Challenges in the Establishment of a National Cadastral Data Model for Kenya – Towards the Creation of a National Spatial Data Infrastructure (NSDI)

James OSUNDWA, Eric NYADIMO and David SIRIBA, Kenya

Key words: Cadastre 2014, Land Information System, Data Model, and NSDI

SUMMARY

As the population in Kenya continues to rise above the 30 million mark, the demand for land and consequently information on land continues to rise immensely. The Geospatial community thus faces the phenomenal challenge of providing accurate and up-to-date Geo-Information, which is key to achieving good governance, and realising sustainable development in the country. The government in its current National Development Plan (2002-2008), is implementing an initiative for the establishment of a National Spatial Data Infrastructure (NSDI) for efficient management of geospatial data in the country. The NSDI initiative, which is mainly spearheaded by the Survey of Kenya, in collaboration with the Japan International Cooperation Agency (JICA). Three NSDI Workshops have since been held, drawing experts from UNECA (CODI), USGS, FGDC, GSDI and ESRI. Various working-groups have been created to handle, data standards, legal issues, education, and dissemination. Further, an inventorying of all geospatial data in the country is being carried out.

Efforts for the establishment of a NSDI for Kenya have mainly centred on the creation of data standards, and the collection of data. Little attention has been given to the development of a data model to support the management of the cadastral system. At the Brighton Congress in 1998, FIG – Commission 7 presented the *"Cadastre 2014 – A Vision for a Future Cadastral System"*. This document has been embraced as a benchmark against which to measure the development and reform of cadastral systems. Environmental Systems Research Institute (ESRI) in conjunction with FIG have since developed a National Cadastre Data Model based on Cadastre 2014. This GIS data model leverages best practices, cadastral data models and standards from around the world, and provides a solid template for cadastral agencies to utilize both now and into the future.

The argument in this paper is that the creation of the NSDI must go hand-in-hand with much-needed ICT-driven cadastral reforms. This paper seeks to address the possibility of developing a National Cadastral Data Model, based on the Cadastre 2014 model, as the country's data management needs push towards data modelling, as opposed to data creation.

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1. INTRODUCTION

As new technologies continue to emerge, discussions develop on how to put these technologies to effective and efficient use. The e-Government concept now gaining considerable acceptance worldwide is one of the initiatives of using Information and Communications Technologies (ICT) to provide individuals and businesses with improved government services and information. E-Government initiatives range from the simple applications such as the establishment of information kiosks at local authorities, to more advanced ones such as the provision of online databases for cadastral, geodetic and topographic databases by government agencies However, towards the actual realization of e-government initiatives, some basic infrastructure have to be put in place; one such infrastructure is the NSDI. NSDI involves the discovery, evaluation and application of geospatial data and information in a country, using the available technology, on the basis of established policies and institutional arrangements.

Geospatial data is the basic building block for the NSDI. The common candidate geospatial datasets for most NSDIs include (Geodetic Control, Digital Elevation Model, Ortho-imagery, International and Administrative boundaries, Topographic Maps and Gazetteers) and framework (cadastral and transportation) datasets. For these geospatial datasets to be used for multiple applications across interoperable systems, it is necessary that such data have characteristics that are basic are basic for multiple applications, besides being consistent, complete and preferably of the highest accuracy and resolution.

An NSDI principally pursues social, environmental and economic goals; in this context the relationship between people and land offered by the cadastre is essential. Consequently the spatial datasets provided by the cadastre are fundamental for any NSDI development. Cadastral information is the most specific description about a land source and is fundamental data for most public and private activities in the world.

In order to have consistency, efficient integration, access and application of cadastral information, some basic aspects have to be considered, and they are: interoperability, standardization and data modelling. In Kenya, discussions on the establishment of an NSDI have mainly revolved around the creation of standards, and collection of data, with little attention being given to the management of the cadastral system. In this regard, it is important to discuss cadastral data modelling in Kenya with a view to proposing a National Cadastral Data Model based on the ESRI Cadastral Data Model. It is hoped that this paper will form a suitable starting point on cadastral data modelling in Kenya. This paper presents

the current cadastral system in Kenya; the ESRI cadastral data model; a proposed National Cadastral Data Model (NCDM) for Kenya, and the challenges in its establishment.

2. CADASTRAL AND LAND REGISTRATION SYSTEM IN KENYA

2.1 The Development of Cadastral Surveys

Cadastral surveys in Kenya started with the introduction of various Legislations and Regulations. These were primarily designed to provide security of tenure to the European settlers and include the East African Land Regulations (1897), The Registration of Documents Act (1901), The Crown Lands Act (1902), The Land Titles Act (1908), The Government Lands Act (1915) and the Registration of Titles Act (1918) *(Njuki, 2001 and Nyadimo, 1998)*. In 1923, the Survey Act, administered by the Director of Surveys was enacted to define the types of surveys and the standards of accuracy required for registration under the Registration of Titles Act. However demand for cadastral records increased with the introduction of Land Reform Programs that gave rise to the enactment of the Native Lands Registration Ordinance in 1959. Shortly, it was changed to the Land Registration (Special Areas) Ordinance, the importance of which lay in the introduction of "General Boundary System" in Kenya. The Ordinance was repealed, with its registration matters being replaced by the Registered Land Act of 1963 and its adjudication and consolidation provision being brought under the Land Adjudication Act (1968).

According to *Nyadimo (1998)* under Government allocations, it is estimated that some 250,000 parcels have been surveyed in Nairobi, other municipalities and townships. Under the Land Adjudication Programme, some 2,000 sections comprising 1.5 million parcels and covering a total area of 7.5 million hectares have been surveyed and registry index maps (RIMs) produced in support of registration and issuance of titles. In the re-settlement programmes some 300 schemes comprising 65,000 parcels and covering some 600,000 hectares of land have been surveyed and RIM made available for registration. In the subdivision of company and co-operative farms, over 800 farms comprising 350,000 parcels have been surveyed in the integrated effort towards individualization of titles. From the foregoing there are over 2 million parcels of land that have been surveyed and records made available for registration of titles. Thus there are indeed volumes of land related data to be processed and managed as a resource

2.2 The Administrative Structure at the Ministry of Lands and Housing (MLH)

Kenya practices juridical cadastre, which is a state register containing information about land parcels. This is a detailed description of the parcel either in the form of Registry Index Maps (RIM) under the Registered Land Act (RLA) or Deed Plans under Registration of Titles Act (RTA). The index maps or deed plans are the end products of cadastral surveys, and together with the corresponding field notes, computations and survey plans, they constitute cadastral records which are to be maintained, updated and managed as a land information resource *(Nyadimo, 1998)*. The responsibility of cadastre and land register development and

maintenance in Kenya falls under the Ministry of Lands and Housing through it departments of Surveying and Lands. Figure 1 below illustrates the departments in the ministry and their functions:

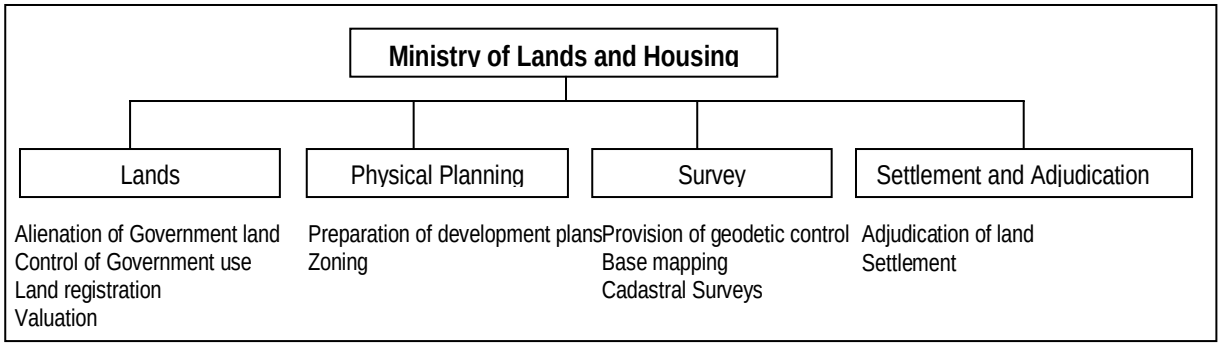

Figure 1: Departments in the Ministry of Lands and Housing

The cadastral records are kept and maintained by the Director of Surveys and give information on the location, boundaries and extents of rights and interests. Land records are maintained by the Department of Lands under the Commissioner of Lands. The department of lands deals with the alienation of government land, control of land use, registration of all land in the country and valuation of all the properties that the government has an interest in. The registration records kept by the Commissioner of Lands provide information about ownership of rights and interests in land. The department therefore maintains a register consisting of a register for each parcel of land and a register for each lease that is required to be registered under RLA. Each land registry maintains a registry map, parcel files, a presentations book and a separate register of the powers of attorney. The register is coloured *green* if the estate is freehold and *white* if the estate is leasehold *(Mwenda, 2001).* Each register is divided into 3 sections: a Property, a Proprietorship, and an Encumbrances section.

According to *Nyadimo (1998)* the Director of Surveys operates an alpha-numerical filing system designed to suit the needs of the inter-departmental approach in which the Departments of Lands, Survey and Physical Planning depend on each other for the supply of Land Information needed for their day-to-day operations including updating of their information bases for policy formulation and decision making however the departments are faced with the following data and information management problems:

- Data are not easily accessible because they are scattered, poorly stored and therefore not fully utilized.
- Because basic information is poor, its updating is difficult and tends not to get done making it difficult for land use planners to monitor land use allocations and actual demands for various development projects.
- Lack of appropriate information storage and processing facilities together with inadequate co-ordination between the various departments on data management practices.

The result of these is that the necessary supply of land information for prompt updating of Departmental information databases is constrained with the likely problems of poor and inadequate cross referencing of records, double allocation of land and overlapping of surveys.

The existing system is therefore not capable of coping with the increased level of cadastral records and those that continue to be generated *(Nyadimo, 1998 and Njuki, 2001). Time is now ripe to move this system to the digital era.*

2.3 Computerization of Land Records

The general stage of overall development of any particular country significantly influences the choice of land administration strategies that it adopts. For example, whether titles or deeds and cadastral maps will be computerized or held as paper records, or whether the Internet can be utilized to access land records, or whether the system is centralized or decentralized.

While attempts have been made at computerizing land records at the Ministry of Lands and Housing, no significant advancements have been made. Recently, attention has been given to the creation of a document imaging system. It is hoped that the more modern method of microfilming will provide for minimal storage space, easy document retrieval, and increased document security. However, it still falls short of digital cadastral records.

3. CADASTRAL DATA MODELLING

The concept of data modelling is becoming increasingly popular amongst Geo-Information (GI) users, as they face increasing challenges to model real-life situations, in an environment that is becoming more and more complex. Data modelling has to do with being able to better abstract and represent real-world objects and relationships. As sources of GI increase, so does the challenge of managing and sharing this information meaningfully. To effectively build and share commonly used layers, GI users should follow a set of common content standards or common data model designs.

Several countries have already adopted Cadastral Data Models in the implementation of their digital cadastres. These include Portugal, which has already implemented a Cadastral Plan Data Model in five municipalities; their main focus has now changed from fiscal to a legal cadastre, in which new planning and management issues are being also considered *(Hespanha et. al., 2004)*. Other countries that have implemented cadastral data models include Denmark, Sweden, Nepal, England, and Slovenia *(ibid.)*. Hungary is in the process of implementing a Cadastral Data Model called DAT that was created by the Institute of Geodesy *(Ivan et. al., 2004).*

By working with a vibrant user community, ESRI has been actively engaged in designing a series of GIS data models using topology and other capabilities, since the release of ArcGIS 8.3 in 2001. These data models cover a number of thematic layer, including: administrative units, topographic basemaps, hydrography, raster imagery and elevation catalogues, transportation, Public Land Survey System (PLSS), parcels, water facilities, and numerous other efforts. It is important to note that all GIS users can use these models (not only ESRI software users).

3.1 Goals of a Cadastral Data Model

According to *Van Oosterom et al (2003)*, a Cadastral Data Model should serve at least three goals:

i. Avoid reinventing and re-implementing the same functionality over and over again, but provide a extensible basis for efficient and effective cadastral system development based on a model driven architecture;
ii. Enable involved parties, both within one country and between different countries, to communicate based on the shared ontology implied by the model;
iii. Facilitate cadastre data exchange between in country organizations (e.g. National Agency and Municipalities) and between countries.

3.2 Cadastre 2014

In order to establish an agenda for the evolution of current cadastral systems Commission 7 of FIG reviewed very carefully institutional, economic, social and technologies changes affecting cadastral systems, partly in terms of developing a vision for the future. This vision was presented in "Cadastre 2014" *(Kaufmann and Steudler, 1998)* that formulated six statements for the development of cadastral systems. In summary, the statements are:

1) Cadastre 2014 will show the complete legal situation of land, including public rights and restrictions;
2) The separation between 'maps' and "registers' will be abolished;
3) The cadastral mapping will be replaced with modelling;
4) "Paper and pencil" – cadastre will be replaced;
5) Cadastre 2014 will be highly privatised with the public and private sectors working closely together;
6) Cadastre 2014 will be cost recovering.

Overall Cadastre 2014 introduces a number of concepts that should be contemplated, which can be considered as jurisdictional, organizational and structural in nature. However, underlining these concepts is the utilization of technology and technological principals. It is important to realize that technology is not the solution but a set of tools used to assist in the design, deployment and operation of a cadastral system *(Astle et. al., 2004)*.

3.3 ArcGIS Cadastral 2014 Data Model

Cadastre 2014 is basically a legal and organizational concept that can only be implemented successfully when modern ICT technology is applied. With this realization, ESRI as a leading provider for GIS technology sought to provide the technical basis with the ***ArcGIS Cadastre 2014 Data Model***. This model represents the basic framework for legal matters with an open and flexible object-based data model. While the model is general and flexible, the unique needs of a variety of land administration and land management users can adapt it easily to the

legal environment of their jurisdiction *(Kaufmann, 2004)*. The model was designed jointly by a number of parties working in cadastre data modelling, including ESRI, FIG, and ITC.

The vision for the ArcGIS Cadastral Data Model is to provide a generic data model based on the principles of the Cadastre 2014 concept. It was intended to create a data model to support the management of the cadastral systems of the future. While the model is founded on the principles of Cadastre 2014, consideration is also given to: best practices from around the world, other cadastral data models (such as the FGDC/ANSI Cadastral Model), and standards *(Gawecki, 2003)*. It is intended to provide a solid template for cadastral agencies worldwide. While the template is primarily designed for use with ArcGIS, as a key goal, the design is open, multi-purpose, and flexible, and can therefore be used by any GIS practitioner, regardless of the software they are using.

UML (Unified Modelling Language), which is an ISO standard in data modelling, is proposed in the implementation of the ArcGIS 2014 Data Model. However, this paper does not go into the detailed discussion of the UML class diagrams, as these are beyond its scope.

The layer structure of the Cadastre 2014 model is as follows:

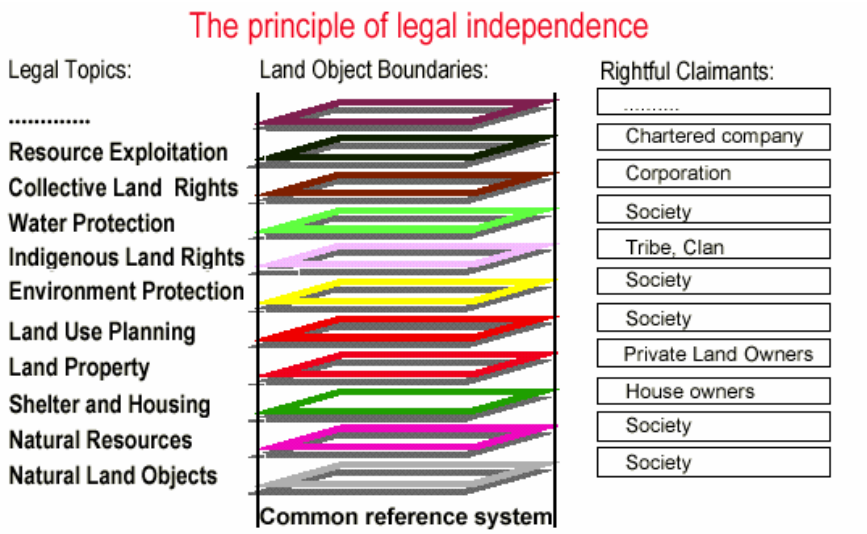

Figure 2: The layer structure of the Cadastre 2014 model *(after Kaufmann and Steudler, 1998)*

Using these simple data structures and the possibilities of object overlaying to identify the geographic location of the objects and to detect if the delimitations of rights interfere with other legal impacts, the complexity of a modern and complete cadastral system can be reduced significantly.

Three types of Land Objects are included in the model: Legal, Informal and Administrative. The distinction between 'legal' and 'informal' is not made in an explicit way, but they are

considered as different types of 'Rights'. Administrative Land Objects are integrated in the planar partition and are managed by Government Agencies. They can represent public rights and are for this reason managed independently from individual rights. The relationship between Legal Objects and people is via 'Rightful Claimants'. Land Objects are closed polygons *(Oosterom et. al., 2003)*. An earlier draft of the entire model is shown in figure 4.

3.4 Initiatives at Cadastral Data Modelling in Kenya

Cadastral data modelling, and data modelling as a whole, is a relatively new concept in Kenya. Little or no work has been done in this field before. Past NSDI initiatives in this regard have focused mainly on making consistent spatial datasets and on data sharing ideals. A Large-Scale Framework - Spatial Data Infrastructure (LSF-SDI) Project for the City of Nairobi was carried out under the Sponsorship of JICA. The objective of this Project was to prepare Digital Spatial Framework Data covering the City of Nairobi at the mapping scales of 1:2,500 and 1:5,000.

It was intended to create a GIS model for the City and pursue technology transfer and capacity building *(Mbaria, 2003)*. Eleven layers were created for the GIS database. Among the tasks at hand was the creation of a cadastral database; this was intended as a support system for cadastral management *(Masuda, 2004)*. Unfortunately, no attention was given to the creation or use of a Cadastral Data Model. Property boundary data was collected, with the following attributes: plot number, area, name of rateable owner, address of rateable owner, telephone number of rateable owner, value of property, type of land use, tenure, lease term, serial number, situation, and valuation book number *(ibid.)*.

3.5 The Proposed National Cadastral Model

A national cadastral data model for Kenya is proposed, based on the Cadastre 2014 Data Model Vision, as presented by *Kaufmann (2004)*. Every law defining land objects that have an impact on private property rights or other legal arrangements valid in certain areas creates a new dataset with the following as a basic structure:

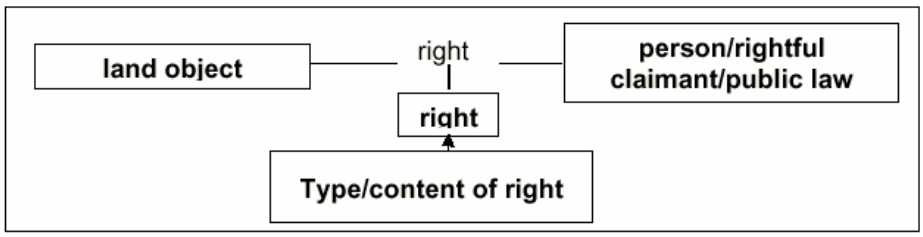

Figure 3: The Basic Structure of Cadastre 2014 *(after Kaufmann, 2004)*

Using this simple data structure and the possibilities of object overlaying to identify the geographic location of the objects and to detect if delimitations of rights interfere with other legal impacts, the complexity of a modern and complete cadastral system can be reduced significantly. Using these basic elements, different situations and rights can be modelled. An

attempt is made in looking at how the Cadastre 2014 Data Model can be adapted to the Kenyan scenario. It has been realised that most aspects of the data model can be adopted with little or no customisation. Consideration is given to the four main Land Objects.

It is proposed that the Legal Land Object contain four main classes: *Property, OwnerParcel*, *Encumbrance*, and *SeparatedRight*. The *Property* class will cover a brief description of the land, and could have *VerticalParcel* as a sub-class, and be linked to *TitleReference*. The *OwnerParcel* class will contain the name(s) and address(es) of the owner(s); further it should contain information on any inhibition, caution, or restriction affecting the right of disposition. The class will also be linked to *TitleReference.* The *Encumbrance* class will contain information on every burden adversely affecting the land; restrictive covenants, charges, leases and easements. The attributes could be the same as in the original model, i.e. the encumbrance type and owner, the legal area, and the area type. Legal land objects will be handled by the Survey Department. Survey Point features are also to be handled by the Department. The main classes could be *Corner* and *CornerCoordinate*, with some of the feature attributes as: the order of the survey (first, second, or third order), the age of the monument, the type of the monument and coordinate system.

The Informal Land Object will involve the documentation of informal land tenure incidences. These could include slum dwellings such as Kibera Informal Settlement, which is one of the largest slums in Africa. Urban areas with major squatter invasion could also be documented.

The Administrative Land Objects will contain five classes: *MapIndex*, *RegulatedUse*, *Restriction*, *TaxDistrict*, and *GeopoliticalArea*. These might prove to be the most challenging objects to model, as the feature classes span across a number of Government departments. The Survey Department is involved in the creation of the various administrative boundaries; these include National, Provincial, District, Divisional, Location, and Sub-Location boundaries. The Physical Planning Department will continue contributing towards the preparation of development plans and land use zonation. These two feature classes can be consolidated under the *RegulatedUse* feature class. They can represent public rights and are for this reason managed independently from individual rights. The Department of Lands is involved in the property taxation, and is the custodian of related information.

4. THE CHALLENGES/ISSUES IN THE ESTABLISHMENT OF A NATIONAL CADASTRAL DATA MODEL FOR KENYA

Cadastre 2014 is a revolutionary idea that will have far-reaching implications on the management of survey workflows, cadastral mapping and the management of registries. In Kenya the implementation of cadastre 2014 will face a number of challenges that can be categorized as legal or technical.

4.1 Technical Challenges

4.1.1 Multiple Reference Systems in Use

To make sure that the legally independent organized land objects can be combined, compared, and brought into relation to each other, Cadastre 2014 expects that they will be localized in a common reference system. The combination and comparison of the thus located land objects can be realized by the method of polygon overlaying *(FIG, 2000)*. In Kenya, there exist at least four projection systems upon which coordinates are declared in different parts of the country. These are the Universal Transverse Mercator (Clarke 1880- modified), Cassini Soldner (Clarke 1858), the East African War System and Local Origin System. All the systems are used for cadastral surveys except the East African War system, which is largely used for topographical mapping *(Lwangasi, 2000*). The challenge of transforming all these into a common system must be addressed.

4.1.2 Boundary System

Kenya supports two registration systems, i.e. the fixed boundary and the general boundary system. This creates a problem in the case of cadastre 2014, which is based on the fixed boundary system. In Kenya, the fixed boundary surveys have been limited to urban areas with a bias towards land markets. In the rural areas the land transactions are too few to justify the cost of setting up expensive cadastral systems hence the use of 4 different types of maps namely registry index maps, demarcation maps, preliminary index diagrams and registry index maps range (provisional). These have been produced to implement land settlement, consolidation and adjudication programmes *(refer to 2.1 above).*

According to *Njuki (2001)* apart from the registry index maps, survey standards have been compromised in the production of the other three types of maps thus reducing their importance and efficacy as instruments of land registration. *Mwenda (2001)* recognizes that interim RIMs do not allow for adequate accurate spatial integration with other thematic land cover types. *Mulaku and McLaughlin (1996)* note that discrepancies exceeding 50% in parcel areas as obtained from some of these interim RIMs have been detected when compared to those from more accurate survey methods and have suggested methods to deal with these.

4.1.3 Computerization of Cadastral Records

Computerization of land records is the very first step in the implementation of a National Cadastral Data Model. As these authors pointed out in section 2.1, there are over 2 million land records to be computerised if a digital cadastre is to be realised. This is one of the biggest hurdles to be overcome.

4.2 Legal Challenges

Different legal instruments govern Land in Kenya, often leading to confusion. The country operates two systems of land law, three systems of conveyancing, and five systems of registration. According to *Macoco (1999)* there are in total 34 Acts of Parliament and related legislations that deal with land. The Institution of Surveyors of Kenya (ISK) has called for the repeal and replacement of obsolete laws *(See Njuguna and Baya, 2001).* They have also proposed for the consolidation of the land law into a few Acts to take care of the substantive land law, registration of land, planning and survey. This harmonization is necessary to facilitate the realization of the Cadastre 2014.

4.3 Institutional Challenges

It has been argued that each of the landed professions follows a "go-it-alone" approach, in which, for example, surveyors are hardly in touch with what Land Valuers, Planners or Quantity Surveyors do. This results in a lot of duplicated effort and data redundancy, in addition to frustrating land owners and developers who have to consult different professionals for land planning, surveying, valuing, etc.

Cadastre 2014 notes that the link between ‘map’ and ‘register’ is not efficient enough and advocates for the **separation between 'maps' and 'registers' to be abolished!** While Kenya is already ahead in this case by having the Department of Surveys and Lands under the same Ministry, greater cooperation between these 2 entities is still required so as to have a seamless integration to realize the goal of cadastre 2014.

4.4 Human Resource Challenges

The concept of data modelling and in this case cadastral modelling is still a relatively new idea. In many cases it is still in the very early stages of design and development. It therefore follows that training of personnel on data modelling will be crucial. Investment should also be made in the Universities and Polytechnic to ensure that data modelling is included within the current curriculum.

The Department of Surveying at the University of Nairobi, which for a long time has been the main academic institution that trains surveyors in the country, is in the process of implementing a new curriculum. While the curriculum covers the NSDI and a generalization of data modelling, it neither mentions cadastral data modelling nor Cadastre 2014 *(Department of Surveying, 2004).*

4.5 NSDI Challenges

In order for the NSDI initiatives to be successful it needs to be addressed together with the government current e-government strategy. However, the ICT infrastructure required in order

to implement and fully enjoy the benefits of an NSDI are not in place. As such the incentives of adopting this technology are limited. This implies that the technology is to a large extent limited to urban areas. It is hoped that the ongoing reforms in the ICT industry will have spiralling effect and spread the benefits to the rural areas that are currently underserved.

It may also be necessary to introduce legislation especially with regards to data ownership and security. An ICT Policy was recently formulated for the country. However, experts' views are that this was done in an incoherent manner, with input from some of the key players being left out of the formulation process. There was no representation from NSDI stakeholders! The NSDI challenge can also benefit from an enhanced public–private partnership. Coordination between the government ministries will be crucial. Public participation will be required to ensure transparency and acceptance.

4.6 Other Challenges

Neither Cadastre 2014 nor the ArcGIS Cadastre 2014 Data Model is complete, as research is still being carried out in various aspects. A critical area that still requires more work is the integration of the 3D Cadastre to deal with sectional properties (vertical parcels, or condominiums).

5. CONCLUSION

Kenya is a good example of a country that has tried to establish a cadastral system for land registration through adjudication of existing traditional rights in a very systematic and comprehensive way. As shown several millions of parcels have been registered in these adjudication processes. Yet, there is no clear evidence that this enormous investment by the government is contributing to economic development in a way that should motivate the investments made. On the contrary, the cadastral system thus established seems in many cases to fall apart through lack of proper maintenance. This can be attributed to lack of interest and understanding among the landowners to lack of appropriate services from the responsible authority.

Hernando de Soto, author of the book “The Mystery of the Capital” has written that without an efficient cadastre, capital locked in real estate cannot effectively benefit society! According to *Enemark, 2004*, the UN, FAO and World Bank attach a lot of importance to cadastral systems. The World Bank has also recognized the importance of establishing appropriate land administration systems as a basis for generating economic development, social coherence and environmental sustainability. Security in land rights is now seen as a basic element in this process where land is increasingly seen as an asset.

The establishment of a National Cadastral Data Model for Kenya will offer an invaluable contribution towards the integration of the cadastre, along with all the constituent benefits, in the NSDI. However, it does not in any way address the traditional problem areas of cadastral surveying in the country. *Oner (2002)* broadly identifies these as the fixation of Adjudication

Surveys and Group Ranches and the adjudication of land in the Arid and Semi-Arid Lands (ASALs) of Kenya. It must therefore proceed hand-in-hand with cadastral reforms in the country so as to make the cadastre: Reliable and complete; Adaptable to the changing needs of the society; Efficient through the use of appropriate technology; Achieve best practice and flexibility by bundling the strengths of the public and private stakeholders and Cost effective resulting into minimum cost for citizens and communities.

Njuki *(2001)* has pointed out on the need to improve the present cadastral system to make it a simple, secure, efficient and up to date land information system. He notes that this will entail a heavy investment involving government funding. In order for all these to succeed political will be of great importance. As the FIG President, *Prof. Magel* has argued time is ripe for Surveyors to engage in political lobbying to ensure that cadastral issues appear on the top agenda of governments. From the foregoing it is evident that collaboration and coordination among the landed professions is of essence. There is a need for all decision makers and GIS professionals to engage in a coordinated effort that will lead to standardized best practices and land record modernization. The result should be a solid foundation of digital land records that will carry us into the future.

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BIOGRAPHICAL NOTES

James Osundwa holds a Bachelor of Science Degree in Surveying from the University of Nairobi (2003). His research interests are in the development of Cadastral and Geographic Information Systems in developing countries. He is an associate member of the Institution of Surveyors of Kenya (ISK), and is currently working as Support Manager at Oakar Services Ltd.

Eric Nyadimo holds a Bachelor of Science Degree in Surveying from the University of Nairobi (2001), and is currently pursuing a Masters Degree in Land Management and Land Tenure at the Technische Universität München, Germany. He is on a study leave from Oakar Services Ltd. where he was previously working as Support Manager. His research interests are in the areas of GIS and Cadastre.

David Siriba holds a Bachelor of Science Degree in Surveying from the University of Nairobi (2000), and a Masters Degree in Geo-Information Management (2004) from the same institution. He is a part-time lecturer at the University of Nairobi. His research interests are in the techniques of Geospatial data capture and NSDI.

CONTACTS

Mr. James Osundwa
Oakar Services Ltd.
P.O. Box 28844
Nairobi -00200,
KENYA
Tel. +254 020 2718321
Fax + 254 020 2721852
Email:
josundwa@esriea.co.ke

Mr. Eric Nyadimo
Technische Universität
München
Institute of Geodesy, GIS
and Land Management
Arcisstrase 21,
80290, Munich
GERMANY
Email:
enyadimo@yahoo.com

Mr. David Siriba
Department of Surveying,
University of Nairobi
P.O. Box 30169,
Nairobi,
KENYA
Tel. +254 734 816686
Email:
dnsiriba@yahoo.com

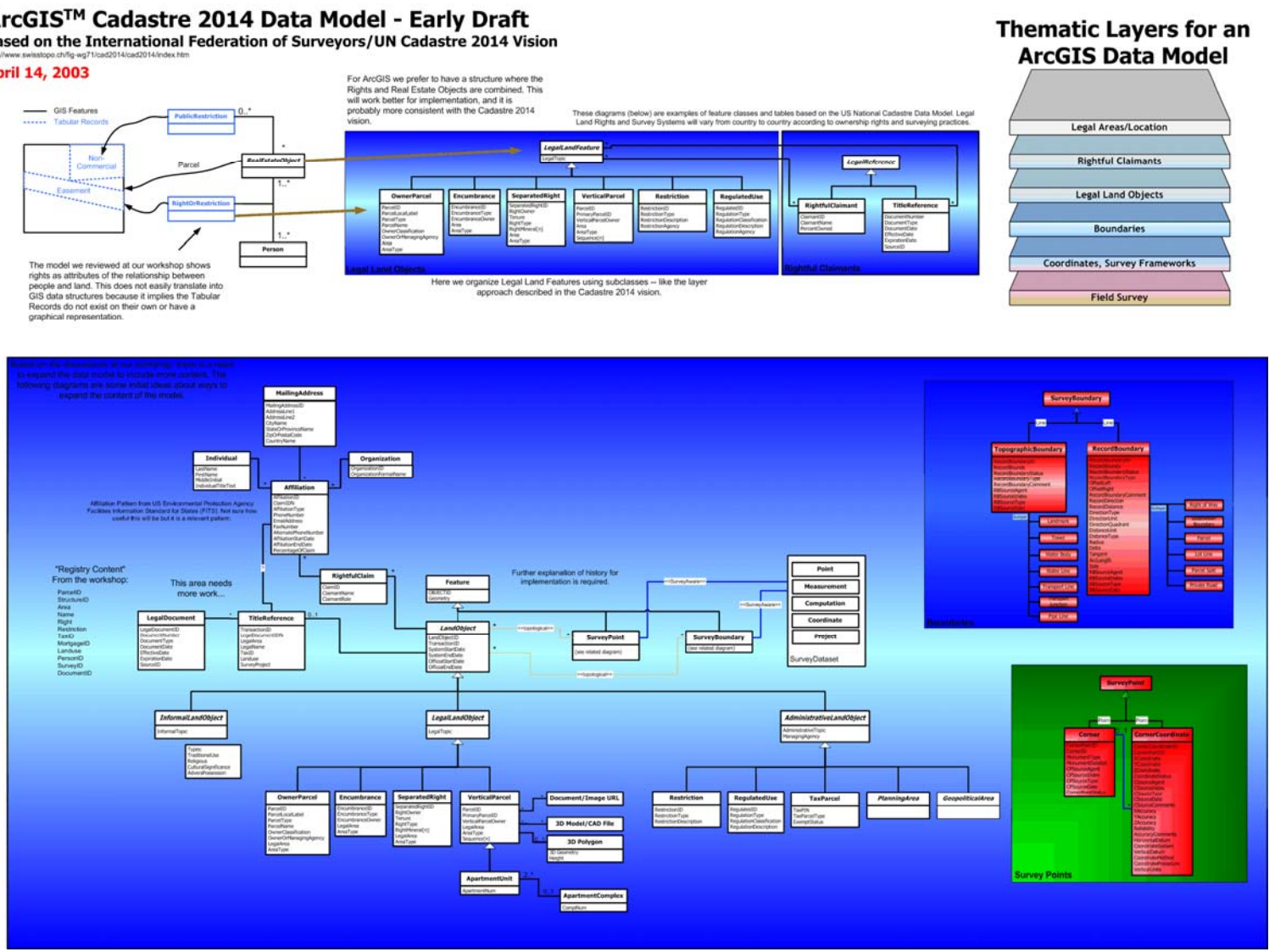

Figure 4: The ArcGIS 2014 Cadastral Data Model (ESRI, 2003)