

# **Moving from a Successful to a Modern Cadastre in LAO PDR**

**Daniel CARTER (Australia) and Bounhom HEUANGSAVATH (Lao PDR)**

**Key Words:** cadastre; digital cadastre; land administration systems; South East Asia

## **SUMMARY**

According to the FIG Statement on the Cadastre (1995), “a successful cadastre should provide security of tenure, be simple and clear, be easily accessible and provide current and reliable information at low cost”. The Lao Land Titling Project (LLTP) within the Department of Lands has developed a paper-based cadastral system based on these principles. The growing pressure on land resources within Lao PDR is forcing land managers to look for digital spatial information solutions, increasing the demand for digital cadastral information that is interoperable and easily coordinated with other spatial information. Simple technological changes are being implemented within the LLTP to link the important role of the cadastre with the provision of relevant land information in support of good governance.

The Department of Lands and National Geographic Department are undertaking a joint initiative to pilot the development of a digital cadastre. The project design is being informed by lessons learned during the establishment and maintenance of other international cadastral systems, while refining processes to suit circumstances in Lao PDR. The pilot is designed to test the quality of existing data for both accuracy and completeness. It will assess the capacity of institutions and their willingness to share information. This paper describes the progress being made towards the Department of Land’s vision, which is for ‘the development of a computer based land information system in which registration details and cadastral surveying and mapping information are seamlessly linked’. This paper also raises some of the technical, institutional and financial issues confronting the cadastral activities within the project.

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## **1. LAO PDR CADASTRAL DEVELOPMENT ACTIVITIES**

In 1986 the Government of the Lao PDR adopted a New Economic Mechanism aimed at creating a market based economy. This approach was reinforced during the Fifth Party Congress in March 1991 that identified land administration as a major factor in economic growth. A commitment was made by the Government of Laos to develop a land titling system to underpin secure land tenure, to establish credit markets, to encourage and support private sector investment, and to instigate a sustainable source of government revenue through formal land registration.

Since 1995, there has been a major government initiative to support the development of land management activities through the implementation of a 25 year land titling program, the Lao PDR Land Titling Project (LLTP)<sup>1</sup>. The Project has been implemented in stages, beginning with stage one on 1 July 1997, and stage two commencing in October 2003. The second stage is being funded for five years ending January 2009, through a development credit agreement between the Government of Laos and the World Bank. The Project has also been implemented in partnership with the Australian Agency for International Development (AusAID) providing key Technical Assistance (TA) through an Australian Government grant. The technical assistance is being provided and managed by Land Equity International.

By developing land management capacity, and providing a foundation for land based administrative revenue and taxation from land, the project will also broaden the country's revenue base and contribute to economic development and poverty reduction goals as set by the National Growth and Poverty Eradication Strategy. Secure land tenure and confidence in land use rights will assist in mobilising domestic resources for investment.

The Project commenced with an initial focus on mapping and registering private property in urban, peri-urban and lowland agricultural areas. These areas generally contain high population growth, are more densely populated and have a higher concentration of economic activity. These conditions contribute to increased land market activity and therefore to increases in revenue from land tax collection and land transaction fees, where formal property registration system exist. During the second stage of the Project, land titling activities are operating in seven of the 17 provinces plus Vientiane Capital City (VCC). The provinces and VCC are equipped with their own Land Offices and administrative staff, which in turn support 20 Systematic Adjudication Teams working in the field to survey, adjudicate and register land use rights to individuals. In addition a central Department of Lands coordinates

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<sup>1</sup> The Lao PDR Land Titling Project throughout the paper is referred to as 'the Project'.

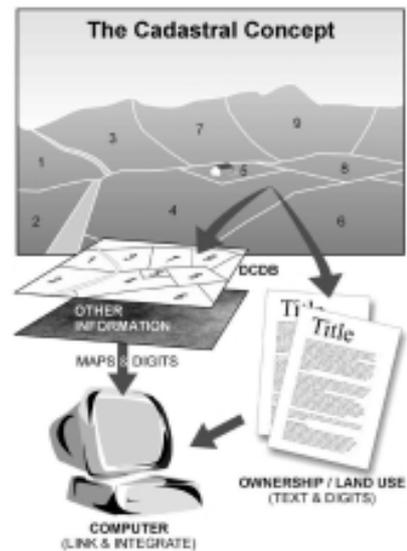
all titling activities and provides top down management of legal, policy and institutional issues. Teams around the provinces have adjudicated in excess of 450,000 land parcels which correlate to the production of more than 4,500 cadastral maps.

The government is looking to upgrade its storage of spatial information from paper based maps to digital and this paper presents an option for developing a digital spatial infrastructure within the Project to facilitate this process. A number of foreseeable technical, institutional and financial issues involved in establishing a project to scan and digitize cadastral map sheets as part of the process are also discussed. The progress towards these technological solutions is part of the Department of Land’s vision, which is for the development of a computer-based land information system in which registration details and cadastral surveying and mapping information are seamlessly linked (Brazenor 2005).

## 2. FITTING THE CADASTRAL CONCEPT FOR LAO PDR

According to the FIG Statement on the Cadastre (1995), “a successful cadastre should provide security of tenure, be simple and clear, be easily accessible and provide current and reliable information at low cost”. It is widely recognized that efficient systems to officially record rights in land comprise two basic sets of information: (1) registers based on textual and alphanumeric data that record rights in land; and (2) maps that define the boundaries and extent of land parcels over which these rights apply. These two basic sets of information constitute the concept of the cadastre, which is illustrated in Figure 1.

The cadastral concept identifies a close and explicit linkage between textual and spatial data used to record property information. The cadastral system is designed with the land registers having equal importance to the cadastral map. Williamson (1997) describes the registers and the map as "two sides of a coin" and as such should not be separated. The Project approach so far has been to develop a paper-based cadastral system based on these principles. Textual information is recorded in the Land Register Book. Spatial data is recorded in a map drawn to scale which shows land parcels in a particular area. These two descriptions of property are linked by a unique parcel number shown on both. The cadastral map has the following purposes, as set out in Article 30 of the Ministerial Direction on Cadastral Surveying and Mapping:



**Figure 1.** The Cadastral Concept (FIG, 1995)

- to show the relationship of land parcels to their adjacent parcels;
- to provide a graphical index for reference to land parcel information;
- to provide a unique parcel identifier number to prevent the issue of more than one land title for each parcel.

The Cadastral Map is a compilation of three separate sheets, these being the Preliminary Sheet, the Final Map Sheet (Figure2) and the Land Parcel Information Table (Figure3). Preliminary map sheets are used as a working copy of the Cadastral Map and are used for recording additional detailed information. The Land Parcel Information Table contains the land parcel number, number of land title and area of land parcel. Every land parcel is allocated a unique parcel identifier that forms the link by which various search mechanisms are used to access information on land rights.



**Figure 2.** Final Cadastral Map

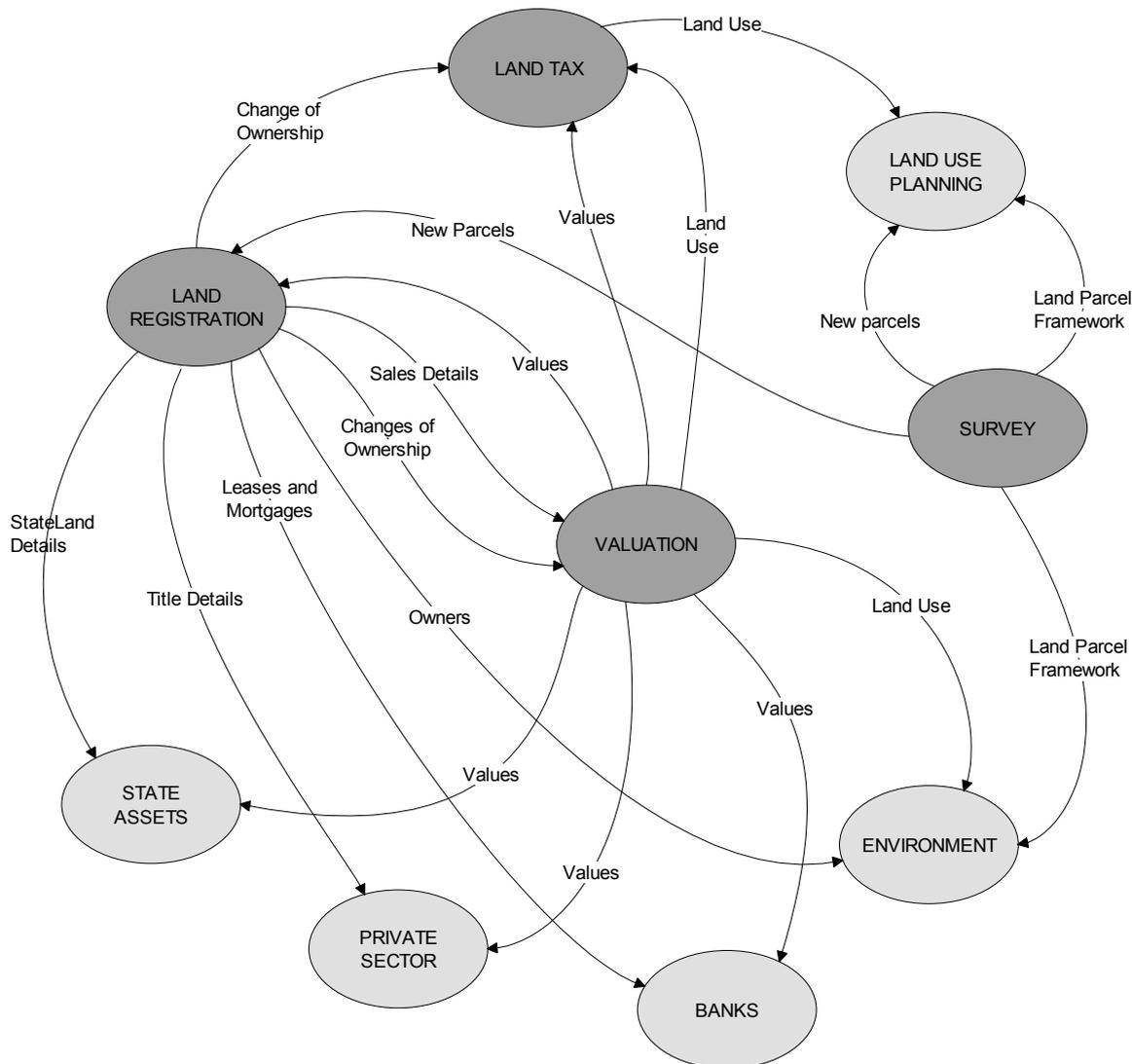
Parcel No.	Area (ha)	Area (mu)	Area (a)	Area (sq m)	Area (sq ft)
01	867	2008	101	238	361
02	124	192	103	237	362
03	819	2769	103	238	362
04	868	2237	104	239	363
05	869	357	105	240	364
06	865	118	106	241	365
07	870	721	107	242	366
08	871	2448	108	243	367
09	867	625	109	244	368
10	114	5352	110	245	369
11	760	2645	111	246	370
12	868	2868	112	247	371
13	868	6165	113	248	372
14	752	611	114	249	373
15	869	1186	115	250	374
16	850	844	116	251	375
17	851	2227	117	252	376
18	351	1614	118	253	377
19	871	1468	119	254	378
20	852	4044	120	255	379
21	741	2611	121	256	380
22	853	6319	122	257	381
23	810	790	123	258	382
24	753	410	124	259	383
25	352	145	125	260	384
26	841	2082	126	261	385
27	733	592	127	262	386
28	728	960	128	263	387
29	734	2004	129	264	388

**Figure 3.** Land Parcel Information Table

An essential prerequisite for an efficient cadastral system is ensuring that the textual and spatial datasets are maintained and up-to-date. Williamson (1997) argues that cadastral systems must be kept up-to-date otherwise there is little justification for their establishment. During the early periods of the Project updating was carried out inconsistently and quality standards were low. Training, the dissemination of procedures and the introduction of a regular audit schedule of cadastral mapping has not only improved the currency of information, but placed more emphasis on quality production, regular maintenance, and drafting standards. These activities have largely revived the integrity of the cadastral mapping process and encourage quality procedures which equip staff with reference manuals to ensure greater sustainability of standards.

### 3. JUSTIFYING CADASTRAL MAPPING

Many users of land information express the need for cadastral information for planning, land management, the provision of services, land development, land valuation and land tax purposes. The growing pressure on land resources within Lao PDR is forcing land managers to look for spatial information solutions. The cadastral map is an important information layer in supporting these requests. It provides the spatial context for displaying, analyzing and managing land information. The diagram below depicts some of the major land-related functions and the data flows required to support these functions.



**Figure 4.** Major data flows between land-related functions (Rainsford, 2002)

In contemplating computerisation of the cadastral survey and mapping function, the wider use of the data generated through the Project needs to be considered. The discussion below provides details of the various demands for applying cadastral mapping information.

1. *Requirements of land registration.* The land registration system requires each land parcel to be uniquely defined spatially so that land owners are secure in their rights and can trade those land rights. Burns et al. (2005) suggest that no set of rights should exist without a spatial parcel to assign them to, and all spatial parcels should be linked to a set of rights. It is generally considered that a cadastral system based on an accurate cadastral map will be more efficient, less expensive and carry greater legal authority than simple sketch maps.
2. *Requirements for land tax and land valuation.* The collection of land tax requires a systematic inventory of all land parcels. This is a government function and is an important priority in the selection of sites for land titling activities. In addition the calculation of land transaction costs has moved from being based on the productivity of the land, to the market value of the property. The maintenance of an accurate cadastral map used in conjunction with valuation zoning maps will allow land transaction fees (and eventually land tax contributions) to be more accurately determined.
3. *Requirement for utilities and infrastructure management.* The placement of utility infrastructure is often managed without clear knowledge of cadastral ownership information. The compulsory acquisition of land for government development projects may require changes to be made to the boundaries of a registered land parcel. Road widening is an example where the use of cadastral maps can significantly help during boundary re-adjustments.
4. *Requirement for land management.* Many different government organizations need the use of cadastral maps for land and environmental management and planning purposes. Land classification, zoning and subsequent land use activities will all benefit from having a reliable cadastral system as a base showing legally defined ownership as opposed to arbitrarily allocated land parcels.

In summary there are different requirements of a cadastral map from different users. More time is needed to increase the coverage and integrity of cadastral map sheets before different stakeholders realize the full multipurpose value from their existence. To aid this, the government's support towards a digital medium largely increases the potential usage of cadastral map information.

Increasing the availability of data adds another dimension to managing this information. The institutional context and arrangements will determine the ability of agencies to use available datasets and to integrate spatial information. Recent institutional changes within Lao PDR have set up a framework that improves methods of coordination and potential data sharing.

#### 4. LEGAL AND INSTITUTIONAL ARRANGEMENTS

The Land Law (2003) sets out the main institutional responsibilities for land management and administration in Lao PDR. This law also defines 17 specific functions of land management that government must fulfill. Management responsibilities for these functions are assigned in a general way to a set of 10 ministries, with the National Land Management Agency "charged with the management of the land of the whole country" (Article 9, 2003). Three key agencies have some responsibility in the development of cadastral information for Laos. These are the National Land Management Agency (NLMA), Department of Lands (DOL), and the National Geographic Department (NGD).

##### *The National Land Management Agency (NLMA)*

The NLMA is a responsibility of the Office of the Prime Minister. The agency's responsibilities are set out in the Land Law (2003) and relate broadly to land management. Article 10 of the Land Law (2003) lists specific rights and duties relevant to the registration of land, maintenance of the register book, and establishment of land data and information. Other responsibilities of the NLMA include the formation of land policy and related legislation and regulations, the coordination of land management being undertaken by sector ministries, land titling, state land management, land information and the regulation of land related professionals. The NLMA is looking to organize the provision of relevant land information as a strategy to support their area of governance.

##### *The Department of Lands (DOL)*

DOL was recently re-institutionalized and is now located within NLMA. The DOL is the core national agency responsible for the design and implementation of land administration programs. DOL has been responsible for the implementation of the first phase of the Project and the majority of the second phase. The mandate of DOL, as defined by the Prime Minister's Office Decree (No. 104) dated 6 July 1993, is to carry out the design and supervision of national land registration and titling programs through the offices of the provincial services. The DOL has expanded and strengthened its capacity and operations during the implementation of the Project with the total staff of DOL now around 60 in the central office and another 1300 staff directly involved in land titling in the provinces. However there are still limited resources and capabilities, particularly noticeable in the provincial land offices. In particular, staff are challenged by a lack of computer usage and spatial information management skills.

##### *The National Geographic Department (NGD)*

NGD similarly to the NLMA sits directly under the Office of the Prime Minister. NGD is a partner agency to the Project, identified to undertake important tasks related to primary survey control and other mapping services. Specifically the Department has the responsibility for carrying out mapping services, such as the establishment of the geodetic control, aerial photography and orthophoto mapping. The Department has played a key role in the provision of control points to support systematic adjudication and the supply of base maps used for

strategic planning and monitoring. Until recently the NGD has held the Secretariat position of the National GIS Committee and been involved in the development of policy, standards and information sharing protocols for land information. NGD has the human resources and the GIS core technology (software and data) needed by DOL for improving the Project's land information system.

## **5. SPATIAL DATA INFRASTRUCTURES**

A Spatial Data Infrastructure (SDI) is a framework of spatial data, metadata, users and tools that are connected in order to use and manage spatial data in an efficient and flexible way. Another definition is the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data (OMB, 2002).

Many countries around the world are developing national SDI. These systems support institutional reform, help lower costs and expand sustainable rural outreach (Proenza, 2007). For similar reasons establishing a national SDI within Lao PDR is a key element in delivering benefits from the collection, management and use of spatially referenced information. A national SDI assures that spatial data from different sources is available and easily integrated to enhance the understanding of physical and cultural resources.

At present the Lao PDR is faced with a lack of metadata, uncertain content of existing datasets, confusion as to the roles of data custodians, inadequate data standards, limited protocols for data sharing, differing data scales and confusion over responsibilities. There is a need to increase accessibility and integration of spatial information to use up-to-date information to supplement decision making, strategic planning and land management.

Accessibility is difficult due to the reluctance of agencies to share information. There has been a perception that government agencies, both associated with the Project and outside the Project, have been reluctant to share information. Datasets have been developed for specific agency purposes from specific agency budgets and are usually jealously guarded from other agencies for a variety of reasons. Often they are not shared because the data is not current or is incomplete and the responsible agency could be embarrassed by the state and condition of the data sets (Grant, 2006).

Integration is hampered by the lack of proper medium for which to transfer spatial information. Despite this, developments in spatial information technology are now providing very useful tools to support land administration and management. Technological changes are being implemented within the Project to promote the transfer of cadastral information within relevant government agencies.

A Land Information Coordination Strategy has been prepared with the objective of guiding data sharing requirements at different levels to ensure its availability to a larger group of

stakeholders. The vision for a Lao SDI will ensure that the economic growth, social and environmental interests of Lao PDR are underpinned by quality spatially referenced information. This information must be of an acceptable quality and integrity and therefore must be current, complete and accurate. To ensure it is more widely used it must also be affordable, accessible and compatible with various stakeholders and formatting requirements. The setup of a Land Information System (LIS) and pilot establishment of an LIS Centre in Vientiane Capital City aims to test the accessibility and integration of datasets.

## **6. CREATING A DIGITAL CADASTRE**

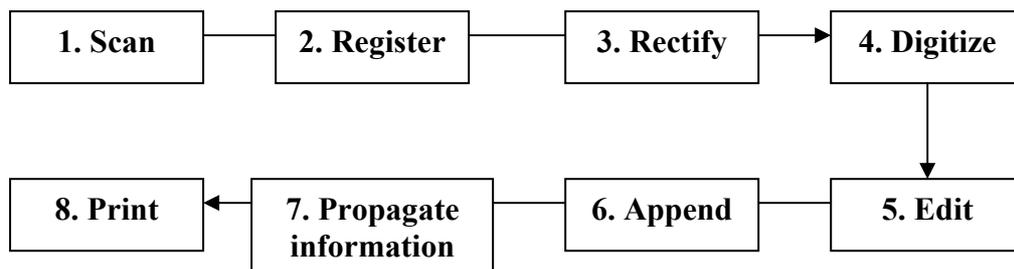
The Project is developing a fundamental data infrastructure for future land administration and land management functions in Lao PDR. The Project has committed to the computerization of land administration activities, involving the creation of a digital cadastre as part of the SDI. A Computerisation Strategy is considered necessary to improve data access, useability, and coordination of land related activities. This plan focuses cadastral surveying activities and is to be implemented through four phases over a period of ten years. There are two methods being used for the creation of a digital cadastre- one is the digital capture of data using total station and GPS instruments, the second is the digitisation of existing hardcopy map sheets. Computerisation will promote efficient field to office data collection, improve data accuracy and provide a digital data backup to hardcopy cadastral map sheets.

In 2005 the Department of Lands undertook a scoping exercise for the suitability of developing digital spatial infrastructures within the Project. A process of scanning, rectification, digitizing and propagating attribute information to cadastral parcels on 114 cadastral maps was undertaken. This activity was managed between the NGD, DOL, Vientiane Capital City Land Office and Technical Advisors to the Project. An evaluation of this activity identified key technical, institutional, staffing and resource constraints which prevented immediate expansion of the exercise. Many of these issues have now been addressed as discussed below. Virachit and Lunnay (2005) found that although the introduction of technology into the Project creates problems, the benefits of moving forward in a controlled way to provide efficiency and sustainability of operations proved it to be necessary.

A detailed proposal has been developed to create a Digital Cadastral Map. The conversion of hardcopy cadastral maps into a digital format is to be initially undertaken in two districts of Vientiane Capital City. The Digital Cadastral Map is to be created from a platform of ArcGIS software. This program is used extensively by NGD staff for GIS applications and is easily interoperable with CAD mapping software used by DOL staff. The use of common technology is important for facilitating the improved usability of existing cadastral information.

The creation of a digital cadastral map base from hardcopy map sheets involves an eight stage process, as shown in Figure 5. The first steps required are for each map sheet to be

scanned and then registered in a cadastral map database. In this sense, the database will serve to create a records management system to backup cadastral information. Rectification is then undertaken using a combination of the land parcel index coordinates and GPS points collected in the field. The Digital Cadastral Map will be positioned on the Universal Transverse Mercator (UTM) map grid by connection to the current Lao National Datum. Each land parcel will be manually digitized using ArcGIS software and recorded in a shapefile (ESRI) format. The cadastral map sheet of parcels is sequentially numbered as a ‘tile’ to cover the jurisdiction. The unique identifier reflects not only the parcel number, but also the relevant cadastral map sheet. Step 5 involves performing edits to parcels which are configured as polygons. The accuracy of each boundary position will be examined and edited when higher than documented standards. Each adjacent map sheet will be appended with careful attention to parcels overlaid across two or more map sheets. Step 7 ensures the textual detail from the Land Parcel Information Table is propagated as attribute data for each polygon. This information is critical for linking the graphical land parcel with the textual registration information. The unique land parcel identifier and unique title reference are important attributes by which search mechanisms can be used to access information from a variety of registration systems. As the final step the Digital Cadastral Map may be printed to update the current paper-based cadastral maps- however the digital database will remain the most up-to-date copy. Printing hardcopy maps provides an option to resort to manual procedures and can reduce the costs of a failure to implement computerisation. Hardcopies are also useful during field activities in remote locations where digital technology resources are limited.



**Figure 5:** Digitisation flowchart of activities

The justification for creation of a Digital Cadastral Map is to promote the accessibility and integration of spatial data in relation to land information. Rainsford (2002) claims the benefits of having the parcel framework in digital form are enormous and include:

- Property values or sales information could be plotted on maps to assist in auditing values or analysing sales to determine rate tables.
- Land use could be portrayed to assist in urban planning, zoning or for identifying non-conforming land uses.
- State land parcels could be graphically displayed to assist in planning, leasing and disposal activities.
- Land tax declarations could be mapped to discover properties and check land areas.

The Digital Cadastral Map will also support integration of large scale topographic maps and ensure consistency to facilitate LIS/GIS applications. Ultimately, this will result in the reduction of duplication in maintaining a cadastral base for many users.

## **7. ISSUES IN MOVING TO A MODERN CADASTRE**

At this stage only a central data base will be used to store and update registration information. While new information and communication technologies are becoming available at a reduced cost, they are not yet fully functional in Lao PDR. In the future Proenza (2007) suggests that all critical elements of property registration could be securely transferred through information and technology systems. At present, the registration of subsequent land transactions is being supported by the Land Office at the Provincial and Capital City level. As the computer skills of land sector staff improves and the communication technologies become more accessible, the transfer of information will become more efficient.

One of the difficulties establishing and maintaining a national digital cadastral map is ensuring there is an accountable custodian to take ownership of the data storage, maintenance, up-dating and sharing of data. This task requires regular inter-agency coordination on a range of topics to ensure map integrity, completeness and currency. A Technical Working Committee with wide representation of staff from the NLMA, DOL, Vientiane Capital City Land Office and NGD will be responsible for, among other things, management, standards, infrastructure, training, promotion and dissemination of information in support of digital cadastral data. This Committee will report to the Head of Cadastral Survey Division at the DOL and is to be linked to all other sectors within the Project. The continuing alliance between the Project and NGD is essential. Working closely emphasizes the necessary development of an integrated and coordinated land information arrangement in Lao PDR. The new institutional arrangements make a positive contribution to coordinating the inter-agency relationship.

The responsibility for updating records must be considered within the contexts of data custodianship, legal requirements and capacity. In saying this, the development of a Digital Cadastral Map for Lao PDR will require a large amount of training and capacity building. The pilot testing and survey support provided to date by NGD, and the relatively fast uptake of new total station technology within the Cadastral Survey Division of DOL shows significant promise. It must also be recognized that currently few staff are well qualified in these areas and rely heavily on external support. In recognition of limited technical capacity the establishment and maintenance of new technology is being carefully managed with support from Technical Advisors. A policy of clear technical specifications and an audit of quality control has been institutionalized to ensure consistent outputs. Efforts to introduce systematic testing and monitoring have proved challenging and have required continual support; however as the capacity increases and survey work expands more emphasis is being placed on the development of routine and easily understood activities.

The application of technology in Lao PDR is based on striking a balance between appropriate levels of accuracy and minimum cost (Zakout, 2003). The LLTP 2006-2007 fiscal year budget has allocated a price of US\$15 per map sheet for the activities of converting hardcopy cadastral map sheets into digital form. Given the total number of cadastral map sheets (approximately 4500) a minimum sum of US\$67,500 should be allocated to this task. Supporting the Lao PDR in these activities is helping to keep government systems current and prepared for the future.

Data will be distributed to private landowners with an identical policy to the requirement for accessing paper-based information. Partnerships are being established with other government data custodians to facilitate ease of access and use of digital cadastral data. The government should recognise that future benefits of the system require complete computerisation, and while it is initially a high cost to the government, future rewards should overcome this outlay.

## **8. CONCLUSION**

Some of the most significant challenges to developing spatial information are concerned with institutional reform and capacity. The newly-formed NLMA “charged with the management of the land of the whole country” (Land Law, 2003) will demand the use of land-related spatial data. The Project recognises the importance of the NGD to support the technical requirements of converting the hardcopy cadastral map sheets into digital format. Capacity is developing within the Project to coordinate the interdepartmental relationships.

Concerns have been raised about the lack of coordination in the management of government land information, resulting in higher costs and poorer outcomes than desired. There has been a tendency for each agency to establish its own standards and manage and distribute its own data. The NLMA is now responsible for the operation of all land information systems and the development of associated data standards. These standards are to be promulgated to the data acquisition agencies, donors and contractors for adoption. Establishing the Land Information System (LIS) Centre and Digital Cadastral Map are helping to nurture partnerships between agencies and organizations at all levels of government and assess the capacity of institutions (technical, institutional, financial, and staffing) and their willingness to share information. The conversion of hardcopy cadastral maps into digital format will test and improve the mechanisms of data sharing which support the land sector in Lao PDR.

The Project is developing a fundamental data infrastructure for future land administration and land management functions in Lao PDR. In support of this, cadastral surveying and mapping activities are utilizing digital technology to increase the accessibility and integration of cadastral information. There are enormous benefits from this, especially when the cadastral framework is overlaid with other land information within a GIS. However, such a system is expensive, and the challenge facing government is to develop partnerships which ease data access and use while financially supporting the development of digital data. Ultimately, this

will forward the vision that spatial information be current, available and accessible to support an increasing array of applications within Lao PDR.

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## BIOGRAPHICAL NOTES

**Daniel Carter** is a Land Administration Specialist at Land Equity International. He holds bachelor degrees in Geomatic Engineering and Science from The University of Melbourne, Australia. Mr Carter provided assistance in areas of surveying and cadastral mapping, monitoring and evaluation, and land registration as an Australian Youth Ambassador for Development on the Lao Land Titling project for a year commencing September 2004. He returned after graduation in 2005 as the Cadastral Surveying and Mapping Adviser on the Project. After his second adviser assignment in Laos he will provide input on the Philippines Land Administration and Management Project as the Cadastral Survey Training Advisor in the latter half of 2007.

**Bounhom Heuangsavath** was appointed Deputy Head of the Department of Lands in Lao PDR in February 2007. Prior to this appointment, Mr Heuangsovath was the Survey Division Head of the National Geographic Department from 2003 to 2007 overseeing geodetic survey control and cadastral mapping digitization activities for the Lao Land Titling Project. In 2003, Mr Heuangsovath graduated with a Masters Degree in Land Administration from the University of New South Wales in Australia.

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