# Applications of open source software in land administration: An initiation with land administration education

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*Abstract*

*The LA System in Nepal is quite traditional. The government has realized the need of modernizing the system and some positive efforts are underway at the moment. Introduction of Geo-ICT in the business system is one of the main objectives of these efforts.*

*Capacity building is an essential aspect to be considered before introducing modernisation in the system. Some efforts are underway in this aspect such as human resource development through Geomatic Education in the country. Recently, Kathmandu University (KU) has introduced a bachelor's degree level course in Geomatics Engineering, i.e. Bachelor's of Engineering (B.E.) on Geomatics, as a collaborative program with Land Management Training Center (LMTC). This new initiative would include Geo-ICT based land administration education. Application of Open Source Software (OSS) for the education could be a better choice for KU and LMTC to exploit all possible functionalities of the OSS in developing / supporting a Geo-ICT based land administration education*

*With this ground, the author carried out a study to overview the possibilities with Open Source Software (OSS) to apply for land administration in Nepal. The paper is developed out of the study.*

## 1. Introduction

Advancement in Geo-Information and Communication Technology (Geo-ICT) offers an opportunity to make land administration efficient and effective. However, not all land administration organizations have been able to introduce its full applications in their daily business work, especially those of developing countries like Nepal, where traditional way of business process is still in practice. Introduction of Geo-ICT needs appropriate infrastructure, resources and capacities. If the case of Nepal is taken into account, land administration organizations in the country are lacking ICT, more specifically Geo-ICT, oriented human resources/capacities. Such limitations with land administration organization in the country have weakened its capacity to align the technological advancement with business strategy.

Some efforts are underway for human resource development through Geomatic Education in the country. Land Management Training Center (LMTC) is a governmental body (under the Ministry of Land Reform and Management) to conduct training courses on surveying, mapping and land administration/management. Recently, Kathmandu University (KU) has started bachelor's degree level course on Geomatics Engineering, i.e. Bachelor's of Engineering (B.E.) on Geomatics, as a collaborative program with LMTC. This new initiative would include Geo-ICT based land administration education. Application of Open Source Software (OSS) for the education could be a better choice for KU and LMTC to exploit all possible functionalities of the OSS in developing / supporting a Geo-ICT based land administration education.

This paper has overviewed the possibility of application of OSS, such as ILWIS, and PostgreSQL / PostGIS / uDig in Land Administration for the purpose of teaching at BE Geomatic Engineering.

## 2. Land Administration in Nepal

This section begins with referencing some definitions on Land Administration (LA) being adopted

from (Enemark and Molen, 2008). FAO defines LA as "'the way in which the rules of land tenure are applied and made operational". It comprises an extensive range of systems and processes to administer the holding of rights to land (allocation, delimitation, transfer, disputes), economic aspects of land (gathering revenues valuation, disputes), and Control of land use (regulation, land use planning, disputes). In the UN/ECE Land Administration Guidelines (1996) LA is defined as the "process of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies". Dale & McLaughlin (1999) define the same as "the processes of regulating land and property development and the use and conservation of the land, the gathering of revenues from the land through sales, leasing, and taxation, and the resolving of conflicts concerning the ownership and use of land".

LA in Nepal is found somewhere around the above mentioned definitions, with some limitations in its operational part. Historical documents reveal that the LA in Nepal is as old as the human civilization, starting from Vedic period. The ancient LA was undertaken only for the purpose of revenue collection to support state affairs by then rulers (Khanal, 2006). Evolution and changes in state affairs gradually came up with changes in the scope and importance of LA. By now, revenue collection remains only a part of LA processes in the country.

LA system in Nepal is largely traditional. The system keeps parcel based information, spatial as well as attribute, on land in analogue form. Efforts have been made to practice the system in the line to meet most of the contents of the UN/ECE Land Administration Guidelines (1996), according to which a good land administration system guarantees ownership and security of tenure, supports land and property taxation, provides security for credit, develops and monitor land markets, protects State lands, reduces land disputes, facilitates land reform, improves urban planning and infrastructure development, supports environmental management, and produce statistical data. However, the result is not at a satisfactory level, even unsupportive sometimes. The traditional way of keeping land records, spatial as well as attribute, has diminished the reliability of information, land disputes are pretty common and land registries are overwhelmed with associated problems[1]. Despite the government's efforts on modernizing the LA Systems since 1990, the system is still waiting for its application in operational level. Efforts on building land information system (LIS) throughout the country are underway through digital archiving of land records, which is performed by scanning the cadastral maps and computerizing the attribute information. The LA system is challenging the statement from (Pieper, 2007); no digital LA System can ever said to be complete, having even not introduced the digital system into it as of the date. Application of Geo-ICT in this sector is still awaited fact for the country, which would probably enhance the efficiency and effectiveness of LA System for the betterment of the societies.

However, the government of Nepal is making its best effort to modernize the LA system. As the most recent effort is an initiation of a project entitled "Nepal: Strengthening Land Administration Services" with the technical assistance from Asian Development Bank (ADB). As per (ADB, 2007), the outcome of the project will be a more reliable, fair, and sustainable land administration and management process made possible by modernizing and improving business processes and developing a road map for a national comprehensive land policy. This outcome is expected to increase the effectiveness of the land administration system and, in the long term, improve social justice and the rights of the poor. The key outputs from the project will be (i) a revised business process; (ii) a strategy for the future with the use of technology in land administration; (iii) accessible, secure, and upgraded land records; (iv) an action plan and costing to implement the strategy; (v) pilot testing of the strategy in selected areas within districts; and (vi) a road map toward a comprehensive national land policy framework. It can be assumed that the modernization of the LA system in the country at present is in the state of 'wait and see' the outcomes of the project and the future beyond it.

## 3. Business Strategy versus Technology

Ministry of Land Reform and Management (MoLRM), Government of Nepal (GoN), is the ministry responsible for core business on land management and administration including surveying and mapping in Nepal. GoN has mandated the ministry the tasks of formulating plans, policies, and regulations for land administration and management activities in the country including their monitoring and evaluation, conducting land reform activities like distribution of lands as per the government's decisions, looking after overall land registration activities, looking after overall surveying and mapping activities and other activities of land administration and management as and when necessary. The mission of the ministry is to support good governance, social justice, environmental protection, improved productivity of land, poverty

*1 www.molrm.gov.np/dept_lia.php*

reduction and sustainable development through proper land management and administration. The ministry mentions its main objectives as to prepare policies and plan for overall land administration and management activities including surveying and mapping, to implement land related laws, acts and regulations regarding land administration, management and surveying and mapping activities in the country, to develop a modernized land ownership record system, to conduct activities for capacity building in its core sector, to develop LIS as well as Geographic Information System (GIS) essential for overall development of the nation, to carryout the activities of land reform and land development, to promote National Spatial Data Infrastructure (NSDI) in the country and to carryout other activities of land administration and management in the country.[2]

An explicit documentation on the business strategy of land administration in Nepal could not be found. However, an abstraction has been made out of above mentioned functions, mission and objectives of MoLRM, and current socio-economic and political situation of the country. Beforehand, it must be kept in mind that the country is in dramatic political transformation in recent years after a decade long inland violent conflict and implementation of an adequate land reform program, what the politicians term as progressive land reform program, is the national agenda at present. Very recently a Land Reform Commission has been constituted to deal with the matters concerning land reform.

Thus, the business strategy of land administration can be listed out as follows:

- Implement an adequate land reform program to assure justifiable access to land and land resources for all
- Support the government in establishing good governance and sustainable development
- Assure security of tenure
- Manage public and government lands effectively
- Implement proper land use plan
- Establish well functioning NSDI
- Develop institutional capacity in the sector of cadastre, land administration and management
- Empower local bodies in land administration and management sector

Unless adequately supported by the technology, effective and efficient implementation of business strategies cannot be expected. Unfortunately, the LA system of Nepal has various deficiencies, such as analogue system, lacking reliable land information, lacking necessary capacity to introduce modern technology such as Geo-ICT, lack of necessary infrastructure for building LIS, lack of ICT policy in LA domain, etc. Therefore, it can be concluded that the technological advancement in LA domain has not been adopted yet and the strategic alignment of business strategy with technology is not satisfactory.

The government's willingness to modernize the LA system as mentioned in previous section and opportunities available with Geo-ICT in the market can be integrated to align the business strategy with technological advancement. However, the job is not easy. Nationwide coverage of reliable land information supported by LIS, comprehensive land policy, and adequate capacity to make the system sustainable are the prerequisites for the success. The first two components are more or less based on capacity of the organisation. Capacity is the power/ ability of something – a system, an organisation or a person to perform and produce properly. On the other words, capacity building has three levels: the broader system/ societal level, the entity/organisation level, and the group of people/individual level (Enemark and Williamson, 2003). In the context of Nepal, the initiative from the third level of capacity building, i.e. capacity building of professional (an individual) is a must to modernize the system, which is of big challenge. A recent initiation of B.E. on Geomatics jointly by LMTC and KU is a positive step towards inland capacity building. The initiation brings an opportunity to introduce ICT based Geomatic education, more specifically LA education. However, the question again remains whether the availability of ICT infrastructure feasible or not for the education as well as its sustainable future while implementing in real life. One of the major components of ICT infrastructure is software component, which requires lots of investment, if proprietary software are used. Making use of proprietary software may not be feasible always for the days to come. Therefore, as the open source movement has attracted world-wide attention, and OSS is increasingly used as an alternative to proprietary software products (Pieper, 2007), the opportunity could be grabbed for Nepal as well.

## 4. Global Initiatives for OSS Applications

The free software movement was launched in 1983. In 1998, a group of individuals advocated that the term free software be replaced by OSS as an expression which is less ambiguous and more comfortable for the corporate world[3]. The Open source communities have successfully developed a great deal of software that has gained a

2 *Summarized from (www.molrm.gov.np)*

3 *http://en.wikipedia.org/wiki/Open_source_software*

reputation for reliability, efficiency, functionality. But it is not free from a perception that OSS is less usable (Nichols and Michael, 2003). On the other hand, OSS tools have a reputation that they are difficult to install, run only on Unix-like operating systems and can be operated only through the command line. However, recent developments show that most OSS products are becoming more user-friendly, with Windows installers and graphic user interfaces (GUI) similar to proprietary software (Pieper, 2007). PostgreSQL, PostGIS, uDig and ILWIS are some of such examples. The major advantages of OSS over proprietary software are that it frees organizations from financial burden of license costs, and it can be customized to meet the organizational requirements.

Efforts are underway to exploit such opportunities available with OSS in LA domain as well. A project, Free/Libre Open Source Software (FLOSS) Project for Cadastre and Land Registration, funded by the Food and Agriculture Organisation (FAO) of United Nations (UN), in this endeavor has been referred for this study. A FAO-FLOSS Seminar Report[4] mentions several land administration projects in developing countries sponsored by the FAO in the past have failed, often due to high software licensing costs and inadequate information technology systems. Despite these failures, IT holds great promise for land administration systems, but only when introduced in a sustainable way. Such a situation motivated the Land Tenure Group of the FAO for the initiative to this FLOSS Project for Cadastre and Land Registration. The conceptual design of the project is termed as OSCAR (Open Source Cadastre and Registry) tool. As the intention behind the project is to develop a FLOSS tool taking the situation of developing countries into account, it is a point of motivation for the author to carryout a general overview on the possibility of OSS for LA system in Nepal, basically to introduce Geo-ICT in LA domain in a sustainable way.

## 5. OSS Application for Land Administration Education in Nepal

The main aim of the study is to overview of the possibility of OSS for LA education, which would, indeed, contribute in developing an effective LA system for implementation in real life. Therefore, the possibilities have been looked in teaching point of view. The study has been carried out in two phases; the first phase looked into the possibilities with ILIWIS, where as the second phase looked into the possibilities with a combination of PostgreSQL, PostGIS and uDig.

**ILWIS** (Integrated Land and Water Information System) is an OSS developed by International Geoinformation Science and Earth Observations, ITC, the Netherlands. It is a Geographic Information System (GIS) package with image processing capabilities. Its powerful image processing functions make it a highly useful tool for natural resources management and for organizations that need to process orthophotos or satellite imagery for base mapping (Pieper, 2007). Therefore, it has been overviewed with its possibilities for land use mapping.

**PostgreSQL** is a powerful, open source relational database system. It has more than 15 years of active development and a proven architecture that has earned it a strong reputation for reliability, data integrity, and correctness. It runs on all major operating systems, including Linux, UNIX, and Windows. It has full support for foreign keys, joins, views, triggers, and stored procedures (in multiple languages). It also supports storage of binary large objects, including pictures, sounds, or video. An enterprise class database, PostgreSQL boasts sophisticated features such as Multi-Version Concurrency Control (MVCC), point in time recovery, tablespaces, asynchronous replication, nested transactions (savepoints), online/hot backups, a sophisticated query planner/ optimizer, and write ahead logging for fault tolerance. It supports international character sets, multibyte character encodings, Unicode, and it is locale-aware for sorting, case-sensitivity, and formatting. It is highly scalable both in the sheer quantity of data it can manage and in the number of concurrent users it can accommodate. There are active PostgreSQL systems in production environments that manage in excess of 4 terabytes of data.[5] Research shows that when comparing PostgreSQL versus proprietary database software (MS SQL Server and Oracle), the FLOSS products are not far off from the proprietary ones and can truly compete. When comparing the software installations, it appears that PostgreSQL is easier and faster to install than Oracle. PostgreSQL includes most of the advanced database features that Oracle has (Pieper, 2007).

**PostGIS** adds support for geographic objects to the PostgreSQL. In effect, PostGIS "spatially enables" the PostgreSQL server, allowing it to be used as a backend spatial database for geographic information systems (GIS), much like ESRI's SDE or Oracle's Spatial extension. PostGIS follows the OpenGIS "Simple Features Specification for SQL" and has been certified as compliant with the "Types and Functions" profile. PostGIS has been developed by Refractions Research as a project in open source spatial database technology. It has been added with

4 *Free/Libre Open Source Cadastre and Land Registration Shell Seminar (FAO-FLOSS Seminar) May 8th – 9th, 2008University of Otago, Dunedin, New Zealand*

5 http://www.postgresql.org/about/

user interface tools, basic topology support, data validation, coordinate transformation, programming APIs and much more.[6] As repository for spatial data, PostgreSQL with PostGIS comes closer to the sophistication of Oracle Spatial than MySQL (Pieper, 2007).

**User-friendly Desktop Internet GIS (uDIG)** is developed by Canadian-based Refractions Research, the same company that is taking the lead in the development of PostGIS.[7] Compared to other FLOSS GIS products, uDIG lacks quite a few options that are normally expected in a GIS such as buffering or calculating the area of a polygon (Pieper, 2007). It supports vector formats like shapefiles, and raster formats like TIFF, JPG, GIF.

has been referenced in this phase, which focuses on using PostgreSQL with PostGIS as a spatially-enabled database backend, with a platform based on uDig for developing graphical tools that interact with the database. Of particular interest is how to implement these in a way that enables the capture of events and process as changes occur in a cadastral database, while being flexible for supporting variations in land administration processes in different countries or jurisdictions. The underlying model for this approach focuses on several core elements, which can be primarily generalized into agents, documents, events, and objects[8]. The design developed out of the project can be expected of potential application in Nepalese case.

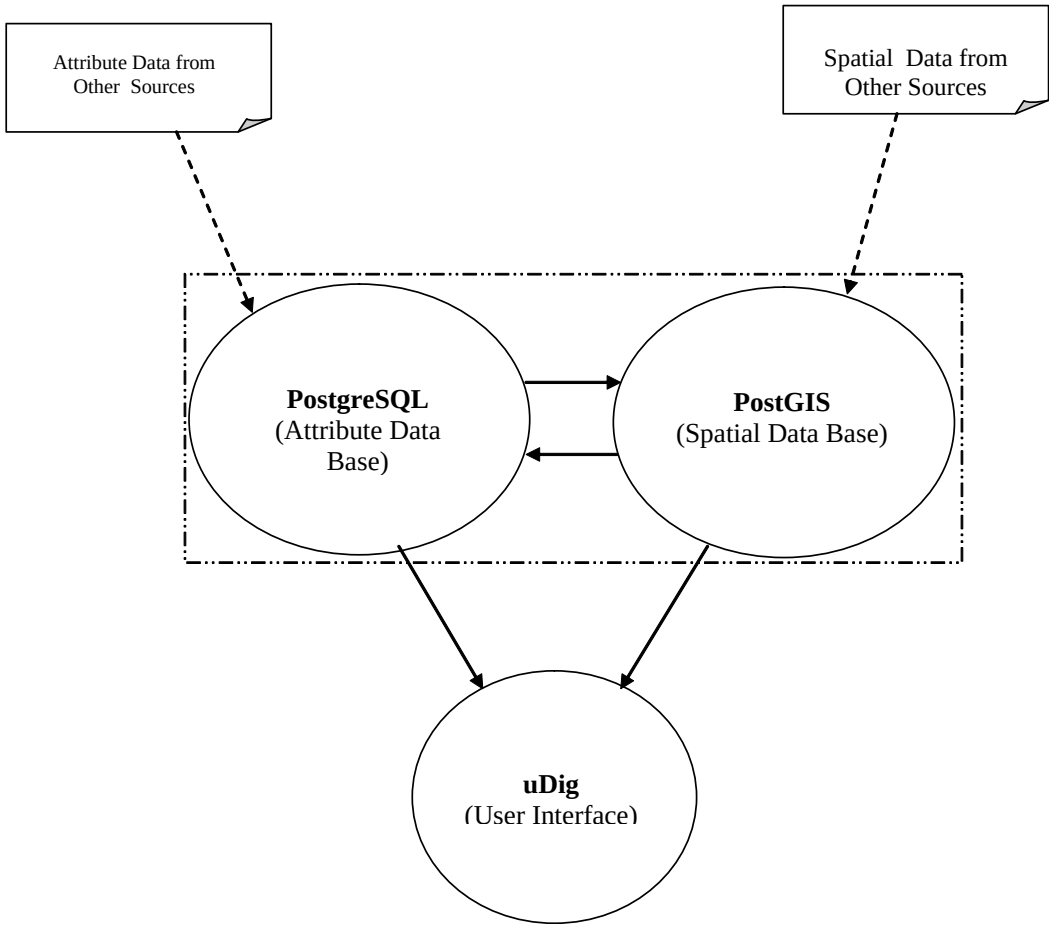


*Figure 1: Combination of PostgreSQL, PostGIS and uDig*

The possibilities with the combination of above mentioned PostgreSQL, PostGIS and uDig for LA systems have been overviewed during the second phase of the study. The approach proposed in the OSCAR Project Wiki for applying open source tools for OSCAR

*6 http://postgis.refractions.net/*
*7 http://udig.refractions.net/*
*8 http://source.otago.ac.nz/oscar/OSCAR_Home*

## 6. Conclusion

The LA System in Nepal is quite traditional. Despite the government's initiation to modernize the system since 1990, it is still not able to exploit the opportunities offered by Geo-ICT for their daily business work. As a result, the system is not able to fully cope with the business strategy of the government. The government has realized the need of modernizing the system and some positive efforts are underway at the moment. Introduction of Geo-ICT in the business system is one of the main objectives of these efforts. If we consider the sustainability of the system, financial requirements can be of prime importance for the future. In this respect, making use of proprietary software may not be feasible always for the days to come. Therefore, as the open source movement has attracted world-wide attention, and OSS is increasingly used as an alternative to proprietary software products (Pieper, 2007). This idea has been considered for the capacity building of the professionals.

A recent initiation of B.E. on Geomatics jointly by LMTC and KU is a positive step towards inland capacity building. The initiation brings an opportunity to introduce Geo-ICT based Geomatic education, more specifically LA education. It has been assumed that application of OSS for LA education at LMTC and KU would be a better choice for this endeavor. With this assumption, possibilities with ILWIS and combination of PostgreSQL, PostGIS and uDig have been overviewed. ILWIS has been overviewed for its application in Land Use Mapping and the latter for LA systems.

## References


1. *ADB (Asian Development Bank), 2007*; Nepal: Strengthening Land Administration Services, a Technical Assistance Report
2. *Enemark, S. and Molen P., 2008;* Capacity Assessment in Land Administration (FIG Publication No. 41)
3. *Enemark, S. and Williamson, I., 2003*, Capacity Building in Land Administration – Conceptual Approach
4. *Khanal, G.R., 2006*; Redesigning and Optimization with Workflow Management System for Land Administration Processes in Nepal, an IFA report, ITC, The Netherlands
5. *Nichols, D.M., Michael B.T., 2003*; The Usability of Open Source Software (http://firstmonday.org/issues/issue8_1/nichols/index.html)
6. *Pieper, G., 2007*; Scoping Paper on the Use of FLOSS in Cadastre and Land Registration Applications (Open for Change: FAO Land Tenure and Management Unit (NRLA), FIG Commission 7, World Bank Thematic Group on Land Administration)
7. *UN/ECE, 1996;* Land Administration Guidelines, With Special Reference to Countries in Transition, New York and Geneva
8. *Wheeler, D. A., 2003*; Why Open Source Software / Free Software (OSS/FS)? Look at the Numbers!, United States