

FUNDAMENTAL CONCEPTS OF SPATIAL DATA INFRASTRUCTURE (SDI) AND THE E-GOVERNMENT

KOMBO MWERO
Director of Surveys, Kenya

SUMMARY

This paper discusses the above topic and specifically elaborates on the real meaning of the term Spatial Data Infrastructure-SDI in very simple terms. The new approach I believe will further promote awareness raising and accelerate adaptation by the country. The paper is another attempt to reach out and qualify the meaning of SDI to the majority who have failed to understand or have a clouded meaning of the underlying principles behind the concept. An illustration shall be drawn in reference to the outdoor advertisement and its significance in reaching out to the masses. The principle in this model is to emphasize the central role played by the super structure as a base Framework in playing host to different notices.

The second aspect to be covered in the presentation is to demonstrate the impact of this infrastructure in the e-Government strategy

1. INTRODUCTION

My inspiration in writing this paper is arising from the conflict of interests that are characterized by the SDI formulation in Kenya. Many organizations have invested heavily in installing GIS Equipment and are very keen to use it but find that there is no common user framework to unify and support the diverse core data sets. Most blame has been directed at the Survey of Kenya-NMO for their inability to run ahead of the rest and provide the desired leadership in core framework formulation. Running ahead of the Geoinformation society means money, money which can only flow if there is consensus by all players in recognizing the importance and concept behind the SD infrastructure. This is all that matters, because the case of SDI has never been presented in a manner that is clear to everybody. I say so because the SDI for all purposes affects all people in any given society. It is therefore important that Politicians and their electorate, Governors and the Governed understand the dynamics involved and the benefit of installing the SDI systems for effective resource planning, utilization/management and promotion of good governance.

SPATIAL DATA INFRASTRUCTURE

WHAT IS IT

In simple terms SDI is that infrastructure which provides a common user platform upon which thematic data sets from various sources may be showcased for easy access. The main assumption under this concept is that of maintaining and agreeing on standards which is usually maintained by use of Fundamental Spatial Data Framework.

Fundamental Spatial Data Framework.

The Fundamental Spatial Data Framework is referred to as the core structure and forms the basis and reference for use by all the Institutions generating spatial core/thematic data sets. To a great extent Fundamental Spatial data sets is Geoinformation that sets out the coarse fabric. Among the data sets commonly referred to as fundamental Core data sets fall under the following category:

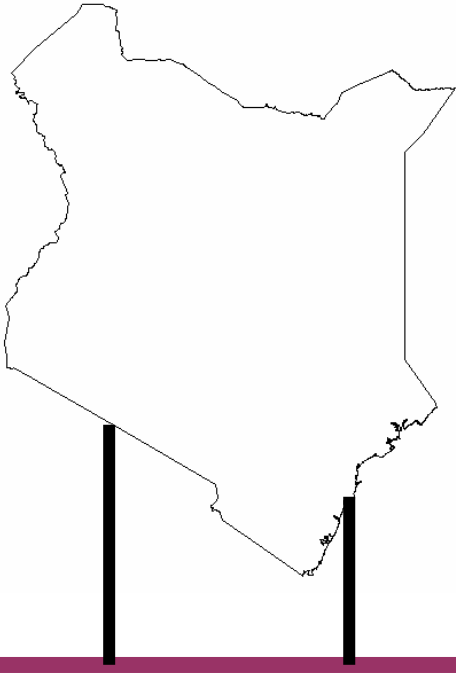
- ✚ Spatial reference frame {i.e Geodetic frame (National Geodetic Control networks)}, which is currently being addressed through the AFREF project but needs to be densified at a National level and updated for the entire continent.
- ✚ National Digital Topographic Data Bases (NDTDB) that includes(ie roads, place Names, Elevation, etc)
- ✚ Ortho- imagery
- ✚ Administrative Boundaries
- ✚ National Cadastre Data Bases (NCDB) for Cadastre

On the other hand the core data sets are finer and to detail and to the extent could be handled at a secondary level. Majority of these data sets fall under the following category:

- ✚ Environment
- ✚ Census or population data
- ✚ Poverty and Human resources
- ✚ Addresses – address of beneficiaries who access services must be documented. This is also a Human right issue for every individual to have an address.
- ✚ Access to basic services (eg Schools, Health, Markets, water and sanitation)
- ✚ Extent of Development funding
- ✚ Education facilities (Schools)
- ✚ Medical Facilities
- ✚ Wetlands
- ✚ Crops Distribution
- ✚ Minerals

My approach is to discuss the concept of SDI at its micro or basic principles. To this end I advance a simple model to demonstrate how the concept works. The model in this case is that of outdoor advertisement and its provision in giving space for multiple adverts.

Kenya is given as the structure used for the outdoor advertisement where various adverts are displayed for mass communication. In this context different themes are mounted on this structure alternately, but what is significant is the fact that the structure remains common and standard to all.



The Kenya Map serves as the Framework



Wetlands



Herd of Zebras



Mango Plantation below Mt Kilimanjaro

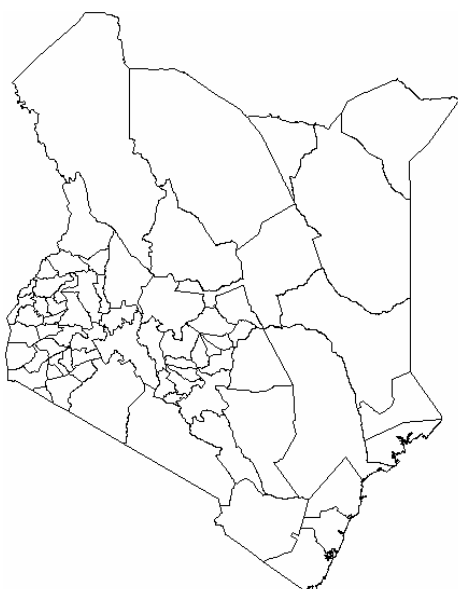


Poultry farm

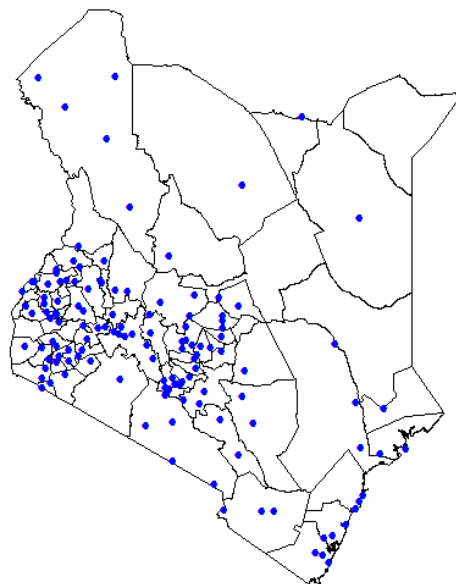


**Conservation experts in their habitat
The Maasai**

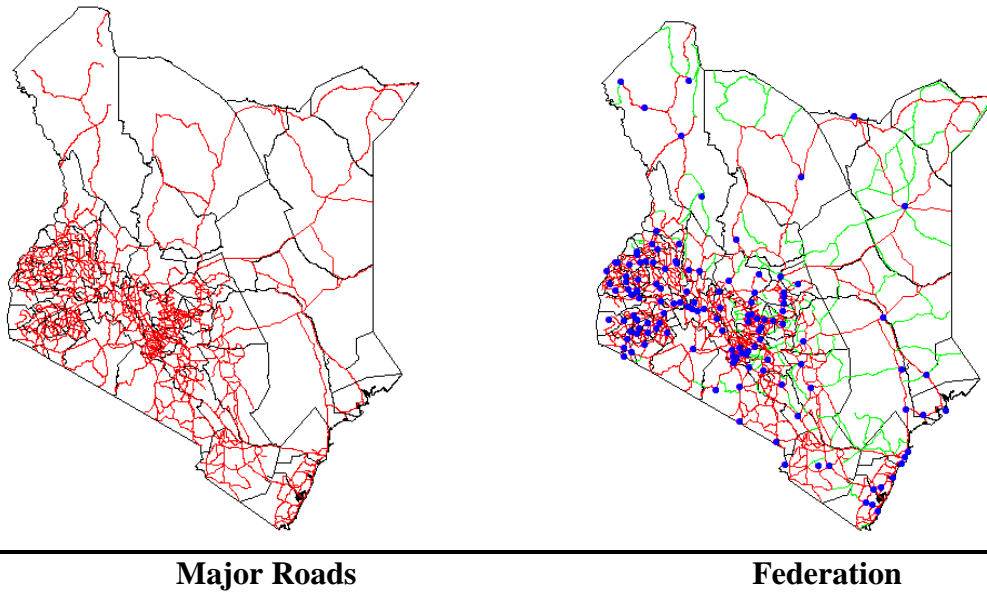
In the case of SDI however the thematic layers can be held in different digital transparent scenes or GIS models running on a background that remain common as described in the structure above. The advantage of this is that the scenes can be conveniently superimposed to generate new composite scenes revealing different and enhanced meaning. These new generic scenes are useful in planning and facilitate decision making that promote Good Governance in resource management.



District Map



Major Towns



In this context the structure in the NSDI scenario is a Super structure, Notice Board, Bill Board or a Warehouse or platform upon which institution that generate spatial data may display, advertise, post, publish or participate in sharing the data for informed decision making. The structure being so common to several situations it is important that such be centrally held and its only logical and appropriate that the process be Government driven. An analogy of the centrality in this phenomenon is given of the Central Bank of Kenya in regulating financial players in Kenya as sufficient example to further demonstrate the importance of the SDI as described in this paper. Take a moment and imagine what would happen if the Central Bank of Kenya were to be privately owned; obviously a disaster would be an understatement.

Just as a way of reinforcing my argument, I wish to discuss a few examples that would further illustrate the extensive application of the SDI concept in every day lives.

1. CLASHES

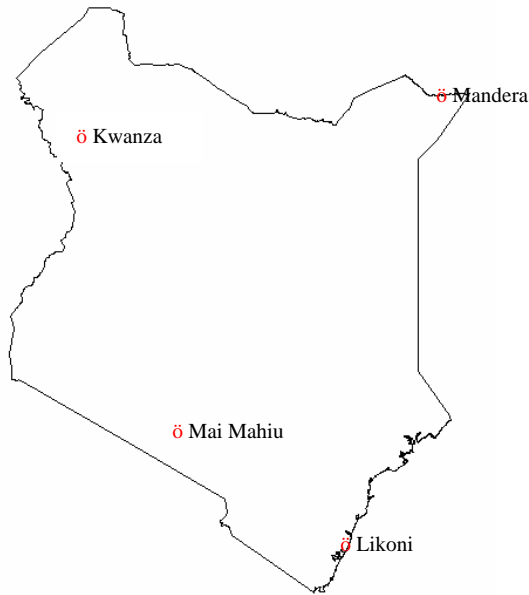
I suppose you have occasionally witnessed local dailies use this technique as they publish news about clashes. These stories have always to be figuratively communicated with the help of the map and obviously this is for a reason, which will become clearer further on in the paper.

The use of the map is meant to expose the uniqueness of a given site or location under attack graphically and represents the real picture much better for easy and deeper understanding.

You appreciate the intensity and impact of sensitive events such as clashes would be best conveyed traditionally through statistics enumerating the spots and the degree of devastations that comes with it, which is obviously inadequate as you will notice.

District	Town	Casualties	Dead	
			Men	Women
Mt. Elgon	Kwanza	100	20	40
Mandera	Mandera	120	50	30
Narok	Mai Mahiu	40	20	5
Mombasa	Likoni	30	5	10

The role of the map is that of an aid, in enhancing the picture and make it more revealing as illustrated here below



In this sense the Framework amplifies and gives a broader meaning of the situation in terms of relative distances and position involved just as is the case for a graph or a pie chart.

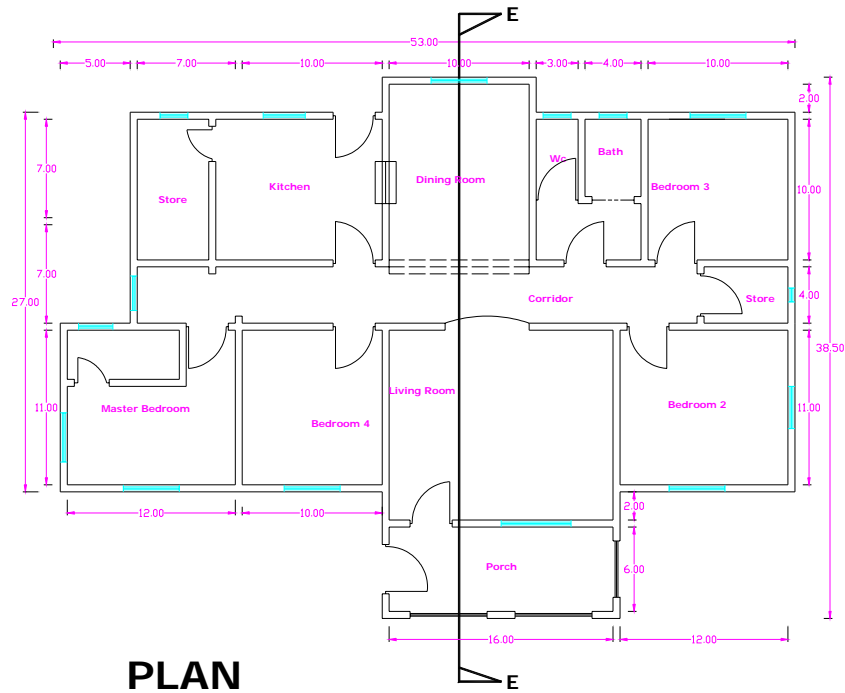
2. HOUSING ARCHITECTURE

You have possibly gone through the agony of having to make a decision on an appropriate shelter for the family. Depending on how this information is presented one could easily make a right or wrong choice. Example below should illustrate

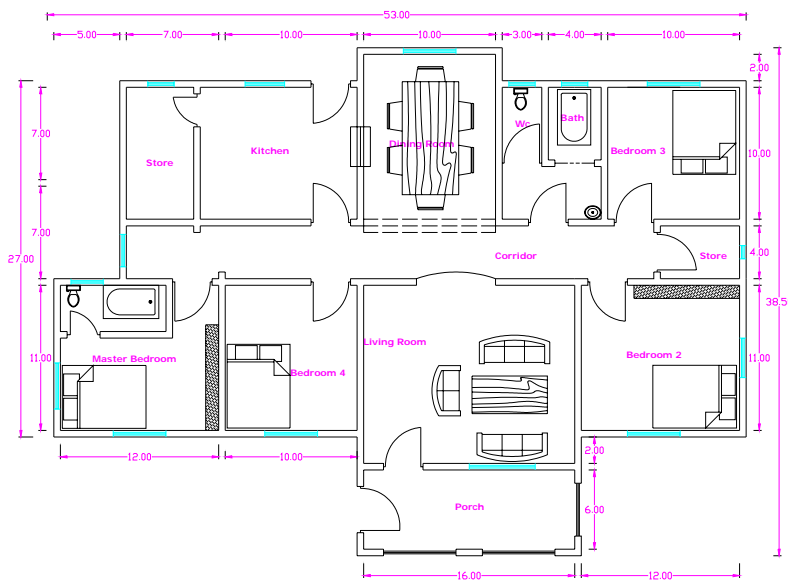
Statistics

Room	Type	Area	Remark
1.	Bedroom	100 ft ²	Single
2.	Bedroom	130 ft ²	Single
3.	Bedroom	130 ft ²	Single
4.	Bedroom	150 ft ²	Ensuite
5.	Living Room	280 ft ²	
6.	Dining Room	130 ft ²	In between the Kitchen and the living Rm
7.	Kitchen	100 ft ²	
8.	Stores	80 ft ²	Two

Visualizing the space in a plan layout says volumes



By introducing the element of Fittings to the plan a prospective buyer will be in a position to graphical comprehend what could be at stake. This makes the whole difference in terms of decision made from an informed position



COMPONENTS OF SPATIAL DATA INFRASTRUCTURE

So how does it Work

By now you must appreciate that SDI has to be a confederation of very many players, because several Institutions generate different data sets into the infrastructure. However the sequence of the SDI processes has to follow a specific pattern:

1. There must be a common user framework by the National Mapping Organizations
2. The rest of the Institution have to archive their respective data onto the same standard framework.
3. There has to be a warehouse that will coordinate and regulate the access and sharing of data
4. Aspects of custodianship may arise
5. Standards are highly important in this exercise

How can we Achieve the SDI

The only way this has been made possible is through the use Geographical Information System, GIS.

Geographical Information System (GIS)

GIS simply means the separation of thematic data to be held on different GIS models. GIS is very key in achieving the goals under SDI and e-Government strategy

What does this entail ?

We go for the internet or intranet

If you asked me I would say there is need to dedicate the Jambo net to provide for the necessary internet connectivity and gateway for government related Information content under the ICT policy. As much as possible the data should flow on the SDI for clarity as earlier explained

E:GOVERNMENT

WHAT IS IT?

E.Government is simply ensuring availability and accessibility of most information, presented in a manner that would facilitate rapid planning and decision making in almost real time. In this respect, the SDI scenario is fundamentally the most appropriate media that can integrate and convey the data and essentially play a key role as a decision support tool for this country.

GEODETIC CONTROL FRAMEWORK

For the above to work harmoniously it is essential that the coordinate system is consistent and symmetric. Today this is not the case. There has to be deliberate effort to establish a unified Geodetic Reference System. Such programme has already been proposed under the AFREF project. In this arrangement Kenya falls under EAFREF which is the East African segment of the AFREF.

GEOINFORMATION AND NSDI ACTIVITIES IN KENYA

NSDI initiatives in Kenya are being Spearheaded by Survey of Kenya the NMO responsible for National Surveying & Mapping and its activities are well defined in the Survey Act (cap299) of the Laws of Kenya.

Mission

To produce, inventorize, archive, maintain and distribute accurate geospatial data to ensure security of land tenure and territorial integrity of the nation.

The Department through the reforms under Structural Adjustment Programmes was able to identify the following core functions:

- Establishment and Maintenance of National Spatial Data Infrastructure (NSDI)
- Production and distribution of accurate geographical data
- Preparation and maintenance of Registry Index Maps (RIM) and Preliminary Index Diagram (PID) to support land registration and controls
- Inspection and maintenance of national and international boundaries
- Quality control and assurance of geographical data produced by other organizations
- Production of Photo enlargement to support Adjudication programmes
- Mapping
- Establishment of a National Digital Topographical Data Base framework
- Depository and custodian of all Spatial data originating from diverse sources

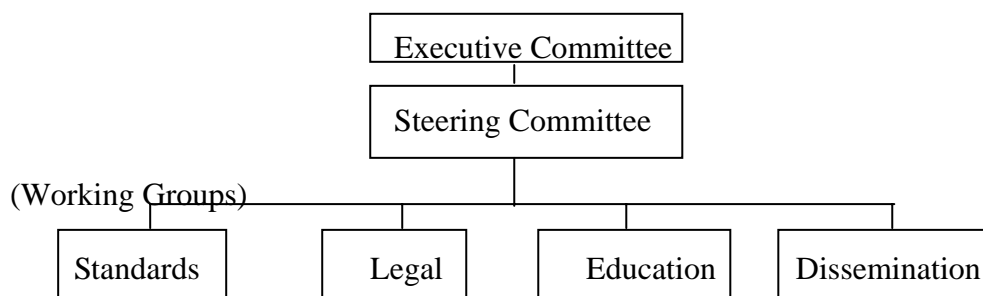
Based on the above mandates, and in response to the CODI-III Resolutions SOK undertook to implement the **NSDI** programmes in conformity the agreed aspirations.

The establishment of NSDI is one of the most important and core functions of the Survey Of Kenya. As earlier stated SOK is responsible for the production, depository, custody, maintenance and distribution of accurate spatial framework data, or fundamental core geographical datasets, that forms a basis for all other thematic data users.

Kenya National Spatial Data Infrastructure Initiatives

Collaborative efforts have been taken by Survey of Kenya with Japan International Cooperation Agency (JICA) to bring stakeholders together to discuss and agree on the subject matter. Several forums have been held to establish structures that would push the process forward as here below:

Structure for Kenya NSDI Adopted at the Second Workshop



The country has specifically engaged in the establishment of Spatial Data framework for the City of Nairobi. The project objectives were to:

- I. Prepare topographic maps and digital spatial data framework covering priority areas of the City of Nairobi at the scale of
 - A. 1:2,500 (approx. 170km²) and
 - B. 1:5,000 (approx. 415km²).
- II. Create a Model GIS as a case study. The GIS database is to support 12 thematic layers
 - Administrative Boundaries
 - Road network
 - Property boundary
 - Water supply line
 - Sewage line
 - Manholes
 - Education facilities
 - Medical facilities
 - Social facilities
 - Vegetation cover
 - Wetlands
 - Land use

Global Mapping

In addition Kenya has successfully completed its Global Mapping at a small scale of 1:1m and published its 1st release in September 2002. This particular release has so far been used in fro several applications eg FAO project, Census mapping and most research work use this framework as the base map.

National Digital Topographic Data Bases – Large Scale

Survey of Kenya has embarked on the development of Digital Database for all the analogue maps covering various mapping scales. Digital maps being developed under the Programme include: -

- 1:1,000,000 Global Map covering the whole country,
- 1:250,000;
- 1:50,000 and
- Other larger scales.

Update of maps under this programme will basically depend on most players participating in the NSDI programme volunteering Spatial Data to SOK for capture and enriching the Digital Kenya Map (framework). To this end the Kenya Government has directed that all stakeholders deposit all form of survey data to the Director of Surveys to facilitate regular update of the SDI and revision of the line maps.

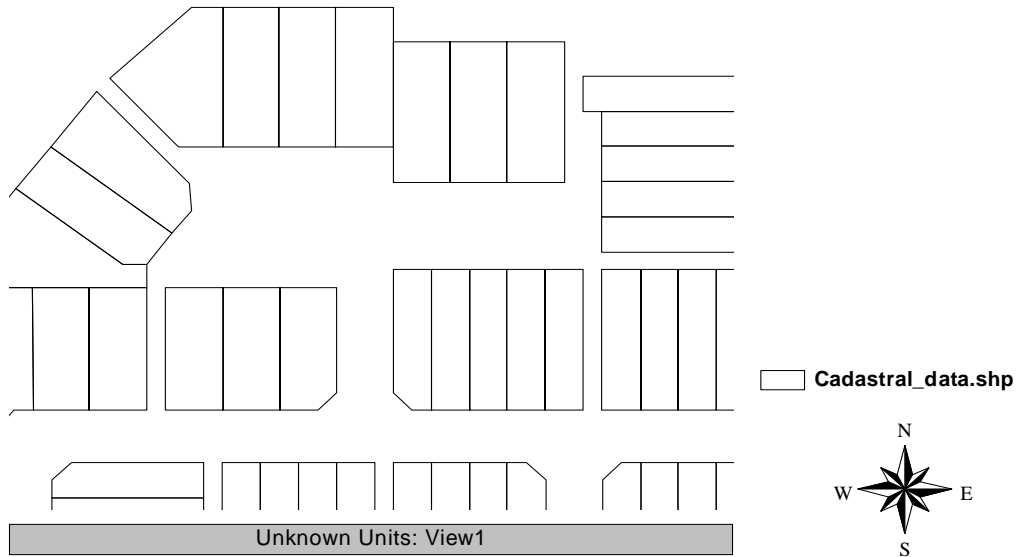
EXAMPLES OF SDI APPLICATION

A practical example under reference is that of title registration based on Cadastral parcel data defining the size, shape and unique geo-referenced turning points marking position of the plots on the ground. In this case the NMO generate the cadastral base data framework, which is cross-referenced with the ownership segment sourced from the Commissioner of Lands to complete the entry of the registry in support of the land title. Of significance however is the fact that the base map that defines and makes property unique is the base framework that remain constant unless or until the parcel is mutated. Other utility information such as sewer

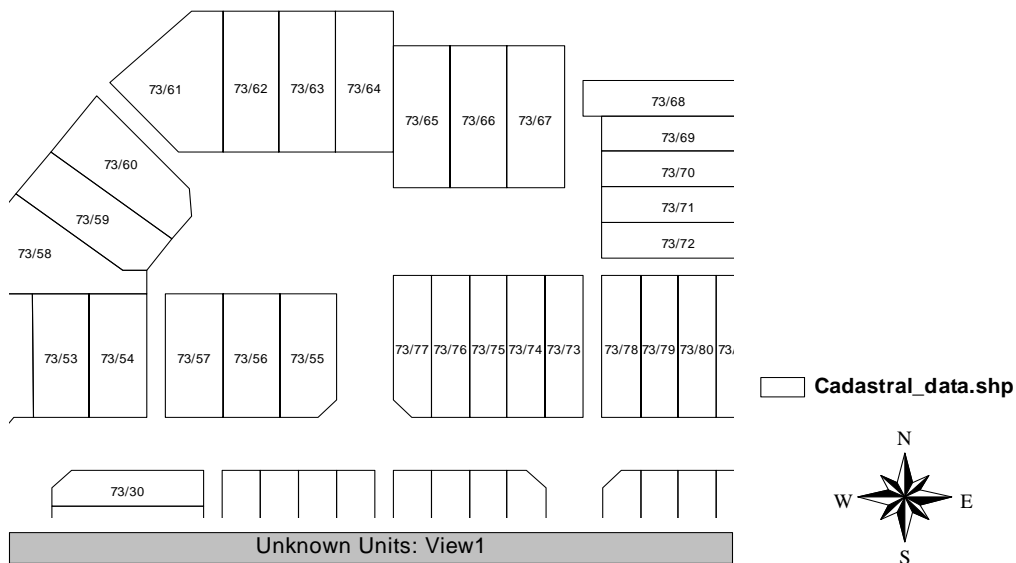
line, water system and even gas line may be overlaid onto each other on the same base framework for planning, analysis and decision making.

The case of Cadastre

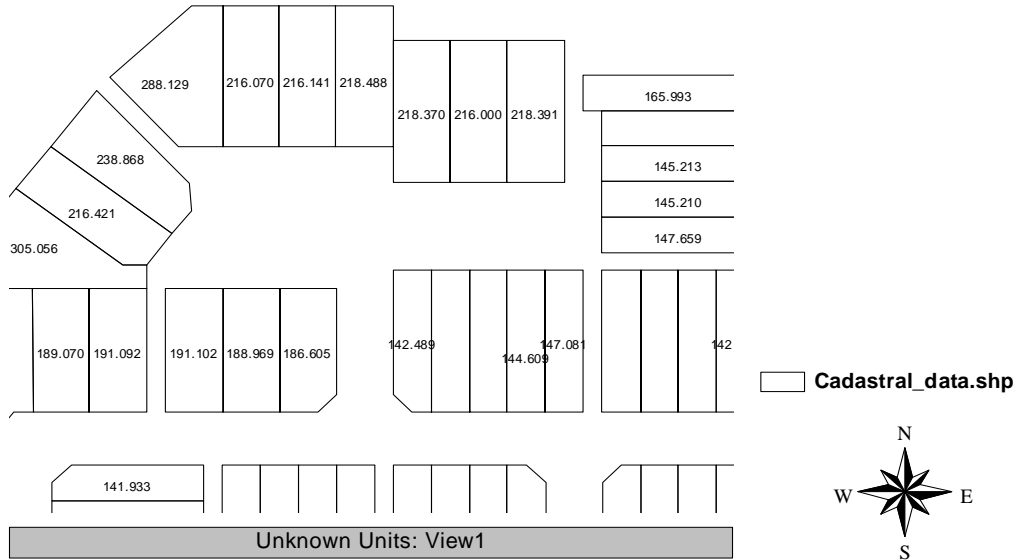
Cad Framework



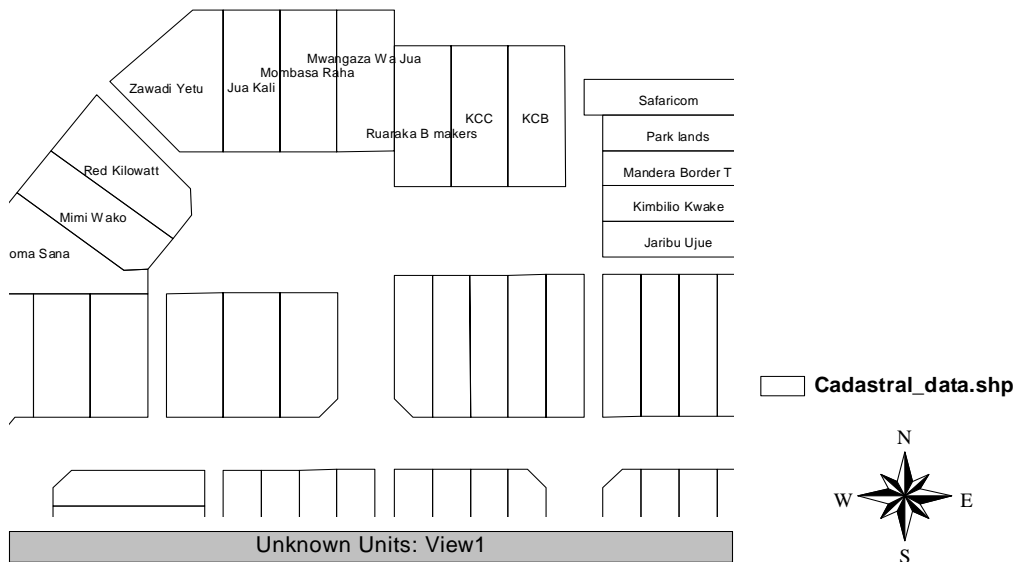
Plot Number



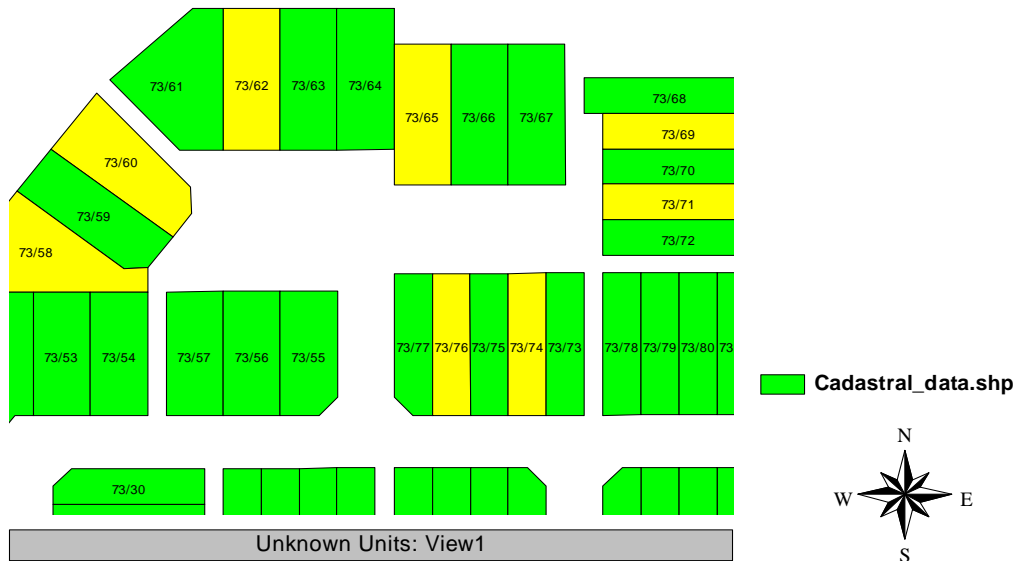
Area



Owner



Rent Defaulters



The analogue systems that have served Kenya over the years were generally acceptable in defining the different roles played by different Institutions. However with the advent of the GIS systems, suddenly competing interests have occasionally emerged and therefore misleading the society. GIS experts are no longer patient and are not prepared to wait for Spatial data framework updates undertaken by the NMOs, simply because the official processes are slow and lack the financial muscle to sustain regular revisions. The bottom line is that the role of the SOK remains as before even when the tools, systems and operations become computer based. This as I observe is the real challenge that most GIS operators have to comprehend and contend with as they wait for the NMO to show the way in the leadership of this process. It is at this cross road that the Private sector is supposed to supplement the capacity of the NMO by surrendering spatial data to be used in composing/compiling a comprehensive framework, uniform to all users.

WAY FORWARD

What is key in the development of SDI is to seek to integrate all data on a common user platform through a standard user framework. This will be made possible if the platform rides on the internet or something similar.

CONCLUSION

SDI for many Kenyans is sensational and exciting but there has been little understanding on this subject. Throughout this paper the reader must have appreciated the fact that GIS is essential for the realization of the overall goal in SDI formulation and fulfilling the e-government strategy. The government has therefore to re align its resources and invest in this infrastructure which provides the single stop shop. This reality can only be experienced through the cyber world.

Ministry of Lands and Housing
P.O. Box 30046
Nairobi-00100
KENYA

Tel: +254(20) 2718050

Fax: +254(20) 2717553

Email: Official sok@gt.co.ke
Private kombo-mwero@excite.com