A Template for Assessing Worldwide Cadastral Systems as Part of National SDI Initiatives

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Abstract

Many countries over the past few years have spent considerable time and energy in attempting to compile descriptions and reports in the area of land administration, without giving much attention to the role of cadastral systems and national spatial data infrastructures within a land administration system. The Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and the International Federation of Surveyors (FIG), together with the Centre for SDIs and Land Administration have attempted to address this through the creation of a joint cadastral template that has so far been filled out by 39 countries. The template collects descriptions of national cadastral systems as part of National Spatial Data Infrastructure (SDI) initiatives on a broad basis and the information is made publicly accessible on the web. The information can be used for comparing and assessing land administration and cadastral systems worldwide, in order to help countries re-engineer and implement their systems to address future needs.

This paper aims to outline the concept and theory behind the development of the cadastral template and its relationship with National SDI initiatives and how it can help spatial information practitioners in improving and re-engineering their infrastructure and systems. Analysis of the data gathered from the completed templates is currently being undertaken with some overall results presented and future areas of work identified.
Introduction

Improving the efficiency and effectiveness of land administration systems within existing and newly formed countries is quite a large task. Effective land administration systems within the context of a spatial data infrastructure (SDI) are becoming ever more important as issues relating to land use and land ownership become a larger part of everyday decision-making. Countries and jurisdictions worldwide have different historical, socio-cultural, political and economic backgrounds and thus have different land tenure and management systems, influencing the development of land information and spatial information systems. The ability to evaluate such systems in order to implement or re-engineer land cadastral systems and identify best practice is a large task.

In order to address this, the United Nations supported Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and the International Federation of Surveyors (FIG), in conjunction with members of the Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne, have developed a cadastral template in order to compare and contrast systems from diverse nations and jurisdictions. By analyzing data from participating countries, individual countries will have information about the status of their cadastral system, allowing them to improve their system. The template will also assist in evaluating and benchmarking cadastral systems and identifying the role they play within SDIs.

This paper aims to outline the concept and theory behind the development of the cadastral template as a guide to analyzing and comparing cadastral systems around the world. The paper also presents the design process and some analysis of the information gathered from the template. The information gathered and analysed will eventually aid in describing the status of cadastral and land administration systems, their contribution to and role in SDIs and the need for improvements, which will facilitate benchmarking and the development of performance indicators.

Research Methodology

With the increased interest in land administration and cadastral systems as part of national infrastructures, there have been a number of other activities which aimed to collect data and information in order to compare and contrast systems. These have mainly been undertaken by FIG and the UN Economic Commission for Europe (UN-ECE), covering a large range of different land administration issues, within their own specific objectives (Available at http://www.swisstopo.ch/fig-wg71/ or http://www.unece.org/env/hs/wpla/). As demonstrated by Lavadenz et al. (2002) however, ‘...despite the significant resources being invested by donor communities for modernising land administration infrastructure, there is little systematic discussion of the key elements of such a system and of what constitutes effectiveness within particular socio-economic, cultural and temporal contexts’.

The development of the cadastral template has been somewhat different to other types of activities conducted in that it attempts to take into account the comments by Lavadenz
within the “Comparative Study of Land Administration Systems by the World Bank” (2003) through discovering the basic social, conceptual, cultural and institutional context of countries cadastral systems as a whole which hinder effective administration of land. Information gained from completed country templates was analysed and used to compare and assess various cadastral systems using a list of indicators (see below) and possible problems and solutions identified.

**Collaborative Nature of the Cadastral Template**

The cadastral template was formed to collect descriptions of national cadastral systems on a cultural as well as technical basis and makes the data publicly accessible on the internet (Rajabifard et al. 2006). The template was completed through collaboration between the PCGIAP, FIG and Centre for SDIs and Land Administration at the University of Melbourne and builds on the work of Steudler and Williamson (2002).

The PCGIAP was established following Resolution 16 of the 13th United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP) in Beijing in 1994. The aims of the PCGIAP are to “maximize the economic, social and environmental benefits of geographic information in accordance with Agenda 21 by providing a forum for nations from Asia and the Pacific” (PCGIAP, 2000). The objectives of the PCGIAP are completed through the creation of four Working Groups, of which Working Group 3 “Cadastre” inputs into the cadastral template. This input was in conjunction with the International Federation and Surveyors (FIG) Commission 7 “Cadastre and Land Management”, which has extensive experience in comparative cadastral studies.

Financial support for the development of the cadastral template was received through the Centre for SDIs and Land Administration at the University of Melbourne through a competitive peer reviewed process for funding by the Australian Government. The centre also provides the overall coordination and facilitation of associated research and activities.

The collaborative nature of the project was an important factor in the success of the project. The ability to build relationships and transparency between nations with different cultural, social and language backgrounds helps to break down not only technical barriers but also institutional barriers, helping to create more effective access to data and services through a culture of information sharing.

The cadastral template aimed to gather information in order to address key issues such as:
- the order of magnitude of the basic tasks in a cadastral system;
- an indication of the problems involved in the informal occupation of land within both the urban and rural areas;
- to try and understand the role of the cadastre in land administration and related SDI activities;
- to get an idea of the completeness, comprehensiveness, use and usefulness of cadastral data; and
to gain an understanding of the capacity which is in place within countries to support cadastral and land administration systems.

In order to try and overcome some of the cultural and language issues in comparing and contrasting systems from different countries, the template is currently available in English, Portuguese and Spanish to enable as greater number of participants as possible. Currently, 39 countries have completed the template, as shown in Figure 1 below.

Figure 1 – Map of countries that have completed the cadastral template

Cadastral Template Design

The cadastral template was designed as a standardized generic proforma to enable the discovery of information, including matters concerned with member countries’ land policy, laws and regulations, land tenure, land administration and cadastre, institutional arrangements, spatial data infrastructures, technology as well as human resources and capacity (Rajabifard, et al. 2006). It aimed to address three main research problems including:

- the development of a benchmarking framework
- act as an evaluation process to respond to the problem, and
- to aid in better understanding the relationship between land administration systems, cadastral activities and SDIs.

The basic principles of the design of the template included that:

- it had to suit and serve the purposes of the mainly Asian PCGIAP member countries as well as the FIG-Commission 7 member countries;
- it had to be easy to fill out;
- it had to have a simple structure, but the results should reflect the main issues of cadastral systems;
- it had to be as short as possible in order to be filled out by senior executives;
it had to be easily understood in order to have a significant enough response rate; and
respondents would not be asked for precise figures or statistics, with estimates being good enough.  
(Steudler et al. 2003)

In order to take into account these design principles, the template had been split into two sections being a country report and a short questionnaire.

The country report section is a descriptive report of the national cadastral system of a country, split into five main topics for easier comparison. These topics include:

   a) Country Context
      - This includes an overview of the context of the country or jurisdiction from a geographical, historical, political and administrative perspective.

   b) Institutional Framework
      - This looks at the institutional and organizational issues of the cadastral system, describing the institutions responsible for land administration, private-public partnerships, professional organisations, licensing and capacity building arrangements.

   c) Cadastral System
      - This includes an overview of the purpose (legal, fiscal, multi-purpose), types (one or many), and content (basic components, informal occupation) of the cadastral system.

   d) Cadastral Mapping
      - This component looks at the spatial data component of the cadastral system including the role of the cadastral map and the role of the cadastral layer in national SDI initiatives.

   e) Reform Issues
      - This investigates the problems and issues that are currently going on in cadastral systems including cadastral issues and also looks at current initiatives.  
      (Steudler et al. 2004)

The short questionnaire section identifies the basic principles and main statistics of the cadastre. The statistics are kept simple and focus mainly on the population and number of parcels and professionals working in the cadastral system. Basic questions include:

- Is the cadastral system based on deeds or title registration?
- Is registration of land ownership compulsory or optional?
- Are landowners required to register their properties systematically during initial establishment of the cadastre or is registration sporadic?
- What are the total number of registered strata units?
- In both urban and rural areas, what is the distribution of land units that are legally registered and surveyed; legally occupied, but not registered or surveyed; and informally occupied without legal title?

All of the completed country templates are made available through a dedicated website (http://www.cadastraltemplate.org) on a country by country basis, as well as in an
integrated data field format to enable a comparison between countries. The website is maintained and updated on a regular basis.

Analysis

On-going analysis of the results of the cadastral template information collected so far (39 countries completed, 34 used in current analysis) has been undertaken within the Centre for SDIs and Land Administration. This analysis has been conducted through the development of a list of performance indicators that help to assess how well the cadastral systems were working in key areas. The indicators were developed so that no extra data or information other than what was available through the country template was needed for analysis. The list of indicators which have been used for analysis include:

- Indicator 1: Registration Systems
- Indicator 2: Parcels vs. Population
- Indicator 3: Strata Units
- Indicator 4: Percentage of Parcels Registered
- Indicator 5: Professionals – Surveyors and Lawyers
- Indicator 6: Professionals – Surveyors vs. Lawyers
- Indicator 8: Cadastral Reform Issues and Current Initiatives

The analysis of results is being undertaken using information from both main sections of the cadastral template and includes both a statistical and descriptive analysis. Figures and tables were developed to represent the statistical analysis, with weighted averages used to more effectively compare countries and eliminate misrepresentation of data by taking into account the size of each sample. These weighted averages were weighed by either population or number of parcels, depending on the data. In the case of extremely large or extremely small values within statistical analysis, these were removed from the weighted averages so as to not significantly influence the averages. Detailed preliminary results of analysis are available in Rajabifard et al. (2006).

Overall Results

One of the main results from the analysis of the cadastral template information regarded the order of magnitude of the basic tasks in a cadastral system. Table 1.1 shows the mixture of registration systems and registration methods for 34 countries, with the same data presented as a percentage in Table 1.2. Information gathered from the cadastral templates shows that the most common combination for registration is a titles registration system where registration is compulsory, which accounts for half of the country information collected. Data pertaining to the type of cadastral registration system used is also shown as a percentage in Figure 2. As can be seen from the figure, a title registration system is used in over two thirds of the countries who have completed the cadastral template.
Table 1.1 - Matrix of Registration System vs. Registration Method (%)

<table>
<thead>
<tr>
<th>Number of countries</th>
<th>Compulsory</th>
<th>Optional</th>
<th>Both</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deeds</td>
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<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Title</td>
<td>17</td>
<td>5</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Mixed</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>9</td>
<td>2</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 1.2 – Matrix of Registration System vs. Registration Method (%)

<table>
<thead>
<tr>
<th>%</th>
<th>Compulsory</th>
<th>Optional</th>
<th>Both</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deeds</td>
<td>14.7</td>
<td>5.9</td>
<td>2.9</td>
<td>23.5</td>
</tr>
<tr>
<td>Title</td>
<td>50.0</td>
<td>14.7</td>
<td>2.9</td>
<td>67.6</td>
</tr>
<tr>
<td>Mixed</td>
<td>2.9</td>
<td>5.9</td>
<td>0.0</td>
<td>8.8</td>
</tr>
<tr>
<td>Total</td>
<td>67.6</td>
<td>26.5</td>
<td>5.9</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 2 - Cadastral Registration Systems

Table 2.1 shows the mixture of registration systems and establishment approach for the 34 countries with the same data presented as a percentage in Table 2.2. The tables show that for a mixed registration system (using both deeds and title registration) it is most common to use both a systematic and sporadic approach to the establishment of cadastral records. The title registration system also has a higher percentage of countries with all of their properties being recorded (35%) than the deeds system (13%). The tables also show that it is very common for a deeds registration system to use a systematic approach to registration. The percentages of countries utilising each cadastral system establishment approach are also shown in Figure 3.

(adopted from Rajabifard et al. 2006)
An indication of the scale of problems that countries are facing in terms of informal occupation of land was also seen within the data analysed. It was found that informal occupation was twice as common in rural areas as it was in urban areas. As Table 3 shows, the weighted averages of informal occupation of land were 3% in urban areas and 7% in rural areas, although these figures for individual countries were as high as 70% in rural Namibia (Figure 5) and 25% in urban parts of the Philippines (Figure 6).

<table>
<thead>
<tr>
<th></th>
<th>Legally registered and surveyed (%)</th>
<th>Legally occupied, but not registered or surveyed (%)</th>
<th>Informally occupied without legal title (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>70.3</td>
<td>26.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Rural</td>
<td>70.6</td>
<td>22.7</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Table 3 - Weighted averages of parcel registration data with respect to total parcel numbers
Figure 4 - Percentage of parcels legally registered and surveyed, legally occupied but not registered or surveyed or informally occupied without legal title in urban areas (Country Reports 2005)

Figure 5 - Percentage of parcels legally registered and surveyed, legally occupied but not registered or surveyed or informally occupied without legal title in rural areas (Country Reports 2005)
In terms of the completion and usefulness of spatial cadastral data within countries, it was interesting to note that only 10 countries (Belgium, Brunei, Czech Republic, Denmark, Germany, Hungary, South Korea, the Netherlands, Sweden and Switzerland) had total coverage of their cadastral records and that all of these countries (with the exception of South Korea) were European. The template also revealed that there was often a lack of educational capacity within nations, particularly in the Asia and Pacific regions, for implementing effective cadastral and spatial information systems in order to improve National SDI initiatives. This highlights the need for a greater emphasis on educational and capacity building initiatives within these regions.

All of the analysis which is being undertaken will be available through the dedicated website, in order for countries to learn from and compare their cadastral systems and help understand the magnitude of basic tasks in a cadastral system. The analysis will also help countries to understand and clarify issues and problems which need to be tackled and help to demonstrate how other countries have successfully tackled some of these issues.

**Conclusions**

Ideally, all countries would like to have their cadastral and registration systems operating under “best practice”, however due to the dynamic nature of systems and continual improvements and innovations, many nations cannot keep up, especially those with limited financial support. There is also a lack of knowledge on what is in fact best practice. The concept of the cadastral template has aimed to address this through the creation of a tool to compare and contrast cadastral systems throughout the world, on a basic basis. Due to the diverse nature of counties that have completed the cadastral template, there are at the very least similarities which countries can draw from each other and learn from.

Continued support of the cadastral template by FIG, the PCGIAP and the Centre for SDIs and Land Administration means that the number of countries involved in the project will continue to grow. The current template has also been aimed at the basic elements of a cadastral system. There are many more aspects, such as the cadastral processes of land transfer, subdivision and adjudication, the main entities of the cadastre and their roles, linkages between main entities, types registers within the system and their roles, etc that would also deserve to be investigated, and this is definitely an area for future work.

There is also the ability to link in with other research and professional organisations such as the Global Spatial Data Infrastructure (GSDI) organisation to add scope to the cadastral template. A marine administration template has already been created along the same lines as the cadastral template, focusing on issues in managing the marine environment within the Asia and Pacific regions. The involvement of the GSDI in such a project would not only aid in assessing the current scope of SDI initiatives, but would also help in putting cadastre, land administration and SDI research within a wider context.
Caveat

The data used in this paper has been collected with reasonable care and is presented in good faith. However since it was sourced from contributions from individual jurisdictions, the authors of the paper, the International Federation of Surveyors and PCGIAP take no responsibility for any errors or omissions in the data, for misinterpretations by individual jurisdictions in filling out the cadastral template or the conclusions which are drawn from the data. As a result, care must be taken in its use.

Acknowledgements

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