method of storing geodetic observations and the metadata associated with them at this point in time.

2.2.2 Geodetic Data Exchange and Storage in New Zealand

New Zealand has recently developed LandOnline, an electronic system that holds and manages land information in a national database. LandOnline allows for the lodging of title dealings and survey information into the Government systems. Also included in LandOnline is geodetic data including coordinates and observations. Recently, the New Zealand Government announced that 100% electronic lodgement of all land title transactions and survey plans will be phased in by July 2008 (LandOnline, 2006). Information on over 100,000 geodetic marks is stored in the geodetic database and is available through the LINZ web site.

2.2.3 Geodetic Data Exchange and Storage in Queensland

Using the State of Queensland as an example, the geodetic network is managed and maintained by the Queensland Government Department of Natural Resources, Mines and Water (NRMW). Data about marks in the geodetic network is stored in the Survey Control Data Base (SCDB). The database stores administrative information about the mark as well as horizontal, vertical and cadastral connection information on every permanent survey mark in Queensland (currently over 142,000 marks). The SCDB also stores the history of previous horizontal and vertical values for each mark. There are over 28,000 marks with accurate positions on the standard horizontal datum (GDA94) and about 46,000 marks with heights of varying accuracies related to the standard vertical datum (AHD).

Over 90% of permanent survey marks installed in Queensland are referenced according to a cadastral survey and do not have highly accurate horizontal or vertical datum values. Marks with cadastral connections are referenced in the SCDB to the cadastral survey plan on which connection occurs. Paper documents relating to these marks, such as location sketches are scanned and stored in a Departmental document imaging system, which is also linked to the SCDB. The SCDB is available for searching by all Departmental officers and the public through Departmental Service Counters and Service Delivery Brokers. The SCDB is updated with information from any Departmental officer or surveying professional who visits the mark.

The raw geodetic observational data that relates to the Queensland geodetic network and marks is not stored in the SCDB. The raw observational data files and the geodetic adjustment files are stored and maintained by the Geodetic Adjustment Officer and there is no formalised process or storage area as yet. These 'static' files tend to consist only of Government-adjusted networks so the quality and reliability of the information can be assured. The metadata in such files has mark details, instrument type, instrument set-up details, weather, date and field officer details. Currently in Queensland, raw geodetic observation data and geodetic adjustment files are rarely obtained from industry. However, in some other jurisdictions this information is sourced from industry.

3. ELECTRONIC "*e*" PROJECTS

3.1 Geodetic and Electronic "*e*" Trends

In Australia and New Zealand, positioning infrastructure has been primarily based upon networks of permanent survey marks in the ground. Although these marks will continue to be relied upon well into the foreseeable future, there is an increasing trend towards the adoption of CORS networks and real time positioning. This trend is largely the result of the evident revolution in the spatial information industry by the widespread use of GNSS (Rizos et al, 2005). Accordingly, current GPS networks will be expanded to include all GNSS and CORS networks are being expanded and further densified across Australia and New Zealand.

As geodesy becomes more interlinked nationally and internationally through technologies such as GNSS, the need to standardise the exchange of geodetic information is drastically increasing. Australia is planning to redefine and refine its datum within the next five to seven years and therefore easily obtaining standardised, reliable geodetic records from all jurisdictions would greatly simplify the process. Due to constant crustal deformation, New Zealand may consider a dynamic datum, where the datum is continuously defined by its relationship to the dynamic global reference system (such as the International Terrestrial Reference System).

The benefit of standardising the exchange of geodetic information also arose from other electronic ("*e*") projects, such as *ePlan*. The ICSM *ePlan* Working Group sought advice and consultation with the ICSM GTSC on aspects of the *ePlan* model, particularly classes and attributes relating to survey control observations, points and datum (i.e. the geodetic parts of a cadastral survey).

With the advancement of technology, the concepts of *eGovernance* and *eLandAdministration* are expanding and being implemented worldwide, and are consequently providing directions on how land administration and land development should be managed in the future. ICSM is embracing these concepts and is progressively developing into the electronic ("*e*") environment. Managing fundamental spatial data such as geodetic and cadastral land survey data in an "*e*" environment will facilitate better management of the data, streamline the decision-making process and permeate efficiencies through the entire land administration processes. This has been another driver for the *eGeodesy* project.

3.2 Current projects in Australia and New Zealand

Within Australia and New Zealand there are many "*e*" projects. Although the term "electronic" is often used, most projects are aiming for a digital environment with structured, intelligent digital file formats that are interactive and could form the basis of the legal record (Cumerford, 2006). Most electronic data is currently aimed at a system to deliver electronic data but the data is often paper copies transferred to an 'image' such as a tiff file. Therefore the file contains unintelligent information that cannot provide additional benefit. The paper document is often still the legal copy of the data.

Current projects in Australia and New Zealand include:
- *ePlan* (Cadastral Survey information, run by the ICSM); (Cumerford, 2006)
- *eDA* (Land Development Assessment, run by the Development Assessment Forum, Australia);
- *eConveyancing* (Title Dealings and Registration, run by the Australian Registrars Electronic Conveyancing Steering Committee);
- *eGIF* (New Zealand eGovernment Interoperability Framework, to ensure interoperability of systems and services within the New Zealand Government); and
- *eGeodesy* (Geodetic information, run by the ICSM).

There are also some local governments, such as Brisbane City Council in Queensland, investigating the electronic lodgement of "*As Constructed and Design*" information of infrastructure within their council area. These "*e*" projects are working collaboratively, and where possible aim to build on existing digital technologies. One such technology that many projects will utilise will be digital signatures, once the technology is secure and legally recognised.

The *ePlan* project models a cadastral survey electronically and aims to standardise the exchange of cadastral survey information within Australia, as well as supply and simplify the cadastral survey data validation (examination) routines. *ePlan* has been working closely with, and with the support of, the vendor community and the LandXML data standard consortium. Through survey control data supplied with cadastral survey data, the *eGeodesy* project is working closely with the *ePlan* project to ensure data harmonisation.

National, state and local governments, industry and software vendors can gain efficiencies in "*e*" projects, such as the streamlining of business processes in Government and Industry; reducing data capture; higher quality of data with automated validation routines; consistent data; more effective searching techniques; faster access to data; reduction in transaction costs; minimising preparation costs; lower software development and maintenance costs through a standard and enhanced functionality.

4. THE *eGEODESY* PROJECT

As previously mentioned, the *eGeodesy* project is sponsored by the ICSM and is being managed through the Geodesy Technical Sub-Committee (GTSC). A steering committee from within the GTSC was formed at the end of 2004 to investigate the scope of the *eGeodesy* concept and to liaise with the *ePlan* Working Group on overlapping topics.

The steering committee soon discovered there was no geodetic model for the entire geodetic business lifecycle from geodetic objectives, campaign planning, field observation, through to final adjustment and datum definition within Australia. (Although a geodetic model has been developed as part of the New Zealand LandOnline project.) There is currently also no standard exchange format for geodetic data, including observational data or results within jurisdictions in Australia and New Zealand, or even between jurisdictions that share common boundaries. Raw observational data files (for example RINEX data files) are often exchanged and then processed within both jurisdictions.

4.1 Project Aims

The *eGeodesy* project outlines the business processes and data of geodesy in Australia, New Zealand and their territories including the modelling of current geodetic business activities. The project aims to:

- Standardise Exchange of Geodetic Information
- Standardise Publishing of Results
- Standardise Recording of Observations
- Enable the Archival of Observational Data
- Streamline Process for Generating Adjustment Files
- Seamlessly Interface with and between Vendor Packages

4.2 Project Methodology

The methodology adopted for the *eGeodesy* project is the information technology systems development life cycle, consisting of the Planning, Analysis, Design, and Implementation phases. Each phase consists of a series of steps, which rely on techniques that produce deliverables.

Initially, the project was scoped and then a detailed requirements document was produced. The project scope includes modelling current geodetic data, roles and business practices, including both horizontal and vertical networks; ensuring capability for incorporating all acceptable data, observations and results from both Government and private industry; and ensuring current, future and historical geodetic data (that all plays an integral role in geodesy) is included.

The geodetic infrastructure is comprised of five key components, being the reference framework, data, physical components, intellectual components and institutional arrangements (ICSM GTSC, 2000). The project does not aim to redefine geodetic standards or institutional arrangements within Australia and New Zealand. Neither does the project aim to build a single geodetic system for implementation within each of the jurisdictions in Australia and New Zealand. However, the project does aim to incorporate standard geodetic elements in the exchange of information.

The project has taken an Object-Oriented approach. Object-Oriented methodologies balance the focus between data and process by incorporating both into one model using self-contained modules called objects, which contain both the data and the processes, such as the Unified Modelling Language (UML).

4.2.1 Unified Modelling Language (UML)

UML is not a new modelling language (it was first available in 1997) and is now used throughout the world as a standard modelling language. The UML objective is to provide a common vocabulary of Object-Oriented terms and diagramming techniques to model any systems development project from analysis through to implementation (Dennis et al, 2005). UML can be used to describe the current system and the "to-be" system. UML is an open standard controlled by a consortium with over 800 members called the Object Management Group (OMG), a non-profit organisation (Object Management Group, 2005). UML was comprised of the best methods of a number of object-oriented graphical modelling languages available such as the Booch method and the Object Modelling Technique (OMT).

UML uses a set of different diagrams to portray various views and elements of the evolving system or project. UML does not define a process for modelling systems but is standardised notation that can be used to describe systems. UML defines 13 different diagrams that can be grouped broadly into 'structure' and 'behaviour' diagrams.

Structural Diagrams are used to model the static elements of a system and the relationship between them such as Class, Object, Package, Composite Structure, Component and Deployment Diagrams. Behavioural diagrams are used to model the way in which static elements communicate with each other such as Activity, Use Case, State Machine, Sequence, Communication, Interaction Overview and Timing Diagrams (Dennis et al, 2005).

UML has been endorsed by ICSM for standard use throughout ICSM and its projects. UML is being used extensively in Australia and New Zealand for modelling the cadastral survey data and processes in the *ePlan* project, and the geodetic data and processes as part of the *eGeodesy* project.

4.3 Analysis of Current Geodetic Data and Processes in Australia and New Zealand

The *eGeodesy* project is currently in the analysis phase. The analysis phase of a project focuses on the business user needs and the 'what' of the business. It involves understanding current systems, identifying requirements and developing requirements for the to-be-system. This phase takes the ideas from the planning phases and refines them into a detailed requirements document and models. Many models can be produced including functional models (such as activity diagrams, use case descriptions and diagrams), a structural model (class and object diagrams) and a behavioural model (such as sequence diagrams).

The roles within the geodesy business processes have also been identified, such as:
- *Geodetic Specifier*, whose role is to provide the geodetic direction and the infrastructure plan required to meet national and jurisdictional geodetic objectives. ;
- *Geodetic Manager*, whose role is to manage the campaigns that action the infrastructure plan. The Geodetic Manager is involved in definition of the campaign area, logistics of the campaign, cost, resources etc.;

- *Reconnaissance Officer*, whose role is to locate marks, check mark condition and suitability in the field. The role may involve the placement of new marks.;
- *Field Observer*, whose role is to observe the geodetic measurements.;
- *Geodetic Quality Assessor*, whose role is to check the observed raw measurements and the quality of the data observed.;
- *Geodetic Reducer*, whose role is to reduce the geodetic data.;
- *Geodetic Adjuster*, whose role is to perform the adjustment of the reduced geodetic data.; and
- *Geodetic Acceptance Officer*, whose role is to check and accept the geodetic adjustment results.

It is important to note that these are roles, not people. The same or different people may perform these roles. The same person may also perform multiple roles, even within the same day. Officers within Government or from private industry may perform these roles. However, some roles are more likely to be performed by Government officers, such as the Geodetic Acceptance Officer, to accept the data and results into the Government geodetic databases.

From the analysis performed to date, the current geodetic data and processes within Australia and New Zealand have been modelled in UML through Use Cases, Activity diagrams and Class diagrams. Activity diagrams are the mapping of business processes and workflows. They incorporate roles, inputs, tasks and outputs. Many geodetic business processes have been mapped. These business processes have been mapped in a simplistic, high-level approach to avoid technical “jargon” and to ensure all steps have been included in the model.

Classes of similar characteristic can be grouped together in packages. The Class Packages identified in current geodetic business in Australia and New Zealand include Standards, Geodetic Planning, Mark Management, Field Measurements, Quality Assurance of Field Measurements, Reducing the Measurements, Adjusting the Measurements and Survey Data Acceptance, including the publishing of results. These packages incorporate data and data fields from each jurisdiction.

For example, the Geodetic Planning package includes the geodetic infrastructure plan and the geodetic campaign plans. The classes in the package contain attributes such as survey area, cost, equipment, personnel and logistics. The Geodetic Planning package links to other packages such as Standards (mark and measurement) and Field Measurements.

Another example is Field Measurements which includes attributes such as the date and time of observation, raw observations, marks observed and details about the mark, weather details, instrument types, instrument set-up height, satellites observed, measurement settings such as the sync rate and minimum number of satellites to observe. The Field Measurements package is also linked to other packages such as Standards and Mark Management.

As these packages are in their infancy stage and are still being evaluated and refined, diagrams have not been included in this paper.

4.4 Future Project Stages

The *eGeodesy* project is still in the analysis phase. To-date only GNSS data and business processes have been modelled extensively, as this is the technique used for most present day geodetic work in Australia and New Zealand. These models are being evaluated, reviewed and refined by all members of the ICSM GTSC, to ensure the GNSS data and processes for each jurisdiction have been incorporated. These models are likely to go through multiple iterations encompassing minor changes in the coming months. These models will then be expanded to include various terrestrial survey techniques used for geodetic work, such as Electronic Distance Measurement (EDM) traversing and spirit levelling.

After the analysis phase, which has been approached from a purely business-oriented perspective, this project will move into the design phase. The design phase is more technical and describes "how" the system/project will operate, be built and be implemented. It is written from the developer's perspective and involves detailed system requirements such as system inputs, system outputs and ways users will interact with the system. There is no clear distinction between business and system requirements. The requirements and diagrams will continue to evolve in both the analysis and design phase. The *eGeodesy* model developed will also be cross-referenced with the current LandOnline model.

The project aims to utilise existing software, systems and processes, incorporating some new elements or new fields in existing databases. The project also does not aim to build a single geodetic system for implementation within each of the jurisdictions. For example, Australia and New Zealand have been developing new geodetic adjustment software to meet current geodetic business needs and new programming technology. It is envisaged that this software could form an "engine" within the Adjustment package outlined in the *eGeodesy* project. On the other hand, most jurisdictions do not have a formalised archival method for storing observational data and results. Through the *eGeodesy* project, it may be possible to build an 'active' observations storage database that could then be utilised across multiple jurisdictions.

After the analysis and design, the project can then move into the implementation phase. This phase is also iterative and will involve testing of the models and systems before installation.

In establishing a standard format for the exchange of geodetic data, existing standards are being investigated. A standardised approach is important so vendors can support the exchange format and users can easily adopt it. One such standard being investigated is eXtensible Mark-up Language (XML).

4.4.1 eXtensible Mark-up Language (XML)

XML is a simple, very flexible text file format, which uses elements or labelled components. (Crews, 2006). XML provides a set of rules for encoding data structures and is reliable and efficient for network transmission and parsing. Labels can be invented to suit individual needs.

Many industry sectors are developing variants of the XML Schema for their own use. For example, aecXML is an XML-based language used to represent information in the Architecture, Engineering and Construction (AEC) industry and the LandXML schema facilitates the exchange of data created during the Land Planning, Civil Engineering and Land Survey process and is based on work by EAS-E (Engineering and Surveying - Exchange) in the United States (Crews, 2006). *LandXML.org* provides the non-proprietary LandXML data standard that is driven by an industry consortium of partners (Crews, 2006).

LandXML is currently being used in the New Zealand LandOnline system as a transfer format for survey components. XML and LandXML are endorsed by ICSM for standard exchange of information and LandXML is currently being used in the *ePlan* project. The *ePlan* project has also liaised closely with LandXML.org consortium to ensure all the Australian and New Zealand cadastral survey components are incorporated within the latest version of this international standard (Version 1.1).

The *eGeodesy* project will use a standard format, such as XML or LandXML, for the exchange of geodetic data. However, until this stage of the project is reached and the requirements of the data exchange format determined, the standard that will be adopted is yet to be decided.

5. CONCLUSION

To coordinate and promote the development and maintenance of key national spatial data, embracing the concepts of *eGovernance* and *eLandAdministration* and incorporating the advances in geodetic, GNSS and information technologies, the ICSM, through the GTSC, has commenced the *eGeodesy* project. This project also builds on the methodology being used in Australia's ICSM *ePlan* Project for cadastral survey information.

The *eGeodesy* project has developed initial models of current geodetic business processes and data of geodesy. From current geodetic data and processes to future capabilities, data and processes will be incorporated into the models and design of new systems and practices being investigated. The project will be built around international best practice approaches and standards such as the use of the UML and XML to ensure vendors can support the exchange format and users can easily adopt it.

The main aims of the *eGeodesy* project are to standardise the exchange of geodetic data as well as standardise the publishing and delivery of results; standardise the recording of observations; enable the archival of observational data and results; streamline the process for generating adjustment files and seamlessly interface with vendor packages.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the support of all the members of the ICSM GTSC, Mr. Aaron Jordan (Wellington, New Zealand) and Mr. Roger Fraser (Brisbane, Australia) whose expertise in geodesy and input into the *eGeodesy* project have been, and will continue to be, invaluable. The authors also wish to acknowledge Mr. Craig Mann from Imaginar Technology (Brisbane, Australia) for his assistance with creating an *eGeodesy* UML model and educating GTSC members in UML.

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BIOGRAPHICAL NOTES

Jemma is a Senior Spatial Information Officer in the Queensland Government Department of Natural Resources, Mines and Water (NRMW).

Jemma has been actively involved in the Intergovernmental Committee on Survey and Mapping (ICSM) Geodesy Technical Sub-Committee for the past two years and currently leads the *eGeodesy* project.

Jemma's most significant career achievements to date include Registration as a Land Surveyor with the Surveyors Board of Queensland in 2003, awarded the Queensland Young Surveyor of the Year 2001 and graduated with a Bachelor of Surveying (First Class Honours) and Bachelor of Information Technology (Distinction) from the Queensland University of Technology (QUT) in 2000.

Jemma is an active member of the Spatial Sciences Institute (SSI) and the Institution of Surveyors Australia (ISA). Jemma currently sits on the SSI Queensland Regional Committee and the SSI Queensland Regional Young Professionals Committee.

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