

THE UNITED REPUBLIC OF TANZANIA



PRESIDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

GIS Technical Guiding Tool For LGA's



Jiandae kuhesabiwa Siku ya Jumanne tarehe 23 Agosti, 2022

June, 2022

1.0 ORGANIZATIONAL STRUCTURE, INSTITUTIONAL LOCATIONS, AND SHARING PROCEDURES

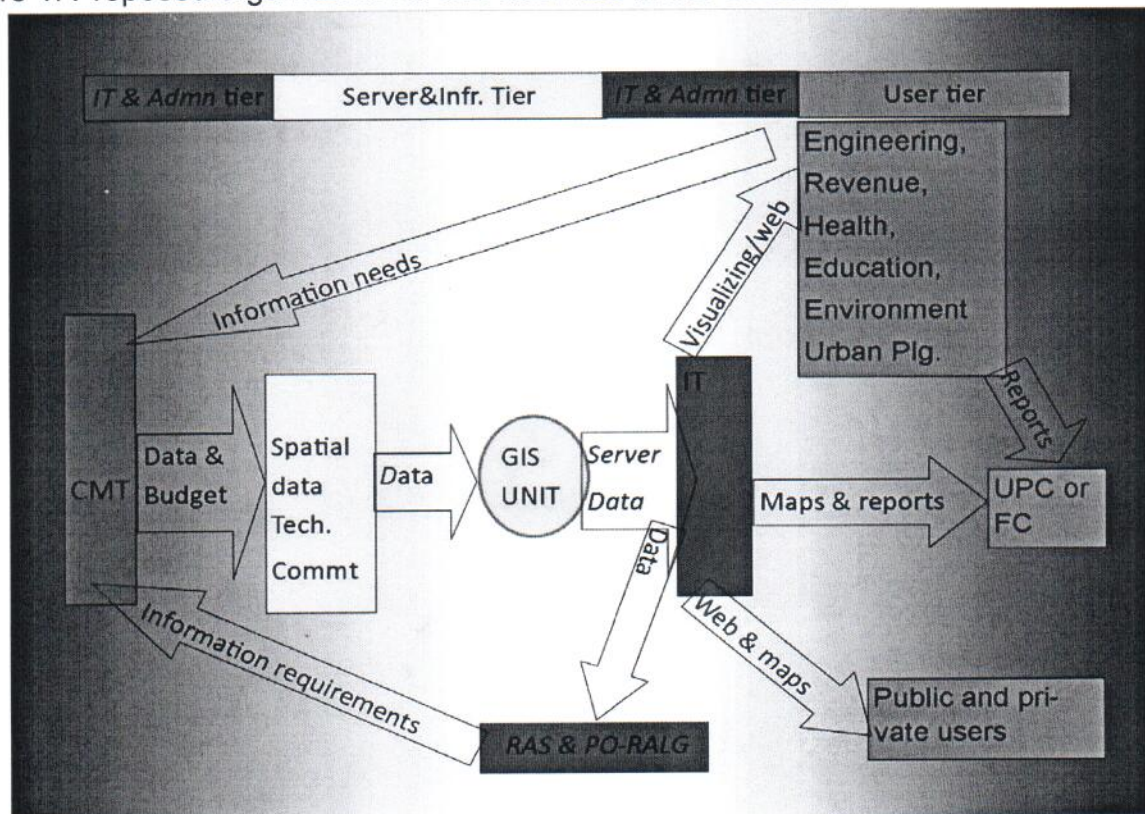
The resulting matrix indicates the outcomes which necessitate GIS to have a multitude of core users. Within the framework of urban servicing, the expected users include internal departments of Councils, public utility providers, thematic user communities, enterprises that use spatial data, and citizens. These actors have a common goal of improving servicing in an urban authority. Revenue collection and cost minimization that comes with the use of GIS improves the capacity of these actors for better servicing. This chapter deals with the distribution of roles and responsibilities within the Councils in relation to GIS. It stipulates issues roles, reporting, rights, and powers as well as monitoring the operations of the systems.

1.1 Structure and Organization of GIS Activities

Within GIS functional framework there should be a three-tier system of operations, administrative rights and reporting as discussed hereunder (figure 1).

- a) **USER-LEVEL TIER** (data users)—dealing with viewing, downloading or printing data measurement, searching data, overlay and other analytic functions. The area will encompass the use of GIS output including printing and visualization. Main software which this tier will use includes TAUSI, map server and Arc GIS online. Users in this tier may use various gadgets such as desktop computers, laptops, specialized point of service remote gadgets and mobile phones. All departments and sector agencies that commonly make reference to spatial need to be connected and access GIS data as users. These use departments and sections include engineering, internal revenue, health, education environment, urban planning, RAS office and utility agencies or service providers.
- b) **INFORMATION TECHNOLOGY AND NETWORKING TIER** (data administrators). The functions of this tier concentrate on interoperability within the agreed standards. Functions related to interoperability are sharing, maintain web based connections, manage links, and overlay functions with external web based data. They also deal with inter and intra organizational web security of the networks. Data exchange should be the priority approach to sharing data especially if outside agencies are involved. They can use map server, FTP or other specialized software. They are also involved with protocols of linking GIS with other computerized systems in the Council. Those involved in this tier allocate administrative/access rights for users. Department of information technology will be the leading in this tier.

Figure 1: Proposed organisation of GIS activities in the Councils



- c) **SERVER AND INFRASTRUCTURE TIER** (data publishers)—this tier is basically about those who have capacity to input data rather than use the system. Meaning those in urban planning. Their roles include inputting, creating, and editing data. They manage data, they manage data servers, they are responsible for GIS data security, maintain metadata catalog, they maintain image and documents (system) catalog, they have legacy data base. They manage link with zoning plans and other national spatial data. In this tier there will be a GIS officer.

1.2 Other Proposed Organs and Reporting Structure

The required Standing Committee should directly receive and deliberate report relating to the performance and progress of GIS in relation to the development needs of a particular Council and population at large. The Council Management Team (CMT) will be internal policy body and approving entity for GIS activities and budget.

There will be a spatial data/GIS technical committee. Its composition will be selected from 18 members, specifically from the tiers of the system explained above. The size

should be between 5 and 8 members and should be able to meet in every two weeks to discuss GIS. The heads of respective department will propose the names and the Council director will appoint the members formerly.

2. Data and standards

2.1 Technical Guiding principles in GIS development within the Councils

- a) *Improve openness and transparency in data;*
- b) *Single point of collection for efficient resource use and omission of redundancies;*
- c) *Quality data and standardization including improving reliability;*
- d) *Focus within core responsibilities and mandates of city Councils (Councils' business processes);*
- e) *Compatibility with legal systems including Statistics Act of 2015, which identified many of the data used by municipal act as statistical data (section 20(1)); and*
- f) *Only data and information that has direct user department should be promoted and operated*

2.2 Data standards

Data standard to be used should be ISO 19152. The organization of data should conform broadly to Land Administration Domain Model (LADM). In this model data are to be organized in sequence of details from a broad ownership or location of the area to the basic administrative or type units; followed by the use and development conditions as defined by rights, responsibilities and restrictions; concluded by parcel units which include legal space, status of survey; and finally the spatial representation meaning typology and geometry.

For users of ArcGIS this standard is incorporated and can be set as follows:

1. Open the **Options** dialog box for your ArcGIS for Desktop application.
 - In ArcMap, click **Customize > ArcMap Options**.
 - In ArcCatalog, click **Customize > ArcCatalog Options**.
 - In ArcGlobe, click **Customize > ArcGlobe Options**.
 - In ArcScene, click **Customize > ArcScene Options**.The **Options** dialog box appears.
2. Click the **Metadata** tab.
3. Click the drop-down arrow and click the style of metadata you want to create. ISO19152 is listed among them
4. Click **OK**.

Note: If you're using the **Description** tab when you choose a new metadata style, you won't immediately see the results of that change. Click another tab in

ArcCatalog or the *Item Description* window, such as the *Preview* tab, then click the *Description* tab again for the new metadata style to take effect.

2.3 Geodetic Reference Frame

Defining a Geodetic reference framework consists of defining ellipsoid, datum, projection, and coordinate system. In Tanzania there is no law or policy statement that clearly states the Geodetic reference frame to be used but they have been ministerial directives on the subject. The last directive recommended the use of Arc 1960, although experts in land survey Tanzania the proposed framework in Tanzania is Universal Transverse Mercator (UTM), with reference datum being WGS 84, Clarke 1860. However the Ministerial directive is adopted in this strategy. The effective standard spatial scale for urban vector data should be 1:2500. Some stakeholders' recommend to use larger scale maps, like 1:1000 for detailed planning.

2.4 Level Unique Parcel Identifier

Unique parcel identified (address system) has been an issue in the local authorities because, GIS in the Council is used by different professionals with different demands of base units or unit of analysis. For example valuers use Property Reference Number (PRN) because valuation is based on the property; business license and building services use Building Reference Number (BRN), and in condominiums and real estate institutions like Dodoma Capital Authority use apartment (tenancy) number. Yet interoperability is required. This is rationale that there should be different data registries organized as per user needs within the Councils, yet where commonalities or similar data are used, the same Unique Parcel Identification Number (UPIN) is to be enforced. Then whether BRN or PRN is used they become subsets of the agreed UPIN as per Land Administration Domain Model. This has to be explicit stated in metadata or/and data catalogue.

2.5 Core Metadata

It has been stated that for each data set there should be core metadata. Meta data could be detailed as stated in the various ISO 19152 reference books. However, table 4.1 illustrates

Dataset title(M) <i>Data set theme for the local area</i>	Spatial representation type (O) <i>Geometry and typology</i>
Dataset reference date (M) <i>Base date for data (representing situations of that date)</i>	Reference system(O) <i>Projections, datum,</i>
Dataset responsible party(O) <i>Main source for creation of the data (could also be the user)</i>	Lineage (O) <i>Link with other data, adjacent data and position of data in data mosaic</i>
Geographic location of the dataset (by four coordinates or by geographic identifier) (C) <i>Coordinates and area of concern</i>	On-line resource (O) <i>Link of the data to online sources, if any</i>
Dataset language (M) <i>Data language in the system</i>	Metadata file identifier (O) <i>Metadata file identification</i>
Dataset character set (C) <i>Spatial and level of attribute information and character</i>	Metadata standard name (O) <i>Meta data name</i>
Dataset topic category(M) <i>Layer names or issue</i>	Metadata standard version(O) <i>Version of meta data (if there has been previous and ate of update</i>
Spatial resolution of the dataset(O) <i>Reference scale and resolution</i>	Metadata language (C) <i>Metadata language</i>
Abstract describing the dataset (M) <i>Some short description of data</i>	Metadata character set(C) <i>Additional description on metadata, details , linkage and availability</i>
Distribution format(O) <i>File format and storage information including compression and software version</i>	Metadata point of contact(M) <i>Compiler of the metadata</i>

Additional extent information for the dataset (vertical and temporal)(O)

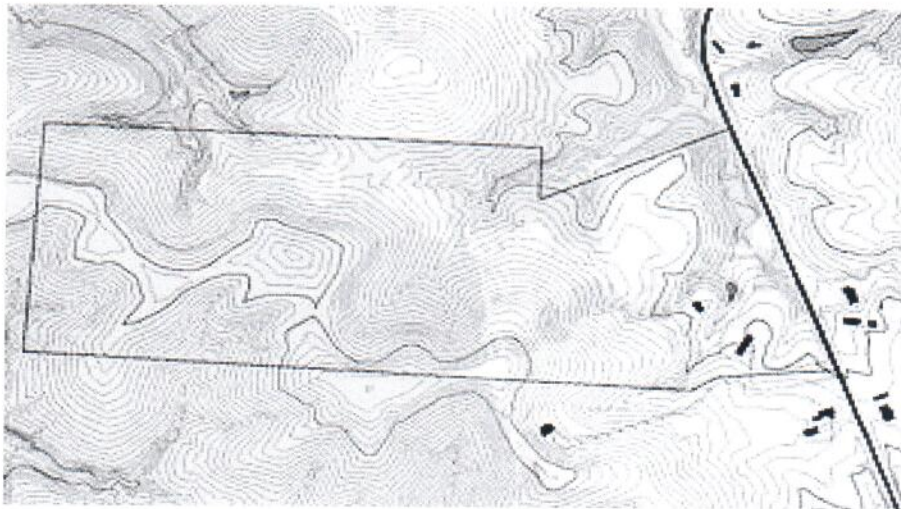
Additional information including issues such as RMS error, vertical/altitude data, azimuth

Metadata date stamp (M)

Approval date by institutional organ of the data originality

Common files formats Shapefile should be a common format for operating spatial data. However for back data more propriotor-free format such as .csv (Comma Separated Values) should be adopted. For use of shapefile will imply data served in other formats like .dwg (CAD), tab (Mapinfo), coverage, .dxf e.t.c. will all have to be exported and stored in shapefiles. For web GIS, kml/kmz formats would be adopted. Debase files should be used to store database which do not yet have spatial reference. If other formats are used, this should be clearly stated in metadata or/and data catalogue. Data themes Data themes are supposed to be a function of the demand or interest of specific users within and without the Council. However, from the typical business processes in the Councils there are minimum data registries that need to be available for each Council. These are enumerated hereunder. The registries are not necessarily one typology of data but rather a folder with sets of related data.

A. Base map



These are composed first of topographical data in typical form of contours, control points, grid and index information. Additionally there could be other information such as spot height and Digital Terrain Model (DTM). Contours interval of 2m-5m is recommended. They also contain environmental (water) features such as flood plans, soils, land cover, hazardous zones, and water catchment areas. They are also to contain administrative boundaries with urban areas such as wards, streets.

C. Land registry



9

ARJ13141

ARJ13139

ARJ13136

ARJ13147

ARJ13140

ARJ13146

ARJ13135

ARJ13132

ARJ13130

ARJ13131

ARJ13133

ARJ13134

ARJ13137

ARJ13138

ARJ13144

ARJ13145

ARJ13134

ARJ13131

ARJ13130

ARJ13137

ARJ13007

ARJ13008

ARJ13009

ARJ13010

ARJ13011

ARJ13012

ARJ13013

ARJ13014

ARJ13015

ARJ13016

ARJ13017

ARJ13018

ARJ13019

ARJ13020

ARJ13021

ARJ13022

ARJ13023

ARJ13024

ARJ13025

ARJ13026

ARJ13027

ARJ13028

ARJ13029

ARJ13030

ARJ13031

ARJ13032

ARJ13033

ARJ13034

ARJ13035

ARJ13036

ARJ13037

ARJ13038

ARJ13039

ARJ13040

ARJ13041

ARJ13042

ARJ13043

ARJ13044

ARJ13045

ARJ13046

ARJ13047

ARJ13048

ARJ13049

ARJ13050

ARJ13051

ARJ13052

ARJ13053

ARJ13054

ARJ13055

ARJ13056

ARJ13057

ARJ13058

ARJ13059

ARJ13060

ARJ13061

ARJ13062

ARJ13063

ARJ13064

ARJ13065

ARJ13066

ARJ13067

ARJ13068

ARJ13069

ARJ13070

ARJ13071

ARJ13072

ARJ13073

ARJ13074

ARJ13075

ARJ13076

ARJ13077

ARJ13078

ARJ13079

ARJ13080

ARJ13081

ARJ13082

ARJ13083

ARJ13084

ARJ13085

ARJ13086

ARJ13087

ARJ13088

ARJ13089

ARJ13090

ARJ13091

ARJ13092

ARJ13093

ARJ13094

ARJ13095

ARJ13096

ARJ13097

ARJ13098

ARJ13099

ARJ13100

ARJ13101

ARJ13102

ARJ13103

ARJ13104

ARJ13105

ARJ13106

ARJ13107

ARJ13108

ARJ13109

E. Rating registry

F. Transportation and utility registry

10

G. Land use registry



This registry will be composed of existing use, masterplan zones, approve town plan drawings, informal areas, central business districts, and special zones. Temporal variation of use (seasonal and daily) should be part of this registry. Demographic aspect such as population densities can also be part of this registry.

H. Social services registry

Typical data in this registry point information on include schools, health facilities, police post, fire stations and hydrants, formal and informal markets and bust stop. They hierarchy of services, actual users in a specified date are part of the attribute information in the registry.

2.6 Sources and technical description of registries

Since the national SDI is not yet in place there are no clear authentic sources of data. In general there has been lack of clear sources of data for use by LGA. Stakeholder has consensus that, the local authorities themselves selves should be major sources of spatial and non-spatial data. Therefore efforts must be made to improve standard for collecting spatial data. Table 4.2 explains required registries and their sources.

Table 4.2: Registry components and their sources

Main data source	Registry	data sets	Attribute
Mapping division MLHHSD, and Ministry of Agriculture	Base map	topography (contours)	height
		vegetation	Names
		Soils	type
		River	Name
		Hazard/constrain	Type

Main data source	Registry	data sets	Attribute
Department of surveys, office of the commission of lands in MLHSD	Land registry	Cadastre	Coordinates , Tenure-type-period, rent data, occupier
Core data from satellite imagery	Buildings registry	Building	Name and occupier
		Development density (storey)	Level of development/use
		Building/space use	Type of use, License information
			Solid waste and other payable services
Local data from the Council department of health and education	Social services	Location of education facilities	Name, type /hierarch and capacity
		Location health facilities	Name, type /hierarch and capacity
		Police post	Name and type /hierarch
		Fire station and hydrants	Name and type /hierarch directions
		Bus stops	Road, stop name
Ministry of Land, Environment, Forestry, Water and Mines.	Land use	Existing use by area/zone	Type off use and subcategories sequences
		Master plan zone	Type of land use and business districts
		Detail plan zones	Name of mines, type, status
		Demography	Category of Land Cover
		Development density	Population and number of storeys, houses per area/ward
		Land control	Categories of control, , special zones over land, allowable density/storeys
Ministry of Infrastructures	Infrastructures	Power Lines	Capacity
		Telecommunication Lines and towers	Hierarch and ownership of towers
		Roads	Name of roads, condition and hierarch
		Public transport systems	Stops and routes name
		Water supply	Capacity hierarchy

3. Technology-hardware and software

3.1 Room and location

Starting with the GIS room, it should be physically connected or networked to the offices that mostly use GIS for decision making (for instance internal revenue, urban planning, administration etc.). To accommodate facilities listed here under, including tables and chairs will require at least 40m² spaces.

3.2 Hardware and software



The room size should be able to accommodate the following facilities:

- a) A seven or above -generation server, with securities including firewall and demilitarized zones.
- b) High capacity desktop computers for data management and handling. In the current (2016) technology, an 8icore, 8GB RAM or higher with I TB or higher capacity. Each data registry must have own 1 TB data backup).
- c) An LCD projector for viewing and exploring data.
- d) An A3-A0 Scanner.
- e) An A0 plotter.
- f) Data cabinet 27U (wireless or LAN connections). It should be possible to use wireless transmission with changing key.
- g) Map cabinet (2m by 1.5m).
- h) Firewall Hardware.
- i) Mountable Server for Security systems.
- j) An ftp networking system security systems.
- k) Window 3000 server for the domain source.
- l) **Erdas, ArchGIS and database software (excel, access or spss). For editing software, initially Arch GIS to be used but capacity must be developed to**

migrate into Quantum GIS (qGIS) or similar open source software. Mapserver for data visualization and community inputs.

- m) Handheld GPS with wireless internet and shapefile serving capability accompanied with licensed software (or any with Arcpad capability). They must be calibrated
- n) Air conditioned room
- o) Two digital cameras



It is proposed that all software to be upgraded within every two years. All datasets/registries will need to be deposited in the server. Depending on the security arrangement, a backup server is proposed. LAN and web network speed need to be high.

LAN should allow internal use of data without having to depend on internet.

4. Training and technical skills

Three goals of capacity building must conform to the mode and content of training adopted. These goals are:

4.1 Capacity building for users' demand stimulation

This is of highest priority since most of GIS development has been on the supply side. The expected users, including decision makers and managers, have either gotten minimal training or training has been how to use GIS. It is proposed that they should be exposed to the capability of GIS. Focus in training could be in locating revenue sources (mapping of tax base), monitoring revenue flow (e.g. status of payments) and reducing leakages (tax compliance maps though live link). The training could be in form of visiting successful cases (study tour). This training should be given priority targeting Councilors, directors and heads of departments. Participation of annual trade fairs could also be taken as one mode of training targeted at general public to stimulate demand for GIS data.

CHAPTER ONE

1.1. Introduction

1.2. An Overview of the GIS Guideline

The Government of the United Republic of Tanzania (URT) adopted the use of GIS technology in the provision of services to its community. There have been significant changes in technology and Government initiatives in provision of Social and economic services to the public. Various technical personnel including doctors, nurses, logicians, water-and-sanitation experts, administrators, and other professionals working in Sector Ministries, Departments and Agencies are providing services in various Sectors in the Country hence necessitate the sharing of data and Information.

The common themes and directive to this Guideline are related to efficiency data saving, data sharing, changes in ways of dealing with customers and compliance with regulations this shall lead to efficient service delivery and decision making.

This GIS Guideline has been structured to primarily support all Stakeholders needs, and is made available to all Stakeholders in private and public sectors. It is made applicable and useful to all Regional Secretariat and Local Government Authorities.

1.3. The purpose of the Guideline

This GIS Guideline guides the Regional Secretariat and Local Government Authorities in making decisions regarding their day-to-day activities related to the provision of social and economic services. The Guideline seeks to make better use of spatial information held by public authorities and other sectors. Geographical information is integral to all RSs and LGAs in decision-making.

1.4. The targeted users

The Guideline is useful to all sector ministries, Regional Secretariats, Local Government Authorities, government and non-government institutions, the Investors both in public and private institutions and the community.

1.5. Expected Output/Outcome

A Geographic Information System (GIS) is a technological system that involves the creation, storage, management, evaluation, and mapping of several Spatial and Geographical data. Through this system, data is being connected to a map. This technology is gaining popularity and recognition for its economic and strategic

Abbreviations

BRN	Building Reference Number
CAD	Computer Aided Design
CMT	Council Management Team
CVS	Comma Separated Values (file extension)
DTM	Digital Terrain Model
dxg	Data Exchange Format (file extension)
FTP	File Transfer Protocol
GPS	Global Positioning System
IRDU	Information Research and Development Unit
ISO	International Organization of Standards
IT	Information Technology
LADM	Land Administration Domain Model
LAN	Local Area Network
LCD	Liquid Crystal Display
LGA	Local Government Authority
LGRCIS	Government Revenue Collection Information System
MoU	Memorandum of Understanding
PO-RALG	President's Office -Regional Administration and Local Government
PRN	Property Reference Number
qGIS	Quantum GIS
GIS	Geographical Information System
GPS	Global Positioning System
RUD	Rural and Urban Development
UEMIS	Urban Environmental Management Information system
UPIN	Unique Parcel Identification Number
UTM	Universal Transverse Mercator
LGA	Local Government Authorities

Abbreviations

BRN	Building Reference Number
CAD	Computer Aided Design
CDA	(Dodoma) Capital Development Authority
CMT	Council Management Team
cvs	Comma Separated Values (file extension)
DTM	Digital Terrain Model
dxg	Data Exchange Format (file extension)
FTP	File Transfer Protocol
GPS	Global Positioning System
IRDU	Information Research and Development Unit
ISO	International Organization of Standards
IT	Information Technology
LADM	Land Administration Domain Model
LAN	Local Area Network
LCD	Liquid Crystal Display
LGA	Local Government Authority
TAUSI	Government Revenue Collection Information System
MoU	Memorandum of Understanding
PO-RALG	President's Office -Regional Administration and Local Government
PRN	Property Reference Number
qGIS	Quantum GIS
TSCP	Tanzania Strategic Cities Project
GIS	Geographical Information System
UDEM	Urban Developmental and Environmental Management
UEMIS	Urban Environmental Management Information system
UPIN	Unique Parcel Identification Number
UTM	Universal Transverse Mercator