

**EVALUATING CADASTRAL SYSTEM WITH THE STANDARDIZED SCIENTIFIC
CRITERIA: SHASHEMENE, OROMIA, ETHIOPIA**



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APPROVAL SHEET

I, the advisors of the thesis entitled “Evaluating Cadastral System with the Standardized Scientific Criteria: Shashemene, Oromia, Ethiopia.” and developed by Melaku Lemma Mengistu, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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I hereby declare that this Thesis entitled “Evaluating Cadastral System with the Standardized Scientific Criteria: Shashemene, Oromia, Ethiopia.” is my own work and has not been submitted to any university for a similar purpose. The references used in this thesis are duly recognized by proper citations.

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I the advisor of this research thesis, hereby certifies that I have closely advised the student while developing this master's thesis and read the draft of thesis entitled “Evaluating Cadastral System with the Standardized Scientific Criteria: Shashemene, Oromia, Ethiopia.” prepared under my guidance by Melaku Lemma. Submitted in partial fulfillment of the requirements for the degree of Master's of Science in Geo-informatics engineering. Therefore, I recommend the submission of the thesis to the department following the applicable procedures.

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LIST OF ACRONYMS

GIS	Geographic Information System
LADM	Land administration.....,
VB.NET	Visual basic.NET
GPS	Global positioning system
GNSS	Global navigation satellite system
FIG	International federation of surveyors
CIS	Cadastral information system
2D	Two dimensional
3D	Three dimensional
CAD	Computer aided drawing
DBMS	Data base management system
RDBMS	Relational database management system
ORDBMS	Object oriented relational data base management system
EFQM	European foundation quality model
SGD	Sustainable Development Goal
CI	Cadastral information
EPDRF	Ethiopian People Democratic Revolutionary Front
FDRE	Federal Democratic Republic Of Ethiopian
RRR	Right, Restriction and Responsibility
FGD	Focus Group Discussion

ABSTRACT

This thesis investigates the effectiveness of cadastral systems within Shashemene Town by employing scientific standards to evaluate their functionality and efficiency. Cadastral systems play a crucial role in land administration, ensuring secure land rights and efficient land use. Shashemene Town, located in Ethiopia, presents a valuable case study due to its evolving urban landscape and the increasing importance of accurate land management systems for sustainable development. The research involves evaluating cadastral information system using standardized scientific criteria in the case study of Shashemene town. The significance of this research lies in its potential to identify strengths and weaknesses within the cadastral systems of Shashemene Town. The aim of the research is to model multipurpose cadastre through The first step is gathering requirements of 3D cadaster (business analysis), The second step is developing conceptual data modeling for 3D cadaster, the third step is Developing a logical data model for 3D Cadaster, the fourth step is Developing a Physical data model for 3D Cadaster, the fifth step is designing a 3D Cadastral database. The fifth step (designing a 3D Cadastral database). Creating login plat form for registration of cadastral system ultimately, the study aspires to contribute to the improvement of land administration practices, fostering sustainable development and equitable access to land resources in Shashemene Town.

Keywords: cadaster, multipurpose, frame work, proclamation, land policy, evaluation registration.

CHAPTER I: INTRODUCTION

1.1. Background of the Study

Development Goals (SDGs) globally, according to the 2030 Agenda for Sustainable Development. The rationale is that because land has so many different economic, social, political, and cultural aspects, it is important to sustainable development. From an economic perspective, land provides a means of subsistence; from a social one, it facilitates communication; from a political perspective, it confers authority; and from a cultural perspective, it represents a shared sense of identity. As a result, tremendous efforts have been made to manage land properly around the world, including the creation of trustworthy cadastral systems.

The cadastral system is the engine of land administration according to the land management paradigm, given that cadastral information supports land administration activities such as land tenure, land valuation, land use, and land development.(Williamson et al., 2010). Likewise, Larsson (1991), deSoto (2000) and Österberg (2001).

Cadastral system usually consists of two components, land registration, and cadastre. With regard to the practical implementation of the land registration (recording who has what right and under which conditions) and cadastre (recording what spatial unit the right concerns and how much area this has), most countries have developed their cadastral system because of huge differences among the systems (Bujar, 2015).

Administers and manages its land by two different legal frameworks and separate institutions. The rural land administration and management is overseen by the Ministry of Agriculture and Natural Resources while the urban land is overseen by the Ministry of Urban Development, Housing and Construction. (MoUDH, 2013). In the same manner, the issue of cadastral system is also classified as urban and rural cadastral system. The primary government agency in charge of carrying out the nation's rural cadastral system is the Ministry of Agriculture and Natural Resources' Rural Land Administration and Use Directorate. The Urban Land Adjudication and Registration Information Agency is responsible for managing the urban cadastral system. (MoUDH, 2016). In this paper, only the urban cadastral system issues are covered.

Cadastral system is defined as a formal subsystem of land administration that includes the organizational system (a set of professional actors with responsibilities to carry out cadastral activities and maintain cadastral information systems), procedures, and regulations, which altogether ensure that the cadastral system is kept up-to-date. In short, a cadastral system is an organizational system usually referring to the operations that a cadastral organization is conducting. Urban cadastral system in this context refers to a cadastral system in an area where there is a human settlement with high population density and infrastructure of the built environment (Chekole et al., 2020b).

The ideas of land governance, land management, and land administration are related to the human aspect of land. Despite the fact that these ideas are related, the land administration guidelines describe each one independently and precisely. The process by which choices are made about who has access to and uses property, how those decisions are carried out, and how competing land interests are resolved is referred to as land governance, according to the land administration guideline. The practice of effectively using land's resources is known as land management, and it includes all actions related to managing land as a resource from both an economic and environmental standpoint.

In Global perspective of Land and its resources have been the basis of wealth for most societies since the beginning of civilization. In early Mesopotamia (4000BC), Egypt (3400BC), China (700AD), and Southern India (1000AD) for instance, land was already a major source of state income through taxation [Ting, 2002]. Dowson and Sheppard [1952] also observed that during the Roman occupation of Britain (58 B.C-426 A.D), Emperor Diocletian's ordered surveys and land recordings for taxation purposes [Steudler, 2004: 8]. Similar situations were found in Northern Germany, Scandinavia, and areas occupied by the Franks, Frisians and Saxon communities where land taxation existed based on yields and supported by survey records (Larsson, 2000).

The management of such land resources, while being central to most societies, was varied in approaches and systems. In England and Wales, for example, the Saxon Kings already had feudal powers on land while in the Germanic kingdoms, private property was customarily held. Gradually, land in Germany came under powerful landlords and by the time of Emperor Charlemagne¹ (800-814AD), all land in Europe was clearly headed towards feudalism (Zweigert and Kotz, 1998).

Ting and Williamson [1999a] and Enemark (2005) have both observed that the various stages of land tenure evolution coincided with specific human stages of development. Feudalism, for example, coincided with the growth of the city-states in Mesopotamia, Egypt, China and India, while the development of the individual tenure coincided with the onset of industrial revolution in Europe and the development of land markets. The establishment of the modern cadastre and the evolution of subdivision schemes coincided with the information revolution.

Cadastral System in Africa

Records of land ownership date back to the Royal Registry of Ancient Egypt that was created in about 3000BC whilst in China in 700AD the taxation system was based on crop yields and land survey records [Larsson, 1996]. The Romans carried out a survey in 300AD to create a register of what lands the Romans controlled as well as using it as a basis for fiscal records (Larsson, 1996).

The feudal system was extended and developed by the Normans after the Conquest of England in 1066. All land was owned directly or indirectly by the king and he granted use of these lands to his subjects (and their heirs) in return for the rendering of military or other services (Ting et al., 1998a). The remnants of that concept lie in the fact that land in modern day England continues to be classified freehold or leasehold – both terms describe a form of "tenancy". Karl Marx commented in "The German Ideology" that: "The chief form of property during the feudal epoch consisted on the one hand of landed property with serf labour chained to it, and on the other of the labour of the individual with small capital commanding the labour of journeymen" (Arthur, 1974).

Historical Outline of Ethiopian Cadastre

The Irst system is believed to be the first property system in the region. The emergence of the Irist system is related with the beginning of sedentary agriculture during the time of late monarchies. The change in the way of life, from hunting and gathering society to agricultural society, is the cause for the beginning of the new social setting and tenure. There are indications and local measuring units (Kelad, Gasha, Hudad, Tmad, etc.) that show the existence of land measurement tradition in the early history. But there is no documented study to show the outline. The first recorded land registration and cadastral survey in Ethiopia was initiated in Addis Ababa in 1909. Also during Haile Selassie's time there was a Ministry of Land Reform and Administration that measured and registered rural land in collaboration with the Mapping

Agency until 1974 aiming to create a system of freehold tenure, provide individual titles of land and to facilitate land sales. The cadastral plans were based on isolated surveys of the town administrations. The urban land registers were also kept by municipalities and there was no organized land register for rural lands. (Cadastral Template 2010).

Ethiopian land tenure was based on communal ownership, but during the Marxist Derg regime (1974-1991), land was nationalized and became state property. The current government has continued with this policy of state ownership of land, where individuals and entities can obtain land-use rights through long-term leases from the government.

There have been discussions and efforts to reform Ethiopia's land policy to address issues of land tenure security, especially in rural areas, and to potentially grant more autonomy to regional governments regarding land management.

When the new federal constitution was adopted in 1995, the issue was settled in favour of public ownership of land and secured as one of the articles of the constitution requiring not only the full agreement of regional parliaments but also a two-thirds majority in a nationwide referendum. In so doing, the government effectively eliminated land policy as a variable instrument that could be used to address the changing circumstances that affect the rural economy.

1.2. Problem Statement

Shashemene City's current landholder registration procedure is unable to address the complex issues that obstruct effective land administration, tenure security, and long-term socioeconomic growth. Notwithstanding attempts to codify and upgrade land records, there are significant problems with the current system that limit its efficacy and inclusion. The lack of a thorough and up-to-date cadastral framework fuels conflicting land claims, overlapping property rights, and unstable property rights, which in turn fuels social unrest, unstable economies, and limited investment prospects.

The purpose of this study is to look at the core issues with the Shashemene City cadastral system, including inconsistent land records, a lack of technology integration, ineffective bureaucracy, and inadequate legal protections. Disparities in land access are made worse by the lack of established processes for surveying, registering, and updating land records. This is

especially problematic for marginalized populations, since it hinders their ability to obtain social services, loans, and education. Furthermore, opaque land governance procedures worsen corruption, erode public confidence in the system, maintain inequality, and obstruct sustainable land management techniques.

The intent of these studies is to thoroughly examine the intricacies of Shashemene City's cadastral system, identify the fundamental causes of its inefficiencies, and provide workable solutions to these problems. The objective of this research is to investigate technological innovations, legal reforms, community engagement models, and capacity-building initiatives. The goal is to generate practical recommendations that will improve the effectiveness of the cadastral system, guaranteeing tenure security, equitable land rights, and promoting socio-economic development in Shashemene city.

1.3. Objectives of the study

1.3.1. General objective

This research is mainly focused to evaluate the current cadastral system with the standardized criteria and developing Cadastral System of the study area to the required standards using the integration of VB.NET and Geospatial technology.

1.3.2. Specific Objectives

- I. To find out scientific Evaluation criteria for Urban Cadastral System of Shashemene city.
- II. To evaluate 2D cadastral and 3D Cadastral system and performance evaluation of Shashemene town with EFQM Excellence model.
- III. To assess urban land policy and proclamation in Ethiopia regarding with cadastral system.
- IV. To develop cadastral system using GIS and real property registration system using VB.NET software.

1.4. Research Questions

- i. What are the scientific Evaluation criteria for Urban Cadastral System in Shashemene city?

- ii. How to evaluate 2D and 3D Cadaster System and performance evaluation of Urban Cadastral System in Shashemene town.
- iii. What are the urban land policy and proclamations related with cadaster system in Ethiopia?
- iv. How to develop cadastral system and real property registration system by using Visual studio?

1.5. Significance of the study

Cadastral Information Systems (CIS) play a pivotal role in land administration, providing the framework for managing land records, property boundaries, and ownership rights. This thesis seeks to delve into the significance of evaluating CIS utilizing standardized scientific criteria, aiming to contribute to the advancement of land administration practices.

The utilization of standardized scientific criteria within CIS offers a multifaceted range of benefits. Firstly, it promotes interoperability and compatibility among different systems, enabling seamless data sharing and exchange between various stakeholders involved in land management. Standardized elements serve as a common language, facilitating communication and collaboration between disparate systems, thereby reducing data inconsistencies and errors that often arise from disparate data formats.

The area of land management might be greatly advanced by employing standardized aspects in the evaluation of cadastral information systems. Incorporating uniform scientific standards not only enhances data consistency and interoperability but also offers a framework for evaluating adherence to predetermined standards. In the end, this thesis seeks to emphasize the significance of these assessments in raising the effectiveness, precision, and dependability of cadastral information systems, consequently aiding in the advancement of land administration procedures worldwide.

1.6. Scope of study

The research will concentrate on the Shashemene City cadastral information system in order to address the issue of what state the system is in and how it may be updated for future relevance. The study's outcome was a thorough documentation of the system in a manual or almost 2D cadastral system.

Such a document is essential in the re-designing the system to provide better services to the users. The modern geospatial technologies in the study will provide a basis of primary objective of this research includes an ambition to evaluate CIS and develop a 3D Cadastre Data Modeling for a solution to enhance the multi criteria cadastre implementation capabilities of Ethiopia. The three main phases in achieving the planned goals were to study the institutional, legal, and technical issues of the implementation of 3D cadastre and its procedure. The modeling development life cycle, which includes conceptual, logical, and physical data modeling, was modeled utilizing the standardize elements technique during the examination of a 3D cadastre implementation. In the end, several data entry interfaces were created using the computer language Visual Basic to display the data. Data bases were also established, and user interface login forms developed.

1.7. Limitation of the study

Shashemene city the cadastral system faces specific limitations that affect land administration and management in the city. One key limitation is the lack of comprehensive and updated cadastral maps and records. This can lead to challenges in accurately identifying land parcels and boundaries, which in turn can result in disputes over land ownership and usage. The reliance on traditional land registration methods, which are often paper-based and manual. This can result in difficulty keeping accurate and easily accessible land records, as well as inefficiencies in the processing of property transactions and the issuance of land titles. Furthermore, there are insufficient resources and trained workers available in Shashemene for cadastral operations. This may lead to difficulties in efficiently maintaining and updating cadastral information, as well as delays in the land registration and titling procedures. Shashemene City's cadastral system is not completely connected with other land management systems, such the tax and urban planning systems. The general growth and governance of the city may be impacted by the inconsistencies and inefficiencies in land management that result from this.

1.8. Definition of Terms

This master's thesis, organized in five main chapters as follows; the first chapter introduces introduction, statement of the problem, objectives, scope, significance of the study. In this chapter status of cadastral system in world, in Africa and Ethiopia and in the study area was,

discussed based on different literatures. Furthermore, the problem is grounded in the literature and encompasses theory and practice, necessitating further investigation. The literature review is included in the second chapter. This chapter provides a brief overview of the theoretical underpinnings of assessing cadastral information systems using accepted scientific standards by introducing a number of literatures that are relevant to the topic of the current study. Despite this, VB.NET, Auto Cad, GIS, and remote sensing are used in multifunctional cadastre applications.

The third chapter discusses general description of study area, data source, data collection, data preparation and general methodological steps. In this chapter, detail description of the study area, in terms of location, climate, population, languages and evaluation cadastral system for all information about the data and logical model, conceptual model, physical model, designing cadastral data base and step taken to achieve stated objective, presented. The fourth chapter discusses about the result and analysis of the study area using the exact software to get reliable and validity of the evaluated criteria SWOT analysis and creating registration plat forms and mapping cadastral map and digitizing parcel and showing the final result. The fifth chapter discusses the conclusion and recommendation of the thesis.

CHAPTER II: LITERATURE REVIEW

2. Introduction

This chapter discusses the literature related to the study in order to explain and discusses the concept, definitions and different types of cadastres and standards elements, evaluation frame work and land policy of Ethiopia.

2.1. Theoretical framework of Cadastre

A cadastre is an up-to-date, comprehensive land information system that documents all of the rights, restrictions, and responsibilities related to specific property parcels. Along with details regarding ownership, legal rights, property prices, and any changes undertaken, it includes descriptions of parcel boundaries. Land parcels are spatially represented on maps or in a geographic information system (GIS) via the cadastre. It is an official, methodical description of each land parcels, each with its own unique number. The cadastre gives users a spatial understanding of each parcel of land's size, location, and other related geographic information.(International Federation of Surveyors, 1995).

Types of cadastre;-

1. Fiscal Cadastre: The location and value of each parcel are recorded in the fiscal cadastre, which is a record of data required for property taxation.
2. Legal cadastre: A legal cadastre is a registry that shows the exact borders and legal owner of every piece of land.
3. Multipurpose Cadastre: a relatively recent invention that combines information on land use, infrastructure, buildings, soil, and other variables with data pertaining to the legal and fiscal cadastre in a single source.

Concept of Cadastre

The regional states are responsible for land administration. The rural and urban lands are administered by different institutions. As a result of this there is significant difference between urban and rural cadastres. In urban areas a parcel is the smallest unit for both cadastral surveying and property registers. Property and parcel corresponds to each other since most

people have only one parcel or property. One notable distinction is that in urban areas, the predominant tenure is a lease hold right for a predetermined period, but in rural regions, the dominating tenure is a holding right for an infinite amount of time. The smallest cadastral unit for both rural and urban areas is called a parcel, and it has its own distinct identity. Holding right is the comparable phrase for property in the context of rural areas.(International Federation of Surveyors, 1995).

Standard of Cadastral Information System.

The main goal of the standard is to give cadastral data a standard definition and structure that will protect and improve cadastral data investments made by the public and private sectors, as well as facilitate data sharing at all levels of government and the private sector. Additionally, the goal is to guarantee that cadastral data is compatible with other data sets. For instance, users will need to browse to that geography and confirm that the minimal core parcel information and associated metadata have been made accessible for that region in order to find out whether there is parcel or cadastral information available in a certain city.

Finally, the standard provides the information necessary to identify the existence of parcel-level cadastral information and the source of that information. The geospatial metadata provided in conformance to this part will include the contact, distribution, and access requirements for the cadastral data. Additional information on the content of the full parcel or cadastral data sets, its accuracy, and its spatial projection, is also provided with the metadata. (Dawidowicz, A., & Żróbek, R. 2018).

Goals of the Standard

The cadastral standard aims to provide the minimum amount of information required to make it easier to find parcel-level data and pinpoint its source. The information on how and where to obtain the data required to enable applications will be provided by these data together with the relevant metadata. Additionally, consistent data criteria for the interchange of National Spatial Data Infrastructure (NSDI) framework data for the Cadastral topic are established under The Geographic Information Framework Data Content Standard, Cadastral. The part's objective is to make the sharing of cadastral (real property) data easier.

Capacities of the Standard

The development of this part of the Framework Data Content Standard, used in conjunction with the Cadastral Data Content Standard will greatly assist in mitigating the following issues Duplication of data and application development, Complications exchanging cadastral data and information, Difficulties in integrating data, Poor framework/support for analytic activities, Difficulties managing multiple representations of features.

2.2. 2014 Cadstere Model

Cadastre 2014 was initiated at the 20th FIG Congress, in Melbourne Australia, in 1994, as an international benchmark for cadastral systems. It was published in 1998 and has since been translated into several languages. At the heart of Cadastre 2014 are six statements about the future of cadastral systems.

First Statement: The future cadastre should reflect the whole legal status of the land, including all rights, obligations, and limitations. Although this is feasible in industrialized nations, it is currently not feasible in Africa and many other developing nations due to the customary nature of most land rights, which are not often reflected in Western legal systems. Therefore, without significant changes to the current cadastral systems, it is not practicable to apply this statement in the developing countries.

In order to create a single, comprehensive database that facilitates the seamless interchange of land information, Statement Number Two addresses the integration of maps and registers. The majority of nations that continue to use conventional cadastral systems are in this scenario. The primary reason for this is that, although land registration mostly requires administrative abilities, cadastral surveying and mapping require certain technical skills to achieve enough accuracy for mapping.

This system has the benefit of a cross-control mechanism that reduces mistakes in land transfers. The bureaucratic and redundant nature of the system, which forces customers to switch between many institutions in order to receive services, is one of its drawbacks. Since each firm charges for services related to the same data, the information held by the many entities is costly and redundant. This research aims to offer remedies for the existing state of affairs in the Ethiopian cadastre.

Statement Number Three implies that under the traditional cadastre, cadastral map defines the Database. While it would be necessary for cadastral maps to address as many users as possible, it is virtually impossible for the current map to address all the required interests of users. This is mainly due to; the changing spatial and legal status of the cadastre all the time, the steady accumulation of survey observations, the multiple demands of a multipurpose cadastre, the fast changing role of the cadastre in a globalized economy, advances in Information Communication Technology (ICT), and developments in GIS which continue to change the way in which information is structured, stored, managed, delivered and used.

Data modeling offers a chance to re-engineer the current cadastral systems in order to address a variety of issues. The issue is that, in order for cadastral modeling to be successful, the developing nations' current land management systems need to be modified in a number of ways. The availability of a well-defined and comprehensive coordinate system, fully digitized and georeferenced spatial data, a comprehensive spatial data spatial infrastructure, a modern administrative setup, and an effective data communication protocol are a few of these. Cadastral information on a uniform geodetic datum is another.

Statement Number Four assumes that the traditional cadastre based on pencil and paper will disappear and will be replaced with a computerized cadastre involving structured Land Information Management Systems, and cadastral databases. Full digitization of spatial data however, raises the issues of electronic signatures and data security. Steudler (2014) has summarized an elaborate ISO certification for Land Management Information Systems, Cadastral Database Management Systems and general security of the spatial data.

Statement Number Five aims to advance public-private collaboration in cadastral system administration. But under this model, the majority of government contracts and all surveys of private land must be completed by the private sector. Involvement from the private sector is also anticipated for all land subdivisions, engineering, infrastructure studies, and site surveys and designs. On the other hand, the public sector is supposed to maintain geodetic control networks, approve and audit inputs, define standards and regulations, preserve records, and offer supervisory and administrative control over cadastral surveys.

Government regulations and system upkeep are sometimes seen as expenses, yet surveyors and their clients gain a lot from them since they guarantee uniform and common standards. In

addition, the control system guarantees that survey data may be retrieved and shared as well as reused.

Statement Number Six implies that spatial data will be taxed in order for the government to raise revenue, and indeed the initial cadastres were developed specifically for tax collection. This is one area where the Ethiopian cadastre has done well as cost recovery system has been in operation since the establishment of the system in 1903. While the government has provided the bulk of the funds for administrative operations of the system, the private sector and the public always pay for the services. Some of the operations charged for cost recovery include, payment for letter of allocation, survey fees, conveyancing, stamp duty on transfer, land registration mortgages, charges, lease extension, approvals and any transaction land in Ethiopia.

2.3. 2034 Cadstere Model

Bennet et al. [2011] have noted that the creation of new cadastre roles, models, and aspirations has been driven by sustainability theory and geographic information technology during the past thirty years. The perception of cadastre and its potential has been drastically changed by concepts like the multifunctional cadastre, Cadastre 2014, and sustainable land administration. Many of these ideas are still applicable in the modern setting, but in order for cadastral science to continue to be useful, scholars need to consider the future and provide fresh policy recommendations for the cadastre of the future.

The proposed Cadastre 2034 Model will be governed by six new statements; Survey Accurate cadastre where communities will move from general boundaries to fixed boundaries, Object-Oriented Cadastres where the focus will shift from land parcels to property objects, 3D and 4D cadastre where height and time will be incorporated into the cadastral frame-works to support the dynamic markets, Real-Time cadastres where spatial information will be updated and accessed in real-time, global cadastre with capacity to link into regional and global cadastral networks, and organic cadastre which will better model the organic natural environment where properties are designed around natural phenomena rather than the strict bearings and distances.

A Critique of 2014 Cadaster model and 2034 Cadaster

Despite advocating a radical shift from the conventional parcel-centric cadastre to a land object-centric approach, Cadastre 2014 is not without flaws. For instance, it is entirely predicated on

the fixed boundary system, although most borders in Africa are non-mathematical and general. Ethiopia is currently facing a significant issue, which the government hopes to resolve by geo-referencing as suggested by the recently adopted Land Registration Act.

Cadastre 2014 does not address the informal and customary land tenure systems which are prevalent in the developing countries. It is also complicated and ambitious for African countries as its application requires a well-developed technical capacity and human capital. El-Sioufi et al. [2010] and McLaughlin [2010] have also observed that it was published before the adoption of the Millenium Development Goals and climate change agenda. Cadastre 2014 therefore is currently inadequate in providing the international benchmark it was initially intended for.

The proposed Cadastre On the other hand, 2034 suggests significant modifications to the global cadastre even before many nations have adopted Cadastre 2014. But the world has new problems that the cadastre needs to deal with. These include issues with economic stability, environmental preservation, poverty alleviation, and good governance. However, this report notes that as Cadastre 2014 is still the standard for the majority of cadastral systems worldwide, key elements of Cadastre 2034 must to be chosen and implemented in conjunction with Cadastre 2014. In this manner, when emerging nations work to upgrade their cadastral systems, they will have the advantage of using the two benchmarks simultaneously.

Purpose of Cadastral Information System

The main purposes are documentation of land ownership, improvement of land registration to support a land market, improvement of land management of land under customary tenure, improvement of land use planning and land management, improvement of recording of land users or owners and finally identifying of state-owned.

Importance of Cadastral Information System

Cadastral information system is a subset of spatial information that is concerned with identifying and maintaining legal boundaries of properties. Land administration in Ethiopia must of necessary involve a cadastral input; since land must be discussed in terms of location, extent size shape size shape ownership rights and encumbrances. Cadastral information system has been positively improved by the advancement in computer and space technology and as

well as techniques of information gathering, storage and dissemination for good land administration. Since land plays a major role in human activities.

The task of any cadastral information system is to register in a concise manner ownership-rights and other relationships between man and the land. There will be numerous problems in the country if there is no up-to-date digital database for effective land administration system.

2.3.1. Forms of Current Cadastral Registration System

There are three categories of land registration systems exist: registration of deeds and registration of title.

Title registration: - Under a title registration system, the legal outcome of a transaction the right itself, or title is registered rather than the deed that describes, for example, the transfer of rights. Thus, the object of the right, along with its limitations and fees, and the name of the legitimate claimant, are recorded simultaneously with the right itself. The title or right is generated with this registration.

Deed registration: - In the case of a deed registration system, the deed a document that details a single transaction becomes registered. This deed proves that a certain transaction occurred, but it does not, in and of itself, demonstrate the legal rights of the parties involved or the validity of the transaction as such. Therefore, the apparent owner must establish a solid source of title before engaging in any transactions. Legally speaking, the most basic distinction is that title registration deals with the legal ramifications of the fact, whereas deed registration deals with the legal fact itself.

Mixed Systems: In order to meet their unique operational and legal needs, several countries may use a hybrid of multiple land registration systems, including components from different models.

Purposes of Land Registration

It costs a lot to create a formal landholding registration. It is crucial to prioritize only wise investments, particularly in emerging nations with little cash. Therefore, it is important to thoroughly research the benefits of landholding registration. The advantages depend on the

prevailing conditions in the subject country and the type of landholding registration system to be established. Some of the general purposes of land registration conversed.

2.3.2. Cadastral information system

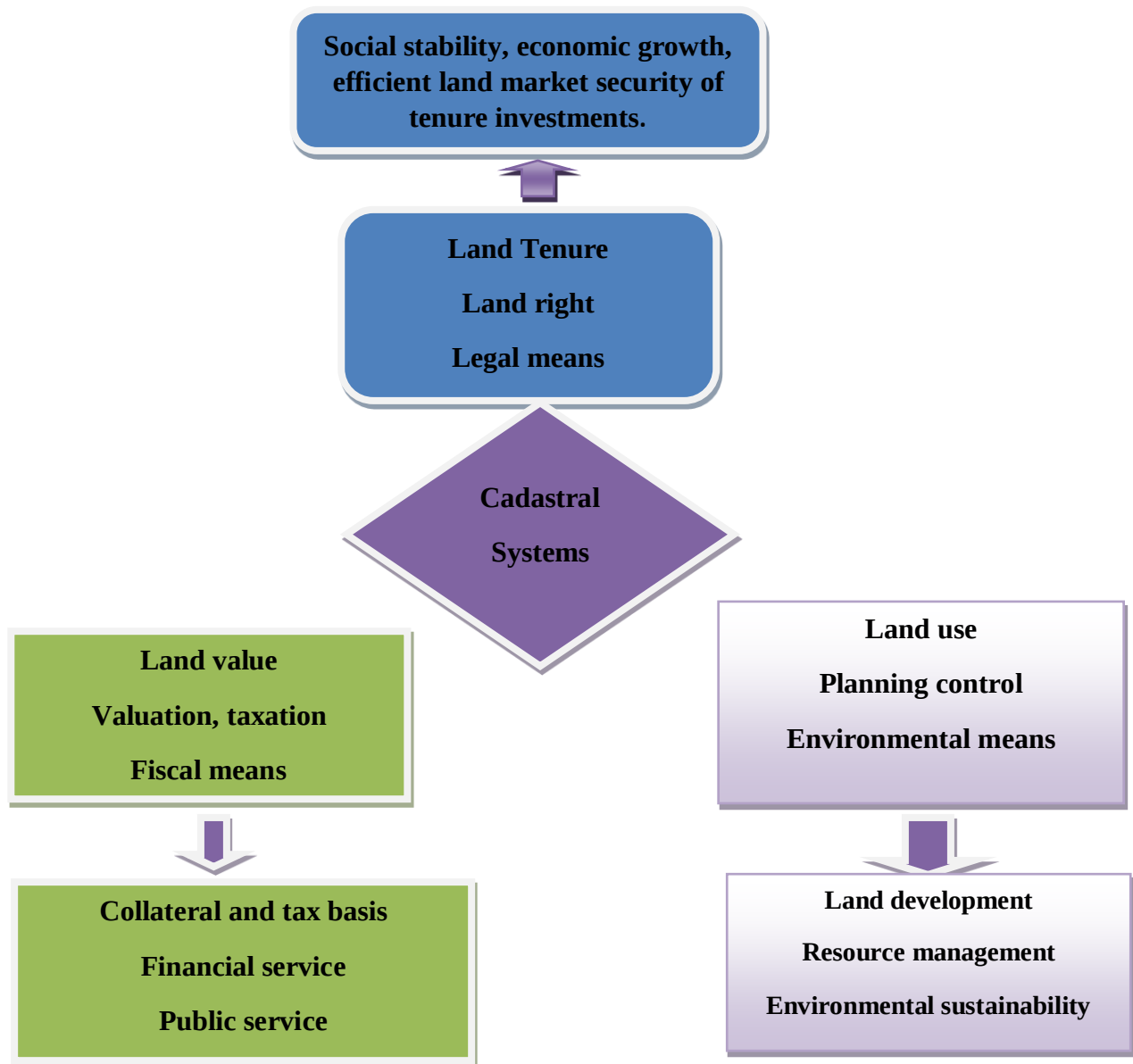


Figure 1 Cadastral systems facilitate land tenure, land value and landuse (Enemark, 2005)

3.2.3 Core Cadastral Model

The Core Cadastral Data Model (Lemmen, C. (2003). more focused on the possesses guardianship over a land item (parcel). These rights are known as use rights (ownership, free hold, long-term leasehold, building right, and usufruct) and security rights (mortgages, charges (encumbrances), easements). The following descriptive details are contained in the 2D object (parcel): parcel identity, parcel address, parcel usage, parcel value, parcel type, and parcel acreage.

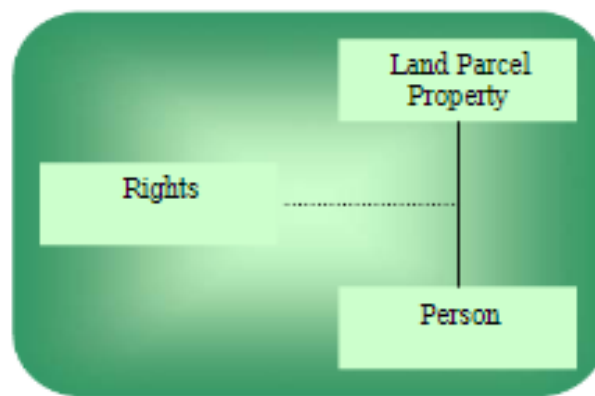


Figure 2 core cadastral model (Lemmen C.2003)

In this cadastral data models there are three core objects. Thus Man, Right and Parcel. Land parcel is the only basic spatial unit of the data model. The core cadastral data model does not support 3D data. Stratified RRRs are projected on the ground land parcel and they are not rendered with 3D primitives. Yeang,D.(2013). Land parcel is the representation of both legal and physical objects. Overall, the core cadastral data model is a conceptual data model to explain the basic element of Cadastre. Although 3D data has not been considered in this model, it is being used as a base model for developing a new 3D cadastral data model.

3.2.4. Right, Restriction and Responsibility (RRR)

Enumerations for tenure security, a continuum of land rights, deeds or titles, socially acceptable adjudication, statutory and customary techniques, co-management approaches, land record management for transactability, and family and group rights are frequently addressed by land rights, records, and registration. (Manandhar, 2015). Restrictions and responsibilities on land, in addition to rights upon land, are significant issues and interests in land management. Over the past fifty years, there have been a lot more rules and obligations governing land use

and development, (R. Bennett, Wallace, & Williamson, 2005). The new Land Management Pattern demands that land and resources be managed holistically: a new model for the management of property rights, restrictions and responsibilities is required. The main conclusions of continuing study into the problematic administration of property rights and obligations are intended to be summarized in this article. The goal is to reframe the problem as one of land management as opposed to information gathering. Numerous institutional, governmental, and policy concerns pertaining to obligations and limitations are also covered. These problems have gotten little attention up until now, yet solving them is necessary to achieve sustainable land management. (Bennett, 2007).

2.3. 2D Cadastre

Since the beginning of human settlement, land has without a doubt been the main source of power and prosperity. Cadastres, in various forms, have been established and administered to ensure a guarantee of land ownership. (Williamson, 1985). Their differences often depend upon local cultural heritage, physical geography, land use, technology, and etc. (Belej, M., Żróbek, S., & Liang, L.-k., 2002). Cadastres were originally intended to help with land redistribution, real estate transfers, and land taxation. Cadastres serve to increase the efficiency of land transactions and security of tenure generally by giving individuals engaged with those transactions pertinent information. They supply comprehensive land holdings inventories to all levels of government for the purposes of regulation and taxes. However, the application of the data in land development, urban and rural planning, land management, city space management, and environmental monitoring is growing in both the public and commercial sectors today, (FIG, 1995).

2.4. 3D Cadastre

A technology used in land administration systems, 3D cadastre allows for the digital management and representation of stratified rights, responsibilities, and restrictions (legal models) along with the corresponding physical models of structures and utilities on, above, or below the ground surface in three dimensions. Within a specified set of standards, a 3D Cadastre may record, store, change, query, analyze, and visualize multi-complex characteristics and frameworks. (Aien, 2013).

Through a subdivision procedure, structures both above and below the ground, such as platforms and tunnels that serve as building foundations, are likewise handled as distinct objects and have the potential to be registered as separate real property. (Kalantari.m, 2008). The increasing complexity of modern cities suggests that modern land administration systems need an improved capacity to manage the third dimension (Zlatanova, S & Stoter, J, 2006).

Therefore, even while there has always been 3D rights over particular plots, it has only been in recent years that complex constructions like infrastructure and buildings have truly made it necessary for them to be included in the cadastral database as separate objects. The cadastral systems must be able to handle the registration of these things given the increasing pace of complex building development and construction. (Aien, 2013).

2.4.1. Problems of 2D Cadaster

The reasons of this involve the deficiency of 3D representation and storage technologies (3D DBMS, 3D topology, and 3D visualization criteria), as well as the absence of 3D data gathering techniques and tools (i.e., lack of information in subdivision plans and architectural maps). However, cadastres features have evolved as a result of 3D advances both above and below ground. Building developments that include residences, buildings, tunnels, and utilities need the construction of both above-ground and below-ground components. (Aien, 2013). As the economy and urbanization develop, the conflict between limited land resources and huge development demand is very serious (Guo R, 2011). As a result, the urban growth extends not only into the external domain but also into the vertical domain. Developing a 3D cadastral management mode is crucial since the old two-dimensional (2D) cadastral management mode cannot meet the demands of modern 3D land use and urban planning due to the emergence of three-dimensional (3D) space. (Renzhong Guo, 2014).

Though the properties have three dimensions, the majority of the existing cadastral systems created in various countries across the world are two-dimensional (2D) and land parcel based, meaning that geometric and descriptive information is based on 2D land parcels. They are unable to accurately depict reality. Existing 2D cadastral systems are unable to handle and depict the rights, obligations, and limitations associated with land ownership in a 3D environment. (Jesper M. Paasch, 2016)

2.5. Evaluation Frame Work for Cadasteral System

Dimensions of aspects	Performance Indicators by yes or No	Good Practices
Political	The Existence of political will in support for the cadastral system (y/n).	There is clear political will to advance cadastral system of the country.
Policy	Existence of a government policy for cadastral system (y/n). Are the identified visions and objectives SMART? (y/n) Existence stakeholder-focused strategy (y/n), if yes, what is the strategic approach that has been adopted to meet the objectives? Frequency of revisiting objectives and strategies Existence of cadastral policy for Supporting Agenda 2030 for SDG: (y/n) Digital cadastral data lodgment portal (y/n) High speed internet for digital data lodgment (y/n)	Particular aspects of the land policy that pertain to cadastral policy are appropriate under the given conditions. To know how to accomplish the objective, vision, and targets, there should be a strategy tool that is SMART (specific, measurable, attainable, realistic, and timely). Excellent companies create strategies that are stakeholder-focused in order to carry out their vision and purpose. (EFQM, 2012) To implement the strategy, plans, goals, and procedures are created and implemented in place. when impartial methods for tracking progress are in place. When the policy governing the cadastral system encourages and aids in the accomplishment of SDGs. when a gateway for the loading of digital cadastral data exists.

Legal and Institutional	Presence of a legal foundation, including rules, laws, and norms (y/n). Uniformity of national policy for the cadastral system. Do cadastral system laws contain open and fair policy procedures along with entities with well-defined mandates? (y/n) If so, describe.	Legal recognition by means of standard operating procedures and enabling legislation that addresses all the specifics. when people's ownership rights over land and property are protected by laws that are appropriate for the cadastral system. When the cadastral system has organizations with distinct roles and simple procedures. Gebrewold, Z.H. (2019).
Social	Does cadastral system involvement that is guaranteed result in the formulation of policies, such as stakeholders? (y/n) If not, what would be the reason? Does the policy have a bearing on society and is it acknowledged? Exists a system in place to settle disagreements amongst landowners?	Once participation is guaranteed. When the public and private sectors work together to make missions and objectives more achievable, implementations are conceivable. Policy for the cadastral system should be recognized and beneficial to society. When there are hierarchical procedures for resolving disputes (such as arbitration or negotiation), that is good practice. Lemmen, C.; van Oosterom, (2015).
Economical	Is there a cadastral system policy for cost recovery? (y/n) if yes, how and in what mechanisms? Is there a well-functioning	The cadastral system procedure need to provide cost recovery and be self-financing. A healthy land market should be supported by cadastral system policy.

	land and property market as a result of the cadastral system policy? (y/n)	
Environmental	Does the policies governing the cadastral system guarantee environmental sustainability? (y/n), and if so, in what ways?	Policies pertaining to the cadastral system must support tasks like zoning, environmental protection, and land resource monitoring.
Public-private partnership	Does the system encourage involvement of the private sector? (y/n), if not, why? Does the policy encourage commercialization of registration? (y/n).	Private sector is the important partner of the public sector in terms of its competence in employing and modifying current technology. Thus, a beneficial practice is when there is collaboration of public and private sectors under the condition of well-determined limitations of both parts' obligations and responsibilities. Lemmen, C. (2015).
Technical	Does the cadastral system policy follow international technical standards? (y/n) if not, why? Existence of international standards such as LADM, technical standards (y/n).	When cadastral systems consider international standards and conform to them in order to communicate information. When worldwide technical standards are adopted by the cadastral policy and customized. Steudler, D.; Kaufman, S. (2014).

Table 1 of evaluating urban cadastral system of Ethiopia.

2.5.1. Evaluation of urban cadastral information system

The evaluation of a cadastral information system typically involves assessing various standard elements to determine its effectiveness and functionality in managing land and property information within a specific area like City. (Chekole, S., Vries, W., & Shibeshi, G. (2020). Ethiopian Urban Cadastral System Policy, An Assessment Framework. In order to better meet the demands of land management and property of information of Land, this evaluation aids in identifying strengths, weaknesses, areas for improvement, and prospective upgrades. These typical components frequently consist of:

- a) **Data Accuracy:** Evaluating how accurate the cadastral data is in the system, making sure that land parcels, ownership details, and other relevant data are current and accurate.
- b) **Data Completeness:** Verifying if the system has all the information needed concerning each and every property and land parcel in the city. Making sure there are no large gaps or missing data is part of this.
- c) **Data Consistency:** Making sure that data representation and format are consistent across the system. This entails confirming that standards, classifications, and data fields are kept up to date consistently.
- d) **Accessibility and Usability:** Assessing how simple it is for authorized users to access the information system. Users should be able to retrieve, update, and analyze data from the system with little technological difficulty.
- e) **Integration and Interoperability:** Evaluating how well the system integrates with other pertinent databases or systems to facilitate smooth data interchange and interoperability across various cadastral authorities.
- f) **Security and Privacy:** Ensuring that the system is protected from sensitive and property information by strong security measures. To prevent unwanted access or data breaches, this also comprises protocols, encryption, and access restrictions.
- g) **Performance and Reliability:** Assessing the speed, responsiveness, and dependability of the system. It must to effectively manage a range of queries and transactions without experiencing frequent mistakes or outages.
- h) **User Support and Training:** Evaluating the availability of user support services and training courses in order to optimize system efficiency and utilization.

2.5.1. Evaluation Framework of Cadastral system by EFQM Models

A cadastral information system can be evaluated and improved in terms of overall effectiveness and quality by using the European Foundation for Quality Management (EFQM) methodology. With the use of this model, important factors including employee happiness, social effect, leadership, strategy, people, partnerships, processes, and continuous development can be systematically assessed. Through the application of the EFQM model, entities can methodically examine and enhance their cadastral information systems, guaranteeing that they are in line with strategic goals, offer precise and easily accessible land data, satisfy user requirements, adhere to legal requirements, and promote socioeconomic development while cultivating a culture of continuous innovation and improvement.

The management of land information is greatly aided by Cadastral Information Systems (CIS), which establish the groundwork for wise decision-making across a range of industries. It is becoming more and more important to evaluate and improve these systems as technology develops. An all-encompassing framework for assessing organizational performance is provided by the EFQM (European Foundation for Quality Management) model. By using this approach for CIS evaluation, it is possible to conduct an organized assessment that promotes efficiency and ongoing progress. This paper explores the use of the EFQM model in Cadastral Information Systems evaluation, emphasizing its salient features and advantages.

Understanding the EFQM Model: The EFQM model is a strategic tool that evaluates an organization's performance based on nine criteria: Customer Results, People Results, Society Results, Partnerships & Resources, Leadership, Strategy, People, Products & Services, and Key Performance Results. Evaluation is guided by certain sub-criteria within each criterion.

Using Cadastral Information Systems as an Example: **Headship:** Stakeholder involvement, direction, and vision are all necessary for effective leadership in the CIS. The strategic alignment of the system's aims with more general organizational goals is evaluated while evaluating leadership in the context of the CIS.

Strategy: The evaluation of the CIS strategy centers on the objectives' clarity, the allocation of resources, and the creative adaptation to new technologies. It analyzes how the system meets the demands of land information management, both now and in the future.

People: CIS personnel are evaluated based on their proficiency, involvement, and their compitance engagement.

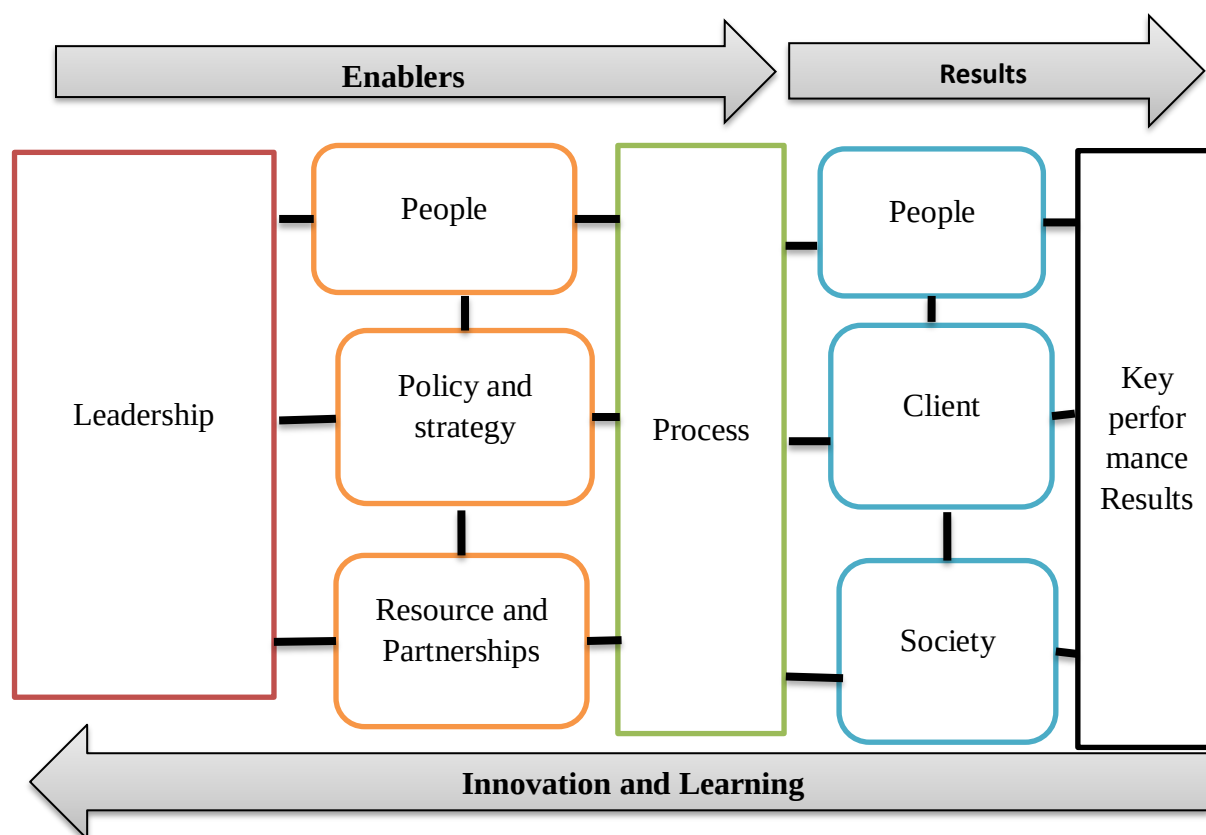


Figure 3 EFQM excellence model for evaluating cadastral system (2019).

Evaluation Framework for Cadastral System with the standardized scientific criteria.

The four components of the proposed framework are as follows: (administrative) level, which describes the level of government at which cadastral system guidelines are formulated; aspect, which refers to the characteristics of the evaluation procedure; indicators, which represent the variables and proxies that can be measured and used to characterize the quality of the system; and good practices, which indicate the extent to which the actions contribute to successful outcomes. Deininger, K., Selod, H., Burns, B. (2012).

This research focuses on evaluating the cadastral system using uniform scientific criteria, leaving out the operational and managerial tiers of the government's "organizational pyramid." Cadastral assessment is the upper hierarchy in this regard, where judgments are guided by a set of rules that produce logical results. The cadastral system review outlines several issues that

must be taken into consideration, including the following: political, policy, legal, institutional, social, economic, environmental, technological, and public-private partnership aspects.

Measurable values known as performance indicators show how a company is accomplishing its goals. Performance indicators are used by organizations to assess their level of achievement in relation to their goals. Good practices and success criteria may be defined in terms of several characteristics by knowing how a cadastral system can be successfully established and maintained.

2.6. ASPECT OF CADASTRE

The systematic and thorough recording of land information is the primary focus of the cadastral component of land administration and management. It includes a number of elements that go into thoroughly comprehending and recording the land parcels in a given location.

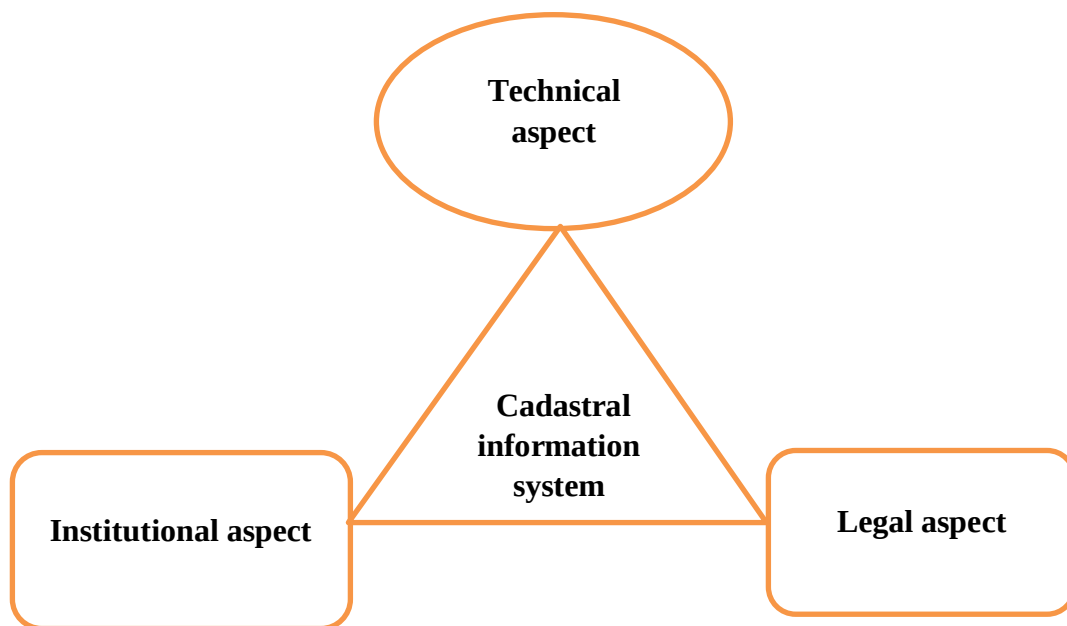


Figure 4 Relationship between different cadastral aspects of 3D (Aien, A. (2013)).

Legal Aspects of Cadastre

Article 40 of the Federal Democratic Republic of Ethiopia's Constitution states that each person is free to construct any permanent asset on their own plot of land, including mobile and immovable properties. The present Urban Development process outlines additional pillars that include the growth of microbusiness companies, the development of housing, the provision of lands and infrastructure, and the development of social services infrastructure, the establishing of urban categorization, urban planning, and environmental protection. Proclamation 818/2014 (Urban Land Holding Adjudication and Registration) is one of the rules and regulations that governs the nation's current urban land information registration system. Land registration in accordance with Proclamation 818/2014 (Urban Land Holding Adjudication and Registration).

Technical Aspects of 3D Cadaster

The basic elements of implementing a 3D cadastre within a certain legal framework are the technical features of multi-purpose cadastre. The foundation for the creation of multipurpose cadastres is the technological features that enable the realization of 3D cadastres. The following data kinds need to be taken into account while installing multi-purpose cadastres: 3D data capture, 3D data representation, Cadastral updating, and 3D data modeling. Using the proper software that supports 3D cadastral items is another important step. 3D data representation includes the vector and raster visualization of 2D earth surface, 3D analyses, and 3D cadastral items. This is something that 3D GIS and Auto CAD systems can offer. In most cadastral systems, 3D data is represented via 2D paper-based blueprints.

Cadastral Updating: updating cadastral objects in DCDB. Geometry and topology of 3D cadastral objects are complex and they need to be maintained in a 3D DBMS. Object Oriented Relational Data Base management system is the most important data base for 3D cadastre implementation. It is a hybrid database management system from ODBMS and RDBMS. An ORDBMS can be thought of as an RDBMS engine with an extensibility framework for handling objects.

Creating data models to identify 3D objects and their connections is known as 3D data modeling. Land rights, limitations, and duties may be captured, altered, analyzed, and visualized with the use of 3D cadastral data modeling. The majority of cadastral data models

now in use are 2D; one example is the Plan data model (ICSM, 2009), which only covers a small number of 3D items, such as geometric plots.

Institutional Aspects of 3D Cadastre

In both public and private sectors of the economy, organizing is the managerial task that often comes after planning. Additionally, it entails work assignment, task grouping into divisions, authority assignment, and resource distribution within the company. Put differently, organization is the deliberate, planned, and coordinated behavior of people toward the creation or gathering of a shared objective. Issues and Policy Recommended Report: Review of the Ethiopian Government's Urban Legal Cadastre (World Bank Group, 2016). Establishing roles, procedures, and official reporting lines inside an organization is known as organization design. The division of labor among organization members and coordination of their efforts to ensure that they are focused on the goals and objectives is the aim.

The objectives of organization structure are to:

Provide effective and efficient performance of the organization and the level of resource utilization. Ho, s. & Rajabifard, A. (2012). Effectively keeping the activities on the organization's operations, Enhance responsibility for tasks completed by teams and individual members of the organization, coordinate the many departments and tasks within the organization, and Allow for flexibility so that you can adjust to shifting outside influences and future demands and technological developments.

Political Aspects

The basis for social welfare, economic growth, political stability, and environmental preservation is a well-functioning cadastral system. A government can create a detailed plan to stimulate the economy of the nation, but it will never be able to carry it out without political will and dedication. The degree of political commitment and will that considers the social, economic, and cultural aspects and makes the required resources accessible is what drives the success of the cadastral system. There can never be a functional urban cadastral system without strong political intent. Enemark has emphasized that strong political will and leadership are essential requirements at the national level, even if all variables have a role in the effective implementation of a cadastral system. Absent the civility of powerful politicians.

Policy, Legal, and Institutional Aspects

A system for recording land ownership and other land-related data is an indispensable tool for a market economy to work properly, as well as for sustainable management of land resources. Cadastral system policies could include principles on the roles and responsibilities of the various cadastral-related activities such as land surveying, mapping, and land registration. These principles could be included in the national cadastral system policy. In line with this, there should be a strategic tool to know how to achieve mission, vision, and targets.

The Ethiopian federal government issued a proclamation and the corresponding subordinate legislation to guarantee appropriate marking, measurement, and mapping of real property borders. Conversely, poor policy design and execution will make it more difficult for cadastral systems to operate. The granting of legal recognition through enabling legislation which addresses all the specifics and standard operating procedures of the processes is, in this instance, the best method. Furthermore, it is advantageous when the legal framework secures individuals' ownership rights over land and other assets, in accordance with the architectural system.

Although dependent on policy and legal aspects, inappropriate institutional arrangements are often a severe limitation in any cadastral system so it is important to combine all of the different cadastral system activities under the control of one specific state department, though the decentralization of the activities and functions to regional level is likewise important. In support of this issue, Williamson has proved that the most successful cadastral systems have been established as a result of all cadastral system activities being combined into one government agency.

Social, Economic, and Environmental Aspects

A cadastral system provides security for governments, moneylenders, investors, and landowners alike, therefore promoting order and stability in society. While land registration systems are often used to protect the rights of individual landowners, they also serve as tools for national land policy as well as supporting mechanisms of economic development.

(Bennet, R., M. 2011). An important factor in improving a nation's social and economic standing is its urban cadastral system policy. An effective cadastral system is the foundation of social welfare and national stability in terms of this social component. A government may

announce its big vision for boosting the nation's economy and make a thousand promises, but it will never be able to carry them out without an effective and efficient cadastral system.

The main outcome from the improvement of the cadastral system is serving the community through securing its tenure. Bennett. (2007). With this in mind, the cadastral system policy needs to be considered and assured of participation of concerned bodies such as stakeholders, professional associations, civil servants, etc. during the development of cadastral system policies. This issue has been suggested by the group of cadastral experts and administrators in order to be able to develop a comprehensive framework. In contrast to the results of Steudler et al. Mitchell et al. and Yilmaz et al. (2011). which all limit the applications and impacts of cadastral systems to legal and technical aspects in particular, it is recommended to expand the effects of cadastral systems beyond this narrow focus. Instead, their performance should also be connected to social, economic, and environmental concerns, since the effects also help communities by solving boundary-related disputes arising among landholders. All these issues should be part of the policy that can be served as a benchmark during evaluation phases.

Public–Private Partnership (PPP) and Technical Aspects

The part of the economy that is not under state control and is managed for profit by private citizens and businesses is known as the private sector. The private sector is the public sector's most valuable partner when it comes to using and modifying contemporary technology. It is important to consider how to include the business sector. Many nations have laws requiring field surveys to be conducted by privately contracted surveyors. Private data centers that have been contracted by the appropriate public body can physically manage databases.

By doing so, commercialization brings new services to market for the betterment of income from land. In this respect, De Soto, (2000). "By including time-to-completion as a measure of performance and therefore of profit, the impact of cadastral system privatization results in faster project completion and reduced delays on infrastructure projects," the statement goes. Spatial data and text records are integral components of a high-quality land information system. Field surveys are conducted by governmental or municipal public agencies in some countries and by private surveyors in another. The degree of geometric accuracy required varies greatly. While some countries have extremely strict requirements for boundary surveying and mapping, others have considerably more relaxed standards.

The surveying and mapping, which should be performed by the private sector, rely on high amounts of resources. The technical solution to address this problem would be more user-driven land information systems, yet a lack of technical standards, PPP, and the ability to share land information currently still hinder a sufficient performance of cadastral systems.

Aspects of Multi Criteria of Cadastral System

An advanced method of land administration and management known as a multi-criteria cadastral system takes into account a number of criteria and data outside the standard borders and ownership records. It entails incorporating a variety of elements into an accurate land information system, including land use, land value, legal rights, environmental concerns, infrastructural specifics, social issues, and cultural heritage. With an increased awareness of land parcels and their characteristics, this system should facilitate improved decision-making in the areas of resource management, urban planning, land development, and policy formation. It allows for a detailed knowledge of land resources and their complexity by taking responsibility for a variety of factors. This facilitates the efficient and sustainable use of land while meeting different societal, economic, and environmental objectives within a particular region or government.

2.6.1. Components of Multi-Criteria Cadastral Systems

Land Tenure Security: The Ethiopian government has been putting authorities in place to give people, communities, and investor's safe rights to land tenure. This entails using accurate cadastral mapping to record land rights, guarantee their protection, and lessen conflicts.

Technology Integration: Using modern technologies such as satellite imaging, Global Positioning Systems (GPS), Geographic Information Systems (GIS), and remote sensing is necessary to modernize cadastral systems. Accurate land parcel management, surveying, and mapping are made possible by these technologies.

Multiple Criteria Consideration: Ethiopian cadastral systems was created to take into account several of factors, including legal, social, economic, and environmental considerations. This entails not just designing physical borders but also adding data on ownership rights, land use, land value, and environmental factors.

Legal Framework and Policy Development: The successful operation of multi-criteria cadastral systems depends on the establishment of a strong legal framework and regulations. Ethiopia has been developing legislation and rules pertaining to ownership, rights, and the transfer of

Land as well as procedures for resolving disputes.

Training and Capacity development: For those working in land administration, training courses and capacity development projects are crucial. The goal of these programs is to give professionals the abilities and know-how needed to properly maintain, update, and use cadastral data.

Community Participation: It is essential to include nearby communities in the process of developing the cadastral system. Their involvement guarantees that community interests, customary land rights, and local requirements are taken into account by the system.

Data Management and Accessibility: In order to effectively manage cadastral data, Ethiopia is concentrating on building centralized databases and information systems. Ensuring that pertinent parties have access to this data is essential for efficient land management and decision-making.

Monitoring and Evaluation: Constant monitoring and evaluation procedures aid in determining the cadastral system's efficiency and effectiveness. This enables enhancements and modifications in response to comments and evolving requirements.

2.7. Urban Land Policy of Ethiopia

In Ethiopia, the adoption of an urban cadastral system has been tested by several administrations under various regimes. In 1909, Emperor Menilik-II established the nation's first cadastral system in Addis Ababa by a proclamation that provided law. (Daniel Behailu, 2015). A decade later, the government sent out notices to people who had not yet registered their holdings, advising them to do so before proceeding with any transactions. Because of this, by 1935, the registrations had been almost all finished, and 45,000 certificates were issued. (Pankhrust, 1966; Markakis, 1974). After a decade, the government noticed to those who had not registered their lands to do so, otherwise any transaction is not possible. As a result by 1935, the registrations have been more or less completed and a total of 45,000 certificates were issued (Pankhrust, 1966; Markakis, 1974).

However for almost eighty years, this was not updated (Zewdie, 1986). Though there have been occasional efforts to create a contemporary cadastral system in Addis Ababa, the system remained essentially nonexistent until quite recently. (Chekole et al., 2020b; Daniel, 2006). Then, the city administration of Addis Ababa decided to launch a cadastral project intended to

register all property owners aimed for taxation (Berisso and Zein, 2013). However, due to varieties of challenges, the project averted into a multipurpose cadastre (Daniel, 2006).

Despite there were advancements achieved and experiences acquired throughout the multi-purpose cadastre process, the following obstacles prevented this project from being considered a success: The absence of any kind of feasibility study for the system, be it technical, economic, social, political, or institutional, resulted in a major deterioration of the Effective Cadastral System Land policy. Other factors that affected this erosion included land tenure, land value, land use, and land development demands. The unreliability of the Supplies 6 cadastral map led to the emergence of informal settlements, encroachment on property, shoddy land record security, and mistrust of the land transaction procedures. These and related challenges have led to the introduction of the new cadastral system policy i.e. Proclamation 818/2014 (FDRE, 2014).

The proclamation aims to improve the nation's real property registration system, decrease land-related conflicts, maximize individual real property rights, and give the general public access to accurate land information. The registration procedure just decides and registers already-created landholding rights; it makes no changes to the rights that are currently in place. Regulations 324/2014 (FDRE, 2014) and 323/2014 (FDRE, 2014) are issued to carry out this. Directives that specify how the necessary duties are carried out are also issued in accordance with the Regulations.

The Urban Land Lease Holding First Proclamation No, 80/1993, Art. 5-7, describes the system of land lease holding which the Ethiopian government has adopted as its urban land policy. This system allows the government to transfer land use rights and value from the state to the private sector. The Government of Ethiopia introduced the land lease policy in 1993 under proclamation **No. 80/1993** with a number of objectives. The main goals of the policy in the region were to provide adequate serviced land so as to improve the economic efficiency of urban lands and to improve the quality of life for residents.

There are many different and opposing views of what land and land policy represent in local, national, and international contexts. Although it is simple to refer to any measures involving land as "land policy," this term minimizes the true complexity of the problems at hand. Concurrently, the mainstream's urge for effective land policy administration and concerns over

"poor" land policies gave rise to the idea of "land governance." These ideas have improved the conversation around land-related concerns, but they also make an already difficult situation worse. (Borras Jr and Franco, 2010).

Current Urban Land Policy

Following the overthrow of the Derg Regime in May 1991 the current Ethiopian People Democratic Revolutionary Front (EPRDF) led government came to power. When EPDRF came to power it has become clear that no major change was to be made to the previous land tenure system. The Federal Democratic Republic of Ethiopia (FDRE) and its people own all land, both rural and urban, as well as all natural resources, according to the Federal Democratic Republic of Ethiopia (FDRE) Constitution of 1995, which was subsequently ratified by the government. In addition, the constitution specifies that the federal government has the sole authority to pass laws pertaining to urbanization, land management, and other natural resource management in Ethiopia, with the twelve regional states retaining the authority to administer land and other natural resources in accordance with federal laws.

Though the state still owns the urban land, as it does under both the present and Derg regimes, it should be highlighted that the methods by which the state exercises this ownership are distinct. The state assumed the role of the good patriarchal families during the Derg Regime. It did not do anything more than maintain the property, collect payments, and assign land to individual citizens. In contrast, under the current regime, the state is just as much the land's owner as any individual. It will engage in legal proceedings concerning urban land in the same manner as any private individual. Urban land was not subject to leases during the Derg Regime, however it was not the subject of lease but it is the subject of lease in the current system.

The introduction of the urban lease holding system was started even before the issuance of the FDRE constitution in December, 1993 by proclamation 80/1993 during the period transitional government of Ethiopia. However, this law was consequently amended by proclamation 272/2002 and proclamation 721/2011. According to the lease hold proclamation the lease holder has a right to use and develop the land. The right to transfer leasehold right through inheritance, gift and sale is also allowed if there is an improvement or development on the land. Furthermore, the leasehold right can also legally be used as collateral for bank loans, at least

for the lease amount already paid. Constitution of the Federal Democratic Republic of Ethiopia Proclamation, (1995).

Although the lease hold system is in place for urban areas, it doesn't appear like the government can guarantee that there is an efficient, transparent, effective, and dependable system in place for the development and administration of urban property. In light of this, the government's adoption of the Urban Land Development and Management Policy in 2011 and the Urban Landholding Registration Proclamation 818/2014, respectively, represent two of the biggest and most significant measures related to land policy and land registration.

2.7.1 Land Lease Policy and its practices or implementation

Article 40 of the Federal Democratic Republic of Ethiopia's Constitution states that land belongs to the country and its citizens and that any use of it must comply with strict legal regulations.

The nation's need for urban land has grown continuously and exponentially as a result of the ongoing, fast economic expansion seen in all sectors and areas. Such development necessitates the responsible and flexible management of land resources. A strong free market economy, the development of an effective, efficient, equitable, and well-functioning land and landed property market, and the creation of an open and accountable land administration system that upholds rights and obligations all depend on the underlying institutional presumptions that good governance predominates.

Overall assessment of the Urban Landholding Registration Laws:

The proclamation was made in February 2014 in compliance with FDRE constitution Article 55(2). The proclamation's preamble lists a few of the main justifications for the new urban landholding law. These are: - To fulfill Ethiopians' entitlement to build moveable property on the land in accordance with FDRE Constitution Art. Under 40(7). To address the basic institutional requirement for urban land registration in order to produce trustworthy data for the nation's economy that will be used for the necessary services, particularly to provide security for citizens' right of possession and thereby hasten the cities' social, economic, and environmental development. To minimize disputes raised related to land and immovable property through establishing transparent, accountable working system and making government

service efficient and enable the possessor to enjoy the property it develops in accordance with the law. To establish a modern, effective, and market-compatible legal framework that makes it easier to register rights, responsibilities, and restrictions pertaining to real estate and improves land and real property for the growth of a free-market economic system. To certify real property and real property rights to the possessor who develops on land and to guarantee his security of possession. When it becomes essential to put into practice legal cadastre principles, such as registering a possession, obtaining the possessor's consent during a transaction, making the registration of a possession public, and using a unique identification number to clearly identify the ownership and possessor.

2.7.2. Land administration

The institutions, procedures, and frameworks in charge of managing and regulating land and its resources are together referred to as land administration. Information regarding land, including ownership, use, value, and location data, must be gathered, maintained, and disseminated. In both industrialized and developing nations, Land Administration Systems (LAS) are an essential component of infrastructure that help with the execution of land laws and regulations. The social, legal, economic, and technological framework that land managers and administrators must function within is the focus of LAS. In addition to promoting effective land markets, these systems manage land management as a natural resource to guarantee its ongoing development.

The four land administration functions—land tenure, land value, land use, and land development are typically carried out by a variety of professions, including surveyors, engineers, attorneys, valuers, land economists, planners, and developers. The four functions differ in their professional concentration.

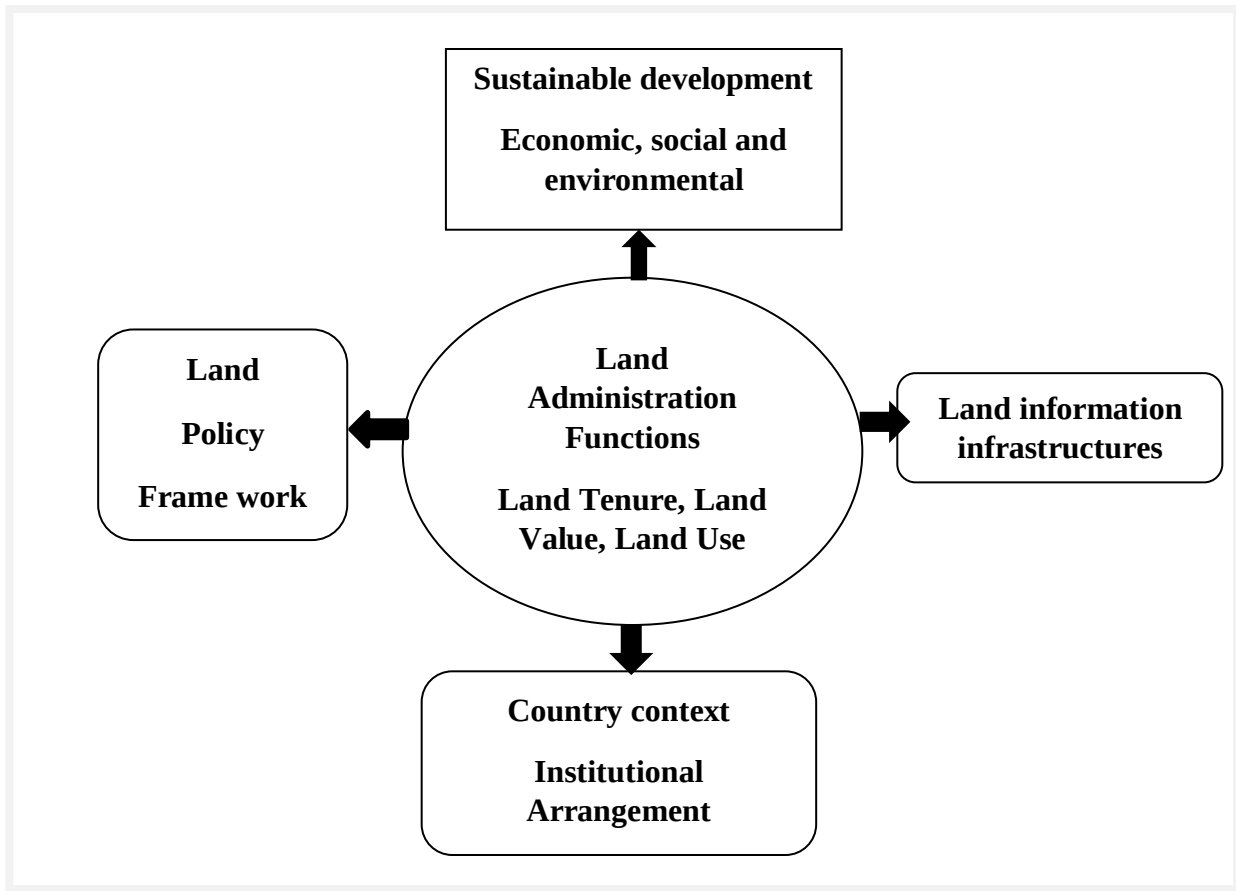


Figure 5 land management paradigm (Enemark, 2005).

2.8. The Role of Geospatial Technology for Standardizing Cadastral System

Systems because they provide accurate and effective ways to map, manage, and identify land parcels. Accurate spatial data collecting, storage, analysis, and visualization are made possible by these technologies, which include aerial imaging, remote sensing, Geographic Information Systems (GIS), and GPS. Land borders may be precisely determined by combining cadastral data with geospatial technology, doing away with the uncertainty and inconsistencies that are sometimes seen in traditional paper-based methods. Standardizing cadastral systems through the implementation of geospatial technologies enhances land governance, property rights, and supports sustainable land management practices essential for socio-economic development. GIS allows for the creation of digital cadastral maps that incorporate various layers of information such as land ownership, land use, and property boundaries, enabling authorities to maintain an extensive and up-to-date land registry. Additionally, geospatial technologies

facilitate interoperability and data sharing among different agencies, promoting transparency and reliability within the cadastral system. (Inge, V., Markwith, A., & Nagy, M. 2008).

2.8.1 Geospatial Technologies Contribute to Standardizing Cadastral Systems

The offering of accurate, up-to-date, and accurate geographic data on land parcels, boundaries, ownership, and land use in order to standardize cadastral systems. The following are some ways that geospatial technology help to standardize cadastral systems:

Accurate Mapping: Accurate mapping of land parcels is made possible by geospatial technologies such as aerial imaging, remote sensing, Geographic Information Systems (GIS), and Global Navigation Satellite Systems (GNSS). This accuracy lessens disparities and boundary disputes by helping to define boundaries and document each parcel's size.

Data Integration and Management: Using geospatial technology, it is possible to combine several datasets into a single, integrated system, including land records, survey data, satellite images, and administrative borders. The upkeep of an extensive and consolidated cadastral database is aided by this connection.

Improved Land Administration: Geospatial technologies simplify land administration procedures by digitizing cadastral data. This include keeping land records up to date, managing property taxes, facilitating transfers of land, and effectively resolving conflicts involving property.

Standardization and Interoperability: By encouraging standardization in data formats, metadata, and protocols, geospatial technologies guarantee interoperability across various cadastral management systems and stakeholders. This makes it easier for government agencies, surveyors, planners, and the general public to share and exchange data.

Monitoring Updates and Changes: Using satellite imaging and other remote sensing techniques, ongoing monitoring of land parcel changes, changes in land use, and changes in land cover aids in the regular revision of cadastral systems. It confirms that the data is accurate and up to date with respect to the current location of land parcels. **Assistance in Making Decisions:** Decision-makers may benefit from the capabilities that geospatial technologies offer for spatial analysis and visualization when it comes to planning, infrastructure management, land development, and catastrophe risk reduction. It enables decision-making by authorities based on reliable spatial data.

Transparency and Public Access: These technologies facilitate the creation of web-based cadastral systems, which provide the general public with access to maps, property information, and other land-related data. Public confidence and accountability in the land management system are strengthened by this transparency.

2.9. Empirical Literature Review

1, Evaluation Frame Work Urban Cadastral System Policy in Ethiopia;-This article aims to develop an evaluation framework to measure and evaluate the performance of urban cadastral systems in Ethiopia based on the methods that have proven successful in developed countries. The goal is furthermore to present a set of good practices and a set of indicators that can provide an objective basis to support a systematic evaluation of urban cadastral systems in Ethiopia .(Land 2020, 9(2), 60; <https://doi.org/10.3390/land9020060> Received: 11 October 2019 / Revised: 24 December 2019 / Accepted: 21 January 2020 / Published: 24 February 2020 (This article belongs to the Special Issue [Responsible and Smart Land Management](#)).

2, “Development of Cadastral Information System Using Geographical Information System (GIS): A Case of Tepi Town, South Western Region, Ethiopia.” This study stated that spatial and non-spatial queries were successfully conducted for the accomplishment of the study. Spatial data queries were performed by applying identify tools whereas the non-spatial data queries were executed by using the select by attribute of the database. Mikir Kassaw, (2019).

3, Cadastre is the basis for any land administration system (Enemark et al 2005). This study stated that Cadastral systems have been set up in different time periods (Williamson and Enemark 1996) and throughout history have had different purposes and therefore different business rules. Most of the cadastral systems are based on similar foundations but also have details which are specific to each system. In order to support this variety of business rules and slight differences in data models, a cadastral information system should be flexible. Cadastre is the basic infrastructure supporting different segments in the area of land administration and land management by improving its underlying information system all related systems will get improved (Enemark 2001). International standard ISO 19152 – Land Administration Domain Model (LADM) defines generic conceptual model for static component of land administration system. Although it defines attributes for modelling of dynamic and temporal component of

data, modelling of process for maintenance of data is outside of the scope of LADM (ISO/TC 211 2012).

4, Country Report on Cadastral System of Ethiopia. This report is focused on the cadastral system practiced in the country Ethiopia. The report gives enlightenment on the cadastral system and its purpose, its development throughout the period of time since its conceptualization, documentation and management of cadastral components/elements. Brief introduction of the country can be found on the report. The historical development of the Cadastral system in the country and its concept in the country. The type of cadastral system followed in the country and its components can be found out in this report. The different governmental and Non-Governmental organizations/institutions involved in the Cadastral system in the country can be recognized from the report. The institutional framework of the system is in given in detail. (sandesh pokhrel-37 Sanjay Shrestha-39 Binod Raj Joshi-10 S Presentation · September 2021 DOI: 10.13140/RG.2.2.29519.41122,)

5, the current state of cadastre and land registration in Bulgaria. this study stated that the objects of cadastre are clarified the necessity of information about rights, restriction and responsibilities increases in complex spatial situations. After a brief review of cadastral and land registration legislation, the possibility of future development of a 3D presentation of the cadastral objects is presented, taking into account the current state of the cadastral system in Bulgaria.

University of Architecture, Civil Engineering and Geodesy, Department of Geodesy and Geoinformatics, Sofia, Bulgaria. Necessity of 3D Cadastre and Possible Cases To cite this article: Christina Mickrenska-Cherneva and Kostadin Nikolov 2019 IOP Conf. Ser.: Earth Environ. Sci. 362 012171

6, Evaluation of Alternatives–District versus Central Cadastral Information Updating in Nepal. This study stated that a Cadastral system consists of two databases, an administrative system and a digital cadastral map. Especially for the mapping part, expensive equipment and experts are necessary (Zevenbergen and Bogaerts, 2000). To manage both spatial and non-spatial part of land information the DoLIA has targeted to establish the automated information systems at each district office.

7, 3D Modelling for Multipurpose Cadastre. the study states 3D modelling for 3D cadastre has been initiated and a concept for volume parcels introduced. The multi-purpose cadastre (MPC) must be integrated to include marine parcels and the strata and stratum condition unified. The incorporation of the National Underground Utility Database with 3D city modelling for the Malaysian MPC is on-going and initial results presented.

8, Cadastral Template 2010 (Based on the PCGIAP-Cadastral Template 2003). Land administration and registration specialist according to Gebeyehu Belay Shibeshi, 2010 or Gebeyehu.belay (at) gmail.com. The report of this study is to initial objective of the land administration system was attaining tenure security to small scale farmers. The data collected for land tenure purpose is currently used as input for tax collection and valuation for the purpose of compensation. The use of land administration data for land use planning and development is minimal so far. The contribution of the system for market is only by recording and by giving protection for land rental and lease contracts. Land is a public property and not subject for sale in Ethiopia. The cadastral mapping in Ethiopia is limited to urban areas. The urban cadastral plans are not connected to any grid and most of them are still paper based. Where as in the rural areas there are no historical maps that can be used as a base for the new cadaster. The rural cadaster is at development stage.

9, Practice of Urban Cadastral System and Its Challenges in Addis Ababa, Ethiopia. this study stated that the initial objective of the land administration system was attaining tenure security to small scale farmers. The data collected for land tenure purpose is currently used as input for tax collection and valuation for the purpose of compensation. Cadastre is the process of final and authoritative determination of the existing rights and claims of people to land. The process of adjudication should simply reveal what rights already exist, by whom they are held and what restrictions or limitations there are on them.

2.10. Flow Chart for Constructing Cadastral Map

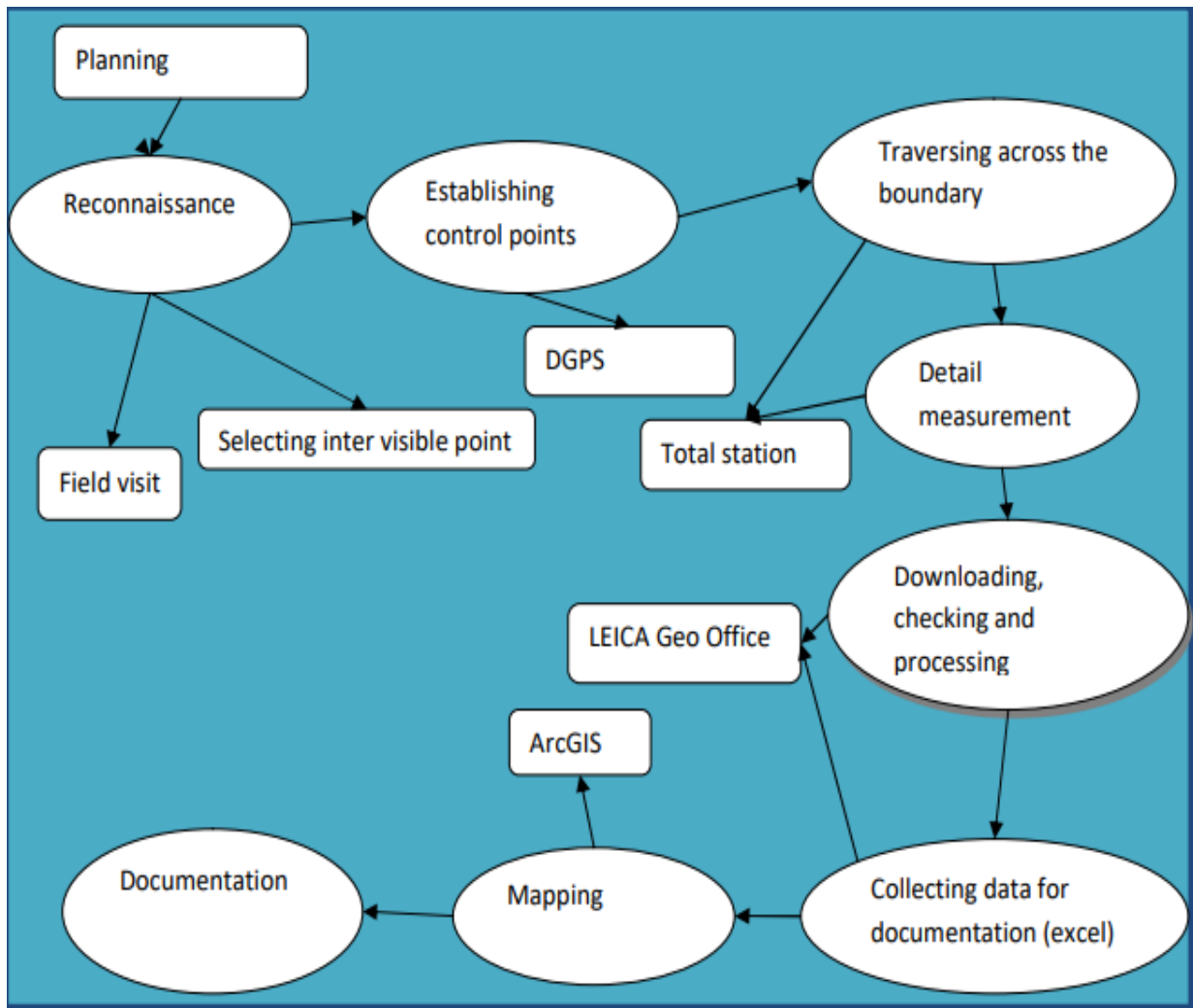


Figure 6 work flow scheme for constructing cadastral map

CHAPTER III: METHODOLOGY

3.1. Study Area

Shashemene town is selected as the jurisdiction to undertake the case study due to its evaluating cadastre implementation and the accessibility to case study data. The case study performed in-depth lead in 2D analysis of the current cadastral systems and explored the institutional and technical 3D cadastral issues.

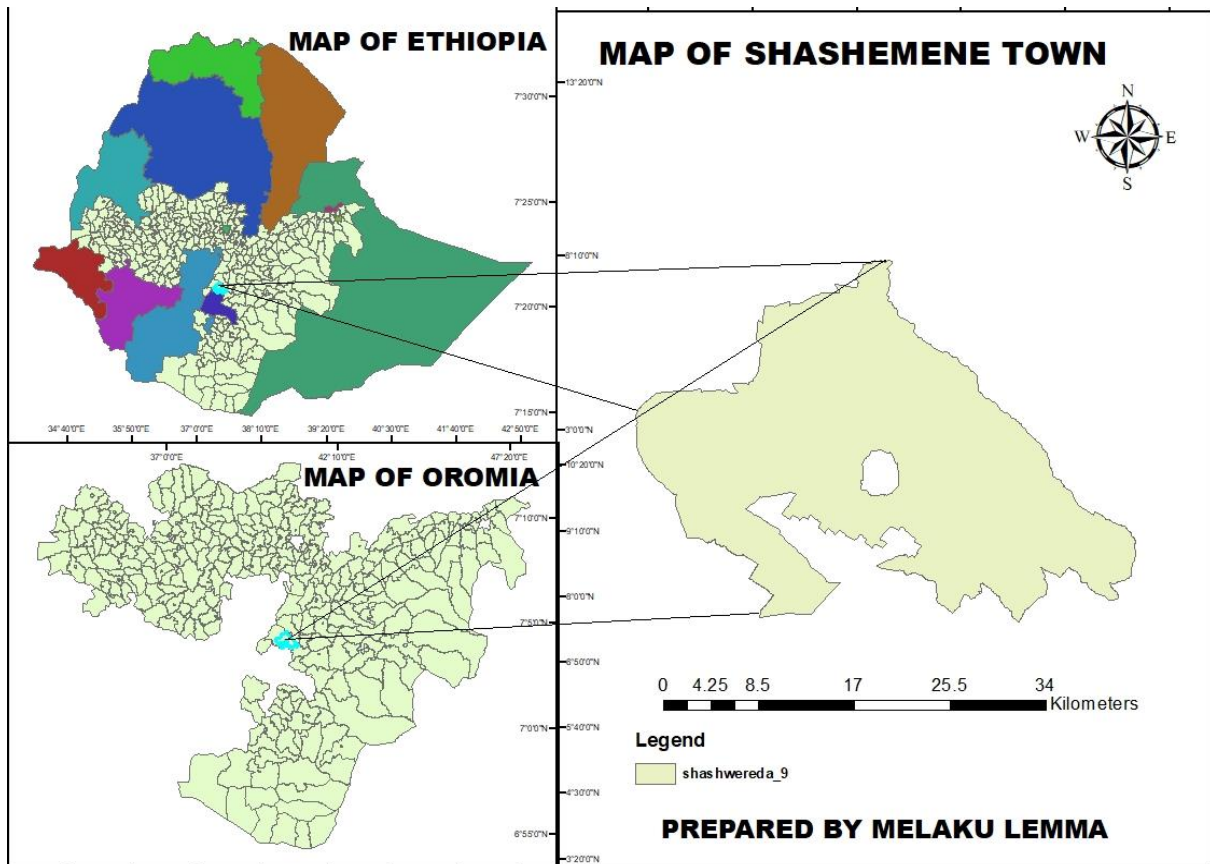


Figure 7 study area map of Shashemene city.

3.1.1. Location and Climate

Shashemene is a vibrant town located in the Oromia Region of Ethiopia. It is situated in the Great Rift Valley, surrounded by beautiful landscapes and fertile farmland. The climate in Shashemene is classified as a tropical savanna climate, also known as a dry tropical climate. The town experiences relatively consistent temperatures throughout the year, with only slight

variations between seasons. The average annual temperature in Shashemene is around 23 degrees Celsius (71 degrees Fahrenheit). Shashemene enjoys abundant sunshine throughout the year. The average annual sunshine duration is approximately 8 to 9 hours per day. However, during the dry season, the town experiences even longer sunny days, with an average of 10 to 11 hours of sunshine per day.

Shashemene is located on West Arsi Zone of the Oromia Region is located on 240KM from Finfinnee. which the coordinate is Latitude 7° 16' 59" N, longitude 38° 39' 15" E, Distance 11.0km (6.9 miles) and bearing 32.9° (SW).

3.1.2. Population and Language

The predominant clan of the Oromo people in this town are the Arsi Oromo. Afan Oromo was spoken as a first language by 45.7%, 29.23% spoke Amharic, 18.49% Welayta, 1.52% Kambaata, and 1.14% spoke Sebat Bet Gurage; the remaining 2.02% spoke all other primary languages reported. In Shashemene 208,368 Population [2022] Projection 10.74 km² Area 19,401/km² Population Density [2022] 5.0% Annual Population Change [2007 → 2022]. 208,368 Population [2022] Projection 10.74 km² Area 19,401/km² Population Density [2022] **5.0%** Annual Population Change [2007 → 2022] Shashamane: town in Ethiopia Elevation 2,008 m.

3.2. Methodology of Making Cadastral Map Preparation

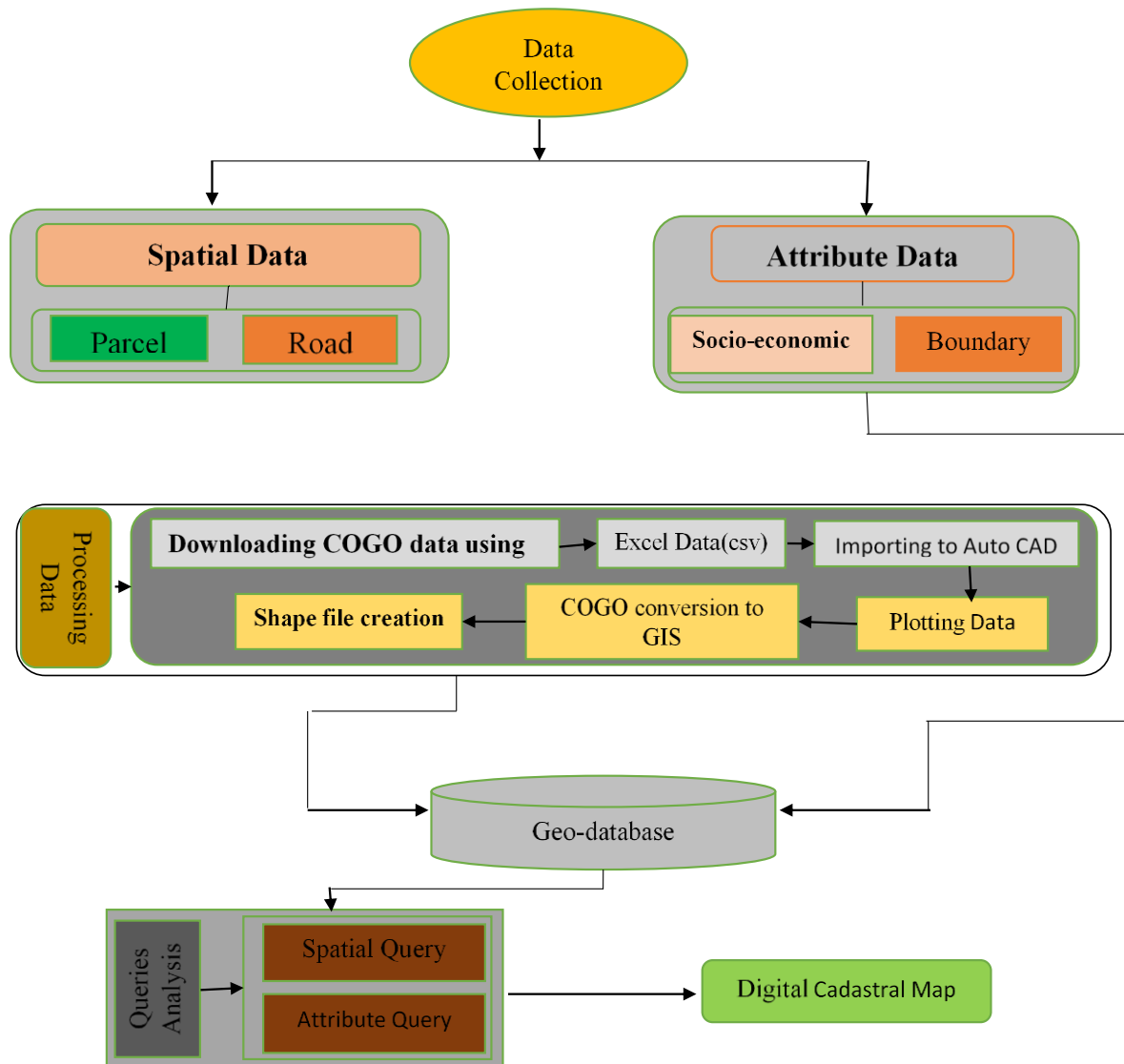


Figure 8 Technological schemes of cadastral map of Shashemene town.

3.2.1 Methods of Cadastre Data Model

The first step is gathering requirements of 3D cadaster (business analysis), The second step is developing conceptual data modeling for 3D cadaster, the third step is Developing a logical data model for 3D Cadaster, the fourth step is Developing a Physical data model for 3D

Cadaster, the fifth step is designing a 3D Cadastral database. The fifth step (designing a 3D Cadastral database which is service based linked by SQL server or Microsoft word to attach the attribute.

3.2.2. Data Obtained and Used

Table 2 data source and obtained system

No	Data source	Primary Data	Secondary Data
1	Satellite imagery and remote sensing	Desk review	Published journal
2	Local authorities and municipal records	Observation	Books
3	Theodolite, leveling, GPS, DGPS, Tape, Total Stations	Questioners	Municipal data
4	Government records and Historical Records	Land surveying	Grey literatures (reports, regulations, standards).
5	Google Earth Pro	Interview	Orthophoto and google earth image.

Additional cadastral data source (according to NSDI)

location, Amount, Pieces, legal synopsis, borders and corners, interests and interests, Value, Agent, Transaction, Restriction, and Action.

3.4. Software's Used for the work

Table 3 Using software's and their propose of used

Software	Purpose of used
Arc GIS 10.8 (ESRI)	used to analyze and interpret aerial photos, possibly offering the parcel's coordinates of the area.

AUTO CAD (Version 2007)	Plotting and exporting data in to GIS environment.
VB.NET (Version 2022)	Utilized software to acquire an object-oriented programming language for creating several data entry interfaces for the attribute data being determined.
Visio (Version 2022)	Used to model conceptual, logical and physical model of 3D cadastre.
Google Earth pro	Allows you to search specific coordinates and download geospatial data files in the KML (keyhole markup language) format for future use.
SPSS Version 27.0.1 2022	Given its statistical analytic capabilities, data management tools, and data documentation features, it may be used to construct and evaluate prediction models utilizing sophisticated methods of statistical analysis.
Microsoft excel 16 pro And Microsoft word 16 pro	Microsoft Word is a word processing program that is used for research writing, creating documents and reports, etc. MS Excel is a spreadsheet program that is used to save the collected data, to export CSV. file format to export Arc GIS.
SQL server 2022	To connect service based data base with registering plat form.

3.4.1. Conceptual data model

Conceptual design is the process of constructing a model of the information used in an enterprise, independent of any physical considerations. Conceptual data model is built using the information in users' requirements specification. The following figure shows the conceptual design of 3D cadaster data modeling in this research study.

3D Cadastral Modeling

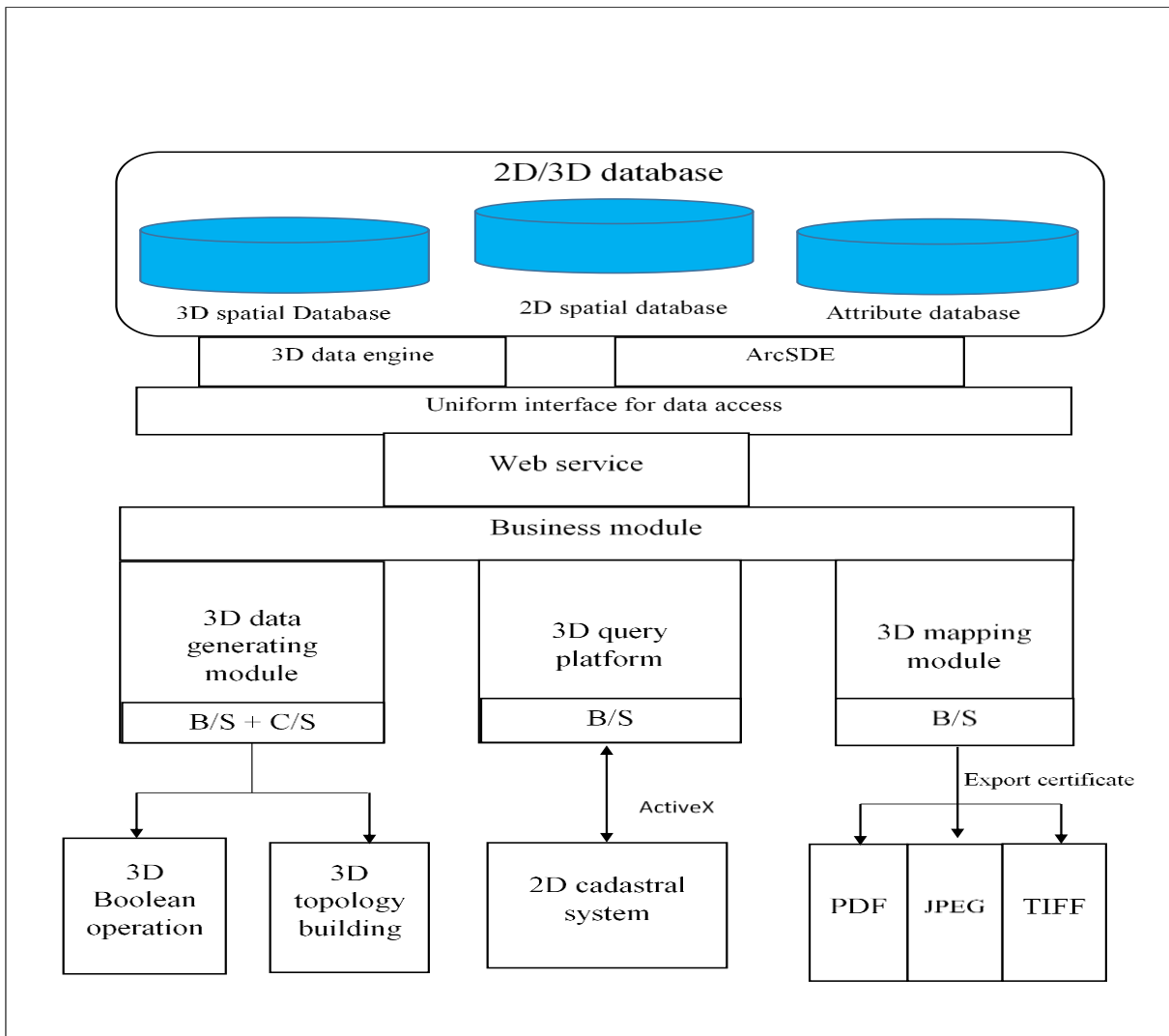


Figure 9 conceptual data model of cadastral modeling

The characteristics of every entity were determined via the inquiry and are shown in the Conceptual Design of 3D Cadaster Modeling in the above. The building, parcel, and interest holder's address were multi-valued characteristics among the previously mentioned elements. Another multi-valued attribute of the structure is its height. The remaining attributes are all single-valued.

3.4.2. Logical Data Modeling

A higher level conceptualization called logical data modeling uses a chosen data model to create the data structure. Building a model of the data utilized in an organization based on a certain

data model (such as relational, hierarchical, network, or object) without regard to a specific DBMS or other physical factors is known as logical design.

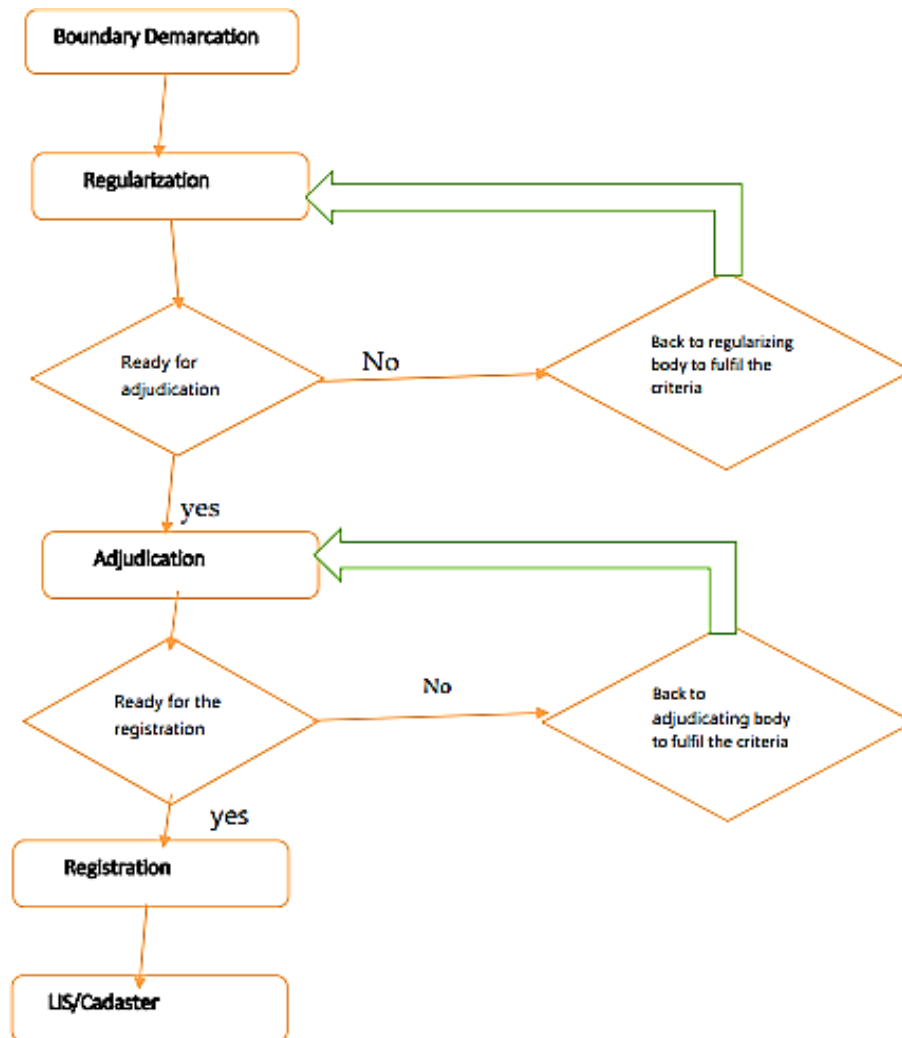


Figure 10 Logical data model for cadastral system according to Leon yen, (2023).

3.4.3. Physical data model

Physical design is the process of producing a description of the implementation of the database on secondary storage. It describes certain database access or storage techniques. A description of the database's physical design, including its tables, file structure, indexes, security, data types, and other data dictionary features, is provided by the physical design of the database.

Interest Holder Physical Data Modeling

no	Attribute	Data type	Storage unit
1	Interest holder (ID)	Integer	15
2	Name	character	20
3	address	character	50

Table 4 interest holder physical data modeling

Parcel Physical Data Modeling

no	Attribute	Data type	Storage unit
1	Parcel ID	integer	15
2	Land use	character	30
3	Coordinate	float	15
4	Address	varchar	20
5	Area	double	15

Table 5 parcel data modeling

Building physical data modeling

no	attribute	Data type	Storage unit
1	Building ID	integer	15
2	Building type	varchar	20
3	Height	Double	15
4	Area	Double	15
5	Coordinate	float	15
6	Basement	Double	15
7	Floor number	varchar	15

Table 6 building physical data modeling

Legal document physical data modeling

No	attribute	Data type	Storage
1	Legal document ID	Integer	15
2	Produced date	varchar	15
3	volume	double	50

Table 7 legal document physical data modeling

ArcGIS Parcel Data Model

The ArcGIS Parcel Data Model aims to provide parcel information to assist business sector and local government decision-making. The model may be used as a basis for GIS experts and parcel managers to define parcel information in the GIS environment and to develop migration plans from existing data designs to the new object environment.

The model's output will enable decision-makers to integrate land ownership data with other data of information. Professionals in land and GIS will be able to use the model's criteria and structure to discover representative and consistent parcel information for data distribution. The three main components of the data model are separated rights, encumbrances, and ownership.

- Ownership Parcel: a parcel is a unit of real property with rights and interests.
- Encumbrances: limitations on the rights and use of the land.
- Separated Rights: rights and interests in land ownership that can be disconnected from the primary or fee simple surface ownership.

Parcel is the only basic spatial unit of the data model and No other forms of spatial units are considered in the data model. The data model can be used for development of parcel level management and support parcel level functionality in the GIS environments. Types of rights are mineral rights, oil rights, grazing right, and fishing rights.

A land parcel represents both physical and legal objects. The ArcGIS Parcel Data Model is a broad and adaptable data model that aids users in managing land parcels using GIS. The data model supports condominium vertical parcels, but does not employ 3D primitives to represent the vertical parcels.

3.5. Theoretical Framework

The research applied desk review, case study and Survey research methods. The desk review focuses on exploring and looking into existing literature on cadastral systems performance evaluation. Case study was used to get real-life situations and better understandings into the detailed actions of cadastral system. The research has benchmarked Connel, J.P.(1995) theory of change to guide the overall theoretical aspect of cadastral systems. Given that the origin of

the theory of change lies in the field of monitoring and evaluation, it is an adequate framework for an urban cadastral system performance evaluation in order to determine how much of the intended result of a given intervention is achieved as a result.

The performance of the urban cadastral system is measured and assessed in-depth using the EFQM Excellence model as an analytical tool. The intervention criteria assesses what and how an organization acts in reaction to reaching its desired goal. Leadership, strategy, people, resource and partnership, and process are the enabling interventions that, when properly used, help the company reach its goal. These facilitators and the results are considered independent and dependent variables for the purposes of analysis, respectively, and may be quantified using the cadastral systems concept. Every criterion has a weight of its own that must be considered.

Every criterion added together amounts for the overall weight of 100%. As a result, the logic model a predicted explanation of the series of causes and effects culminating in an outcome of interest and the general procedures of the theory of change both adhere to a relationship between cause and effect. It illustrates how actions taken by organizations and their desired outcomes relate to one another. In the assessment of an urban cadastral system, organizational results (business results) are benchmarked as organizational accomplishments, while enablers (policies and strategies, leadership, excellence of professional abilities, partnerships, and results) are benchmarked as enabling needs.

3.6. Research Approach

As the research is an evaluative research, it involves evaluation of different alternatives based on EFQM. The parameters used for the evaluation are both qualitative and quantitative. The various methods employed in this research. The research was undertaken following three steps: 1) Gathering preliminary data and secondary data, 2) data collection, 3) data analysis and 4). Creating plat forms to make registration easy and digital form. During the preliminary data gathering, field visits, FGD and observation methods were employed to collect initial information that could help outline the overall theme of the dissertation. Furthermore, target respondents who could be suitable candidates for the data collecting instruments (questionnaires, interviews, physical observation, and focus group discussions) might be selected. Besides these duties, policy papers, scientific publications, and reports were analyzed

to inform the concept of the research. Distinguishing between the evaluation of the 2D and 3D cadastral methods. The actual data collection was carried out utilizing data collecting instruments from the case study sites after general information was obtained from targeted respondents. The gathered data was then subjected to qualitative and quantitative analysis and interpretation, along with the adding of new plat forms for the registration and cadasteral mapping of specific study areas.

3.7. Research strategy or work flow

This is a method for describing the data to be collected and the tools to be used. Case studies, desk reviews, surveys, experiments, and archive analysis are a few examples of research methodologies. The form of research problem or research questions determines which tactics to use. Therefore, both case study, surveying, and desk review procedures were used, depending on the qualitative and qualitative character of this research as well as the data to be obtained. The goal of the desk review was to gather useful and relevant data on the problems with the cadastral system, whereas the case study focused on understanding current phenomena.

3.8. Sampling Technique and Sample Size

Sampling is the method of choosing certain individuals or a subset of the population in order to estimate statics of the entire population and draw statistical conclusions from them. As a result, the purposive sampling approach is utilized in this study, where a research uses judgment to select study participants from a community. When particular respondents are required to answer the questions, this kind of sampling approach is employed. Because of this, the study requires both public participants and responders with a certain professional experience who are best suited to reply to the research questions. In order to ensure accuracy of inferences and the study's ability to draw conclusions, the sample size was established using Yamane's (1967) sample size calculation (see Eq. 1). Using this formula, the sample size was calculated to be 100 participants as respondents for the questionnaire. In addition to this, 8 interviewees and 8 FGDs for part I; 10 interviewees and 10 FGDs for part II &III; and 17 interviewees both from public and private sectors were included in the analysis.

$$n = \frac{N}{1+N(e)^2} \dots\dots\dots q. 1$$

Where, n = The sample size to be determined

N = Population size, which in this case 242

e = Level of precision or sampling error, which is $\pm 5\%$

Tasks	Methods of analysis	Validation technique
Task 1	Qualitative (thematic analysis)	Method to method (interview with FGDs) Literature comparison and person to person triangulation.
Task 2	Qualitative(thematic analysis)and qualitative(ordinal regression)	Method to method (among questionnaires, interview and FGDs) literature comparisons and person to person triangulation.
Task 3	Qualitative (thematic analysis)	Method to Method (among personal observation, interview and FGDs, literature comparisons and person to person triangulation.
Task 4	Qualitative (thematic analysis)	Method to method (among personal observation, interview and FGDs, literature comparisons and person to person triangulation.

Table 8 Methods of data analysis and validation Technique.

CHAPTER: IV ANALYSIS AND RESULT

4.1. Statistical Methods

After the necessary data collection, the degree of internal consistency between a groups of items (questions) was assessed using Cronbach's alpha. The data was validated and reliability checked using Cronbach's alpha, which guarantees that each respondent's response was consistent or not. Techniques for both qualitative and quantitative data analysis are used, depending on the data that was gathered. Regression modeling is employed in the quantitative analysis to look at how much the dependent variable is influenced by the dependent variables.

To determine which variable has more effect, the correlations between the independent variables were also examined. Qualitative descriptions were made of the information gathered through open-ended focus groups, questionnaires, observations, and interviews. The results were validated using Cronbach's alpha in SPSS to ensure that the information gathered is accurate, consistent, and valuable for its correctness and reliability versus respondents. The alpha coefficient for this study is 0.883, suggesting that the items have relatively high internal consistency. A reliability coefficient of 0.70 or higher is considered “acceptable” in most research studies. After ensuring that the data reliability was correct and certain, Equation (1) was used to calculate the overall organizational achievement of the cadastral system. The equation represents the influence of independent variables X on the dependent variable Y, which is a fundamental concept in ordinal regression.

$$Y = \beta_0 + \beta_1 X_1 W_1 + \beta_2 X_2 W_2 + \dots + \beta_n X_n W_n \dots \dots \dots (1)$$

Where Y is the dependent variable (overall organizational performance), β_0 is the intercept, β_n is coefficients (estimates), X_n is the mean value of independent variables, and n refers to the number of independent variables, which in this case is 9. The intercept for ordinal regression model is zero since it starts from the origin.

Basic descriptive statistical information about the response statistics. The minimum and maximum numbers are bounded between 1 and 5 to represent level of satisfaction. The Mean describes the average of the responses; median explains the value separating the higher half from the lower half of a response, while the mode explains the number that appears most frequently.

4.2. Evaluated cadastral system by EFQM excellence model using SPSS software

Table 9 Response statics of the respondents (n=100)

		Statistics								
		strategy	leadership	people	resource_part eneship	process	people_result	customer_res ult	societal_resilt	organizational _result
N	Valid	1	1	1	1	1	1	1	1	1
	Missing	0	0	0	0	0	0	0	0	0
Mean		100.000000	100.000000	100.0000000	100.000000	100.000000	100.000000	100.000000	100.0000000	100.000000
Median		100.000000	100.000000	100.0000000	100.000000	100.000000	100.000000	100.000000	100.0000000	100.000000
Mode		100.0000	100.000	100.00000	100.0000	100.000	100.0000	100.0000	100.00000	100.0000

Table 10 Descriptive evaluation value

Descriptive Statistics										
	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness		Kurtosis	
Policy and Strategy	10	3.00	2.00	5.00	3.2000	.91894	.601	.687	.396	1.334
Leadership	10	2.00	2.00	4.00	3.1000	.73786	-.166	.687	-.734	1.334
People	10	4.00	2.00	6.00	4.4000	1.57762	-.195	.687	-1.835	1.334
Resource_Partenership	10	2.00	2.00	4.00	3.1000	.73786	-.166	.687	-.734	1.334
Process	10	3.00	2.00	5.00	3.8000	1.03280	-1.029	.687	.485	1.334
People_Result	10	2.00	2.00	4.00	2.5000	.70711	1.179	.687	.571	1.334
Custemor_Result	10	2.00	1.00	3.00	2.4000	.69921	-.780	.687	-.146	1.334
Societal_Result	10	2.00	2.00	4.00	3.1000	.73786	-.166	.687	-.734	1.334
Valid N (listwise)	10									

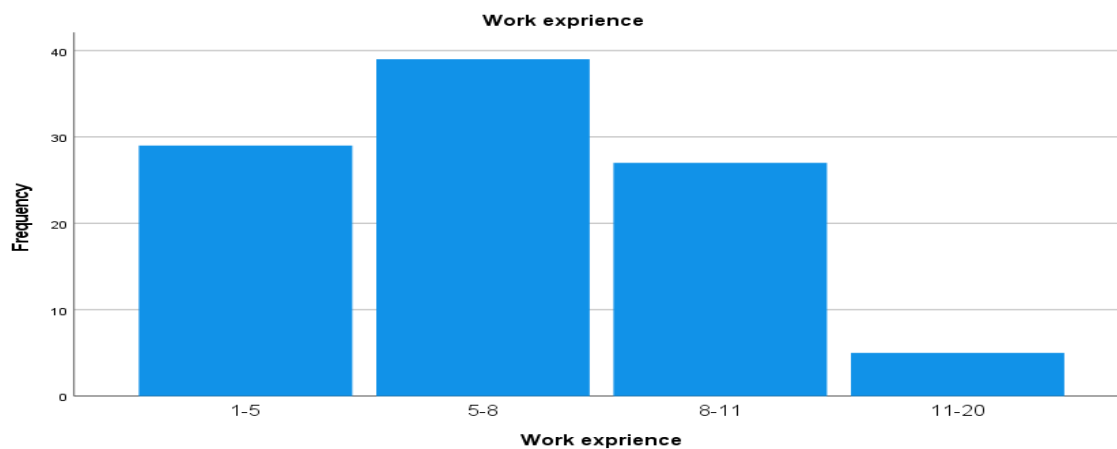


Figure 11 work experience

Table 11 Performance Evaluation

		N	%			N	%
POLICY AND STRATEGY	Poor	2	20.0%	RESOURCE AND PARTENERSHIP	poor	6	60.0%
	Fair	5	50.0%		fair	3	30.0%
	Good	2	20.0%		good	1	10.0%
	Very Good	1	10.0%	PROCESS	very poor	1	10.0%
LEADERSHIP	poor	2	20.0%		poor	4	40.0%
	fair	5	50.0%		fair	5	50.0%
	good	3	30.0%	PEOPLE AND RESULT	poor	2	20.0%
PEOPLE	poor	1	10.0%		fair	5	50.0%
	fair	3	30.0%		good	3	30.0%
	good	1	10.0%	CUSTOMER AND RESULT	poor	2	20.0%
	very good	1	10.0%		good	6	60.0%
	excellent	4	40.0%		very good	2	20.0%
SOCIETAL RESULT	poor	2	20.0%				
	fair	5	50.0%				
	good	3	30.0%				

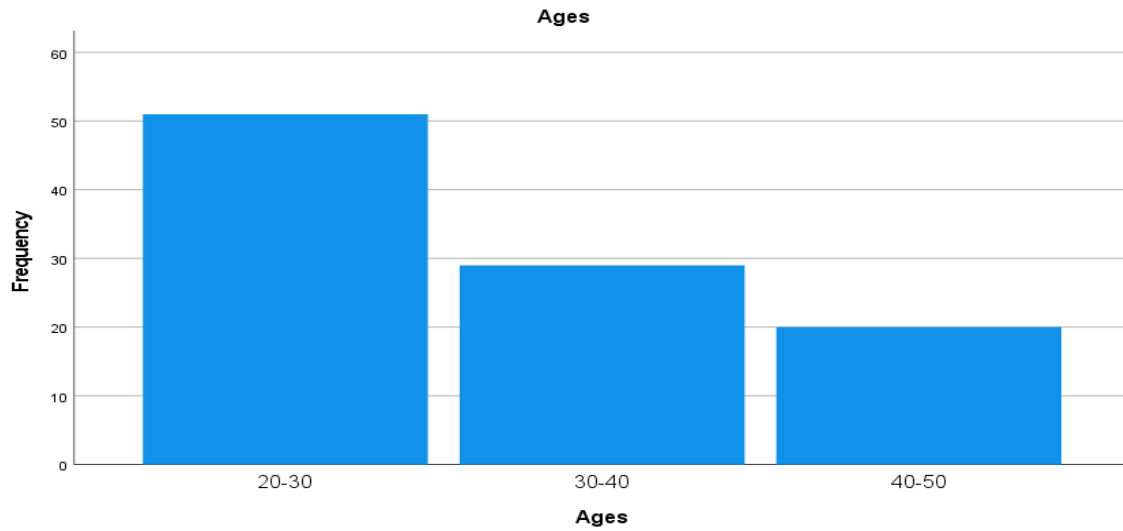


Figure 12 age variance frequency

3.2. Frequency Table of analysis

Table 12 frequency analysis

Statics			Ages	Work experience	Qualification	Marital status	Background study
MARITAL STATUS	Valid		1		1.0	1.0	1.0
		Married	45		44.6	44.6	45.5
		Single	55		54.5	54.5	100.0
		Total	101		100.0	100.0	
BACKGROUND STUDY	Valid		1	1.0	1.0	1.0	
		Geomatics	36	35.6	35.6	36.6	
		Surveyor	41	40.6	40.6	77.2	
		Civil	23	22.8	22.8	100.0	

		Total	101	100.0	100.0	
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4.3. Assumptions of Ordinal logistic regression model

Given one or more independent variables and an ordinal dependent variable, ordinal logistic regression often simply referred to as "ordinal regression" is used to predict the latter. To validate this model, four presumptions must be met.

1. The ordinal level is the appropriate measurement for dependent variables.
2. Independent variables must be treated as either continuous or categorical, they cannot be treated as ordinal variables.
3. At least two independent variables that don't need to have a strong correlation with one another (multicollinearity).
4. The effects of every independent variable are the same for every cumulative split of the ordinal dependent variables.

Regression model fitting information: An ordinal regression model was used to extract relevant data from the questionnaire as the answers were gathered in the form of order (rank) using a Likert scale. Five requirements must be met for this kind of regression model.

Model fitting: this is the measure of how well the model fits the data. The significance level of alpha is 0.05, which limits the level of significance value. The result from this model is 0.00 (See Table below), which is less than the common alpha level of 0.05, which indicates that it is statistically significant, telling that the model gives better predictions. The statistical significance indicates that changes in the independent variables (enablers) correlate with shifts in the dependent variable (organizational performance).

Goodness of fit: A statistical model's goodness of fit indicates how well it fits a given set of data. A measure of the model's goodness of fit usually provides an overview of the differences between the observed and anticipated values. The goodness of fit (Pearson) significance value is 1 (see Table 13), which is higher than the standard alpha threshold of 0.05. This means that the model fits the data rather well and is statistically significant.

Model Fitting Information				
Model	−2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	485.218			
Final	309.316	175.902	43	0.00
Link function: Logit.				
Goodness-of-Fit				
	Chi-Square	df	Sig.	
Pearson	558.504	851	1.00	
Deviance	309.316	851	1.00	
Link function: Logit.				
Pseudo R-Square				
Cox and Snell		0.690		
Nagelkerke		0.719		
McFadden		0.363		
Link function: Logit.				
Test of Parallel Lines ^a				
Model	−2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	363.724			
General	338.524 ^b	25.200 ^c	40	0.967

Table 13 Assumptions of Ordinal logistic regression model.

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories. A Link function: Logit. B The log-likelihood value cannot be further increased after maximum number of step-halving. C The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.

Pseudo R2: The pseudo R2 statistic represents the proportion of the variance in the dependent variable (organizational performance) that can be explained collectively by the independent variables (enablers). When the dependent variable, in this example 0.719, is explained by 70% of the independent variables, the R2 (Nagelkerke) value is larger than 0.7.

Test of parallel lines: this test is based on the proportionate odds assumption. In ordinal regression, this is a fundamental premise. It is assumed that the effects of any explanatory factors are proportionate and constant across the various thresholds (the divides between each pair of categories in your ordinal outcome variable are referred to as thresholds). Put another way, that regardless of the threshold, the explanatory factors have the same effect on the odds.

4.4. The Evaluation of 2D Cadastre and 3D Cadastre

Terms	2D Cadastre	3D Cadastre
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Definitions	The 2D Cadastre is usually represents property borders and land parcels on a flat plane, similar to a map. It offers fundamental data including land area, boundaries, and ownership details. When it comes to complicated properties or situations where value is greatly impacted by vertical features (such as height or volume), 2D cadastre-based valuation is less accurate.	3D cadastre is a digital representations of real property ownership rights, restrictions, and responsibilities (legal objects) and their corresponding physical objects such as buildings, utilities, on, above or under the ground surface. 3D cadaster provides a more accurate and comprehensive representation of land parcels, buildings, and infrastructure, facilitating better visualization and understanding of complex property structures. It uses to see the vertical dimension of properties, which is particularly useful in urban areas with high-rise buildings and underground structures.
dimensionality	Addresses the two-dimensional representations of land parcels, focusing areas, borders, and ownership rights on flat terrain.	Includes three-dimensional features of land parcels that are important for building information modeling (BIM), infrastructure development, and urban planning, such as volumes, heights, and spatial relationships.
Complexity and precision	Providing basic information about land parcels, it is suitable for the cadastral operations and land management.	Provides more accurate and detail information, which is crucial for intricate urban settings, underground utilities, and multi-level strictures.

Applications	Mostly used for basic land use planning, taxes, and land registration.	Enables 3D city modeling applications such as environmental planning, disaster management, 3D city modeling, and mapping of underground utilities.
Data representation	Represents land parcels as polygons on a flat plane, often with attribute data like ownership details.	Represents land parcels as volumetric objects with additional attributes related to height, volume, and 3D spatial relationships.
Technology And tools	Relies on traditional GIS (Geographic Information System) tools and mapping techniques.	Utilizes advanced technologies like LiDAR (Light Detection and Ranging), BIM software, and 3D modeling tools for data collection, processing, and visualization.

Table 14 evaluating 2D and 3D cadastre of the study area.

4.5. SWOT Analysis of Cadastral System in Ethiopia

No	SWOT Analysis	Results
1	Strength	1. Increasing digitization: The cadasteral system is becoming more digital over time, which can increase accessibility and efficiency. 2. Increased accuracy: Land records can be more accurate thanks to digital mapping and surveying technology. 3. Support from the government: The Ethiopian government has demonstrated a commitment to enhancing the cadasteral system, acknowledging its significance for economic growth. 4. Potential for revenue generation: A well-functioning cadasteral system can lead to increased revenue collection through property taxes and land transactions.

2	Weakness	1) Limited coverage: Not all parts of Ethiopia are covered by the cadastral system, which can cause issues over unregistered land. 2) .Data quality: Outdated or erroneous information in the cadastral system may give rise to administrative and legal issues. 3. Lack of knowledge: Low participation rates may result from residents' ignorance of the significance of registering land. 4. Institutional capacity: The cadastral system may not be adequately managed and maintained by government agencies.
3	Opportunity	Technological developments: The cadastral system's accuracy and efficiency can be improved further by continuous technological developments. Public-private partnerships: Working together with companies in the private sector can facilitate the administration and digitalization of cadastral data. Legal reforms: By making land registration rules easy to understand, more people will be encouraged to register their land. International support: Funding and technical aid for enhancing the cadastral system provided by international organizations and donor agencies.
4	Threat	Political instability: Efforts to enhance the cadastral system and promote investment in the field could be by instability in politics. Land conflicts: Unresolved land disputes have the potential to cause societal instability and damage the cadastral system's validity.

		Corruption: Efforts to improve the cadastral system undermine by corruption within the land administration system. Environmental challenges: natural disasters and climate change have the potential to harm land records and interfere with the cadastral system.
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Table 15 Cadastral System SWOT Analysis.

4.5.1. Result of developing cadastral system using GIS and real property registration system

The study on the development of cadastral information system at Shashemene town was carried out by performing spatial and non-spatial queries in GIS environment. In this study the factors necessary for cadastral information system were reviewed and incorporated with ground survey, an interview with tenants and municipality. According to Babalola, S. O. & Kardam, M. S. (2011). Stated that, queries were generated for retrieval and displaying of parcel information. By the help of this system, different analysis was performed by generating queries from the database table with the use of selection tool in Arc Map environment.

4.6. Spatial Query Analysis

According to Wunderlich, A.L. (2012). His explanation states that geographic data are essential to the creation of geodatabases and to the speedy resolution of spatial queries, which would otherwise be extremely challenging or time-consuming to solve. The details about the parcel and its description are identified in this study using the Identify Tool. This was carried out. Select the desired tool from the 'Tools' toolbar. Next, locate and click on the parcel containing the attribute the user want to look over. A dialog box will automatically popup in the center of the screen, so that it appears different from the rest.

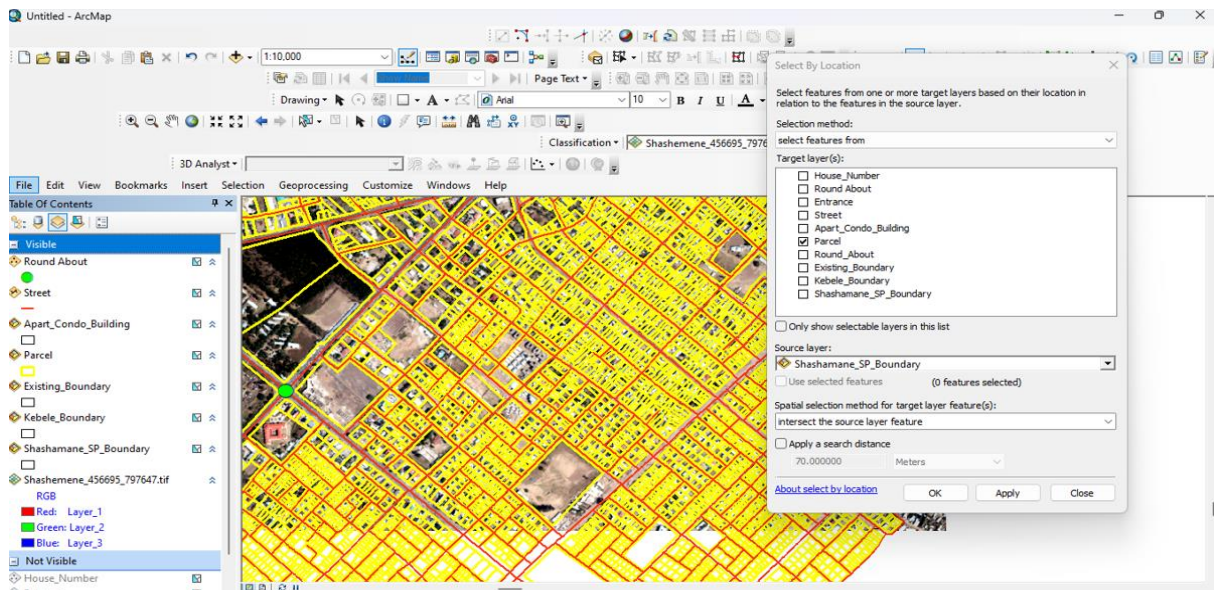


Figure 13 select by attribute dialogue box in arc Map.

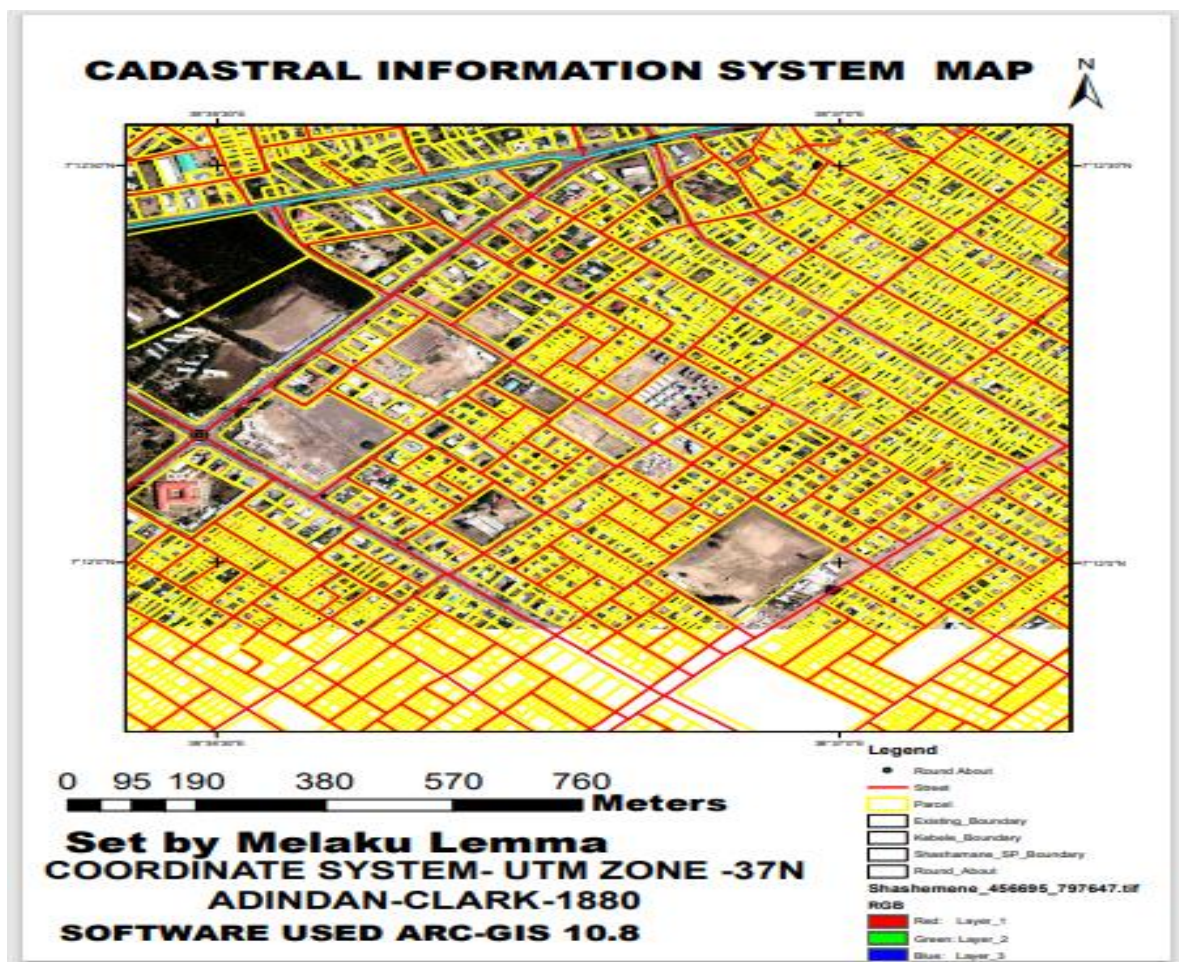


Figure 14 Map of cadastral information system some areas of Shashemene city

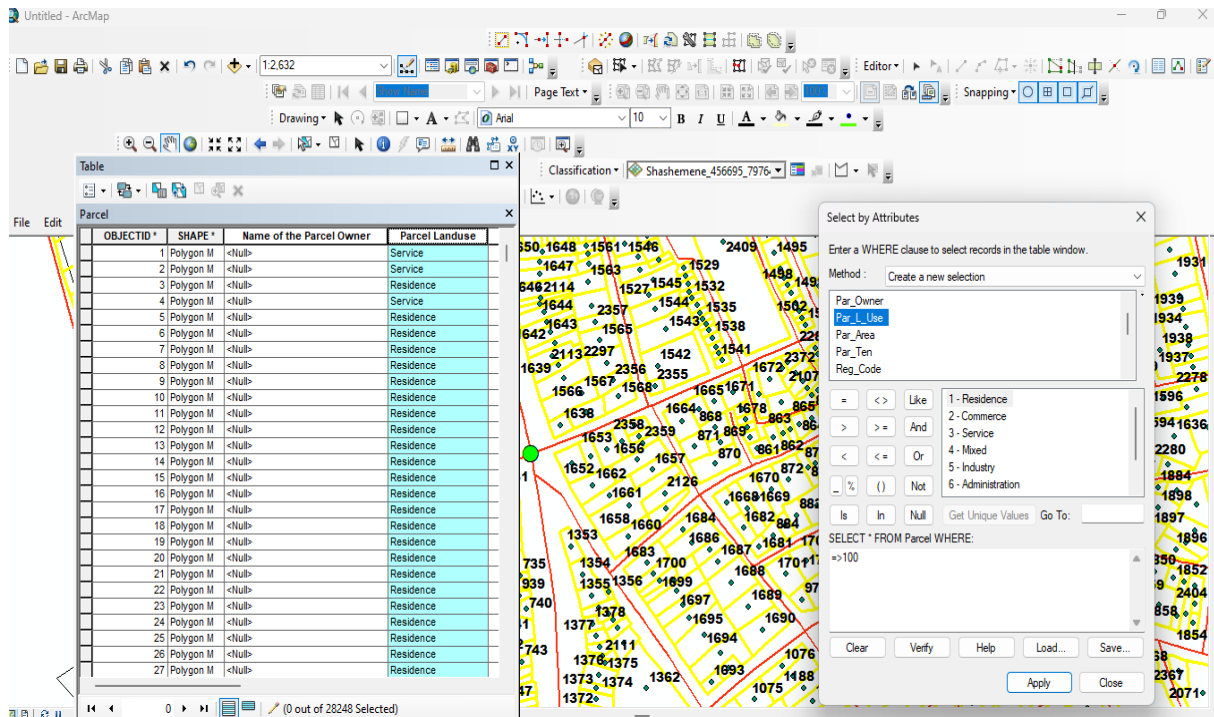


Figure 15 Attribute table of a parcel part of the study area

4.7. Results of Creating Login Platform for the Registration System

Figure 16 Login plat form for cadastral system registration

The screenshot shows the 'SHASHEMENE TOWN CADASTRAL SYSTEM LOGIN PLAT FORM' window. It features a user profile picture on the left. The login fields are as follows:

- User Name**: A text input field.
- password**: A text input field with a 'show password' checkbox below it.
- Login**: A yellow button.
- Cancel**: A red button.

Figure 17 Ownership information plat form

SHASHEMENE TOWN 3D CADSTRAL LOGIN PLAT FORM

Owner Information

Owner ID

First Name

Middle Name

Last Name

Region

City

Gender

Nationality



[Sign In](#)

Figure 18 Building information plat form

SHASHEMENE TOWN CADASTRAL REGISTRATION FORM

BUILDING INFORMATION



Building ID

Building Type

Region

City

Kebele

Area

Floor Number

Coordinate X

Coordinate Y

Coordinate Z

CHAPTER: V CONCLUSION AND RECOMMANDATION

5.1. Discussion

This study proved that cadastral information systems are able to generate precise computer-aided cadastral maps. It has been shown that CIS is capable of handling substantial amounts of both spatial and non-spatial data. It was completely modified to make quick and accurate decisions on land problems, which are among the essential components required for any organization's economic success. In order to assist the relevant agencies responsible for managing land records more effectively, the implementation of an automated cadastral information system will be beneficial.

This CIS has also given the authority an opportunity to make some typical analysis in the assessment of land use, as well as building code violations; the sale transaction of a particular parcel or for the whole block; and the assessment of property for issues of planning permission. Finally it can also evaluate the cadastral system of Shashemene town serve as an interactive means of land information for immediate and ready extraction of plot-wise details through the multi-query facility that was provided in the database which allow any individual user to gather information regarding land holding.

The EFQM Excellence Model is predicated on the logical that better outcomes stem from excellence in enablers. Accordingly, leadership influences policy and strategy, people management, partnerships and resources, and all three aspects have an impact on results through appropriate processes. EFQM, (accessed on 30 October 2019).

As a quality model, the EFQM Excellence Model clarifies the areas that the company should take into account as input to enhance its outcomes and the result indicators that must be met through its enabling criteria. In this sense, the EFQM Excellence model offers a pattern of connections between the criteria and results as well as between enablers and results. According to empirical data, there are important connections between the outcome elements, with one level's results influencing another's. Oakland, J.S.; Oakland, S. and Sadikoglu, E.; Olcay, H, (2014).

The excellence model assumes that customer results, people results, and society results will, together, ultimately infer organizational performance. Research on the Land 2020, of 14 relationship between enablers and results indicates that weaknesses in leadership can affect people, customer, societal, and key organizational results. Eskildsen, J.K.; Dahlgard, J.J. (2000).

5.2. Conclusion

This paper's goal is to evaluate the cadastral information system using standardized scientific criteria, utilizing Shashemene Town as a case study and the EFQM excellence model as a foundation. The research's main concept is that cadastral data serves as the foundation for land tenure, land-use planning, property valuation, and land development.

Cadastral information offers Accurate land parcel inventories, a true and accurate description of the legal status of land rights, a standardized database for public land management, the basis for taxation and valuation, and proof of ownership in court cases are all provided by cadastral information. In light of these and other relevant land administration and management functions, the research helps stakeholders in land administration. The EFQM, an international performance evaluation paradigm, served as the framework for this investigation. This empirical study uses primary data from in-person observations to examine Shashemene Town's urban cadastral system. It can therefore be considered literature within the scientific community. The research will help those involved in land administration and management (government agencies, non-governmental organizations, the commercial sector, etc.) by bringing to light the experiences of Shashemene City's urban cadastral system. However, the study finds that both spatial and non-spatial data's. Were effectively performed to achieve the study's objectives. While non-spatial data searches were carried out using the database's select by attribute, spatial data inquiries were carried out utilizing identify tools. The cadastral system A strong instrument for gathering, storing, retrieving, processing, and presenting geographical data from the actual world without losing the data is a geographic information system (GIS). The technology is so broadly applicable that it makes it simple to save and retrieve data about cadastral holdings by simply querying any area of interest.

5.3. Recommendation

The present Cadastre offers several advantages over the previous one, including increased government commitments, resource and technology transfers, capacity building trainings, and a legal framework. However, the legal cadastre implementation process is moving extremely slowly, and in certain zones and woredas levels, no preparations are being made. As a result, the federal minister of urban development and construction ought to focus more on monitoring areas, zones, and woredas and set aside funds for resource and technology transfer trainings.

At Shashemene city, files are organized very well but in other kebeles and wordas files are found in insecure places, files are damaged, corrupted and disappears such as in Awasho sub city and Kuyera sub-city. Therefore, the regional concerned body should take action in order to secure the files.

Oromia region offers strongly thorough short- and long-term cadastral and land management trainings, but only after the training. After leaving their home institutions, trainees remain without using their newly acquired abilities to perform everyday activities.

To maintain in high quality, there should be an appealing workplace with intensives. Various institutional setups exist in various regions. Better possibilities, work environments, and salary variations result from this. To maintain high official and expert turnovers, the same institutional architecture should be put in place.

During ground surveying measurement, many regions using low cost instruments with bad accuracy levels. The researchers recommend to apply and use very accurate surveying instruments since this legal urban cadastre expected to bring good governance and minimized land related conflicts.

A careful evaluation was conducted on various land proclamations, laws, regulations, directives, and standards. From Literature Review: Despite vertical development, Ethiopia does not have 3D legislation. For the purpose of implementing 3D cadastering throughout the country, I advise the governments to establish 3D urban land law proclamations, rules, regulations, standards, and directives. The task of adopting 3D cadasters in cities is not the responsibility of several organizations, including Urban Land Development and Management, Urban Land Holding Adjudication and Registration, Urban Planning Institute, and Urban Land

Information Project Coordination Office. As a result, I suggest Shashemene City establish an organization that uses 3D cadavers. Two ways exist for recommending such an institution: Restructuring the current institution or Establishes a new institution that can implement 3D cadaster.

Developing a Comprehensive and Up-to-Date Land Information System: Establishing a modern cadastral system requires integrating digital tools to maintain accurate and current land records. This system should be capable of handling various land-related data, including tenure, value, use, and development.

Enhancing Institutional Capacity: There is a need to build the capacity of institutions responsible for land administration. This includes training personnel, improving infrastructure, and ensuring that the organizations have the necessary resources to perform their duties effectively.

Implementing Clear and Uniform Procedures: The cadastral system should have standardized procedures for land registration, surveying, and record-keeping. Clear guidelines and regulations can help reduce ambiguities and improve the efficiency and reliability of land transactions.

Improving Public Awareness and Participation: Educating the public about the importance of a cadastral system and how to use it can lead to better cooperation and compliance. Public participation in cadastral processes can also help ensure that the system meets the community's needs and concerns.

Strengthening Legal Frameworks: Updating and enforcing legal frameworks related to land administration can provide a solid foundation for the cadastral system. This includes laws that protect land rights, ensure transparency, and address disputes effectively.

Utilizing Technology and Innovation: Leveraging Geographic Information Systems (GIS) and other technological advancements can significantly improve the accuracy and accessibility of cadastral data. These technologies can help in mapping, data analysis, and providing user-friendly interfaces for stakeholders.

Ensuring Sustainable Financing: Sustainable financing mechanisms should be established to support the ongoing maintenance and improvement of the cadastral system. This might include government funding, fees for services, or public-private partnerships

National structure of urban landholding registration institution (uniform structure) has been established within the context of wider national strategy to have an integrated parcel based land information database despite the constitutional principle of division of power under the federal structure of the FDRE government.

Registration of land is not an end by itself rather it is a means to an end. Therefore, should not be considered as land administration aspect which is given to regions under the FDRE constitution based on division of power.

Currently, Oromia region are given to establish their own regional urban land registering institution which is totally in contrast with the idea of establishing national integrated land information database centrally. Maintaining uniform or universal criteria in the use of legal cadastre registration would be challenging. Regions have to decide on staffing levels, organizational capabilities, budgetary constraints, and organizational structure. Such that regional differences will exist, which will cause issues with the consistent application of the legal cadastre. Empirical evidence suggests that there is currently no established shared integrated database center.

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Appendixs

Appendix A.

Evaluation Criteria of the Cadastral System Organization Within the framework of the EFQM excellence model, nine criteria were developed and distributed to the respondents in the form of Likert scale questions. The concept behind this research is that people results, customer results, and societal results are achieved through leadership-driving cadastral policy and strategy, people, partnership and resources and processes, which leads ultimately to excellence in cadastral organizational performance achievements. There are included sub-criteria, though broad questions are only presented here.

1. Leadership: how do leaders develop mission and vision, and implement them via appropriate plans for urban cadastral system organization?
2. Strategy: does the urban cadastral system organization implement their mission and vision by developing a stakeholder focused strategy?
3. People: does the urban cadastral system organization value its people and create a culture that allows the mutually beneficial achievement of organizational goals?
4. Partnership and resource: how does the urban cadastral system organization plan and manage external partnerships, suppliers, and internal resources in order to support their strategy, policies and the effective operation of processes?
5. Process: does the urban cadastral system organization design, manage, and improve processes to generate quality services for customers and stakeholders?
6. People results: does the urban cadastral system organization achieve and sustain outstanding results that meet or exceed the needs and expectations of their people?
7. Customer results: does the urban cadastral system organization achieve and sustain outstanding results that meet or exceed the needs and expectations of their customers?
8. Societal results: does the urban cadastral system organization achieve and sustain outstanding results that meet or exceed the needs and expectations of relevant stakeholders within society?
9. Organizational results: does the urban cadastral system organization achieve and sustain outstanding results that meet or exceed the needs and expectations of their business stakeholders?

Part II: Demographic Information

Instruction: Please put “√” mark to all your responses in the box provided beside each question.

1. Gender: ☐ Male ☐ Female
2. Marital status: ☐ Un-married ☐ Married ☐ Divorced ☐ Other
3. Age: ☐ 20 – 30 ☐ 31 – 40 ☐ 41 – 50 ☐ 51 – 60 ☐ Above 60
4. Educational Level: ☐ PhD ☐ Master’s Degree ☐ First Degree, ☐ Below First Degree
5. Current Working Position: -----

APPENDIX B. Cadastral Query and Attribute Data

Figure of query of parcel of land use of the study area.

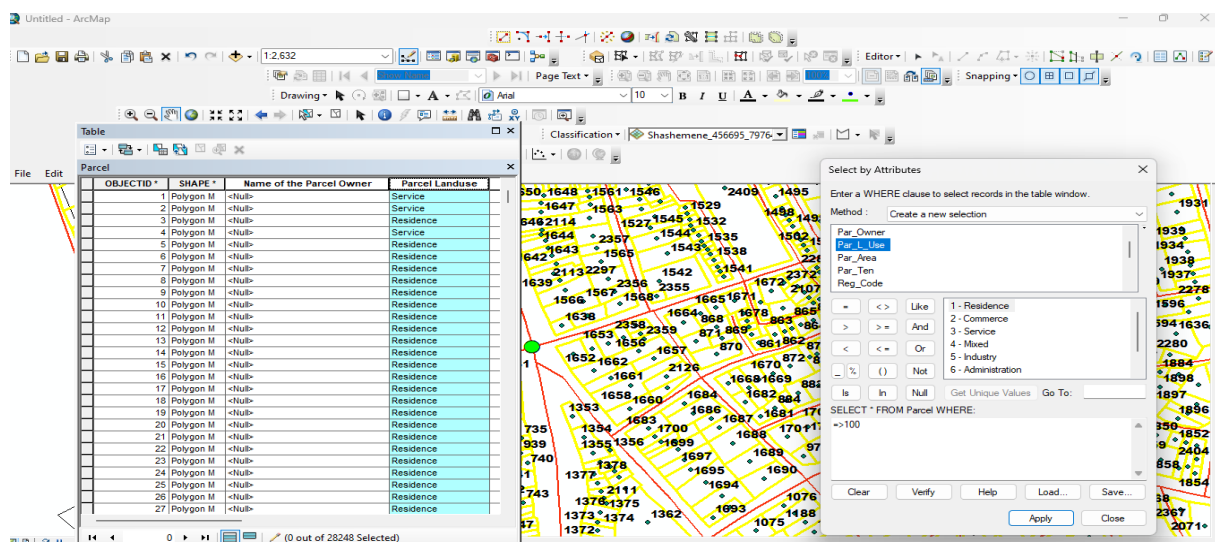
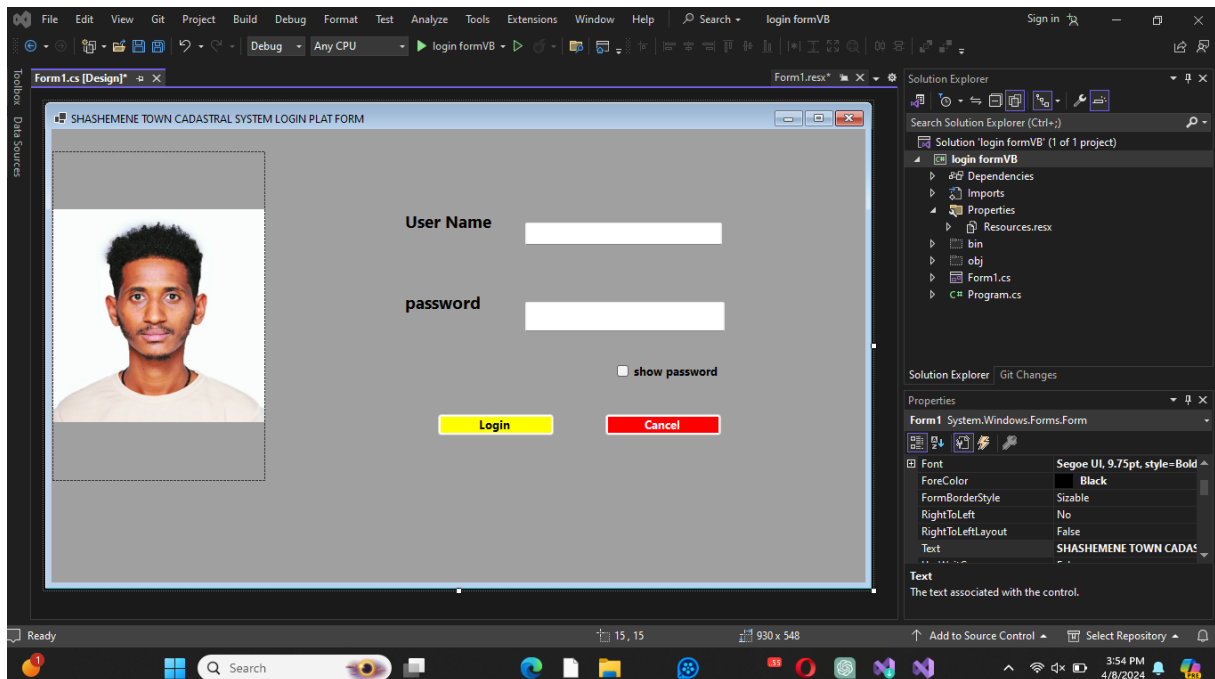


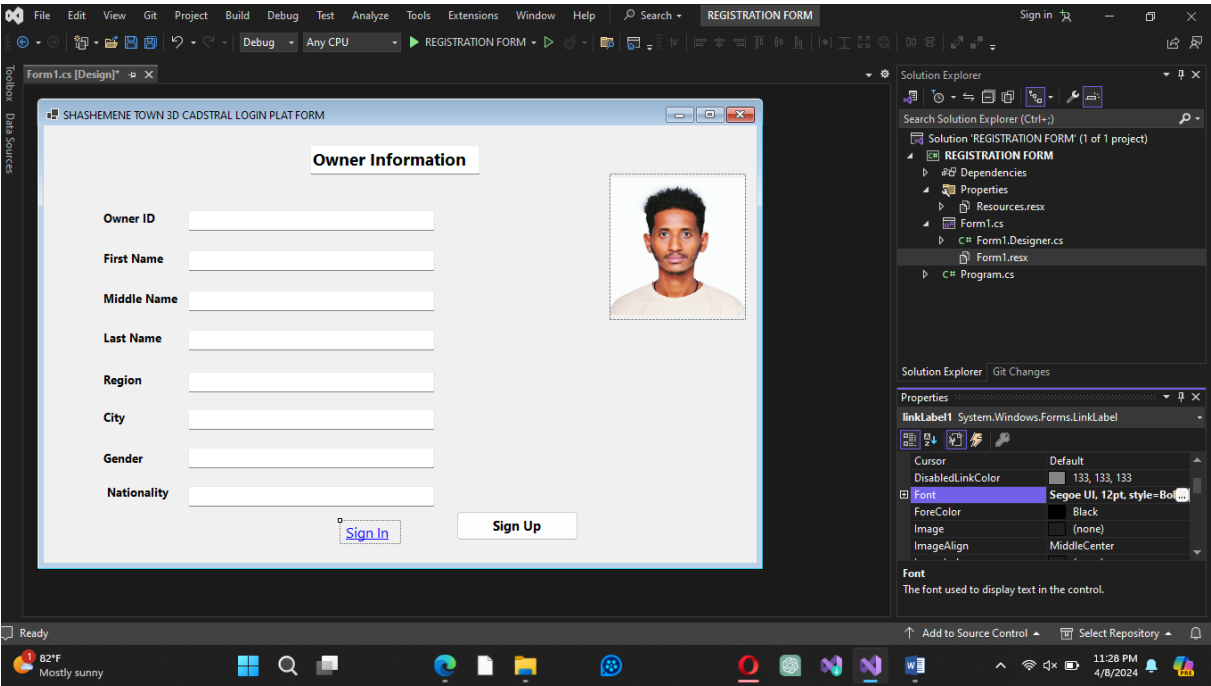
Figure of attribute table of a parcel part of the study area

OBJECTID	SHAPE	Name of the Parcel Owner	Parcel Landuse	Parcel Area	Parcel Tenure	Region Code	City Code	Kebele Code	Parcel Code	New House Number	SHAPE_Length	SHAPE_Area
1	Polygon M	<Null>	Service	123653.090889	Government	OR	002	8	001	7208	1520.148922	123653.090889
2	Polygon M	<Null>	Service	25167.871475	Government	OR	002	8	001	507	682.781593	25167.871475
3	Polygon M	<Null>	Residence	90010.963977	Private	OR	002	8	002	156	1267.868554	90010.963977
4	Polygon M	<Null>	Service	51715.603766	Government	OR	002	8	001	7510	1131.969596	51715.603766
5	Polygon M	<Null>	Residence	445.155112	Private	OR	002	8	001	151	85.37107	445.155112
6	Polygon M	<Null>	Residence	219.425839	Private	OR	002	8	002	133	62.637349	219.425839
7	Polygon M	<Null>	Residence	424.166321	Private	OR	002	8	003	117	82.195915	424.166321
8	Polygon M	<Null>	Residence	225.18732	Private	OR	002	8	004	105	63.858289	225.18732
9	Polygon M	<Null>	Residence	198.086493	Private	OR	002	8	005	93	61.13833	198.086493
10	Polygon M	<Null>	Residence	216.673317	Private	OR	002	8	006	85	62.749451	216.673317
11	Polygon M	<Null>	Residence	209.002367	Private	OR	002	8	007	73	61.818132	209.002367
12	Polygon M	<Null>	Residence	213.336802	Private	OR	002	8	008	63	62.097867	213.336802
13	Polygon M	<Null>	Residence	394.754774	Private	OR	002	8	009	49	79.549189	394.754774
14	Polygon M	<Null>	Residence	257.614142	Private	OR	002	8	010	33	67.825688	257.614142
15	Polygon M	<Null>	Residence	457.385662	Private	OR	002	8	001	146	85.620015	457.385662
16	Polygon M	<Null>	Residence	199.879686	Private	OR	002	8	002	123	58.725897	199.879686
17	Polygon M	<Null>	Residence	593.21422	Private	OR	002	8	003	103	99.955711	593.21422
18	Polygon M	<Null>	Residence	188.753851	Private	OR	002	8	004	83	59.144023	188.753851
19	Polygon M	<Null>	Residence	211.601253	Private	OR	002	8	005	73	60.909075	211.601253
20	Polygon M	<Null>	Residence	379.997276	Private	OR	002	8	006	59	78.031063	379.997276
21	Polygon M	<Null>	Residence	211.573482	Private	OR	002	8	007	43	60.083354	211.573482
22	Polygon M	<Null>	Residence	187.605145	Private	OR	002	8	009	23	57.426283	187.605145
23	Polygon M	<Null>	Residence	258.497324	Private	OR	002	8	010	319	65.817882	258.497324
24	Polygon M	<Null>	Residence	229.938565	Private	OR	002	8	011	32	63.359457	229.938565
25	Polygon M	<Null>	Residence	202.29628	Private	OR	002	8	012	42	61.15293	202.29628
26	Polygon M	<Null>	Residence	416.875409	Private	OR	002	8	013	58	82.230627	416.875409
27	Polygon M	<Null>	Residence	378.378266	Private	OR	002	8	014	76	78.125996	378.378266
28	Polygon M	<Null>	Residence	276.81817	Private	OR	002	8	014	92	69.101838	276.81817
29	Polygon M	<Null>	Residence	233.466252	Private	OR	002	8	015	102	65.17771	233.466252
30	Polygon M	<Null>	Residence	228.438201	Private	OR	002	8	016	114	64.954408	228.438201

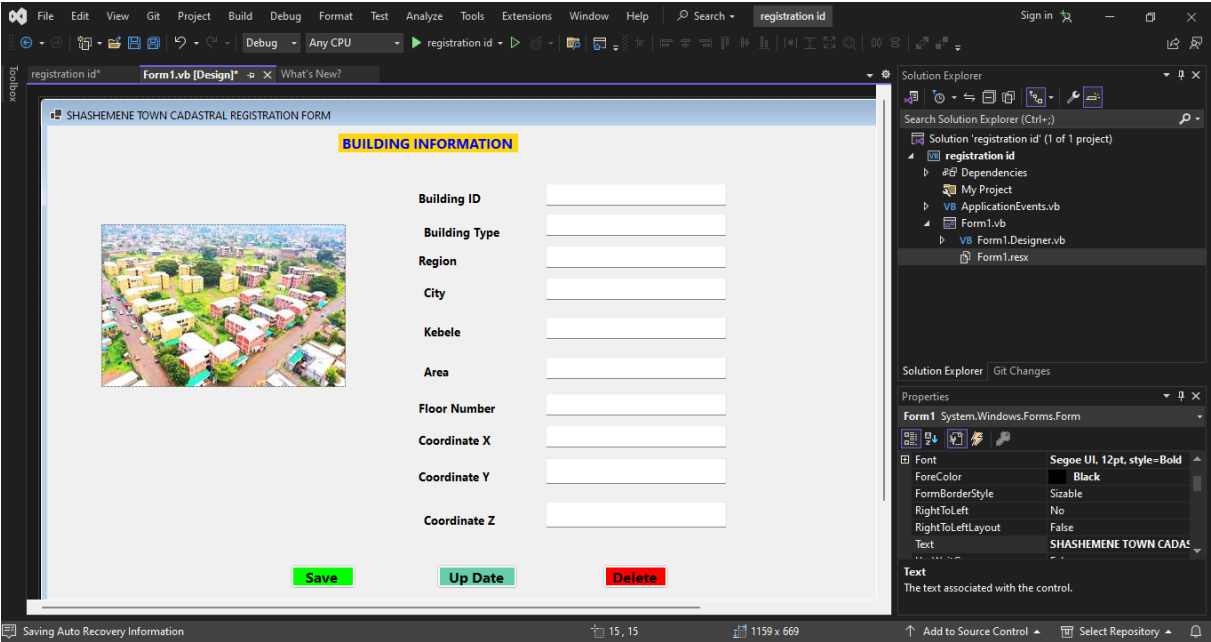
Appendix C. Login platform using visual studio (VB.NET)



Owner information plat form



Building information



Appendix D. Data view for statical analysis

IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

Visible: 5 of 5 Variables

	Age	Educational_ba ckground	Marital_status	Qualification	Experience	var	var	var	var	var	var	var	var	var
1	1.00	1	1	1	2.0									
2	2.00	1	2	1	2.0									
3	2.00	2	1	1	2.0									
4	3.00	1	1	1	2.0									
5	3.00	1	1	2	2.0									
6	1.00	1	2	1	2.0									
7	3.00	2	2	1	2.0									
8	3.00	2	2	1	2.0									
9	1.00	2	2	1	2.0									
10	1.00	2	2	1	2.0									
11	1.00	2	1	1	2.0									
12	2.00	2	1	1	3.0									
13	2.00	2	1	1	3.0									
14	2.00	2	1	1	3.0									
15	2.00	2	1	2	3.0									
16	2.00	2	1	2	3.0									
17	2.00	2	1	2	3.0									
18	2.00	2	2	2	3.0									
19	2.00	2	2	2	3.0									
20	2.00	2	2	1	3.0									
21	1.00	3	2	1	3.0									
22	1.00	3	2	1	4.0									

Data View Variable View

IBM SPSS Statistics Processor is ready Unicode:ON

IBM SPSS data view used for analysis

IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

Visible: 16 of 16 Variables

	Policy_Stra tegy	Leadership	People	Resource_ Partnershi p	Process	People_Re sult	Customer_ Result	Societal_R esult	ZPolicy_Strategy	ZLeadership	ZPeople	ZResource
1	3.00	2.00	3.00	3.00	4.00	2.00	3.00	3.00	-.21764	-1.49079	-.88741	
2	3.00	4.00	3.00	3.00	4.00	2.00	3.00	3.00	-.21764	1.21974	-.88741	
3	3.00	3.00	3.00	3.00	4.00	2.00	3.00	3.00	-.21764	-.13553	-.88741	
4	3.00	3.00	5.00	2.00	4.00	2.00	3.00	4.00	-.21764	-.13553	.38032	
5	3.00	2.00	4.00	2.00	5.00	3.00	3.00	4.00	-.21764	-1.49079	-.25355	
6	4.00	3.00	2.00	4.00	5.00	3.00	2.00	4.00	.87057	-.13553	-1.52128	
7	4.00	3.00	6.00	4.00	2.00	3.00	2.00	3.00	.87057	-.13553	1.01419	
8	5.00	3.00	6.00	4.00	2.00	2.00	2.00	3.00	1.95879	-.13553	1.01419	
9	2.00	4.00	6.00	3.00	4.00	2.00	2.00	2.00	-1.30586	1.21974	1.01419	
10	2.00	4.00	6.00	3.00	4.00	4.00	1.00	2.00	-1.30586	1.21974	1.01419	
11												
12												
13												
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21												

Data View Variable View

IBM SPSS Statistics Processor is ready Unicode:ON

Figure of Variable view used for data analysis

IBM SPSS Statistics Data Editor

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	Age	Numeric	12	2	Ages	{1, 00, 20-30...}	.00	12	Center	Scale	Input
2	Educational_background	String	8	0	Background study	{1, geomat...	.0	12	Center	Ordinal	Input
3	Marital_status	String	8	0	Marital status	{1, married}...	.0	12	Center	Ordinal	Input
4	Qualification	Numeric	8	0	Qualification	{1, BSc}...	.0	12	Center	Scale	Input
5	Experience	Numeric	8	1	Work experience	{1, 0, 1-5}...	.0	12	Center	Scale	Input
6											
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IBM SPSS Statistics Processor is ready Unicode:ON

Figure of Mean, Midian and mode statcal analysisis

IBM SPSS Statistics Viewer

Frequencies

		strategy	leadership	people	resource_part eneship	process	people_result	customer_res ult	societal_reslt	organizational _result
N	Valid	1	1	1	1	1	1	1	1	1
	Missing	0	0	0	0	0	0	0	0	0
Mean		100.000000	100.00000	100.0000000	100.000000	100.00000	100.000000	100.000000	100.000000	100.000000
Median		100.000000	100.00000	100.0000000	100.000000	100.00000	100.000000	100.000000	100.000000	100.000000
Mode		100.0000	100.000	100.00000	100.0000	100.000	100.0000	100.0000	100.00000	100.0000

Frequency Table

strategy

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100.0000	1	100.0	100.0

leadership

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100.000	1	100.0	100.0

people

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100.0000	1	100.0	100.0

IBM SPSS Statistics Processor is ready Unicode:ON

Appendix E: List of Policy and Legislative Instruments Related to Cadastere in Ethiopia

- The Constitution of the Federal Democratic Republic of Ethiopia Proclamation 1 of 1995
- Federal Democratic Republic of Ethiopia, Planning Commission Growth and Transformation Plan II (2015/16 -2019/20
- Federal Democratic Republic of Ethiopia Ministry of Urban Development and Housing (2013), Urban Land Development and Management Policy Directions and implementation Strategies, second edition, August 2013
- Federal Urban Real Property Registration and Information Agency Establishment Council of Ministers Regulation 251 of 2011
- Urban Landholding Registration Proclamation 818 of 2014
- Urban Lands Lease Holding Proclamation 721 of 2011
- Definition of Power and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia Proclamation 1097 of 2018
- Definition of Power and Duties of the Executive Organs of Addis Ababa City Government Proclamation of 2019
- Urban Cadastral Surveying Council of Ministers Regulation 323 of 2014
- Urban Landholding Adjudication and Registration Council of Ministers Regulation 324 of 2014
- Urban Landholding Adjudication and Registration Directive 45 of 2015
- Urban Landholding Adjudication and Registration Amendment Directive 61 of 2018
- Standard 03/2015: Urban Legal Cadastre Standard
- Standard 05/2015: Urban Land Adjudication and Registration Standard

Appendix F

Shashemene city cadastral office registration and storing document.

