DEVELOPING SPATIAL DATABASE APPLICATIONS USING ONE-STOP-SHOP CONCEPT (A CASE STUDY IN CITY OF KIGALI, RWANDA)

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February, 2016

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Enschede, The Netherlands, February, 2016

Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.
Specialization: Land Administration

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ABSTRACT

A database system supports data sharing and helps organizations to improve their efficiency and performance by providing a centralized control access to datasets. But many organizations in developing countries are facing difficulties in data sharing and service delivery to the users/citizens, and therefore, they need an urgent intervention for better efficient and effective services. Therefore, building sharable database among the sectors is an effective way for achieving organizational objectives which includes good service delivery for the citizens.

This research describes the development of spatial database application based on One-Stop-Shop (OSS) concept in Kigali city, Rwanda for integrating information and for better service delivery. A system architecture is designed based on client/server system concept using the needs and requirements of the users so that the system can sustain and enhance the efficiency of the district office OSC related to land information service delivery. In the prototype implementation a user-friendly interface was designed and developed for both front and back-office. Front-office applications are responsible for the interactions with the users composed of citizens, governmental and non-governmental organizations. The back office is responsible for data storage and management the spatial databases. This approach used to develop the database application was validated a) to prove that the system can operate smoothly and b) to address the limitation of the current situation related to service delivery and data sharing.

ACKNOWLEDGEMENTS

First and foremost, praises and thanks to the God, the Almighty, for his showers of blessings throughout my research work to complete the research successfully. I could never have done this without the faith I have in you, the Almighty.

My grateful gratitude goes to my first supervisor Dr. Tuladhar for his patient guidance, encouragement and regular discussions. I would also like to express my deep gratitude to my second supervisor Dr. Sliuzas for the valuable advice and supports throughout my research thesis. Thank you both.

I also would like to thank all my friends here at ITC and at back home for your accompany in study and life. Mostly i am very much thankful to my dearest friends Juildna (konjey), Prakash, yismew (zilto), burtiqaneee, Kelvin, Fikersha, Mahiey, Eluey, Kaleshu, Abdi, and Fre. Thank you for the friendship, encouragement and help. I am extremely grateful Omar, thank you for kindness, truthful support.

I am very grateful to my parents for their love, prayers and caring, Araya Wube, Mebrat Alemseged and my twin brother Mewale Araya. Thank you for understanding, prayers and continuing support to complete this research work.

My special thanks goes to my dearest Husband Biniey, love you so much, am so thankful that I have you in my corner pushing me when I am ready to give up. I am truly thankful for having you in my life. Thanks for not just believing, but knowing that I could do this! I Love You Always & Forever!

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1. INTRODUCTION

1.1. Background and justification

These days the need for sharing data between different organizations has been increasing with the technology and economic growth of a country. Sharing data among organizations help organizations to increase their efficiency and performance by reducing manual works. Therefore, building sharable database among sectors is an effective way of achieving organizational objectives which include good service delivery for citizens.

A spatial database is a kind of database that stores and maintains spatial information about the spatial objects similar to other objects in the database (Güting, 1994). The major motivations behind the use of database systems are to integrate the variety of enterprise data in a structural way within a given organization. This provides centralized control access to those datasets by taking into consideration the role of users for their applications (Özsu & Valduriez, 2011).

Data integration is considered as a process of making different datasets compatible with other data sources within the organization (Gahegan, 1995). Literature study shows that an absence of a proper data integration can result in significant inefficiencies (Halfawy, 2010). Basically, many agencies have their own systems where the datasets are stored and managed separately. In practice, the maintenance of the datasets is done by the employees who are responsible for administrating those databases. The employees of one department or divisions of an organization may maintain the datasets in an isolated database without connecting them with other databases which exist in the same organization. This makes the operational decisions difficult to any particular department or division and may have an impact on the other departments with the lack of data sharing between them. Additionally, it will make the process of data management between two different organizations or departments very difficult. "Any changes to one infrastructure can directly and/or indirectly affect other infrastructures" (Rinaldi, Peerenboom, & Kelly, 2001). Adopting an integrated approach would eliminate inefficiencies of data sharing and managing within the organization.

Unorganized methods of data storage and management cause tremendous difficulties in accessing and exchange of data and information. Mostly this problem is the result of the today's municipal applications which operates as a stand-alone system, with limited capability on sharing data with each other (Halfawy, 2010). Different departments operate under different legislations to fulfill their needs. Often they use different application software to complete their tasks and to manage their information separately. The absence of a shareable database system often results in duplication of data or information, service delay and difficulties to access information. In order to maintain exchange and disseminate the up-to-date information, a centrally managed database management system with the distributed applications is recommended for data collection, update, and distribution in the big organizations like local government. Such improved and integrated database management systems would help to solve many of problems with the organization. Although a successful implementation of this approach relies on the ability to integrate and share data within the different departments of the organizations (Halfawy, 2010); such ability would require a transparent and flexible system architecture which is adaptable to the variety of users' need. Moreover, the information needs to be comprehensive, complete and interoperable so that it can be integrated and shared among different interest groups and stakeholders.

A One-Stop-Shop (OSS) is a place where the users/citizens get different kinds of services from a single office (UN-Habitat et al., 2013). The provision of a variety of services in one place will reduce opportunities for corruption and delay (Seth Asiama et al., 2013). OSS requires all public authorities to be interconnected and that the users or citizen is able to access public services in a single point even if these services are provided by different public authorities (UN-HABITAT & TI, 2004). Therefore, OSS can be adapted as a service end of the information management system to enhance information accessibility and also increase user's confidence in the local administration system.

Many countries are facing difficulties in data sharing and service delivery to the users/citizens, and therefore, they need an urgent intervention for better efficient and effective services. Kigali, the capital city of Rwanda is not an exception to this case. It is composed of three districts, namely: Gasabo, Kicukiro and Nyarugenge, 35 Sectors, 161 Cells and 1183 Villages. The district offices of Kigali city provide different services to the public from a number of governmental organizations like land agencies and other departments (including Road development, Electricity-maintenance, Water and etc.) (Dagenais & Kelley, 1987). Since these are the different departments, they manage their data separately with limited capability to share data between each other. The data are typically exchanged using the file formats that often need to be re-entered from one application to the other. This process is time consuming and inefficient process. Moreover, it also confuses the public what process to follow and where to go to get services provided by the agencies. This type of administration may result corruption, delay of service, etc. To address this problem, developing a spatial database applications using one stop shop concept is vital.

Considering the above mentioned context, this research deals with firstly the development of overall system architecture, and secondly, with the development of spatial database applications focusing on district level of Kigali city one stop centre (OSS). In order to deliver a successful implementation of an OSS, the management strategies largely depends on the availability of the overall system architecture to improve the ability to efficiently integrate, share and manage information (data) within and across different departments and organizations. An OSS system addresses the specific requirements and proposes as an approach for developing a sharable data repository and interoperable applications among the departments and organizations which will result efficient sharing and management of data.

1.2. Statement of the problem

Information gaps and lack of efficient data exchange mechanisms are a common problem when datasets are stored independently within departments (isolated). It often brings the duplication of data/information, service delay, inefficient sharing & management process and difficulties to access information provided by the agencies. Different departments (e.g. Land administration, Construction Permit, Road development, Electricity-maintenance and etc.) of an organization may follow different legislations for a variety of application tasks, and use different applications to manage their information separately. This results a limited capability to share data with each other. Due to the absence of a shareable database, data are typically exchanged using file formats that often need to be re-entered from one application to another in a time consuming way. Moreover, it also confuses the public users what process to follow and where to go to get services provided by the agencies. This type of administration may result in corruption, delay of service, etc. To address this problem, developing spatial database applications using one stop shop concept helps for efficient data sharing and managing within and across different departments and organizations as well as for customer satisfaction. Therefore, the main objective of this research is to develop spatial database applications (namely urban planning and land administration services) using OSS concept for efficient information sharing and managing, and effective service delivery for Kigali city, Rwanda.

1.3. Objectives and question

The main objective of this research is to develop sharable spatial databases and applications using one-stop-shop concept at the city of Kigali (Rwanda) that enhances information accessibility, sharing and managing data.

1.3.1. Specific objectives

To achieve the general objective of the research, the following sub-objectives are considered

- To analyze the organization structure, actors, processes and the problems/weakness related to sharing and managing spatial datasets, and service delivery to the citizens in the existing situation of local government at the city of Kigali;
- To identify and analyze the requirements (overall architecture, users, data and process) to develop spatial database applications and one-stop-center;
- To prototype and validate the spatial database applications based on one stop shop concept.

1.3.2. Research questions

To achieve the above objectives, the following research questions are formulated based on each specific objectives which are:

Specific Objectives	Research Questions
• To analyze the organization structure, actors, processes and the problems/weakness related to sharing and managing spatial datasets, and service delivery to the citizens in the existing situation of local government at the city of Kigali.	1. What is the institutional and the organizational structure of Kigali City? 2. Who are the users/actors involved in spatial data access and applications? 3. How does the existing situation respond to data sharing and service delivery? 4. What are the institutional and organizational problems and weakness in the current situation?
• To identify and analyze the requirements (overall architecture, users, data and process) to develop spatial database applications and one-stop-center.	5. What are the requirements for overall architecture, users, data and process? 6. How are an overall system architecture and components developed to overcome institutional and organizational problems and weakness? 7. How to design centralized sharable spatial database, applications and one-stop-shop for efficient service delivery?
• To prototype and validate the spatial database applications based on one stop concept.	8. How to prototype the centralized shareable and supporting application databases accessible from one-stop-shop center? 9. How to validate the prototype? 10. How can the prototype be further improved?

Table 1.1 Research questions

1.4. Conceptual framework

The overview of the conceptual framework for this research is given below in Figure 1.1. There are five main concepts that concern institutional and organizational aspects, system architecture, enterprise spatial database management system, OSS, and internal users including citizen.

These concepts are used in developing spatial database applications based on OSS for Kigali city, Rwanda, and to indicate how the new enterprise database management system will address the above mentioned problems caused by the existing data management system. As the research aims to design sharable spatial databases based on OSS concept, it is important to assess institutional and organizational aspects together with the user's requirements. Each of these aspects are briefly described in the following sections.

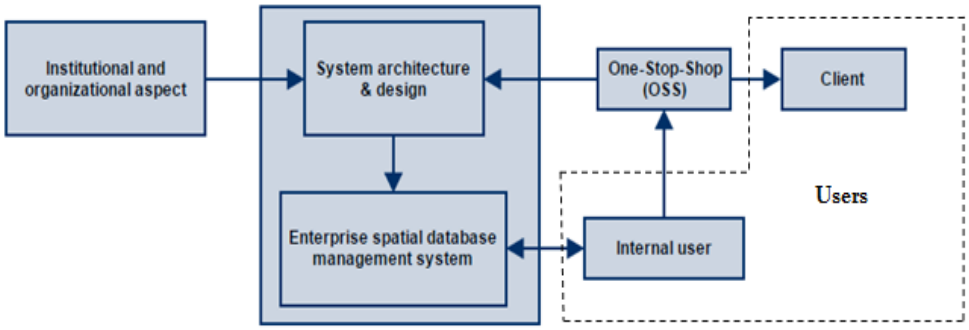

Figure 1.1 Conceptual framework

1.4.1. Users (internal users and citizens)

In organizations, many people will involve in the design, accessing/using and managing of a database, and those people are called users (Coronel & Morris, 2014). Database users can be divided into two groups, those who involve in maintaining the database system (e.g. database designer, database administrator and end users) and those who use information provided by the system (Courtney, Paradice, Brewer, & Graham, 2010). A user who use the application but they just use the system to get their task done is referred as end-user (Coronel et al., 2014). According to Everest (1986), there are two types of end-users direct and indirect users. Direct users use the application program which is already developed for getting the desired result (e.g. an employee at municipality to provide service to a customer, those who directly interact with the database) and indirect users are users who are concerned with the output for a different purpose. Database users help to design, administer and use a database to deliver services to citizens/client. Whereas the term citizens/client refers to a person or company that receives a service from organization in return for payment (Stiegler, 2004). According to CSSP (2007), any organization's ultimate goal is to satisfy the client/customers need by providing an efficient and effective service. Nowadays, most of the governmental organizations are using new technology to increase the efficiency and effectiveness of service delivery. However in practice, it's an issue as the system is designed and implemented without understanding what customers need or lack of customer involvement (Frese & Sauter, 2003). For instance, India's financial management system development project failed because of lack of user involvement, inadequate dedication and improper planning (Wimmer & Chappelet, 2010). The most important question in development process of a software product is how to find out what users really need. Damodaran (1996) argues that user participation in the development of a system plays its own part for the developments system to improve the quality in several ways and brings many benefits to the users.

According to Courage & Baxter (2005), the organization system should be client centric to improve the efficiency, availability and accessibility of services and the provision of information to the clients/citizens. Additionally, to improve the services delivery by local governments the relationship between the actors involved which are the national government, private sector, communities and civil society should play an important role in shaping demand, developing state policies and delivering services (UNCDF, 2010). Moreover, the development of information technology and media are influencing the relationship between the government and the citizens by giving the chance to get closer. A good quality and affordable services delivery is crucial for citizens/customers and also it is a good image for the government as well (Eigeman, 2007).

1.4.2. Institutional and organizational aspects

North (1990), stated that institution as a set of formal and informal rules that govern human behaviour in economic, social and political life. Formal rules include laws, regulations and constitution, while informal rules refer to social norms, beliefs and values (D. C. North, 1991). Where organizations are group of individuals bound by some common purpose to achieve objective like political bodies, social bodies and educational bodies. Also they have their own particular rules, internal system of authority which only applies to the members of the organization (Leftwich, 2010). According to Courtney et al., (2010) major functional areas in organizations have developed from the recognition that the function being managed has an essential significance. Organizational data and information must be regarded as an asset of vital importance within the organization. Managing organizational data and data processing functions is often called information management (Maritz, 2003). An organization whose data resources are usually stored in databases, which are highly integrated sets of files shared by users throughout the organization, have a system that provide efficient and effective information (Courtney et al., 2010). Such system requires appropriate alignment both at strategic and operation levels within the organization. However most organizations fail due to the lack of alignment between the business and IT strategies of an organization; so proper alignment will allow them to use information technology efficiently to achieve their objectives (Henderson & Venkatraman, 1993). According to (Coleman & Papp, 2006) strategic alignment ensures that the operating elements of the organization to work together in harmony and perform better. Moreover, strategic alignment model is composed of external and internal domains: external domain refers to strategy domains which are business strategies and IT strategy domain. Internal domain also refers to infrastructure domain (Business infrastructure and IT infrastructure domain). As described in chapter 2 section 2.4 detail all of the components will work together to determine the extent of the alignment.

1.4.3. One-Stop-Shop concept

According to PWC (2012), OSS is a location where citizens and customers are able to access information and service transaction from a single point. Additionally, it offers efficient & effective service delivery. Schoukens (2007) stated that the concept of OSS as organizational model could be applied in many fields; originally it was developed in US business practice to offer customers multiple needs which meet in one location, instead of having to attain related services at different stores. Development of OSS increases the administrative efficiency and performance and especially it improves the relation between the general public and local government (Contiades, 2007). Provision of effective and efficient governmental services depends on the relationship between the local government and its citizens; which must be good and democratic; OSS is considered as one of the effective and efficient method for service delivery process (Hecker & Netolický, 2010). Although different scholars discuss about OSS depending on the context of their research areas. For instance, (Dias & Rafael, 2007) stated OSS e-government as the use of information technologies to deliver public services to the client and they propose a one-stop e-government and distributed architecture to deliver client-centred services. Moreover, Wimmer (2002) also proposes online one-stop government to provide electronic public services from a single point of access in order to improve customer-to-government interactions. EC (2015) discloses that establishment of OSS can play an important role in improving service delivery, which can also increase the efficiency and effectiveness of public services.

1.4.4. System Architecture and design

System architecture is a conceptual model that describes how the system will be structured to align with the organizational and user requirements. Furthermore, architecture is not specifically about the detail

implementation; rather it focuses on the responsibilities of each element, platforms & technologies and their interaction with each other (Coronel & Morris, 2014).

According to (Eden, Hirshfeld, & Kazman, 2006) design is defined as "concerned with the modularization and detailed interfaces of the design elements, their algorithms and procedures, and the data types needed to support the architecture and to satisfy the requirements." In order to design an application, first the software architect should minimize the complexity by separating the design into different phases.

Thus, the success of any system depends on the architecture pattern which is used to describe the overall characteristics of the architecture (Richards, 2014). High-level patterns and principles are commonly used for application, which is often referred as client-server, layered architecture, component-based architecture, message bus architecture, and service-oriented architecture (SOA); they are set of principles which shape an application (Microsoft Developer Network, 2009). Qian (2010) stated that in order to describe the components, their connections, interactions among them and deployment configuration of all components; software architecture can use different methods like Architecture View Model (4+1), IEEE1471, and Unified Modelling Language (UML) to model and design software application. UML is defined as a graphical representation of a real-world organization, hard ware and software system. Moreover, it is a language that allows to specify, visualize, construct and document business process as well as software systems (Alhir, 2003).
UML offers nine diagrams to model systems: (1) *use case diagram* gives a graphic overview of the actors involved in a system; (2) *Sequence diagram* for modelling message passing between objects; (3) *Collaboration diagram* for modelling object interactions; (4) *State diagram* for modelling the behaviour of objects in the system ; (5) *Activity diagram* for modelling the behaviour of Use Cases, objects, or operations ; (6) *Class diagram* for modelling the static structure of classes in the system; (7) *Object diagram* for modelling the static structure of objects in the system (8*) Component diagram* for modelling components; (9) *Deployment diagram* for modelling distribution of the system (Lange, Chaudron, & Muskens, 2006). Literature study shows that software architecture solves problems in the design phase and helps to determine the current and the next phase (Microsoft Developer Network, 2013). This research implements component, use case, activity and class diagram to model the system architecture of the OSS.

1.4.5. Enterprise database management system

Data is one of the organization's most valuable assets. In order to manage data efficiently, it should be stored in a database. Even though database has evolved from computer file systems, it also helps to eliminate the limitations of file system data management (Courtney et al., 2010). Database is a set of related data to represent some aspect of the real world which is organized so that it can be accessed and managed efficiently (Coronel & Morris, 2014). Nowadays databases are widely used in every organization to control data resources and for management purposes. The ability to access the data will be provided by "database management system" (DBMS) which is a collection of programs that will allow the user to interact with data that are stored in the database. In addition, DBMS is used to build different types of databases to manage the data more efficiently and effectively (Coronel et al., 2014). DBMS provides multiple users to access the same data at the same time as well as it also eliminates data redundancy (Özsu & Valduriez, 2011). The main objective of a database system is to provide information so that an organization could have effective managerial system (Courtney et al., 2010). And it is a key part of an information management strategy which offers opportunities to increase the sharing of data (Martinez-Uribe & Patrick, 2011). In order to design a database system, we need to define the requirements through different ways such as interviews, documentation of existing systems and reports (Coronel et al., 2014). Following this, there are three main stages to develop database design which are conceptual, logical and

physical. Conceptual concerned about the information content of the database; which includes entities, relationships and attributes; that uses data requirements and map them in UML class diagrams (Connolly & Begg, 2015). According to (Teng, 2011) UML class diagram refers as a graphical representation of the entities and relationships among them in order to create a database. Whereas the logical design phase transforms the conceptual data model into an understandable format by the DBMS as well as in physical design stage which produces a set of detail data that define the database. Connolly et al. (2015) stated that DBMS used to store administrative information in different database application areas for instance for banking, finance, universities and so on. It provides many advantages, including the increase of data share ability, data integrity, and easy access of data that supports management in its decision-making role.

1.5. Research matrix

To achieve the objective of the research and answer the research questions as given in Section 1.3 the following research techniques are provided in Table 1.2. It gives detail overview of the research techniques accordingly by using research matrix as guidance in order to bring the whole process into the research following a logical step and linking to the expected results the detailed analysis of the relationship between the expected results with research question, data collection and processing method are provided in the research design matrix (Table 1.2).

Main Objectives	Sub Objectives	Research Question	Data Collection Methods	Data Processing Techniques	Expected output
To develop spatial database applications using one-stop-shop concept at the district level of Kigali (Rwanda)	• To analyze the organizational structure, actors, processes and the problems/weakness related to sharing and managing spatial datasets, and service delivery to the citizens in the existing situation of local government at the city of Kigali.	1. What is the institutional and the organizational structure of Kigali City?	Literature review, document analysis(reports, government documents) & questionnaire (email)	Desk study	The structure of the organization
		2. Who are the users/actors involved in spatial data access and applications?	Questionnaire (email), document analysis(reports , documents)	Desk study	List of users/actors involved in spatial data access
		3. How does the existing situation respond to data sharing and service delivery?	Existing organization data, reports and questionnaire (email)	Desk Research, activity diagram	The current data sharing and service practice
		4. What are the institutional and organizational problems and weakness in the current situation?	Organizational documents, reports and questionnaire (email)	SWOT Analysis	Weakness of the organization current situation
	• To identify and analyze the requirements (overall architecture, users, data and process) to develop spatial database applications and one-stop-centre.	5. What are the requirements for overall architecture, users , data and process?	Literature review, document analysis(organizational: reports , publications, website)	Desk study,	List of requirements of shareable database and application database for the user
		6. How are an overall system architecture and components developed to overcome institutional and organizational problems and	Organizational documents, literature review/ document analysis	UML diagrams	Architecture design

		weakness?			
		7. How to design centralized sharable spatial database, applications and one-stop-shop for efficient service delivery?	Literature review expert consultation, software documents , internet search	Database design technique	Methods and explanation to design the applications
	• To prototype and validate the spatial database applications based on one stop concept.	8. How to prototype the centralized shareable and supporting application databases accessible from one-stop-shop center?	Literature review expert consultation, software documents , internet search	Prototyping the system	Methods and explanation to prototype the applications
		9. How to validate the prototype?	Literature review , expert consultation, questionnaire	Desk study, result analysis	List of answers form the experts questioner
		10. How can the prototype be further improved?	Literature review , expert consultation/discussion,	Desk study	Conclusion and recommendation

Table1. 2 Research design matrix

1.6. Research design

This research is carried out in three main steps: determine requirements, developing architecture and spatial database applications and implement a prototype for validation. Figure 1.2 below illustrates the research methods that were used to meet the objectives in each phase of the research project.

The research is initiated with a literature review in relation to the objective. The review helps to justify methods which are utilized in this study. The first step is the development of the research which includes the formulation of research objectives and research questions along with identification of study area & data source. The next step focuses on analysis of the organizational structure and existing system related to data exchange and service delivery to determine the requirements which is gathered through questionnaire. The last step is to design the system architecture based on the requirements and followed by the development of a spatial database and applications will then be validated through the implementation of a prototype. The detail process of the research approach is provided in the Figure 1.2.

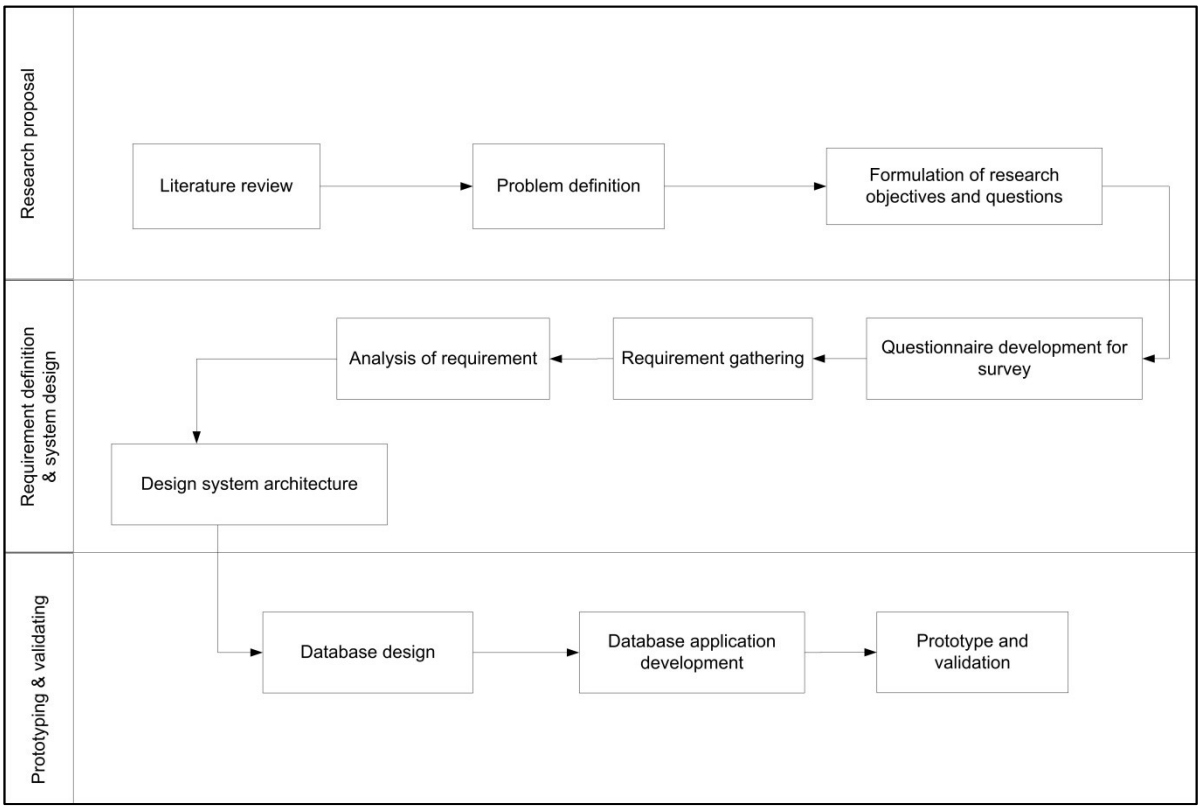

Figure 1.2 Research design

1.7. Significance of the study

This research aims to provide an accessible database application prototype consisting of spatial information related to land management. An integrated information system will assist OSC's officers to efficiently obtain information and reduce the length of the decision-making process. While this research is primarily intended for OSC district offices of Kigali city by providing different services to the public, it will also be useful for other governmental organizations who are interested in using this application for managing their resources.

1.8. Thesis structure

The following chapters are included in this research.

Chapter 1- Introduction – this chapter contains the background, problem statement, objectives and questions that should be answered by this study are discussed.
Chapter 2- Theoretical Concepts and Framework – the relevant studies related to OSS for developing spatial database and spatial applications for urban planning and land administration services reviewed and compiled in this literature review chapter.
Chapter 3- Research Methodologies - methods used to achieve the objectives and to answer the related research questions are discussed in this chapter.
Chapter 4- Current situation and needs for One-Stop-Centre in the city of Kigali (Rwanda) – the organizational structure and actors involve in data access are briefly described and the requirements to develop spatial database are defined.
Chapter 5- Enterprise System Architecture for One-Stop-Centre in the city of Kigali – this chapter gives a system architecture that satisfies the needs of local government of Kigali, Rwanda including internal and end-user requirements.
Chapter 6- Designing and validating – this chapter includes the designing of spatial database based on requirements identified from Chapter 5. A prototype is developed and validated in this chapter.
Chapter 7- Conclusion and Recommendations- conclusions based on the objectives and questions are drawn and recommendations for further studies are presented in this chapter.

2. THEORETICAL CONCEPTS AND FRAMEWORK

2.1. Introduction

The previous chapter provides an overview of the research. This chapter reviews different literatures about the concepts of (a) User and service requirements, (b) One-Stop-Shop (OSS), (c) implications of OSS , (d) Strategic Alignment Model (SAM). At the end, a framework for OSS is provided using literature for research.

2.2. Users and service requirements

A requirement is a statement that is derived directly from the user needs or stated in a contract, standard, specification, or other formally imposed document (Oberg, Probasco, & Ericsson, 2000). The user requirements define the system in all its aspects and including business constraints such as cost, time and risk. Understanding user requirements is an integral part of information systems design and is critical to the success of system implementation. It is now widely understood that successful systems and products begin with an understanding the needs and requirements of the users (Maguire & Bevan, 2002). As specified in the ISO 13407 standard (ISO, 1994), a user-centred design begins by taking into consideration of users requirements and needs. The benefits include increased productivity, enhanced quality of work, reductions in support and training costs, and improved user satisfaction. However, to meet the requirements of the different clients, a careful investigation of their needs is required by considering an appropriate method to support the process of user requirements generation. The first step is information gathering, which gathers background information about the processes that currently take place and identifies all the users who may influence or be impacted by the system. According to Preece, Sharp and Rogers (2015), data gathering can be done by using different techniques such as interviews, questionnaires, focus groups, observation and studying documentation. These methods help to acquire information and understand users' needs and to ensure that the needs of all those involved are taken into account. Each of these techniques has their own pros and cons for instance for those who are more comfortable to express their ideas interview will be more preferable than questionnaire. On the other hand questionnaires will be advantageous to collect data from those individual who are good in expressing their view by writing (Mifsud, 2013).

Nowadays, all customer want quality, comfort and appropriate-ness but not all the institutions are completely familiar with the fact that customers always demand high quality goods and service (Patterson, Johnson & Spreng, 1997). Literatures in the service sector have shown that organizations need to focus and consider on customers satisfaction. In order to examine satisfaction or quality of services it's intended to use on of the above methods to collect user's perception data. Successful organizations will be those that can provide goods and services to the customers who want it, where they want it and in the quantity and the price they want it (Aigbavboa & Thwala, 2013).

In addition this study also tries to investigate the two user categories: internal and external users. External users are both citizen and other governmental organization who demand services which are produced by the organization as an end product; while internal user are employees in an organization to serve the external users (end-users) delivering different services Typical examples of services by local government to the end-users or citizens include a) land administration services such as subdivision, land transfer, delivery of land ownership (or lease) certificates, and b) urban services such as building permits,

environmental permits, provision of water, sewerage and electricity lines. In order to realize these services, there are similarly some social services such as registration of birth/death, issuance of birth certificate, and so on.

In this research, the services under a) and b) will be realized by using spatial applications as services at the front office in one-stop-shop environment, while back office will maintain a sharable/central database to enhance sharing data among the different platforms.

2.3. One-Stop-Shop concepts and implications

2.3.1. One-Stop-Shop concept

One-Stop-Shop is one of the most promising concepts for service delivery (IFC, MIGA, & WB, 2009). During the 1980s, the concept of a "One-Stop Shop" (OSS) came to deal with administrative barriers in order to provide more streamlined and investor friendly policy environment (Al-Fattal, 2008). The basic idea of OSS is that a customer/citizen would only have to be contact with one single entity to obtain all the necessary work to be done in one efficient and coordinated process, rather than having to go through a labyrinth of different government bodies (PWC, 2012). However, in the last decade within the e-government environment OSS presents more often virtual location, i.e. web portal, which through the means of modern information technology even enhances the possibilities and functionalities of OSS (Vishanth, 2012). OSS aims to overcome the problems of service delivery by providing single point of access to services, possibly using communication channels of users' choice, addressing exact circumstances, needs and requirements and attempting to reduce the number of contacts to a minimum. The structure of OSS is adapted from Armoks (2016) described as in the following figure (Figure 2.3).

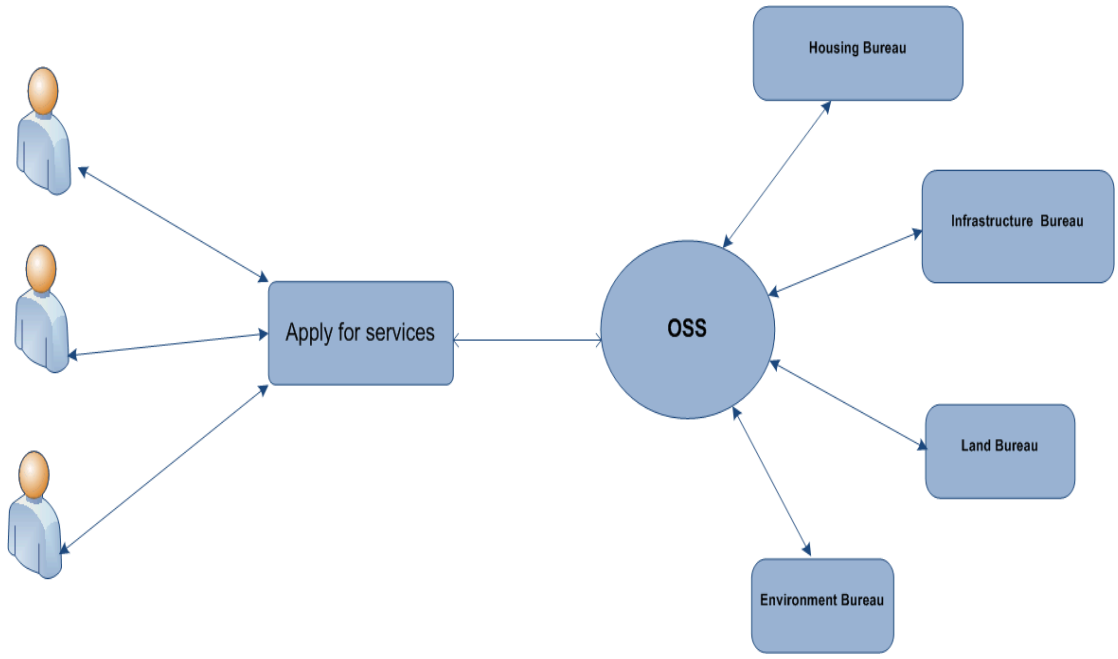

Figure 2.3 OSS structure adapted from Armoks (2016)

As depicted in the figure above (Figure 2.3) citizens and/or (non-)governmental organizations apply for different services in the OSS. These services could be related to housing, infrastructure, land and/or environmental services. Then depending on their need they will get services they wanted with in one place with minimal time and cost.

Applying OSS concept can bring several benefits to users by providing simpler, clearer and faster access of public services (Kreitner, 2012). This is why different institutions and international organizations have been actively promoting the establishment of OSS in order to simplify the administration environment. These make implementation of OSS extremely demanding (Contiades, 2007). But, implementation of OSS is not a simple process. It requires interoperation and integration of back-office systems with the front-office side as well as redesigning and integration of service delivery processes. Besides, involvement and cooperation of many public as well as organizations from different jurisdictions and fields of operation is a success factor (Oliveira, Abranches, & Healy, 2009).

2.3.2. Why is OSS needed?

OSS brings advantages to businesses, in particular to merging firms, by reducing the costs and burdens arising from multiple filling obligations and by eliminating the risk of conflicting decisions resulting from the concurrent assessment of the same transaction by a number of competition authorities under diverse legal regimes(Middleton, Rodger, Culloch, & Galloway, 2009). In addition, the provision of a one-stop-shop is beneficial to competition authorities and businesses alike. Moreover, The handling of a merger by a single competition authority normally increases administrative efficiency, avoiding duplication and fragmentation of enforcement effort as well as potentially incoherent treatment (regarding investigation , assessment and possible remedies) by multiple authorities (Contiades, 2007).

According to Hecker and Netolický (2010) there are several reasons why a one stop shop is useful for local government organisation:

- To overcome the administrative fragmentation of bureaucratic procedures;
- It improves the quality of the service delivery of local government.
- It improves the relationship between the local government and its citizens.
- It organises the contacts between citizens and the local government organisation more efficiently and effectively.

There are many instruments that either improve the quality of the services, or the relationship with citizens, or that restructure your organisation to work more effectively and efficiently, but there is only one instrument which combines all that is a OSS (Hecker & Netolický, 2010).

2.3.3. Implications of OSS

According to different scholars, OSS concept can bring several benefits; for instance improving service delivery can benefit customer by reducing delays, consolidating multiple services under one roof and eliminating the frequent visits to government offices (Hecker & Netolický, 2010). In order to implement OSS it is important to learn from the studies of field experiences. Many studies confirm that there are many obstacles to successfully implement; including political financial objectives and lack of citizen interest (IFC et al., 2009). The implementation of OSS concept makes the administration more citizen-oriented, efficient, transparent and responsive to the needs of public (Bertucci, 2007). Moreover transforming the service delivery through a 'One Stop Shop' can significantly improve customer

experience and outcomes through enhanced service levels at the same or reduced cost. The solution lies in developing citizen-centric models that draw inspiration from the relative success with which the private sector has addressed the situation (EC, 2011). Since, Citizens today are more aware of their rights to access information about public services and have higher expectations of service levels and service experience (Contiades, 2007). The development of citizen-centric models calls for customer insight, looking at customers' wants and needs focusing on improved customer journeys and measurable benefits, and understanding the strategic risks associated with various service delivery models (PWC, 2012). In addition, the most prominent benefit of OSS is reduction of corruption and increase transparency. Therefore these benefits OSS results more efficient and user-friendly public sector. On the other hand, despite the potential benefits of OSS initiatives a number of challenges such as existing conditions, privacy, lack of resources and necessary skills (UN-HABITAT & TI, 2004).

2.3.4. Strategic Alignment Model (SAM)

As discussed in chapter 1 section 1.4.2 strategic alignment helps to integrate organization's resource in an effective way to achieve objectives. Depending on different perspectives scholars reflect their views on it in different ways. Different scholars provide many definitions of strategic alignment. For instance, In the article written by Maes, Rijsenbrij, Truijens, and Goedvolk, (2000) define strategic alignment as "a continuous process involving management and design of sub-processes of consciously and coherently interrelating all components of the business-IT relationship in order to contribute to the organization's performance over time." Henderson and Venkatraman (1993) also discuss Strategic Alignment Model (SAM) as a process and the result of linking an organization's structure and a resource with its strategy and business environment; additionally it ensures that the operating elements of the company all work in harmony. Besides SAM is based on the concept of strategic fit between internal and external views and the functional integration between organizational and technology views. In addition, Luftman (2000) also argues that strategic alignment refers to applying information technology in an appropriate and timely way in harmony with business strategies, goals and needs. According to Henderson and Venkatraman (1993), SAM is a conceptual model that has been used to understand the strategic alignment from the perspective of these four fundamental domains such as business strategy, information technology strategy, organizational infrastructure and processes, and information technology infrastructure and processes. The key message of this model is that to become a successful organization, one should make sure that the IT strategy is fully aligned with business strategy.

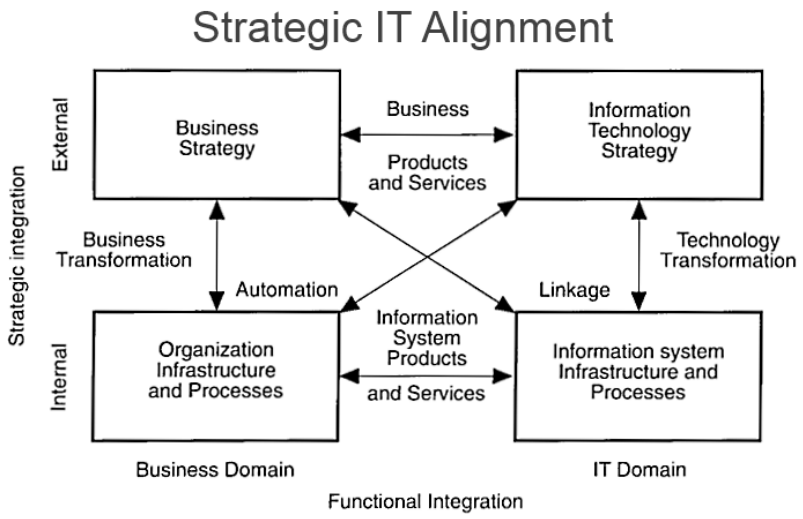

Figure 2.4 Strategic Alignment Model Henderson and Venkatraman (1993)

SAM is composed of four quadrants consisting a components that work together to determine the extent of alignment along with the linkages between the quadrants. The first linkage is a strategic fit which is the vertical linkage and refers to the use of strategy to determine the infrastructure of the business. The second linkage is functional integration; this horizontal linkage is most directly related to the alignment of business and IT (Henderson & Venkatraman, 1993). Strategic linkage refers to the relationship between business and IT strategies. That is, it is fundamentally concerned with the integration between the positions of an organization with respect to the business and IT marketplaces (Henderson & Sifonis, 1988). This linkage between these two strategies is a fundamental requirement for understanding the transformations required for realizing value from IT investments (Venkatraman, Henderson, & Oldach, 1993). Thus, the basic elements that must be interpreted and understood leverage of IT as linkage between four areas such as organizational infrastructure, business strategy, IT strategy, and IT infrastructure. The concept of IT strategy is relatively new and open to differing definitions and assumptions (Bleistein, Cox, & Verner, 2005). According to Coleman and Papp (2006), if IT is aligned with the business goals of the enterprise then optimal IT alignment can only occur. In order to effectively align IT with the enterprise goals; the goals must be clearly stated; as well as must truly be goals, and not as so often occurs, This will require greater knowledge of the strategy process and the strategy vernacular (Henderson & Venkatraman, 1989). Inappropriate alignment can cause problems with the development and integration of business and information technology strategies. Since information technology plays an increasingly vital role in corporate decision-making. In order to implement the model to determine which perspective a company is following yields important insights with which they can maximize their information technology investment and develop their business and technology strategies (Coleman et al., 2006). Moreover, strategic visions need to be formulated and needs to be implemented into projects, which aslo should consider to re-engineer the organizational structures, business process and object models to fit them to the strategic decisions. Although the interest of alignment is widely recognized but the implementation remains too often limited (Smits, Fairchild, Ribbers, Milis, & Geel, 2009). The strategic alignment approach helps bridge the gap between the strategic goals or polices and operational requirements. Developing a strategic alignment links results a better aligned organization and information system (Papp & Luftman, 1995).

2.4. Framework for One-Stop-Shop

OSS is customized differently in different organizations and/or countries depending on the context; because it depends on the specific context, regulatory environment, actors and different priorities in each government. OSS promotes a new philosophy of service that start by redesigning backwards ambiguous processes, optimizing times, and with responsibilities that are clearly defined. Furthermore times and expected services are reasonably foreseeable and citizens are suitable informed about them. In this way public administration changes not only the approach to service but also the way of responding to all stakeholders demands (Kreitner, 2012). With the creation of the OSS, the relationship between citizens and public administration takes place through a single front office having as its main aim:

- To overcome the administrative bureaucratic procedures
- To increase the productivity and management's efficiency
- To establish a two-way channel of communication, thus enhancing transparency and accountability (Tambo, 2008)

However, in order to implement OSS it is essential to identify the requirements on fundamental aspects including citizen's focus, legal, organizational/institutional, budget and technical aspects in order to realize one-stop-shop (UN-HABITAT & TI, 2004). All these requirements combining with existing conditions in each country are input sources for developing OSS. As the following figure (Figure 2.3) describes the components of the OSS framework; the existing situation, actors (internal and external users),

organizational business strategy and system architecture and design taken together to represent the OSS concept to meet user's requirements. The organizational business strategy consists the plans, policies and management process required to implement; it also includes strategic plans, IT planning process. System architecture design includes the description and documentation of the current and the desired relationships among business and management processes and information technology. Moreover, these components are integrated to determine what users want to improve services delivery which is provided at the front office by letting a direct interaction between front officers and customers. Whereas in the back office there will not be direct interaction with officers the customers. Rather the officers' role at this position is related to database maintenance, issuing a land certificate, planning and monitoring implementation of plans, approving construction projects and ensuring maintenance of infrastructure. When there is a need individual from different bureau share information from the common database

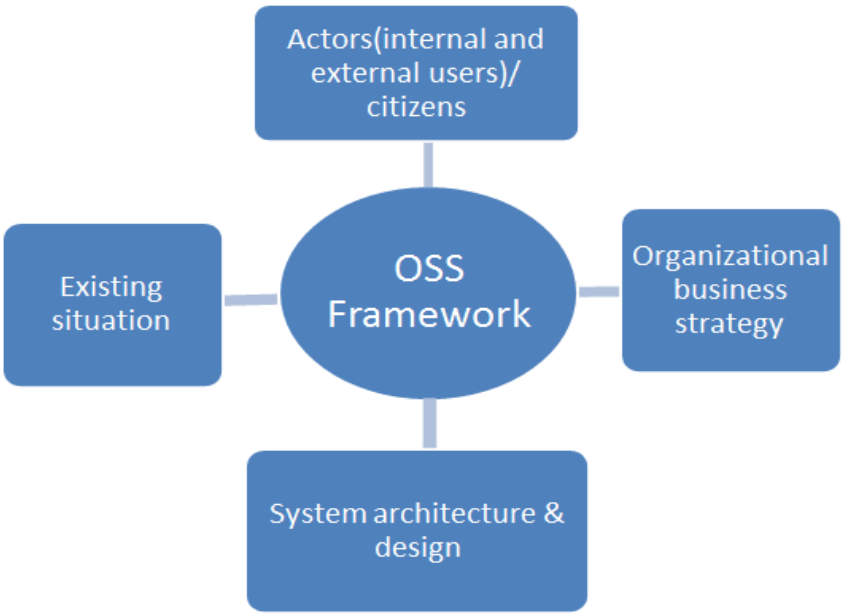

Figure 2.5 Framework for One-Stop-Shop adapted from U.S. Department of Labor (2003)

2.5. Concluding Remarks

OSS approaches provides fast and an efficient service delivery and minimize bureaucracy and corruption in an organization. Thus, to implement this concept successfully it is important to design OSS framework consisting the existing situation, actors (internal and external users), organizational business strategy and system architecture and design taken together to represent the OSS concept and to meet user's requirements. Additionally, in order to implement OSS system that provides efficient and effective information, an organization should consider a suspicious analysis of system requirements, strategies and operation that are available within the organization. Moreover, the most important concept the organization should be user-centred. A user-centred design considers what the users need which will results a successful system and products. Moreover, to meet the requirements of the different clients, a careful investigation of their needs is required by considering an appropriate method to support the process of user requirements generation. The methodologies for the research and designing architecture are discussed in following chapter Origin.

3. RESEARCH METHODS

3.1. Introduction

This chapter gives a brief introduction about the selected study area (Kigali, Rwanda), methodology applied in this research and approaches used to collect the required data for the research in order to achieve the overall objectives of the study. In this research, One-Stop-Centre (OSC) of Kigali (Rwanda) is considered as a case study. The current situation of Kigali's OSC is identified through questioner and desk study. Therefore, in the following sections a detail view of the research methodology is given.

3.2. Study area

This study is carried out in Kigali city in Rwanda, Kigali city has a surface area of 376 km2 and it is composed of three districts, namely: Gasabo, Kicukiro and Nyarugenge, 35 Sectors, 161 Cells and 1183 Villages (Dagenais & Kelley, 1987). For the purpose of this research, Kicukiro district was selected (Figure 3.6). The district offices of Kigali city provide different services to the public from a number of governmental organizations. Study area is selected from one of the districts of Kigali city which have a digital data. The reason for choosing the sites is that Kicukiro district offices have both spatial and attribute data in digital format and the PGM department has an agreement with Kigali City for research and that this is why much of the data was available already.

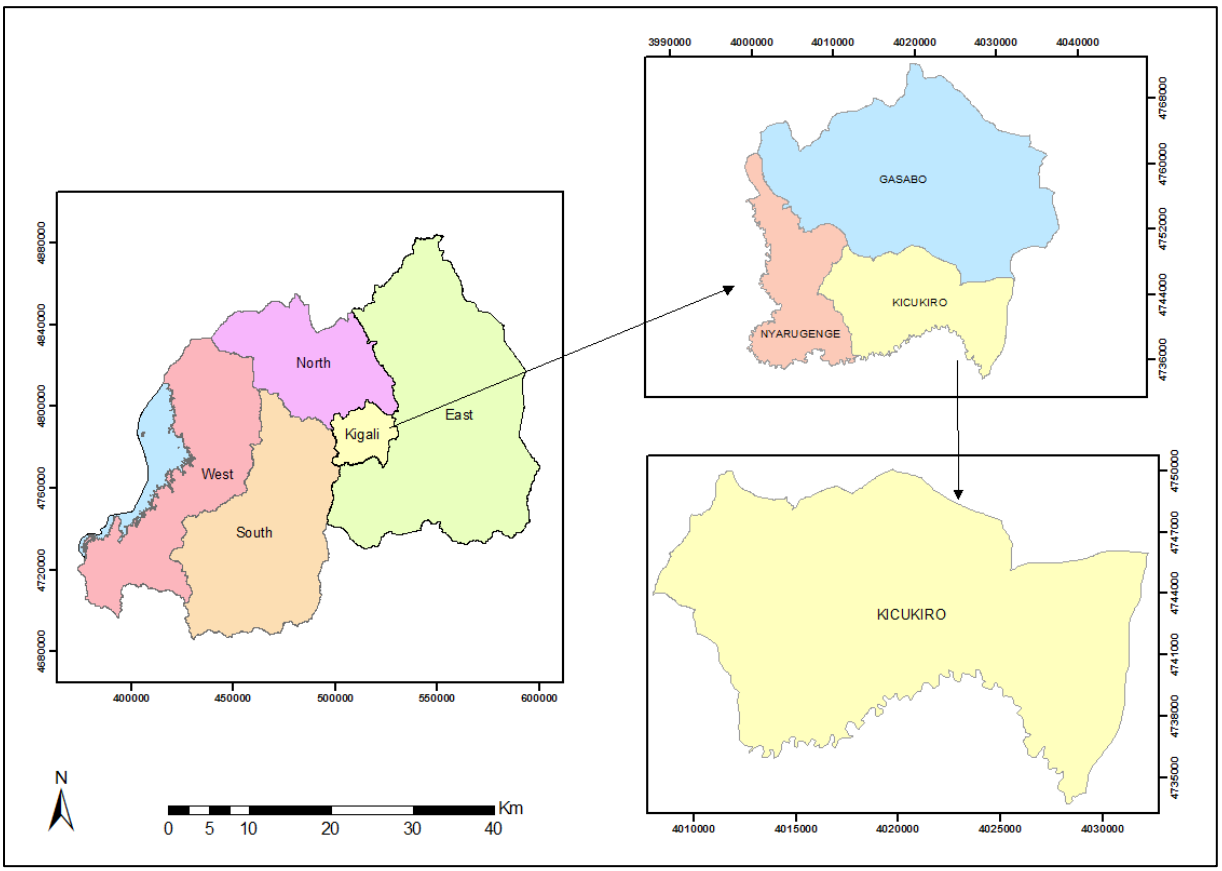

Figure 3.6 The Study Area

Kicukiro district is composed of 10 administrative sectors (Figure 3.6): Gahanga, Gatenga, Gikondo, Kagarama, Kanombe, Kicukiro, Kigarama, Masaka, Niboye and Nyarugunga. This district extends over a total area of 1667 sq. km having 86,426 registered parcels (Gollapalli, 2013).

3.3. Data Source and Collection Methodology

To develop a spatial database application for OSC, a set of requirements are needed to understand the existing situation. The study was based on both primary and secondary data. Primary data was collected through questionnaire. Secondary data which are database file/scanned document of all district organizations of Kigali was gathered from ITC.
Both primary and secondary sources of data were used for this research which is described below.

- Literature review: relevant literature was reviewed to get the knowledge and understanding of how current spatial database application developers design the architecture and application.
- Reports, internet research was utilized to collect information
- Questionnaire (via internet): the survey captured information related to existing situation, user and service requirements.
- Digital data: database file / scanned document of all district organizations of Kigali are available in ITC. Those data are used as a main input for the design of spatial database application. See the details in appendix.

3.3.1. Primary Data source

Primary data were gathered mainly through questionnaire. The questionnaire was designed for the officers of One-Stop-Centre and the citizens. The survey captured information related to services delivery, efficiency in terms of time, quality, there satisfaction and the process to deliver services. The survey was conducted through email. The questioners are presented in (Appendix-I) from a total of 26 individuals, from which 15 of them are customers/citizens and 11 of them are OSC officers from Kicukiro district, Kigali city. OSC directors, land valuators, land processors, land administrators and land surveyors were among the officers participated in the questionnaire.

3.3.2. Secondary data sources

Secondary data was collected to design a centralized sharable spatial database, applications and one-stop-shop for efficient service delivery. The secondary source of information include: relevant reports, internet websites were recognized and as a main source of information database file / scanned document of all district organizations of Kigali city were used as a main input for the design of spatial database application. The reference materials includes journals, report, books, internet websites were also recognized as a main source of information. The secondary data are presented in the table below (Table 3.2).

No	Type of Data	Data Type
Geodatabase (Base Map)		Vector
1	Administrative boundaries	polygon
	Elevation	poyline
	Hydrography	polygon, line
	Physical infrastructures	polygon, point, poyline
	Social infrastructures	point

	Land cover(aggregate)	polygon
	Shape file	Vector
2	Plots	Polygon
	Building	Polygon
	Road network	Polyline
	Zoning	Polygon
3	***Topographic Map***	Raster
	Topo Kigali 1978 NLC	
	final7	TIFF
	final8	TIFF
	final11	TIFF
	final12	TIFF
4	Reports(LAS manual , establishing District and Kigali city OSC and District-Sector-organizational-chart)	PDF format

Table 3. 3 Data obtain from Kigali City

3.3.3. Challenges in Data Collection

As in most surveys, difficulties were encountered during the data collection period. One of the limitations of this study includes lack of some reports that are relevant for the OSC's IT developments which can help to obtain the user requirements and the system specifications of the main OSC functions. In addition, the questionnaire survey was not obtained on time which was very useful for analysing opportunities, and to identify system weakness and user requirements.

3.4. The Design Method

The information about the existing situations including actors and services was described by using activity diagram. It helps to visualise and understand the role of actors ('who is doing what') with the corresponding process flow. Visual interpretations of the process together with SWOT analysis were used to assess the existing situation and to design strategies that use strengths and opportunities to overcome weaknesses and threat of OSC. The database application is designed to provide an integrated information system which will assist OSC's officers to efficiently share information and to minimize bureaucracy and related costs for citizens. The design takes in consideration the functional and user requirements. User and functional requirements were used as inputs for the system architecture design. Next enterprise Geo-database in ArcCatalog (using ArcTool) was created followed by loading and structuring data in ArcSDE geo-database (Base Map, building, cadastral_data and utility). Then, creating a relationship between the entities and registering the data sets as versioned was done. Fourth, designing the services in ArcMap (labels_layers scale range_scale format…) for cadastral management and then the .mxd file was published into ArcGIS server. Finally, the web application service was designed with some basic tools using ArcGIS Silverlight application. The detailed workflow of built application database is presented in Figure 3.8.

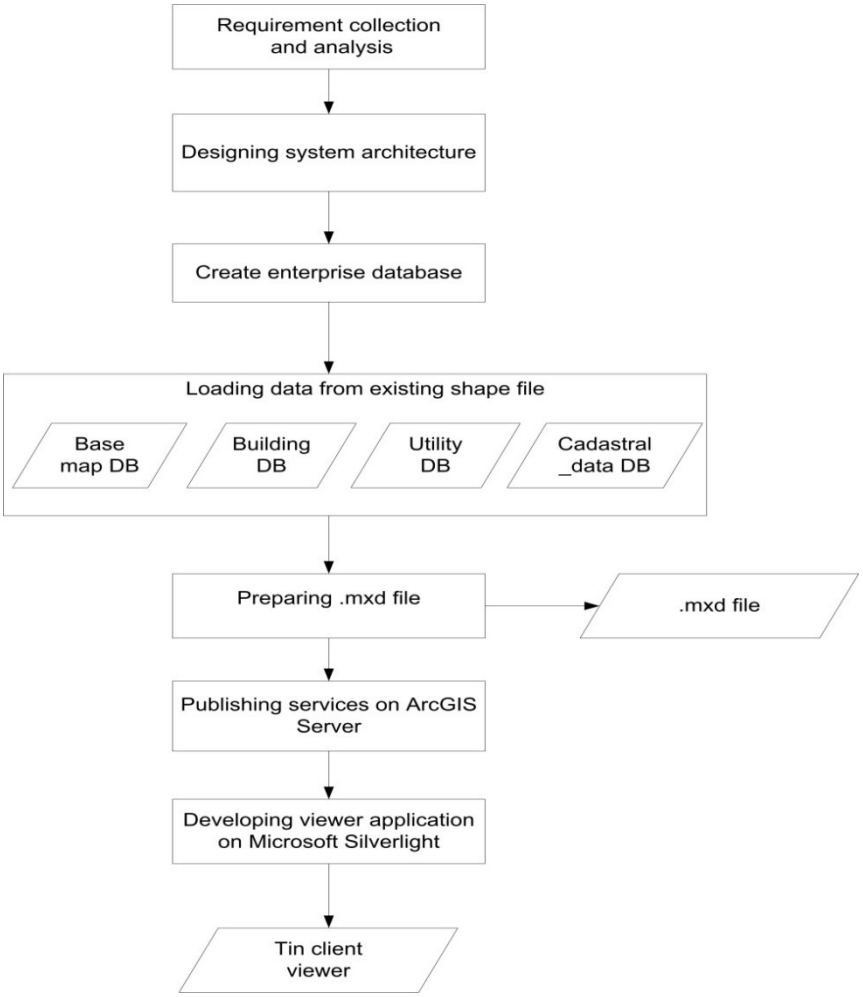

Figure 3.7 Methodology flow chart

3.5. Validation

The designed prototype needs to be validated. The validation was performed based on scientific knowledge acquired from literature reviews, and by developing a system prototype. The data is used to simulate the prototype. The validation is done by gathering information by asking experts who will ultimately use the services by making questions and discussion with ITC urban/land experts and cadastre experts.

3.6. Concluding Remarks

This methodology was designed to achieve the research objectives and to answer the research questions. Hence, the first phase was requirement collection and analysis; the data were collected using different data collection techniques including questioners (email) and existing documents. The second phase was the design phase; different software's were selected to develop spatial database application such as ArcSDE, ArcMap, and Microsoft Silverlight. In addition, the design of the system architecture and database applications further expanded and briefly explained in chapter 5 and 6. Finally to validate the application data were gathered using questioners. The next chapters four, five and six provide the results generated by the use of this methodology.

4. CURRENT SITUATION AND NEEDS FOR ONE-STOP-CENTRE IN THE CITY OF KIGALI (RWANDA)

4.1. Introduction

The previous chapter on research methodology gives a general view of the modelling process used in this research also illustrated by the Figure 3.7. This chapter presents the results related to research questions about the organizational structure, users/actors involve in data access and, problems and weakness in the current situation. Section 4.2 briefly describes the current structure of the OSC organization and users with their corresponding tasks. Section 4.3 examines the weaknesses of the current system using SWOT analysis. Section 4.4 presents the requirements to be respected in the design of the system architecture and spatial database application to address the problem.

4.2. Situation analysis of OSC

In order to develop spatial database application for OSC and to improve the quality services delivery in the district, understanding organizational structure and functions is a pre-requisite. The analysing the situation is done based on the information gathered from documents, and questionnaire. As part of the analysis the organizational structure, users/actors of OSC, their tasks and the services and processes in OSC are presented below. Finally, SWOT analysis is used to analyse the situation and design strategies.

a) Organizational Structure

OSC is bureau that combines, at the level of district and the city of Kigali, the land bureau, the housing bureau, the infrastructure bureau and environmental bureau for better and timely delivery of housing, land management, infrastructure and environmental services (Remezo, 2012). The responsibility of OSC is to centralize the combine the delivery of the services mentioned. OSC at the level of the district and City of Kigali comprises the following organs:

- The coordination
- The Housing Bureau
- The Land Bureau
- The Infrastructures Bureau
- Inspection

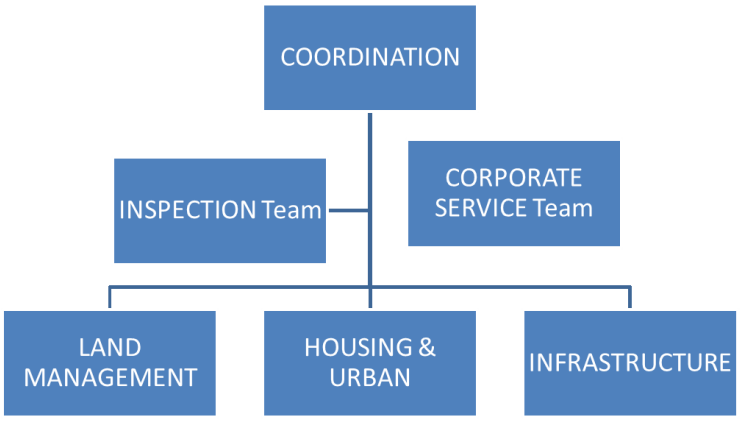

Figure 4. 8 Organizational chart of OSC Remezo, (2012)

The main task of One-Stop-Center is to centralize and combine the delivery of housing, land management, infrastructure and environmental services. The tasks at each department/organ are described below.

The coordination department is responsible for coordinating the activities of OSC, submitting reports of activities to the steering committee of the district and the city of Kigali, and speeding up the service delivery and advising the steering committee.

Under land bureau manages the process of issuing land documents, offering notarial services related to land, determining the value of land and ensuring the secretariat of land commission. The housing bureau is responsible for monitoring the elaboration of the specific urban development plan, monitoring the implementation of the city and district development master plan, issuing building, rehabilitation, renovation, occupation or demolition permits, ensuring that construction projects, and approving construction projects.

Monitoring the construction and rehabilitation of infrastructures in the district and the city of Kigali, ensuring maintenance of infrastructures, advising the steering committee regarding appropriate sites for infrastructures and preparing tender documents for infrastructures in the district and the city of Kigali is the responsibility of the infrastructures Bureau.

The inspection department on the other hand, has responsibilities of controlling the construction of public buildings, ensuring that the construction and rehabilitation of infrastructures, identifying illegally built houses and propose appropriate remedies, approving environmental impact assessment, and monitoring the implementation of the district and city of Kigali master plans.

Land transfer, land subdivision/merging, first registration, rectification of boundaries, replacement of title, correction of names and availing land information are among the land related services provided by the OSC to customers. The presence of these services assures the existence of some interaction between the service provider and customers. The following figure (Figure 4.9) shows such interactions between the OSC and internal or external users/actors.

b) Users /Actors of OSC

As depicted in the figure below (Figure 4.9), bureau of housing, land, infrastructure, inspection and Rwanda housing authority are the actors that are participating in the delivery of services in OSC. Moreover, external organizations like RNRA for information concerning land information and land use plan and RHA for information about master plan and urban plans are actors that took part in the OSC. This has been illustrated to understand the process flow so as to give an insight where information system could be incorporated. The idea here is to identify where certain process could be improved by mainstreaming information technology.

To understand the existing situation more, assessment of the process workflow to get ownership certificate and building construction permit followed by the SWOT analysis is presented following section 4.2.

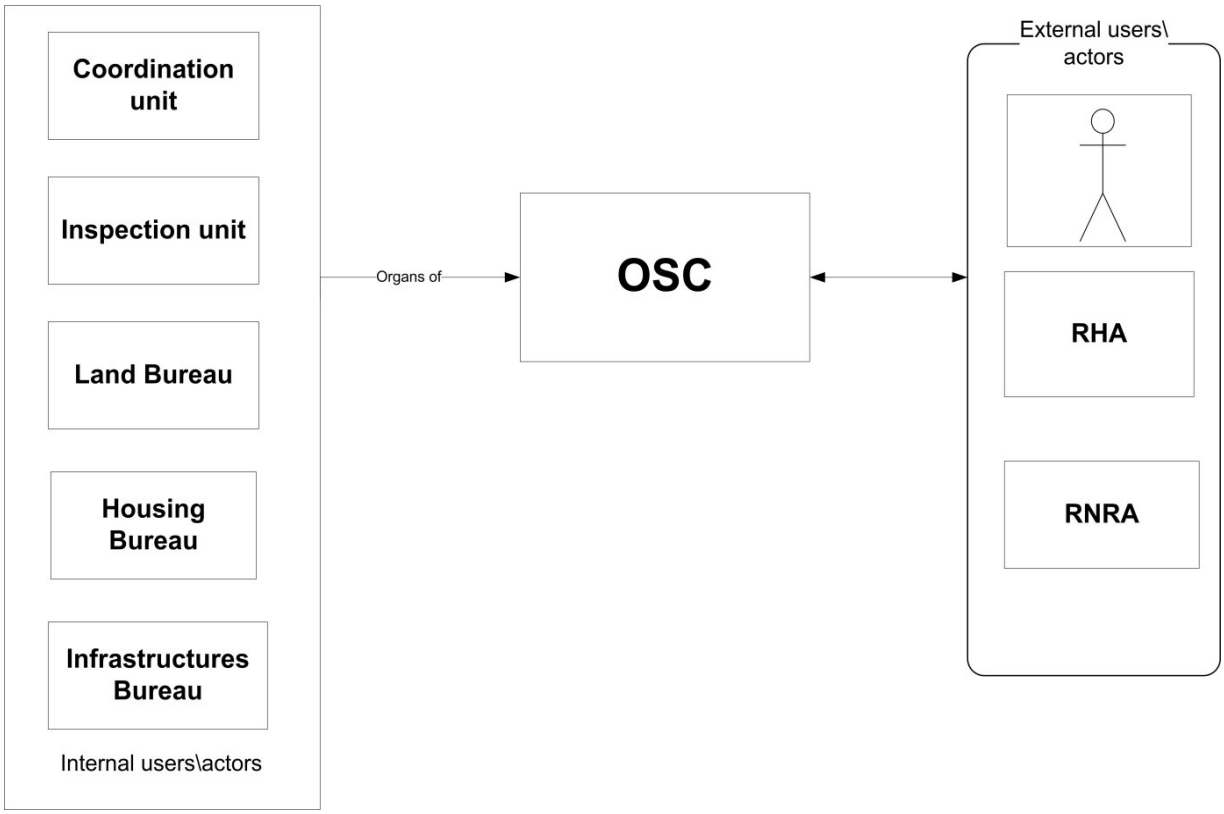

Figure 4. 9 Users of OSC

4.2.1. Assessment of the existing OSC process

The procedures manual described how the registration of changes in land information is to be done (RNRA, 2012). The manual described the workflows made of actors and tasks by the use of activity diagrams. The following table describes the current process that is implemented at OSC and the two selected workflows are presented in figure (Figure 4.11) below that will clarify the process.

In general, the existing OSC workflow for both occupancy certificate and building permit process the approval was done at deputy registrar which is not on same organization as the district officer process the different services; so in the existing situation service delivery will not be easy because district officers have to wait for the approval which is time taking. Moreover, even though in the OSC combines different departments such as (land bureau, housing bureau and infrastructure bureau and inspection) with one organization still the customer still has to contact different departments to request and receive service from the OSC. Even though it's well organized, still it will confuse the public users what process to follow where to go to get services provided by the agencies. This type of administration may result in corruption, delay of service, etc. Therefore to address this problem, developing spatial database applications using one stop shop concept helps to integrate different service in one place and efficient data sharing and managing within and across different departments and organizations as well as for customer satisfaction.

First the applicant communicates with the district land officers about the necessary information for application requirements. The customer then applies for transaction and the district land officers check whether the application is according to the requirements or not. The district land bureau officers process the accepted applications. Then, the deputy registrar office approves those accepted transactions and documents which are rejected will be send back to district land bureau officers for further rectification. If the documents fulfil the requirements it will be sent for approval. Then if the document is found to be correct by the deputy registrar office it will be approved and printed. Then the land officer issues the certificate and gives it to the applicant.

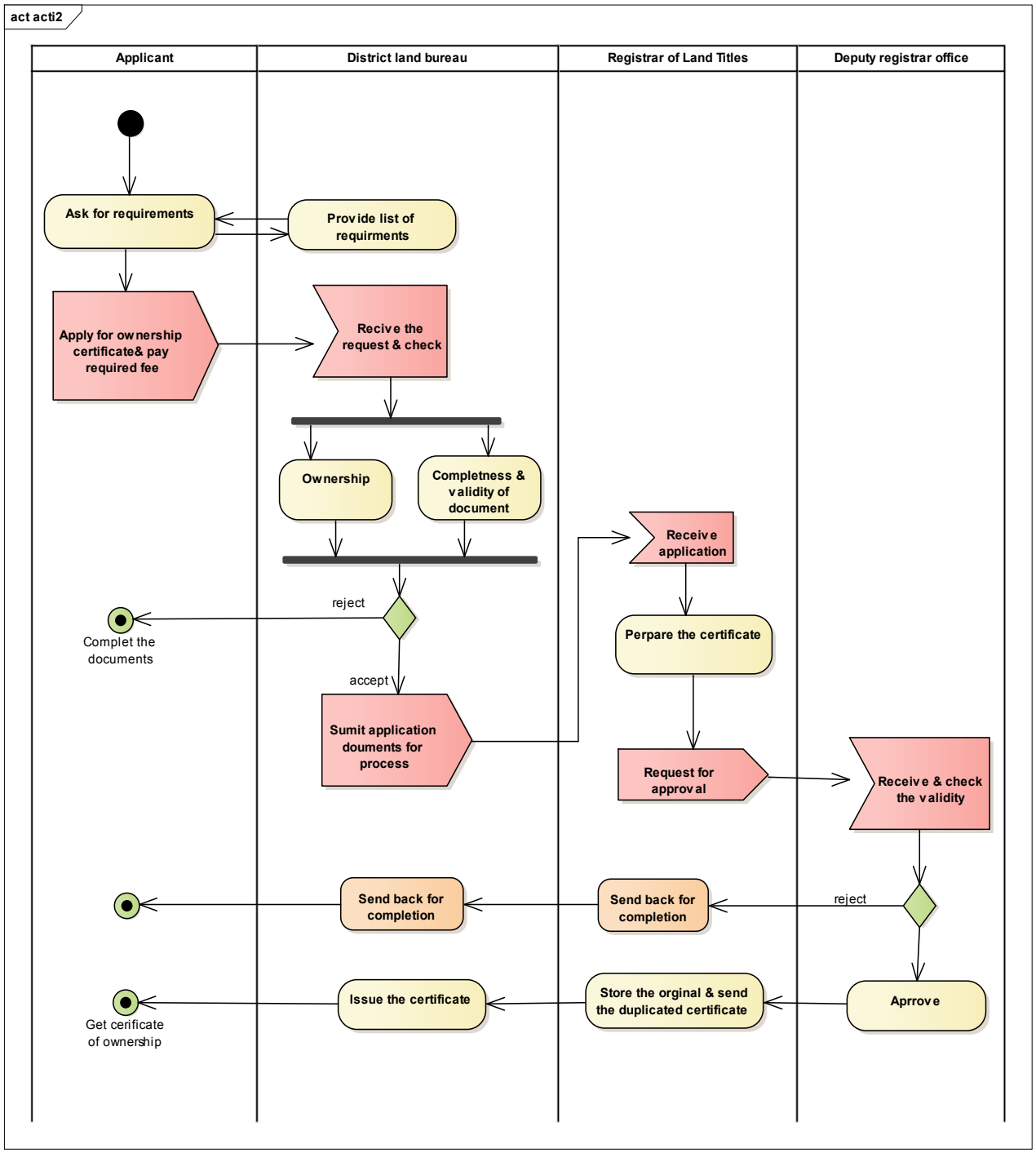

Figure 4. 10 Activity Diagram of occupancy certificate

In this case, the applicant has to communicate with the district land officers about the necessary information for application requirements. Accordingly, the customer applies for the service (building permit) and the district land officers check whether the application is according to the requirements or not. If the documents fulfil the requirements it will be sent for approval. Otherwise, the document will be sent back to the applicant for to fulfil the requirements and reapply. Then if the document is found to be correct by the deputy registrar office it will be approved and printed. Then the land officer issue the certificate and give it to the applicant.

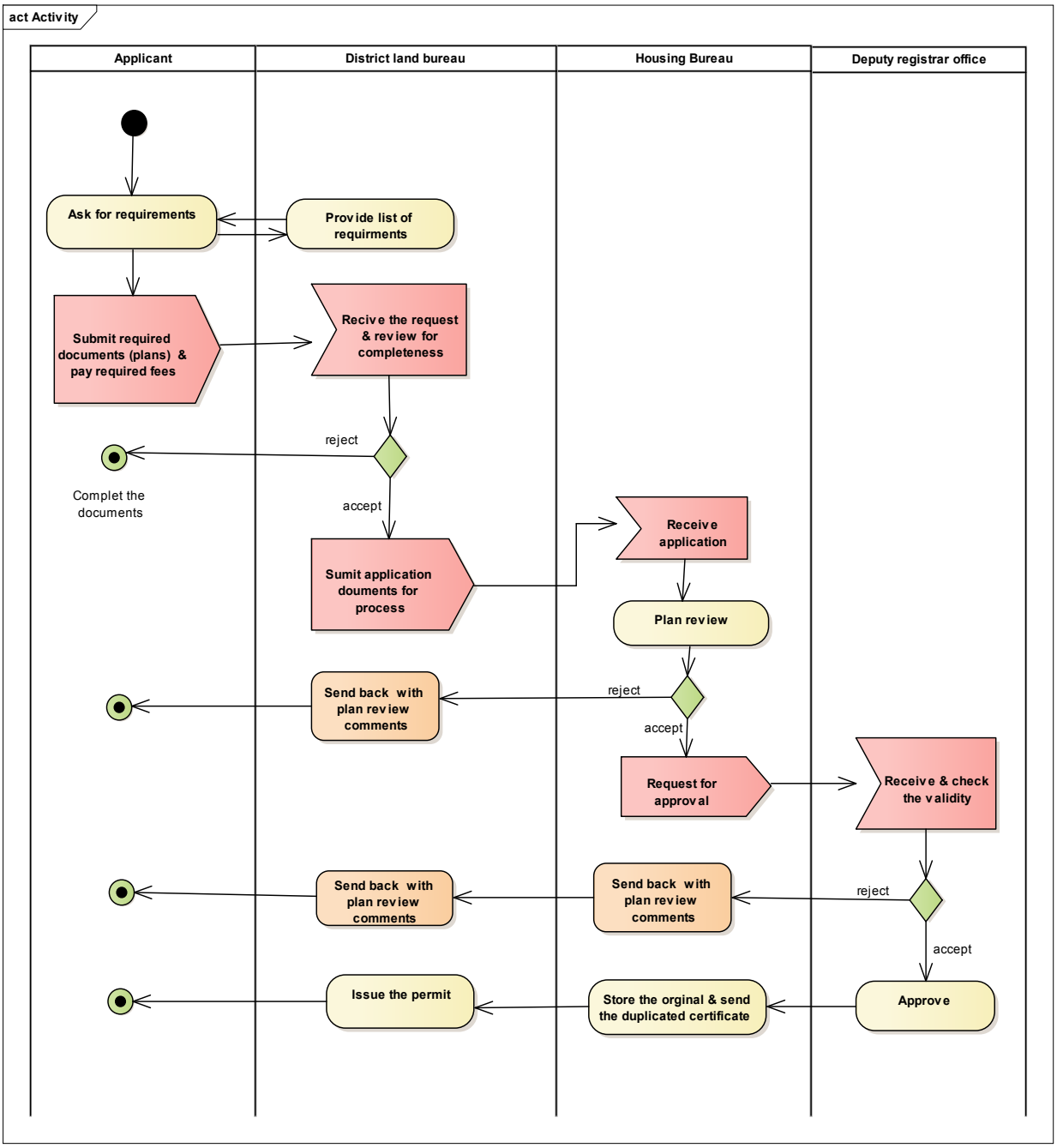

Figure 4.11 Activity diagram of building construction permit

4.3. SWOT Analysis and Strategies

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats, which is the most common approach for defining strategy (Team FME, 2013). Moreover, it is used to identify the strategies by applying the pair wise comparison to overcome the weaknesses and threat with respect to strengths and opportunities. To define strategies for an organization it is better to investigate the organization from both the inner and outer side. Inside an organization, bearing in mind factors related to capacity and infrastructure help to design the strategies for improvement. Considering external factors also play their own part for a successful strategy. In this review, the SWOT analysis is used to assess the current situation of OSC, Kicukiro district, Kigali city.

Organizational SWOT analysis –

Organizational issues analysed on the base of information received from questionnaires and literature's study. In the current approach of the organization towards service delivery and data management and sharing was investigated. Moreover, the source of information is mainly the questionnaires which are designed to address different target groups- citizens and the OSC officers. Based on SWOT analysis, strategies and requirements analysis are created. To define strategies for an organization it is better to investigate the organization from both the inner and outer side. Inside an organization, bearing in mind factors related to capacity and infrastructure help to design the strategies for improvement. Considering external factors also play their own part for a successful strategy. Such issues are presented and analyzed by SWOT analysis method as discussed below in (Table 4.4). In this section, the strengths and weaknesses of the OSC are derived from the internal factor. Whereas the opportunities for and treats of OSC are derived from the external factors. The strategies are made so that the strengths and opportunities are encouraged to overcome weaknesses and threats. Particularly strengths are used to minimize weaknesses and opportunities are used to minimize the effects of threats.

Strength • Act and clear rules and regulations • OSC organs	Weakness • Lack of Information sharing (DBMS / Spatial Data Infrastructure) • Paper based work environment • Service delay • No IT support team
Opportunities • Partnership with external organizations • Customer's need reliable service and online service • Government support • Academic institutions	Threat • Trained human power • Financial resource

Table 4.4 SWOT Analysis

As depicted in the SWOT matrix above the availability of clear acts, rules and regulations are the stronger components of the OSC.

Strengths

- Act and clear rules and regulations: the existence of good and clear rules & regulations makes sure a well-planned, responsibly administered and accountable to their citizens.
- OSC organs: the other strength of OSC is the existence of the coordination unit in the OSC organs which is well organized and helps to get the work done as planned.

Weakness

- Lack of Information sharing (DBMS / Spatial Data Infrastructure): lack of efficient data exchange mechanisms are a common problem when datasets are stored independently within departments. Different departments (e.g. Land administration, Construction Permit, Road development, Electricity-maintenance and etc.) of an organization may follow different legislations for a variety of application tasks, and use different applications to manage their information separately. Since these are the different departments, they manage their data separately with limited capability to share data between each other. This results a limited capability to share data with each other.
- Paper based work environment: the paper based work environment and lack of information sharing database which lead to service delay.
- Service delay: in the existing situation service delivery will not be easy because district officers have to wait for the approval which is time taking. Moreover, even though in the OSC combines different departments such as (land bureau, housing bureau and infrastructure bureau and inspection) with one organization still the customer still has to contact different departments to request and receive service from the OSC.
- No IT supports team: The other important but missed component in the structure of the OSC is the IT department. The value of this unit is mainly observed when technical problems arise. This unit would have played a great role in system maintaining and upgrading systems in time.

Opportunities

- Partnership with external organizations: The opportunity to outsource products and the customers need to get fast online service is an opportunity for OSC to focus on data sharing issues mechanisms.
- Customer's need reliable service and online service: might be a good way able to adapt to new issues by developing effective, creative tools to deliver services and meet the needs of their citizens.
- Government support: in order to establish OSS concept in organization the support from the government which will discourage bureaucracy and motivate good governance and customer service is an opportunity for the OSC.
- Academic institutions: it might be good to have academic institutions to train staff that will benefit OSC organizations to form and maintain data, facilities the process.

Threat

- Trained human power: absences of trained human power in the market is one the challenges; IT skilled staff are needed to maintain these geographic databases is obtained.
- Financial resource: On the other hand, lack of financial sources to upgrade the system and human capacity are among the challenges.

The strategies have been derived from the SWOT analysis matrix above. The main concept is to analyze how we can improve the present system with the help of strategies using strength and opportunity to overcome the weakness and threats. This process helps to provide strategies for achieving competitive advantage in the market. Thus, based on the SWOT analysis above the following strategies are designed.

- Use the support of the government and existing acts to cover financial needs and train staffs in the academic institutions. Hence to include IT team and enhance capacity of existing OSC.
- Improve the partnership with other organizations to develop a shareable data base with in the OSC and to outsource products.
- Cover financial needs from out sourcing and service delivery incomes.
- Restructure the OSS based on reliable Geo-database that minimizes the dependence on paper based service. This also helps to avoid overlapping tasks and foster service delivery by introducing Geo-IT application.

4.4. Process and Data requirement analysis

SWOT is pre-requisites for system requirements analysis of OSC; In addition, the requirements of the current process are defined next to SWOT analysis since the results of the SWOT analysis is used to identify problems. Defining the problem enable us to identify data requirements that are relevant to the application. The identification of data requirement means documenting the data which is necessary to describe each item in the definition of the problem domain. Data describes real world problems and the procedure of identification is an iterative process. Data can be identified by different means in this study it was acquired from SWOT analysis and questionnaires.

According to the research there was lack of information sharing database and the paper based work environment which lead to inefficient sharing and management process, duplication of data and service delay. It was discussed already during the SWOT analysis, that there were service delay and lack of data sharing. This lacking and required information was identified, together with the process from which these data should be obtained and with actors responsible for process execution. The process that should contain in the developed database applications for better efficient service delivery for citizens are discussed in the following section:

4.4.1. User requirements analysis for OSC process

Relevant documents and questionnaire results indicated that OSC process is utilised by land processors, land administrators, building inspectors, planners, surveying technician, legal assistants, and the coordinator of OSC department. All these users have their own needs and responsibilities when accessing the system. The user requirements include the data required to process a building construction permit application, the information required to be input to and output from the system. The user requirements from a practical point of view are shown below in Table No 4.5.

User	Responsibilities	Data required	Required action
The coordination	Present report , check information	Base map, Parcel layer Building layer	• To approve the application • Sign the grant permission
Land processors (back-		Base map	• Get the parcel number

office)		Building Plot layer	information • Get parcel attributes information of the approved application • Prepare layout certificate for occupancy certificate • issue plan
OSC land officer (front-office)	Provide information , Deliver occupancy certificates,	Building Base map Plot layer	• Get the parcel number information • Get parcel attributes information of the approved application • Print attach certificate
Housing bureau officer	Provide construction permit	Building Base map Plot layer	• Overlay the maps • Determine available land for development • Query the attribute database • Prepare permit certificate • Attach permit
OSC housing officer (front-office)	Provide information , permit certificates,	Plot layer Base map Plot layer	• Get attribute information of the parcel/building of the approved application • Print permit

Table 4.5 User requirement

4.4.2. Requirements of the System

In this paper, several facts finding methods have been employed – Both primary and secondary data collection were used. The information obtained from questionnaire and reports are used to identify the requirements. Based on the case study, system requirements, the functional and non-functional requirements of the system are identified.

Aspect	Problem	Requirement definition
Service delivery	Long process to deliver different services	A database application in order to improvement of service delivery and Data sharing through application of Geo-IT
Information sharing	Lack of access to information	There should be sharable database to allow different departments and other governmental organization to share , access data

Table 4.6 system requirement

Functional Requirements

The system is expected to provide the following important functionalities.

Requirement ID	Requirement Definition
FR 1	The system should provide all kind of information
FR 2	The system should process occupancy certificates
FR 3	The system shall process construction permit
FR 4	The system should maintenance building information
FR 5	The system should able to maintain the land parcel
FR 6	The system should able to print certificate and attach

Table 4.7 Functional Requirements

Non-Functional Requirements

For an efficient, correct, and robust operation of the system, some additional non-functional requirements emerged as necessary. These requirements are not directly related to functionality.

1. The system shall have easy to use user interface
2. The system shall authenticate and authorize users

4.5. Concluding Remarks

The current organizational structure of OSC combines the land bureau, housing bureau, infrastructure bureau and inspection bureau. In order to design the new system architecture from both primary and secondary data collection were used to obtain information obtained and identify the requirements. Moreover, using SWOT analysis for pair wise comparison to overcome the weaknesses and threat with respect to strengths and opportunities.

5. ENTERPRISE SYSTEM ARCHITECTURE FOR ONE-STOP-CENTRE IN THE CITY OF KIGALI

5.1. Introduction

This chapter provides an architectural description for One-Stop-Centre (OSC) using different views of the system. The views include high level architecture view, use case view and data view. The designing are done in UML and Microsoft Visio based on the requirements that are identified from the previous chapter. In general this chapter provides the architecture of OSC using standard UML diagrams, including use case, activity diagram and package.

5.2. Overview of High-Level system architecture of OSC

The following package diagram shows the high level packages and elements that make up OSC database application. Moreover, the architecturally significant parts of the design and its decomposition into packages and subsystems. The Figure below shows a high-level architecture diagram depicting the structure of the system OSC, such as the database architecture, services, products and actors involved. The user will use products of the service which are stored in the database which are requested by applicants; the database allows to stores the products and to maintain/use the service by the user. For some significant packages the logical view is further decomposed into use case, activity diagram and class diagram.

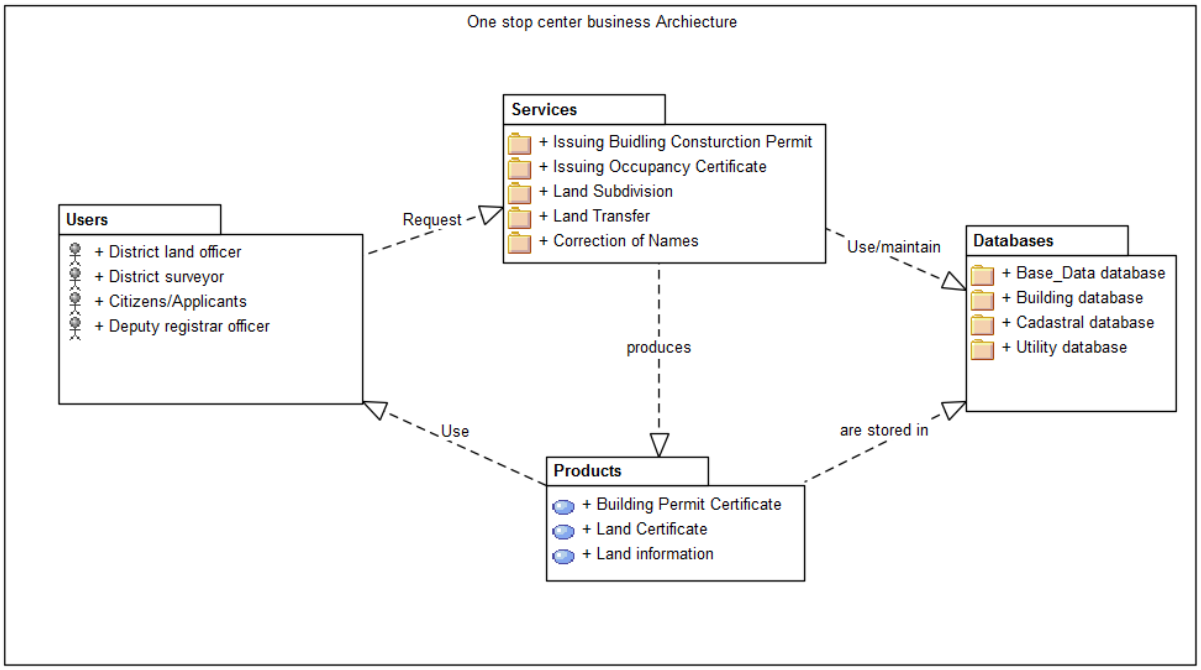

Figure 5.12 High-Level system architecture of OSC

5.3. Modeling services as spatial application

The diagram describes the functionality of the system from the user point of view. In the following Figures (5.13, 5.15) gives a use case diagram which describe the common tasks that the OSC database application should support. All the use cases describe the situation the process of delivering both land and buildings permit certificates. Moreover, the activity diagrams show the step-by-step movement of actors as they react to changes in the system brought about by previous actions, or by the actions of other objects or actors in the system. As show in below in Figures (5.14, 5.16) the activity diagrams for both application are presented.

a) Building permit

In section (4.2.4) the process and the drawbacks of the existing OSC were discussed; by clarifying the difference between the proposed workflow and the existing the new proposed workflow will improve the limitation of the existing process. As shown in the following Figures (5.13, 5.14) the building permits application initiated by the applicant requesting information at the district land officers about the necessary information for application requirements. The customer then applies for transaction and the district land officers check whether the application is according to the requirements or not. The district land bureau officers process the accepted applications. Then, the director officer approves those accepted transactions and documents which are rejected will be sending back to district urban planner officers for further rectification. If the documents fulfil the requirements it will be sent for approval. Then if the document is found to be correct the director will approve and sent to back officers. Then the urban officer will scanned the document and attach on the database in order the front office will get the attached document to be printed and issue to applicant.

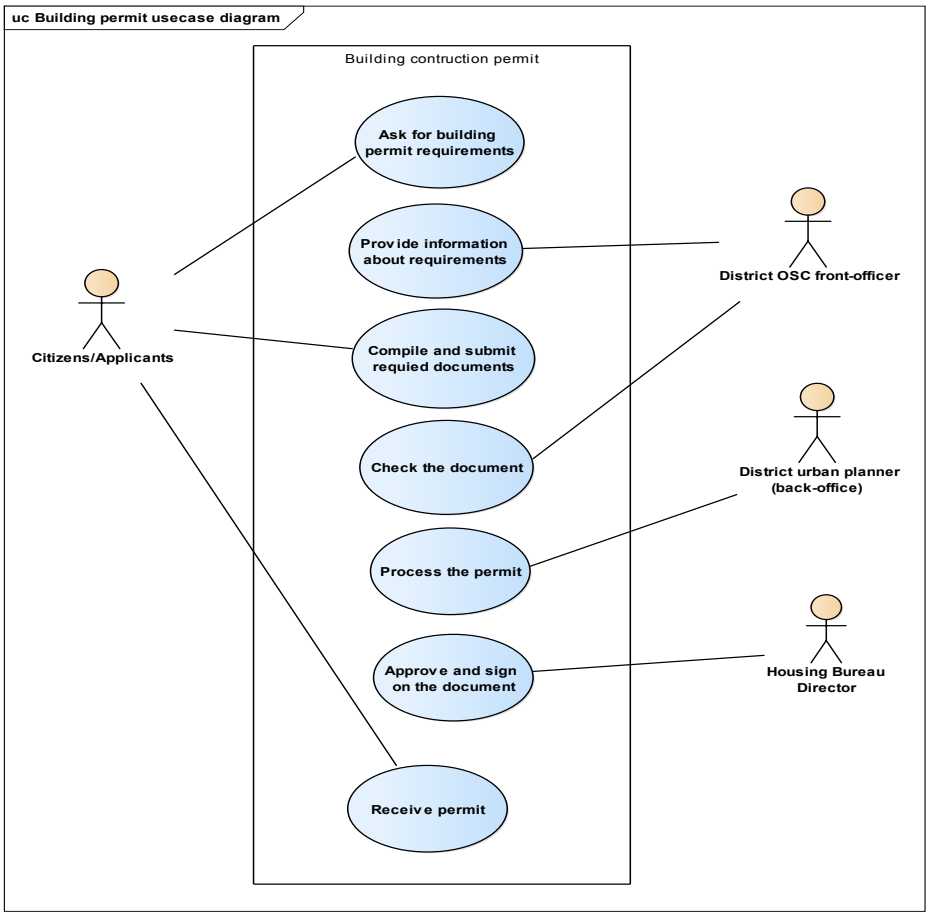

Figure 5.13 Use case diagram of Building permit

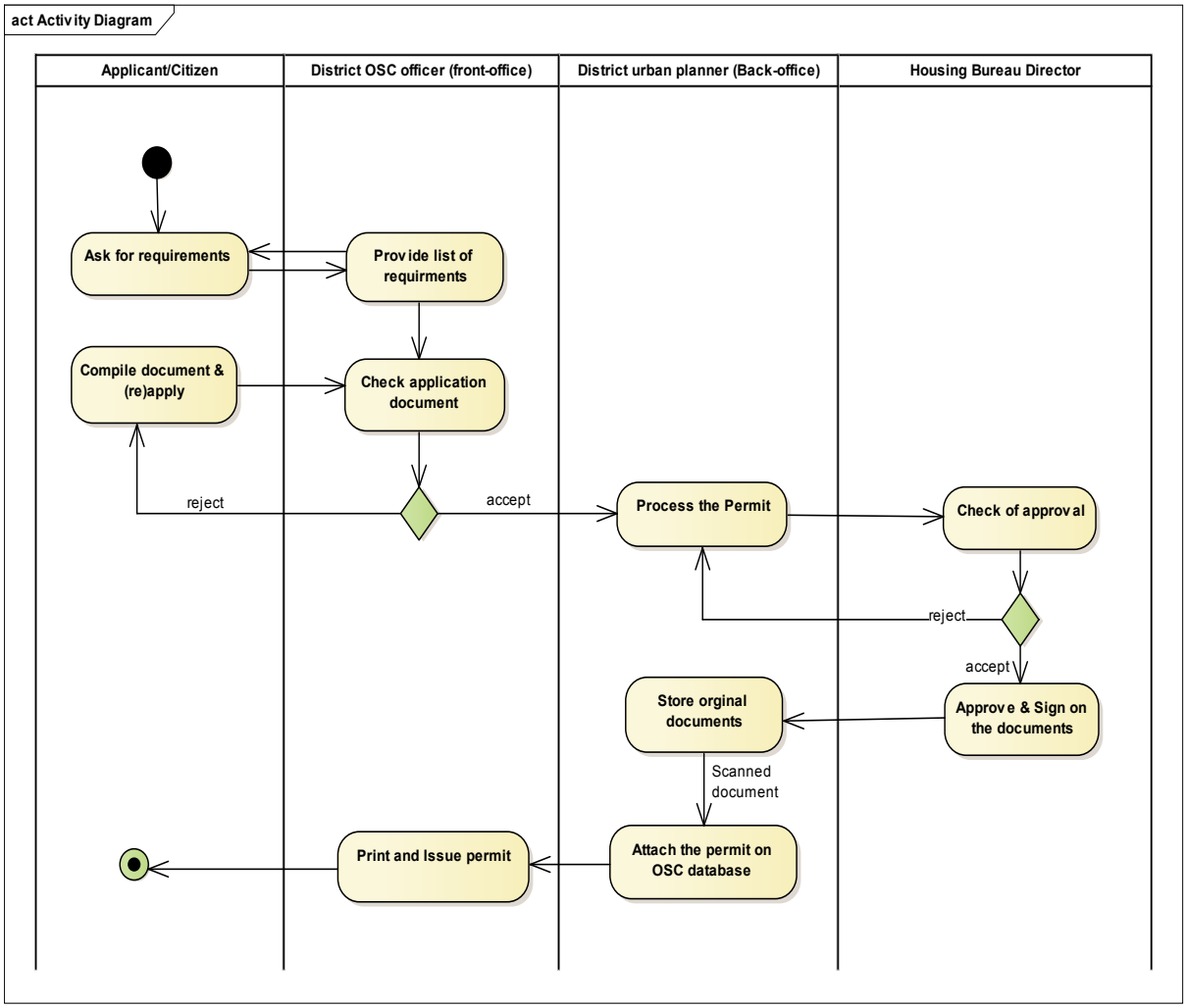

Figure 5.14 Building permit process activity diagram

b) Occupancy certificate

The following diagram shows what system functions are performed and for by which actor. As discussed in section (4.2.4) the process and the drawbacks of the existing situation of OSC; by clarifying the difference between the proposed workflow and the existing the new proposed workflow will improve the limitation of the existing process. As shown in the following Figures (5.14, 5.15) the process to issue an occupancy certificate is described below; the process is initiated by the applicant requesting necessary information for application requirements in order to apply for occupancy certificate. The district land officers (front office) will provide information for the requirements and check if the application is according to the requirements or not. Then the district land bureau officer (back office) will process the accepted applications and send to the district land bureau director for approval. Then, the approve document will be scanned and attached in the database so that the front officer can get the document to be printed in order to issue to the applicant.

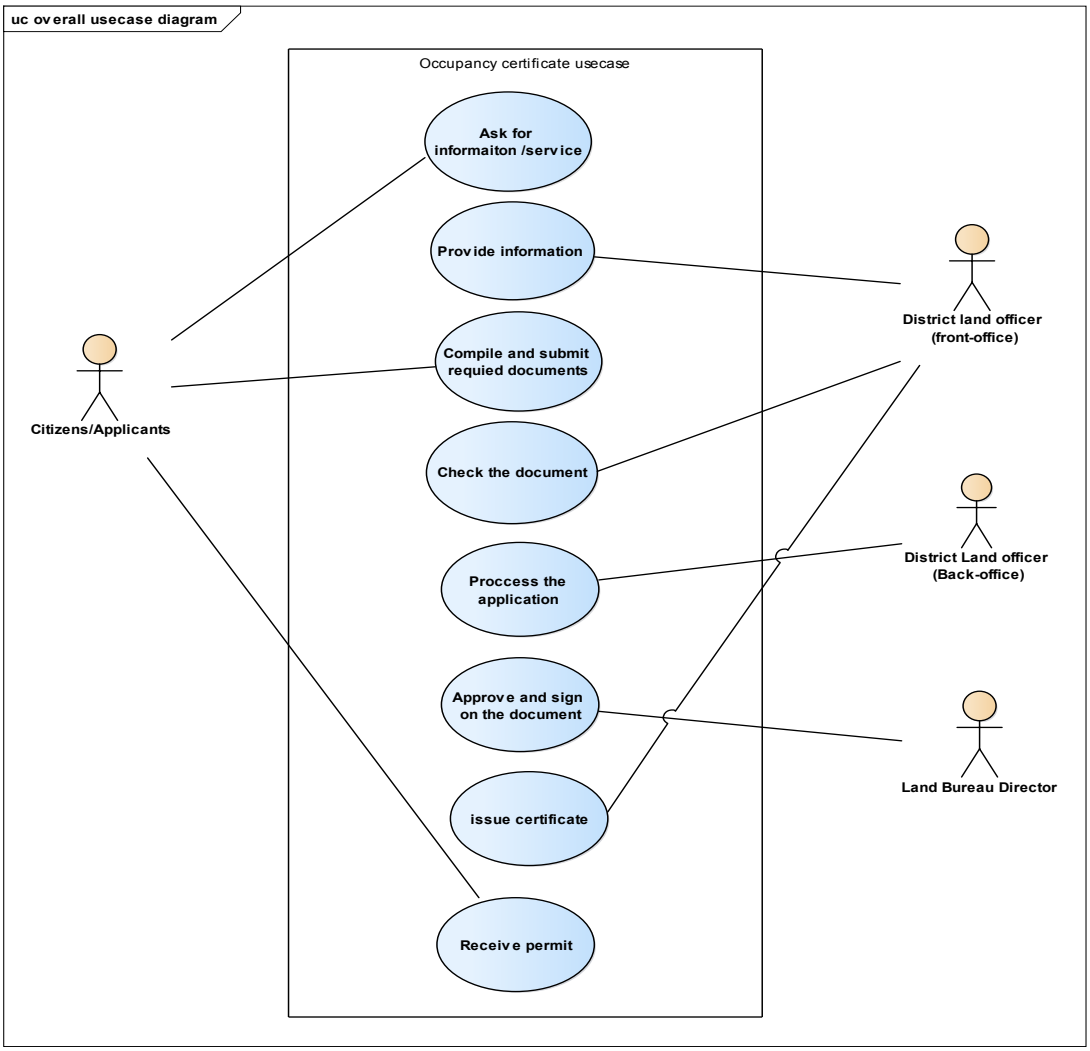

Figure 5.15 Use case diagram of occupancy certificate

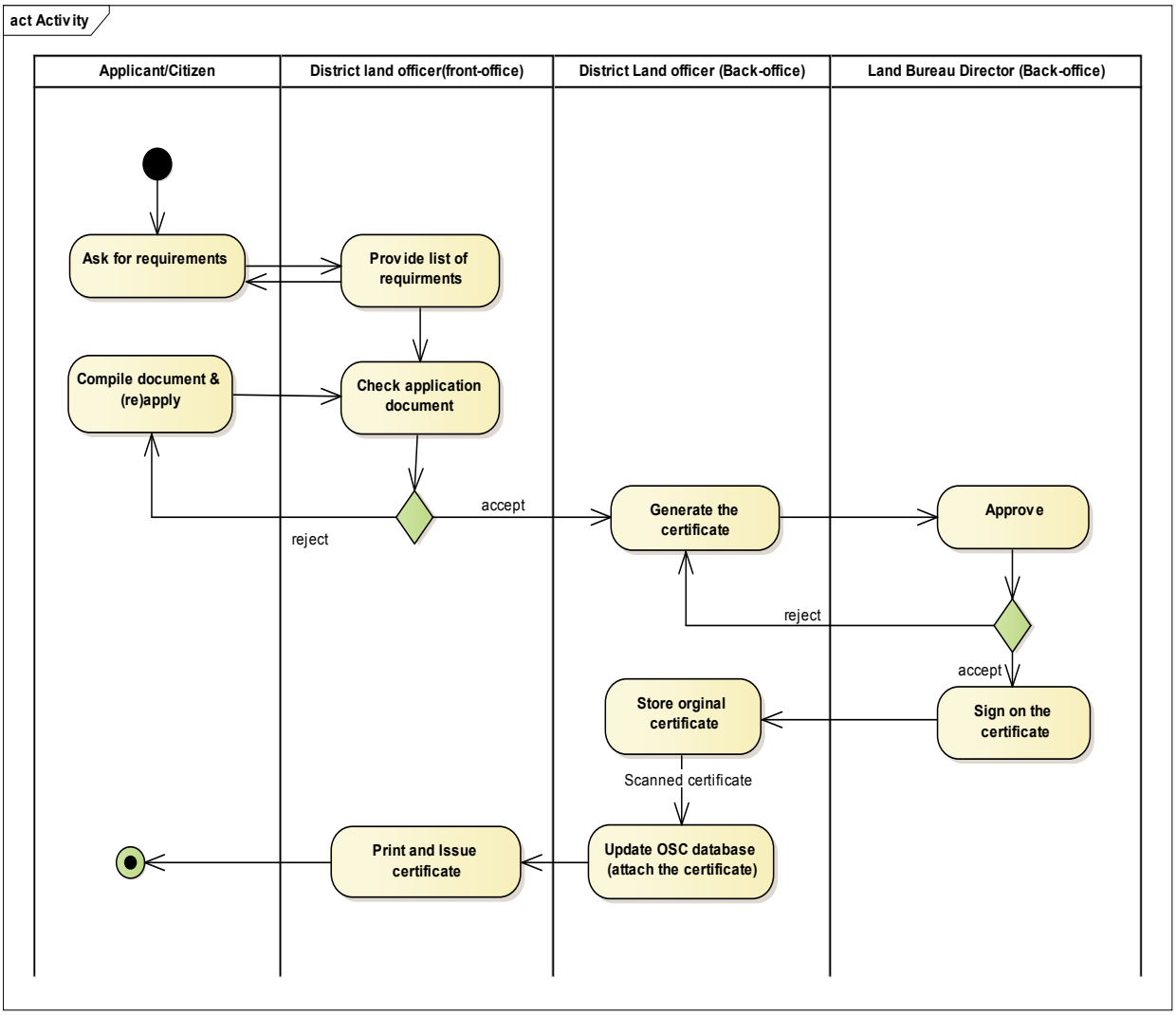

Figure 5.16 Issuing occupancy certificate process activity diagram

In general, the new proposed OSC workflow use front and back office approach which is helpful for fast and efficient service delivery, to ensure customer care and data security, to minimize bureaucracy and corruption. Moreover, as shown in the previous section 4.2.1 the workflow for both occupancy certificate and building permit process the approval was done at deputy registrar which is not on same organization as the district officer process the different services; so in the existing situation service delivery will not be easy because district officers have to wait for the approval which is time taking. Moreover as discussed in section 4.2.1 Even though the current situation is well organized, still it will confuse the public users what process to follow where to go to get services provided by the agencies. This type of administration may result in corruption, delay of service, etc. Therefore to address this problem, developing spatial database applications using one stop shop concept helps to integrate different service in one place and efficient data sharing and managing within and across different departments and organizations as well as for customer satisfaction The new proposed system has fewer transaction workflow steps, cost and time reduction in service delivery and enhancing land governance are among the benefits of the approach.

5.4. Modeling database

This section provides an overview of the architecturally significant persistent elements in the data model. The Figure 5.17 below used to show how the data is organized using database management system. This model is derived from the high level architecture of OSC (5.12). Moreover, it identifies the component and strives to bring the data structures of interest together into a cohesive, inseparable, and whole by eliminating unnecessary data redundancies and by relating data structures with relationships. The OSC data model consists of four databases containing a number feature class namely: Base_data, cadastral database, building, utility database.

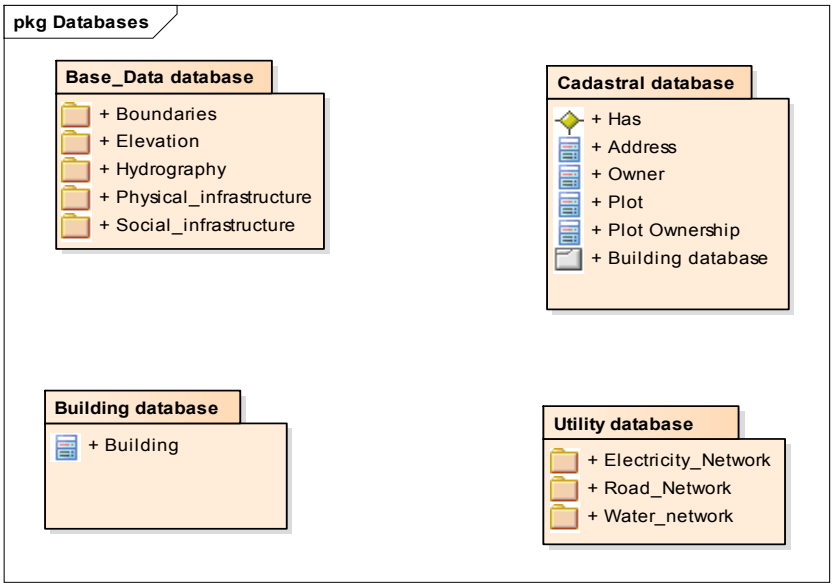

Figure 5.17 OSC databases

5.5. Technical architecture design

System architecture is the representation of system along with its components, relation between them and the product. The components of the architecture need to link with each other, data used should be interoperable and the way of providing information should be identified. It gives the integral technical overview of the system. The architecture is designed on the basis of needs and requirements of the users so that the system can sustain. As shown below in figure (Figure 5.18), the architecture is designed with the concept of web based application for OSC and three tier client server concepts. The entire system is designed as a client/server system in order to obtain an OSC model that can be used to enhance the efficiency of the land agencies in the land delivery service.

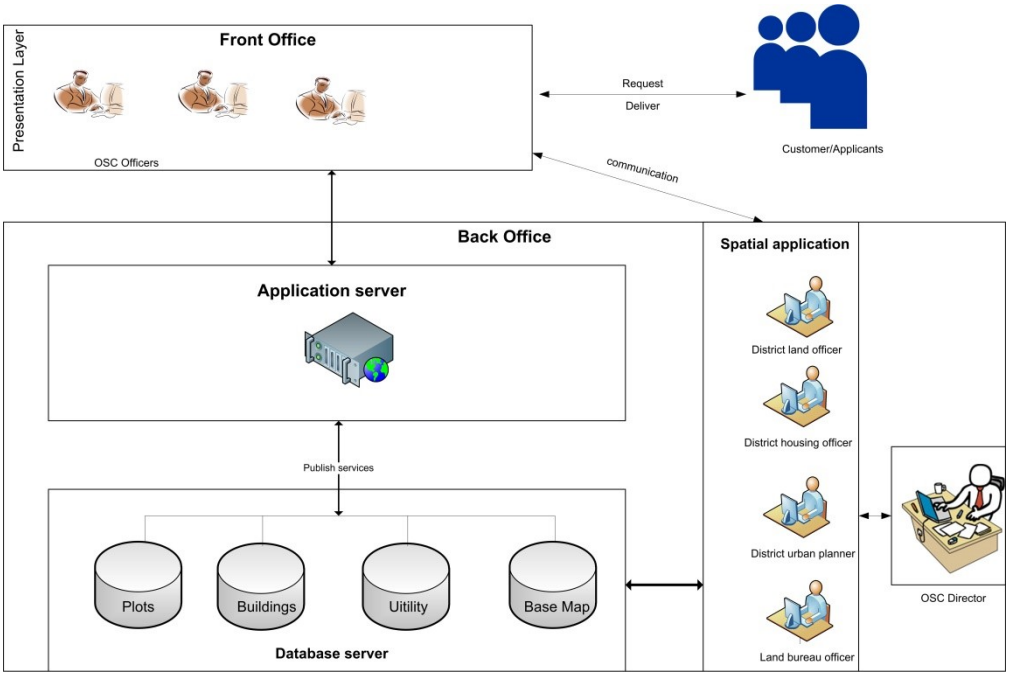

Figure 5.18 System Architecture

The architecture design consists of the front and back-office. Front-office applications are responsible for the interactions with the users composed of citizens, governmental and non-governmental organizations. The back office is the layer responsible for data storage and management the spatial database. The databases are stored by the OSC back office and the applications are maintained by the department. The users at the back office will use ArcGIS Desktop software to maintain the database for variety services like producing land occupancy certificate, building construction permit and so on. Thus, Arc GIS server facilitates the communication between the Silverlight application and database. The ArcGIS server is the central part of the system and publishes the services. It reads data from the database and cooperates with users to provide them with dynamic information through the Silverlight application.

The front-office's OSC application viewer is main interface for employees of the customer contact centre. The front-office application viewer allows the OSC officers to access the database and deliver service based on Customer/applicants request. Silverlight application is used in the Front-office to communicate with the system using web browsers. In front-office the users will use the Silverlight web application to access the database in order to deliver different service to customer like occupancy certificate, building permit and other information which is done at the back office using ArcGIS desktop.

The system architecture anticipated in this paper is three tier client server having client layer, service layer and data layer. Overview of each layer is presented as follows:

- Presentation layer

Presentation layer provides application's user interface. It is a Web browser with a client viewer a plug-in component for Internet Explorer. Here the user interacts with the Silverlight Webmap. This client side viewer provides both vector and raster viewing. It has built-in client-side functionality for users to perform GIS analysis at the client side. The interface is a website which is easy to use. On this interface, users are able to know about parcel and owner information. For citizens, the provided information is limited at

basic level. For professionals and experts, the interface provides special account with more details information related to specific purposes.

- Application layer

The application layer processes the user requests and connects database. IT provides services which can be used by the applications on the presentation layer. It will provide services, like map services, which will be used by the presentation layer. Another task of this component will be the centralized user management and authentication service. All services on this layer will be provided as web-services such as WMS or WFS.

- Data layer

The data layer is responsible for storing the application data. The database provides support for storage and manipulation. Data layer (database) it is considered to be the backbone of the OSC system. This will be implemented in ArcSDE for storing and maintaining spatial data. The database contains spatial and non- spatial information: the base map, utility, cadastral data having the parcels, the buildings, zoning, address and the customer. The parcels will cover the entire area of Kigali city. The data can be retrieved from data servers.

5.6. Concluding Remarks

This chapter was focussed on designing the system architecture based on one stop concept. By apply use case and activity diagrams the process of delivering both land and buildings permit certificates are described. Moreover, the activity diagrams show the step-by-step movement of actors as they react to changes in the system brought about by previous actions, or by the actions of other objects or actors in the system. Based on the system requirement as discussed in chapter 4, the design phase architecture is established, System components, interaction among components and interfaces are identified and defined.

6. DESIGNING AND VALIDATING PROTOTYPE

6.1. Introduction

This chapter specifies database design and application design for Kigali city OSC. In the design phase the database data model is established, the system components, interaction among components and interfaces are identified and defined. Further it details on the implementation of spatial database applications for the prototype is discussed.

6.2. Hardware and software requirement

The prototyping of the database was done using a number of software and hardware resources. Among the software components, we used ArcGIS desktop to create GIS resources and publish the resource as services. ArcSDE is also one of the software used as data management software which functioned as a backend database to store and manage the spatial data. In addition, we used ArcGIS server software which is used to process, share geospatial data and facilitate the communication between Microsoft Silverlight application builder and the database. Moreover, Microsoft Silverlight application builder is one of the software used during this research work to design the front-office application viewer which allows the OSC front-officers to access the database in order to deliver variety of services to customers. On the other hand, we used PGM database server for storing a sharable databases, ArcGIS server for deploying the services and a personal computer with all basic Peripherals as a hardware components.

6.3. Physical design of Database schema

a) Data model

The aim of design phase is to map functional requirements. In order to design database application, a shareable database must be designed first. The data model is used to design the relational tables. A database data model describes the structure of the data and it represents classes of entities about which an organization wishes to retain information, the attributes of that information, and relationship among those entities as well as relationships among those attributes (Alhir, 2003). Different data models (languages) as discussed in Chapter 1 are used to create data base models one of them is UML diagram. The physical design of the enterprise Geodatabase with Unified Modelling language (UML) was build and maintain in enterprise architecture software. In this section, UML was utilized to build the database model of the Kigali city's OSC Geodatabase.

The model describes the organization of the data how might be represented in a computer system. The diagram below illustrates the data model, it helps to model the entity and establish the relationship between them. The diagram identifies entities which are an object that exists conceptually independent in the real world which can be identified. The database design diagram for OSC is shown in Figure 5.20. The diagram shows identified tables, their columns and relationships among the tables namely: Utility, base_map Owner, Address, Building, Plot and plot_ownership.

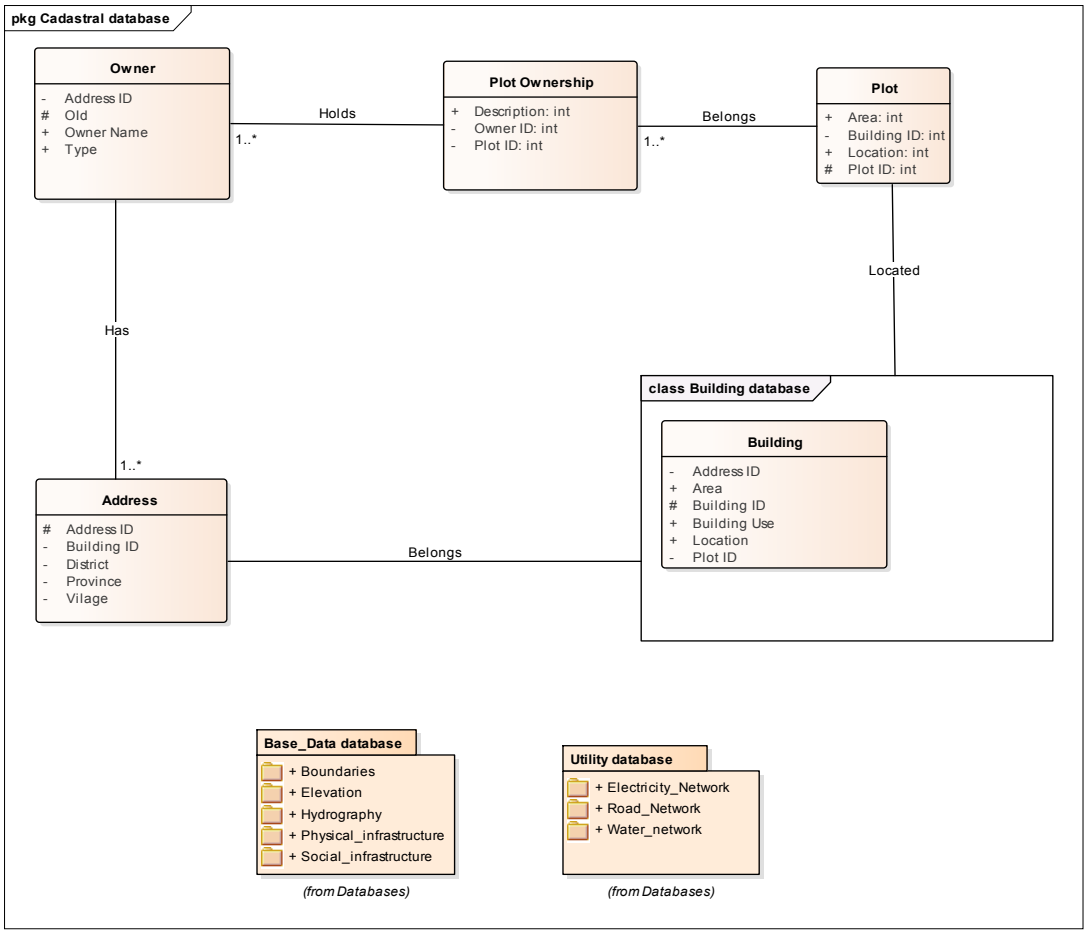

Figure 5.19 Database data model

b) Schema

The above figure (Figure 5.20) shows how the different entities relate to each other. The following are a list of the entity types that were identified for the development of the database and relationships occur between the entities.

The schemas of the OSC database are:

- Base_data – contains a data that boundaries ,elevation hydrography, physical infrastructure and social infrastructure
- Building – data describing the building managed by the agency
- Utility – contains the three main utility data's (road network, water network and electricity network)
- Address – address details
- Owner – contact and related details for owners (individuals, organizations)
- Plot – a data describing the parcels
- Plot_ownership – a table contains description of parcel

And, Relationship type

Has	owner and address
Holds	owner and plot
Belongs	plot and owner
Located	plot and building
Belongs	building and address

6.4. Enterprise spatial datapase

a) Process to create Database

Implementation involves translation of the database design model into a physical database schema. The database model (Figure 5.20) has been implemented in ArcSDE and Postgres Database. In this research project, ArcSDE is used as the backend database. ArcSDE is a spatial database engine product of ESRI. It uses the middleware technology to store and manage the spatial data in the commercial database, such as Postgres, SQL server and etc. . . .

In order to manage the spatial data, attribute data and the relationship that exists among them an enterprise database was created in Arc Catalogue. Creating geo-database and database schema was the first step of the design process. Hence, Geographic Information System is an appropriate tool to collect, store, manage, analyze and display spatial data; the geo-database includes the plot, utility, base map and building feature datasets along with other auxiliary data were created using ArcGIS software. In addition, three different database tables were created i.e., person information database, owner database and address database. These tables were used to differentiate the owner of the plot and joined with the feature class used to extract different information.

Every feature datasets, feature class, and attributes are defined and created then loaded the database with data from the existing shape files. Once the data have been loaded into the appropriate classes they can be used, in combination with associations to explore database content. The final result is an Enterprise spatial database which is open for manipulation and analysis using standard and custom tools available in ESRI's ArcGIS. The database content can now be used to address substantive research questions for service delivery, management process and as a foundation for web application.

6.5. Overview of Database Applications

The diagram of the methodology is shown in Figure 6.22 below and presents the software's and hardware needed to develop the database applications which were discussed in section 6.2. As one can see from the diagram there are: ArcSDE which is used for database management; the ArcGIS server which provide a link between database and viewer interface; and Microsoft Silverlight viewer which is used for displaying, querying and print spatial data for the front office. There is also ArcGIS desktop which allows for editing, process and sharing geospatial data at back office. The databases are stored by the OSC back office and the applications are maintained by the department. The users at the back office uses ArcGIS Desktop software to maintain the database for variety services such as producing land occupancy certificate, building construction permit and so on. Thus, ArcGIS server facilitates the communication between the Silverlight application and database. The ArcGIS server is also the central part of the system and publishes the services. It reads data from the database and cooperates with users to provide them with dynamic information through the Silverlight application. The Silverlight application is used by the Front-end users to communicate with the system using web browsers. In front-end the users uses the Silverlight web application to access the database in order to deliver different service to customer such as occupancy certificate, building permit and other information which is done at the back office using ArcGIS desktop.

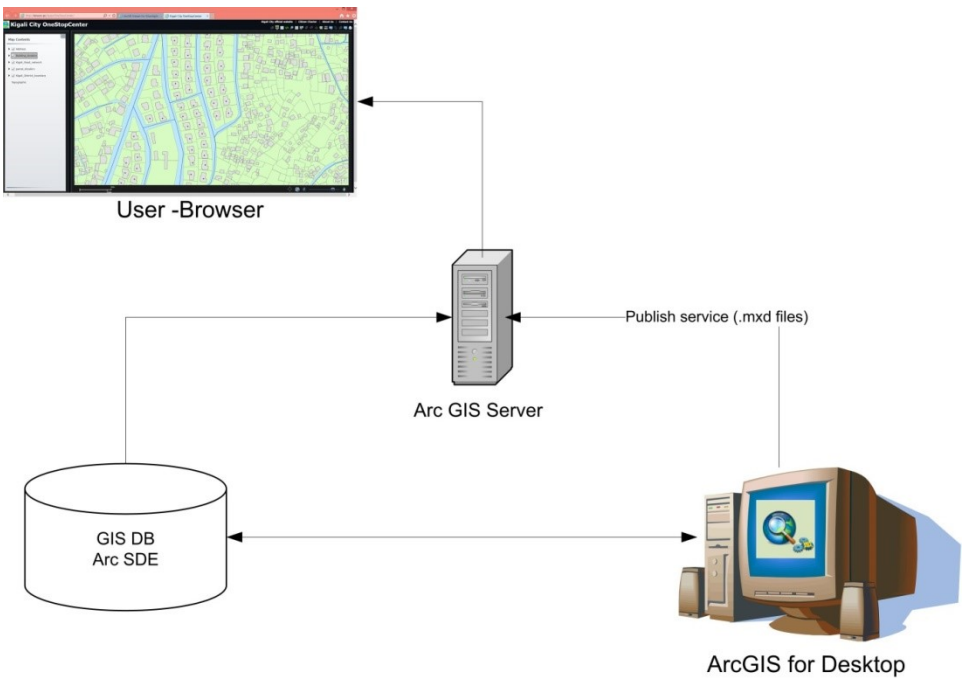

Figure 6. 20 Implementation of database application

6.6. ArcGIS server

ArcGIS server is a platform for building enterprise GIS applications that are centrally managed. It allows us to share GIS resources across an enterprise and across the web. One of the most important capabilities of ArcGIS server is the capability to publish and share geospatial information on the internet for large number of people on the web. This sharing capability of ArcGIS server is an important and effective way of working in many kinds of applications by sharing information on the internet, accessing and retrieving data. These data sharing capabilities are drastically improved compared to conventional paper distribution

maps or character based web systems (MacEachren et al., 2008). In addition, by using ArcGIS server users could have the ability to access information or layers and to see and manipulate spatial data based on their requests that comes from the customer/applicant. In this research ArcGIS server used to facilitates the communication between the Silverlight application and database. It is the central part of the system and used to publish the services. It also reads data from the database and cooperates with users to provide them dynamic information through the Silverlight application as described in the above Figure 6. 21. In addition the ArcGIS server used to integrate services on one server and to perform the following functionalities; to publish the services, to design the services in ArcMap (labels_layers scale range_scale format etc.), and to Set publishing services on the server. Therefore, using these capabilities of ArcGIS server and web application, the front officer can use and manipulate the database through ArcGIS server by designing an ArcGIS Silverlight application to build these services with some basic tools.

6.7. ArcGIS Desktop Interface (back office)

ArcGIS Desktop has supported management of land information by enabling easy creation and maintenance of data for land records, land planning and land use (Fang, Shandas, & Cordero, 2014). In this research, the users at the back office will use ArcGIS Desktop software to customize the database for variety services such as producing land occupancy certificate, building construction permit and so on. The ArcGIS desktop interface allows the user to edit, insert, and modify spatial and retrieval of data such as parcel records, occupancy certificate. These are important component of the interface, which elaborates the flexibility and usability of the application. Moreover, the back officer (a person who is responsible for data storage and management of the spatial database) of OSC use the application to manage land registry for recording titles, land holdings, preparing land-use certificate and cadastral mapping etc. Thus, these applications can manage a different service which is done in OSC of Kigali city. It is convenient for OSC departments to inquire and account all kind of information. As shown in Figure 6.22 -6.24 below this platform supplies user-friendly interface and simple usage mode such as: exploring map layers, editing and managing spatial data. The other most important capabilities of ArcGIS desktop is the capability to publish and share geospatial information through the application server in order to get the up to date data. Sharing of geo-spatial information is an important and effective way of working in many kinds of applications and it will reduce the length of service delivery to the customer.

This application manages variety services which are carried out in OSC of Kigali city, it is convenient for OSC back office departments to inquire and account all kind of information. The application contains both spatial and non-spatial data which are managed and manipulated by the OSC back officer's in order to process the requested services by the applicants. This platform supplies user-friendly interface and simple usage mode, such as exploring map layers, editing and managing spatial data. Below are some examples implemented by using the ArcGIS functions: editing, attaching document, query Information, Print, selection, overview of the map and others (see more in Appendix III).

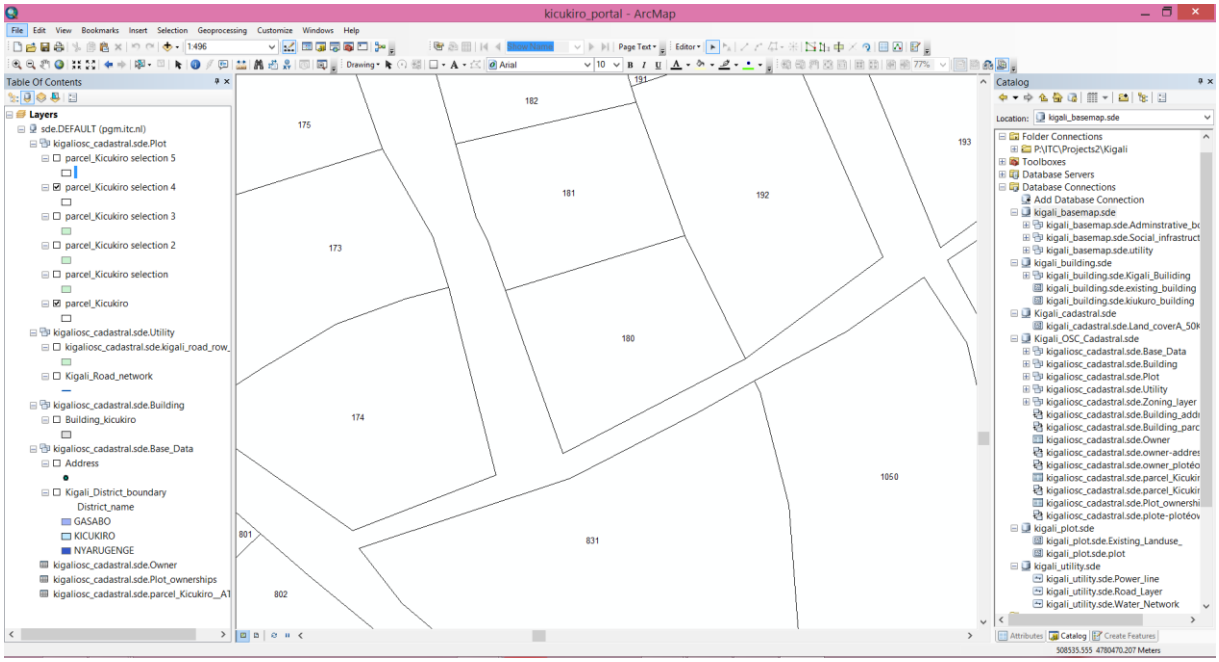

Figure 6. 21 general view of back office application

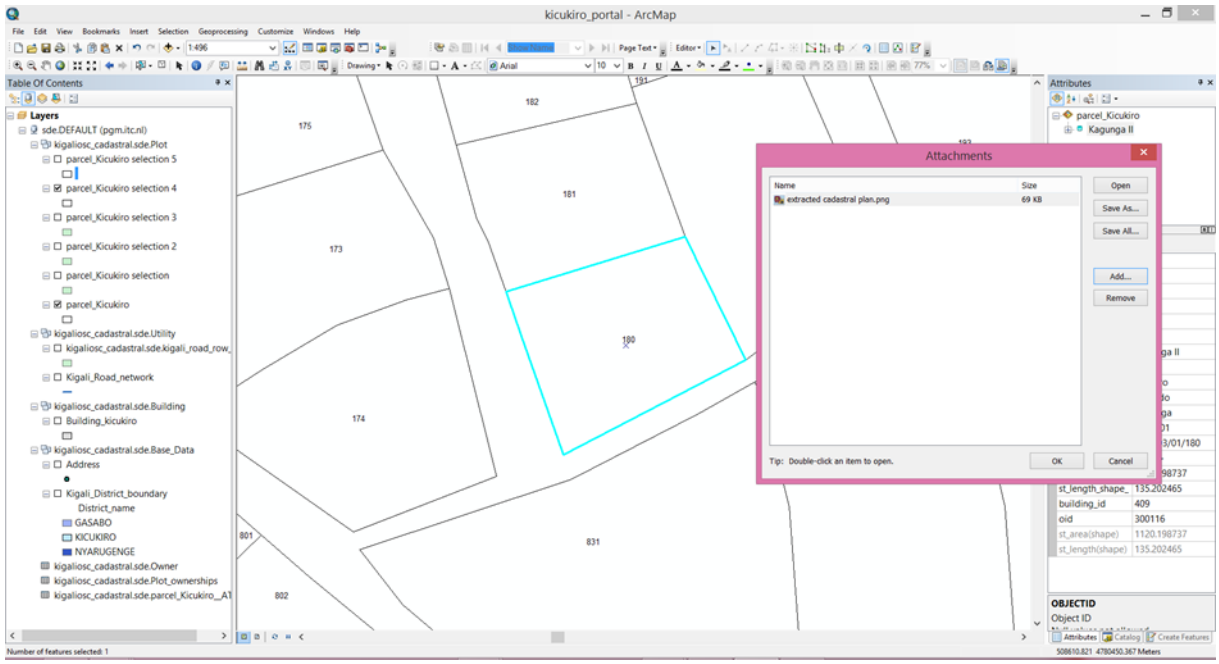

Figure 6. 22 attaching scanned certificate on parcel

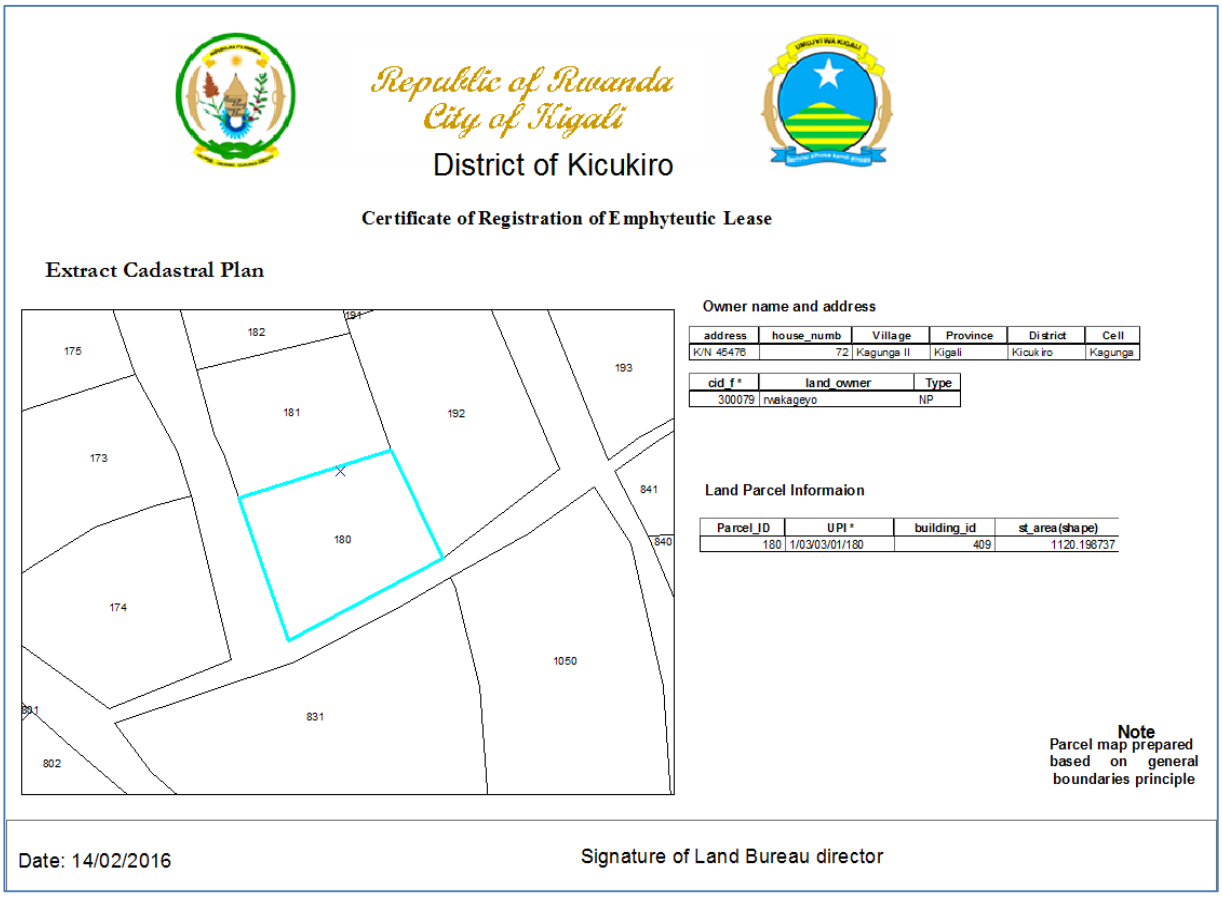

Figure 6.23 prepared certificate layout

6.8. Front office viwer application

A web client viewer was developed using ArcGIS Viewer 3.3 for Silverlight. It is an application builder for creating a web client viewer for ArcGIS Server and ArcGIS Online services (Dalton, 2012). This application builder enables to create a fully functional and custom web mapping client interface. Moreover, other suitable programming language like HTML was also used to develop the login page, citizen charter, about us and contact us pages. This web client viewer application will serve as a window to the user to visualize, query, print and manage the data.

The user interface (front office) web application is in charge of displaying all the layers to enable the user to communicate with the application. Moreover allows the OSC officers to access the database and deliver service based on Customer/applicants request. In front-office the users will use the Silverlight web application to access the database in order to deliver different service to customer like occupancy certificate, building permit and other information which is done at the back office using ArcGIS desktop. Any changes in the database such as data update can be viewed in the web application as the two are linked through application server.

The designed user interface shown in figure (Figure 6.24 - 6.26) consists of map layers in the right side and basic tools, which are used to navigate through the map on the top of the window, which enable users (OSC officers) to access information. This application contains a thin client application based on server/Client architecture. A general map interface provides a user friendly interface to navigate map using common navigation tools like Zoom In, Zoom Out, Pan, Identify features on map, measuring tool ,print tool and a query builder which provides the users a dialog box to query using address and UPI(unique parcel identifier). Below are some examples implemented by using the functions mentioned above: Information, Print, selection, overview and detail maps, and query results. The designed user interface for front officers shown below in Figure 6.24 consists of map layers in the right side and basic tools.

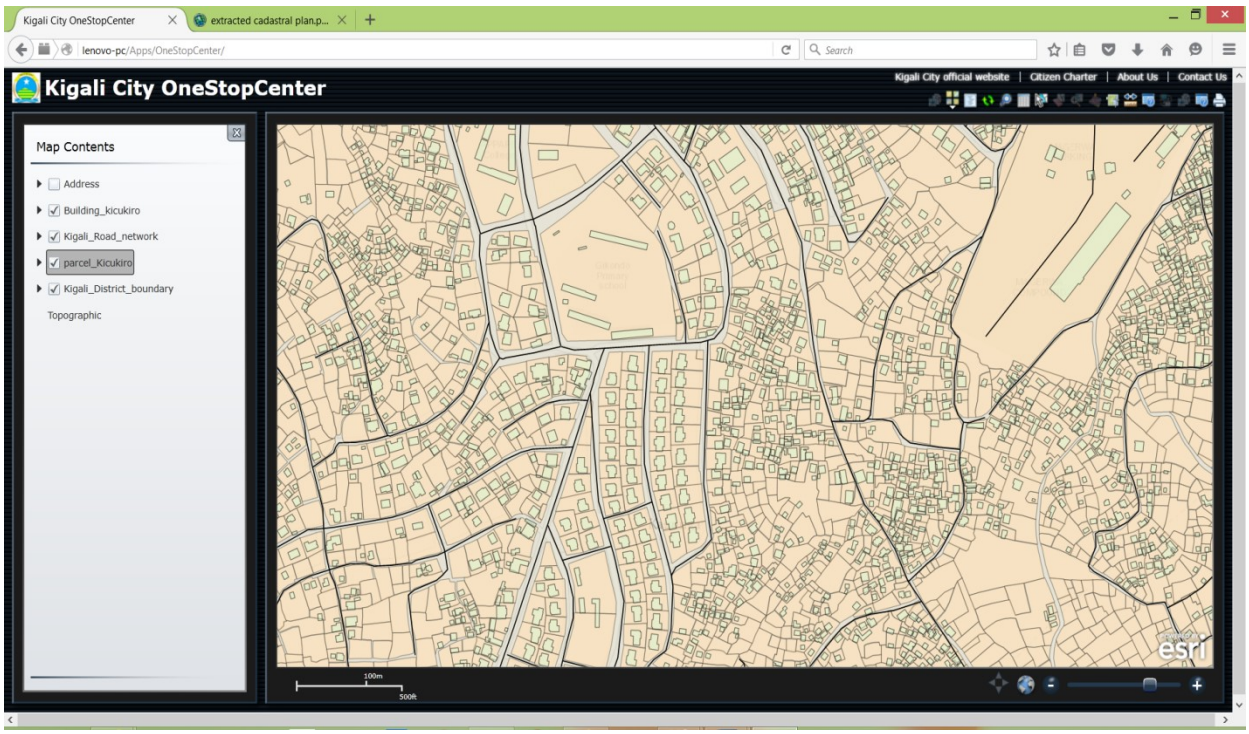

Figure 6.24 user interface used by front officer

a) Functions and components

This application can manage a different service which is done in OSC of Kigali city, it is convenient for OSC departments to inquire and account all kind of information. This platform supplies user-friendly interface and simple usage mode, such as exploring map layers, query and printing attach data. Below in Figure (6.23-6.29) shows the users interface of the system and tools functionality to access the information. The basic functions includes the following area in the map accompany with tools.

- Layer manipulation tools: pan, zoom.
- Map selection tools: clear selection, select, etc.
- Map searching tools.
- Measuring tools: distance and perimeter.
- Simple query tools: identification, query builder, get related data.
- Print tool: print attracted document (See more Appendix II)

.

The designed user interface shown below in Figure 6. consists of map layers in the right side and basic tools, which are used to navigate through the map on the top of the window, which enable users to access information. The user interface has basic tools, which enable the user to easily navigate through the map. It includes zoom in, zoom out, zoom to full extent, spatial query and Attribute query. The basic tools are shown in Figure 6. - 6. and their function.

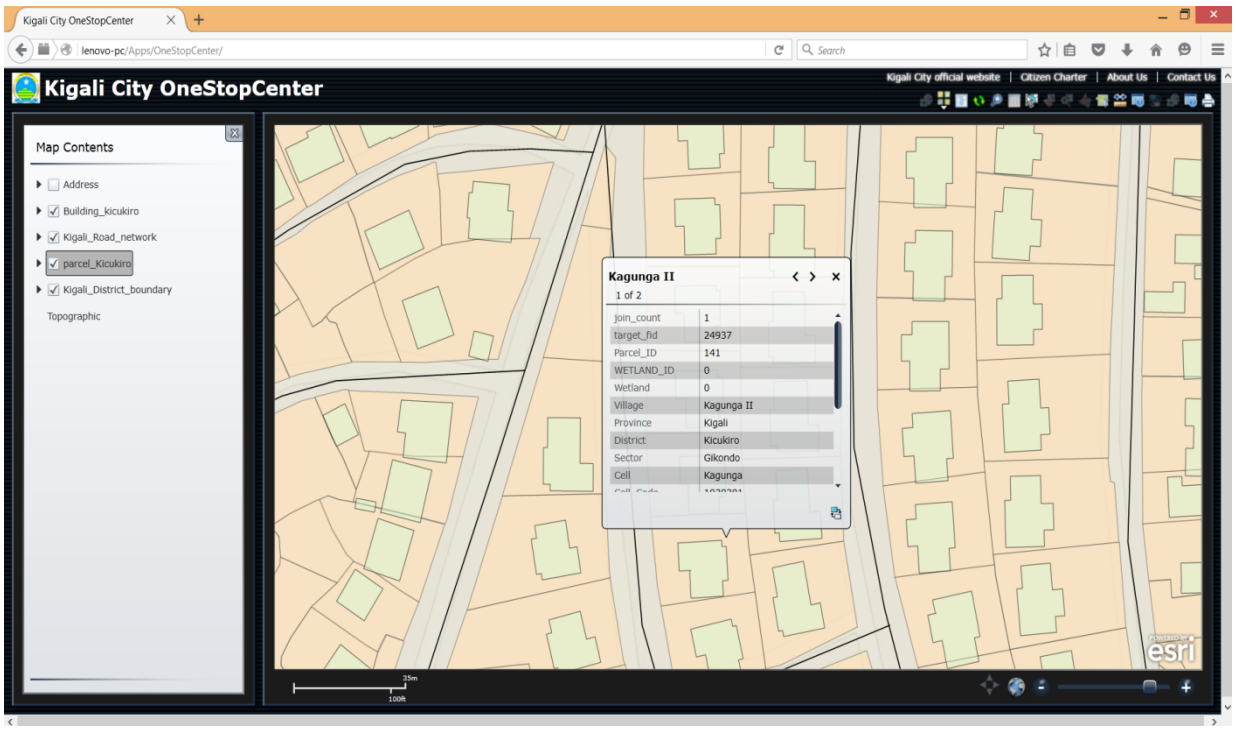

Figure 6. 25 Identifier tool

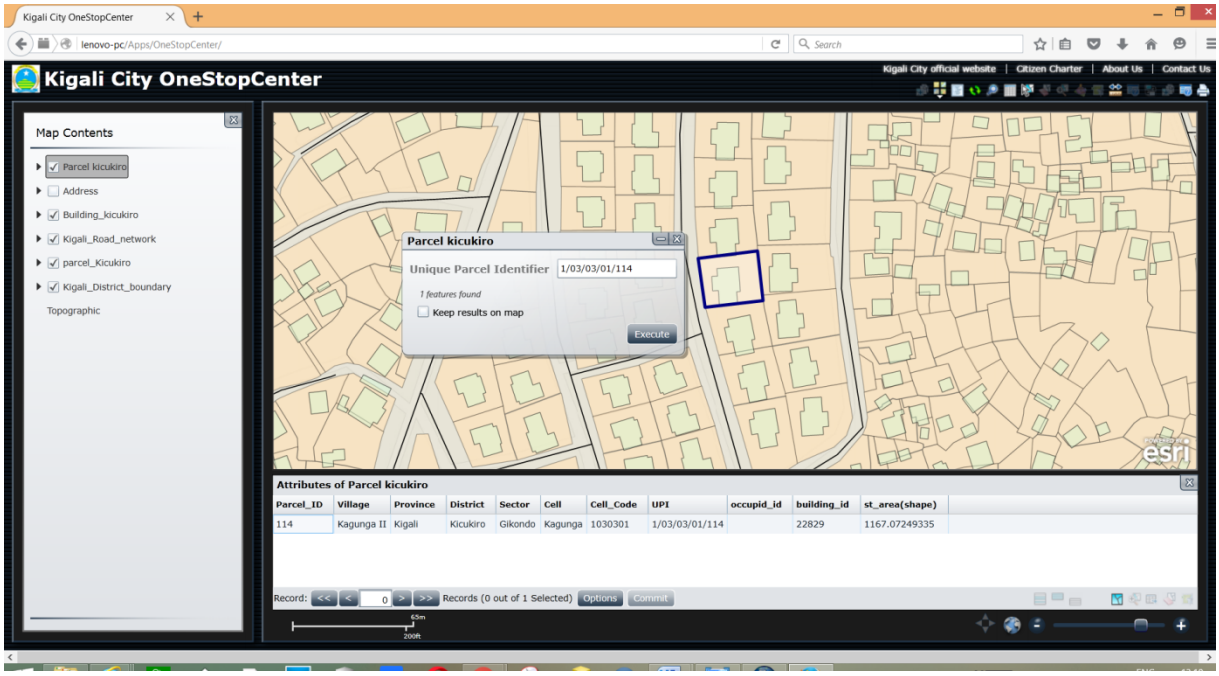

Figure 6.26 Query analyzer tool

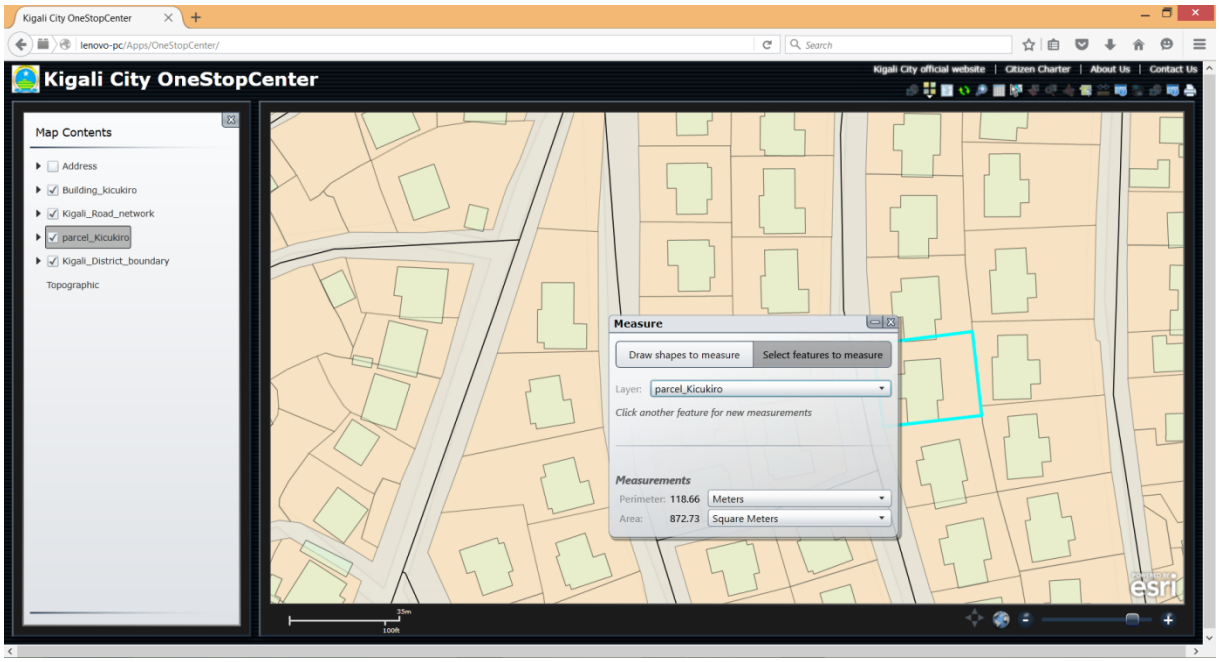

Figure 6. 27 Measuring tool

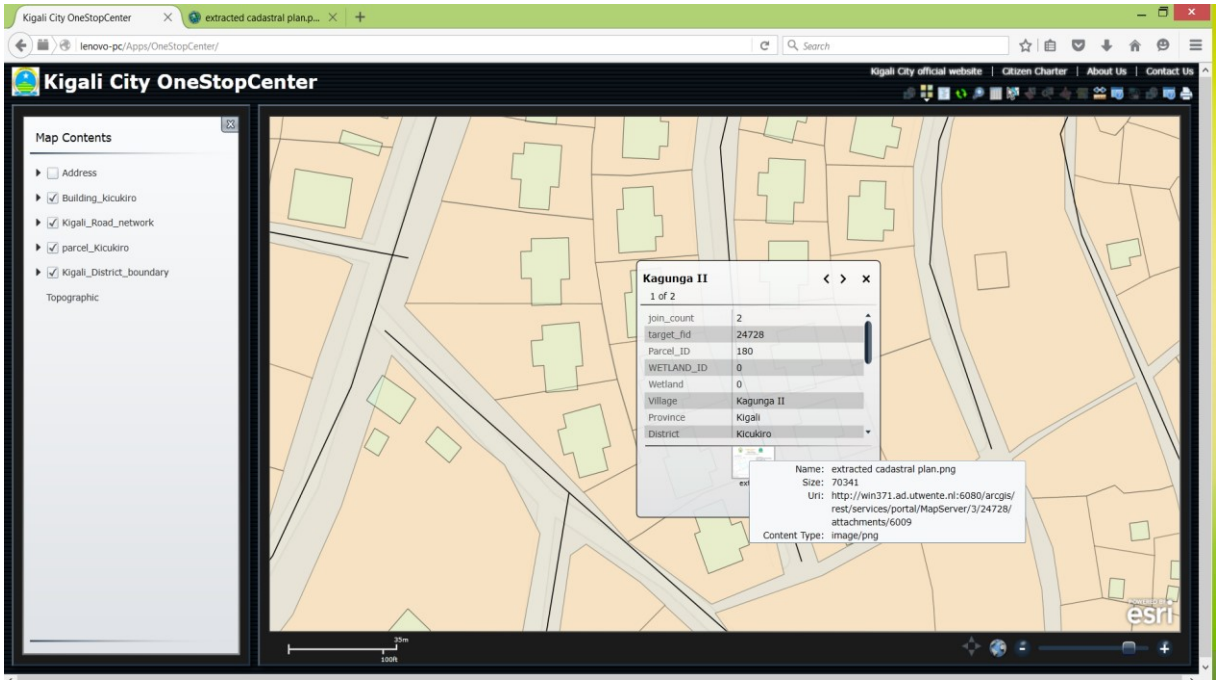

Figure 6.28 Print tool

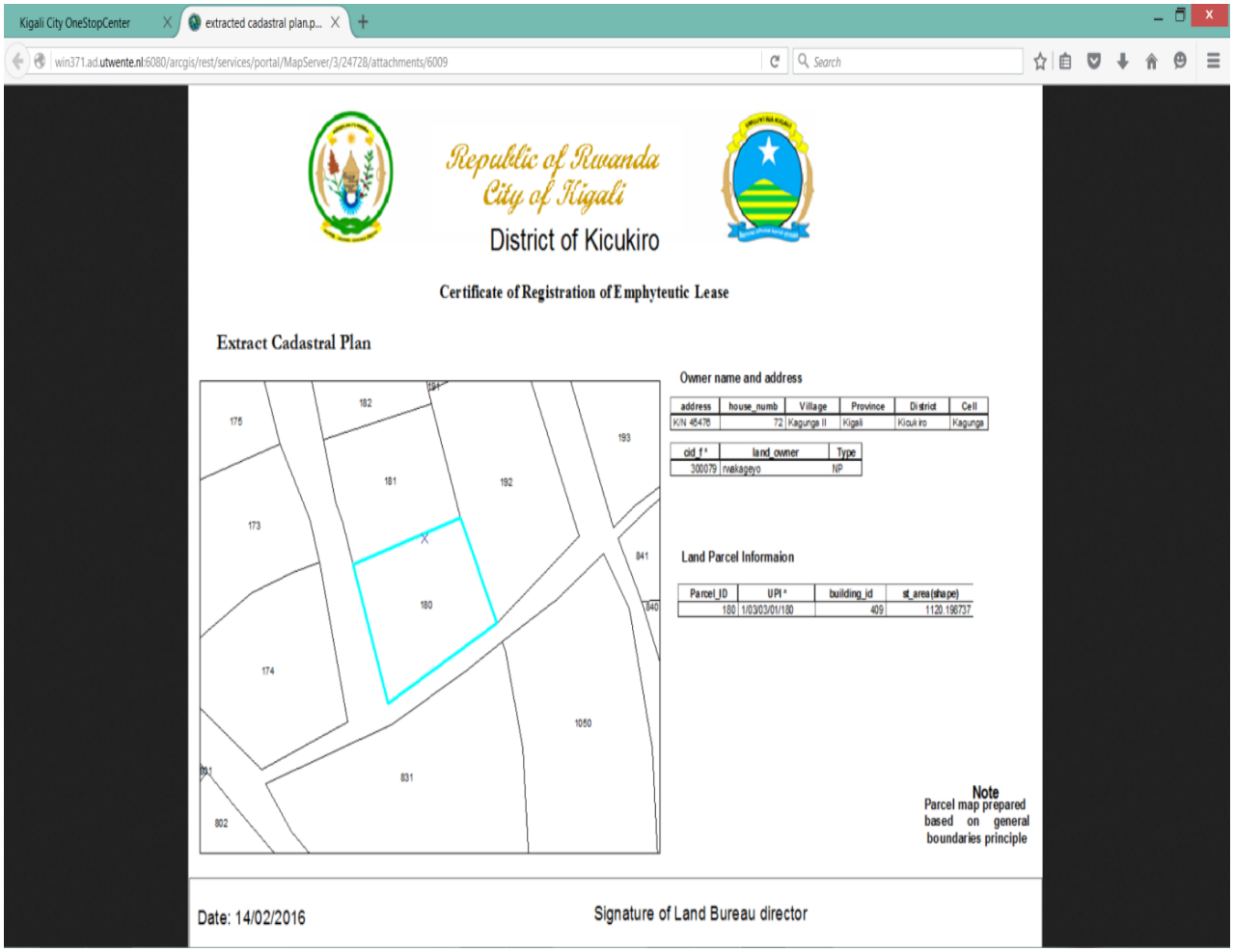

Figure 6.29 sample certificate layout

6.9. Validation

The designed database application is validated through prototyping process of producing certificate. The process of producing certificate is demonstrated to prove that the system can operate smoothly. For the validation information were gathered through questionnaire; it was conducted for the purpose of validating the spatial database application system architecture designed for certification of land occupancy and building permit applications. The questionnaire (Appendix II) consists of three parts. The first part includes information about the respondents' background. Questions in the second part are constructed to address the respondents' degree of agreement with the user interface and uses of the system implementation to system delivery and data sharing. Whereas in the third part addresses the overall respondents feedback regarding benefits and deficiencies of the designed application.

The respondents are selected purposively based on their background. A total number of 10 individuals participated in filling the questionnaire. Regarding the professional background of the respondents, well-experienced teachers and professionals: one from land administration department and one from the urban planning department, ITC, University of Twente, One from Kadaster international were included. Besides, students in ITC: 4 from land administration department and 3 from urban planning department were included. Many of the respondents have had experiences in the study area.

The percentage of agreement of respondents with respect to easiness of the designed user interface to use, the capability of the system to facilitate data sharing and data management and about the role of the application in enhancing service delivery is analyzed and presented in the following bar graph.

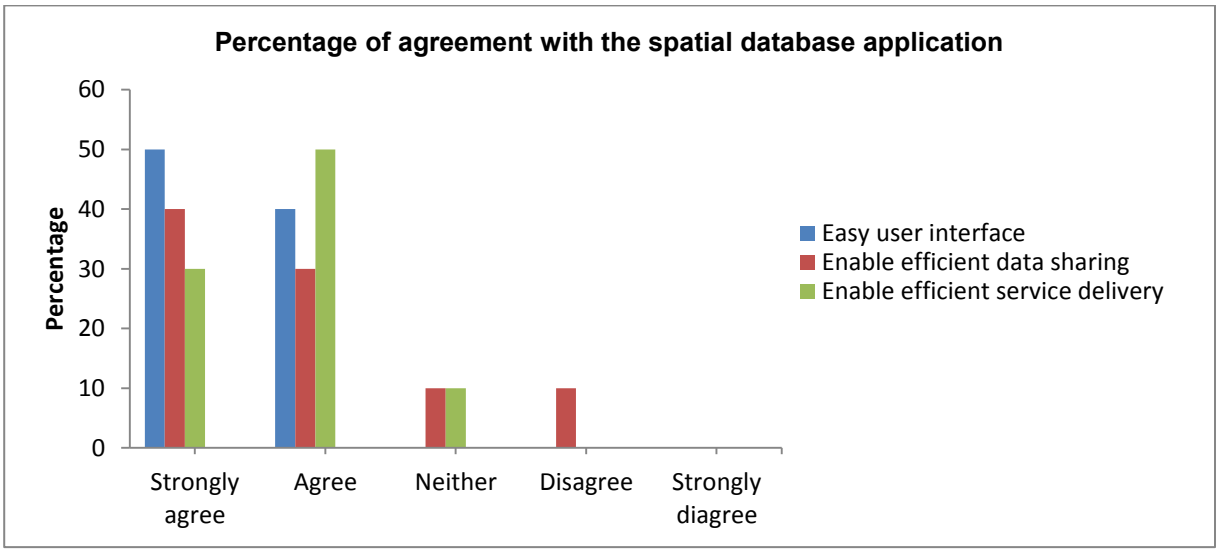

Figure 6.30 Percentage of agreement with the spatial database application

Almost all respondents agree that the designed interface is easy to use, efficient data sharing and facilitate service delivery. Particularly, on the easiness of the user interface to use 50% of the respondents strongly agree and 40% of them agree. On the capability of the system to facilitate data sharing 40% (30%) of them strongly (agree). And while 30% of them strongly agree that the system enables efficient service delivery, 40 % of them agree the benefit of the system to efficient service delivery. Only 10% of them neither agree nor disagree on the benefit of the system to data sharing and for efficient service delivery. Even though most of the respondent was agreed on the designed interface but as shown in the above figure 6.30 still

there is one respondent who do not agree on that the designed application will enable data sharing; the reason for the disagreement was since the developed application was only within OSC departments so that the respondent was desired that could also accompany with other organizations outside the OSC.

In addition, the respondents' views and suggestions are summarized and presented as follow. The foci of their ideas are related to the front office and back office approach, benefits of the application for citizens and the city council, the deficiencies observed and their suggestions.
With regard to the front office back office approach, they mentioned that the approach is helpful for fast and efficient service delivery, to ensure customer care and data security, to minimize bureaucracy and corruption. Fewer transaction workflow steps, conducive working environments for staffs, cost and time reduction in service delivery and discouraging fraud and enhancing land governance are among the benefits of the approach. The respondents also suggest valuable points for improving the system further. They suggested considering an automatic way of communication (like email notification) between the front officers and back officers when tasks are accomplished. Besides, they pointed out the value of including historic ownership information for the purpose of conflict resolution and online application service for better service delivery.

Overall, from the prototype, the added value of the designed application is proved as effective in improving service delivery and efficient data sharing.

6.10. Concluding Remarks

In the design of the database application to deliver services, it is possible to meet users and system requirements as it is proven in this chapter. The aim of design phase is to map functional requirements. A prototype for a database application for Kigali city OSC is developed to improve the services delivery. The validation is done by gathering information by asking experts who will ultimately use the services by making questions and discussion with ITC urban/land experts and cadastre experts.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Introduciton

In this chapter, conclusions are drawn as outcomes of the research in 7.2. Then the recommendation for further research are presented in section 7.3

7.2. Conclusion

In this section the objectives are revisited, concluding remarks are given and possible recommendations for further research are suggested.

The main objective of the study was to develop a sharable spatial databases and applications using one-stop-shop concept at the city of Kigali (Rwanda) that enhances information accessibility, sharing and managing data. As described in section 1.3 the research aimed at addressing three specific objectives with corresponding questions. The objectives were achieved by employing the designed methods.

In relation to the first four questions for sub-objective1; was achieved through the data collected from the questionnaire (via email) and the existing documents.

Sub-objective 1: The organization structure, actors, processes and the problems related to sharing and managing spatial datasets and service delivery to the citizens in the existing situation of local government at the city of Kigali were analyzed based on the information gathered by document analysis.

1. What is the institutional and the organizational structure of Kigali City?

OSC of Kigali City combines different departments/organs together which are (land bureau, housing bureau and infrastructure bureau and inspection) .At district level the organization is structured in such a way that, at lower level the land management bureau, housing and urban bureau and infrastructures bureau are organized. These bureaus are coordinated by a team called organization team. The inspection team also takes part in controlling the implementations of tasks and procedures according to the rules and regulations.

2. Who are the users/actors involved in spatial data access and applications?

The actors involve in OSC are Housing bureau, land bureau, infrastructure bureau, inspection bureau and Rwanda housing bureau are the main users and actors involved in sharing the spatial data. Besides, RNRA and RHA are also involved in using and sharing spatial data.

3. How does the existing situation respond to data sharing and service delivery?

The district OSC of Kigali city provides different services to the public from a number of governmental organizations like land agencies and other departments (including Road development, Electricity-maintenance, Water and etc.). Since these are the different departments, they manage their data separately with limited capability to share data between each other. The tasks are centralized in one office so that the

delivery of housing, land management, infrastructure and environmental services are provided at one office. But, data are shared among users and actors manually/on paper based.

4. What are the institutional and organizational problems and weakness in the current situation?

In general, the existing OSC workflow for both occupancy certificate and building permit process the approval was done at deputy registrar which is not on same organization as the district officer process the different services; so in the existing situation service delivery will not be easy because district officers have to wait for the approval which is time taking. Moreover, even though in the OSC combines different departments such as (land bureau, housing bureau and infrastructure bureau and inspection) with one organization still the customer still has to contact different departments to request and receive service from the OSC. Even though it's well organized, still it will confuse the public users what process to follow where to go to get services provided by the agencies. This type of administration may result in corruption, delay of service, etc. Therefore to address this problem, developing spatial database applications using one stop shop concept helps to integrate different service in one place and efficient data sharing and managing within and across different departments and organizations as well as for customer satisfaction.

The main driver behind the research was to achieve an efficient service delivery and information sharing among other departments. Based on the information's gathered from the questionnaires and document analysis lack of information sharing (DBMS / Spatial Data Infrastructure), poor coordination with other, overlapping tasks, paper based work environment and Service delay are among the weaknesses identified in the existing system.

Sub-Objective:2 To identify and analyze the requirements (overall architecture, users, data and process) to develop spatial database applications and one-stop-center.

5. What are the requirements for overall architecture, users, data and process?

From the existing situation the requirements was identified from relevant documents and questionnaire results indicated that OSC process is utilised by land processors, land administrators, building inspectors, planners, surveying technician, legal assistants, and the coordinator of OSC department. All these users have their own needs and responsibilities when accessing the system. The user requirements include the data required to process a building construction permit application, the information required to be input to and output from the system.

6. How are an overall system architecture and components developed to overcome institutional and organizational problems and weakness?

Based on the requirements the design of system architecture was established, System components, interaction among components and interfaces are identified and defined. The architecture is designed with the concept of web based application for OSC and three tier client server concepts. The entire system will be designed as a client/server system in order to obtain an OSC model that can be used to enhance the efficiency of the land agencies in the land delivery service. The designing are done in UML and Microsoft Visio based on the requirements that are identified from the chapter 4.

7. How to design centralized sharable spatial database, applications and one-stop-shop for efficient service delivery?

Spatial database applications are developed to address the problem related service delivery and information sharing. An integrated information system will assist OSC's officers to efficiently obtain information and reduce the length of the decision-making process. In order to design database application, a shareable database was designed first in ArcSDE and Postgres Database to store and manage the spatial data. And the application viewer interface is created in Microsoft Silverlight viewer which is use for displaying, querying and print spatial data for the front office. ArcGIS desktop allows editing, process and sharing geospatial data at back office.

Sub-Objective 3: To identify and analyze the requirements (overall architecture, users, data and process) to develop spatial database applications and one-stop-center.

8. How to prototype the centralized shareable and supporting application databases accessible from one-stop-shop center?

For this research two applications were chosen which are delivering building permit and occupancy certificate. In order to implement the database application based on OSS concept. The OSC district office of Kigali city provides different services to the public form those service two application are used for the back office ArcGIS desktop which enables to manage, edit and update spatial information and prepare certificates; at the front office will use Silverlight viewer to access, query information and to print the attached certificates and provide services to the customer/citizens.

9. How to validate the prototype?

The designed database application is validated through prototyping process of producing certificate. A prototype dataset has been created following the data model. The process of producing certificate is demonstrated to prove that the system can operate smoothly. For the validation information were gathered by asking experts were chosen based on their professional back ground two experienced professional from (ITC) University of Twente, 7 students (experts) from urban/land department and from Dutch Kadaster expert. The background concepts on how the application works were explained and demonstrated to them. Then, a questionnaire (Appendix II) involving open questions was given to them. Finally, by integrating what they saw with their experience they validate the application developed for Kigali city. The validation result showed that the developed approach is effective; on the easiness of the user interface to use 50% of the respondents strongly agree and 40% of them agree. On the capability of the system to facilitate data sharing 40% (30%) of them strongly (agree). And while 30% of them strongly agree that the system enables efficient service delivery, 40 % of them agree the benefit of the system to efficient service delivery. Only 10% of them neither agree nor disagree on the benefit of the system to data sharing and for efficient service delivery.
Overall, from the prototype, the added value of the designed application is proved as effective in improving service delivery and efficient data sharing.

10. How can the prototype be further improved?

For the prototype the process of delivering building permit and occupancy certificate were demonstrated to prove that the system can operate; however the prototype can be further improved based on the feedbacks provided during the validation. Which are considering an automatic way of communication (like email notification) between the front officers and back officers when tasks are accomplished. Besides, they pointed out the value of including historic ownership information for the purpose of conflict resolution and online application service for better service delivery.

7.3. Recommendation

This study mainly focuses on developing a spatial database applications based on OSS concept. The database and applications were developed for two services only which are producing certificates for building construction and land occupancy certificate. Within the limited period of time, the following tasks could not be investigated fully and the following list of recommendations should be given for further research.

- This research was focused in the designing of database application based on OSS concept by identifying user requirements which are not much taken care because of it was done through email. Therefore, further research is recommended to investigate the government, citizen's interest/ requirements in the system.

- The database application in this research were concentrated on service delivery and data sharing but has not fully covered the methods of submission and transferring of digital documents. Therefore, a study is required to introduce electronic registration system.

- The prototype can be further improved by taking into account an automatic way of communication (like email notification) between the front officers and back officers when tasks are accomplished. In addition, could be done by using the workflow management system or other techniques to automate the process like process maker.

- The database application developed in this research is more concentrated on the OSC of Kigali City and does not fully discuss about the other governmental organization. Therefore , it is recommended to develop a database application which connects all the organization (wide area network)

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APPENDIXES – I

Questionnaires for data requirement

Organization's opinion access to information

My name is Saron Araya Wube. I am an MSc student at university of Twente; I am doing a research on developing a spatial database application. The purpose of this questioner and your answers is to help me to understand the process of sharing, managing spatial datasets, and service delivery to customers from the district bureaus and used as an input to find out the user requirements.
However, your answer will be used for academic purpose. Hopefully you would help me to answer the questions freely and openly. Thank you for your cooperation.

Organization's name: ----------
Department: ----------
Respondent's name: ----------
Position: ----------

1. What is your main responsibility?

   ----

2. What are the services provided by your organization?
   2.1 How long does it take to provide complete services for the customer?

	In practice How long it takes					
List of Services	**day**	**week**	**one month**	**six months**	**One year**	**> one year**

3. Who are the users of the services that is provided by your (organization) OSC?

Services	**users**	**Products received by the users**	**Digital**	**Analogue**

4. What kind of information/data does your organization provide? And how is it provided?

Information/data	**Manual**	**Digital**

5. What is the situation of providing information to the citizens?
   a. Easy b. difficult

6. If your answer is b, which problems/difficulties do you face when providing services to citizens? In your opinion, what are the reasons of the problems/difficulties?

Services	**Problems/difficulties**	**Reasons**

7. What could you suggest the solution to improve this problem you mentioned before?

8. Is there any possibility to get necessary information or data from another organizations
   a. Yes b.No
9. If your answer is yes, what kind of information/ data does your organization need from other governmental organizations? And How to get that data or information?

External organization	Information/data		
		Manual	Digital

10. Is there any difficulty in sharing data among government organizations?
    a. Yes b. No

11. What will be the benefits if other governmental organizations will share their databases?

12. What do you understand by One-Stop-Centre?

13. How desirable is a One-Stop-Centre (OSC) option to your organization?

14. Do you think OSC will make the services easier and faster?

15. Would you like to add something else on the delivery of services/products?

Questionnaires

My name is Saron Araya Wube. I am an MSc student at university of Twente; I am doing a research on developing a spatial database application. The purpose of this questioner and your answers is to help me to understand the process of service delivery from the district bureaus and used as an input to find out the user requirements.

However, your answer will be used for academic purpose. Hopefully you would help me to answer the questions freely and openly. Thank you for your cooperation.

Questions for customers (citizens)

District: ……. ***Sector: ……***

Date: ……..

1. Full name of respondent:

2. Sex
   a. Male ---------- b. Female----------

3. Have you used any services from One-Stop-Center?
   a. Yes b. No

4. If your answer is yes, which service did you use?

Services	Products delivered at the end of services	The purpose of services/products Used

5. Which bureau and how many times do you visit to get the services?

Services	Name of Bureau	No of times visited/year	No of times visited/month	No of times visited/day

6. How many people you should contact to get the services completed?
   6.1 How long does it take to get the services done?

Services	No of people	Days/ hours

7. Please rate your satisfaction with

Measure	**Services**	**Very satisfied**	**Satisfied**	**Not sure**	**Not satisfied**	**Very dissatisfied**
The time it took you to be served						
The quality of information provided by the organization						
Prices/ Cost of the services and products						
Overall, the way the bureau service delivery						

8. Would you please provide your reasons if you were not satisfied/very dissatisfied?

9. Do you believe that delivery of all kinds of services in one front desk would make the service easier and faster?

   a. Yes b. no

10. If your answer is yes how? Any opinions?

11. If your answer is no, what are your suggestions to improve the service delivery?

Questionnaires for validation of OSC spatial database application

Part I: Personal details

- Name of your organization:----------
- Role(s) :----------
- Work experience in years:----------

Part II: Please indicate your level of agreement to each of the statements below by ticking one of the boxes.

1. The user interface (for the front office) is easy to use.

Strongly Agree **[ ]** Agree **[ ]** Neither agree nor disagree **[ ]** Disagree **[ ]** Strongly disagree **[ ]**

2. This system implementation will enable efficient data sharing and management.

Strongly Agree **[ ]** Agree **[ ]** Neither agree nor disagree **[ ]** Disagree **[ ]** Strongly disagree **[ ]**

3. This system implementation will enable efficient service delivery?

Strongly Agree **[ ]** Agree **[ ]** Neither agree nor disagree **[ ]** Disagree **[ ]** Strongly disagree **[ ]**

Part III: Please explain your feedbacks accordingly in the space provided below each questions.

1. What is your opinion on the front–office and back-office approach for service delivery?

   ---
2. What benefits do you expect the system to bring to the city council?

   ---.
3. What benefits do you expect the system to bring to citizens?

   ---
4. Major deficiencies you have observed, if any?

   ---
5. Your suggestions to improve the system design and interfaces?

Thank you very much for your contribution!

APPENDIXES - II

In the following tables, the base structure of the tables composing the database for the prototype are shown along with information about primary and foreign keys .

Owner

Field name	Data Type	Description
OID	Integer	Primary key (Owner ID)
Building_ID	Integer	Foreign key from Building table (Building ID)
Land owner	Text	
Type	Text	Natural person / non-natural (organization)

Address

Field name	Data Type	Description
OID	Integer	Foreign key from owner table (Owner ID)
Address	Text	
Building_ID	Integer	Foreign key from Building table (Building ID)
House_Number	Integer	
Province	Text	
District	Text	
Cell	Text	

Building

Field name	Data Type	Description
BID	integer	Primary key (Building ID)
UPI	Text	Foreign key from plot table (Unique parcel identifier)
OID	Integer	Foreign key from owner table (Owner ID)
Building use	Text	
Area	Geometry	

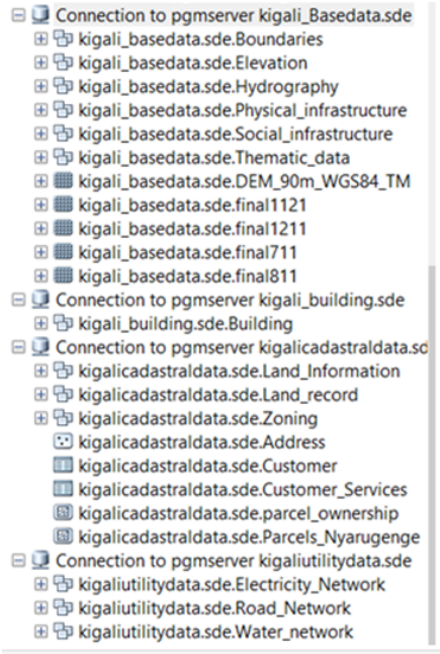
Plot

Field name	Data Type	Description
UPI	Text	Primary key (Unique parcel identifier)
Building_ID	Integer	Foreign key from Building table (Building ID)
Area	Geometry	

Plot_ownership

Field name	Data Type	Description
OID	Integer	Primary key (plot_ownership ID)
OID	Integer	Foreign key from plot table (Unique parcel identifier)
UPI	Text	Foreign key from plot table (Unique parcel identifier)
Right type	Text	
Description	Text	

Database connection in ArcGIS

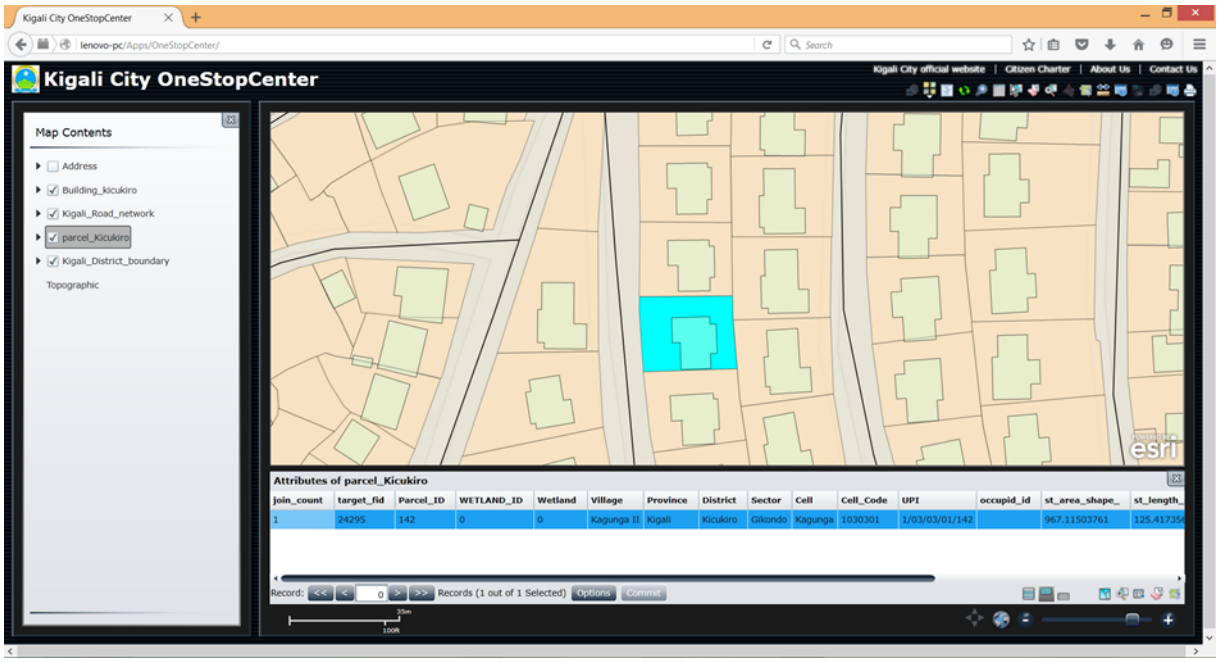


APPENDIXES - III

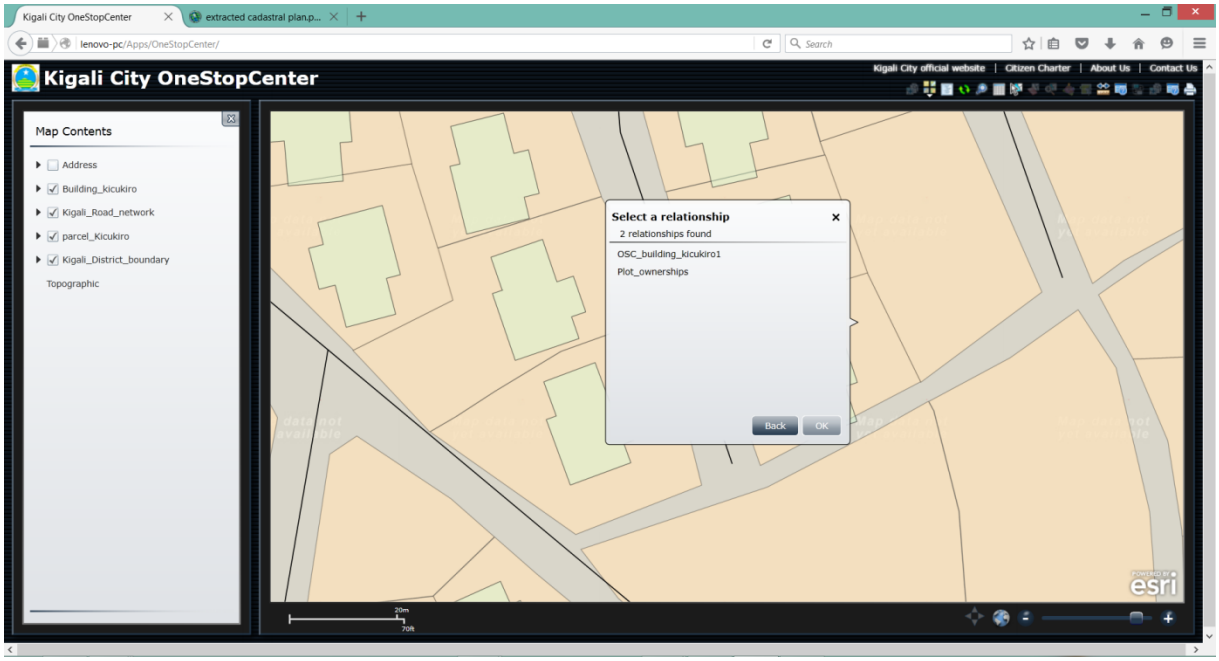
Results of Front office viewer application

1. Login page (front-office)

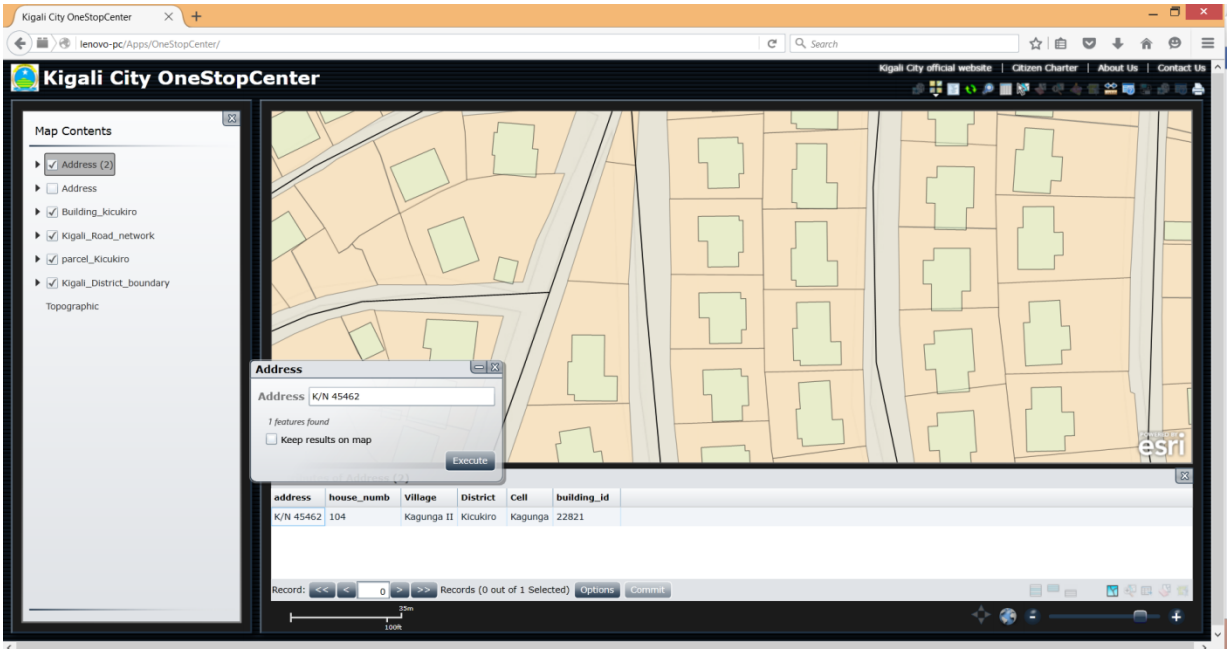
2.



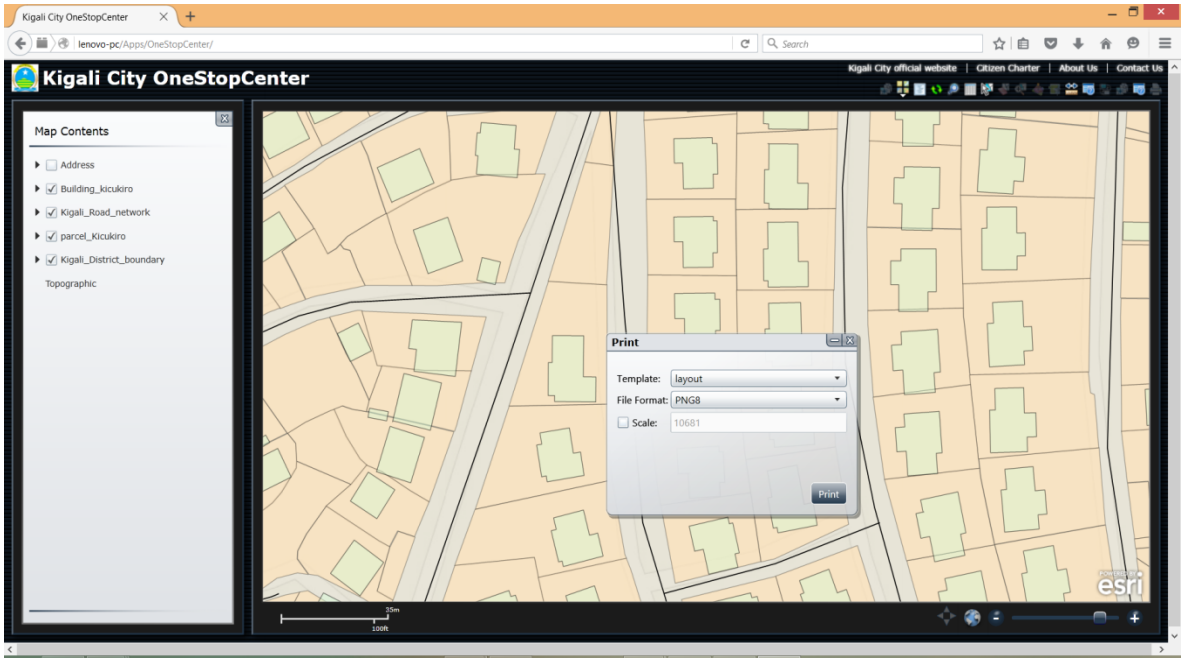
3.

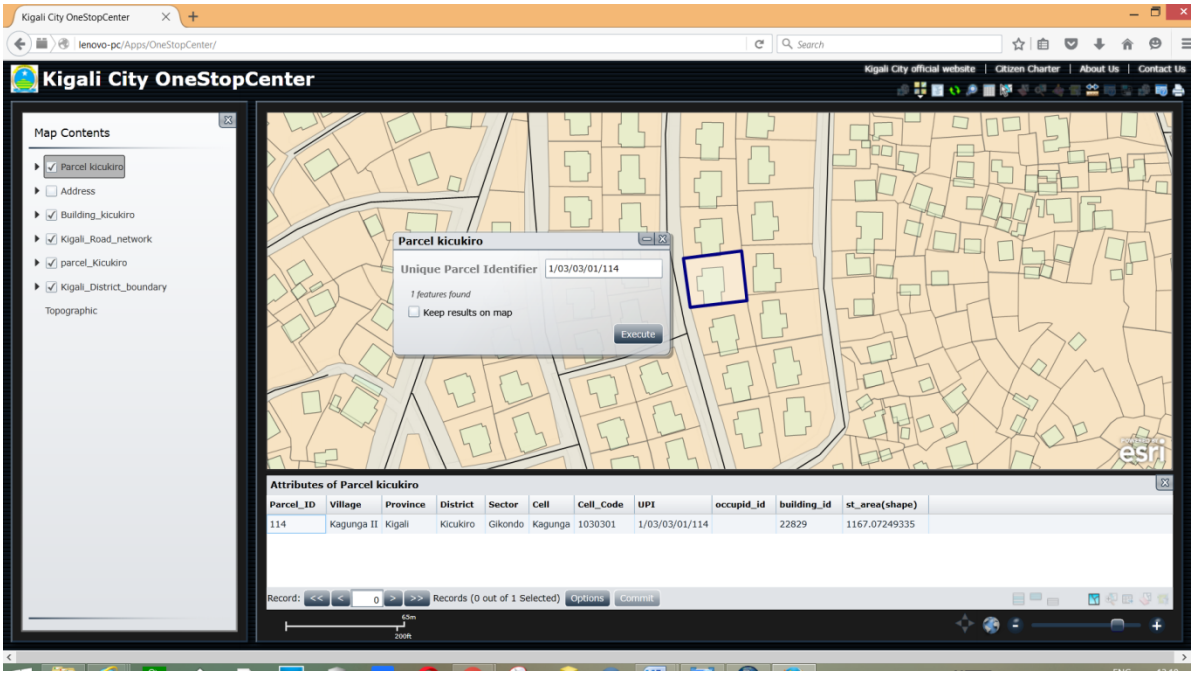

Kigali City OneStopCenter
Kigali City official website | Citizen Charter | About Us | Contact Us
Map Contents
Address
Building_kicukiro
Kigali_Road_network
parcel_Kicukiro
Kigali_District_boundary
Topographic
Select a relationship
2 relationships found
OSC_building_kicukiro1
Plot_ownerships
Back
OK
esri

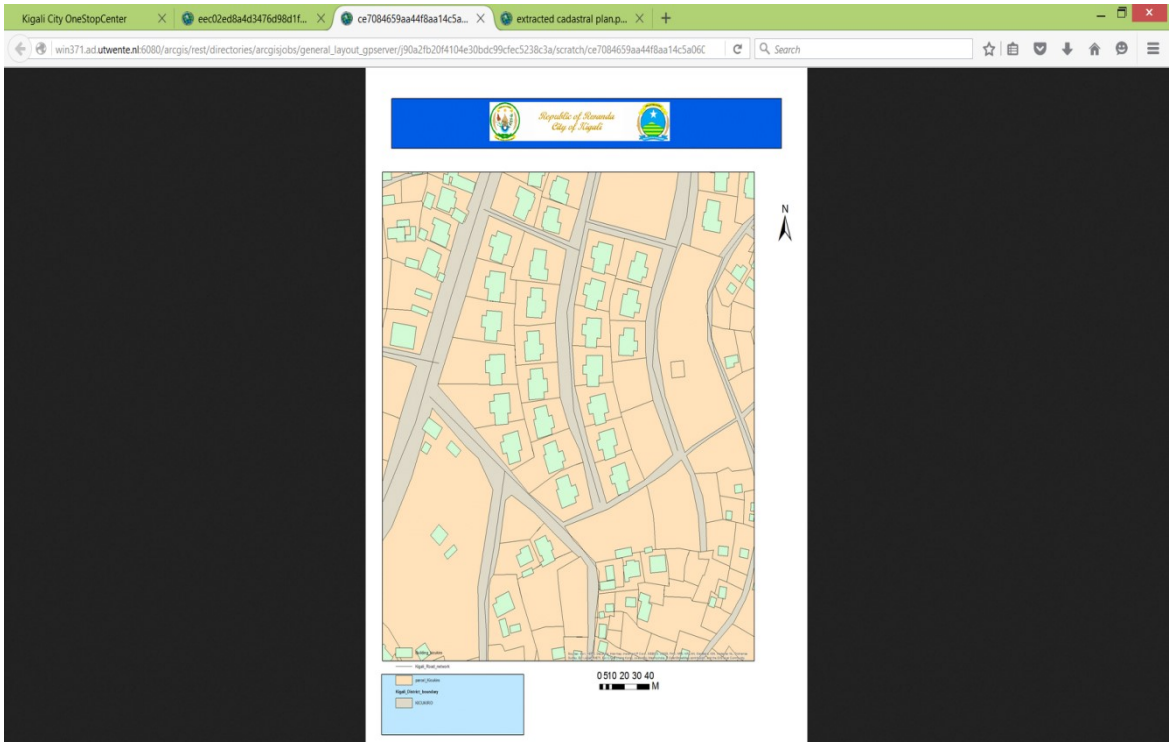
4.


Kigali City OneStopCenter
Kigali City official website | Citizen Charter | About Us | Contact Us
Map Contents
Address (2)
Address
Building_kicukiro
Kigali_Road_network
parcel_Kicukiro
Kigali_District_boundary
Topographic
Address
Address K/N 45462
1 features found
Keep results on map
Execute
address
house_numb
Village
District
Cell
building_id
K/N 45462
104
Kagunga II
Kicukiro
Kagunga
22821
Record:
Records (0 out of 1 Selected)
Options
Commit
esri

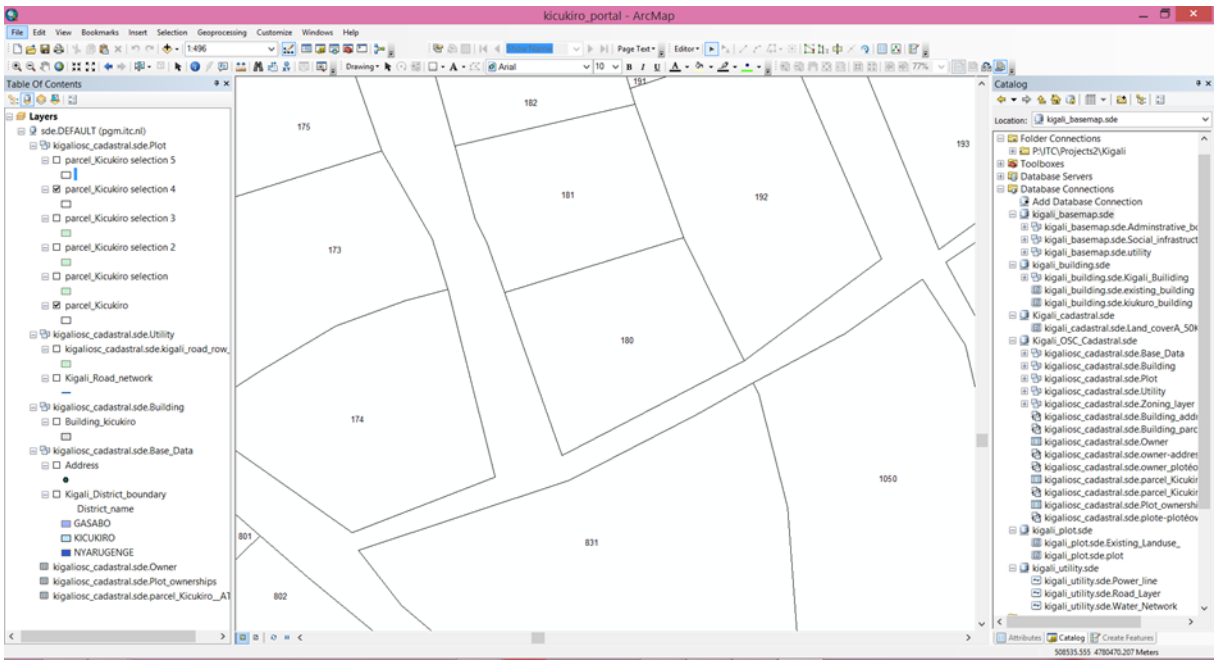
5.

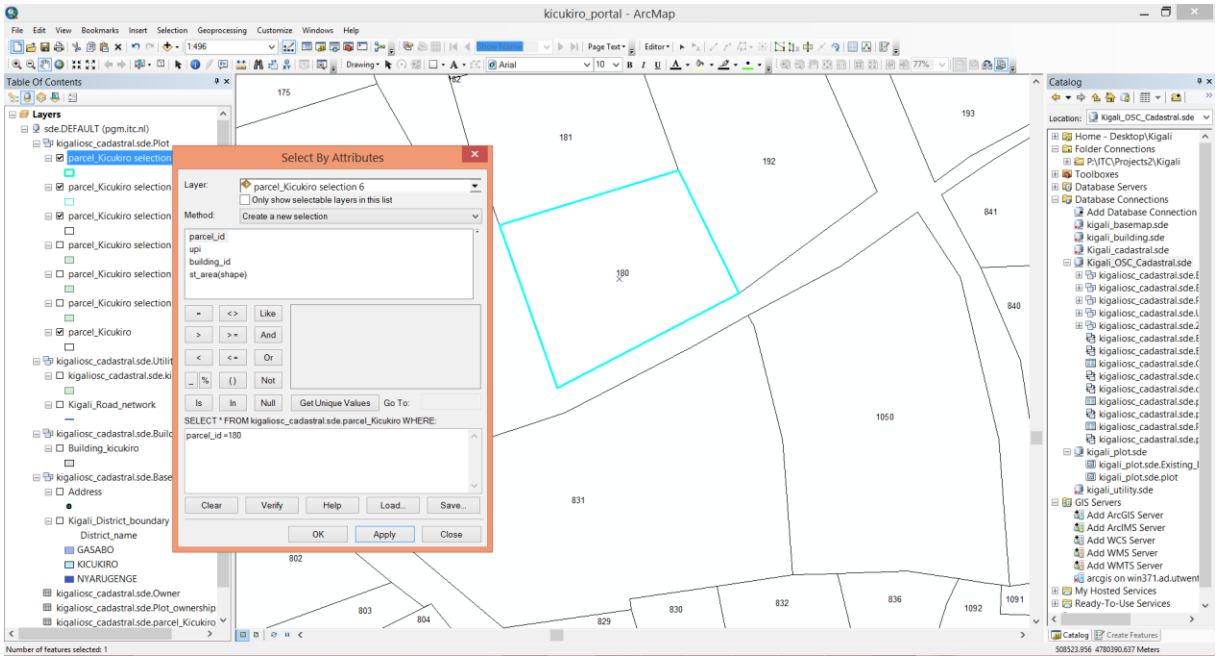

Kigali City OneStopCenter
Kigali City official website | Citizen Charter | About Us | Contact Us
Map Contents
Address
Building_kicukiro
Kigali_Road_network
parcel_Kicukiro
Kigali_District_boundary
Topographic
Print
Template: layout
File Format: PNG8
Scale: 10681
Print

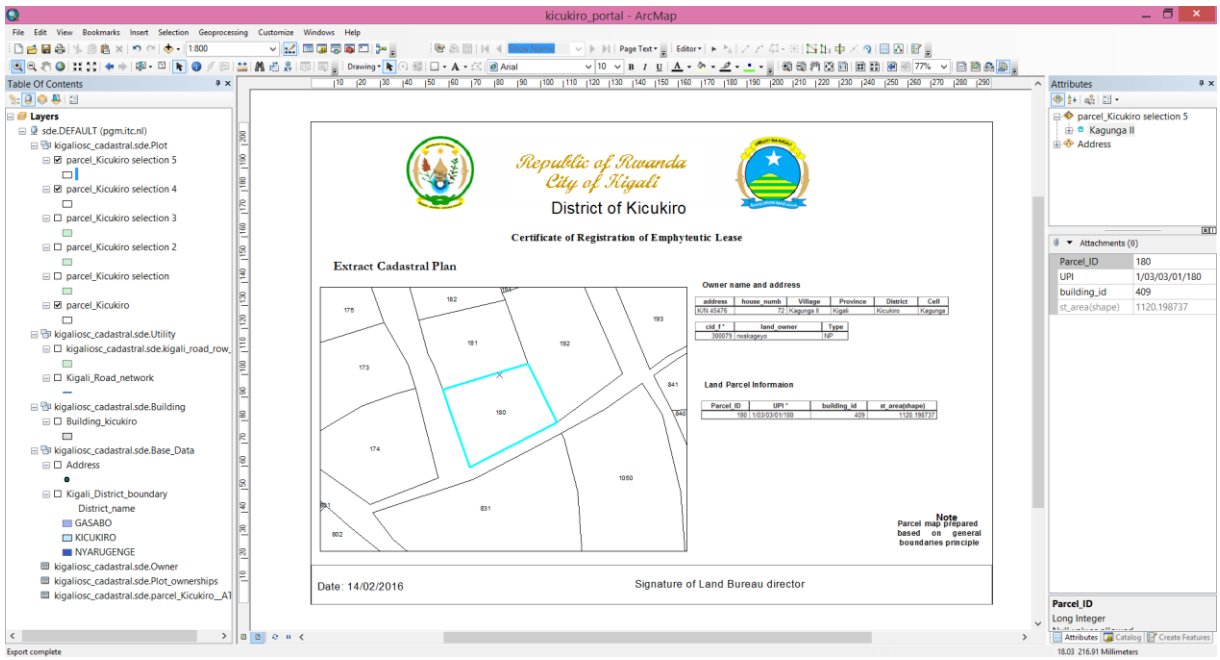

Kigali City OneStopCenter
Kigali City official website | Citizen Charter | About Us | Contact Us
Map Contents
Parcel kicukiro
Address
Building_kicukiro
Kigali_Road_network
parcel_Kicukiro
Kigali_District_boundary
Topographic
Parcel kicukiro
Unique Parcel Identifier 1/03/03/01/114
1 features found
Keep results on map
Execute
Attributes of Parcel kicukiro
Parcel_ID Village Province District Sector Cell Cell_Code UPI occupid_id building_id st_area(shape)
114 Kagunga II Kigali Kicukiro Gikondo Kagunga 1030301 1/03/03/01/114 22829 1167.07249335
Record: 0 Records (0 out of 1 Selected) Options Commit

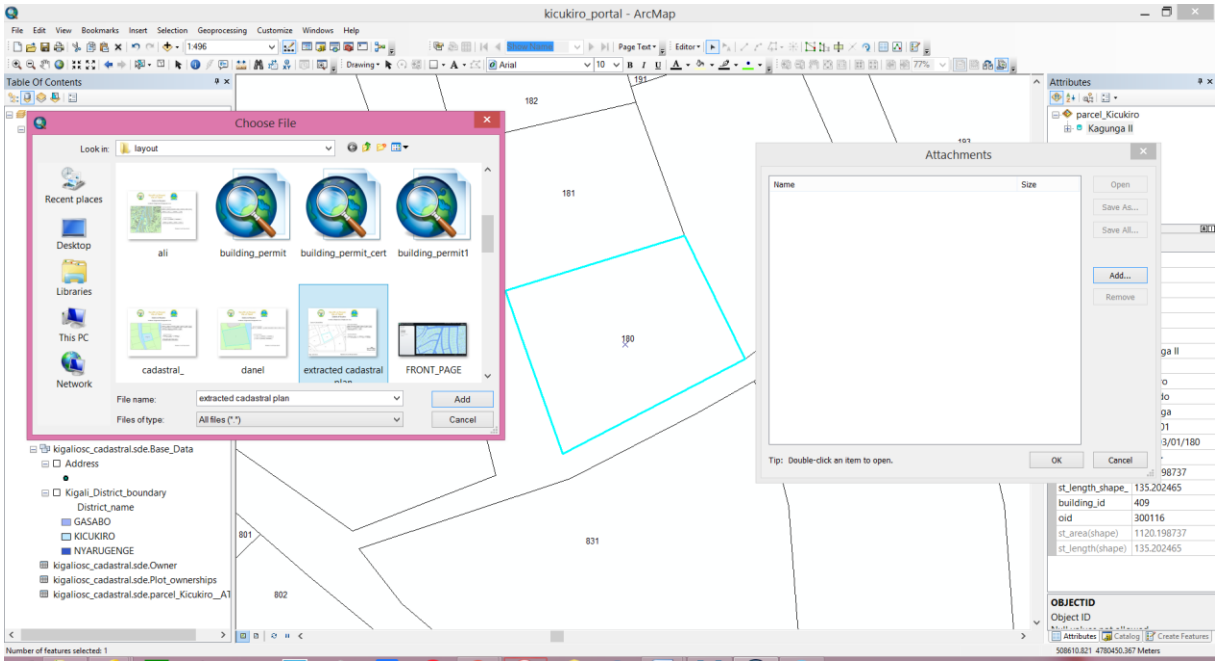


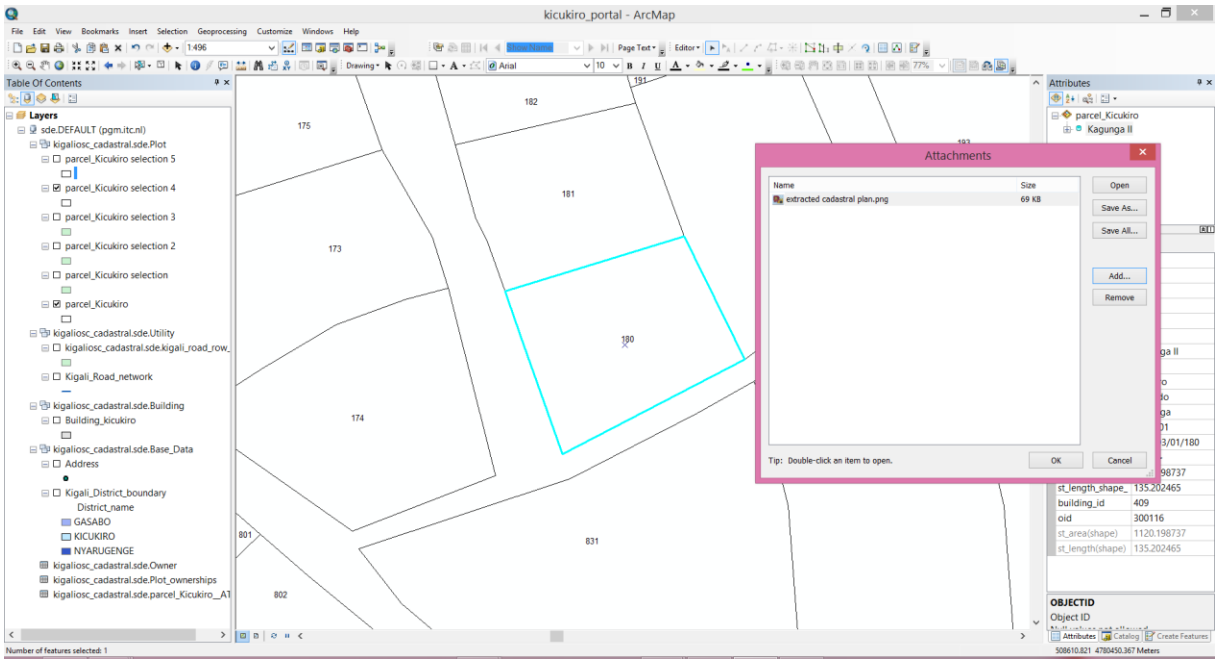
User interface of Back-office (ArcGIS desktop)




kicukiro_portal - ArcMap
Select By Attributes
Layer:
parcel_Kicukiro selection 6
Only show selectable layers in this list
Method:
Create a new selection
parcel_id
upi
building_id
st_area(shape)
Like
And
Or
Not
Is
In
Null
Get Unique Values
Go To:
SELECT * FROM kigaliosc_cadastral.sde.parcel_Kicukiro WHERE:
parcel_id = 180
Clear
Verify
Help
Load...
Save...
OK
Apply
Close
Table Of Contents
Catalog


kicukiro_portal - ArcMap
Republic of Rwanda
City of Kigali
District of Kicukiro
Certificate of Registration of Emphyteutic Lease
Extract Cadastral Plan
Owner name and address
Land Parcel Informaion
Note
Parcel map prepared based on general boundaries principle
Date: 14/02/2016
Signature of Land Bureau director
Table Of Contents
Attributes


kicukiro_portal - ArcMap
Choose File
Look in: layout
Recent places
Desktop
Libraries
This PC
Network
ali
building_permit
building_permit_cert
building_permit1
cadastral_
danel
extracted cadastral plan
FRONT_PAGE
File name: extracted cadastral plan
Files of type: All files (*.*)
Add
Cancel
Attachments
Name
Size
Open
Save As...
Save All...
Add...
Remove
Tip: Double-click an item to open.
OK
Cancel
Table Of Contents
kigaliosc_cadastral.sde.Base_Data
Address
Kigali_District_boundary
District_name
GASABO
KICUKIRO
NYARUGENGE
kigaliosc_cadastral.sde.Owner
kigaliosc_cadastral.sde.Plot_ownerships
kigaliosc_cadastral.sde.parcel_Kicukiro__AT
Attributes
parcel_Kicukiro
Kagunga II
st_length_shape_ 135.202465
building_id 409
oid 300116
st_area(shape) 1120.198737
st_length(shape) 135.202465
OBJECTID
Object ID
Number of features selected: 1
508610.821 4780450.367 Meters


kicukiro_portal - ArcMap
Table Of Contents
Layers
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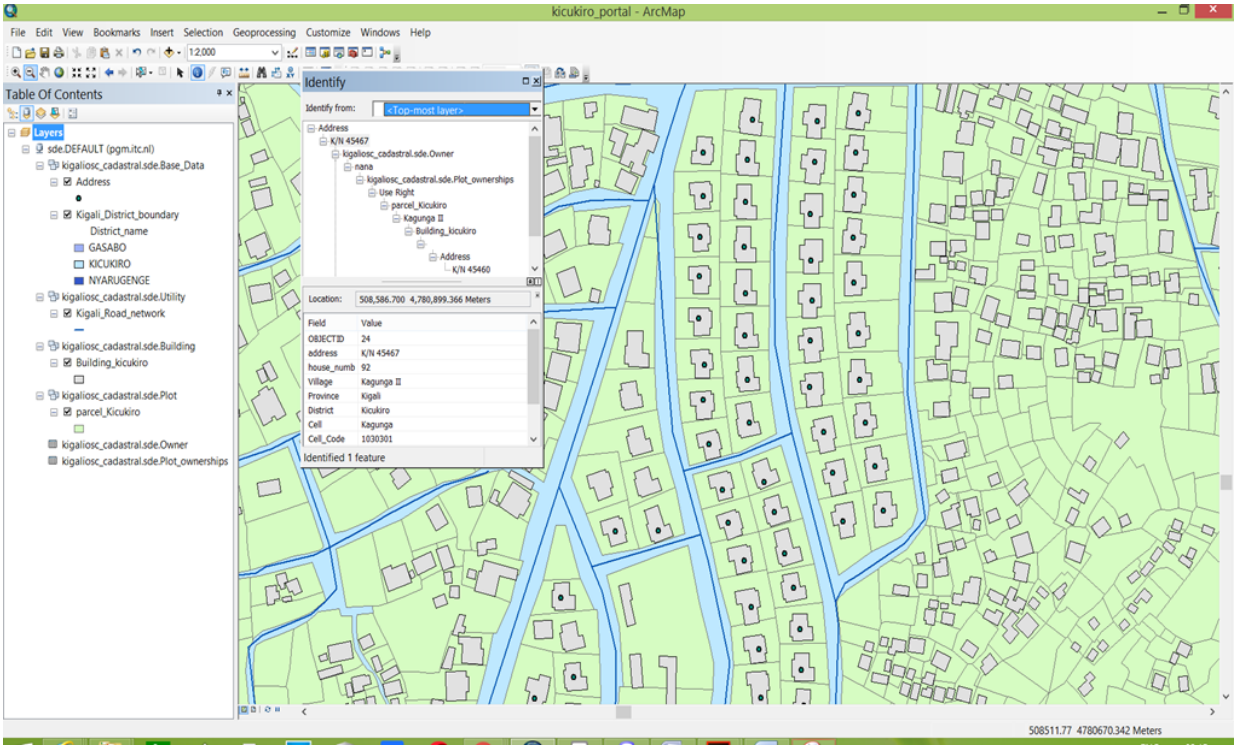
kigaliosc_cadastral.sde.Plot
parcel_Kicukiro selection 5
parcel_Kicukiro selection 4
parcel_Kicukiro selection 3
parcel_Kicukiro selection 2
parcel_Kicukiro selection
parcel_Kicukiro
kigaliosc_cadastral.sde.Utility
kigaliosc_cadastral.sde.kigali_road_row_
Kigali_Road_network
kigaliosc_cadastral.sde.Building
Building_kicukiro
kigaliosc_cadastral.sde.Base_Data
Address
Kigali_District_boundary
District_name
GASABO
KICUKIRO
NYARUGENGE
kigaliosc_cadastral.sde.Owner
kigaliosc_cadastral.sde.Plot_ownerships
kigaliosc_cadastral.sde.parcel_Kicukiro__AT
Attachments
Name
Size
extracted cadastral plan.png
69 KB
Open
Save As...
Save All...
Add...
Remove
Tip: Double-click an item to open.
OK
Cancel
Attributes
parcel_Kicukiro
Kagunga II
st_length_shape_ 135.202465
building_id 409
oid 300116
st_area(shape) 1120.198737
st_length(shape) 135.202465
OBJECTID
Object ID
Number of features selected: 1
508610.821 4780450.367 Meters


kicukiro_portal - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
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Layers
sde.DEFAULT (pgm.itc.nl)
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District_name
GASABO
KICUKIRO
NYARUGENGE
kigaliosc_cadastral.sde.Utility
Kigali_Road_network
kigaliosc_cadastral.sde.Building
Building_kicukiro
kigaliosc_cadastral.sde.Plot
parcel_Kicukiro
kigaliosc_cadastral.sde.Owner
kigaliosc_cadastral.sde.Plot_ownerships
Identify
Identify from:
<Top-most layer>
Address
K/N 45467
kigaliosc_cadastral.sde.Owner
nana
kigaliosc_cadastral.sde.Plot_ownerships
Use Right
parcel_Kicukiro
Kagunga II
Building_kicukiro
Address
K/N 45460
Location:
508,586.700 4,780,899.366 Meters
Field
Value
OBJECTID 24
address K/N 45467
house_numb 92
Village Kagunga II
Province Kigali
District Kicukiro
Cell Kagunga
Cell_Code 1030301
Identified 1 feature
508511.77 4780670.342 Meters