The Cadastral Template 2.0, From Design to Implementation

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Key words: Cadastral Template 2.0, Cadastral Template Project, Land Administration, PCGIAP

SUMMARY

In 2003, the Cadastral Template Project (http://www.cadastraltemplate.org/) completed gathering data on four key issues under the support of the UN-sponsored PCGIAP Working Group 3 on Cadastre. These key issues are: the magnitude of the basic tasks in the cadastral system; the magnitude and problems involved in the informal occupation of land; the role of the cadastre in SDI, and to get an appreciation of the completeness, comprehensiveness, use and usefulness of spatial cadastral data; and lastly, to get an understanding of the capacity building activities in place or which are needed to be established to support the system. The Cadastral Template Project has collected data on 47 different national cadastral systems with updated reports being provided regularly by countries, demonstrating the continued merit of the exercise. However, in line with new technologies, the evolving conceptualisation of the role of the cadastre and an increasing focus on spatially enabled societies, an evolution of the project is now in the pipeline.

This paper presents a new platform for the template, Cadastral Template 2.0. It will be a web-based resource that will gather and authenticate information through an enabling platform that is equipped with new functionalities and flexible design for updating and populating information about cadastres. Cadastral Template 2.0 will also be designed to reflect the increasing acknowledgement of the relationship between cadastres and the concept of spatially enabled societies. Data of those 47 countries has been already moved into the Cadastral Template 2.0 and it can be updated by the authorised users.

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1. INTRODUCTION

Cadastres are regarded as the foundation for sustainable social, economic and environmental development of societies. In 2003, under the auspices of the UN-sponsored PCGIAP Working Group 3 on Cadastre, a generic cadastral template was developed to establish a standard form, which allowed cadastral organisations to present and describe national cadastral systems in a standardised format. Such standardisation was important for enabling the identification of similarities and differences in matters such as land policy, laws and regulations, land tenure issues, institutional arrangements, spatial data infrastructures, technology, human resources and efforts to support capacity building.

The Cadastral Template Project (http://www.cadastraltemplate.org/) commenced and endeavoured to gather data on four key issues (Steudler et al., 2003; 2004):

- the magnitude of the basic tasks in the cadastral system;
- the magnitude and problems involved in the informal occupation of land;
- the role of the cadastre in SDI, and to get an appreciation of the completeness, comprehensiveness, use and usefulness of spatial cadastral data; and
- to get an understanding of the capacity building activities in place or which needed to be established to support the system.

A decade on, the Cadastral Template Project has collected data on 47 different national cadastral systems with updated reports being provided regularly by countries, demonstrating the continued merit of the exercise (Country Report, 2003). However, in line with new technologies, the evolving conceptualisation of the role of the cadastre and an increasing focus on spatially enabled societies, an evolution of the project is now in the pipeline.

This paper presents a new platform for the template, Cadastral Template 2.0. It will be a web-based resource that will gather and authenticate information through an enabling platform that is equipped with new functionalities and flexible design for updating and populating information about cadastres. Cadastral Template 2.0 will also be designed to reflect the increasing acknowledgement of the relationship between cadastres and the concept of spatially enabled societies (Rajabifard and Steudler, 2013). In addition to continuing to collect cadastral-related data, Cadastral Template 2.0 will also seek to gather data on the key elements that have been identified for a spatially enabled society, as outlined in FIG Publication No. 58, ‘Spatially Enabled Society’:

- legal framework;
- common data integration concept;

- positioning infrastructure;
- spatial data infrastructure;
- land ownership information; and
- data and information.

It is envisioned that this new platform of data will provide a fundamental resource to assist countries in assessing and benchmarking their own national systems. This ultimately will facilitate the decision-making process in land administration systems and bring efficiency to their processes.

2. Web 2.0

Web 2.0 concepts encourage end users to interact and communicate with the web, rather than being a simple web reader. Web 2.0 (websites, social media, etc) allows users to do more than just retrieve information. A user is invited to 'write' as well, instead of purely 'reading', or contribute to the content available to everyone in a user friendly way. By increasing Web 1.0 features, the user has more user-interface, software and storage facilities, all through their browser (O'Reilly, 2005). Cadastral Template Project was designed successfully based on Web 1.0 concept in 2003. However, existing of new technologies (technology push) and also the user demand to utilise these technologies led to develop Cadastral Template 2.0 based on Web 2.0 concepts.

3. Cadastral Template 2.0, Design

3.1 Technologies used in the Cadastral Template 2.0

The following web-based programming technologies have been used in this template:

- Database
    - MySQL: to store and maintain cadastral data provided by the individual participants.

- Back-end Technology
    - PHP: a server-side scripting language to communicate and retrieve the data from the database.

- Front-end Technology
    - JavaScript: client-side scripts to interact with the user and visualised the retrieved data.
    - JQuery: to simplify the client-side scripting of HTML.
    - Datamaps: a SVG-based data maps using D3.js to provide some data visualisations based on geographical data.
    - D3.js: a JavaScript library that uses digital data to drive the creation and control of dynamic and interactive graphical form.

- Google Chart API: A Google API to create charts from some data and embed it in a web page.

3.2 Architecture of the Template

3.2.1 Interactive Map and Visualisation features

Architecture of Cadastral Template 2.0 is based on providing interactive mapping services and visualisation features for end users. This helps users of the template to analyse and compare different data and supports decision making for improving their cadastral systems based on the findings from the template. Figure 2 shows the designed interactive map of Cadastral Template 2.0. Using this interactive map, users can perceive the distribution of countries which participated in this template.
As it can be seen in figure 1, there is a gap in participation from North and South America, Africa, and Middle East regions. The ultimate goal of this architecture is to ease the data manipulation and updating process to encourage more participants.

3.2.2 Open Source and free licensed technologies

Also, all the deployed web technologies which are used in Cadastral Template 2.0 are open source and they have free licensing systems. This provides more opportunities for other developers and increases engagement to improve this template.

3.2.3 Regional-based and country-based classes

In Cadastral Template 2.0, countries are divided into 6 regions respectively Asia, Europe, Africa, North America, South America, and Oceania (Figure 1). This regional-based classification facilitates analysing and comparing different cadastral data within a region or inter-regions.

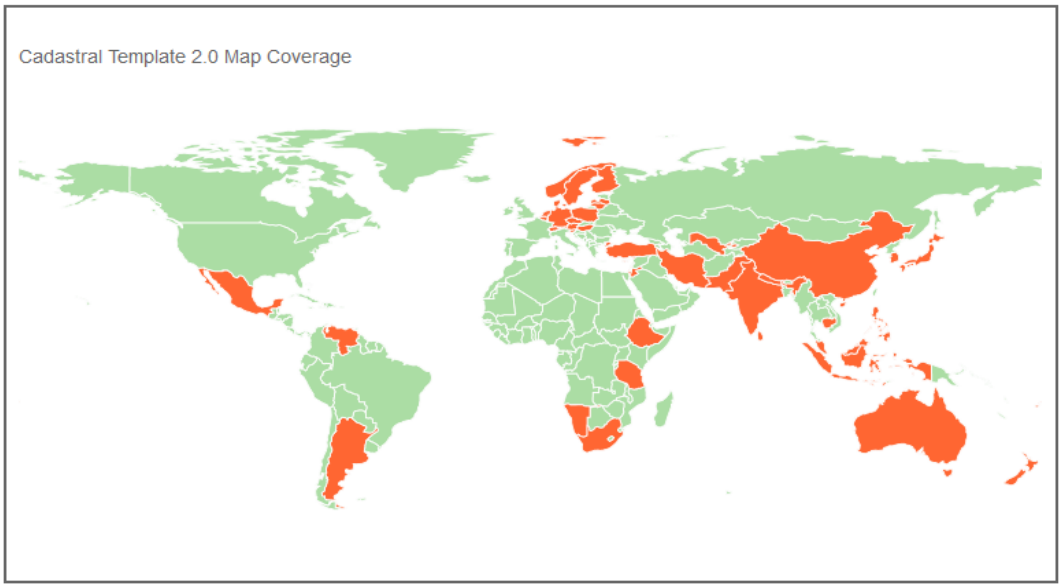
3.2.4 Principles and Statistics

Cadastral Template 2.0 provides predefined statistical analysis based on the provided data by the participants. This data is retrieved from the database. Section 4.1 will provide further detain about this function.

Cadastral Template 2.0

Home | Map and Countries | Principles and Statistics | Publications | Project Partners | Contact

Map and Countries



List of participated countries in Cadastral Template 2.0 project.

Asia	Europe	Africa	North America	South America	Oceania
Brunei	Austria	Ethiopia	Mexico	Argentina	Australia
Cambodia	Belgium	Namibia		Venezuela	Fiji
China	Bulgaria	South Africa			Kiribati
Hong Kong	Cyprus	Tanzania			New Zealand
India	Czech Republic				
Indonesia	Denmark				
Iran	Finland				
Israel	Germany				
Japan	Hungary				
Jordan	Latvia				
South Korea	Lithuania				
Macau	Netherlands				
Malaysia	Norway				
Nepal	Poland				
Pakistan	Slovenia				
Philippines	Sweden				
Sri Lanka	Switzerland				
Turkey					
Uzbekistan					

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Figure 1. Cadastral Template's interactive map which contains participated countries

4. Cadastral Template 2.0, Implementation

In this section, we will navigate into different parts of the template to demonstrate the existing functionalities of Cadastral Template 2.0. The end user can select a country, via clicking on a country or selecting from the table which links to new page containing two buttons: Country Context and Country Principles. Figure 2 shows these buttons for the selected country, Australia.

Figure 2. Country Context and Country Principles for Australia

Country Context covers demographic information, institutional framework, and cadastral systems, mapping, and issues for each individual country. Table 1 lists the materials which are maintained in the Country Context section.

Table 1. List of materials in Country Context section

Country Context	Geographical Context
	Historical Context
	Current Political and Administrative Structures
	Historical Outline of Cadastral System
Institutional Framework	Government Organizations
	Private Sector Involvement
	Professional Organization or Association
	Licensing

	Education
Cadastral System	Purpose of Cadastral System
	Types of Cadastral System
	Cadastral Concept
	Content of Cadastral System
Cadastral Mapping	Cadastral Map
	Example of a Cadastral Map
	Role of Cadastral Layer in SDI
Reform Issues	Cadastral Issues
	Current Initiatives
References	

Figure 3 is an example of Country Context page for Australia. This information is editable by authorised users. Country Context section covers more descriptive information of cadastral matters for each country.

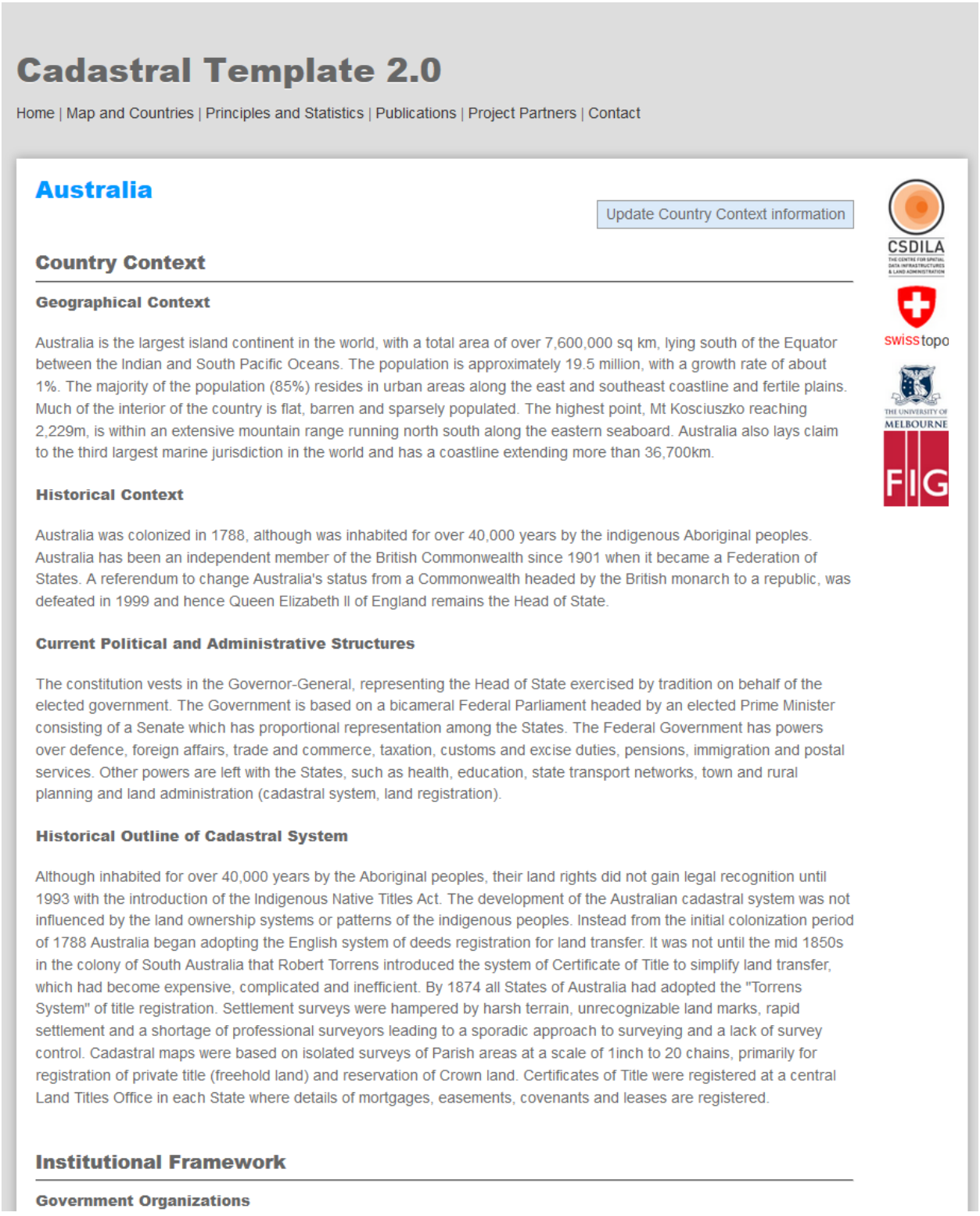


Figure 3. A section of Country Context of Australia

The second option, Country Principles comprises more numerical information of cadastral matters compare to the descriptive information covered in Country Context.

Table 1. List of features covered by Country Principles

	Categories	Sub-categories
Cadastral Principles	Registration System	title registration
		deeds registration
		other
	Registration of Land Ownership	compulsory
		optional
		other
	Approach for Establishment of Cadastral Records	systematic
		sporadic
		all properties already registered
		other
Cadastral Statistics	Population	
	Urban Population Distribution (%)	
	Rural Population Distribution (%)	
	Total Number of Land Parcels	
	Total Number of Land Parcels per 1 Million Population	
	Total Number of Registered Strata Titles/Condominium Units	
	Total Number of Strata Titles/Condominium Units per 1 Million Population	
	Land Parcels in URBAN Areas	
	Land Parcels in URBAN Areas that properly registered and surveyed (%)	
	Land Parcels in URBAN Areas that legally occupied, but not registered or surveyed (%)	
	Land Parcels in URBAN Areas that informally occupied without legal title (%)	
	Land Parcels in RURAL Areas	
	Land Parcels in RURAL Areas that properly registered and surveyed (%)	
	Land Parcels in RURAL Areas that legally occupied, but not registered or surveyed (%)	

	Land Parcels in RURAL Areas that informally occupied without legal title (%)	
	Number of Active Professional Land Surveyors	
	Proportion of Time that Active Professional Land Surveyors Committed for Cadastral Matters (%)	
	Number of Active Lawyers/ Solicitors	
	Proportion of Time that Active Lawyers/ Solicitors Committed for Cadastral Matters (%)	

Figure 4 is an example of Cadastral principles for Australia. This section shows if the land registration of a country is title-based, deeds-based, or both or even other. It also displays if registration of land ownership in a country is compulsory, optional, or both or other.

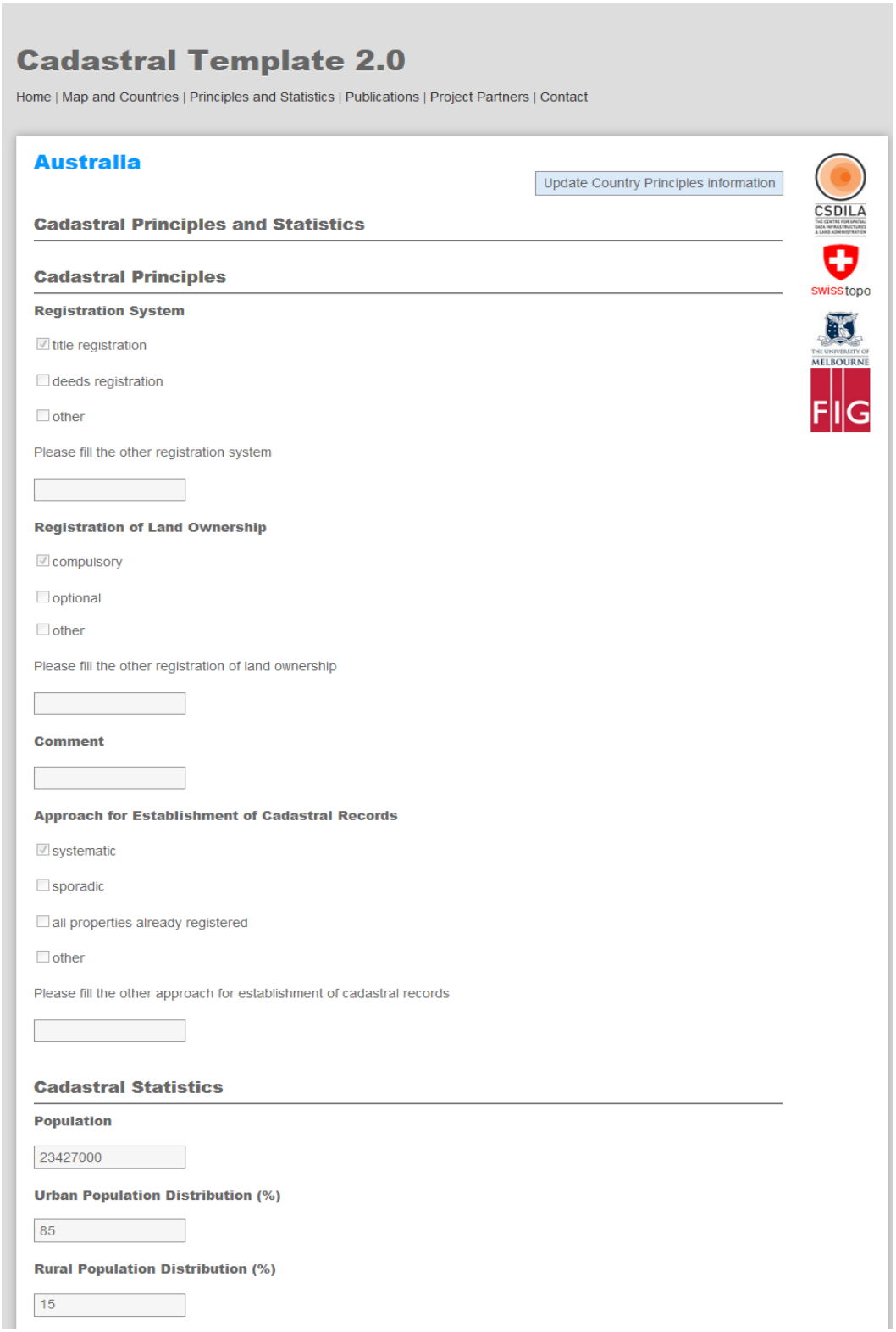


Figure 4. Country Principles of Australia

4.1 Principles and Statistics

This section displays how statistical information is queried in Cadastral Template 2.0. Here, the user should first select a region and then a country or countries of the region or even from other regions for comparison (Figure 5).

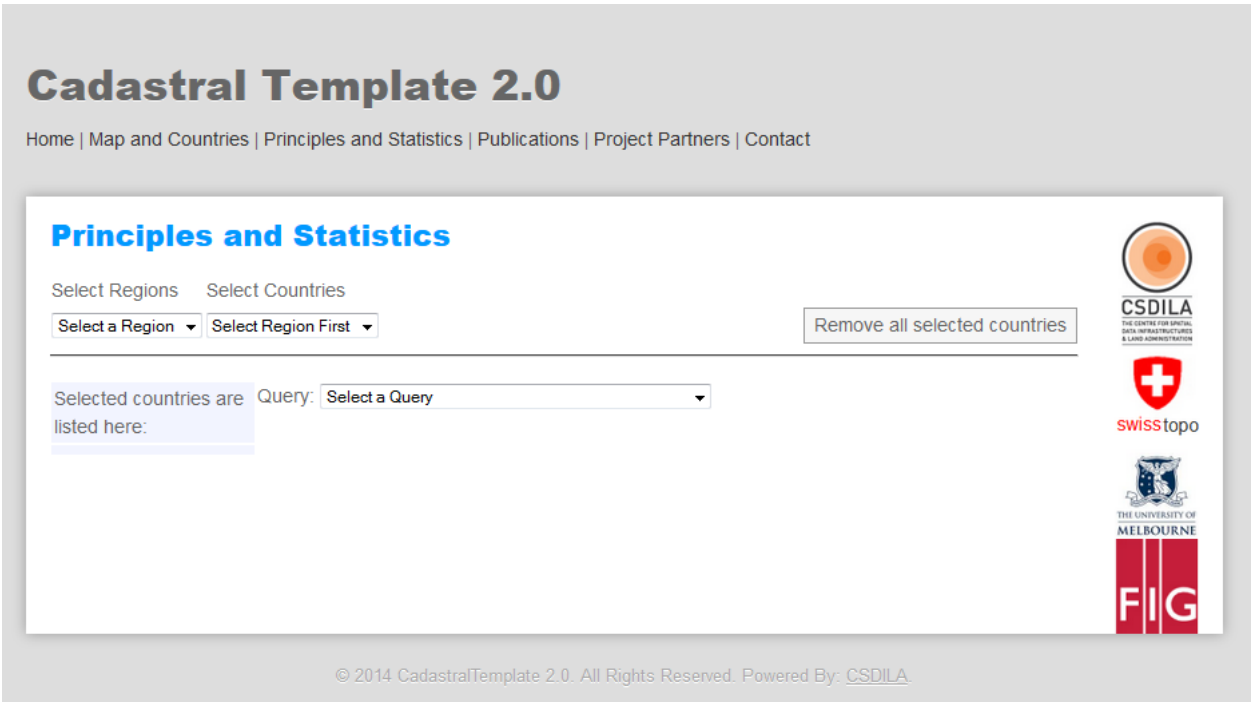


Figure 5. Main interface of Principles and Statistics page

Figure 6 shows that a region, Europe, in this example is selected. Figure 7 displays the country name in the selected region. Selected countries are listed in the Principles and Statistics page for confirmation of selections (Figure 8).

4.1.1 Selection of regions and countries

In this template, it is possible to select all countries, or countries of different regions. This helps users to evaluate and compare cadastral data in different ways.

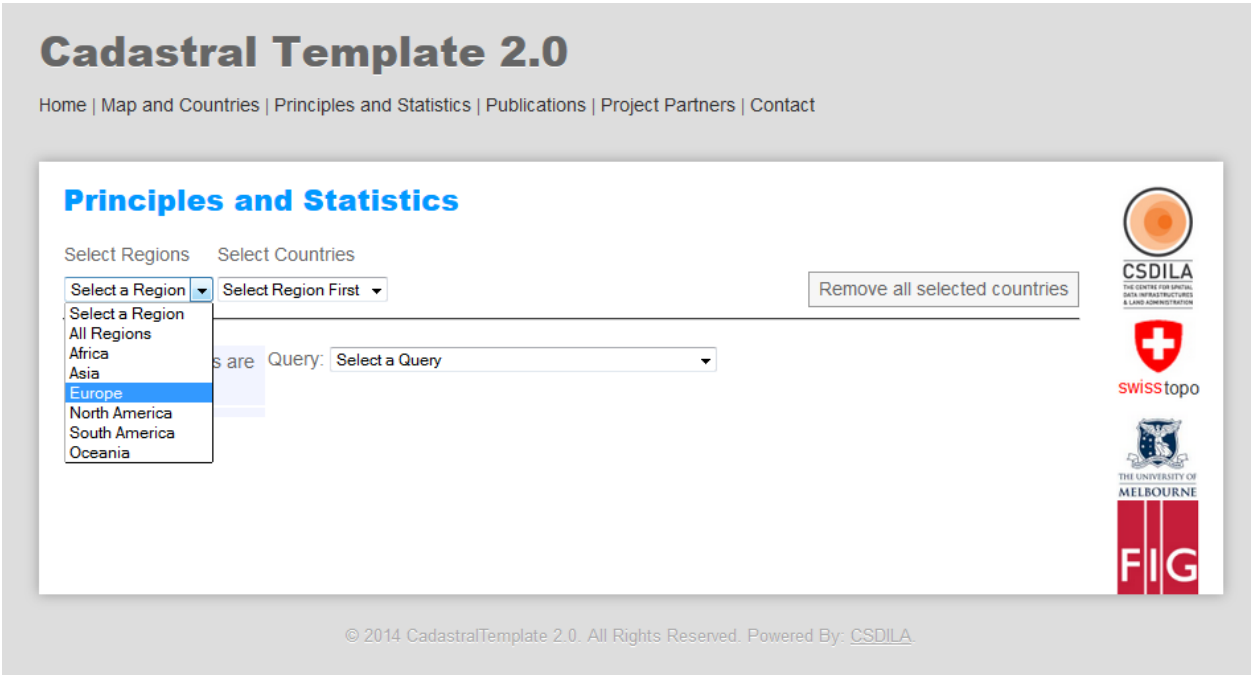


Figure 6. Selection of a region

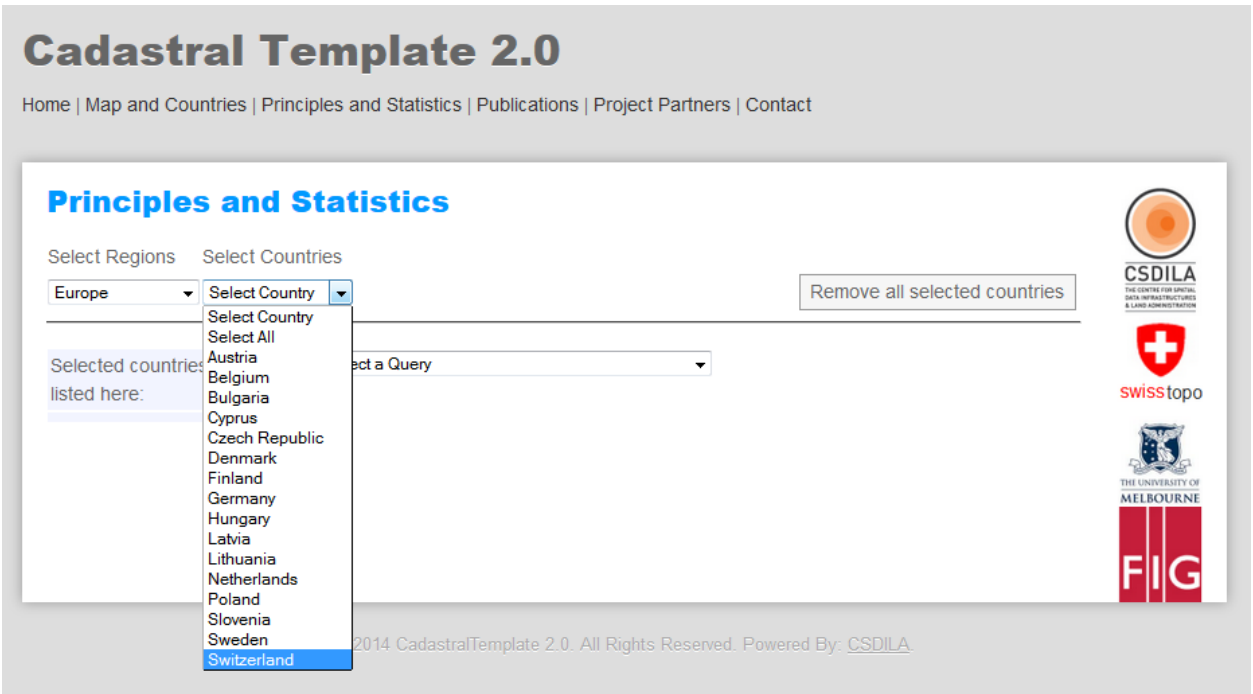


Figure 6. Selection of a country

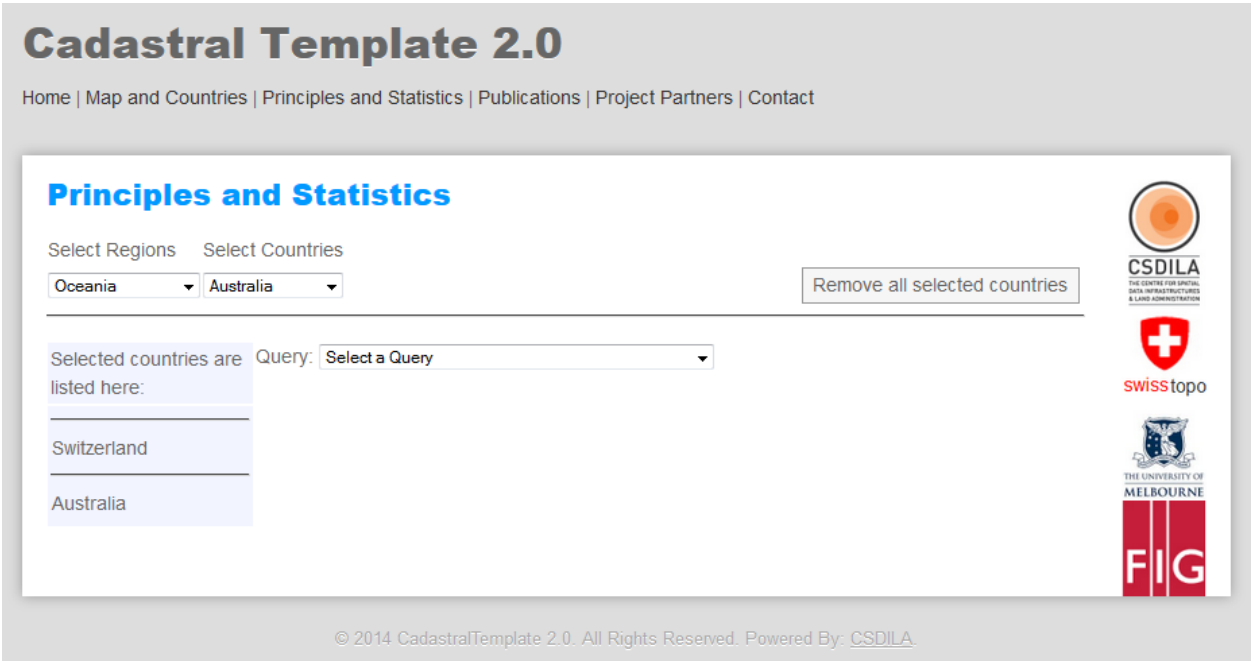


Figure 7. List of selected countries (Switzerland and Australia in this example)

4.1.2 Select a query

After selection of regions and countries, it is time to select a query based on the user need (Figure 8).

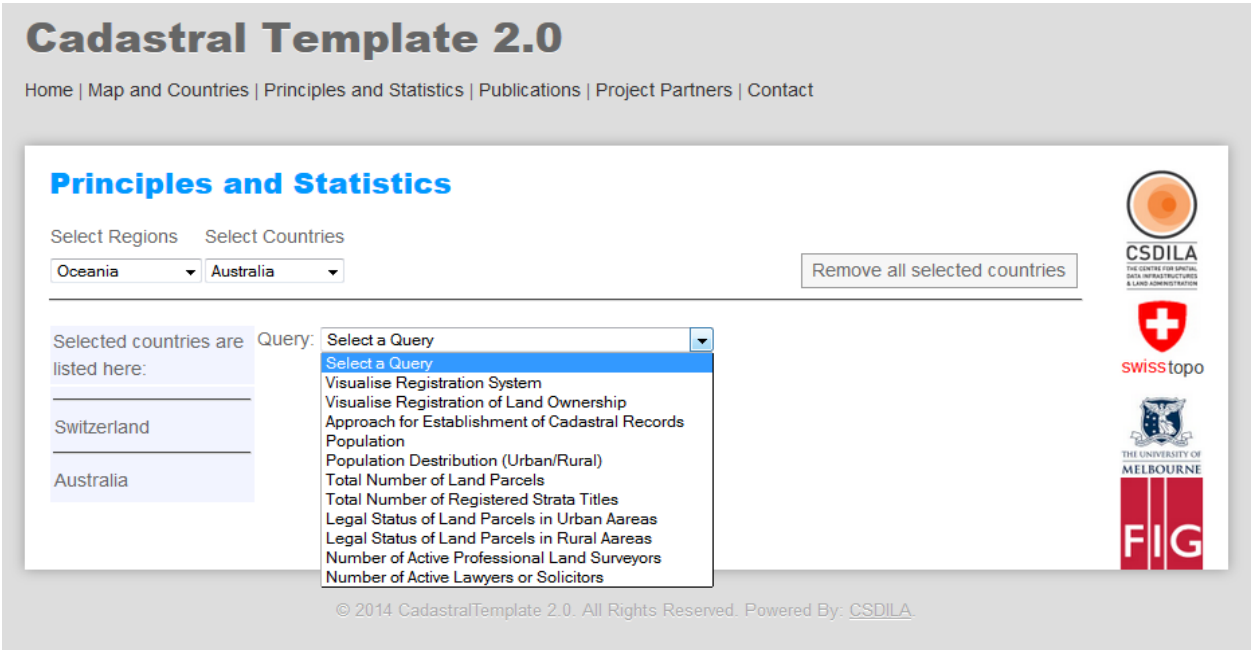


Figure 8. Selection of a query

Following examples (Figure 9, 10, 11, 12, 1nd 13) show the result of different queries on the selected countries.

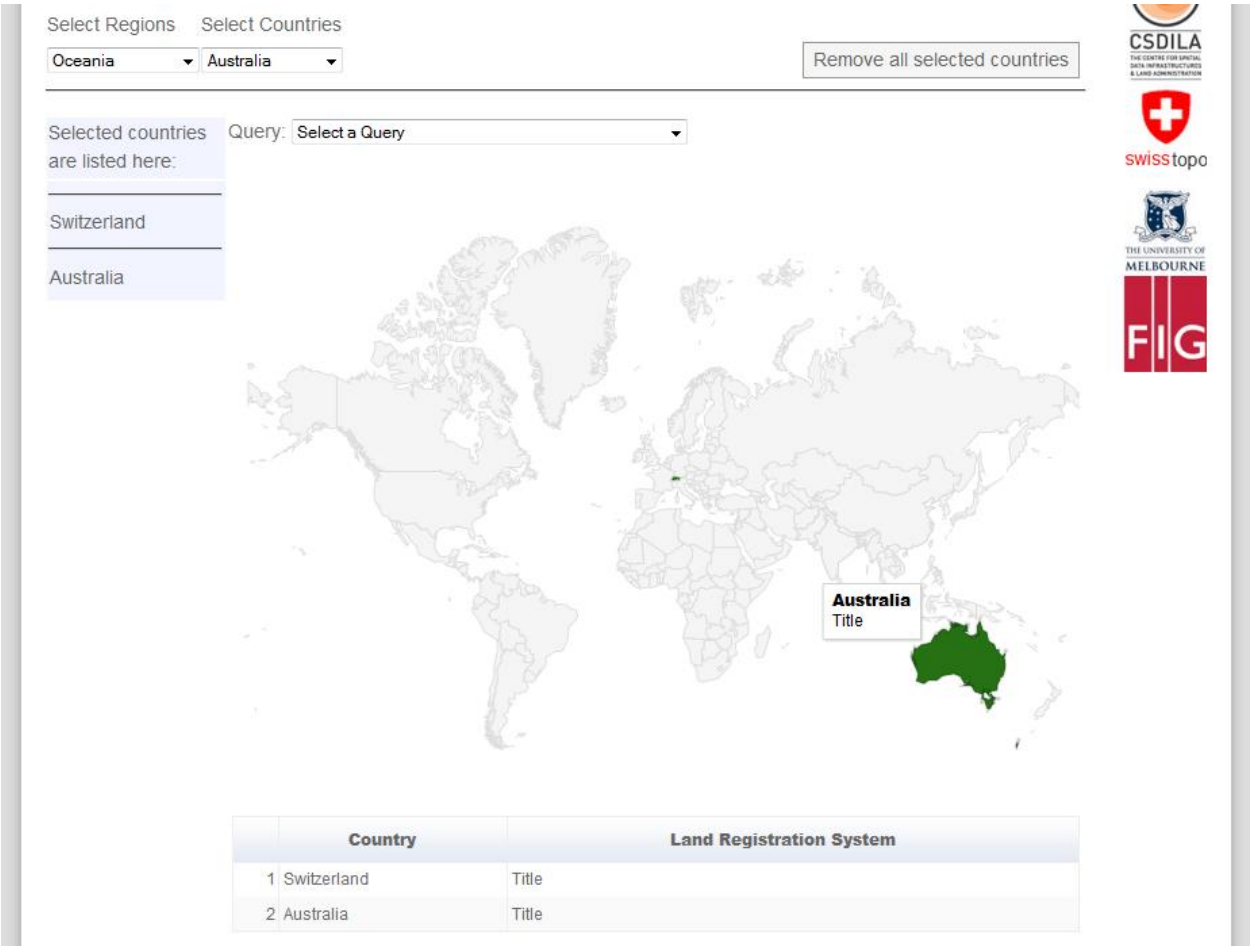


Figure 9. Query = Land registration system, Countries= Switzerland and Australia

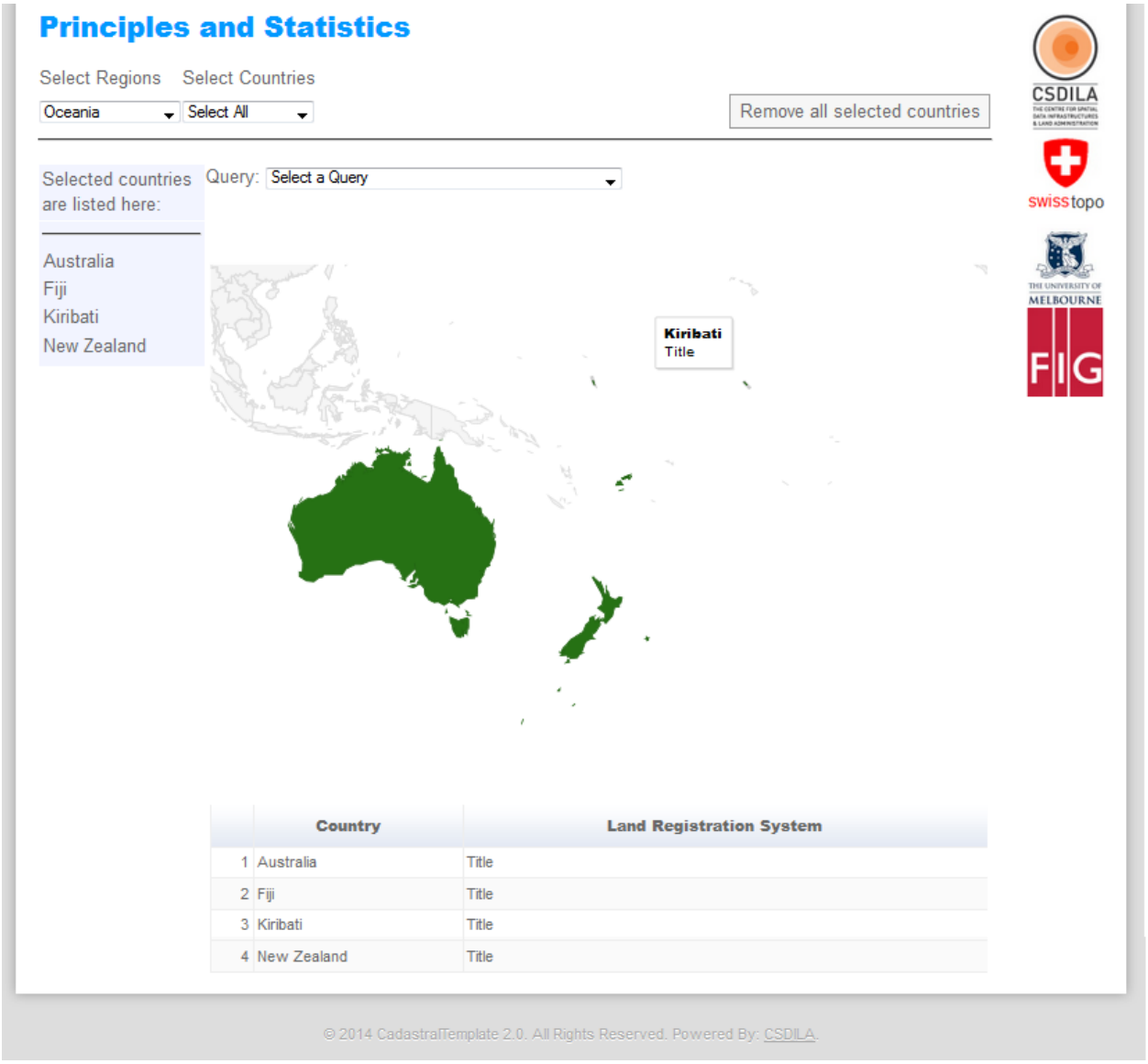


Figure 10. Query = Land registration system, Countries= Australia, Fiji, Kiribati, and New Zealand (Oceania Region)

Figure 11. Query = Land registration system, Countries= All countries

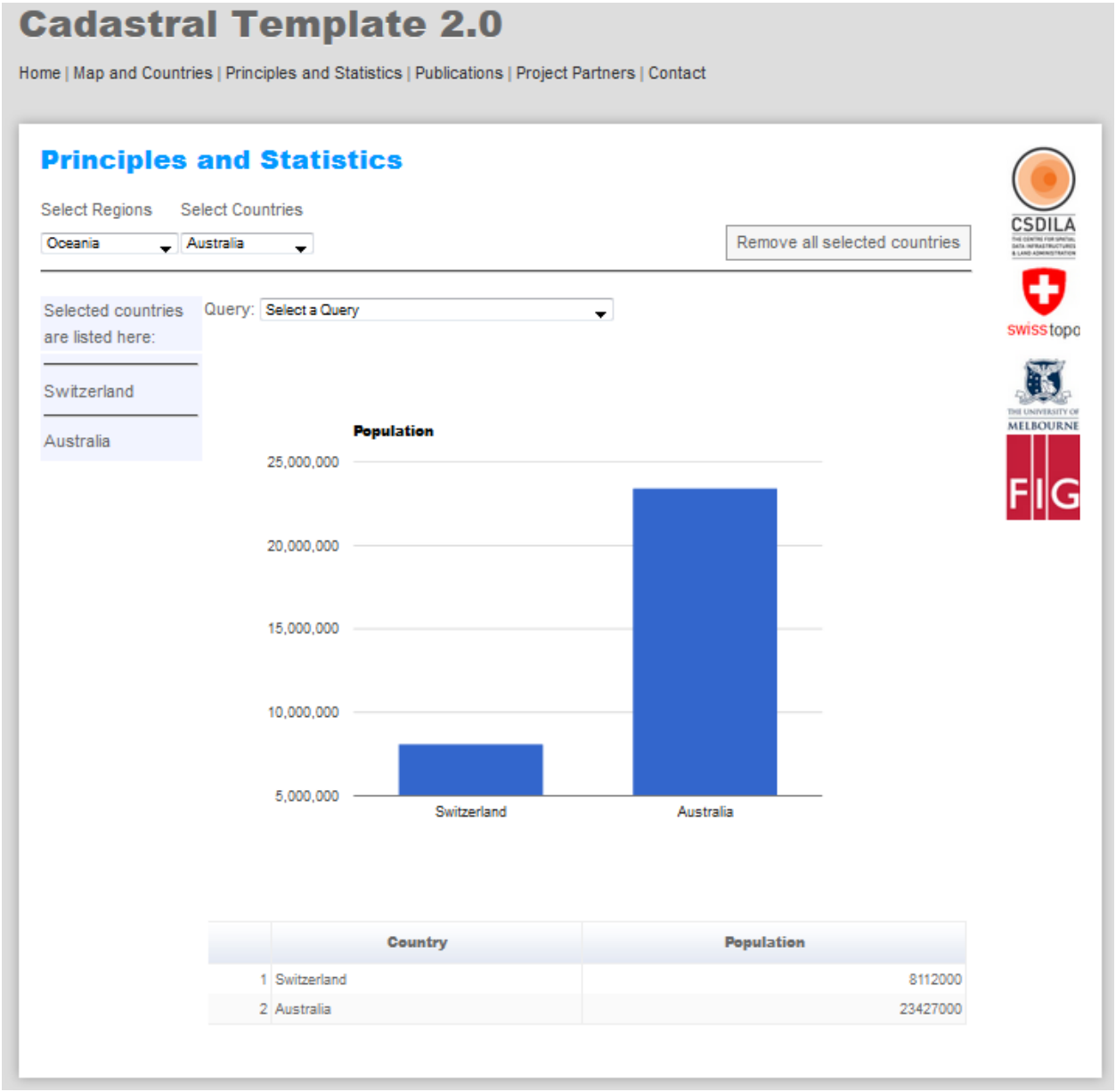


Figure 12. Query = Population, Countries= Switzerland and Australia

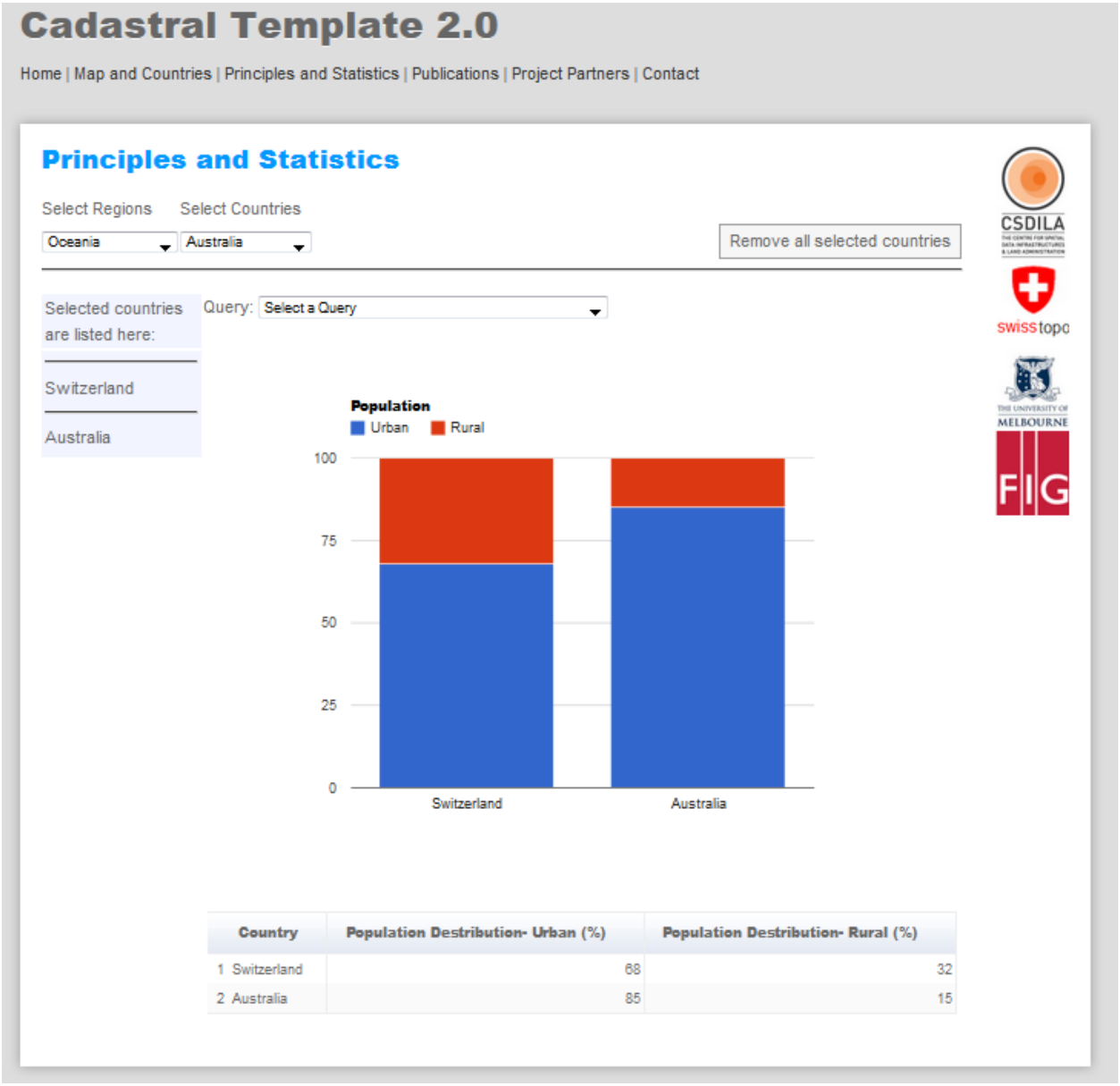
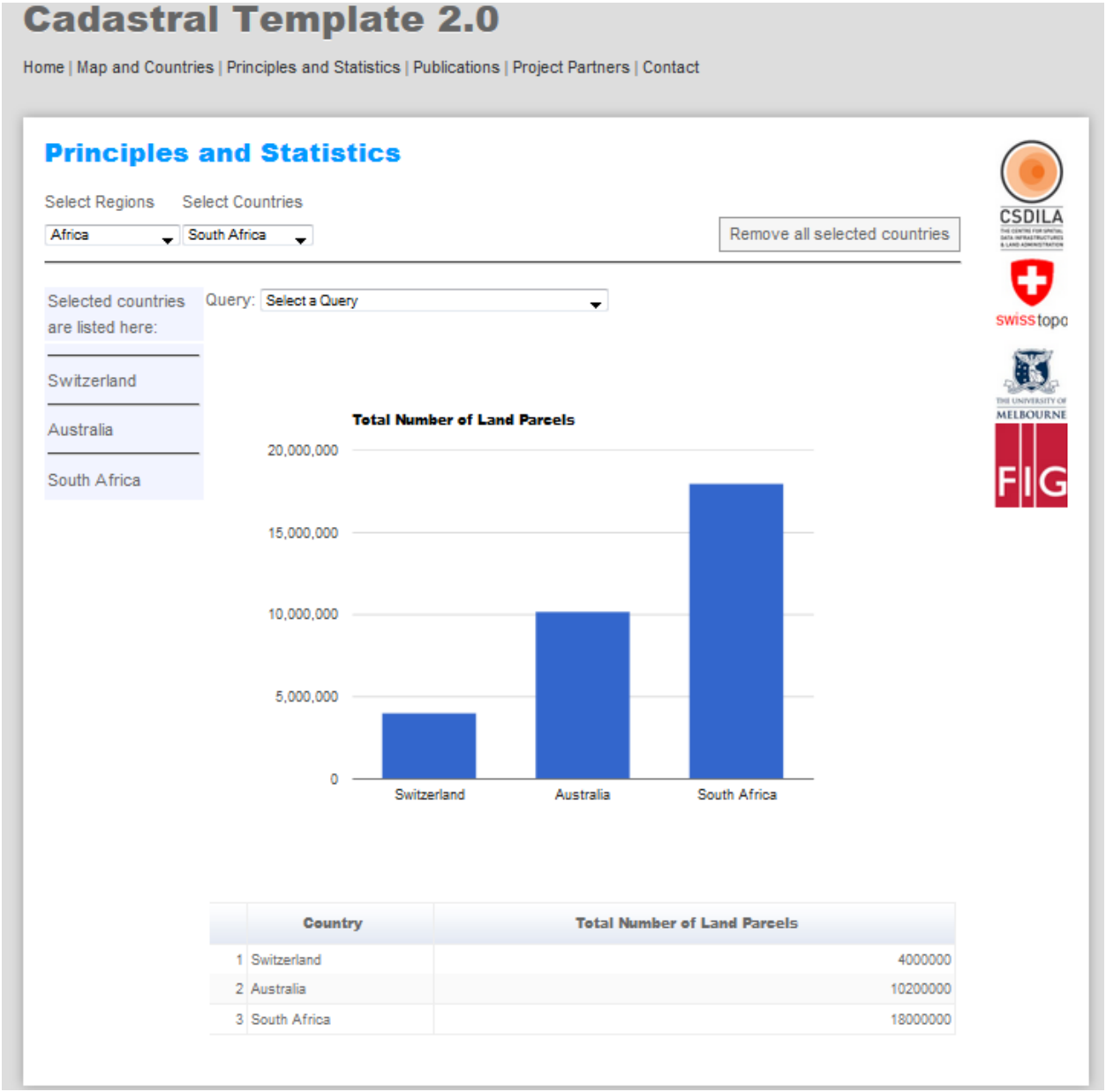
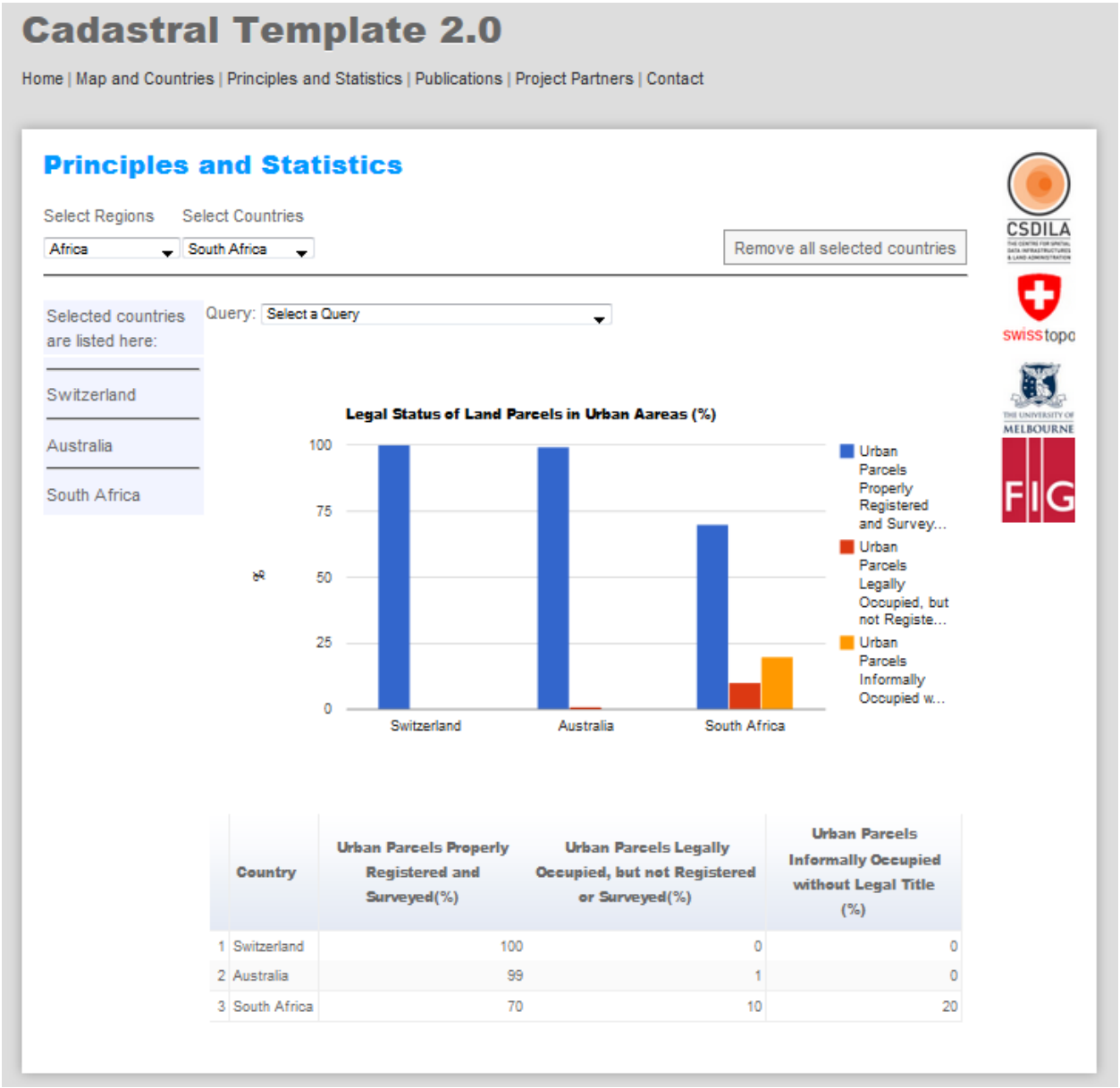


Figure 13. Query = Urban/Rural Population Distribution, Countries = Switzerland and Australia



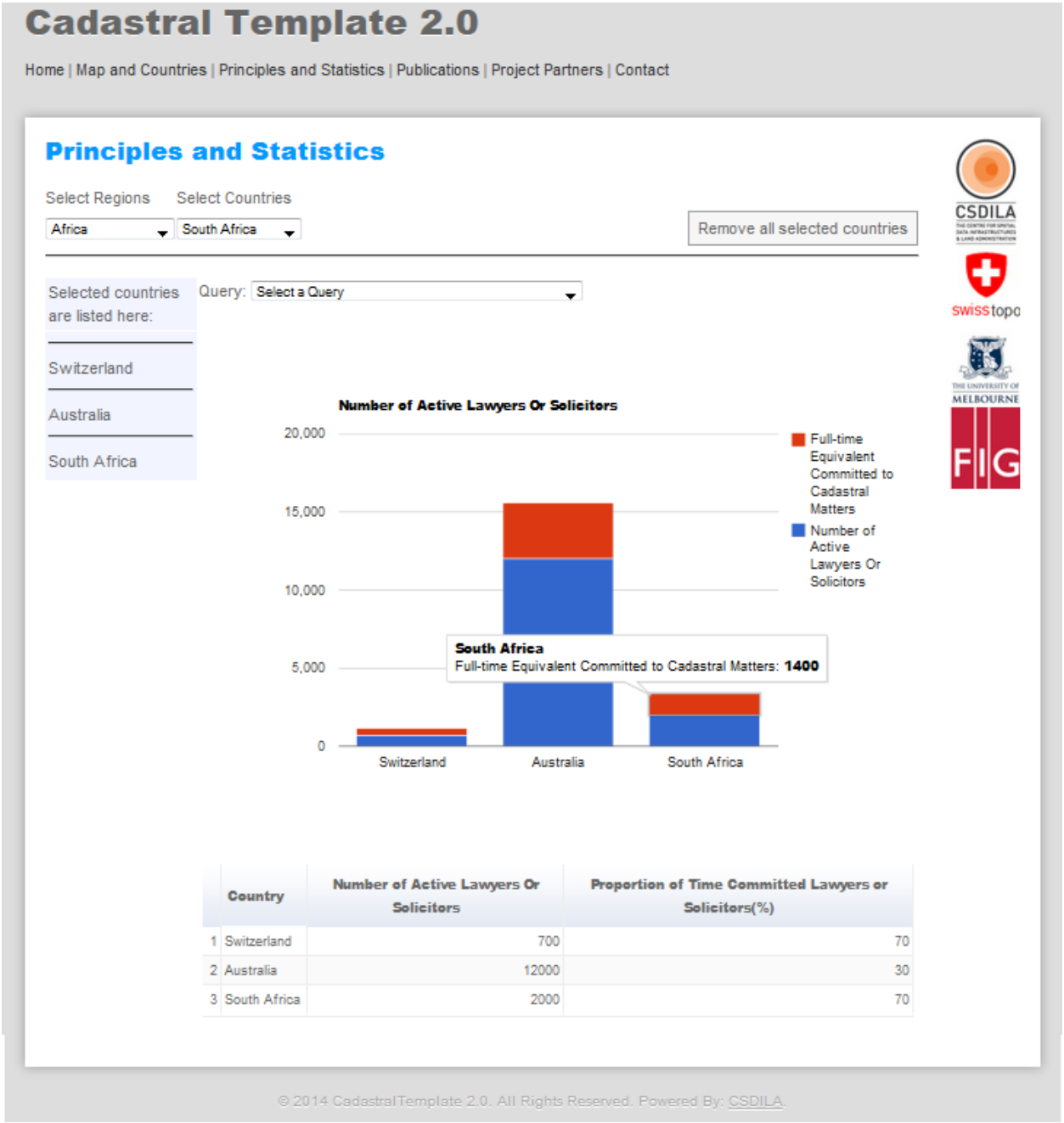
	Country	Total Number of Land Parcels
1	Switzerland	4000000
2	Australia	10200000
3	South Africa	18000000

Figure 14. Query = Total number of land parcels, Countries = Switzerland, Australia, and South Africa



	Country	Urban Parcels Properly Registered and Surveyed(%)	Urban Parcels Legally Occupied, but not Registered or Surveyed(%)	Urban Parcels Informally Occupied without Legal Title (%)
1	Switzerland	100	0	0
2	Australia	99	1	0
3	South Africa	70	10	20

Figure 15. Query = Legal status of land parcels in urban areas, Countries = Switzerland, Australia, and South Africa



	Country	Number of Active Lawyers Or Solicitors	Proportion of Time Committed Lawyers or Solicitors(%)
1	Switzerland	700	70
2	Australia	12000	30
3	South Africa	2000	70

Figure 16. Query = Total number of active lawyers and solicitors, Countries= Switzerland, Australia, And South Africa

5. Conclusions

The cadastral template project was a first step to collect generic information about cadastral and land administration systems. Technology push and user demand pull led to upgrade the existing cadastral template to a Web 2.0 based template. Cadastral Template 2.0 contains cadastral data of all 47 countries. It allows the authorised users to edit the data, make queries and compare the data of different countries and regions. Cadastral Template 2.0 has an interactive map allows users to find the coverage area of the template and easy access to the information of interested countries. However, there are many more features and aspects such as the cadastral processes of land transfer, subdivision and 3D cadastres (Aien, 2013); etc. that would deserve further investigation. This project aims at the most basic to provide Web 2.0 concepts for the users. However, it will provide the basis for further research and future data collection.

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BIOGRAPHICAL NOTES

Abbas Rajabifard is a Professor and Head of Department of Infrastructure Engineering at The University of Melbourne. He is also Director of the Centre for Spatial Data Infrastructures & Land Administration (CSDILA). He is former President of the GSDI Association, a member of ICA-Spatial Data Standard Commission, and a member of Victorian Spatial Council.

Daniel Steudler graduated from the Swiss Federal Institute of Technology (ETH) in Zurich in 1983, earned the Swiss license for licensed land surveyor in 1985, and did his M.Sc.Eng. degree at the University of New Brunswick, Canada from 1989-91. Since 1991, he is working with the Swiss Federal Directorate of Cadastral Surveying with the responsibilities of supervising and consulting Swiss Cantons in organisational, financial, technical, and operational matters in cadastral surveying. Since 1994, he is involved in the activities of FIG-Commission 7 as a working group secretary, and in 2003, he became the official Swiss delegate to Commission 7. In February 2004, he completed the requirements for a PhD degree at the Department of Infrastructure Engineering, the University of Melbourne.

Ali Aien completed his PhD in 2013 at the Department of Infrastructure Engineering, the University of Melbourne. His research aimed to develop and implement a data model for 3D cadastre. He is currently working as a research assistant in the Centre for Spatial Data Infrastructures & Land Administration (CSDILA).

Mohsen Kalantari is a lecturer at the Centre for SDIs and Land Administration at the Department of Infrastructure Engineering, the University of Melbourne working on 3D cadastre. He finished his PhD from the University of Melbourne in 2008.

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