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**INTEGRATION OF BUILT AND NATURAL ENVIRONMENTAL
DATASETS WITHIN NATIONAL SDI INITIATIVES**

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Integration of Built and Natural Environmental Datasets within National SDI Initiatives

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Introduction

Sustainable development and meeting “the triple bottom line” (economic, social and environmental objectives) requires an understanding of the natural and built landscape in order to observe and monitor change and to create realistic simulations of the evolving environment. This requires access to both built and natural environmental datasets. Over the last decade these needs have attempted to be addressed by establishing spatial data infrastructures (SDI) where one of the key objectives is facilitating access to a wide range of spatial data from various custodians and agencies and different jurisdictional levels. There is now a need to take the concept of a National SDI to the next level through incorporation of the ability to integrate the datasets available, specifically cadastral (built) and topographic (natural) spatial data.

This integration involves an understanding and documentation of issues and problems within and between jurisdictions within the Asia-Pacific region. Integration of externally sourced spatial data and information has raised many technical problems such as semantic and modeling heterogeneity and there is a need to develop policies, programs, logical and physical architecture and deliverables that removes duplication of effort in attempts to solve these technical problems. There is a need to build a framework for the reciprocal exchange of fundamental infrastructure with the risk of misuse or misapplication of built and natural environmental datasets effectively managed. This includes the creation of models that cater for both high end and highly resourced as well as low end and lowly resourced organisations.

This project aims to achieve this through development and documentation of best practice with a focus on Asia-Pacific countries. This will be through Working Group 3 (WG3) of the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) who is responsible for exploring technical, institutional and policy issues regarding the contribution of SDI in designing, building and managing large scale, spatial, people relevant datasets, and in particular their role in cadastral, land administration and marine administration systems. This is a major initiative of WG3 activities and will be undertaken as part of its workplan.

Built and Natural Environmental Datasets

Amongst spatial data, cadastral and topographic datasets are the most important for describing the built and natural environment. These datasets are the ‘foundation data’ (Groot and MacLaughlin, 2000) in modern market economies. Cadastral datasets are the accumulation of individual property boundary surveys undertaken by land surveyors. By nature, cadastral data is

very different to topographic data which is produced at medium to small scales over large regions using various techniques.

Cadastral data is usually large to medium scale (1:500-1:10,000) and focuses primarily on boundaries of land parcels and properties shown within cadastral maps. It usually includes details of size, location and nature of land parcels, and in developed systems, a geo-referenced description of the land. Topographic data primarily represents physical features found on the surface of the earth including rivers and lakes, vegetation, landmark features, and hydrology. Topographic data is generally available at various precisions and scales, and can be represented in both two- and three-dimensional form. The nominal scale of these datasets is normally smaller than cadastral data and ranges from medium to small scale mapping.

In all countries, the two foundation datasets were developed to serve different purposes and are usually managed separately. This separation is recognised as a barrier to implementation of sustainable development. Duplication imposes unjustifiable costs on data collection and maintenance. The datasets should adopt the same overarching philosophy and data model to achieve multi-purpose data integration, both vertically and horizontally (Ryttersgaard, 2001). Merging of these datasets at a local level has been achieved to some degree, however, attempts to integrate the datasets at a national level, even where SDIs are well developed, has been difficult and problematic internationally.

Project Aims

This project aims to better understand and describe the technical, jurisdictional, institutional, legal and land policy perspective surrounding the two foundation datasets (cadastral and topographic) in a National SDI. The project will investigate the justification for integrating these two forms of spatial data in support of sustainable development (Figure 1) and develop a model, framework and associated tools for integration capable of being used in diverse jurisdictions.

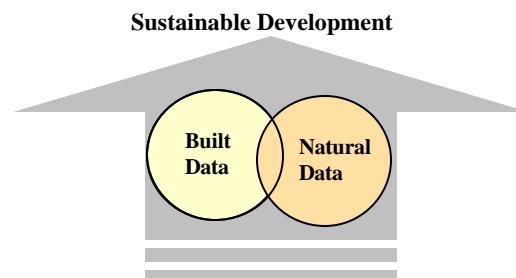


Figure 1: Integration of datasets to facilitate sustainable development

The project has four main aims:

- 1 Investigate the problems and issues in integrating data in National SDIs within case study countries, through an analysis of:
 - a) History of integration of cadastral and topographic mapping and related National SDI initiatives.
 - b) Capacity for and policies relating to data integration of cadastral and topographic datasets.
 - c) Institutional support for and barriers against data integration of cadastral and topographic datasets.
- 2 Develop a framework model for the integration of built and natural environmental datasets at a national level, through the development of National SDIs.
 - d) Investigate interoperability issues of national topographic datasets and state/territory

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- cadastral (and other relevant) datasets and develop a methodology to prioritise SDI datasets.
 - e) Develop a justification and strategy to integrate these datasets in support of sustainable development.
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- 3 Identify the benefits of the integration framework model for developed and transitional countries in the Asia-Pacific region, with reference to case study countries.
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- 4 Publication Strategy
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Despite some successes in integrating data at a local level, lack of understanding of the importance and necessity for access and interoperability between the two forms of data remains among policy makers. The project will therefore investigate and clarify the relationship between integration of the two forms of spatial data and capacity to deliver sustainable development. Lack of understanding is a universal problem as identified by United Nations resolutions, and also identified as a major barrier to achieving sustainable development within a National SDI initiative.

Project Outcomes

The primary aim of the project is development of a methodological framework for institutional initiatives in integrating cadastral and topographic data. The project relies on new and cutting edge technologies in ICT to develop opportunities for data integration and access.

The project will advance knowledge and understanding of the ability of National SDIs to deliver sustainable development objectives in a modern information society. This will be achieved through the development of new concepts and policies to integrate medium to small scale topographic datasets with large scale people relevant datasets (especially cadastral data). Increasingly, cadastres and SDIs use the latest information and communications technology (ICT). Simultaneously with improvements in access technology, the project will deliver improved functionality and usability of spatial data particularly in situations of growing need for integrated data: for instance, risk management (fire and flood), coastal management, tree cover, land degradation and salinity, water, improved land use planning, heritage protection and native title management.

The development of integrated datasets for a nation is a cultural and institutional challenge more than a scientific one. Therefore, this research aims to develop a data model, framework and strategy to facilitate organisations to better tackle this challenge and be more proactive in developing relationships at all levels of government. This includes a critical examination of philosophies, structures and processes and is significant to both industry and governments alike.

The technical, institutional and policy issues concerned with integrating framework datasets are recognised internationally as a major priority by UN conferences in Asia-Pacific and the Americas [Resolution 5, 6th UN-Regional Cartographic Conference for the Americas, New York 1997 (E/CONF.90/3); Resolution 5, 7th UN-Regional Cartographic Conference for the Americas, New York 2001 (E/CONF.93/3)]. For example, Resolution 15 adopted by the 14th UN Regional Cartographic Conference for Asia-Pacific (UNRCC-AP) calls for an investigation into “issues, problems and solutions concerned with integrating digital cadastral mapping with large-scale topographic mapping within the context of a wider national spatial data infrastructure” (14th UNRCC-AP, 1997). An approved strategy for this investigation requires

exploration and justification of associated conceptual, institutional and technical issues (16th UNRCC-AP, 2003).

Use of integrated cadastral and topographic data to deliver sustainable development objectives was identified in the UN Bogor Declaration on Cadastral reform- section 4.7 (FIG, 1996) and the UN Bathurst Declaration on Land Administration for Sustainable Development (FIG, 1999). These declarations also highlight the need for sharing of integrated data among nations, particularly to address common ecological problems.

The project builds on international and regional collaboration within the Asia-Pacific region through a partnership with Working Group 3 (Cadastre) of the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP). Further outcomes include a solid technical foundation for data sharing and a strategic policy position upon which sustainable development initiatives can be based. Figure 2 shows how the integration of foundation data in a National SDI facilitates better decision making in disciplines such as Land Administration, helping to achieve the social, economic and environmental objectives of sustainable development. This research will test this model and develop a framework and strategy to sustain the fiscal, technical, human and political resources critical to the achievement of this vision.

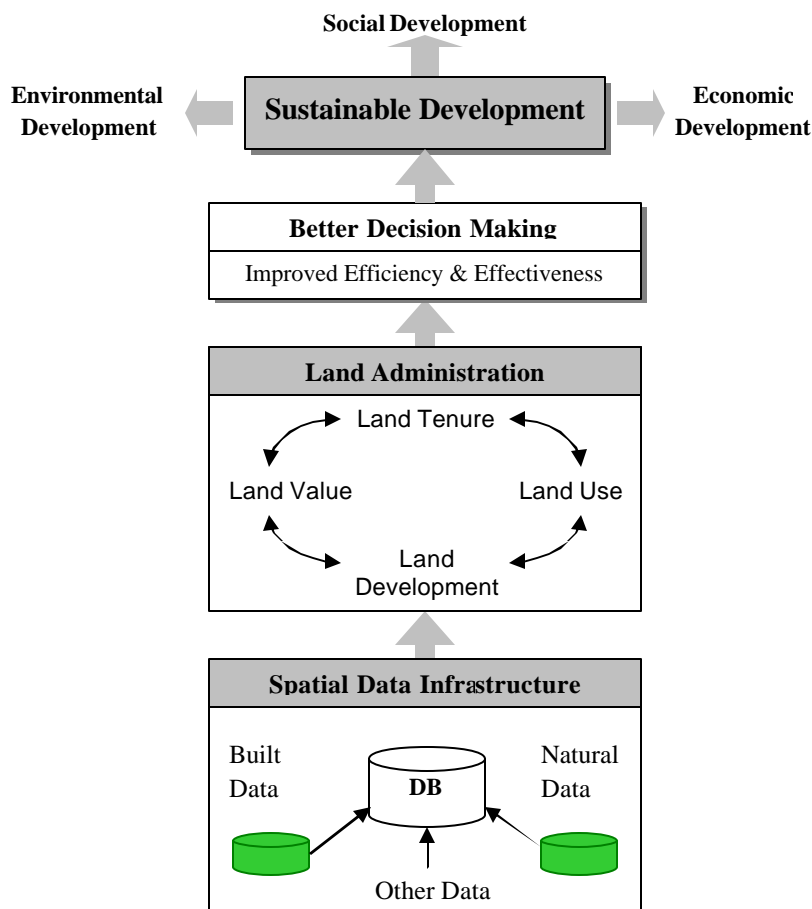


Figure 2: Integration of Built and Natural Environmental Data within an SDI to support Sustainable Development Objectives

A case study methodology will be utilized within this project based on the links established through Working Group 3 of the PCGIAP. This will enable the development of solutions which can be utilized within across countries and enable best practice to be established. It will also built on the development of the Asia-Pacific SDI, one of the major goals in the creation of PCGIAP.

Overall Plan and Project Methodology

The project is to be completed as part of the WG3 Work Plan for 2006-2009 as described in the project methodology below (Figure 3). Investigating the justification for integrating the built and natural environmental datasets within National SDI initiatives has been undertaken along with an initial investigation of concepts and current research into SDI, built environmental data and natural environmental data, including an investigation of data models within Australia. International case studies are currently being undertaken through the use of an Integration Template developed as part of the project. This template has been distributed to all Asia-Pacific countries through the PCGIAP with presentation at the International Workshop being undertaken by case study countries including Thailand, Japan, New Zealand, Australia, Indonesia and Brunei Darussalam.

Once the results of the Integration templates have been analysed, the research team will visit case study countries to investigate issues and problems in greater detail. A data integration model will be created based on case study outcomes, and this will be tested within case study countries. Refinement of the model and a development of a framework for the integration of built and natural environmental datasets will follow with an implementation strategy and guidelines developed that can be used in various jurisdictions.

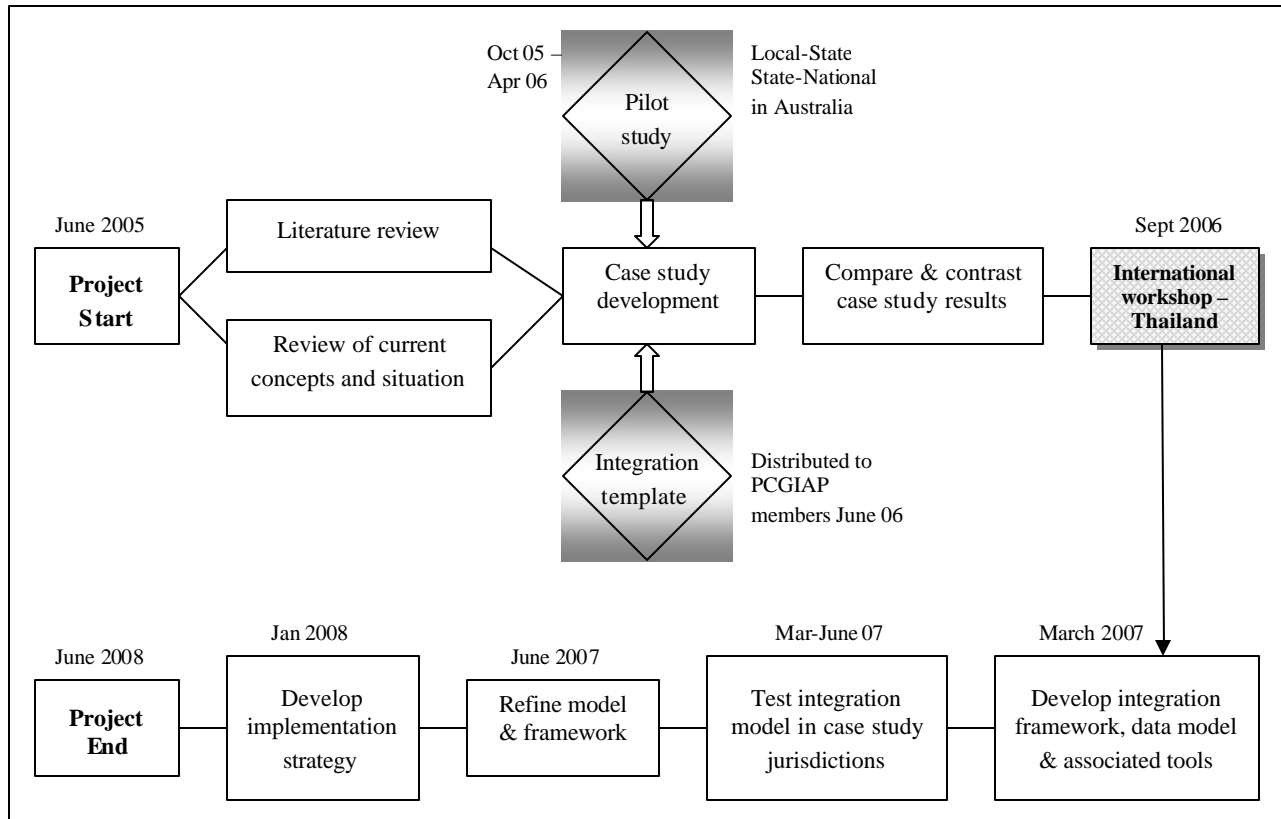


Figure 3: Project Methodology

Conclusion

National SDIs underpin the ability to gain access to spatial information, a key driver in decision-making within industry and government. The integration of people-based data and environmental data within a National SDI will further promote more efficient and effective utilisation of land, and a better understanding of human and environmental systems. This will enable a more comprehensive understanding of human activities and their interplay with natural systems, and the effects of management measures. This will provide an opportunity to deliver more products and solutions within the sustainable development of land, and enable more efficient use of infrastructures such as SDI across the Asia-Pacific region.

BIOGRAPHICAL NOTES

Abbas Rajabifard BSurv (KNT), MSc (ITC), PhD (Melb), is Deputy Director of the Centre for Spatial Data Infrastructures and Land Administration, and a Senior Research Fellow in the Department of Geomatics at the University of Melbourne. He has been an Executive Board member and National representative to the United Nations sponsored Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and is currently WG3-Research Coordinator. He is a Chief Investigator of an Australian Research Council project looking into the development of marine cadastre and in particular investigation into the development of a seamless SDI model covering both land and marine environments. His current research and interest are spatial data management, SDI design and development (both land and marine environments), spatially enabled platforms and SDI capacity building.

Ian Williamson, AM, FTSE, is Head, Department of Geomatics, University of Melbourne, Australia, where he is Professor in Surveying and Land Information, and Director of the Centre for Spatial Data Infrastructures and Land Administration. He is Chair, Working Group 3 (Cadastre) of the United Nations sponsored Permanent Committee for GIS Infrastructure for Asia and Pacific (PCGIAP). He was Chairman of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors (FIG) 1994-98 and Director, United Nations Liaison 1998-2002. His teaching and research interests are concerned with designing, building and managing land and marine administration systems, cadastral, and land and geographic information systems in both developed and developing countries. He has consulted and published widely within these areas.

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