Development of the New Cadastral Survey System in Tanzania

Samwel S. KATAMBI, Tanzania

Keywords: Cadastral Survey System, Cadastre, Land Administration, NSDI.

SUMMARY

In recent years the demand for cadastral survey informations in Tanzania has been increasing tremendously due to the need for timely processing of land transactions due to social and economic reforms that are happening in Tanzania and abroad. The existing Cadastral system to date can not meet these requirements of the Land Market and therefore a new system need to be established. The objective of a new cadastral survey system is to create an efficient and well-functioning digital cadastral system in order to improve the land survey service delivery to the public in order to ensure timely availability of information for Land transactions and administration. The new system would have several major functions including examinations of new survey jobs, creation of efficient survey data storage, dissemination and retrieval, locating new surveys on the Cadastral Index Map, etc. The system will also accommodate the recent initiatives to establish Zonal survey offices at the regional level that will require creation of Local Area Networks (LAN) for links with the Surveys and Mapping Division as a Centralized custodian of all Surveying Data. This Project will be executed by using **GIS** approach for unifying all un-computerized and computerized activities of the existing Survey system into one. The successful implementation of new cadastral survey system will pave way towards the creation of 'cadastre whose records include Land ownerships and Maps of land parcels. Finally the development of the National Spatial Data Infrastructure (NSDI) whose main objective is to disseminate, utilize, and manage spatial information for all activities related to Land and its resources would be realized.

Development of the New Cadastral Survey System in Tanzania

Samwel S. KATAMBI, Tanzania

1. INTRODUCTION

The need for Cadastral Survey information in Tanzania has increased significantly from the late 1990s due to economic reforms taking place inside our Country and abroad. This demand for cadastral information have made the number of surveys and data increased significantly to an extent that cannot be controlled by the existing Survey System at our records of SMD. The problems have been caused by inadequacy of resources (funds, equipments and personnel) to handle such influx of survey jobs and the ultimate data and plans produced that would need an efficient system of storage and retrieval.

Several attempts to solve this problem have been made by SMD including the development of Survey Registration System (SRS), SR Manager and survey-info that are instruments for checking Cadastral surveys submitted to the Director of Surveys for approval and storage of data. These initiatives included scanning and digitization of cadastral plans and Data entry into the SMD's Centralized server to form a Cadastral Survey Database were executed. These initiatives have continued to play an important role to date in strengthening the Cadastral System in our Country. But inspite of all of these developments still there are several activities that are yet to be automated including plot numbering, locating the new Surveys on TP drawings, Topographical Maps or any other form of Maps Data entry, scanning and Retrieval of Cadastral Plan, etc.

This gap had made the existing system more fragmented and thus require substantial human manual work. In order to strengthen the existing system it is important to integrate it with new system in order to form an efficient cadastral survey system will address all requirements for cadastral information for land development, valuation and taxation, etc.

2. WHY NEED FOR A NEW CADASTRAL SURVEY RECORD SYSTEM IN TANZANIA?

Cadastral record keeping methods which started with a few records, worked very well until the number of documents grew to a size which made it difficult to maintain the documents using the old manual system. Without any financial returns from cadastre, it was difficult to maintain good record management practices. The result has been duplicate allocations of the same parcel, insecurity of tenure and delays in land transfers. Currently, land allocation is progressing at a very slow pace. There is never enough surveyed land to be allocated. Record keeping has become so problematic that it is impossible to find files at the Open Registry. It takes a lot of effort to check against duplicate registration of the same document. On the average it takes about two years from the receipt of a letter of offer to process a certificate of occupancy and register a little, if one chooses to do through the normal administration process.

Recently the government has adopted the policy that land has value which makes it a marketable commodity. The policy attaches security to customary rights, accepts the marketability of land, encourages investment in land and property, promotes collateral security and ensures all the benefits of revenue from transactions in Land. For this purpose, the cadastral system needs to be improved to support recordation of fiscal activities involving land (Refer DSM doc.)

Even before the adaptation of the new land policy, it was evident that the land delivery process needed to be reviewed and improved. The new policy indicates that the cadastral system should not only be aimed at legal issues, but information that may be used for valuation and tax assessment should be added to the cadastral records. But first, the cadastral system must be purged of all the problems which have prevented the efficient registration of documents. In addition to the fiscal information, it is expected that the system should be able to trap duplicated registration of the same document, speed up the registration process, provide efficient information recording, storage and retrieval procedures, be able to trace the sequence of land transfers over a specified period and finally, have a better parcel referencing system. In effect the cadastral reform should include error trapping mechanisms, temporal information and be efficient; easy to update and retrieve information. In order to design a cadastral system, it is essential to understand the design of the current system and to identify its deficiencies. Only then can a reform be designed and implemented.

3. THE EXISTING CADASTRAL SURVEY SYSTEM IN TANZANIA

The existing Cadastral Survey System called Survey Registration System (SRS) have been developed from modified System inherited from Colonial reins that was designed to serve for delineation land parcels for acquiring Title deeds only which it is not case now because Land now have Value and therefore need for a Comprehensive digital Cadastral Survey System. The SRS System is composed of a number of fragmented source codes designed to solve specific tasks without inter-linkages between them. The programs of SRS include: (1) Cad-pro software for Survey Computations, (2) Survey-info for Survey data storage, (3) SR-Manager for processing approval of new surveys and Data entry, (4) Smart Deeds for drawing deed plans and retrieval of scanned survey plans images. These programs are administered by SMD at a certain level but the authority rests on the power of the System administrator for Management of Information System.

But the System does not cover all activities required for examination and approval of new surveys including: (1) Plot and block numbering, (2) Locating a new survey on TP drawing or Topographic Map, (3) Retrieving a drawing in GIS software, (4) Importing survey data from other programs, (5) Working performance, (6) Data entry and (7) Revenue collected from new surveys.

4. OBJECTIVE

The objective of this project is to develop a well functioning digital Cadastral Survey System in order to improve: (1) Process of Cadastral Surveys approval, (2) Data Storage and Retrieval, (3) Prevent survey overlaps and repetition of plot numbers, (4) Availability of reliable cadastral survey data, (5) Development of an internet link between the SMD records office and regional survey offices LANS (Local Area Networks) for (1) – (4).

These objectives will be achieved if and only if the New Cadastral Survey System is implemented through our National initiatives, grant or multilateral or international partnership.

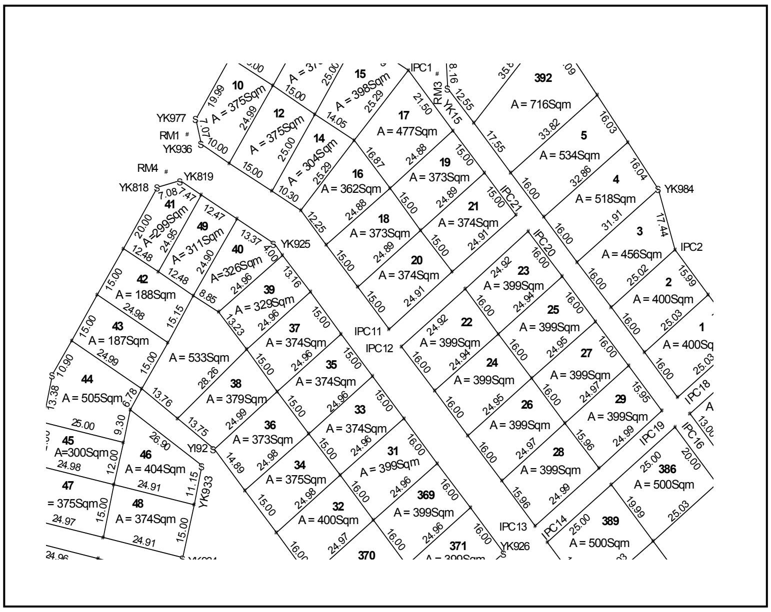
I hope that these initiatives within SMD are vital in implementing reforms in cadastral survey system in our country in order to capture the increased need of cadastral information for land translations and other related economic activities.

5. CADASTRAL SURVEY MAPS

In order to develop this new system the cadastral maps of Townships and rural areas have to be prepared to enable easy referencing of any new survey made on location in Tanzania. This map will act as cadastral index maps that define the location of a new survey in order to be able to eradicate the problem of overlaps. If the locations of surveys are defined, then blocks and plot numbers can be automatically determined digitally/electronically. The index maps will be the basis of information about all surveyed land parcels and can be merged by satellite images when need for updating arises.

At the beginning, the system will be established with all functions at SMD and then integrated to link the regional survey offices to be established very soon. The survey checked and approved at these offices has to be registered at SMD database with all coordinates and plans electronically saved into SRS at Headquarters.

Sample of digital Cadastral Maps



GIS Database for Cadastral attribute

ArcView GIS 3.2

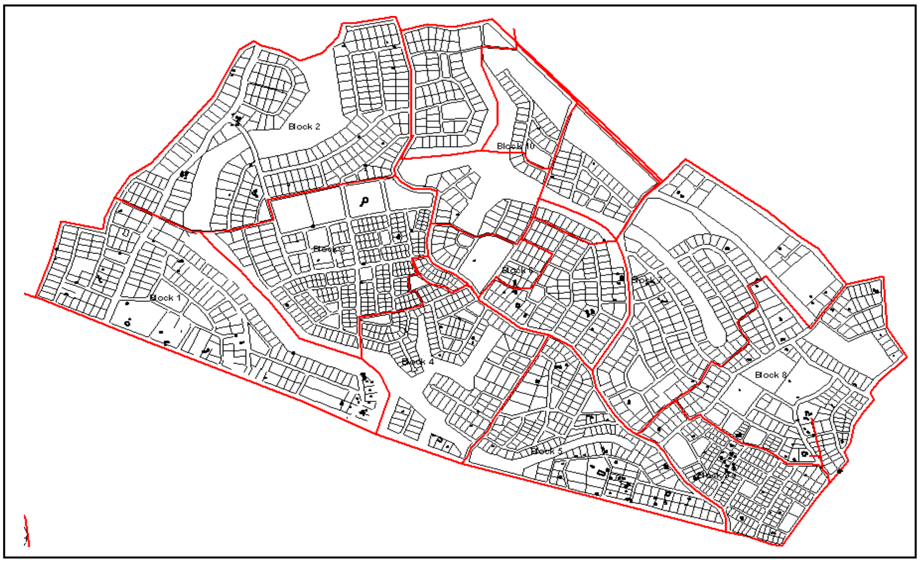
File Edit Table Field XTools ST Window Help

0 of 69 selected

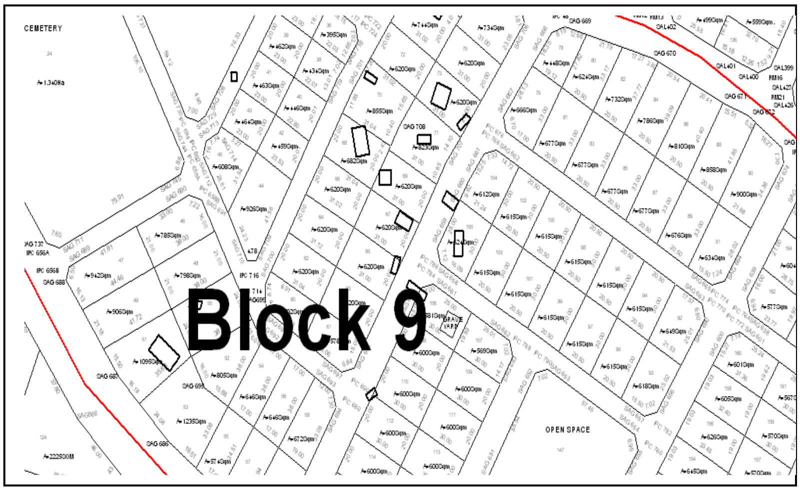
Attributes of Mbagala block j poly.shp

Shape	Id	Area_Meters	Perimeter_Meters	Acres	Hectares	Area =Sqm	Plot No
Polygon	39	374.957	79.994	0.093	0.037	A = 375Sqm	12
Polygon	40	304.339	74.632	0.075	0.030	A = 304Sqm	14
Polygon	41	399.514	81.935	0.099	0.040	A = 400Sqm	373
Polygon	43	362.114	79.289	0.089	0.036	A = 362Sqm	16
Polygon	44	373.284	79.771	0.092	0.037	A = 373Sqm	19
Polygon	45	373.283	79.771	0.092	0.037	A = 373Sqm	18
Polygon	46	373.538	79.805	0.092	0.037	A = 374Sqm	21
Polygon	47	373.538	79.805	0.092	0.037	A = 374Sqm	20
Polygon	48	398.686	81.881	0.099	0.040	A = 399Sqm	28
Polygon	49	398.563	81.871	0.098	0.040	A = 399Sqm	29
Polygon	50	399.409	81.926	0.099	0.040	A = 399Sqm	27
Polygon	51	399.409	81.926	0.099	0.040	A = 399Sqm	26
Polygon	52	399.119	81.890	0.099	0.040	A = 399Sqm	25
Polygon	53	399.119	81.890	0.099	0.040	A = 399Sqm	24
Polygon	54	398.830	81.854	0.099	0.040	A = 399Sqm	23
Polygon	55	398.830	81.854	0.099	0.040	A = 399Sqm	22
Polygon	56	500.015	90.008	0.124	0.050	A = 500Sqm	389
Polygon	57	500.241	90.026	0.124	0.050	A = 500Sqm	386
Polygon	58	374.491	79.948	0.093	0.037	A = 374Sqm	390
Polygon	59	499.160	89.917	0.123	0.050	A = 499Sqm	384
Polygon	60	382.749	80.536	0.095	0.038	A = 383Sqm	9
Polygon	61	384.131	80.647	0.095	0.038	A = 384Sqm	7
Polygon	62	382.917	80.558	0.095	0.038	A = 383Sqm	8
Polygon	63	371.799	77.734	0.092	0.037	A = 372Sqm	6
Polygon	64	726.717	114.410	0.180	0.073	A = 727Sqm	391
Polygon	65	455.517	90.361	0.113	0.046	A = 456Sqm	3
Polygon	66	518.313	96.810	0.128	0.052	A = 518Sqm	4
Polygon	67	400.472	82.059	0.099	0.040	A = 400Sqm	1
Polygon	68	400.199	82.031	0.099	0.040	A = 400Sqm	2
Polygon	69	533.500	98.719	0.132	0.053	A = 534Sqm	5

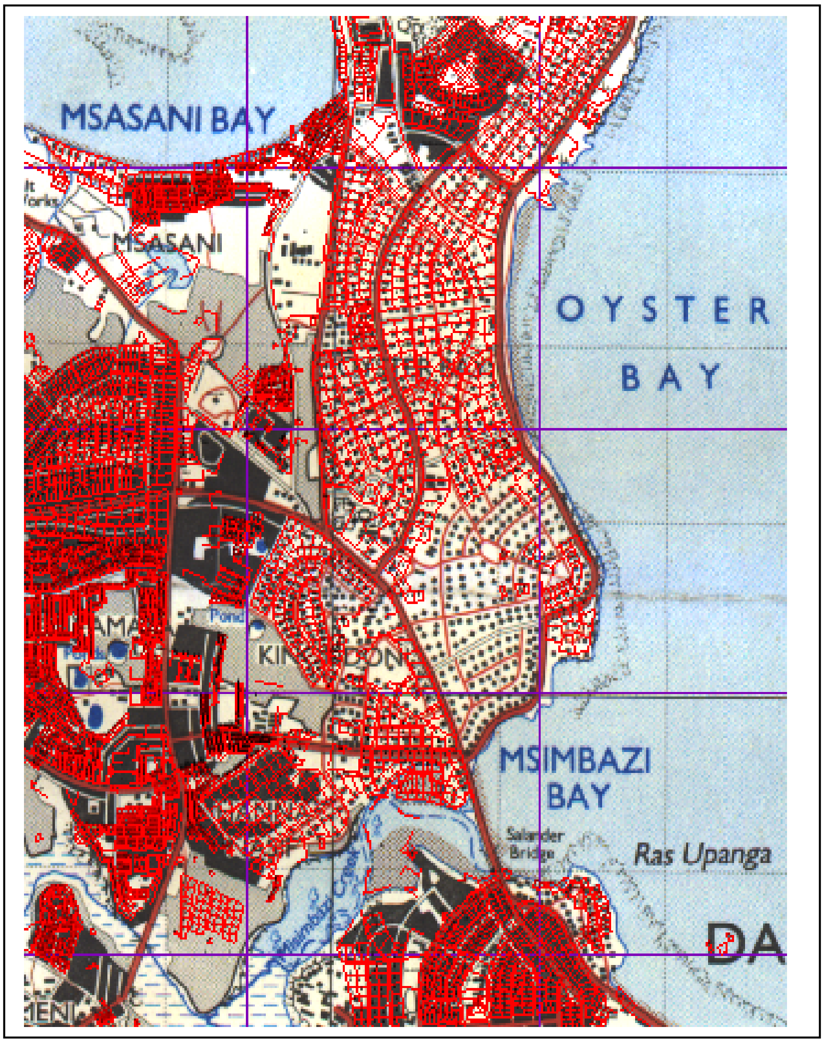
Block Numbering



Plot Numbering



Cadastral Plan superimposed onto Topographic Map



The Cadastral survey image on the Topographical Map will play a vital role for locating the new surveys submitted for approval in order to identify block and plot numbers and to prevent overlaps with old surveys. But the technique requires field work in case the new survey is in local coordinate system.

6. APPROACH

The examination of cadastral surveys will be similar to the manual system we have for the moment except that the activities that require human intervention will be computerized including plot numbering, Data entry and storage. The major steps required for developments of **CSS** include:

- **At District or Regional Office**:
The Surveyor has to accomplish: field survey and computations, drawing cadastral plans, sending the Survey for examination to SMD. The plan should be in softcopy as well as hardcopy.

- **At SMD Office**:
The GIS experts have to plot the new survey onto the cadastral map to check for overlaps and repetition of plot numbering. Then, the surveys have to be compiled, examined, checked and approved. The approved plans have to be scanned, geo-referenced, digitized and stored in our database using appropriate GIS Softwares including ArcGIS, Map info and new ones to be procured soon. For regions whose Regional Land Surveyors are Assistant RASs will approve new survey jobs as done at SMD but all data should be deposited to CSS through internet link that will be established.

- **Retrieval of data:**
Can be done through SMD website or open internet sources.

This Survey registration process can be expressed on a Flowchart shown on Appendix A that shall form an algorithm of a new Cadastral Survey System. The algorithm shall cover a multitude of Land administration Sub-Systems including: Adjudication, boundary definition and demarcation, surveying, registration, dispute resolution and information management.

6.1 Advantages of CSS

This computerization can be summarized by an algorithm extracted from the flowchart shown on Appendix A that forms a Cadastral Survey System that covers a multitude of Land administration Sub-System including: Adjudication, boundary definition and demarcation, surveying, registration and information management. The major advantage of cadastral survey system is that it accurately identifies the position and extent of rights of every land parcel. Also the advantage of this System over the existing one include: (1) Display a Location of cadastral survey anywhere in the Country and its corresponding Topographical Map, block and parcel details, (2) Remove survey overlaps and prevent plots forgery, (3) A web-based product can be viewed anywhere in the world if one given the right, (4) Friendly user tools and reliable for Cadastral GIS database timely update, (5) Eliminate human errors and interferences, (6) Easy to cross checking the reliability of a new survey under examination- is it where it meant to be?, (7) Makes it easier to adopt any System of Land use policy as all data are in digital, (8) Security is high and flexibility is what makes it of value.

6.2 Decentralization of Cadastral Survey approval

In order to implement the Land Reform on Cadastral Surveys; the Director of Surveys and Mapping under Land Survey ordinance CAP 324 part I, Section 3 can delegate powers to any government Surveyor in writing. In this case the Land Surveyors who work in Regional Administrative secretaries Offices (RAS) and have Assistant RAS title will be empowered by the Director of Surveys and Mapping to approve survey jobs in their regions and few from nearby Districts. These offices shall be provided with all facilities and link with SMD will be established to enable data and Comps of the examined and approved jobs to be stored in CSS of SMD.

7. CHALLENGES IN DEVELOPING CSS

In implementing CSS there are several challenges that lie ahead if our inspiration to develop a sound and reliable Cadastral Survey System include:
- (1)The existence of surveys made on Local coordinate system, (2) Changes made on old Cadastral Survey Plans, (3) Approval made in Regional Offices after decentralization, (4) reliability of surveys submitted for approval.

7.1 Datum for Cadastral survey in Tanzania.

Like most countries, Tanzania uses three dimensional Euclidean coordinate system. Units of measurement are metric. For Geodetic purposes, the country has adopted Clarke 1880 (modified) as the spheroid with origin in Cape Town. The National Coordinate System is based on the Universal Transverse Mercator system. Tanzania is covered by zones 36 and 37 with central Meridian at 33^0 East and 37^0 East respectively. A False Origin is located at 10,000,000 N and 500,000 E.

7.2 Survey Control Points.

The national control network was established during the colonial days by triangulation and densified with Aerodist and traverse survey methods. Wherever the terrain permitted, triangulation was used. The control points were classified according to their overall positional accuracy. Primary control points have positional accuracies of 1:20,000 or better whiles secondary points have accuracies between 1: 10,000 and 1: 20,000. Primary control points were established by triangulation. These were established on mountain tops and what were then boundaries of urban areas. Secondary control points were established by traverse and hence the name Secondary Traverse Point (STP). Most STPs were established along streets and highways. As most of the control points were on mountain tops and in remote areas, control points for cadastral work in the urban areas were based on local origins with magnetic bearings for orientation. The practice has continued since the colonial days. In general, the accuracy of the controls for cadastral work is very good, especially as they were established with linear misclosure that is 1: 10,000 or better. For cadastral, surveys in urban areas, the acceptable linear misclosure 1: 6000 or better(*Survey and Mapping report*).

7.3 Density and Quality of the Survey Control Points

In the colonial days, local cadastral survey controls were established in the urban centers. Those points were very accurate for cadastral purposes. Their positional accuracies were good enough to be classified as second order control points. Since then, the urban centers have expanded beyond the boundaries that existed at that time. Unfortunately, the extension of survey controls to the new urban areas has not kept pace with the rate of expansion of the urban towns. Density of controls in the urban centers has not been examined, but it is fair to say that they are neither comprehensive nor adequate.

Between the late 1960's and the mid 1970's the Surveys and Mapping Division encouraged the Regional Surveys offices to establish new survey controls within the urban centers. The controls were established along the arterial roads leading to urban centers. But when some of the roads were turned into multi-lane carriageways and the road sides were excavated for the placement of utility lines, almost all the control points that were on the edges of the roads were destroyed. However, those that remained are still very firm in the ground and accurate within their expected tolerances. The destruction affected the distribution of cadastral control points in the urban centers. Except in areas that are prone to soil erosion, most control points are firmly buried into the ground where they were established. Visibility, accessibility and stability are essential requirement for selecting a location for the control points.

When the control points were initially established, the configurations were in groups of three inter-visible. As such, some of the points have lost their usefulness for orienting a traverse survey. Other points haven been lost because the descriptions were made with reference to physical features which have since been demolished or destroyed, thus making it impossible to locate the control points. Given that all the control points have two markers, it is always possible to uncover the second marker if it is suspected that the top marker has been tampered with. In general, the accuracy of the controls for cadastral work is very good, especially as they were established with linear misclosure that is 1: 10,000 or better. For cadastral, surveys in urban areas, the acceptable linear misclosure 1: 6000 or better (*Survey and Mapping report*).

7.4 How to deal with CSS challenges

The problem of Local Coordinate Systems especially in regions will require some field observations in UTM system in order to transform coordinates to enable harmonization of surveys into a unified System. Also block adjacent technique can be applied to join survey of different System. The challenges 2 to 4 will be solved by CSS.

8. STRATEGIES OF IMPLEMENTATION OF CSS

In order to implement this System we need both financial and Technical support within our Country and abroad. The Project is extensive and therefore requires the utilization of new Technology and enough funds for its execution. I have view that through international cooperation for bringing in technology and capacity building it is possible to come out with an efficient and Sustainable Cadastral Survey System in order fasten the Land delivery services in our Country that would provide conducive environment for Land transactions. The financial Support sought for this project includes World Bank through BRU, SIDA, Public Service Reform Programme Phase II (PSRP II) and Internal Development sources. The process of soliciting fund will begin as soon as the proposal is accepted by the Management Team of our Department.

9. CADASTRAL INFORMATION SYSTEM

With the acceptance of land markets, it is important to execute land transactions quickly and efficiently. The numbers of transactions are going to increase considerably with the number of documents in the open registry and the land registry, it is impossible to maintain the records manually. Besides certain problems have been identified which would best be solved easily with a computer e.g. if the same parcel has been resurveyed using different beacon numbers, it would be difficult just by looking at the records to know that the two documents refer to the same piece of land. By adding information which will make it possible to do valuation, tax assessment, stimulate land markets.

The database associated with the Cadastral System makes it a Land Information System with accurate graphical representation of the cadastral map; it is possible to do spatial analysis of the information. Comprehensive and accurate cadastral record keeping can have several benefits to the individual as well as the government. It is recommended that the cadastral reform process should be geared toward Cadastral Information System (CADIS) with gradual transition into Multipurpose Land Information System (MPLIS) and ultimately Geographic Information System (GIS).

CADIS may be described as a system comprising of computer hardware, software and a database containing cadastral information such as shape, area, location and encumbrances. The system enables the performance of ad hoc queries on the data and fast graphical capabilities for the display of the results.

The main purpose of the system will be for administering cadastral and land registration processes. The CADIS will contain Cadastre and Land registration Information in the early types of date such as population census, agricultural census, valuation, land use, Health services, building plans, demographic data and socio-economic data may be added at a later stage to build a Multipurpose Land Information System. By adding other spatial/graphical information such as geological maps, road maps, natural resource management maps and other attribute data, the system may be developed into a full blown Geographic Information or National Spatial Data Infrastructure – **NSDI**.

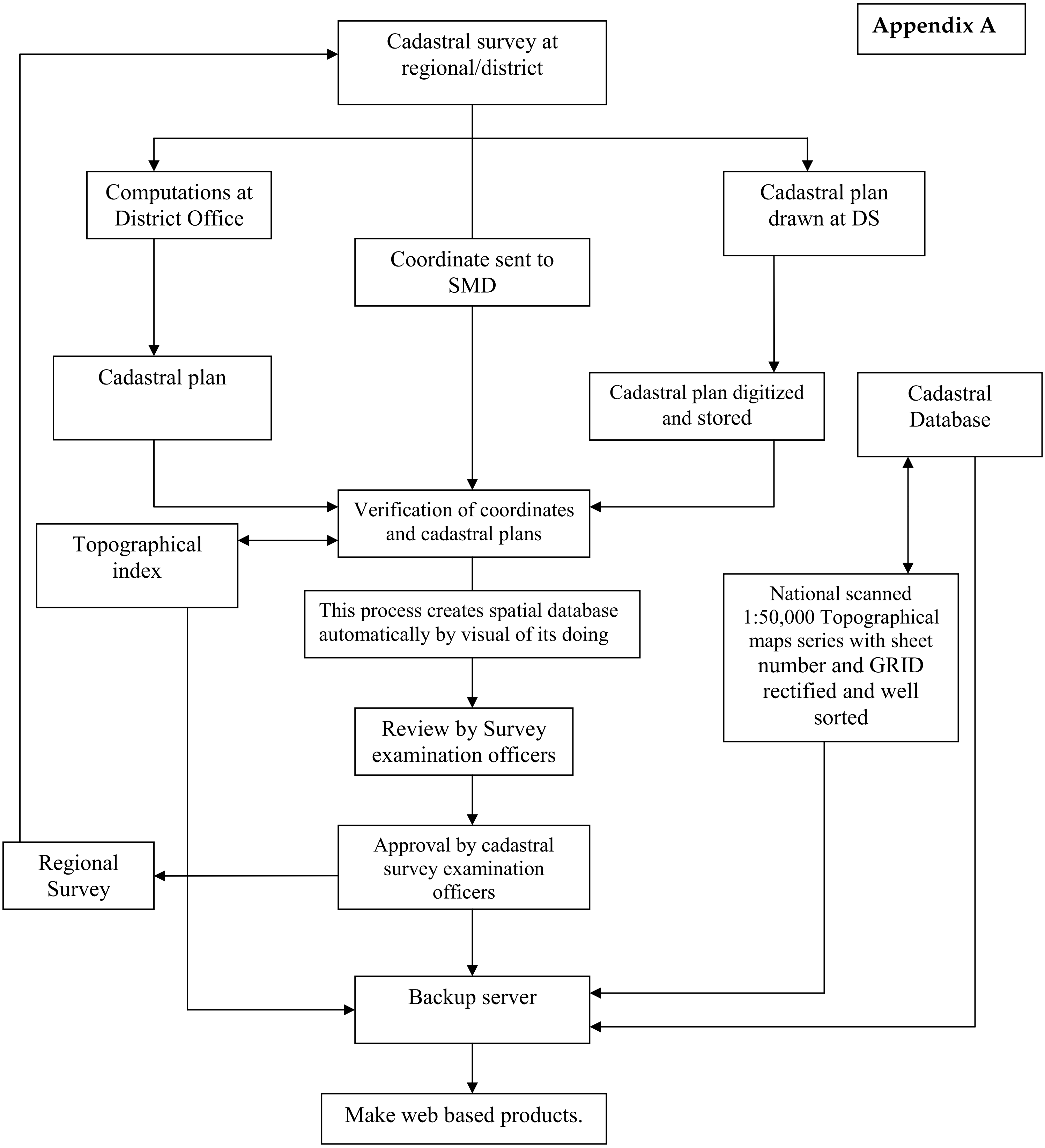
REFERENCES

1. Director of Surveys and Mapping (2000).”National Survey and Mapping report on Review of Cadastral Survey System in Tanzania”
2. Jaap Zevenbergen (2004). “A Systematic approach to Land registration and Cadastre”. Nordic Journal of Surveying and real Estate research Volume 1.
3. Regional Centre for Mapping Resources for Development (RCMRD) website.
4. National Land Policy (1995). “ Role of Surveys and Mapping on securing Land tenure in Tanzania”.
5. National Surveys and Mapping Policy (Draft). “Strengthening of Cadastral Surveying”.
6. Land Information of New Zealand (Linz web). “Survey System Overview”.
7. Country report (2003). “ Cadastral Survey and Land information in Tanzania”.

CONTACTS

Samwel Simon Katambi
Assist. Director - Urban Cadastral Surveys
Surveys and Mapping Division
P.O Box 9201
Dar es Salaam.
TANZANIA
Email: katambi@hotmail.com

Appendix A



Cadastral survey at regional/district
Computations at District Office
Coordinate sent to SMD
Cadastral plan drawn at DS
Cadastral plan
Cadastral plan digitized and stored
Cadastral Database
Verification of coordinates and cadastral plans
Topographical index
This process creates spatial database automatically by visual of its doing
National scanned 1:50,000 Topographical maps series with sheet number and GRID rectified and well sorted
Review by Survey examination officers
Approval by cadastral survey examination officers
Regional Survey
Backup server
Make web based products.