An-Najah National University

Faculty of Graduate Studies

Planning GIS for Palestinian Municipalities: Bidya Municipality as a Case Study

By

Sana Yousef Qasim

Supervisors

Dr. Ali Abdelhamid

Dr. Ihab Hijazi

This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Urban and Regional Planning, Faculty of Graduate studies, An-Najah National University, Nablus, Palestine.

2015

Planning GIS for Palestinian Municipalities:

Bidya Municipality as a Case Study

By

Sana Yousef Qasim

This thesis was defended successfully on 23/7/2015 and approved by :

Defense committee members:	**Signature**
– **Dr. Ali Abdelhamid / Supervisor**	**……**
– **Dr. Ihab Hijazi / Co-Supervisor**	**…….…….**
– **Dr. Adbulnaser Arafat / External Examiner**	**…….**
– **Dr. Ahmed Rafat Ghodieh / Internal Examiner**	**……**

Dedication

الاهداء

إلى من أفتقده دوما في كل خطوة اخطوها... ويرتعش قلبي لذكره...

ولم تمهله الدنيا لأرتوي من حنانه.. و لم يسعفه القدر ليرى نجاح ابنائه...

الى روح والدي رحمه الله ...

الى من كلت اناملها لتقدم لي لحظة سعادة...

الى من حصدت الاشواك عن دربي لتمهد لي طريق العلم...

الى سبب وجودي في هذه الحياة... الى القلب الكبير ... امي الحبيبة

الى من امدني بكل الدعم والتشجيع... الى من بث بوجداني الصبر والقوة...ولولا صبره وتفهمه لما ابصرت رسالتي النور... زوجي الحبيب

الى فلذات كبدي الحبيبات ...اللواتي صبرن صبر الكبار... وتفهمن تفهم العقلاء...رغم نعومة اظفارهن...بناتي

الى من ساندوني بكل مسؤولية... ووقفوا بجانبي بكل حب...

وامدوني بكل الدعم والحنان...اخوتي واخواتي

الى اساتذتي الافاضل...الذين اناروا بعلمهم دربي...

الى كل من ساعدني ووقف بجانبي...وساهم بتوفيقي

الى شهداء فلسطين... الى وطني الحبيب...

اهدي هذا البحث

Acknowledgments

I should firstly express my great thanks to almighty Allah, who gave me
power and patience to accomplish this work.

I would like to express deepest respect and appreciation to my supervisors: Dr. Ali Abdelhamid and Dr. Ihab Hijazi, who have the substance of wisdom, for the good advice of introducing me to the topic, as well for the abundant support and help on the way.

I greatly Thank both of them for their understanding of my circumstances and acceptance to extend the period of my study.

A special thanks to “Art technologies” company for the continuous help they offered to me to enrich the practical part of the thesis through their technical expertise in the GIS technology.

I wish to express my gratitude and sympathy to my husband and daughters for their patience and understanding to the forcible Dereliction which I may have done. And the courage and motivation they offered to me.

الإقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان

Planning GIS projects for municipalities:

Bidya municipality as a case study

أقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل درجة علمية أو بحث علمي لدى أي مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

اسم الطالب : Student's name:

التوقيع : Signature

التاريخ : Date:

Table of Contents

List of Tables

List of Figures

Planning GIS for Palestinian Municipalities:
Bidya Municipality as a Case Study

By

Sana Yousef Qasim

Supervisors

Dr. Ali Abdelhamid

Dr. Ihab Hijazi

Abstract

With the continuous increase in population and high demand on services and resources along with the rapid development in the information systems and computers, municipalities require an effective tool to manage these resources and a smart system to best keep and organize data with the ability to modify, manipulate, retrieve, display and link to geographic locations. Geographic information system is a powerful tool to do that, but it needs great capabilities in terms of financial resources and highly skilled people as well as the ability of acquiring precise data. Because the incorporation of a GIS in a municipality would consume a considerable amount of its budget, well-examined plan should be conducted to justify the money allocation for the GIS adoption. A preset plan also specifies accurately what we will get out of the GIS and eliminates all unneeded effort, and certainly this would save money and raise benefits. The prior knowledge of costs and benefits supports the decision making of whether or not to adopt such system.

This research has inspected the extent of the need for geographic information systems in the municipalities and how they could benefit the Palestinian municipalities and used Bidya municipality as a case study. To do that a practical thorough investigations were conducted on

the workflow of the different duties usually done by municipal staff at all departments within what is called information product description which included mainly a thorough understanding and description of the spatial and attribute data and functions needed to obtain the information product. Depending on the information product descriptions a comprehensive relational database schema was built for the overall municipality. In fact this database schema was the main result of this research. During this practical work some constraints of adopting EGIS was detected, therefor an implementation schedule was proposed for Bidya municipality to overcome these constraints.

The main conclusion that we can reach out of this research and study is the emphasis on the need for planning GIS projects separately for each organization which intends to adopt GIS, and that geographic information systems couldn’t be directly bought.

Accordingly as a governmental policy it is recommended that a Comprehensive diagnostic study of all Palestinian municipalities should be conducted to examine the degree of preparedness to adopt geographic information systems according to preset criteria or model as an introduction to find the ways to overcome impediments for GIS adoption within a national strategic plan in Palestine.

Chapter 1

Introduction to GIS in Palestinian Municipalities

1.1 Introduction

City planning and management (represented by the core of municipal work) requires thorough knowledge of the complicated information in the surrounding spatial environment, in which most information in most sectors has components related to the geographic locations, and this is a difficult task when using manual and traditional tools, But the existence of an information system linking geographical locations and spatial elements with databases can ensure proper planning and best use of resources.

GISs are modern tools which are widely used in urban planning activities, and can link geographical reality with integrated database which facilitate getting maps and information uniformly a prelude to put proper solutions to mitigate negative phenomena, and keep up with the rapid changes experienced by the city (Mennecke, 1998).

GIS technology and systems are increasing noticeably in popularity, use and interest within the Palestinian public and private sector institutions as well as non-governmental organizations.

Today, organizations and groups of all types, are looking forward to use GISs for a wide variety of spatial data activities. A GIS is a great tool for creating, managing, analyzing and using geospatial data. As such, it can provide users with many benefits: improving operations, saving money

and time and facilitating decision making. GISs can also enable data analysis and manipulation that have long been impossible (Ashiagbor & Fosu, 2012).

However, while GISs can be very useful to organizations and individuals, their effectiveness and success depends upon how they are planned, implemented, managed and used. in this context, a paper published by (EMH&T company, 2007) indicated that 85% of GIS projects fail, 87% go more than 50% over budget, 45% don't produce expected benefits and 90% go over schedule, and this is due to the absence of advance planning for the project.

This thesis discuses GIS project planning for municipalities and the methodology that should be followed to obtain the most appropriate project in the least cost. the methodology which is followed in this research describes how to prioritize what the organization needs from GIS in order to plan a system that meets the actual requirements. R. Somers stated that "*most successful GIS projects are implemented according to a structured process that assures that the end product will meet the users' needs*".

The outcome of the thesis reflects both the theoretical background studied, and the practical experience of the researcher obtained during the work for 7 years in a representative local government.

1.2 What is GIS

An educational material for Westminster College have defined the reality and components of GIS as: A geographic information system (GIS) is a computer-based tool for mapping and analyzing spatial data. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps (ESRI). These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. a working Geographic Information System integrates the following five key components:

1. Hardware

Hardware includes the computer on which a GIS operates, the monitor on which results are displayed, and a printer for making hard copies of the results. Today, GIS software runs on a wide range of hardware types, from centralized computer servers to desktop computers used in stand-alone or networked configurations.

2. Software

GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components include tools for the input and manipulation of geographic information, a database management system (DBMS), tools that support geographic query, analysis, and visualization, and a graphical user interface (GUI) for easy

access to tools.

3. Data

Data may be the soul of a GIS. A GIS will integrate spatial data with other data resources and can even use a database management system, to manage spatial data through a relational tables which includes spatial geocode to link attributes to locations (Mennecke, 1998). Data may be obtained by in-house collection or produced by digitizing images from aerial photographs or published maps. Data can also be purchased from commercial data provider. Some data can be obtained from the governmental resources at no cost.

4. People

GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work.

5. Methods

A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

Figure 1.1 : components of Geographic information system

GIS technology has developed from:

- Digital cartography and CAD
- Database management systems (DBMS)

CAD has the capability of mapping and handling spatial data with limited capability of storing descriptive data, while DBMS are effective tools for managing information with no capability of handling spatial data. GIS has developed as a multi- purpose tool for handling both spatial data, cartography and manipulating descriptive data with significant capabilities of descriptive and spatial data analysis and the construction of relationships between geographic data which represent the real world and the associated descriptive data. (Zhao, 2002).

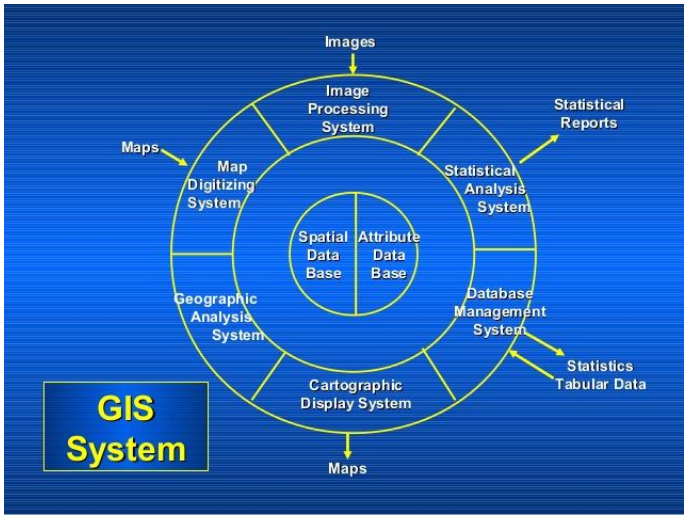


Figure 1.2 : GIS data input & output

GIS has very strict relationship with other disciplines and sciences which formulates the base for it, these sciences are:

1. Geography
2. Cartography
3. Remote Sensing
4. Surveying
5. Photogrammetry
6. Statistics
7. Computer Sciences**:** which include; Computer Aided Design (CAD), Computer Graphics, Data Base Management System (DBMS), Artificial Intelligence. (Awad, 2010) see the figure below:

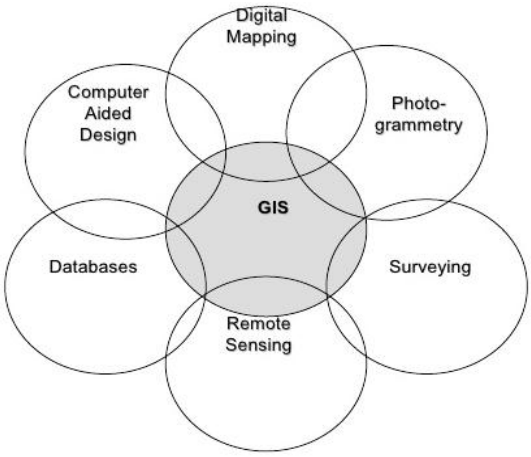


Figure 1.3 : Cross-disciplinary Nature of GIS

1.3 Geographic Information System in Developing Countries

1.3.1 The Emergence of GIS.

The GIS arose independently in Australia, Canada and U.S.A in the 60s of the last century and this was due to the actual need for handling a different forms of spatial data, in particular map production, the term "Geographic Information System" was firstly used in Canada in 1966 ***(Venkatachalam,Eolss)***. in 1960 was the development of the world's first true operational GIS in Ottawa, Ontario, Canada by the federal Department of Forestry and Rural Development. Developed by Dr. Roger Tomlinson, it was called the Canada Geographic Information System (CGIS) and was used to store, analyze, and manipulate data collected for the Canada Land Inventory (Wikipedia, 2014). The first GIS software in U.S.A was developed in 1967 for address matching, computer mapping and small area analysis.

In general, the development in the GIS and its applications was successive and rapid due to the actual need for it to manage the large and diverse amounts of information. This was supported by the successive development of computer devices and software which made it easier to deal with the huge amount of data.(Al-Salman, 2005).

What distinguished the period of 1970s is that the National Aeronautics and Space Administration (NASA) launched Earth Resources Technology Satellite (ERTS1, later known as Landsat) which enabled

obtaining high quality images for earth surface for anyone who request it. (Eria,2012).

The rapid development of computer software and hardware and other technical tools and the affordability of acquisition of these tools especially the invention of the personal computers in the early 1970s led to GIS diffusion (Eria,2012).

1.3.2 State of GIS in the Developing Countries

Developing countries - also referred to by World Bank and United Nation as less- developed countries - although the UN stated that there is no commonly agreed definition of developing countries, they are nations of low standard of living, backward industrial base and occupies a low ranking in the human development index compared to other countries. Since the end of the nineties of the twentieth century, indicators showed that developing countries achieve higher growth rates than industrialized countries.

According to this definition, in general the countries of south America, Africa and most of Asia are labeled as DCs.

The GIS was introduced to the developing world by virtue of the UN through the organization of UNEP -United Nations Environmental Program- which was established in 1972 as result of the United Nations conference on the Human Environment in Stockholm, Sweden. The organization's mission was *"to provide leadership and encourage*

partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations" (Mooneyhan, 1998). The role of the UNEP was to monitor and gather data about the environment, in the same year 1972 was the launch of the Landsat satellite by NASA which could take high quality images for all earth surface and provided huge amount of data that created a big need for an advanced technology to process and manage these data, and thus NASA released a high raster-based capability GIS in 1983. In 1984 NASA agreed to provide UNEP and its member countries with soft and hardware and expertise needed for image processing and GIS technology as well as all regional and global datasets for free. UNEP named this project the Global Resource Information Database (GRID), and the first center was opened in Geneva in 1985 and Nairobi in 1986, and many donations of hardware and software and training programs were introduced to UNEP for the benefit of many developing countries. (Eria, 2012). The UNEP carried out national and sub-national case studies in the DCs for environmental assessments and resource management using GIS and spatial data models these case studies include: Argentina, China, Costa Rica, Indonesia, Kenya, Nepal, Panama, Peru, Saudi Arabia, Thailand, and Uganda" (Mooneyhan 1998).

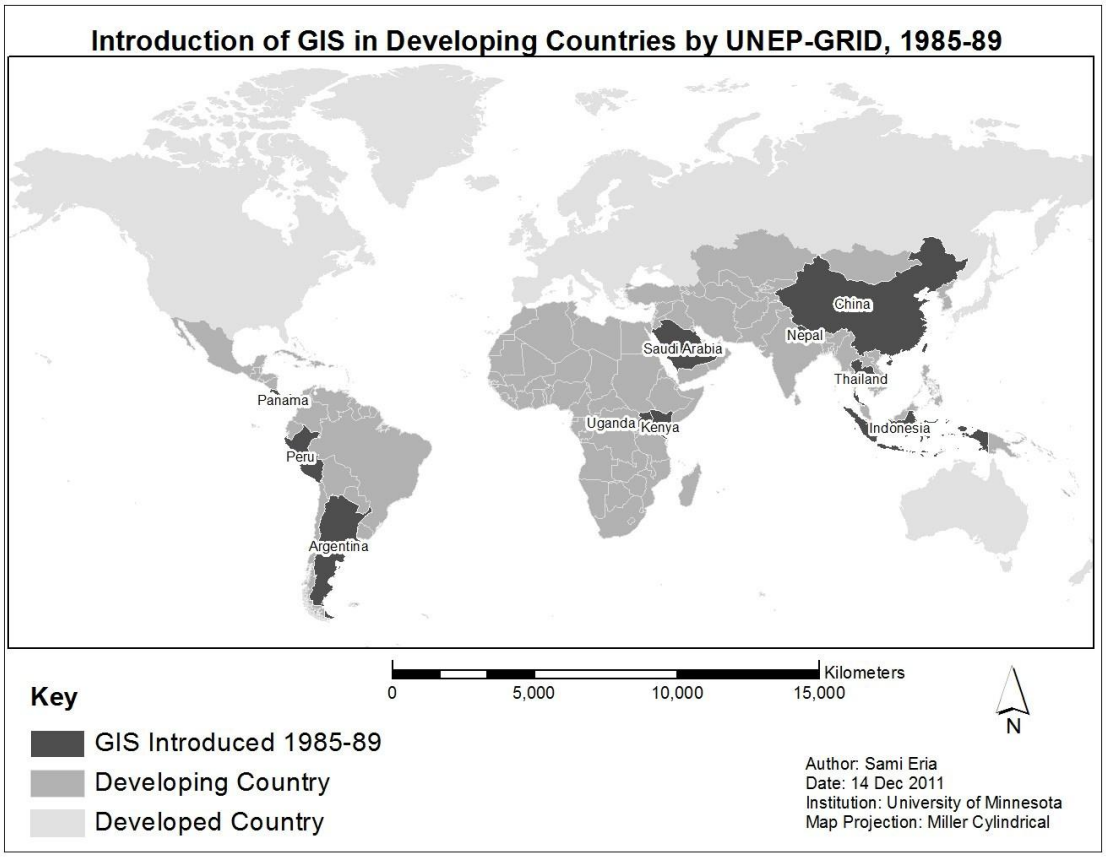


Figure 1.4 : The First Countries in the Developing World to Receive GIS Technology, through UNEP-GRID.

The DCs are characterized by features that emphasize the need for GIS as a tool for planning and development and indicate many potential uses and applications of GIS, of these features the high rates of growth, the spread of slums and informal settlements, high demands for services and infrastructure due to the overpopulation, poverty and negative social phenomena (Bishop, 2000), and despite that, using GIS in developing countries is something that seems very unusual for many people.

1.3.3 Impediments to the Spread of GIS in Developing Countries

There is a consensus by most researchers that using GIS in developing countries is limited and still in early stages. several researchers talked about different factors inhibiting GIS adoption in DCs, But there are general common constraints to DCs and on top of these constraints cost issues especially, within countries that already suffer from the limited financial resources or poverty, the high cost of the GIS components comes from the fact that the appropriate tools, software and hardware are developed and sold by industrialized countries at expensive rates. And data collection depends on advanced tools that are not available in DCs such as satellites necessary to obtain the needed imagery this also will add to the cost. There are constraints related to data availability and data accessibility mainly because many of the DCs have not been democratically ruled and many have been occupied and thus, either data was not available, not accessible or might be faked. Constraints also are related to computer illiteracy in the DCs and the limited availability of skilled people to deal with GIS project (Zellar, 2002).

The factors inhibiting or influencing GIS adoption in DCs are classified into two main categories (Mennecke, 2001):

- **Technological Characteristics**: that is GIS requires a special types of data, special types of technology (soft and hard ware) as well as special personnel expertise.

Data constraints are related to data source , data collection, data management and data integration.

Physical spatial data in DCs are obtained by digitizing paper maps which are old and inaccurate, some political data such as areas' boundaries, census blocks, voting limits are changing over time. Socioeconomic data are difficult and costly to be collected it couldn't be collected by overhead imagery as well as it is not fixed it is changing over time, such as population count and distribution of social categories and phenomena, economic detailed data about industry types and agricultural crops. There are also difficulties in data management and integration specially at the national level when data are integrated from different institutions, it stems from the different positional references, inconsistent classifications and methodologies of data collection, use of different spatial units and also missing positional information.

- **Organizational Characteristics** of the system environment, these include: organizational resource constraints, system implementation policies.

GIS projects require significant financial investments with relatively no immediate tangible benefits, that is the actual outcomes of a comprehensive GIS system take years to appear, this makes it difficult to justify this kind of projects specially in DCs which are facing financial constraints and urgent need to the basic services *(* Mennecke, 2001).

There is a problem in training suitable staff, the training is expensive, time consuming and face the risks of the move of trained personnel to more

lucrative non-government positions. Some organizational problems are represented in the possession of data by organizational members. Possession of data and control over technological resources by organizational members is a source of power for those members, this fact changes the power relations between organizational members, thereby providing motivation for members to take (political) actions that secure or maintain power, these organizational politics influences the implementation and diffusion of GIS in DCs.

An issue related to data ownership could affect GIS implementation and diffusion When a significant effort and resources are expended by an agency on spatial data collection and technology, there could a problem in data sharing with other agencies specially if there is no protocols for exchange of information.

1.4 Scope of work of Municipalities in Palestine

Municipalities play an important and key role in the development and delivery of services to citizens as a form of administrative decentralization. they have administrative and financial independence and legal legitimacy. municipalities are institutions which are closest to the community as it is the connecting link between the citizen and the official authorities, (Toukan, 2001). Municipalities carry out many tasks and responsibilities as defined in the Local Authorities Law No. (1) for the year 1997, which included Article No. (15) that defines functions and authorities of the municipal council, which included town planning, streets, buildings and

building permits, the collection of taxes and fees, water and electricity services, sewage, public markets, crafts and industries, cleanliness, parks, transportation and advertising, and many other tasks, all of these tasks are carried out within the area of the rule of the local authority, which is defined in the same law as a "unit of local government within a certain geographic and administrative scope."

Because of the urgent need to institutionalize the work in Palestinian municipalities in order to respond to the circumstances and variables and social, economic and environmental challenges at the local level, local governments require innovative working methodology to manage towns and cities in a way that copes with the requirements of sustainable development and also consistent with the need to lay the foundations of transparency and governance in the local government sector. (Qawasmi, 2009).

Local government is also the unit that recognizes the needs of the population and determine priorities based on the principles of overall development without neglecting the needs of emergency that may arise from time to time, hence the municipal or local body representing the source of the information and data that represent the basis for the formulation of policies and strategic objectives of the central government.

For the very linkage between the nature of municipality work and the need for a system like GIS, it is helpful to show the authorities and responsibilities of municipal councils as defined by local authorities Law

No. (1) for the year 1997 on the local councils which can be practiced within the area of the rule of the local authority either by its employees or by external contractors, and these functions and duties are:

(Table 1.1) the authorities and responsibilities of local governments in Palestine

No.	Scope of work	duties
1.	Planning of town and streets	planning, roads' construction, determine roads' width and path, road pavement, maintenance, lighting, cleaning, coding, naming, landscaping and prevent overtaking them.
2.	Buildings and Building Permits	Monitoring building construction, demolition, license issuance according to regulations.
3.	Water	Provision of safe drinking water, subscription, distribution, management., and prevent pollution
4.	Electricity	Provision, subscription, distribution, management.
5.	sewage	Provision, subscription, distribution, management.
6.	public markets	Organizing, monitoring, set types of goods

7.	Crafts and industries	Organizing, classification, monitoring, prevent pollution, licensing.
8.	cleanliness	Solid waste collection, organize disposing it.
9.	Public health control	Monitoring, organizing, establishing health facilities
10.	Public places	Regulation , monitoring.
11.	Parks	Establishment, monitoring, regulating.
12.	Transportation	Create, organize and set positions of vehicles parking places
13.	Advertisements	Monitoring, organizing and licensing.
14.	Demolition of buildings	Demolition of buildings in bad conditions
15.	Graves	Establishment, canceling and organizing locations of of cemeteries
16.	Hotels	Monitoring and organizing
17.	Managing financial resources	Management and audit
18.	Cultural and sports institutions	Museums, public libraries, schools, cultural and sports clubs and musical facilities

It is noticed that all municipality duties have a spatial dimension, and need to link descriptive data with its place through an innovative system like GIS to facilitate storage, retrieving, manipulation, conversion, linking, analyzing and displaying information of spatial nature related to surface of the earth, and above and below it. According to population of localities, local governance laws have classified municipalities into four classes and have identified typical organizational structure for each class, the following is for municipalities of class II (B),for the rest of the classes, see annex(A).

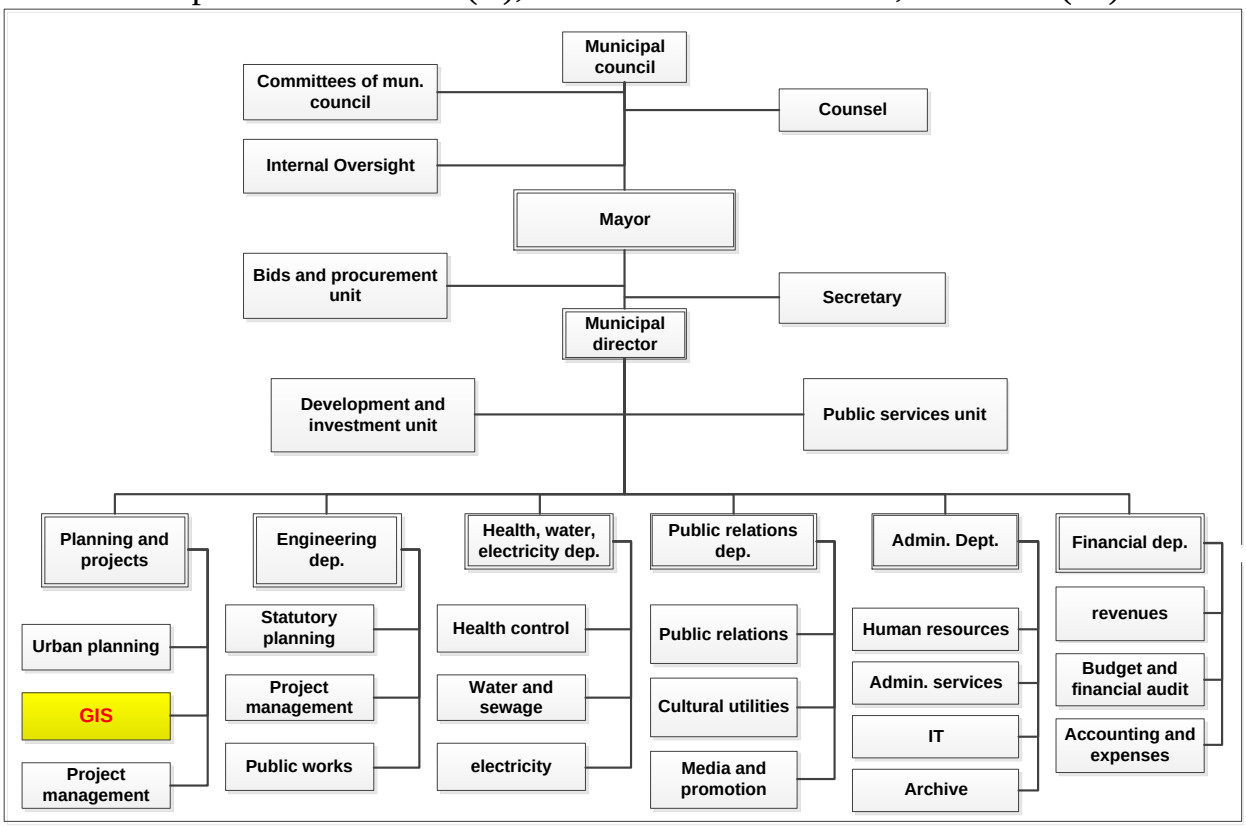


Figure 1.5 : Organizational structure of municipality class II (B)

we can observe that the organizational structure of large municipalities, includes a special unit for data and GIS.

1.5 The Reality of GIS in Palestine

interest in (GIS) started in Palestine in the last ten years through academic firms especially universities, which started to educate students about GIS, while some entrepreneur private firms interested in GIS projects implementation started to appear gradually, recently, the formal bodies such as ministries and municipalities started to show a special interest in GIS applications despite of the obstacles facing them, some non- governmental organizations have implemented pilot (GIS) projects for services institutions, especially municipalities to find out the extent of the success of such projects and then expand the experience to other local bodies (Global Communities, 2014).

So far, the capabilities of municipalities in the use of GIS applications are considered very simple and modest, this is because of the lack of budget required to establish a complete GIS system especially under the large number of priorities and needs, and most municipalities lack the qualified specialists in the field of GIS, in addition to the lack of precise data and digital maps which are considered the base of any GIS project (Awad,2010).

Despite of all obstacles and constraints , we can see that there is interest in GIS at the level of central government and local governments represented by municipalities, this seems from:

1. The adoption of a unit for GIS in the organizational structure of the ministry of local government, this unit has recently launched a project of

"Web Spatial Information Services" for municipalities.

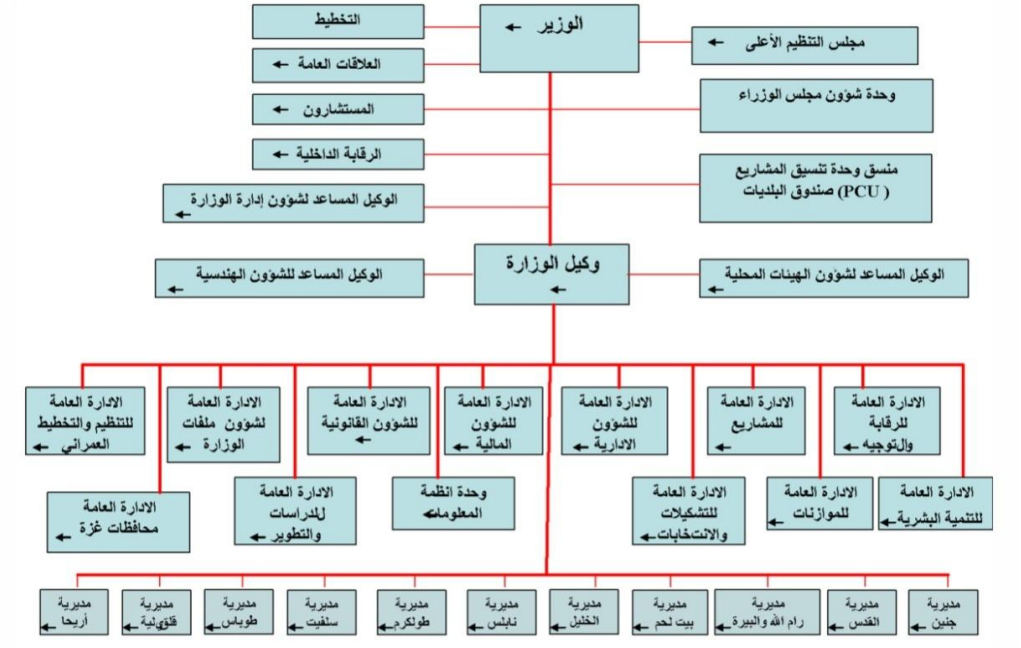


Figure 1.6 : Organizational structure of Ministry of Local Government

2. The adoption of GIS units in the organizational structures of municipalities of class A and B (large municipalities).

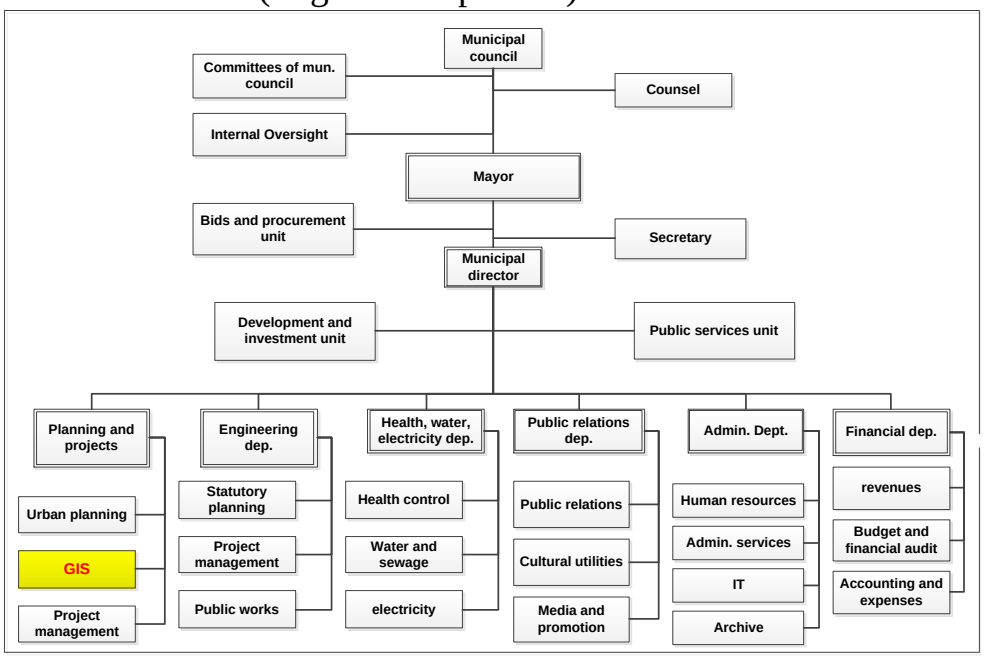


Figure 1.7 : Organizational structure of municipality class II (B)

3. Some municipalities have established a GIS department and created an actual geographic information system, such as Ramallah municipality.
4. Some municipalities tried to create a GIS unit through an external grants to finance the project, because of budget deficit, such as Bidya and Tobas municipalities.
5. Some municipalities tried to use " ArcMap" to achieve certain tasks using PCs in a random way, and this indicates the need for such tool.

We can also observe the interest of non-governmental organizations in GIS as:

1. They collect funds to implement GIS projects for municipalities and other institutions such as (Global Communities organization).
2. They encourage municipalities to prepare proposals or studies for GIS projects to help them collect funds such as GIZ organization.
3. They offer free training courses in the field of GIS, such as house of water and environment (HWE) organization.

At the level of high education, universities have become more interested in the field of GIS in the academic programs and researches.

1.6 Obstacles to GIS Implementation in the Palestinian Municipalities.

According to a study done by Rami Awad, 2010, the study concluded that there are a lot of obstacles facing the adoption of GIS in Gaza which also applies to other municipalities in Palestine, they mainly are the lack of data, restrictions set by Israeli occupation, No general policy at the level of government to adopt building GISs, lack of financial resources and lack of specialized cadres within the municipalities.

Moreover, 70% of land in Palestine is not registered and no parcel plans and surveys are available. (Samarah, 2010).

1.7 An Overview of the Study Area

Bidya town is located in Salfit governorate 11 km to the west of Salfit city it represents a vital center for the neighboring villages, where most commercial and social services needed by citizens are available specially, health, educational and business services (Bidya municipality). Bidya population is estimated at about 10,000 inhabitants according the Palestinian Central Bureau of Statistics updates for the year 2015. The area of Bidya town is about 21,000 donums, about 2000 donums are within the approved structural plan.

Bidya municipality had been village council since the beginning of the sixties i.e. period of Jordanian rule in the West Bank, then it was among the municipalities that have been adopted municipalities after the advent of the Palestinian National Authority in 1997, where the members of the

village council continued functioning until the first local elections under the Palestinian Authority - in 2005, when it was the first elected municipal council for Bidya.

Bidya municipality like all municipalities provides public services for citizens, such as water and electricity services, solid waste collection and disposal, monitoring health and environmental conditions in the town, maintenance of public facilities and monitor the implementation of the master plan through the issuance of building permits in accordance with the regulatory provisions attached to the master plan. As well as the implementation of development projects in most sectors of the planning, and many other tasks and services ... etc.

work at Bidya municipality is done by a staff which is organized by an organizational structure approved by ministry of local government, this structure in general, is composed of 3 main departments which are: engineering department, administrative and financial department and director of municipality. Municipality of Bidya has a staff composed of 45 employees to fulfill the general duties. It possesses fixed assets differ between buildings roads, networks for water, electricity and sewage, gardens, vehicles and equipments. It works within a yearly budget of about 3 millions of dollars. the main source of revenues is electricity distribution project, different fees and taxes and external grants by donors. (Bidya municipality)

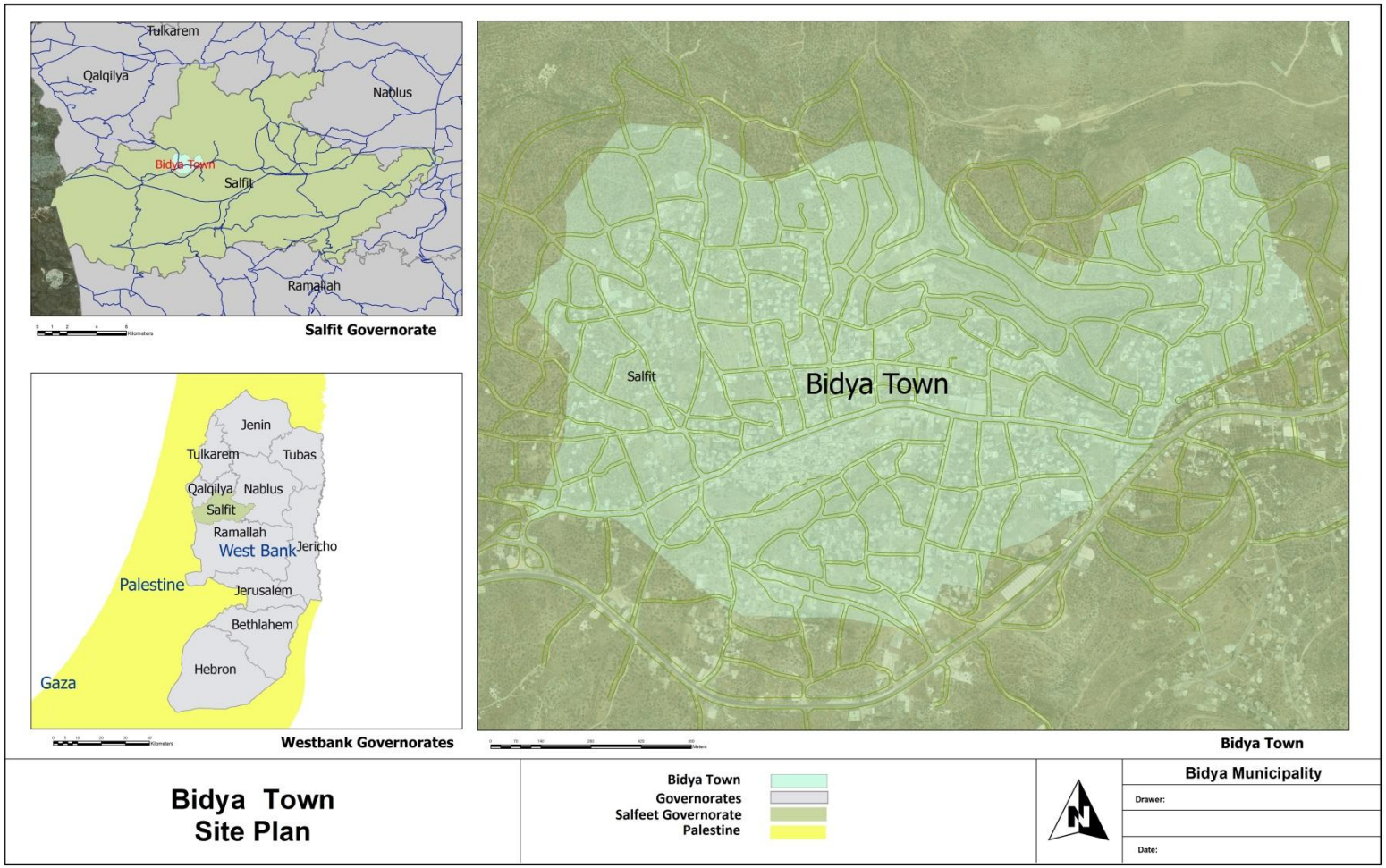


Figure 1.8 : Location Map of Bidya

In fact, Bidya municipality can represent many other municipalities which has similar circumstances and characteristics, this may be evident from the statistics published by formal organizations such as:

- Population: according to the population estimates of the Palestinian Central Bureau of Statistics for the year 2016 it shows that 82 out of 135 municipalities have a population fall between 6 and 14 thousands inhabitants which Bidya town represents an average for them in terms of population. (www.pcbs.gov.ps , 2015)
- Performance assessment: according to performance assessment carried out yearly by the municipal development and lending fund (MDLF) which is based on a criteria consists of several indicators such as the existence of : budget surplus, external audit, efficiency in revenue collection, integrated financial management system, fixed assets record, procedure manuals technical & managerial, strategic plan with community participation…etc. Bidya municipality has a rank of (C) according to the assessment process for year 2014. The number of municipalities which has the same rank is 75 out of 135 municipalities in Palestine.
- Some issues which are very related to the GIS implementation and apply to Bidya and many other localities are land registration and parcel maps issues. Bidya suffer from the total absence of this data, no registration, property, and division system for lands and other real estates. This situation applies to more than 65% of lands in Palestine (Albarghothi, 2015).

It is noted that Bidya municipality represents 61% of the Palestinian municipalities in terms of population, 56% in terms of performance

indicators and 70% in terms of land issues. From the previous statistics and knowing that Palestinian municipalities work according to standard organizational structures and provide similar services according to law, we can say we can say that Bidya municipality represents a considerable range of the Palestinian municipalities.

1.8 Problem Definition:

The Palestinian municipalities need to manage huge amount of data in the fields of planning and service delivery, for this purpose they use different traditional tools for storing and retrieving data, these tools are inefficient and lack the link between statistics and locations, this status for data management negatively affect the decision making process which is often based on inaccurate information or totally absent information.

GIS is powerful tool for data management -both tabular and spatial data-. It is powerful in data storing, retrieving, manipulation, analyzing and display. Most municipal activities have spatial components, so GIS is very useful to promote these activities, improve service delivery and increase work efficiency through liking data with its location on land and the high efficiency in getting information which is necessary for decision making. Interest in GIS technology is increasing noticeably within the Palestinian municipalities, and there is a growing enthusiasm for decision makers and senior level to adopt GIS in pursuit of sophistication.

But GIS benefits depend on its success and sustainability. Not only in the developing countries , but also in the industrial countries there are

indicators that most GIS projects fail and often go over budget and schedule as well as don't produce expected benefits.

Studies applied on different DC and IC articulated that absence of structured GIS planning is one of the major causes of GIS projects failure.

One of GIS basic components is data, data is considered the soul of the GIS, without data the system doesn't work at all, getting data and updating it is considered one of the challenges facing the GIS success and it often consumes the majority of the project budget and time, this applied study uses the case study approach to investigate the extent to which the Palestinian municipalities are ready to adopt the GIS in their daily work.

1.9 Research Questions:

1. How can we apply the GIS planning process within municipalities in Palestine.
2. What are the requirements of the GIS in the Palestinian municipalities in terms of data.
3. What are the particular benefits of GIS for the municipal work in Palestine.
4. How could the Palestinian municipalities migrate to the EGIS in terms of data issues.
5. To what extent data acquisition issues are considered obstacles to GIS adoption and success in the Palestinian municipalities.

1.10 Research Assumptions

6. Planning for GIS projects provide a clear image of the needs and requirements, expected results and benefits, costs, obstacles and solutions, as well as it supports the decision making regarding the GIS adoption.
7. Lack of good planning for GIS delays the success of GIS adoption efforts within the localities in Palestine, because unplanned efforts lead to failure.
8. GIS has many uses and benefits to municipal work.
9. Lack of data is considered one of the main constraints to getting maximum benefits of GIS.

1.11 The Importance of the Study

The significance of the study is based on the following points:

1. The necessity of planning for any GIS project before implementation, to adopt a GIS project that meets the real needs within reasonable cost.
2. The lack of studies in GIS in Palestine, and specifically studies and researches that explains how to plan for a GIS project.
3. Lack of applied studies at the local level, which shows the requirements of the introduction of GIS in the nature of the work of Palestinian local bodies and study and analysis of the reality of the municipalities in terms of potentials and obstacles and ways to overcome them, if any, and to know the reasons for the delay in the use of these systems in local municipalities.

4. The first study that tries to plan for a GIS project according to structured methodology.

5. The need to use modern methods and techniques at municipalities to provide services effectively and efficiently.

6. The importance of GIS as a tool for data management which is necessary for decision making to solve problems.

7. The need for well qualified persons to make feasibility studies for GIS projects for non- profit organizations and firms.

8. Strategic planning for municipality work can be positively affected by introducing well planned GIS projects.

9. Gain experience that could be applicable to other Palestinian municipalities.

10. Need to enrich the researcher information in this field as a worker in the local government sector.

1.12 The Objectives of the Study:-

1. Study of systematic planning for GIS projects.

2. Prepare a schema and develop a model for the automation of municipal work using the applications of GIS.

3. Prepare a feasibility study for GIS utilization at the Palestinian local governments.

4. Results of the study will be used to support and assist the Palestinian municipalities in adopting the use of GIS applications.

5. Keep up with modern technology in the field of data management.

6. To highlight the role of modern technological methods to increase the efficiency and effectiveness of services provided by municipalities and methods of access to information by the largest number of beneficiaries, which achieves the principle of transparency.
7. Introduce sample study that represents the actual needs for all same municipalities.

1.13 Work Plan and Methodology

In this study, the methodology of planning for GIS projects introduced by (Roger Tomlinson, 2003) was followed ,and Bidya municipality was chosen as a case study to apply this methodology, this included:

1. Collecting data regarding work and authorities of Palestinian local governments according to laws and regulations.
2. study of daily tasks and workflows of the different departments at Bidya municipality, in order to prepare an initial list of information products.
3. Describe the information products in terms of map requirements, tabular data requirements, text documents, images and needed functions ... etc.
4. Define system scope in terms of needed spatial and non-spatial data and specifications.
5. Use the information product descriptions to build a database schema for the whole municipal work.
6. create benefit cost analysis.

The descriptive approach was followed to describe the state of GIS in the developing countries and Palestine as well as for describing the nature of

work in the Palestinian local government. While the analytical approach was followed to extract the uses and benefits of GIS for Bidya municipality workflow and the deductive approach was used to conclude some of the impediments of GIS in the Palestinian municipalities through identifying the data requirements and data availability. The following tools were used to accomplish this study:

1. Group interviews with different officers and decision makers of the municipality of Bidya to know and document the workflow of transactions and services.
2. individual meetings with departments' heads.
3. viewing and observation of available procedure manuals, job descriptions and other documents.
4. The actual engagement into work as an employee in the municipality.

1.14 Sources of Information and Data:

1. sources of official data:

These include mainly "Roger Tomlinson 2003" methodology in planning GIS projects, in addition to laws and regulations governing the work of municipalities, as well as available publications and statistics relating the subject of the research.

2. Electronic sources

These include websites that are interested in this topic, such

Journals, universities, Government official sites, NGO’s

and international bodies.

3. Sources on the field

These represent the practical side of the thesis which include the information to be collected by the researcher.

1.15 Content of the Study:

In light of the research objectives, the study is divided into eight chapters the first chapter includes an overview on the GIS; definition, emergence, state and impediments of GIS in the developing countries and Palestine, scope of work of Palestinian municipalities, as well as the importance, objective, methodology and content of the study. Chapter two provides an introduction to planning geographic information systems, which includes an overview on the planning methodologies and a brief description of the Tomlinson's methodology which represents the model followed in this study. Chapter three provides Analysis of Business Needs of Bidya municipality, which includes a description of the workflow and the potential uses of GIS to promote the efficiency and effectiveness of work. The fourth chapter includes information products descriptions which is an analysis of system needs in terms of data requirements (descriptive, spatial, text, lists, reports, photos and schematics). The fifth chapter provides a definition of system scope which includes the extracted datasets and their priorities in addition to a collection of data about the dada and the final municipal database schema. Chapter six provides an implementation plan and includes a proposed implementation schedule according to data requirements, data availability and status of financial and human resources.

Chapter seven provides an initial cost benefit analysis and Includes a rough estimate of the system cost and qualitative benefit analysis. The last chapter shows results, conclusions and recommendations).

1.16 List of Abbreviations

NO.	Acronym	Indication
1.	GIS	Geographic Information System
2.	ESRI	
3.	DBMS	Database Management System
4.	GUI	Graphical User Interface
5.	CAD	
6.	U.S.A	United States of America
7.	NASA	National Aeronautics and Space Administration
8.	ERTS1	Earth Resources Technology Satellite
9.	UN	United Nations
10.	DCs	Developing Countries
11.	IDs	Industrialized countries
12.	UNEP	United Nations Environmental Program
13.	GRID	Global Resource Information Database
14.	**URISA**	Urban and Regional Information Systems Association
15.	PCs	Personal Computers
16.	NGOs	Non-Governmental Organizations
17.	GIZ	(Name of an NGO)

18.	HWE	House of Water and Environment
19.	OS	Organizational Structure
20.	(IPs)	Information Products
21.	IPD	Information Product Description
22.	MIDL	Master Input Data List
23.	MP	Master Plan
24.	MOLG	Ministry of Local Government
25.	DWG	Drawing
26.	DEM	Digital Elevation Model
27.	EGIS	Enterprise GIS
28.	CBA	Cost Benefit Analysis
29.	TOR	Terms of Reference

Chapter 2
GIS planning Methodologies

2.1 Introduction

Just like that planning is a basic process for any kind of projects or activities, it is more important specifically for GIS projects because GISs have unique techniques, unique expertise, unique data types and tools and their success is dependent to a great extent on the institutional and organizational environment, so that unplanned GIS projects are definitely failing, while planning will rise the likelihood of success but it is not a magic recipe for success. Relating the GIS projects failure, the failure is categorized as one of three cases: total failure in which the initiative never implemented or abandoned immediately after implementation – did not operate. Partial failure in which the major goals aren't attained or there are significant undesired outcomes, in some cases only part of the specific objectives are accomplished. Sustainability failure where the initiative succeed at first and then abandoned after a period of time for different range of reasons (Heek, 2002). The lack of an adequate GIS plan can be considered one of the main reasons for difficulties and problems at various stages of GIS development and operation (Taleai, Mansourian, Sharifi, 2009). Many organizations complete their GIS without enough and effective planning. Effective GIS strategic planning draws on basic strategic planning methodologies and incorporates techniques that are specific to GIS and to the institutional and organizational condition.

Several approaches exist for strategic planning and in this chapter we will review some of these methodologies.

GIS projects range from small GIS project to multipurpose enterprise-wide GIS program such as that of a local government, and the latest type requires higher level of planning, integration, testing and support and requires an extensive and thorough understanding of the goals, objectives of the organization and desired outcomes from the GIS project.

2.2 Project Management

The project management institute in the U.S.A has defined the project as a combination of human and non-human resources, pooled together in a temporary organization to achieve a specific purpose.

The primary challenge of a project management is to achieve all project goals and objectives despite preconceived constraints, typical constraints are scope, time and budget**.** So the most common symptoms of GIS project failure are: running out of planned budget, out of planned time, not providing the expected objectives or not sustained over time.

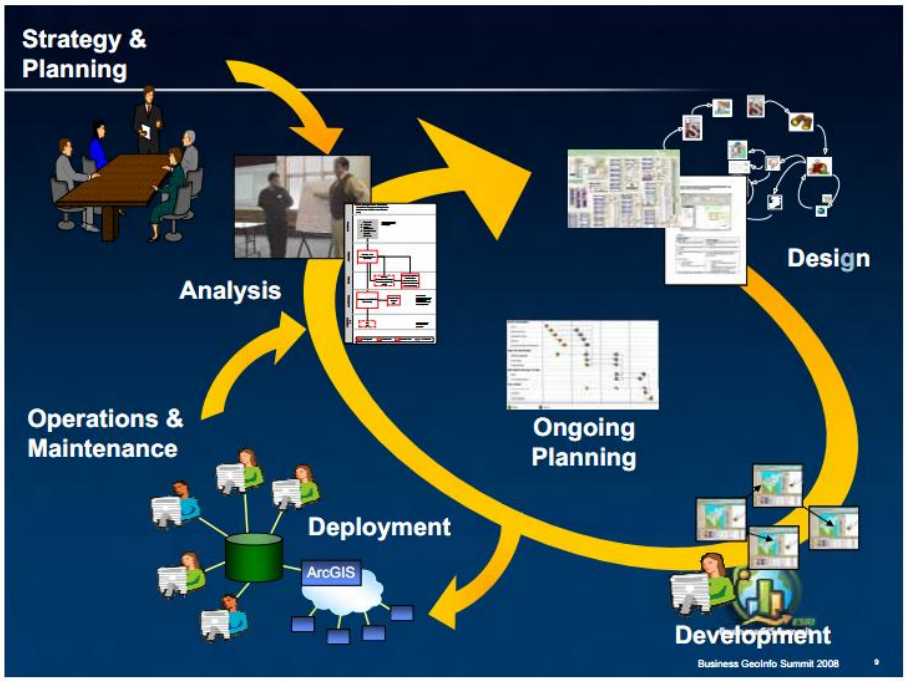


Figure 2.1 : GIS project lifecycle

In order to have a successful project, a GIS project manager has to "build" his project organization keeping in mind that it must be:

- On schedule.
- Within budget.
- Of good quality.
- Complete.
- Accepted by the customer or user.

The most common general reasons for GIS project failure in terms of project management are:

- Inadequate definition of requirements.
- Changing requirements.
- Unrealistic time scale.
- Underestimating project costs. *(Bestebreurtje, 1997)*

To avoid GIS projects failure due to the mentioned reasons, planning activities are advocated according to a structured methodology, several approaches are available prepared by different planners, and in the following section we will display some of the available methodologies which were prepared by different planning experts.

2.3 Objectives of Planning GIS Projects

Planning a GIS project is very important and it should be conducted for any GIS project specially for public - sector organizations like municipalities and other governmental agencies. if we know that GIS projects are very expensive and it will cost the institutions both investment costs and operational costs and so it is expected to consume a part of its financial resources, then we recognize that it is very worthy to plan for the project. we can summarize the reasons for the significant need for planning in the following (Tomlinson, 2003, Somers, 2000):

2. GIS include very wide range of applications, we plan to know which applications we do need and which we don't, this is to avoid unneeded cost and effort.

3. To define the strategic goals and objectives of the organization to which the GIS is being planned, to insure that the final system fits the organization, and truly support its objectives.

4. Planning leads to understand the business of the organization in details in order to identify the GIS information products that would benefit the business and improve the workflow of the organization.

5. Planning process which includes the identification of system overall requirements during the stages of both implementation and operation, would provide an accurate cost estimates, and hence a meaningful benefit cost analysis, which will support the decision making for adopting the system and provide a clear picture of what the organization in particular wants.
6. Ultimate GIS success, comes through the thorough knowing of what we want to get out of the system, again this could be achieved by planning.

Through planning, an institution can avoid spending large amounts of money for technology, data, and personnel without knowing exactly what is needed from the system.

2.4 GIS Planning Methodologies

A methodology is a standard framework including a set of practices and procedures describing the way a certain task- in this case project planning- can be handled. A project planning methodology can be used as a foundation for doing projects and it describes all the steps which have to be taken (Bestebreurtje, 1997).

By reviewing literature about GIS project planning and management one can conclude that it is big mistake to think of GIS as a software or package that can be bought from the market and be operated within any organization, GIS project involves both complex technical issues such as building databases, appropriate hard and soft ware and institutional and

organizational issues such as acceptance and involvement. Every organization has its special environment, business needs and users, so the appropriate system is built as a result of a long investigation and understanding activities made in the planning phase of the project to determine the specific outcomes expected from the system in line with the organizational mission and vision. See figure.

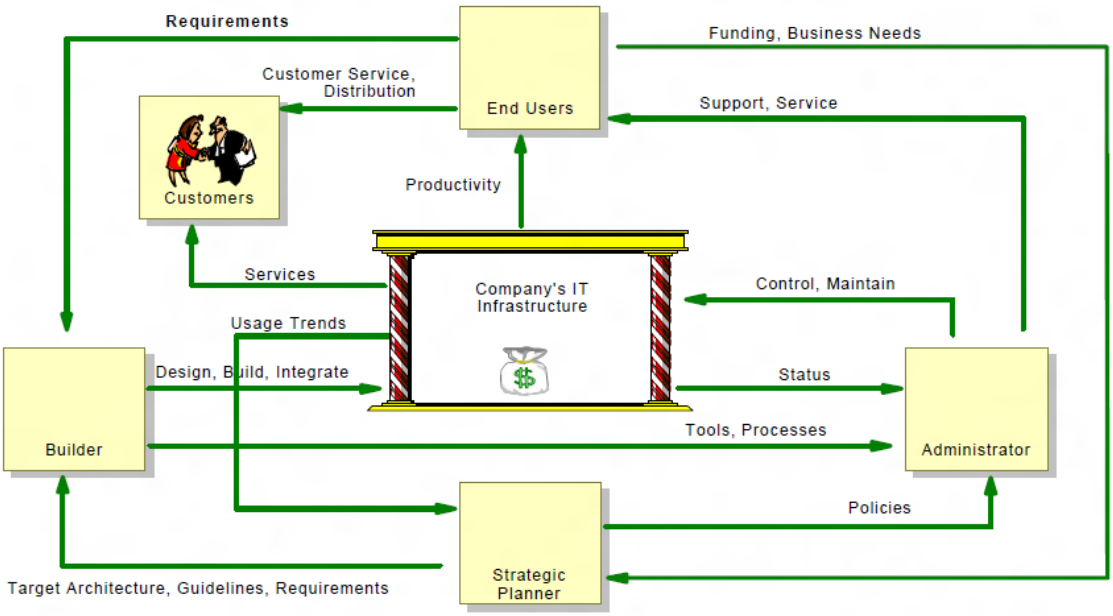


Figure 2.2 : Roles interaction during the system building

The figure above shows the role interaction during GIS planning and implementation, by looking at the strategic planner box, we note that the GIS project planner is the first person who must extensively understand end user business needs and interests, and communication and understanding of different interests is the key for success, the end user support is a main issue in planning process so they should be properly involved in this process. It is also noticed that the GIS project planner is the person who

provides guidelines, requirements and target architecture for the system builder based on the user needs analysis, he provides policies to administrator in order to control and maintain the system infrastructure, all of the parties need to communicate and understand each other properly (Bestebreurtje, 1997), this make us conclude that the proper planning build a rigid foundation for success, and in order to be near from success and avoid -at least- the most common mistakes, planning methodologies that explain in details the way things can be handled and the exact methods of implementing phases are necessary to be followed in the planning process.

There is a variety of methodologies available in planning GIS projects, the following are examples of such methodologies:

1. **An Eleven- Step Process -** GIS Development Guides for State of New York, Local Government Technology Services (1997)

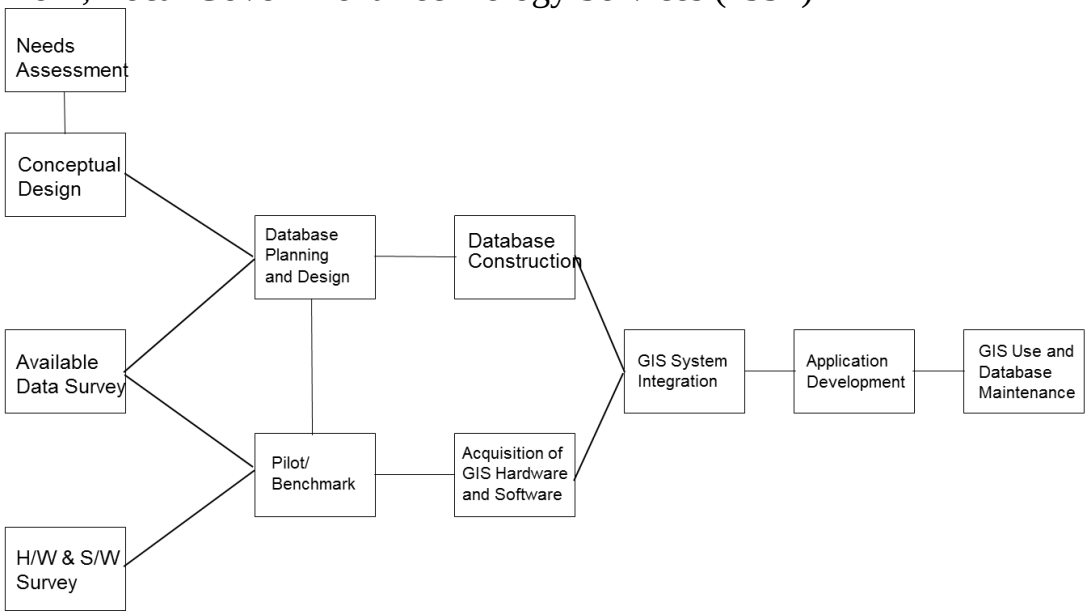


Figure 2.3 : Eleven Step Planning Process

2. A Fourteen Step Implementation Process This process assumes external acquisition.

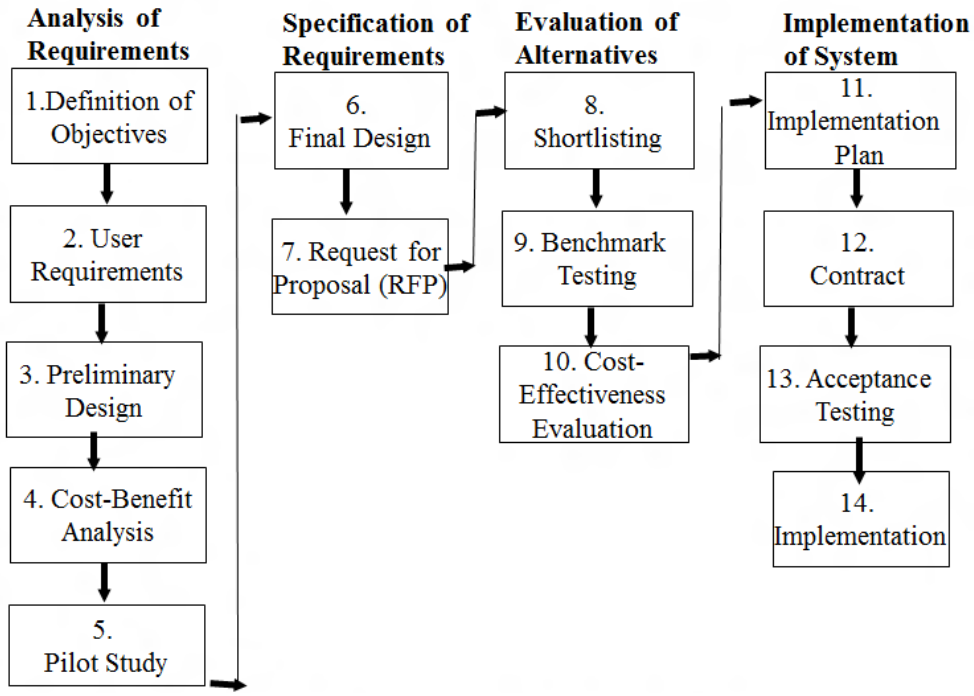


Figure 2.4 : Fourteen step Planning Process

3. Five-Step Process from Somers/URISA

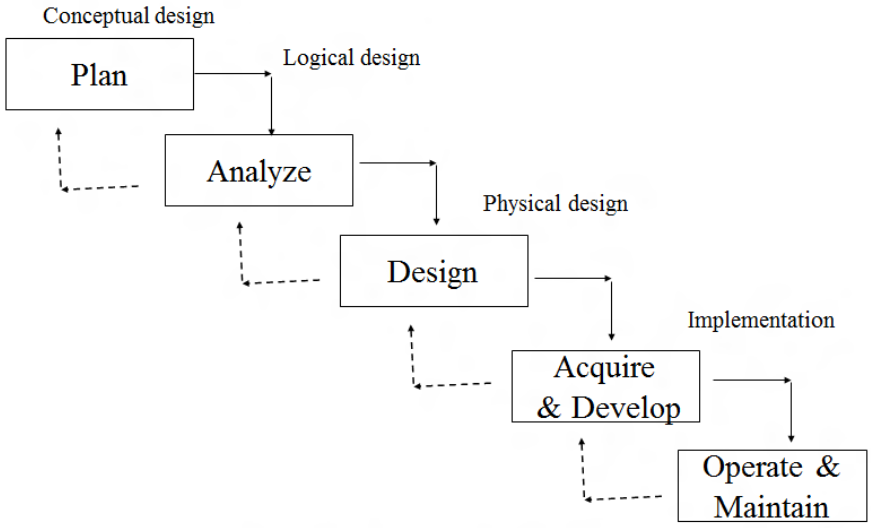


Figure 2.5 : Five-step planning Process

4. **A 10-Stage GIS Planning Methodology by Roger Tomlinson**

- Consider the strategic purpose
- Plan for the planning

} Conceptual Design

- Conduct a technology seminar
- Describe the information products
- Define the system scope

} Logical Design

- Create a data design
- Choose a logical model

} Physical Design

- Determine system requirements
- Benefit-cost, migration and risk analysis
- Make an implementation plan

} Implementation

Figure 2.6 : Roger Tomlinson methodologies

Regardless of the arrangement of steps and phases, all methodologies includes the basic initial stage which is identification of user needs whatever the method was.

Tomlinson’s methodology in planning GIS project is the reference followed in applying the planning process on the case study Bidya municipality. This methodology includes ten stages, a brief definition of each stage is involved here.

2.5 Overview of Tomlinson's Methodology Stages

Planning methodology introduced by Roger Tomlinson, 2003 in his hand book (Thinking about GIS) is the methodology followed to achieve this thesis, while municipality of Bidya is the case study that was chosen to apply the methodology, this is a briefed description of each stage as explained by Tomlinson.

stage 1: **Identify the strategic purpose**

The planner should consider the strategic purpose of the organization for which he is planning the system, he should recognize the goals objectives and mandates of the organization to ensure that the final system fit the organizational context and truly support its objectives. understanding what the organization does and its vision for the future make the GIS manager to design information products that are directly related to those objectives.

stage 2: Plan for the planning

Planning for GIS is a process that takes time and needs resources (people & money), it can take six months or even a year for large organization, so it needs the senior level in the organization to distinguish between planning and implementation and a commitment to provide the resources needed for

the planning. Political commitment to the planning process is essential to a successful GIS implementation especially in public- sector organization like municipality. At this stage the planner introduces a planning proposal to the political level of the organization and take the approval to launch the formal planning process.

stage 3:conduct a technology seminar

when the planner or GIS manager takes the approval to start the planning process, a planning team is formulated, the planning process aims mainly to define the specific GIS requirements by meeting the customers or clients who will use the system and the output from the system.

The team begins to gather information about the actual requirements from the users perspective. The effective method to know the requirements of the organization in details is holding one or more technology seminars which can be a form of hall meeting involving participants from the organization staff according to their roles and responsibilities. This stage is very important and has the following purposes:

- Explaining the nature of GIS to the key personnel and identifying its benefits and potentials as well as explaining the planning process itself.
- Gathering information about business requirements.
- Ensure the participation of the stakeholders in the planning process and make them appreciate it.
- To initially identify the information products.

stage 4: Define the information products

Knowing what you want to get out of the GIS is the key to successful implementation. at this stage and after gathering information about organization requirements from the previous stage, information products could be prepared as a document includes a description of all the information products that can be reasonably expected, together with details of the data and functions required to produce those products.

To perform this purpose planner needs to talk to the end user about his job and duties involved in his job and the data he needs to perform these duties.

stage 5: Define the system scope

After the GIS project planner was able to describe information products, then he can begin to define the scope of the entire system. This includes the data that should be acquired, when it will be needed, data volumes that will be handled, data timing of the production of the information products. it will be clear that one input data source may be used to generate more than one information product.

stage 6: Create a data design

In GIS, data is a major factor because spatial data is relatively complicated thing. all system requirements identified in the earlier stages will be used to develop database design. In order to create a conceptual system design, planner should have a thorough understanding of the characteristics of the

needed spatial and tabular data, these characteristics include each data set scale, resolution, error tolerance, map projection and other.

stage7 : choose a logical data model

The database weather it is simple or complex, should fit together in a logical manner so that data can be easily retrieved and required analysis can be carried out efficiently. there are several options available, each have advantages and disadvantages, the nature of data, system complexity, data accuracy, update requirements and error tolerances all affects the choice of logical model.

stage8 : Determine system requirements

This includes determination of suitable software configuration, interface design, hardware, communication and networking. planner needs to review the information product descriptions and system functions to determine the system requirements.

stage9 : Benefit-cost analysis

benefit cost analysis is a technique that offer a comparison between the expected cost of the implementing the system and the benefits that will result from having new information product. the purpose of this comparison is to take an indication of whether or not the system will be financially viable. also the result of this stage can be used to secure funding for the system to be implemented, operated and maintained.

stage10 : make an implementation plan

The final product of the planning process gives sufficient information to implement a successful GIS, and the final report will be the guidance in the implementation process.

*** stages 7, 8 are completely out of scope of this thesis.**

Chapter 3
Analysis of Business Needs

3.1. Introduction

This stage is very important. It is the base of all the coming effort, it will show the real need for the system. In the ideal practical case, all departments should be involved in the planning process through formulating a planning team, the planning team is preferred to include -at least- a member from each department in order to actually represent the organization. The best way of doing that is to conduct a technology seminar (Tomlinson, 2003), which could be a hall-meeting during which the team understand the planning process and the fundamental concepts and terminology of GIS. This kind of participation is of great importance, it will ensure the staff support and cooperation along the process. This surely would contribute to the success of the planning and implementation of the GIS project.

For research purposes group and individual meetings and interviews with employees and heads of different departments with the participation of the political level would be sufficient.

3.2. Methodology and Approach

Reference to GIS planning stages described by Roger Tomlinson, that have been exhibited in brief in the previous chapter and applied to Bidya municipality (case study), the first three stages of Roger Tomlinson

methodology which are: consider the strategic purpose, plan for the planning, and conduct a technology seminar have been merged into one stage called analysis of business needs or conceptual design.

With regard to the first stage - consider the strategic purpose - we reviewed the available strategic plan (2013-2016) at Bidya municipality, mission, vision and objectives as well as the yearly executive plans of departments each separately, in addition to the expertise of the researcher as a worker at the same agency for seven years as the head of planning and projects department as well as the administrative responsibility of technical services for two years.

Second stage which is - plan for the planning - was not needed, it is needed in a practical context not for research purposes because the objective of this stage is to gain the agreement and Logistical support of the political level and ensure the coverage of the needed financial resources as well as time of employees who are engaged in the planning process .

The core of this stage is the determination and evaluation of organization's requirements in details, through thorough analysis of workflow of all duties and tasks that are usually performed by municipality cadres (users).

Because Bidya municipality up to this time doesn't possess procedure manuals that show the details of business - technical and administrative - workflow, several meetings with senior and junior personnel was conducted to understand in details the nature of the tasks they perform, or the nature of business reports they usually need. During that there was a

need to review the laws and regulations which rule the work, as well as job descriptions of all the employees which were available.

For this thorough study of business workflow, a kind of procedure documentation was developed for most of the tasks (Table 3.1) it was an intense brain storming process.

During this stage the participants was informed of the GIS potentials and functions which encouraged them to explain the difficulties they face when they perform tasks and to express their expectations to improve the techniques and tools by using the GIS system.

The final product of this stage was an initial list of information products, which then was investigated, improved and expanded.

3.3. The Organizational Structure of Bidya Municipality (OS)

The organizational structure of Bidya municipality is located between level (3) and level (4) according to the law of local bodies' employees No. (7) for year (2009). It includes two main departments in addition to the position of municipal director. Most administrative and technical sections emerge from these two main departments, all these departments follow the mayor who in turn follows the municipal council, figure (3.1). The number of employees is about 45 between managerial, technicians, skilled and unskilled workers, who are located at different positions in the administrative hierarchy.

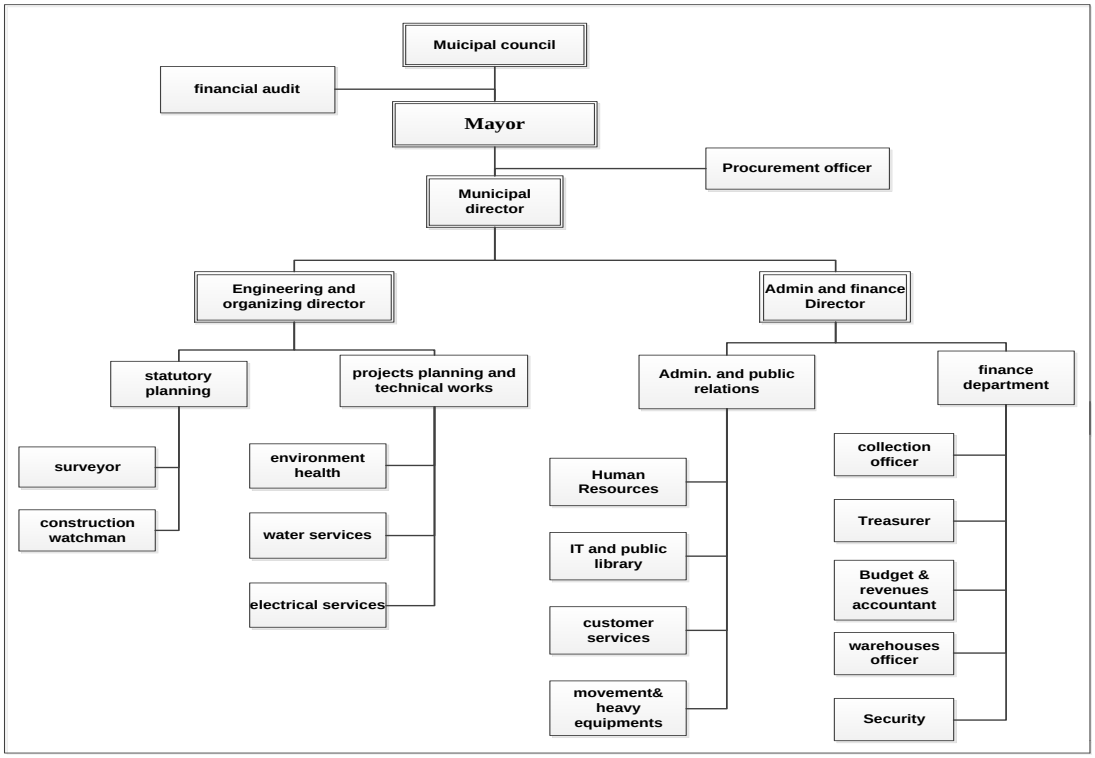


Figure 3.1 : Organizational Structure of Bidya Municipality

It is found that the municipality perform the following duties (Table: through its departments, see the (OS):

(Table: 3.1) Brief Description of Municipal Departments and Main Functions

No.	Department	Main Duties
1.	Statutory planning department	Ensure commitment to laws, regulations and master plan in construction activities.
2.	Projects, strategic planning and technical works department	project studies, project planning, follow-up project design, projects implementation management, coordinate strategic planning

		and administrative supervision on technical divisions.
3.	Water department	Water provision, network extension, operating and maintenance.
4.	Electricity department	electricity provision, network extension, operating and maintenance.
5.	Health of environment department	solid waste disposal, crafts licenses supervision of the environmental health slaughterhouse and shops.
6.	Finance department	Runs the overall financial control, allocates budgets to all departments.
7.	Collection division	collects money from water and electricity services subscribers and other money payers.
8.	Information Technology	provides the technical support for the whole municipality, including hardware, networking and limited software support.
9.	Customer Services center	communicates with the public, receive enquiries, complaints, services applications. collection and billing system and the treasurer.
10.	Archive	control, organize and co-ordinates the documents to the whole municipality

		functions.
11.	Human Resources	provides the internal employment and manage all staff affairs.
12.	Legal Consultations and contract management	manages the interaction between any client and the municipality from a legal perspective.
13.	Financial audit unit	audit financial transactions.
14.	Procurement unit	responsible for all procurement processes.
15.	Movement and heavy equipment unit	allocate and organize vehicles and equipment's to departments

3.4. Procedures and workflow

It is not enough for the GIS planner to know the overall tasks of main units and departments of the municipality in order to imagine how the GIS could benefit the organization, he needs to have thorough understanding in procedures and workflow of each transaction.

That's exactly what was done for the purpose of this research, to explain that: the department of statutory planning is chosen as a sample, the detailed frequent tasks were written, then a workflow diagram is developed for each task.

This department performs the following main frequent tasks:

1. The issuance of building permits, according to the "regulatory system of local bodies for construction" No. (5) for the year 2011.

2. Demarcation of the boundaries of the streets on the ground upon the request of citizens or for purposes relating to the municipal business, such as municipal roads or building retaining walls installation of infrastructure networks as lines of water or electricity or lighting.

3. Provide citizens with information about the regulatory provisions in different areas, information about land and real estates in terms of the regulatory provisions, the owners of neighboring properties .... etc, for the purpose of the transfer of ownership and other transactions.

4. Participate in the issuance of clearance for citizens with regard to regulatory issues.

5. take notes about existing buildings and structures in terms of regulatory provisions for the purpose of services transactions such as water, electricity, sewage...

6. Provide appropriate solutions to citizens' complaints and follow-up to be resolved.

7. Monitor the implementation of the structural plan by taking measures such as monitoring the activities of construction, and compel citizens to obtain permits before casting any structural element.

8. Participate in council meetings to discuss the recommendations of engineering department relating issuance of construction licenses.

9. Conduct all survey activities needed for project planning and design that include municipal land survey and survey of infrastructure elements such as lines of water, electricity, sewage and retaining walls.

10. Prepare detailed structural plans for some areas in the town.

11. Land survey to a certain area to construct a road with least hurt to property owners and to achieve social justice.

12. Field survey to an unlicensed new-built structure such as a wall, and overlay to the structural plan to know if there is a violation.

13. Field survey to a road in order to estimate excavation and backfilling amounts and so costs for the purpose of new road construction.

14. To store data about buildings licenses, and retrieve to make reports in different forms.

15. Prepare reports about violations to regulations.

16. Supply mayor or direct supervisor in reports about work issues like Citizens' complaints, objections or any other issues in the courts.

17. Overlay schemes or maps for the purpose of comparison between sites of some structures or proposed projects and their impact on the natural elements or infrastructure elements or otherwise, such as:

- Road expansion project and the impact on existing buildings and green spaces and farmland.
- Building a retaining wall, and the impact of excavation or backfilling on electricity poles, water lines or streams.

18. To overlay the site of any proposed project on the structural plan to compare it with the boundaries of different, political, administrative or urban classifications.

19. To apply for expanding the area of structural plan and prove the necessity of the application by maps and geographic statistics.

20. Check out the commitment of citizens in the regulations by regular field visits and inspection the making reports.

A workflow was then developed for each task of this department, as a sample, the workflow of "Issuance of Building Permits" is chosen to be shown in this context, (Table 3.1).

Table (3.2) building license procedure and workflow

Issuance a building permit				
No.	**Description of action**	**Procedure**	**Responsible person**	Attachments
	application for proposed building permit	fill the form and sign by applicant provide the applicant with a list of required attachments provide the applicant with a site map and regulatory provisions notify the applicant to pay the fees	Customer services	. ID of the applicant. . property deed
	Pay application fees	receive the fees and deliver a receipt for the applicant	Treasurer	.the application form
	Open a file of building permit	open a paper file and give it a serial number provide the applicant with a form of pledge to be signed by notary	Statutory planning engineer	. ID of the applicant .property deed . The

		in court ask the applicant to make land authority attest on land survey overlay of land survey to the master plan. preserve documents in the file		application form 4. Receipt 5. 6 copies of land survey and soft copy
	deliver all required documents to statutory planning engineer.	receive attachments and ensure that: pledge is signed and sealed land surveys are attested by neighboring owners and land authority for the six copies. direct the applicant to start in building design	Statutory planning engineer	pledge signed and sealed by notary attested land survey
	Submit the building design plans to the engineer.	review and audit design plans to ensure commitment in regulatory provisions & possibility to connect to sewage network. convert the plans to directorate of Antiquities and directorate of health	Statutory planning engineer	6 copies of building design plans

	Formal permit issuance	formulate recommendation regarding permit issuance present the transaction to the local committee of organizing to decide (agree, reject, modify	Statutory planning engineer	building design plans (6 copies)
	Identify building license fees	calculate fees in accordance with the law provide the amount of fees to customer services.	Statutory planning engineer	.license transaction with complete attachments including municipal decision
	Receive license fees from the applicant	provide the treasurer with the amount of fees. take receipt from the treasurer provide a copy of the receipt to eng. to print the license	Customer services officer	.Internal memo from eng. that show the amount of fees
	Issue the license	Print the license form, must be signed and sealed by mayor. preserve a copy to the file.	Statutory planning eng.	.Receipt of all the amount of fees

		submit a copy to customer services to be received by the applicant		

The procedure which the transaction passes through is briefed and shown through the following workflow diagram.

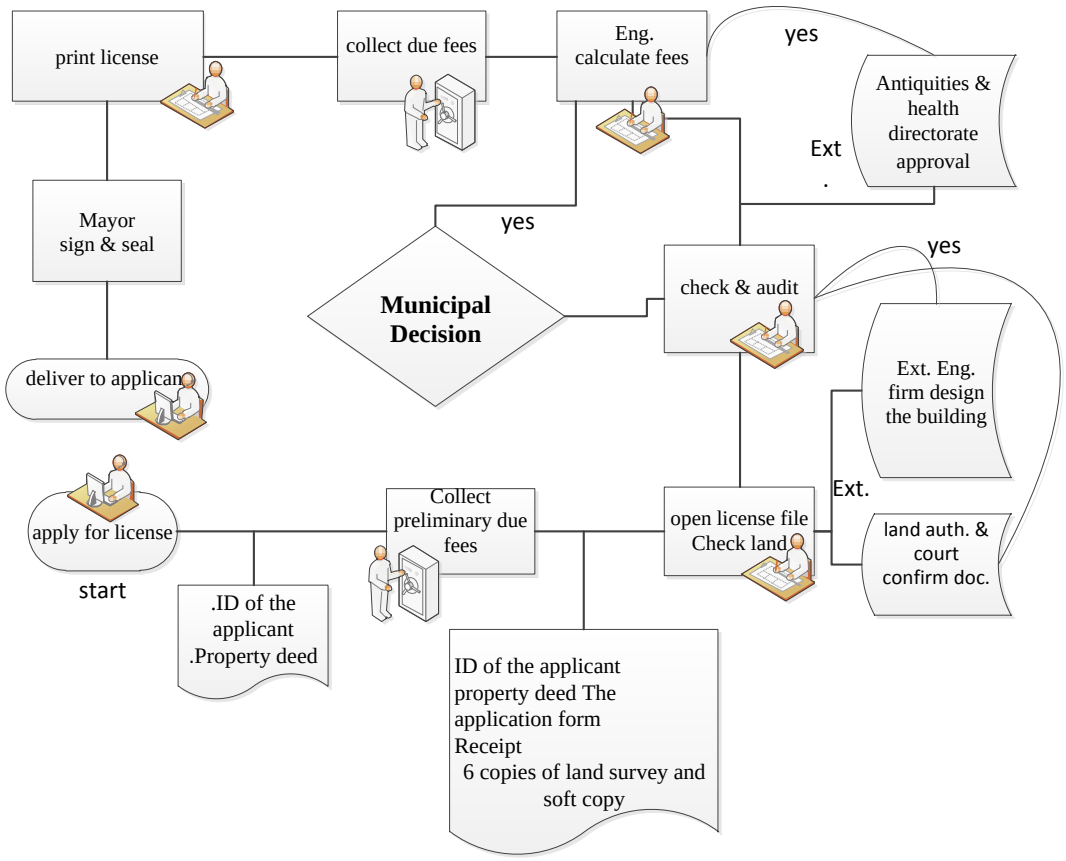


Figure 3.2 : Workflow Diagram for Building License Procedure

The previous table and workflow diagram which show the detailed procedure followed to issue a proposed building license was a good tool to deduce the required information products. similar tables were developed for most tasks which are performed by municipality, and then an initial list of information products was developed.

3.5. Information Products (IPs)

After reviewing all job descriptions, laws, systems and conducting frequent individual meetings with different officers at different levels, and recording tasks they perform in details, and during that many literature reviews (Stuver, 2002, Krupnik, 2000, EOEA, 2000, esri publications et al.) were conducted to have wider view on the uses, applications, benefits and requirements of GIS. The final product was an initial list of information products. At this point , for every information product there must be a department or a person name who will use it so, no name means no information product. Also, it should be known how each IP would benefit the organization, how these IPs fits into the strategic objectives of the organization, which budgets will the IP benefit. that's in order to identify the most important IPs. the following list is classified according to departments:

Table (3.3) information products list

No.	Information Product	Department
2.	Bldg. licenses map & list	Statutory planning dep.
3.	Site map (for Bldg. license)	Statutory planning dep.
4.	Area regulatory provisions map & list	Statutory planning dep.
5.	Land parcels location map and list	Statutory planning dep.
6.	Roads location map & list	Statutory planning dep.
7.	Bldg. location map & list	Statutory planning dep.

No.	Information Product	Department
8.	Walls location map &list	Statutory planning dep.
9.	Road names and numbers map	Statutory planning dep.
10.	Building numbers map	Statutory planning dep.
11.	construction monitoring map and list	Statutory planning dep.
12.	Topographic features photo	Statutory planning dep.
13.	3-D simulation model of the town	Statutory planning dep.
14.	Web service for public about regulatory provisions and structural map	Statutory planning dep.
15.	Schools & public institutions map & lists	Projects and St. planning dep.
16.	Digital elevation model	Projects and St. planning dep.
17.	Roads analysis map & list	Projects and St. planning dep.
18.	municipal property location map &list	Projects and St. planning dep.
19.	implemented projects analysis map & list	Projects and St. planning dep.
20.	water network elements location map & list	Water dep. / Projects and St. planning dep.
21.	water network analysis	Water dep. / Projects and St. planning dep.
22.	Electricity network elements location map & list	Electricity dep. / Projects and St. planning dep.

No.	Information Product	Department
23.	Electricity network analysis	Electricity dep. / Projects and St. planning dep.
24.	Sewage network elements location map & list	Sewage dep. / Projects and St. planning dep.
25.	Sewage network analysis	Sewage dep. / Projects and St. planning dep.
26.	professions and crafts location map & list	Health of Env. dep. / Projects and St. planning dep.
27.	property tax collection map &list	Finance dep.
28.	Trace back vehicles movement map	Mov. & heavy equip. dep.

Chapter 4
Information Product Description

4.1. Definition

Information product description is referred to by the acronym IPD, which is defined briefly as thorough descriptions of information-specifications that will allow the required information to be produce properly. This stage is considered the crucial step in the planning process, it is a creative process, when this step is executed in the wright way the rest of the planning stages will fall into place systematically (*Roger Tomlinson*). At this stage it is needed to:

1. Clarify the information products needed to be produced by the GIS.
2. Determine the spatial and descriptive data which is needed to create the information product.
3. Identify the system functions which will be used to create the information product.
4. Assess the benefit to the organization of having the information product.

The information product description includes some or all of the following components:

1. Title.
2. Name of the department that will use it.
3. overview of the IP as a narrative summery.
4. Map requirements

5. Tabular data requirements.
6. Text documents.
7. Image requirements.
8. Schematic requirements.
9. Steps required to make the product.
10. Model builder.
11. Frequency of use.
12. Logical linkages
13. Error tolerance.
14. Wait and response tolerance.
15. Current cost .
16. Benefit analysis.

4.2. Methodology and Approach

Description of information products is started, the initial IP list found in the previous stage is the starting point, a well defined description of IP is created by looking at the IP realistically and practically, the process needs a lot of brainstorming in order to creatively plan for a useful system.

We started to improve the initial list of IP, so we chose the most important of them and tried to merge some of them and reformulate the titles to make a short list of the most important ones. During that a kind of literature review for different guides from different global institutions in addition to deferent galleries of GIS applications were conducted to get wider view on the IPs. then each IP was then described systematically by identifying all of the above 16 components.

After the initial list of IP was studied we recognized that certain data sets will produce several information products, the following IP and needed data to produce it will be used to obtain plenty of important data reports and maps. A sample information product description is shown here in details, while the rest of the IPDs are attached in the annexes:

1. (IP) Title:

Building License Application

2. Name of the department who will use it:

Statutory planning department

3. Overview of the IP

Because Bidya municipality - like most Palestinian municipalities - lacks land registration and land parcels maps and then have no available information about lands (boundaries, areas, ownership, occupants, numbering, and many other valuable data .....) Engineer needs to know the site of a land parcel within the master plan in order to know:

- The regulatory provisions of the zone which the parcel falls in.
- The nearby planned roads bordering the parcel.
- know the actual planned path of existing roads -as in the master plan- and produce a map show road edges relative to land boundaries.

These are the prerequisite spatial data for building license issuance, while after issuing a building license, the engineer needs to keep the land survey within the master plan with attributes such as ownership, license number, file number..etc. this data inventory will be kept by the system and data reports will be produced by retrieving data through many forms of query

functions, for example the engineer provides the 'Palestinian bureau of statistics' in a report about issued building licenses in terms of buildings' areas, No. of issued licenses and types of building uses. The finance department needs a report about actual revenues achieved by building licenses for the purposes of budget planning. the planning department needs a report about the direction, block or region which is experiencing the largest urban extension for the purposes of infrastructure planning and identifying priorities and then budget allocation. To have indication about the economic activity and its spatial distribution, a report about -for example- industrial building licenses and a map show the spatial distribution during a certain period of time. building licenses carry a lot of planning indicators which make it very important to keep them in a creative way that lets users to retrieve data in different forms.

4. Map requirements

- Boundaries of the master plan
- boundaries of blocks
- Land use (classification)
- Roads (existing roads centers, planned roads edges)
- landmarks
- Walls bordering roads.
- New aerial photo (raster) as a background for vector data.

As an information product of previous data, and for the purposes of issuing license, engineer wants a map that contains :

- Site map (scale 1:500) that show land boundaries within master plan.

- Regulatory provisions as a list printed on map which are:

– land use (classification)

– Front setback

– Rear setback

– Side setback

– Building height

– Number of floors

– Building Percent allowance

– Price- per meter of building area- (license fees)

This IP map is usually provided to the license applicant to provide the guidance for the designer who will prepare the building drawings, in order to abide with regulatory provisions

5. Tabular data requirements

The following tabular data lists are the primary input for the needed reports mentioned in the IP narrative overview (item 3) above.

Table (4.1): Data related to file of license and associated with parcel polygons

Title: Building license application IP
Required by : Statutory planning dep.
Name: .....
List #1
List title: file of license

Headings	**Parcel #**	**Name of applicant**	**Applicant ID**	**File No.**	**Opening Date**	**Land area (m2)**	**property deed**	**zone**
Typical entries	xxxxx	xxxxxxxx	xxxxxxxx	105	1/7/2012	900	agreement	RAA
Source		File of license	File of license	File of license	File of license	File of license	File of license	Site map

RAA : Residential Area (A)

Table (4.2): Data related to issued license

	Title: Building license application IP **Required by** : Statutory planning dep. **Name**: ..... **List #2** **List title**: issued licenses								
Headings	**Parcel #**	**Name of applicant**	**App. ID**	**License No.**	**Date of issuance**	**Bldg. use**	**Bldg. area (m2)**	**Total fees** JD	**Zone**
Typical entries	xxx	xxx	xxxxxx	1210	15/8/2013	Comm.	420	1480	RAA
Source		license	license	License	license	License file	license	license	license

Table (4.3): Data related to area classification associated to use polygons (classification)

Title: Building license application IP

Required by : Statutory planning dep.

Name: .....

List #3

List title: Regulatory provisions

		MIN.		**MAX.**			**MIN.**			
Headings	**Land zone**	**parcel area (m2)**	**length on road (m)**	**Bldg. % allowance**	**No. of floors**	**Bldg. height**	**Front margin**	**Rear margin**	**Side margin**	**Fees (JD/m2)**
Typical entries	RAA	1000	25	36%	5	18	5	5	4	2.275
Source	MP	Fixed for	Fixed for	Fixed for zone	Fixed for	Fixed for	Fixed for	Fixed for	Fixed for	Fixed for zone

		zone	zone		zone	zone	zone	zone	zone	

MP=master plan

RAA=Residential Area class A

6. Text document requirements

Table (4.4): Text document requirements

Title: Building license application IP **Required by** : Statutory planning dep. **Name**: ..... **Scanned document display**		
Data set name: : Building license IP		
Document title: building license documents		
No of pages per retrieved document	Typical : 4	Max. 10
Search keys (all) **Spatial :** parcel number		

Attribute :owner's name / ID			
Data elements (required to be seen) : **1. License/s documents** **2. Property deed** **3. Planning commission notes and recommendations document**			
Action	√	Visually observe	read only
	√	Copy whole	hard copy
	√	Copy whole	digital
Change	√	Copy part	hard copy
	√	Copy part	digital
		Add data	none
No Change Permitted	√	Delete data	none
		Edit data	none

7. Image requirements: no images required

8. Schematic requirements

Table (4.5): Schematic requirements.

Title: Building license application IP **Required by** : Statutory planning dep. **Name**: ..... **Scanned document display**		
Data set name: : Building license IP		
Document title: building license documents		
No of pages per retrieved document	Typical : 1	Max. 4
Search keys (all) **Spatial :** parcel number **Attribute** :owner's name / ID		

Data elements (required to be seen) : **1. land survey approved by all parties**			
Action	√	Visually observe	read only
	√	Copy whole	hard copy
		Copy whole	digital
Change		Copy part	hard copy
		Copy part	digital
		Add data	none
	√	Delete data	none
		Edit data	none
No Change Permitted			

9. Steps required to make the product.

Table (4.6): Data and Functions

	Description	**Data needed**	**Functions needed**
1.	Staff member receive a survey plan(Cad format)/(hard copy) for a land parcel attached with an application for construction license.	• show Site of the parcel within the master plan, map scale (1:500). • zoning of the area and all related regulations.	• data input of the parcel survey to the master plan.(same scale) all data in the same coordinate system. • graphic overplot of the parcel survey to the master plan. • display output map on screen, with the capability of editing and symbolization. • spatial query to identify the zone class which contains the parcel. • attribute query by zone class to identify zone regulations.

	Description	Data needed	Functions needed
			• plot of map as a hard copy with a table of regulatory provisions according to land zone.
2.	Engineer wants a report about licenses issued during certain period, or within a certain block or region.	Attributes about dates. Location of parcels within the MP.	• attribute query about licenses issued during certain period. • spatial query about parcels that has issued licenses.
3.	Engineer wants a report about license revenues during a certain period.	Attribute about licenses total fees and dates of issuance.	• attribute query.

10. Frequency of use

Table (4.7): Frequency of use

Title: Building license application IP **Required by** : Statutory planning dep. **Name**:			
Function	**number**	**Frequency per year**	**Number per year**
Data input	7	90	420
Graphic overplot	1	90	90
Editing and display	1	90	90
Symbolization	3	90	270
Plot	7	90	630
Spatial query	3	10	45
Attribute query	4	15	60

11. Logical linkages

Logical linkages are relationships between data elements and data sets, these relationships must be in place when database is built, we have three types of relationships:

1. Relationships between lists and graphic entities: these are relationships between features (points, lines, polygons) and their characteristics (attributes) i.e. names attached to items.

In this IP (building license application), parcel number should be the formal logical linkage between the feature (polygon which represent the parcel) and licenses list.

The disappointing fact at Bidya municipality is that unfortunately, there is no land registration system which give a number for each parcel of land and show land boundary lines at a master plan, this fact is one of the challenges facing the project and may limit the achievement of extreme benefit from the GIS.

2. Relationship between maps or map layers: these are the relationships between the different kinds of maps or data layers.

For the purposes of this IP and in order to be able to overlay all the spatial datasets required to issue a building license (parcels, roads, master plan elements, walls...etc.) they all must be of the same scale and same coordinate system.

3. Relationship between attributes: these are relationships between characteristics and between data elements.

In this IP it is noted that, parcel number is the link between parcel and attribute lists.

12. Error types and tolerances

Table (4.8): Error types and tolerances

Title: Building license application IP **Required by** : Statutory planning dep. **Name**:				
Type of error	**Possible occurrences**	**Result of error**	**Impact on benefits**	**Error tolerance**
Referential	Wrong linkage between parcel polygon and parcel # Wrong linkages between land parcels and land use polygons	Wong parcel identification Wrong identification of properties	▪ Erroneous site regulations. ▪ no system benefits ▪ may cause social problems ▪ Bad impression to the public	0%
Topological	Unclosed polygons	Wrong areas calculation	▪ Reports not reflect actual context ▪ wrong indicators	-----
Relati	• Inaccurate	• Inaccurate	▪ wasting time and	(0.2)m

ve	boundaries positions/coordinates of the parcel • shifts in positions	location within the master plan. • misleading results for the applicant. • inability to continue process.	effort ▪ getting wrong answers /no answer. ▪ social problems	
Absolute	Wrong site of land within zone class	No match between land and regulations	Wrong site characteristics	0.30 m

13. Wait and response tolerance.

This is a measure of how fast and robust the computer and network system must be, i.e., what is the maximum allowable time between the last keystroke and the full display or output of the information product. For the purposes of this IP it is suitable to obtain the output of the IP during five seconds.

14. Current cost .

In order to justify the implementation of the project, a comparison between the current way of creating the IP and what it costs the municipality in terms of both labor and materials, and how the GIS will improve the workflow.

In order to produce the IP of a site map and regulatory provisions which is mentioned in the third component of IPD above, this takes a lot of staff

time, especially if we know that it is needed frequently in a town like Bidya which is experiencing a rapid urban expansion and active construction process. Each building license transaction needs six copies of the site map which is now prepared manually and consume a lot of staff time and effort. The relevant reports also consume a lot of time and need a lot of effort. Bidya municipality lack the staff who are allocated for data entry to keep it in a form which is suitable to extract different information reports, so it is a laborious process to make a report by returning back to the files of licenses. Sometimes the required reports become ready too late when it becomes useless. In fact, even if there is a data entry employee, there are no programs with the powerful and various potentials of data query which still make the preparation of reports a laborious time-consuming process.

It is expected that the GIS could substitute the employment of a new officer, and at the same time will enable staff to submit required reports on time. Specially, if the system (central database and software interfaces) is designed in an effective way that ensures the ease and simplicity in data entry in addition to safety and security in data storage.

15. Benefit analysis.

The final step in preparing the IPD is to perform benefit analysis. benefits should be considered whether it was explicitly required or implicitly achieved. The cost of system and data acquisition should be weighed against benefits that the organization would receive from the information product created. The following three categories of benefits should be examined:

1. Financial savings: actual cash saved from current budgets if required information products were made by the GIS, such as reduction in current staff time or increase in revenues.
2. Direct benefits to agency: things that will result from the new IP which was not available prior to implementing the GIS. These could include improvements in operational efficiency and workflow or the reduction of a liability.
3. External benefits: benefits that accrue to others who are not directly using the GIS.

By examining the current way of implementing work at Bidya municipality we can extract the following benefits:

1. There will be a lot of staff time saving as a result of work automation instead of manual procedures, as previously mentioned it will absolutely substitute the employment of new officer who will cost the municipality not less than 15000 Dollars per year.
2. There will be great potentials and readiness to prepare various reports on time, which are currently impossible to be achieved under chaos or even unavailability of data, these reports are crucial in decision making, planning, projects studies and could be strong indicators to enhance projects proposals which in turn enhances the possibility of obtaining external funding.

3. The possibility to exploit some of the existing employees who are skilled for data entry through a well designed interfaces that provide a standard way of data entry, while they couldn't be exploited at the current status.

4. Easy access to information by the use of web applications which enable public to navigate through maps and display data, could greatly reduce the applications for information, this can free the engineers for other important duties.

These benefits may be expressed by the term efficiency which was defined as more or better output can be obtained with the same amount of input, or that the same output can be produced with fewer inputs (UN,2000).

Chapter 5

Define System Scope

5.1. Overview of this Stage

This stage includes the clarification of the amount of data needed for system in order to be able to get the required information products, and the time to know the needed software and hardware required for the system to work.

In the previous stage the required information products are identified and described in details, and we knew what is wanted out of the GIS system. in this stage of planning we take a more detailed look at the input data required to create the IPs, and create a new document called master input data list referred to by the acronym (MIDL).

MIDL is a detailed list of all the data sets that must be entered into the GIS system to generate all the information products needed, it should identify data with its name, ID, volume , source and format and any other factor which affects the work in terms of effort, cost and time required to collect and enter the data into the system, this data about the data is called metadata.(Tomlinson, 2003)

It is noted that each data set included in the MIDL should be required to generate at least one information product, no other data should be described in the MIDL, this is to avoid the confusing array of unneeded

layers and the cost of acquisition of such data which will never be used by anybody.

5.2. Methodology and Approach

A thorough study is applied again to the IPDs which are prepared in the previous stage to confirm the data needed for each IP and think of the steps of creating it and the different cases of transactions and reports to ensure that no other data might be needed, then each IP should be confirmed by the person who requested it, and it shouldn't be adopted if not confirmed.

After IPDs confirmation process completed, a list of datasets is extracted from all the confirmed IPD array. This list of datasets is the base of the GIS system design. Description of data is then started by firstly assessment of available data at Bidya municipality and studying the amount of required datasets based on available data, maps and statistics, some properties such as scale and resolution is identified based on reviewing IPs already found in the departments which are being prepared using CAD software.

The following is a suggested hierarchy of dataset groups for map requirements as concluded from the IPDs.

5.3. Extracted Dataset Hierarchy

1. **Base Map**

1.1. Administrative Municipal Boundaries

1.2. Contour Lines

1.3. DEM

1.4. **Master Plan**

1.4.1. M.P Boundaries

1.4.2. Urban Classification

1.4.3. M.P Road Network

1.5. **Landmarks**

1.6. **Aerial photo raster image**

2. **Land Registration**

2.1. Blocks

2.2. Parcels

2.3. Buildings

2.4. Building numbers

2.5. walls

3. **Transportation Network**

3.1. parking complex

3.2. Roads Centerlines

3.3. Road Edges

3.4. Traffic Signs

3.5. Roundabouts

3.6. road names or numbers

4. **Electricity Network**

4.1. source point

4.2. Transformers

4.3. Towers

4.4. Switches

4.5. Poles

4.6. medium voltage Cables (hanged)

4.7. medium voltage Cables (ground)

4.8. Low Voltage Cables

4.9. distribution boards

4.10. Subscriber Connections

4.11. subscriber meter boxes

4.12. Lightening panel

4.13. light Units

5. **Water Network**

5.1. Tanks

5.2. Pipes

5.3. Valves

5.4. Subscriber connections

6. **Wastewater network**

6.1. Treatment station

6.2. pipes

6.3. Manholes

6.4. Subscriber connections

7. **Crafts, Industrial plants**

7.1. Light industry workshops and buildings.

These spatial datasets are then rewritten in the following matrix and examined from different aspects to give a whole picture of the effort, time, and then cost of data collection and also to identify the suitable software and hardware requirements.

Table (5.1) master input data list MIDL

Data Identification				Source of data		Graphic portion					Digitizing effort			Attribute data		
Data set name	Data set number	Source of the data	Availability in digital format	Source data medium	Digital data format	Size	Schematic	Photo image	Map projection and datum	scale	Lines/ sheet	Points/ sheet	Polygons/ sheet	Lines per sheet	Data elements per record	Source of Data
Base map	1															
administrative boundaries	1.1	Salfit governorate / MOLG	100% available	GIS dep.	GIS				Palestine 1923_Palestine Grid D_Palestine_1923	1:30,000	N.A	N.A	N.A	1	4	System geometric calculations
Cont	1.2	municipality	100%	Master	Auto				=		N.A	N.A	N.A	1000	2	System

our lines				**plan**	**Cad DWG**											**geometric calculations**
DEM	**1.3**	**Up to date aerial photo available in the municipality**	**0%**	**Should be built using aerial photo**	**Image**				**=**							
Master plan	**1.4**															
MP boundaries	**1.4.1**	**municipality**	**100% available**	**Master plan**	**Auto Cad DWG**	**2015 Dunum**	**No**	**No**	**Palestine 1923_Palestine Grid**	**1:250**	**N.A**	**N.A**	**N.A**	**1**	**4**	**System geometric**

s									D_Palestine _1923							calculations
Land use polygons	1.4.2	municipality	100% available	Master plan	Auto Cad DWG	2015 Dunum	No	No	=	1:250	-	-	-	12	10	Master plan, Palestinian construction system (law)
Planed Roads	1.4.3	municipality	100% available	Master plan	Auto Cad DWG.	35 Km long	No	yes	=	1:250	-	-	-	150	5	M.P
Road	1.4.4	municipality	100%	Master	Direct	N.A	N.A	N.A	=		N.A	N.A	N.A	N.A	N.A	N.A

Organizational Information			**available**	**plan**	**editing**											
Landmarks	**1.5**	**municipality**	**100% available**	**Aerial photo**	**Image**				=		**10**		**30**	**30**	**5**	**Aerial photo availabl e at municip slity**
Aerial phot	**1.6**	**Municipality**	**100% available**	**Engineering dep.**	**Image**				=		**N.A**	**N.A**	**N.A**			

o																
Land regist ratio n	**2**															
Block s polyg ons	**2.1**	**municipality**	**100% available**	**Natural blocks map**	**Hard copy**				**Palestine 1923_Palest ine Grid D_Palestine _1923**	**1:100 0**						
Parce ls	**2.2**	**municipality**	**Not available**		**-**				**=**	**1:500**				**5000**	**8**	**registra tion records**
build ings	**2.3**	**municipality**	**70% available**	**Master plan &**	**Auto Cad**	**2200 build**			=	**1:250**	**-**	**-**	**400**	**400**	**15**	**License records,**

				aerial photo	**DWG. & tif. file needs digitizing**	**ings**										**field survey, engineers**
Walls	**2.4**	**Municipality**	**0%**	**Updated aerial photo**	**Image tif. file**				**Palestine 1923_Palestine Grid D_Palestine_1923**	**1:250**	**1500**	**-**	**-**	**1500**	**5**	**field survey, engineers**
Building numbers	**2.5**	**-**	**0%**	**-**	**-**											

Transportation network	**3**															
Parking complex	**3.1**	**Municipality**	**100% available**	**Updated aerial photo**	**Image tif. file**				**Palestine 1923_Palestine Grid D_Palestine_1923**				**1**	**1**	**17**	**Project file, engineer**
Existing Road centerline	**3.2**	**Municipality**	**100% available**	**Updated aerial photo**	**Image tif. file**				=	**1:250**	**50**			**50**	**9**	**Project file, engineer**

s																
Existing Road edges	**3.3**	**Municipality**	**100% available**	**Updated aerial photo**	**Image tif. file**				=	**1:250**	**100**			**100**	**3**	**Centerlines attributes**
Traffic signs	**3.4**	**Actual positions on the ground**	**0%**	**Field survey**	**CAD file type**				=	**1:500**		**150**		**150**	**3**	**Engineer**
Roundabouts	**3.5**	**Municipality**	**100% available**	**Updated aerial photo**	**Image tif. file**				=	**1:250**				**4**	**7**	**Project file, engineer**
Road name	**3.6**	**Municipality**	**70% available**	**M.P**	**Annotation**				=	**1:250**						

s or numbers																
Electricity network	**4**															
Source point	**4.1**	**Actual position on the ground**	**0%**	**Field survey**	**CAD file type**				**Palestine 1923_Palestine Grid D_Palestine_1923**	**1:250**				**1**	**3**	**Electrical eng.**
Electric trans	**4.2**	**Position on the ground**	**0%**	**Field survey**	**Cad**	**15 transform**	**No**	**No**	**=**	**1:1000**	**-**	**18**	**-**	**18**	**12**	**Paper records, electrici**

form ers						er										ty dep.
Towe rs	4.3	Position on the ground	0%	Field survey	Cad				=			60		60	9	Electric al dep. files
Switc hes	4.4	Position on the ground	0%	Field survey	Cad				=			10		10	3	M.P , towers attribut es
Poles	4.5	Position on the ground	0%	Field survey	Cad	900 pole	No	No	=	1:250	-	900	-	900	8	Paper records, electrici ty dep.
Medi um	4.6	Position on the ground	0%	Field survey,	Cad				=	1:250	70			70	8	Paper records,

voltage cables (hanged)				**As built DWGs**												**electricity dep.**
Medium voltage cables (ground)	**4.7**	**Position on the ground**	**0%**	**Field survey, As built DWGs**	**Cad**				=	**1:250**	**10**			**10**	**8**	**Paper records, electricity dep.**
Low	**4.8**	**Position on**	**0%**	**Field**	**Cad**				**Palestine**	**1:250**	**900**			**900**	**7**	**Paper**

voltage cables		the ground		survey					1923_Palestine Grid D_Palestine_1923							records, electricity dep.
Distribution boards	4.9	Position on the ground	0%	Field survey	Cad				=			29		29	8	Paper records, electricity dep., tower attributes
Subscriber conn	4.10	Position on the ground	0%	Field survey	Cad	2500	No	No	=	1:250	2500	-	-	2500	7	Paper records, collection dep

ections																**Field inspection**
Subscribers meter boxes	**4.11**	**Position on the ground**	**0%**	**Field survey**	**Cad**				=		**600**			**600**	**7**	**Paper records, collection dep.**
Lighting panels	**4.11**	**municipality**	**0%**	**Field survey**	**Cad**				=							
Light	**4.12**	**Position on**	**0%**	**Field**	**Cad**				=		**700**			**700**	**8**	**Paper**

units		**the ground**		**survey**												**records, collection dep Field inspection**
Water network	**5**															
Water tanks	**5.1**	**municipality**	**100%**	**Master plan**	**CAD**	**1**	**No**	**No**	**Palestine 1923_Palestine Grid D_Palestine_1923**	**1:2500**	**-**	**-**	**1**	**1**	**8**	**Projects files, engineering dep.**

Water pipes	5.2	Position on the ground	0%	Field survey	CAD	25 Km	No	No	=	1:500	250			250	8	Water dep. Engineering dep
water manholes	5.3	Position on the ground	0%	Field survey	CAD		No	No	=	1:500		250		250	8	Water dep. Engineering dep. Field survey
subscriber conn	5.4	Position on the ground	0%	Field survey	CAD	2200	No	No	=	1:250	2200		2200	2200	15	Water dep. Collecti

ections																on dep.
Sewage network	6															
Sewage treatment plants	6.1	Position on the ground	100% available	Master plan	CAD	1	No	No	Palestine 1923_Palestine Grid D_Palestine_1923	1:2500			1	1	7	Projects files, engineering dep.
Sewage pipes	6.2	Position on the ground	0%	Field survey	CAD	45	No	No	=	1:500	45			45	8	Water dep. Eng.

																dep.
Sewage manholes	6.3	Position on the ground	0%	Field survey	CAD	45	No	No	=	1:500		45		45	8	Water dep. Field survey
Sewage subscriber connections	6.4	Position on the ground	0%	Field survey	CAD	55	No	No	=	1:250	55			55	8	Collection dep. Water dep.
Crafts profe	7															

ssion s and indus trial plant s																
Build ings	**7.1**	**municipality**	**20%**	**M.P**	**CAD**				**Palestine 1923_Palest ine Grid D_Palestine _1923**				**200**	**200**	**11**	**License records, field survey, health dep.**

It is noticed that no graphic data available in paper format so no need for scanning, maps are either available in digital format or not available at all, such as electricity network map.

Some data are not available and there is a difficulty in creating it because they require higher policy cooperation such as land registration which requires the support of land authority as a governmental agency. In fact, Bidya municipality has this project as a priority in its strategic plan 2012-2016, they look forward to be able to implement the land registration during 2015/2016 or at least start it, this will support the system very well.

Some data needs to be created and the municipality has the absolute power of its creation such as naming and numbering of roads and buildings, and they are already put at the list of priorities of the municipality and it has been working to raise funds for it.

The actual effort really is expected in collecting and entering the attribute data, they are fully scattered and many of them most likely not found. the real challenge in collecting attribute data that it couldn't be fully appointed to external consultant whatever was the contract it mostly depends on the municipal staff which is overburdened in work and has no time to spend in collecting attributes, as well as any collected data by external firm should be checked and audited by municipal staff. This fact increase the risk of slow arrival of GIS benefits.

This risk was expressed by municipal technical and administrative departments of Bidya municipality and was experienced in previous projects of similar nature such as the project of municipal assets record and

the unified accounting system project, they took about three times the planned timeline schedule, while this delay was mainly because of the lack of full time dedicated staff for data collection and entry. So this issue should be planned very well.

5.4. Setting Priorities

Now after datasets have been identified it is time to prioritize data acquisition because it may be difficult or costly to build all data required to produce all information products, so the organization specifically Bidya municipality needs to know which datasets should be acquired or got delivered at the first stage of project implementation based on the relative importance in contributing to the municipality's objectives.

Scoring method is used to prioritize data, the criteria used for the datasets ranking is that the most frequent used datasets the most prior to be delivered, and the most frequent used data means data that either used for several information products or for an information product which is used very frequently by municipal departments. The table below show the result of this criteria of datasets ranking.

Table (5.2): data set priorities

Headings	IP1	IP2	IP3	IP4	IP5	IP6	IP7	IP8	IP9	IP10	IP11	IP12	IP13	IP14
administrative boundaries		√										√	√	
Contour lines			√	√			√							
DEM								√	√	√	√			
MP bound	√	√	√	√	√	√		√	√	√	√	√	√	√

aries														
Land use polygon	√	√			√	√								√
Planed Roads	√	√	√	√	√	√		√	√	√	√			√
Road Organizational Information	√	√	√	√	√									
Land						√						√	√	√

marks														
Aerial photo	√	√	√			√	√							√
Blocks polygons	√	√												√
Parcels	√	√	√	√	√	√		√	√	√	√		√	√
buildings	√	√	√	√	√	√	√	√	√	√	√	√	√	√
walls	√	√	√	√					√	√	√			
Parking complex								√					√	

Existing Road centerlines	√		√	√	√									
Existing Road edges	√		√	√	√									
Traffic signs								√						
Roundabouts								√						√
Road names	√	√	√	√	√	√		√	√	√	√			√
Power									√					

Source point														
Electric transformers			√	√					√			√		
Towers			√	√					√			√		
Switches									√			√		
Poles									√			√		
Medium voltag			√	√					√			√		

e cables (hanged)														
Medium voltage cables (ground)			√	√					√			√		
Low voltage cables			√	√					√					

Distribution boards									√					
Subscriber connections									√					√
Subscribers meter boxes									√					
Light units									√					
Water		√	√	√						√				

tanks														
Water pipes		√	√	√						√				
water manholes		√	√	√						√				
subscriber connections		√	√	√						√				√
Sewage treatment		√	√	√							√			

plants														
Sewage pipes		√	√	√							√			
Sewage manholes		√	√	√							√			
Sewage subscriber connections		√	√	√							√			√
Crafts												√		√

professions and industrial plants														

The table above show in which information products each dataset is used either directly or indirectly. when we look at the table it seems that some datasets are necessary for almost all information products such as planned roads, buildings, M.P boundaries and parcels. some datasets such as those related to electricity network although they are needed mainly for electricity- related IPs but they are of great necessity because of their importance and the high frequency of use of the information product per year.

5.5. Municipal Database Schema

The main goal of an enterprise GIS is the diffusion of data and information throughout the organization using uniform methods and addresses and then provide consistent information to the public and other parties by different departments when applying spatial analysis, reporting or display to the business functions, by virtue of a comprehensive and uniform database for spatial and attribute data using codes and addresses that are consistent with other in-use technologies which can be integrated with the GIS. (ESRI, 2007).

Halfawy and Figueroa, 2006 articulated that: " *A major challenge in building centralized data repository is the need to develop a data model and a corresponding database schema to represent and integrate asset life-cycle data in a unified, comprehensive, and preferably standardized, manner*".

In the municipal database system suggested for the case study (Bidya

municipality), data is stored using relational data model in which data is stored as collections of tables that are logically associated to each other by shared attributes.

All the previous data modeling activities represented in IPD have enabled us to formulate a database schema for the municipality which can illustrate the structure of tables and relationships of the database. So What is database schema: it is a collection of meta-data that describes the relations in a database. A schema can be simply described as the "layout" of a database or the blueprint that outlines the way data is organized into tables. Schema are normally described using Structured Query Language as a series of CREATE statements.(Chapple,2014).

A database schema helps to identify the different tables and fields of each table in a concise manner. It also describes the relationships between different tables and helps to identify the constraints on the system. So a user can be assigned login permissions to a single schema so that the users can only access the objects they are authorized to access, (*http://stackoverflow.com)*.

The following database schema for Bidya municipality is built as a result of studying all activities and businesses usually carried out by its staff, and the knowledge of approximately 90 percent of the usually required reports and maps, so it can be considered as a comprehensive database of all aspects of the work of Bidya municipality.

Figure:5.1: Database Schema for Bidya Municipality

source: prepared by the researcher

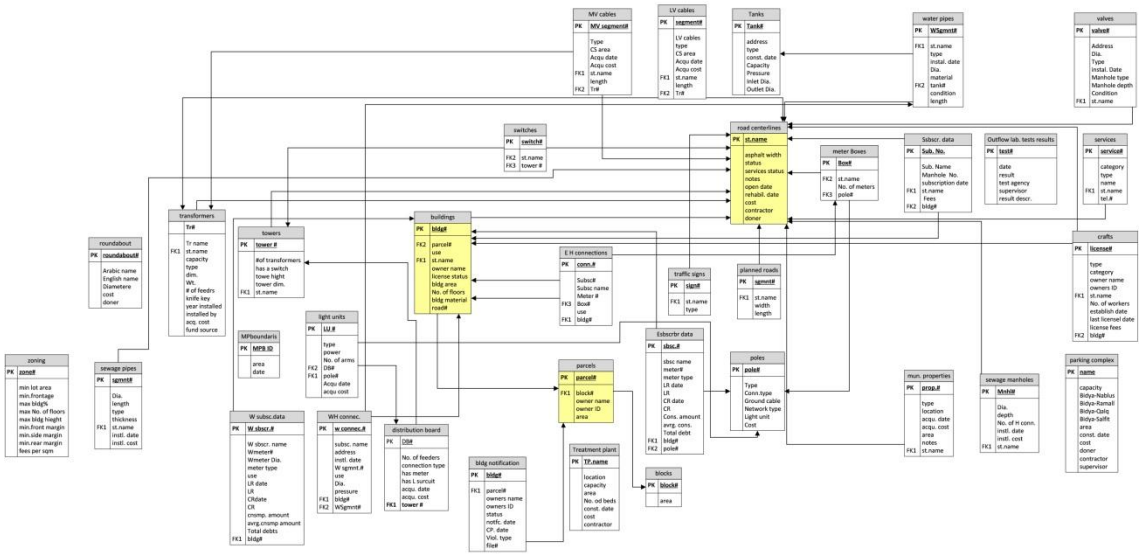


Figure 5.1 : Database Schema for Bidya municipality

In light of study of data requirements and data availability we can conclude that Bidya municipality has strengths and weaknesses in terms of data issues and the readiness to adopt the system.

- **Strengths are**:

- It has an approved master plan which is the base for the spatial data needed for the system.
- It has an approved organizational structure and jobs descriptions that illustrates powers and responsibilities under law and this is a strength in reducing the institutional factors that may lead to failure.
- it has an IT department responsible for technical support for IT infrastructure (internet, intranet computers and other related devices which are available within the municipality).
- it has a prepaid system for electricity subscriptions and thus subscribers database.

- **Weaknesses are:**

- Bidya municipality lacks the data about land parcels, because there is no available system for land registration neither at municipality nor at land authority so, because many of the municipal services are linked to parcel number then data about land parcels should be collected through a separate project and then be linked to the system.
- property tax system is not active in Bidya because it is directly related to property registry which is not already available.

- Bidya municipality also doesn't have building numbers while these numbers are an essential requirement for database and system design, so the buildings should be numbered through a separate project too.
- most roads in Bidya town doesn't have common names, so roads also have to be named and numbered to satisfy database design requirements.
- All names and numbers should be planned, fixed, and adopted through a standard and official way to be used by local community and governmental agencies and be consistent with the system.
- GIS system as a relational data model needs three basic requirements for suitable design and geocoding: **land** registration and numbering, **building** numbering and **roads** naming and numbering.

  these numbers and names are the basic linkage between spatial entities and their attributes, so a municipality like Bidya can't incorporate an integrated GIS system without adopting a system for naming and numbering of lands, buildings and roads.

Chapter 6

Implementation Plan

6.1. Introduction

For implementing an enterprise GIS -EGIS- project there should be a strategic plan to direct the successful implementation, this strategic plan includes mainly a time schedules for the multiyear works and annual priorities as well as vision and rough order estimates of resources required.

This work plan provides this information for each of the four components of the EGIS: software and hardware and required infrastructure, applications, database, and staffing.

The term enterprise refers to a comprehensive information system for the entire organization that integrates all business tools and technologies to benefit a large number of users with minimum redundancies and uniform references.

Implementing an EGIS has not to be sudden, commonly it includes gradual transition from an existing departmental GIS to the new organization-wide system architecture. During the migration, organizational business processes that depends on the GIS must be assured of continued operations.*(Esri, 2007)*

During the diagnostic study of the current status in Bidya municipality and preparing the IPDs to identify the source and availability of data, it was found that Bidya municipality lacks the majority of data needed for the system, it lacks the following basic spatial data:

- land management database : No maps of parcels boundaries and parcel numbers, no system for land registration.
- addressing system: No road naming, no building numbers.
- maps: No maps for electricity network, 50% coverage 40% precision in location water network map.
- licensing data: paper records, no automated data system.

6.2. Available Data

Engineering work depend on a set of spatial data that are available in a CAD format, while there is an automated billing system for water and electricity services but not referenced spatially and crafts are managed manually using paper files. Property tax is not activated because it lacks the base for that which is property system

Table (6.1) Available spatial Data

No.	Data	Format	Update
	Buildings	AutoCAD file	2014
	Roads edges	AutoCAD file	2014
	Contour lines	AutoCAD file	2014
	Water network 50%	AutoCAD file	2003
	Waste water lines	AutoCAD file	2006
	Approved Master plan	AutoCAD file	2008
	Proposed master plan	AutoCAD file	2014
	Digitized Ortho- photo	AutoCAD file	2006
	Ortho- photo	Image	2014

For success in incorporating an enterprise GIS in an organization, ESRI recommends in an incremental approach to migrating from the existing status to the enterprise GIS. The ultimate goal of the chosen incremental approach is to build the core capabilities of the EGIS to benefit all departments. This EGIS can be built on a service by service basis as needed then they could be combined to create a web application for the use of different departments and business processes.

Additional single or multi department applications are added to the core capabilities as determined by real daily needs, overall priorities, and budget availability. The goal of the work plan is to establish a foundation that brings widespread use of GIS, ensuring success is built at each step in the implementation process. Within the work plan, it is important to set reasonable goals for each step and to produce tangible results.(Esri, 2007).

The advantages of the incremental approach include:

1. less initial investment costs.
2. This approach reduces risks by reducing costs and consumed resources.
3. Expands the perceptions of users to understand requirements through the gained experience.
4. ability to keep up with the latest technology because the initial investment is smaller.
5. Minimizing operational disruptions in the organization.
6. greater acceptance by staff because introduction of EGIS is gradual. (Esri, 2007).

The researcher thinks that this approach fits Bidya municipality for the following reasons:

1. Unavailability of departmental GIS at current and lack of most of the needed data.
2. Some of the needed data require separate projects to be achieved such as naming, coding and land registration.
3. Staff is not familiar in GIS usage and application and is in need for practical experience.
4. Scarce financial resources in conjunction with the large number of priorities in other tangible fields.
5. The need to improve requirements assessment based on experience.

Based on the study of municipal services, authorities, responsibilities, workflow, municipality strategic plan, and available and unavailable data required to operate the system and obtain the needed IPs efficiently; an implementation plan for EGIS was proposed for Bidya municipality,

The ultimate goal of the strategic plan is to acquire and utilize an enterprise GIS by year 2020 incrementally.

In fact, timing issues are crucial to the GIS success, and time management is an art when developing schedules. Time management start when dependencies are considered technically and organizationally, such that certain activity must be completed before a dependent one can be started (Somers, 1996)

The vision of Bidya municipality is: " facilitate providing services for public in ultimate efficiency and on the basis of transparency and accountability using technological instruments to achieve citizens' maximum satisfaction".

The following table shows a proposed implementation timeline for acquiring an EGIS for Bidya municipality based on: the study of the unavailable data which is required for the system to operate, the financial status of the municipality, the available staff and their qualifications and finally the political trends of the upper management.

Table(6.2) Implementation Timeline

	EGIS Implementation Proposed Timeline for Bidya Municipality							
Objectives	**Activities**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
	Networks							
Create an Electricity network automated database	**Electricity network** (*poles, lines, transformers, meters boxes, subscribers, light units, distribution boards*) With all needed attributes							
Create a water	**Water network** *(tanks, lines, manholes*							

network automated database	*and valves)* With all needed attributes							
Create a waste water network automated database	**Waste water network** *(treatment plant, lines, manholes***)** With all needed attributes							
	Transportation							
Create a road network map in shape file format	**Roads** (complex, road edges, road centerlines) map							
	Creating preliminary base map							
Create a buildings map in shape file format	**Buildings (***Digitizing polygons from the orthophoto and keep as shape file format* **)**							
Create a master plan in shape file format	**Master plan** *(admin. boundaries, planned roads, classification, MP boundaries***)**							

Transform to shape file format	**Contour lines**							
	Land registration							
Create land property inventory	**Land registration official process** *To be Launched by land authority*							
Create map of Parcel boundaries	**Parcel boundaries maps** *as shape file format , parcel numbering implicitly included*							
	Geocoding							
Create a uniform referencing system	**Naming and numbering include creating maps and fixing on site** *of roads and buildings*							
	Data entry							
Create licenses database spatially referenced	**Building Licenses attribute data entry**							

Create crafts database spatially referenced	**Crafts data collection and entry Map and attributes**							
Create a data inventory about violations	**Construction monitoring data entry and spatial referencing**							
	Migration to EGIS							
Integration of all departmental or service based data	**System design** (*database, infrastructure and technology,, software, interface)*							
Provide the physical requirements, programing, software and applications	**Procurement and operation**							
Provide the suitable personnel	**Allocate best fit Staff and conduct training programs – gradual**							

	process.							
Assess the achievement of objectives and project success	**Project assessment report**							

This plan is compatible with the strategic plan of Bidya municipality and its current work, the land registration project is one of the strategic plan priorities, while the current work includes a project of the master plan update of which outputs will be maps for roads, buildings, contour lines, electricity network and master plan in a shape file format.

This strategic plan for adopting an EGIS when approved, a detailed annual plans should be created and yearly assessment should be conducted assuming that the business needs and conceptual design are ready and approved.

Chapter 7

Cost Benefit Analysis CBA

7.1. Introduction

Benefit cost analysis is a process of quantifying costs and benefits to allow the comparison between the expected cost of implementing a system and the expected benefits that will result from having the new information products.(Tomlinson, 2003). And this process is stage 9 of Tomlinson methodology for planning GIS.

This technique has to be done during the planning stage to justify the financial amounts which would be spent to build the GIS within the organization through clarifying the gained benefits against the expenses, especially that GIS is relatively expensive technology that consumes significant parts of the organizational or municipal budget, so the GIS manager or planner must provide more reliable and defensible justification to the policy maker or the senior management to allocate the human and financial resources required to build, operate and maintain the system based on the expected benefits .

7.2. Cost Analysis

(Tomlinson, 2003) identifies five categories which costs would fall within during GIS project implementation:

1. Cost of Hardware and software.
2. Cost of data – spatial and non-spatial data

3. Staffing and training.

4. Application programming

5. Interfaces and communications.

These costs are classified as tangible costs which prices could be measured and quantified directly, because they represent costs of products that are bought and sold in the market at knowable amounts.(Obermeyer, 1999).

At Bidya municipality the major cost lies in the data element and staffing and training because it lacks the basic foundation in terms of data for adopting the GIS, it lacks data about lands both in terms of property and boundaries which directly affect the most important aspects of the system, it also lacks the foundation for the relational data model represented by geocoding i.e. names and numbers of roads, buildings and parcels. This fact forces the planner to think about the cost and time of acquiring this data as a prerequisite for implementing an enterprise GIS. In the case of Bidya municipality-the case study- the GIS may be thought of as a long term program which extends along four to five years in the minimum. This will be a must for the following reasons:

- The large scale of the project requires division to phases specifically because of lack of data, some kinds of data need separated projects such as land registration and producing maps for parcels.
- To cope with the limited financial resources of the municipality under the unlimited tangible needs and priorities.
- To let the staff obtain enough training, practice and practical expertise in using the GIS to well support the system development, acceptance and

diffusion through the municipality specially if we know that the municipality staff is not familiar with the system and its applications and software.

The case study -Bidya municipality- is a case that represents a wide range of similar local government status in the Palestinian country because it lacks the base for coding to enable system effective implementation and use, so the project is expected to start providing actual benefits after completion of naming and numbering of roads and buildings and land registration.

Table (7.1) Shows an estimate for project implementation costs which extends to four years.

System Cost Matrix

#	Cost Category	year1		Year2		Year3		Year4		Year5	
		System elements	**Cost $**	**System elements**	**Cost $**	**System elements**	**Cost $**	**System elements**	**Cost $**	**System elements**	**Cost $**
	Hardware and software	5 workstations, server, LAN	25,000	3 additional workstations	15,000	3 additional workstations	6,000	Web server	20,000	Maintenance or replacement	10,000
	Data	base map. transportation network. buildings	5,000	Water, Wwater & Electricity networks maps	50,000	Naming and coding of roads and buildings in addition to stage1 of land registration process	150,000	Stage2 of land registration process	100,000	-	-
	Data integration cost										

	Staffing and training	Training courses for the current staff	5,000	Hiring two new officers	18000	Training courses for the current staff	5,000	-	-	One GIS specialist	10,000
	Application programming	Software license	50,000	Software license	-	Software license	-	-	-	-	-
	Interfaces and communications	LAN	20,000	LAN	-	LAN	-	WAN	20,000	-	-
Totals $			**105,000**		**83,000**		**161,000**		**140,000**		**20,000**
Grand Total $	**509,000**										

Table (7.1): Cost Matrix

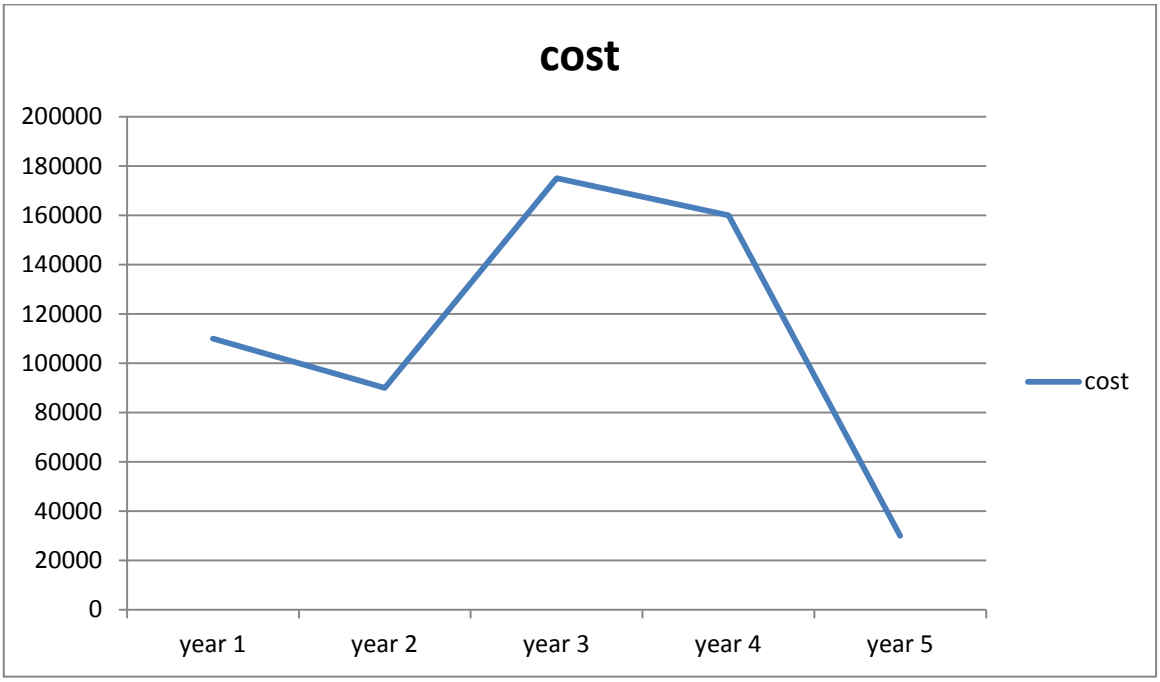


Figure 7.1 : Cost versus Time curve

From the cost analysis above we note that 60% of the cost will be allocated for data collection, and although the cost of staffing is relatively slight but it should be remembered that it is running cost. Figure (4) show that the cost is high in the early stage of the project lifecycle, while the benefits start to rise after the completion of data collection in the fourth year.

7.3. GIS Benefits

At first it is important to mention that many of the GIS benefits are difficult to measure; for example: increased reliability, data organization, data transparency and facilitating decision making are difficult to be quantified to figures for the comparison purposes, also it may be difficult to count all benefits absolutely, specially that this study didn't focus on a certain duty, it included all municipal activities. So it would be not fair to compare upon incomplete benefit identification.

(Obermeyer, 1999) has argued that there are several difficulties in benefit-cost analysis:

1. The effect of time and economic inflation, especially that GIS projects often have multi-year implementation plan, which affects the numerical value set for costs and benefits.
2. Time also influences the risks and uncertainties among benefits and costs. Specially with lack of experience which leads to underestimation of the long term costs.
3. Some of the benefits accruing to external bodies and indirectly reflects on the general context, such benefits are difficult to be quantified.
4. Stakeholders: the point of view from which the benefit is seen.
5. There are also many intangible benefits for which it is difficult to place a specified dollar value, for example: improved morale of the staff, enhanced reputation, diminished institutional confusion… etc.

These benefits are described in text in some detail to help in decision making regarding the adoption of the GIS.

Many authors such as Huxhold and Levinsohn (1995) recommended an examination of the financial, technical, and institutional feasibility as an alternative to benefit–cost analysis.

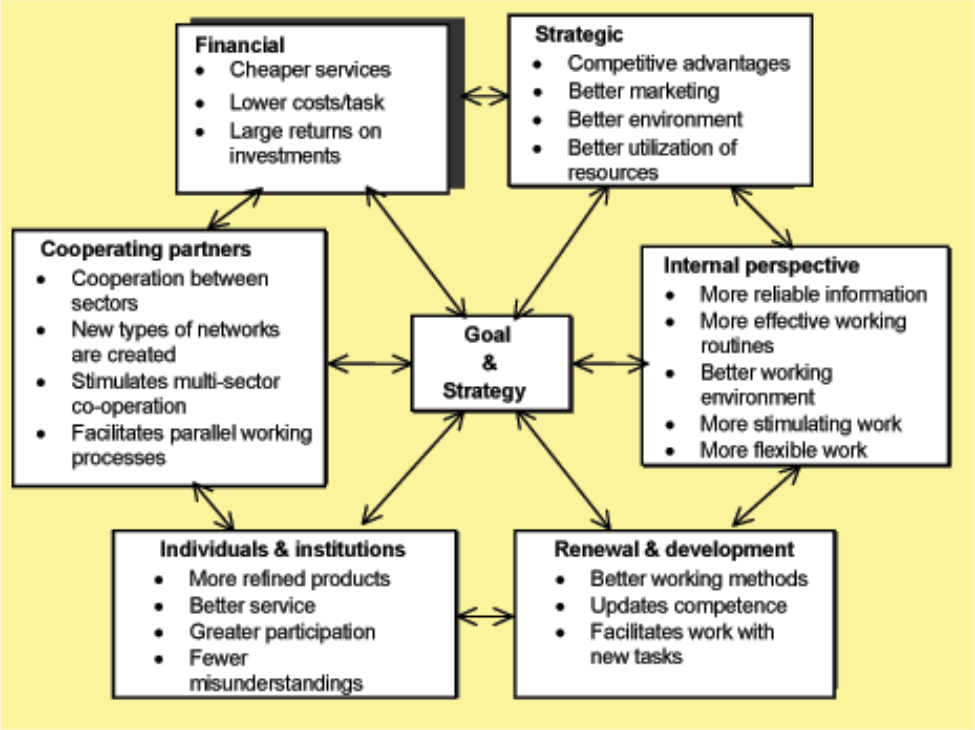


Figure 7.2 : The Benefits of a GIS in General

7.4. Discussion of GIS Benefits at Bidya Municipality

GIS technology provides municipalities with amazing quantitative and qualitative benefits. Some of these benefits and changes can be achieved early to some extent in the GIS development process; while others take much longer to be realized. A GIS may take several months to develop and the full benefits are experienced after many years (Somers, 1998), much

time is required to build a database and procure a Geographic Information System.

There are several benefits that come spontaneously as a result of having a GIS system, at the forefront of benefits is the possession of a unified central database accessible by different departments as needed while performing business work according to specified rules of access privileges. a municipality like Bidya which lacks many important kinds of maps such as electricity, water, sewage network maps will have the opportunity to acquire these maps through a GIS project in a format that allow for adding attributes as required and allow for manipulation and analysis.

Another significant benefit is the opportunity to have a standard geocoding service that ensures all departments receive consistent address information and provide uniform response to public inquiries. this standard geocoding is very basic when municipal departments integrate their GIS with other IT solutions.

So, geocoding is defined as: the process of transforming a description of a location—such as coordinates, an address, or a name of a place—to a location on the earth's surface. You can geocode by entering the location description in a table, the resulting location is output as geographic features with attributes, which can be used for mapping or spatial analysis, (www.help.arcgis.com).

Bidya municipality is in an urgent need to geocoding, it lacks all kinds of standard place names or numbers, even it has no enough codes for postal

addresses. The effect of that is directly reflected on emergency service specially ambulance services and civil defense. GIS project is a good opportunity for geocoding services.

The delivery of geographic information through the internet for public with ability to access maps and data behind maps will drop personal attendance to municipal offices to 25-50 percent which will free staff to other tasks. in particular, data such as planned roads, land parcels, construction regulations, land division provisions and so on, an example of that: during the process of construction license the step of providing the regulatory provisions to the applicant on a paper survey plan which is written manually on the plan and consume a lot of time, this step could be completely eliminated by letting the engineering office (designer) to obtain these regulation through the web site which contains enough information and go ahead in design and later on take the approval from the engineer of the municipality.

The disclosure of information of this type will emphasize transparency and accountability and prevent or mitigate manipulation and corruption, it could enable efficient arbitration when complaints are submitted to ministry of local government office.

It is thought that distribution of such geographic data could improve regulatory compliance by citizens through raising awareness of regulatory provisions between them by virtue of the wide spread of internet services.

These benefits are really achieved by incorporating enterprise GIS (EGIS), while the term enterprise refers to looking at the entire municipal structure as a single entity supported by information systems that can be used in combination to produce the information products required by end users while minimizing data and process redundancies, (www.esri.com-Enterprise GIS for Local Government). The goal of an EGIS is to distribute GIS functions and data throughout the organization while leveraging and integrating the functions and data offered by other technologies.

The availability of maps of services networks (electricity, water, sewage, storm water, roads) with needed attributes improves service delivery, infrastructure maintenance and management efficiencies.

EGIS within the municipality enables Data sharing that supports decision making, and decrease redundancy which save effort and keep consistency as well as support daily workflow through the organization and offers users better productivity because of fast access to maps, as well as the data behind the maps.

7.5. Examples of Direct Benefits of GIS but not limited to.

1. Clearance issuance: clearance is needed to be issued for every citizen who wants to receive a service from the municipality, at the current status there is no system that could show all liabilities of any citizen towards the municipality, so clearance action take about 1-3 days to tell the applicant about liabilities if any, the clearance form should move from division to

division (building licenses, electricity service, water service, sewage service, crafts licenses, environmental health, financial and administrative departments), the system is expected to collect all liabilities in one place which is the public services officer desktop by virtue of the unified database, so the data about liabilities shouldn't take more than few minutes. this systematic way of collecting liabilities is estimated to increase revenues and drop debts on citizens.

2. Property taxis collection: at the current status property taxis collection is the responsibility of ministry of finance although 90% of the collected taxis are deposited to municipalities and 10% are allocated for the operational expenses for the collection duties. GIS is an efficient tool for tax collection management and can be inspected during clearance issuance within the municipality using property number by integrating property data to the municipal database to help in tax collection and this would increase municipality revenues. Property taxes are directly connected to land registration so, at the current status it is not activated in Bidya municipality.

3. crafts licenses: at the current status, no system for recording licenses is available as well as the paper records don't reflect the actual number and variety of crafts because there are false licenses issued to help workers in obtaining the agreement for permission to work inside the green line areas, also some crafts (heavy crafts) actually exist but have no license because of the environmental impact they cause, so the actual number, distribution and variety could accurately be known by linking the craft with its location on the ground. now to have exact information about licenses we need about 3-

5 days, but using GIS it takes few minutes, and provide an efficient tool for query, map presentation and follow up annual fees collection in addition to environmental impact assessment, specially that Bidya contains the majority of the industrial activities of Salfit governorate.

4. Relating the services networks: Bidya municipality has the full responsibility of an electricity and water networks of about 30 km for each. it has the responsibility of distribution, management, extension, maintenance, fund raising for development and collection of due amounts from citizens. at the current status it has no maps for networks, in general, information is very difficult to be obtained and takes long time with low precision, so decisions are taken randomly. with the aid of GIS information can be taken with good precision, in short time with the ability to present data on map in different ways and purposes, one can query the attributes and locations efficiently, which helps in decision making, fund raising, resources effective allocation and good management.

5. monitoring construction works: violations in construction should be reported to the administrative level and documented through a variety of actions (mailings, notifications, photos...), these actions with dates and attachments should be kept and linked to the location. To follow up any complaints raised by the affected citizen which may reach courts, municipality needs to retrieve all actions and documents which at the current status is mixed up, chaotic, confusing and take long time. Using GIS it provides very efficient way to keep and retrieve information through a central database and could be used by any officer via a well-designed

interface. These documents are very critical and if lost it costs the municipality very large amounts of compensations.

6. query functions either spatial or attribute are very difficult and sometimes almost impossible to perform specially in the field of municipal work because of the huge amount of data in different fields and the need for data in various forms, GIS has a powerful capabilities in performing such functions of which benefits are countless and priceless.

Chapter 8
Result Analysis, Conclusions and Recommendations

8.1. Results Analysis

In this study we investigated the methodology of planning GIS projects for municipalities, through applying it on Bidya municipality as a municipality that represents wide range of the Palestinian local governments. From this study we found that the planning stage is very crucial, and should be made for any GIS project either big or small. GIS projects are built to fit the particular institution exactly, so the feasibility of the project may change according to the particular situation. The study included reviewing the processes and procedures of doing work and providing services, to have a knowledge of how GIS could improve the procedures and methods of implementation works and providing services in terms of fast delivery, reduce the effort or to obtain the best results for accuracy.

1. One important result of the study is the production of the -information product description- document (annex- B) which describe exactly:

- How advantages of GIS can be taken in each process or task .
- data required to obtain each IP.
- the required GIS functions and the frequency of use, which is necessary for the system design and technology.
- This document could serve as a template to be used by other municipalities for system planning, where it may be adopted as it is or be modified as the case, any way it could be a good guide.

- At implementation of the project this document will control data collection, so no useless data should be collected, and no collected data may be useless.
- this document is a good base for estimating the cost of data collection, and then cost of acquiring the system, because it describes clearly the types of needed data, source and size of data, and technical specifications of data especially spatial data in terms of precision, scale and resolution.

This represents the answer of the first research question "How can we apply the GIS planning process within municipalities in Palestine".

- Comprehensive MIDL and database schema have been drawn from the IPD document for the whole municipality.

This represents the answer of the second research question" What are the requirements of the GIS in the Palestinian municipalities in terms of data.".

2. Direct and indirect benefits has been summarized, direct benefits are those that are intended to be obtained when identifying IP. and indirect benefits are either those general benefits reflected on the municipality from incorporating the system or additional benefits on business work procedures, which enable obtaining new IP from available data.

This represents the answer of the third research question "What are the particular benefits of GIS for the municipal work in Palestine".

3. An implementation plan was developed for Bidya municipality Based on the study of data requirements and the status of the existing situation, it shows that the EGIS is a long term program that extends to several years.

This represents the answer of the fourth research question “How could the Palestinian municipalities migrate to the EGIS in terms of data issues”.

4. The study of data requirements and data currently available at Bidya municipality indicates that data issues may be a challenge that delays the adoption of EGIS or affects the success of the system and getting maximum benefits.

This represents the answer of the fifth research question “ To what extent data acquisition issues are considered obstacles to GIS adoption and success in the Palestinian municipalities”.

8.2. Conclusions

In light of the previous discussions and analysis we can conclude the followings:

1. The planning stage is a must for any successful GIS project. This is evident from the fact that GIS has so many applications and functions and planning process specifies the exact requirements of the particular organization. To build the system and procure its components one need to know what data is required and what is the design and arrangement of tables and maps to get the needed information, as well as what are the needed functions and the specifications of the technology and infrastructure required to support these functions. Without the study of these factors the system couldn’t be built and couldn’t provide the expected benefits. Planning process answers these questions.

2. The GIS system is very useful in the field of municipal services and its feasibility depends on what is needed and what is available within the municipality, so the feasibility varies from situation to situation.

3. Most municipal services and activities are of spatial dimension, Which emphasizes the need for a geographic information system.

4. Bidya municipality has weaknesses specially in terms of data acquisition which might be fatal for the concept of EGIS and postpone or indeed prevent the implementation.

5. GIS system in the municipal services requires a plan for system sustainability in terms of qualified staff, technical support and systematic data updating while all these requirements need political will by decision makers.

8.3. Recommendations

1. Because the land registration and also coding issues -which are shown as obstacles for the GIS adoption- applies to most of the Palestinian localities and can be considered a national issue then it is recommended that The Supreme authority in the local governance sector represented by ministry of local government has to make a diagnostic study and a plan for adopting GIS in the local bodies administrative system. This plan has to take into consideration The degree of readiness and availability of the resources to incorporate the system so that the ready localities are advised to start including the system while the less readiness start to be configured , improved and recommended for other projects such as land registration and coding as priority projects.

2. The priority in Bidya municipality is for land registration process which is the real basis for land management and organization and then GIS will be a good tool for this management.

3. it is recommended that Bidya should start as soon as possible in buildings and roads numbering and naming according to the legal methodology and labeling addresses in place.

4. Bidya should raise funds and direct it for these projects as prerequisite for an enterprise GIS.

5. It is recommended that Bidya municipality start to collect data in accordance with the IPD document and store it in a format that allow importing it easily to GIS later on when it really has the readiness.

6. looking ahead, It is recommended that any intended information system whether financial or technical system or whatever it is, that it should be able to integrate with GIS in the future, this condition should be set in the TOR of contracting with any external consultant. Because the inability to integration between systems is one of the technical challenges of the system and its success.

7. Future researches: it is recommended to conduct a study to assess the implemented projects in the field of GIS in Palestine particularly in local governance system. To highlight the extent of success of these projects and diagnose the causes of failure if any.

References

1. **Tomlinson, R., 2003. *Thinking about GIS**: Geographic Information System Planning for Managers*, ESRI Press.

2. **United Nations Publications, a handbook on geographic information systems and digital mapping**, , New York, 2000.

3. **Somers, R. (1996, July). GIS management Strategies and Issues. In SIRC'96***: Proceedings of the 8th Annual Colloquium of the Spatial Information Research Centre, RT Pascoe, NC Sutherland and P. Gorman (Eds), University of Otago*(pp. 1-7)..

4. **Somers, R., GIS project planning and implementation, in advanced geographic information system, in Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO**, Eolss Publishers, Paris, France, [http://www.eolss.net].

5. **Somers, R., 1998. Developing GIS Management Strategies for an Organization.** Journal of Housing Research, 9(1), p.157-178.

6. **Obermeyer, N. J., 1999. Measuring the benefits and costs of GIS.Geographical information systems,** *2*, 601-610.

7. **Taleai, M., Mansourian, A. & Sharifi, A., 2009. Surveying general prospects and challenges of GIS implementation in developing countries**: A SWOT-AHP approach. Journal of Geographical Systems, 11(3), p.291-310.

8. **Halfawy, M. R., & Figueroa, R. (2006, June). Developing enterprise GIS-based data repositories for municipal infrastructure asset management. In Proc.**, *Joint International Conference on Computing and Decision Making in Civil and Building Engineering, ICCCBE/ASCE/DMUCE/CIB, Montreal, Canada*.

9. **Heeks, R., 2002. Information Systems and Developing Countries: Failure, Success, and Local Improvisations.** The Information Society, 18(2), p.101-112.

10. **Zhao, H. (2002). USING GEOGRAPHIC Information Systems (GIS) in a Local Government---**a Case Study of GIS Implantation in ascension parish government, LOUISIANA (Doctoral dissertation, Faculty of the Louisiana State University and Agriculture and Mechanical College In partial fulfillment of the Requirements for the degree of Master of Science in The School of Architecture By Hongwei Zhao Bachelor of Architecture, Southeast University, Nanjing).

11. **Mennecke, B.E. & West Jr., L.A., 2001. Geographic Information Systems in Development Countries:** Issues in Data Collection, Implementation and Management. Journal of Global Information Management, 9(4), p.44.

12. **Zellar, J., 2002, GIS in developing countries**: Possibilities and Constraints**,** Sheffield University, UK.

13. **Mennecke, B., 1998, Lawrence a. West, Geographic Information Systems in Developing Countries:** Opportunities and Options for Decision Support, East Carolina University, University of Central Florida, USA , Idea Group Publishing, 1998.

14. **Bishop, I.D. et al., 2000. Spatial data infrastructures for cities in developing countries.** Lessons from the Bangkok experience. Cities, 17(2), p.85-96.

15. **Somers, 2001, Rebecca. Quick guide to GIS implementation and management.** Urban and Regional Information Systems Association.

16. Somers, R., 2000. GIS strategic planning. In URISA Proceedings.

17. **Bestebreurtje, J. G. A., Scholten, H. J., & Bestebreurtje, H., 1997. GIS Project Management.**

18. **Venkatachalam,p., Geographic information system as tool for development, center of studies in resources engineering**, Indian Institute of technology, Bombay, India, EOLSS, sample chapters.

19. **Eria, S., 2012. The state of GIS in developing countries:** a diffusion and GIS & society analysis of Uganda, and the potential for mobile location-based services(Doctoral dissertation).

20. **Mooneyhan, W. D. (1998). International Applications of GIS. In T. W. Foresman (Ed.),** The History of Geographic Information Systems: Perspectives from the Pioneers (pp. 349–366). Upper Saddle River, NJ, USA: Prentice-Hall, Inc.

21. **Stuver, S., GIS database and web application feasibility study for the city of San Antonio, master thesis**, The University of Texas at San Antonio, 2002.

22. **Ashiagbor, G., & Fosu, C., 2012. GIS Application for Local Government Revenue Mobilization.** In GSDI 13.

23. **Local Government Resource Handbook, , GIS For Municipalities, Service Nova Scotia and Municipal Relations**, April 2001, Section 5.4 - Page 1-38.

24. **ESRI, White Paper, 2007, Enterprise GIS for Local Government,. NewYork, USA, December 2007**. http://www.esri.com/enterprisegis-wp

25. **ESRI, 2008, Best Practices for implementing a successful GIS project,** ESRI Business Geoinfo Summit, 2008 presented by Clancy, J., esri proceedings.

26. **GIS Development Guides for State of New York,** Local Government Technology Services (1997)

27. **Alqarni, Abdullah, 2013. Advanced GIS project management, King Saud University**, presentation material.

28. **Executive Office of Environmental Affairs (EOEA), 2002, Getting Started with GIS,** a Guide for Municipalities, Massachusetts, Oct. 2002.

29. **Krupnik, A. (2000). Accuracy assessment of automatically derived digital elevation models from SPOT images**.

Photogrammetric Engineering and Remote Sensing, 66(8), 1017-1023.

المراجع العربية

1. **قانون تنظيم المدن والقرى والابنية** رقم (79) لسنة 1966.
2. **قانون الهيئات المحلية** رقم (1) لسنة 1997.
3. **قانون الابنية والتنظيم رقم (5) لسنة 2011.**
4. **نظام موظفي الهيئات المحلية رقم (1) لسنة 2009 والاحكام التفصيلية المنبثقة عنه.**
5. **القواسمي، خالد، 2009، الاطار الاستراتيجي لوزارة الحكم المحلي.**
6. **الخطة الاستراتيجية لبلدية بديا للفترة (2012-2016).**
7. **الاوصاف الوظيفية لكادر بلدية بديا، بلدية بديا، دائرة الشؤون الادارية.**
8. **عوض، رامي، 2010، معوقات تطبيق نظم المعلومات الجغرافية في بلديات قطاع غزة – فلسطين، رسالة ماجستير، الجامعة الاسلامية، غزة.**
9. **سمارة، علي، 2010، تطبيقات نظم المعلومات الجغرافية في التخطيط العمراني في فلسطين**
10. **الإمكانيات، المعوقات، المقومات، جامعة النجاح الوطنية، نابلس فلسطين.**
11. **السلمان، عبد الملك ، 2005 ، تعريب انظمة المعلومات الجغرافية، كلية علوم الحاسب والمعلومات، جامعة الملك سعود، مادة عرض.**
12. **المؤسسة العامة للتعليم الفني والتدريب المهني، الادارة العامة لتصميم وتطوير المناهج، نظم المعلومات الجغرافية، المملكة العربية السعودية.**
13. **عباس، علي، علي، صباح، استخدام نظم المعلومات الجغرافية في انشاء وتمثيل بيانات نموذج الارتفاع الرقمي لنماذج مختارة من شمال العراق، جامعة الموصل.**
14. **طوقان، طارق، 2001، تقرير حول اللامركزية والحكم المحلي، الهيئة الفلسطينية المستقلة لحقوق المواطن، رام الله.**
15.

Internet Websites

1. Training materials on IPDs, network analysis, geocoding, data management available at: http://www.esri.com

2. The definition and components of GIS, available at: http://www.westminster.edu/staff/athrock/GIS/GIS.pdf viewed on: 1.Jan. 2015

3. http://www.croswell-schulte.com/

4. http://www.sara.nysed.gov/pubs/gis/gisindex.htm

5. Introduction to Geographic information system by Prof. Sumanta Das, department of civil engineering, MEFGI, Rajkot, India. Available from: http://www.slideshare.net/sumantagargibhattacharyadas/geographic-information-system-29590419

6. project management methodology and skills available at: http://www.thoughtware.com.au/documents/method123-ebook.pdf

7. presentation materials about project management available at: http://www.slideshare.net/iirmjaipur/project-management-and-project-life-cycle

8. Definition of database schema by mike chapple (database expirt) available at: http://databases.about.com/cs/specificproducts/g/schema.htm .

9. Definition of GIS available at: http://www.gislounge.com/what-is-gis/

10. Emergence of GIS available at: http://en.wikipedia.org/wiki/Historical_geographic_information_system viewed on: 15.Jan. 2015.

11. GIS tangible and intangible benefits, available at: http://www.cookbook.hlurb.gov.ph/4-02-04-cost-benefit-analysis-municipal-gis viewed on: 9.sep. 2015

12. population estimates for the year 2016 available at: http://www.pcbs.gov.ps/site/lang__ar/816/default.aspx

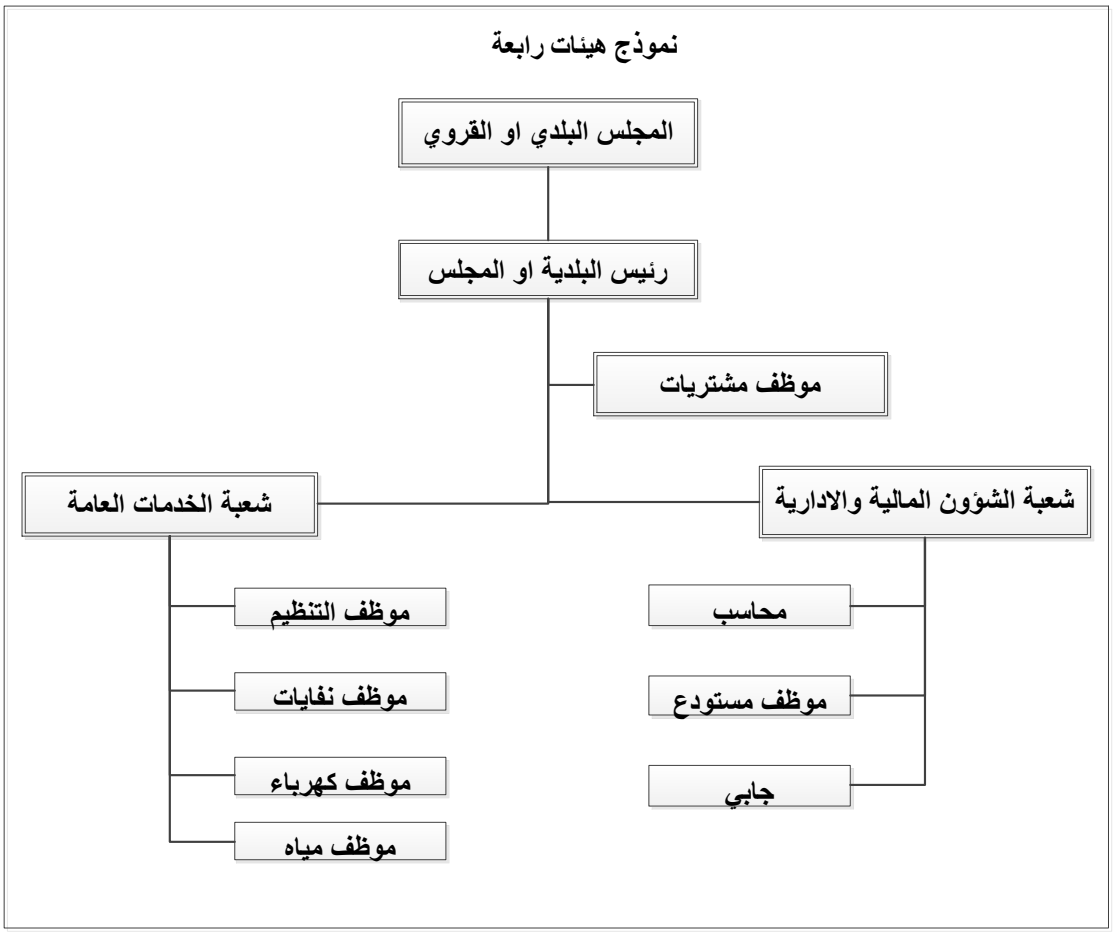
13. performance indicators and ranking reports of municipalities available at: http://www.mdlf.org.ps/Details.aspx?LangID=Ar&PageID=107&mid=17 viewed on: 9.sep. 2015

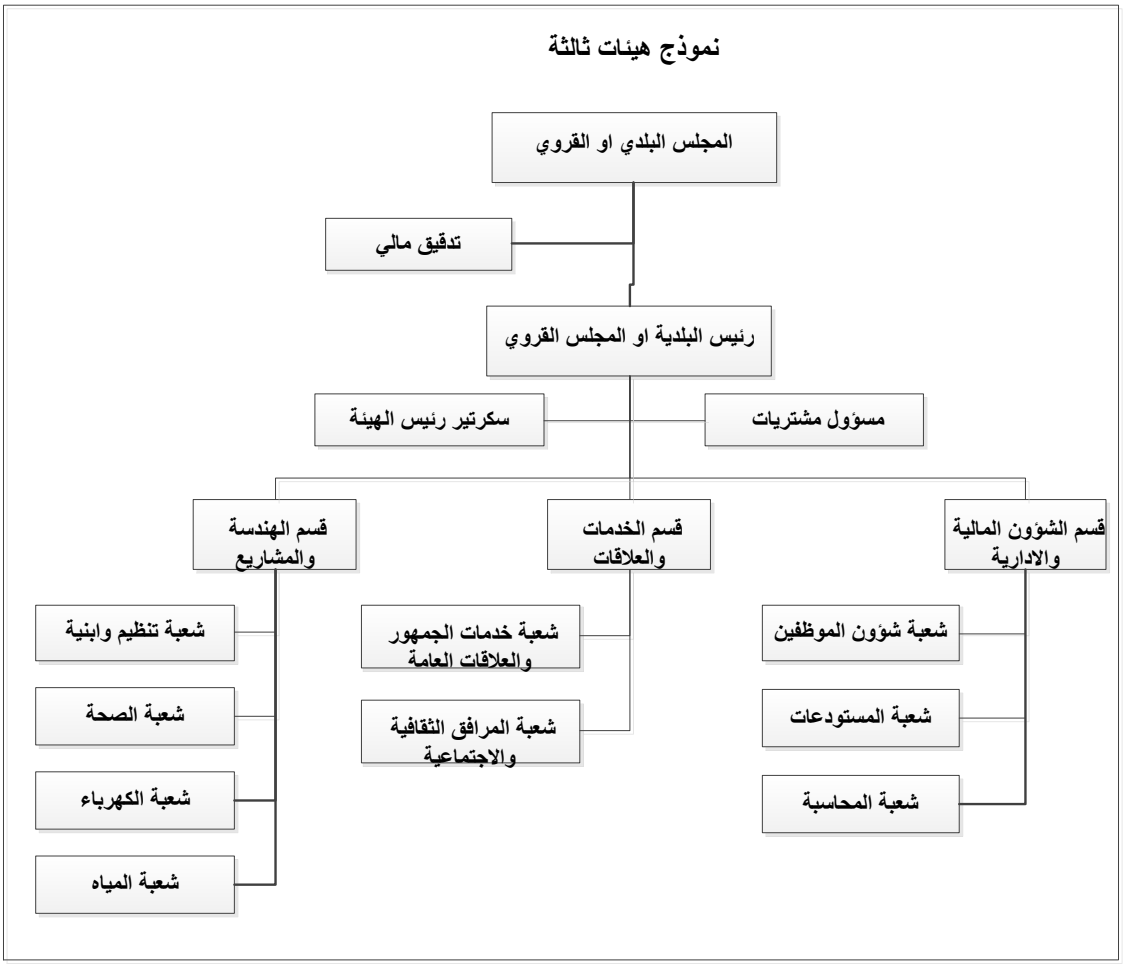
14. land registration ratio available at: http://www.aliqtisadi.ps/ar_page.php?id=2ea382y3056514Y2ea382 viewed on 20.jul.2015.

ANNEXES

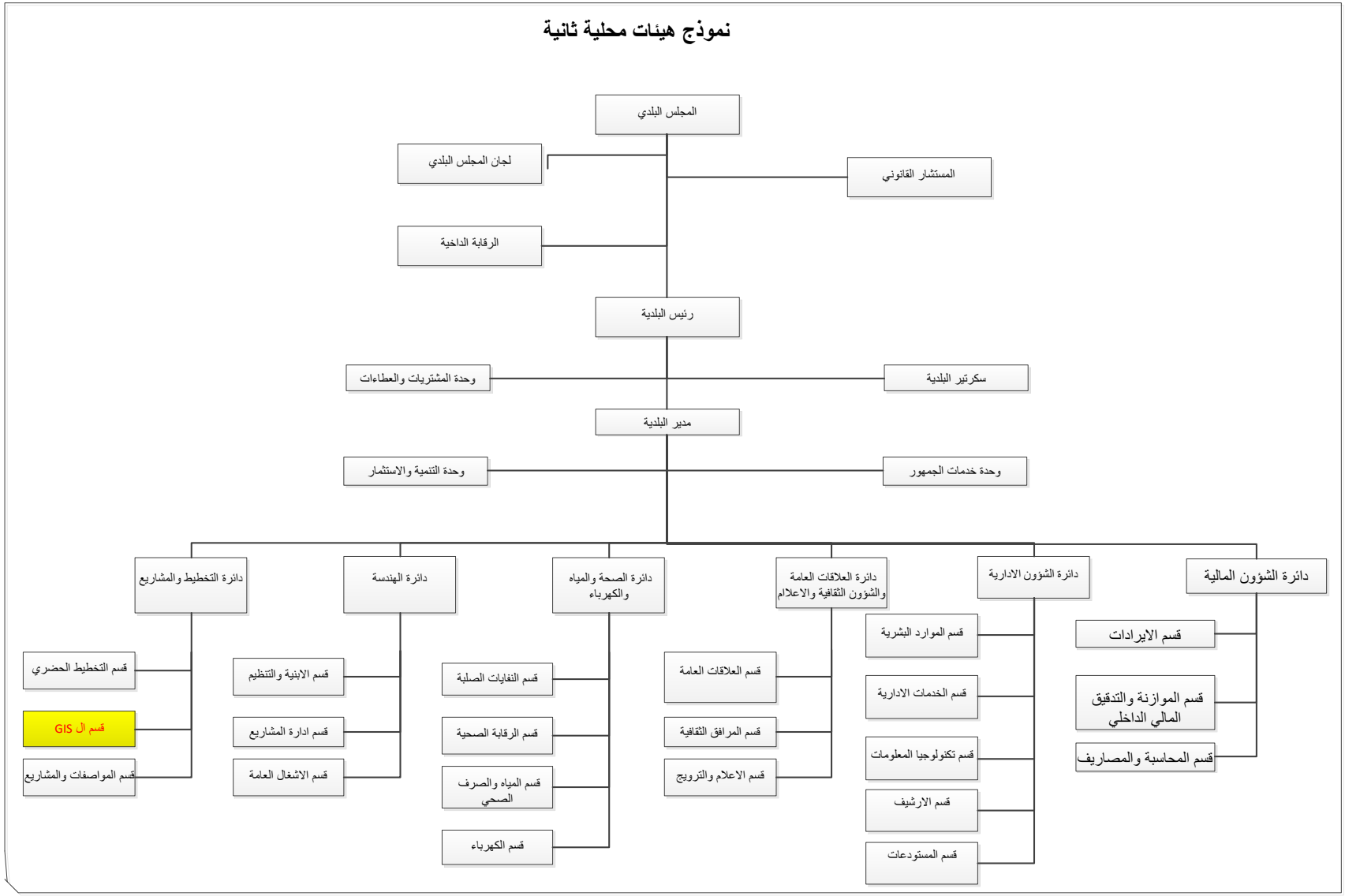
ANNEX – A

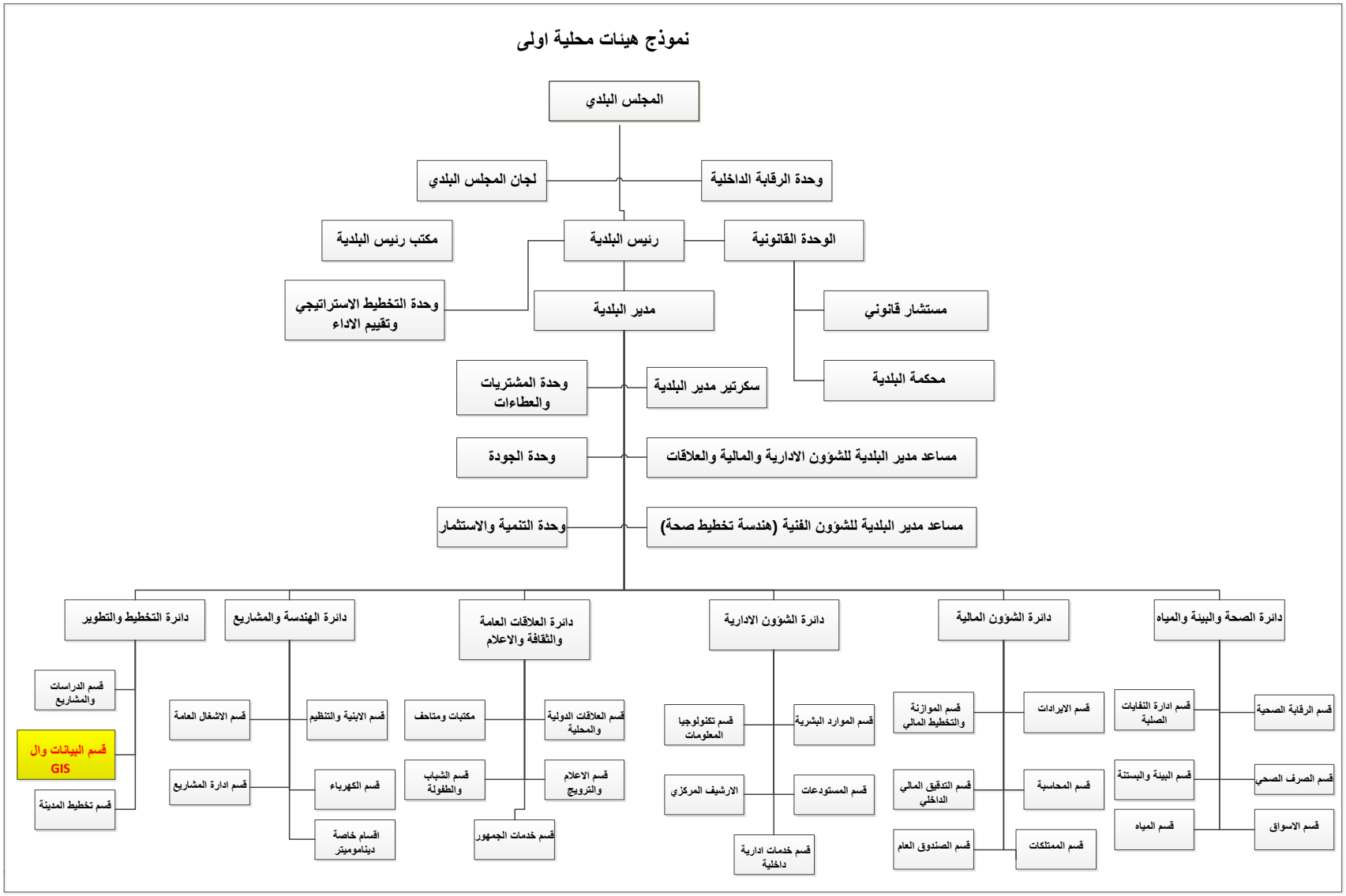
The Organizational Structures of the Palestinian Municipalities according to the different levels

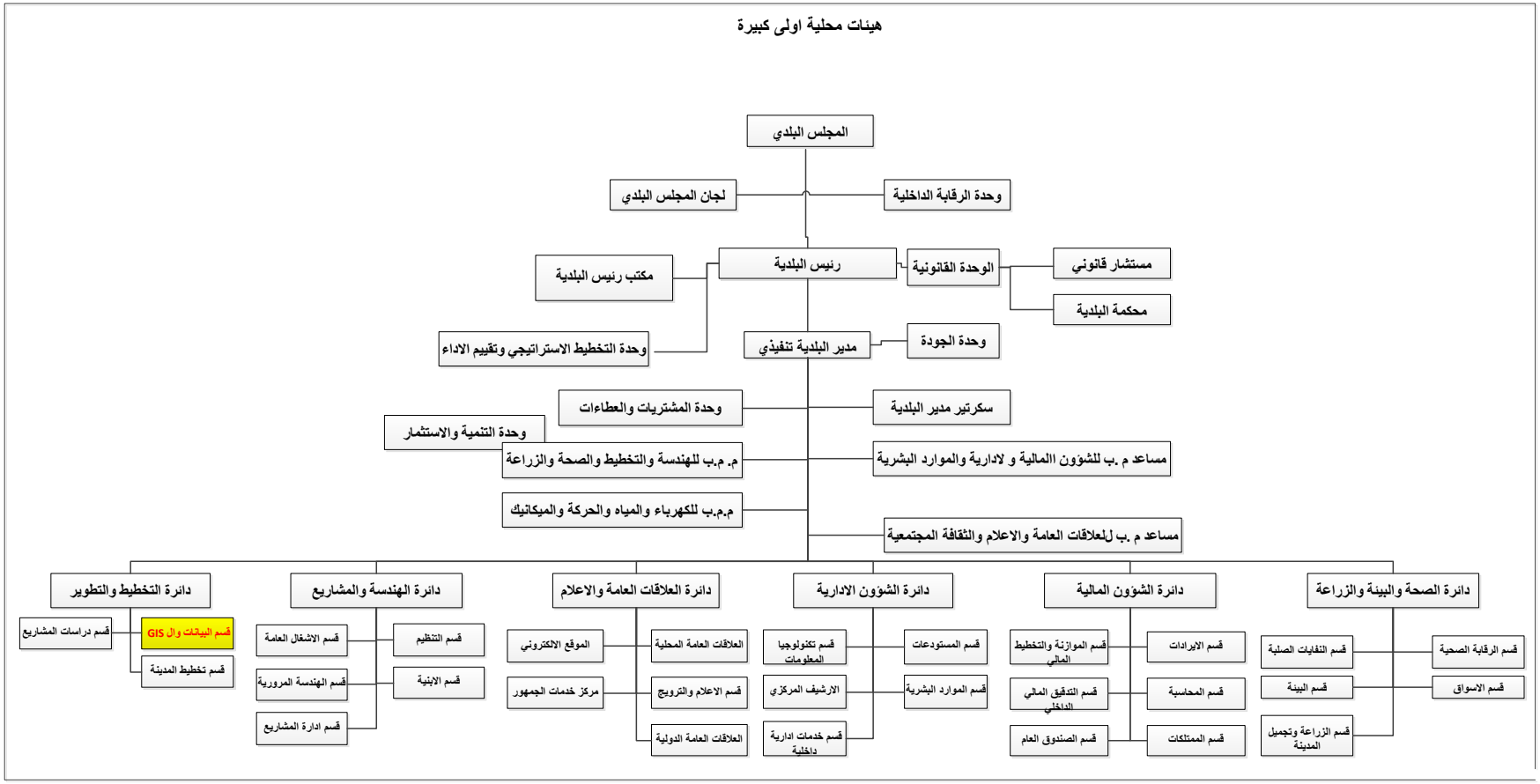



نموذج هيئات ثالثة
المجلس البلدي او القروي
تدقيق مالي
رئيس البلدية او المجلس القروي
سكرتير رئيس الهيئة
مسؤول مشتريات
قسم الهندسة والمشاريع
قسم الخدمات والعلاقات
قسم الشؤون المالية والادارية
شعبة تنظيم وابنية
شعبة الصحة
شعبة الكهرباء
شعبة المياه
شعبة خدمات الجمهور والعلاقات العامة
شعبة المرافق الثقافية والاجتماعية
شعبة شؤون الموظفين
شعبة المستودعات
شعبة المحاسبة

نموذج هيئات محلية ثانية




نموذج هيئات محلية اولى
المجلس البلدي
لجان المجلس البلدي
وحدة الرقابة الداخلية
مكتب رئيس البلدية
رئيس البلدية
الوحدة القانونية
وحدة التخطيط الاستراتيجي وتقييم الاداء
مدير البلدية
مستشار قانوني
وحدة المشتريات والعطاءات
سكرتير مدير البلدية
محكمة البلدية
وحدة الجودة
مساعد مدير البلدية للشؤون الادارية والمالية والعلاقات
وحدة التنمية والاستثمار
مساعد مدير البلدية للشؤون الفنية (هندسة تخطيط صحة)
دائرة التخطيط والتطوير
دائرة الهندسة والمشاريع
دائرة العلاقات العامة والثقافة والاعلام
دائرة الشؤون الادارية
دائرة الشؤون المالية
دائرة الصحة والبيئة والمياه
قسم الدراسات والمشاريع
قسم البيانات وال GIS
قسم تخطيط المدينة
قسم الاشغال العامة
قسم ادارة المشاريع
قسم الابنية والتنظيم
قسم الكهرباء
اقسام خاصة ديناموميتر
مكتبات ومتاحف
قسم الشباب والطفولة
قسم العلاقات الدولية والمحلية
قسم الاعلام والترويج
قسم خدمات الجمهور
قسم تكنولوجيا المعلومات
الارشيف المركزي
قسم الموارد البشرية
قسم المستودعات
قسم خدمات ادارية داخلية
قسم الموازنة والتخطيط المالي
قسم التدقيق المالي الداخلي
قسم الصندوق العام
قسم الايرادات
قسم المحاسبة
قسم الممتلكات
قسم ادارة النفايات الصلبة
قسم البيئة والبستنة
قسم المياه
قسم الرقابة الصحية
قسم الصرف الصحي
قسم الاسواق


هيئات محلية اولى كبيرة
المجلس البلدي
لجان المجلس البلدي
وحدة الرقابة الداخلية
رئيس البلدية
مكتب رئيس البلدية
الوحدة القانونية
مستشار قانوني
محكمة البلدية
وحدة التخطيط الاستراتيجي وتقييم الاداء
مدير البلدية تنفيذي
وحدة الجودة
وحدة المشتريات والعطاءات
سكرتير مدير البلدية
وحدة التنمية والاستثمار
م. م.ب للهندسة والتخطيط والصحة والزراعة
مساعد م .ب للشؤون االمالية و لادارية والموارد البشرية
م.م.ب للكهرباء والمياه والحركة والميكانيك
مساعد م .ب لـلعلاقات العامة والاعلام والثقافة المجتمعية
دائرة التخطيط والتطوير
قسم دراسات المشاريع
قسم البيانات وال GIS
قسم تخطيط المدينة
دائرة الهندسة والمشاريع
قسم الاشغال العامة
قسم التنظيم
قسم الهندسة المرورية
قسم الابنية
قسم ادارة المشاريع
دائرة العلاقات العامة والاعلام
الموقع الالكتروني
العلاقات العامة المحلية
مركز خدمات الجمهور
قسم الاعلام والترويج
العلاقات العامة الدولية
دائرة الشؤون الادارية
قسم تكنولوجيا المعلومات
قسم المستودعات
الارشيف المركزي
قسم الموارد البشرية
قسم خدمات ادارية داخلية
دائرة الشؤون المالية
قسم الموازنة والتخطيط المالي
قسم الايرادات
قسم التدقيق المالي الداخلي
قسم المحاسبة
قسم الصندوق العام
قسم الممتلكات
دائرة الصحة والبيئة والزراعة
قسم النفايات الصلبة
قسم الرقابة الصحية
قسم البيئة
قسم الاسواق
قسم الزراعة وتجميل المدينة

ANNEX – B

Information Products Descriptions

1. (IP1) Inquiry about a parcel of land

People need information about lands either undeveloped lands, for selling and buying and other kinds of business transactions, or lands with existing buildings for a building removal and reconstruct, and also they need a documented replies or answers, to do this, engineer should give these answers as a map and a list of data.

❖ **map requirements**

- Site map of the land parcel- of interest- within the master plan.
- Adjoining roads - planned and existing roads.
- Land classification polygons.
- boundaries of blocks
- Boundaries of master plan.

❖ **Tabular data requirements**

Engineer needs also to supply the applicant with the following data about the land parcel:

Title: inquiry about a parcel of land

Required by : Statutory planning dep.

Name: .....

List #1

List title: Regulatory provisions

		MIN.		**MAX.**			**MIN.**			
Headings	**Land zone**	**lot area (m2)**	**frontage (m)**	**Max. Bldg. %**	**No. of floors**	**Bldg. height**	**Front set back**	**Rear setback**	**Side set back**	**Fees (JD/m2)**
Typical entries	Res. (A)	1000	25	36%	5	18	5	5	4	2.275
Source	MP	Fixed for zone	Fixed for zone	Fixed for zone	Fixed for zone	Fixed for zone	Fixed for zone	Fixed for zone	Fixed for zone	Fixed for zone

❖ Data and Functions

Description	**Data needed**	**Functions needed**
▪ Staff member receive an application for inquiry about land parcel attached with a land survey (Cad format)/(hard copy).	▪ map (1:500) Site of the parcel within the master plan .	▪ data input of the parcel survey to the master plan. "scanning and digitizing land survey if it is hard copy". ▪ over plot of the parcel survey to the master plan.

		▪ edit and display output map on screen, with the capability of editing, symbolization, and plotting ▪ spatial query to identify the zone class which contains the parcel. ▪ attribute query by zone class to identify zone regulations. ▪ plot of map as a hard copy with attribute data.

❖ **Error types and tolerances**

Title: inquiry about parcel of land

Required by : head of organizing department (eng.)

Name: .....

Error tolerance	**Impact on benefits**	**Result of error**	**Possible occurrences**	**Type of error**
-----	----	----	----	**Referential**
-----	----	----	----	**Topological**
(0.3)m	▪ wasting time and effort ▪ getting wrong	• Inaccurate location within the master plan.	• Inaccurate boundaries positions/coordinates	**Relative**

	answers /no answer. ▪ social problems	• misleading results for the applicant. • inability to continue process.	of the parcel • shifts in positions	
0.50 m	Wrong site characteristics	No match between land and regulations	Wrong site of land within zone class	**Absol ute**

16. Frequency of use

Title: inquiry about parcel of land

Required by : statutory planning dep.

Name: .....

Function	**number**	**Frequency per year**	**Number per year**
Data input	1	50	50
overlay	1	50	50
Editing	1	50	50
Symbolization	1	50	50
Plot	2	50	100
Spatial query	1	50	50
Attribute query	1	50	50

17. Logical linkages

1. In this IP (inquiry about a parcel of land), it is known that, land boundaries are not available as a master plan at Bidya municipality and also no parcel numbers are available, for that no way to know needed information precisely except parcel survey overplot to the master plan. This requires relationships between maps (parcel survey and master plan) which are consistency in scale and coordinate system.

18. Wait and response tolerance.

For the purposes of this IP it is suitable to obtain the output of the IP during five seconds.

19. Current cost .

In order to produce the IP of a site map and regulatory provisions, this takes a lot of staff time, especially if we know that it is needed frequently in Bidya because of the relatively strong development activity and the attraction to external investors to establish economic projects in Bidya *(Bidya municipality)* so they need this information for their preliminary project study and design. This consumes staff time and also applicant time especially when his application is postponed several days.

20. Benefit analysis.

4. Financial savings: actual cash saved from current budgets if required information products were made by the GIS, such as reduction in current staff time or increase in revenues.

5. Direct benefits to agency: things that will result from the new IP which was not available prior to implementing the GIS. These could include improvements in operational efficiency and workflow or the reduction of a liability.

6. External benefits: benefits that accrue to others who are not directly using the GIS.

By examining the current way of implementing work at Bidya municipality we can extract the following benefits:

5. There will be a lot of staff time saving as a result of work automation instead of manual procedures, especially using web-based GIS which could provide efficient and effective users' access to information at any place and any time, by providing spatial data and descriptive data related to regulatory provisions through a web page.

Web-based GIS with spatial data which include map requirements mentioned above with an aerial photo as background will be very efficient to satisfy most applicants who need general information.

6. There will be great benefit on public by getting immediate information through web-based GIS at any time and any place. this will:

- Save applicants time.
- Increase public awareness in regulatory provisions which directly or indirectly reflects on the planning context in general specially in the Palestinian rural towns like Bidya and similar towns.

2. (IP2) Preparation of a road detailed map.

Engineer needs to prepare detailed road maps at a certain part of the city, according to the annual implementation plan of the municipality for the purpose of road construction, the map should show all details of elements which might be affected by the work , he wants to have a map that reflects the reality and enable the engineer to prepare a report about obstacles and difficulties which may face the work. the main challenge in this

process is to know land owners, land divisions, and areas of extracted lands for public services, and then submit a report that shows:

1. Spatial obstacles, difficulties and potential social problems.
2. list of land owners affected by the project.
3. know the compensation amounts if any.
4. making slight modifications on road path to mitigate land and environment abuse like avoiding tree cut.

❖ **Map requirements**

1. Existing and planned roads
2. boundaries of land parcels.
3. polygons representing zones of land use
4. buildings and structures.
5. walls
6. trees
7. master plan boundaries

❖ **Tabular data requirements**

1. land parcel numbers
2. land owner
3. areas of land divisions

Engineer need to know the affected land parcels adjoining the road under construction and the amounts of extracted areas, the laws states that if the extracted areas exceed 30% then the owners should be compensated, so the engineer also needs to know who are the land owners.

- Tabular data related to affected parcels

Title: preparation of road detailed map

Required by statutory planning dep.

Name: .....

Parcel number	owner	area m2	Subtracted area m2	%
235	xxxx	850	200	23.5
234	xxxx	1300	320	24.6
233	xxxx	520	250	48

❖ **Data and Functions**

Title: preparation of road detailed map

Required by : statutory planning dep.

Name: .....

Description	**Data needed**	**Functions needed**
▪ Staff member receive an order to prepare a study to open or expand a road. first he needs to prepare a map show all obstacles and boundaries of land parcels.	▪ map (1:1000) ▪ Site of the parcels within the master plan. ▪ zoning of the area.	▪ spatial query to identify land parcels that are affected by road construction. ▪ attribute query to identify

		land owners. ▪ graphic overlay of the map with an aerial photo to clarify the general context. ▪ data storage, and data print.
▪ staff member wants to know the site of the road within the MP.	▪ master plan with road identified.	▪ Attribute query to identify road.
▪ staff member wants to see the intersection between the road and land properties.	▪ map contains road and land parcels	▪ Overlay of land boundaries and roads.
▪ to see quantitative indication to the amount of land subtracted for road construction.	▪ map display the specified road - parcels intersection and areas or percents of that subtraction.	▪ area measurement to calculate the areas of subtraction. ▪ storing these data in the attribute tables ▪ good

		symbolization to create high quality output. ▪ print output.
▪ to have a list of land owners	▪ attribute table	▪ attribute query to create a list of land ID no. & names of owners.
▪ propose some simple modifications on road path.	▪ map to display road modifications and effect of road shifts. ▪ the map contains all properties (lands, buildings)	▪ key board inputs to edit and symbolize.

❖ **Error types and tolerances**

Title: preparation of road detailed map

Required by : statutory planning dep.

Name: .....

Error tolerance	**Impact on benefits**	**Result of error**	**Possible occurrences**	**Type of error**
0%	Erroneous	Wrong	Street name error	Referential

	situation analysis	identification of properties		
0%	Time wasting	Mismatch land parcels with land owners	Wrong owners names	
0%	Wrong decision making	Wrong parcel areas	Unclosed polygons	Topological
0.30m	▪ waste time • increase costs • create social problems • decrease credibility	• Inaccurate amounts of subtraction. • Increased difficulties • wrong compensation amounts	• Inaccurate parcels positions/coordinates • shifts in positions	Relative
---	---	---	---	Absolute

- Sometimes data transfer might be needed to input a land survey and overplot it with the road, some land surveys might need scanning, digitizing, change scale change coordinate system ....but this is not standard case.

❖ **Frequency of use**

Title: preparation of road detailed map

Required by : statutory planning dep.

Name: .....

Function	**number**	**Frequency per year**	**Number per year**
Data input	1	15	15
Data transfer	1	4	4
spatial query	2	15	30
Attribute query	2	15	30
graphic overlay	4	15	60
Data editing and display	6	15	90
symbolizing	4	15	60
plot	2	15	30

❖ **Logical linkages**

1. In this IP (preparation of road detailed map), it is known that, land boundaries are not available as a master plan at Bidya municipality, and also no parcel numbers are available, for that no way to know needed information precisely except parcel survey overplot to the master plan. This requires relationships between maps (parcel survey and master plan) these relationships are consistency in scale and coordinate system.

21. Wait and response tolerance.

For the purposes of this IP it is useful to obtain the output of the IP during ten seconds.

22. Current cost .

The current status at Bidya municipality relating to road construction represent a kind of traditional way in land management, lack of land boundaries and ownership data are real obstacles in the face of all forms of planning and land development. It is a challenge to construct a road under the full lack of land data.

To construct or expand a road Bidya municipality tries to:

- Recognize the relevant land owners.
- In a traditional way ask them to show the boundaries of their parcels at the ground.
- Demarcate road by its staff.
- Survey the extracted parts of land and know the areas and percent of extraction.
- Negotiate with land owners about compensations and implementation of the work.

This long procedure consumes long time, specifically because of lack of data relating lands and subdivisions. the case is similar to the work in a minefield.

Municipality couldn't know in advance:

- what are the difficulties in terms of land extraction.
- what are the amounts of compensations.
- what are the probable social issues in connection with land ownership.

As a result of that, it is frequent event for municipality to start a road construction then stop working at the beginning.

23. Benefit analysis.

It is thought that the good GIS benefit is the web based GIS, which lets people to view the road track which is intended to be opened or widened, with an aerial photo as a background of the structural map with the road name shown, then, when the municipality announce for the public that the specified road will be opened within a specified period, then land owners could navigate through the map and contact the

municipality to clarify their problems if any, and then they offer a land survey for their properties to be used for calculation of land extraction and compensation amounts.

The expected benefits are:

1. Financial savings: **save expenses** which are paid at the beginning of the work and then the work stop as a result of several kinds of difficulties and problems. by letting people to view road track, they could contact the municipality and be recognized immediately. this would **save time** and enable the municipality to recognize problems at the early stages and try to solve them prior to project beginning.

It is worth mentioning that 10% of the lands in Bidya are located within area (B) according to Oslo administrative classifications *(Bidya municipality-engineering dep.)*, this is the percent of land which could be officially registered by land authority and 90% are classified as area (C) which In the current political conditions couldn't be registered, knowing that road construction is 80% needed within area (C) where the urban development is expanding, this fact supports that idea.

2. Direct benefits to agency: increase work efficiency, rapid the achievements and decrease staff work pressure, enable relatively effective project planning of road works, enable problems identification and relevant solutions.

3. External benefits: data diffusion to public supports community participation and transparency, increase credibility and prevent corruption.

3. (IP3) Demarcation of road edges

Engineer needs to plot road borders (edges) at their actual positions at ground, either upon request of a citizen or administrative order (for road construction, widening or

building up services networks such as water, electricity and sewage) upon a citizen request who intends to implement a construction activity.

❖ **Map requirements**

1. road edges and centerlines
2. road names and numbers
3. buildings and structures
4. walls
5. land use polygons.
6. master plan boundaries

❖ **Tabular data requirements**

- road name or number
- planned road width
- zone of land use in which the road is located.

Attributes associated to roads

Title: plotting a road borders **Required by** : head of organizing department (eng.) **Name**:		
district	**name**	**width**
Khallet larez	Al- salam st.	12 m

❖ Engineer also needs a list that contains information about previous similar actions

Road name: Al-Shohadaa' St. **Address: Khallet Larez**						
No.	**Action**	**Requested by**	**Objective**		**date**	**File**

						no.
1	Demarcation of road	Head of eng. dep.	Install water pipe		20/10/2010	10
2	Demarcation of road	property owner(xxx)	Build activity		15/4/2012	10
3	Demarcation of road	Head of eng. dep	Issue a bldg license		20/3/2013	105

❖ Data and Functions

Title: Demarcation of road

Required by : statutory planning dep.

Name: .....

Description	**Data needed**	**Functions needed**
▪ Staff member receive administrative order / citizen application to do the needed actions for road demarcation.	▪ map (1:500) ▪ road location within the master plan. ▪ any items which may impede the work. ▪ zoning of the area . ▪ tabular data	▪ attribute query by road name to identify the road of interest. ▪ spatial query to identify adjacent land parcels and the land owners. ▪ overplot of master plan to infrastructure networks plan to be considered during

		work. ▪ if there are elements at field which are not available at digital maps, then field survey is needed(GPS or any survey tool), then data input to GIS map is needed. ▪ overlay of the above-mentioned survey data to the master plan, with needed symbolizing made. ▪ sometimes this work may need over plot of road map to aerial photo to clarify the context. ▪ measure lengths to know the distances between road edges and other points of interest.

		▪ data display, storage and data plot.
▪ staff member wants to display data to decision makers .	▪ hard copy of the map (intersection of all data)	▪ plot process to create hard copy of any desired size.
▪ staff member wants to document this action and store it in the road attribute. ▪ make the needed archiving of the hard copy.	▪	▪

❖ Error types and tolerances

Title: plotting a road edges

Required by : head of organizing department (eng.)

Name: .....

Error tolerance	**Impact on benefits**	**Result of error**	**Possible occurrences**	**Type of error**
0%	Erroneous situation analysis	Wrong identification of road	Street name error	Referential
----	----	----	----	Topological

0.20m	▪ waste time and money. • create social problems • decrease credibility.	• Inaccurate amounts of measurements. • inaccurate position on ground. • wrong indications. • Increased difficulties/ • wrong compensation amounts	• Inaccurate road edges positions/coordinates • shifts in positions between overlaid maps.	Relative
---	---	---	---	Absolute

❖ Frequency of use

Title: demarcation of road

Required by : statutory planning dep.

Name: .....

Function	**number**	**Frequency per year**	**Number per year**
attribute query	5	25	125
Graphic overlay	4		100
measurement	12		300

Edit and display	7		175
symbolize	5		125
Plot	3		75

4. (IP4) Monitoring construction activities

In order to ensure the application of all laws, regulations and conditions related to construction processes and activities, municipality make control on such activities by its staff, through daily inspection rounds. Also, municipality imposed what is called "casting permission" to ensure that no violent element could be built up. casting permission is a document that insures the municipality approval on the building specified stage, this document is approved by head of engineering department and statutory planning department.

Engineer needs to retrieve notifications related to certain building or certain individual to make a report about notification history, also he may need the casting permission history during construction. these reports are usually needed when:

- A citizen applied to a clearance from municipality.
- There is a conflict with a violent citizen, and intend to transfer the issue to the court.

For that he needs an effective method to store and retrieve such information.

❖ **Map requirements**

7. buildings and structures
8. building numbers

9. walls
10. road edges
11. roads names
12. boundaries of master plan
13. polygons of land use

❖ **Tabular data requirements**

- building No.
- owners' name
- owner ID No
- status (licensed /unlicensed)
- notifications/warnings details
- casting permission details
- violations
- file No.

Tabular data related to building

Monitoring construction works

Required by: statutory planning engineer

Name:.....

Building	**Owners' name**	**Owners ID No.**	**status**	**Notifications Dates تواريخ الاخطارات**	**"Casting permission " dates**	**Violations**	**File No.**

ng No.							
25	xxxx	xxxx	unlicensed	1/5/2009/owner 15/5/2009/builder 1/6/2009/owner	none	On margins	50

❖ Data and functions

Title: control over the construction works

Required by : Statutory planning dep.

Name: .....

Description	**Data needed**	**Functions needed**
▪ staff member (construction inspector) wants to document any action he make relating buildings or structures to prevent violations and store it in the building or structure attributes.	▪ master plan with buildings. ▪ data and doc. of notifications	▪ adding attributes to spatial features(bldg) ▪ generating features to the map (data input), this is done when the structure is new.

1. Staff member needs a report about notifications for a building 2. or he wants to issue a clearance to a citizen.	▪ map contains buildings and all above mentioned elements scale 1:250. ▪ tabular data associated to building enhanced by documents.	▪ attribute query to identify the specified building on map. ▪ data editing and display ▪ plotting to create a hard copy. ▪ attach scanned notification documents and reports and photos.
▪ staff member wants to display data ....etc .	▪ hard copy of the map scale 1:250 (with violations if possible)	▪ plot process to create hard copy of any desired size. with a list of notification dates

❖ Error types and tolerances

Title: monitoring construction works

Required by : statutory planning dep.

Name: .....

Error tolerance	**Impact on benefits**	**Result of error**	**Possible occurrences**	**Type of error**
0%	Inability (or difficulty) to make report	Wrong identification of building	Building number error	**Referential**

---	---	---	---	**Topological**
0.20m	▪ waste time and effort. • decrease credibility.	• wrong violation identification • confusion	• Inaccurate structure position/coordinates when generating new feature to map	**Relative**
---	---	---	---	**Absolute**

❖ Frequency of use

Title: monitoring construction works

Required by : statutory planning dep.

Name: .....

Function	**number**	**Frequency per year**	**Number per year**
Data input	6	100	600
attribute query	3		300
Edit and display	7		700
Plot	2		200

5. (IP5) Overplot of certain property (spatial feature) survey to the master plan.

It is a frequent need for the engineer to make overplot between the master plan and a certain survey for certain feature such as a new-built wall in an open area which contains planned roads and other planned features which are not so far identified on ground, to take a decision concerning that wall engineer should make a report to show

the effect of that wall or structure on the future plans, to do that engineer has to make field survey of the structure and overplot that survey to the master plan.

❖ **Map requirements:** all master plan components

1. roads (existing & proposed)
2. buildings and structures
3. monuments
4. walls
5. polygons of land use
6. master plan boundaries
7. aerial photo

❖ **Attributes of the new feature**

Title: overplot a new feature survey to the master plan

Required by : statutory planning department (eng.)

Name: .....

Headings	Type	Street name/No.	Parcel No.	Owner	Owners' ID	Building date	Notification date
Typical entries	wall	Tunis	115	xxx	xxx	Jan.2.2010	Jan.3.2010
	building	45	1024	xxx	xxx	10.june.2013	10.june.2013
	addition	Al-Adle	1116	xxx	xxx	21.aug.2012	23.aug.2012

24. Text document requirements

Title: overplot a new feature survey to the master plan

Required by : statutory planning department (eng.)

Name: .....

Scanned document display

Data set name: violent structure		
Document title: violent structure documents		
No of pages per retrieved document	Typical : 5	Max. 10

Search keys (all)

Spatial : parcel number

Attribute :owner's name / ID

Data elements (required to be seen) :

4. **notifications**
5. **posts and massages**
6. **solution agreements**

Action	√	Visually observe	read only
	√	Copy whole	hard copy
	√	Copy whole	digital
Change		Copy part	hard copy
		Copy part	digital
		Add data	none
No Change Permitted	√	Delete data	none

- Data and functions

Title: overplot a new feature survey to the master plan Required by : statutory planning department (eng.) Name:		
▪ Description	▪ Data needed	▪ Functions needed
▪ staff member (eng.) should make a report to show the effect of a new-built unlicensed structure on the future plans (master plan).	▪ map contains buildings and all elements mentioned in the above map requirements.	▪ Data input of the field survey to the map. ▪ transformation or converting coordinates. ▪ generating features include points, lines and polygons. ▪ graphic over-plot of field survey on the master plan. ▪ symbolization ▪ measurement ▪ data editing and display ▪ paper plot of map to generate a hard copy.

❖ **Error types and tolerances**

Title: overlaying a field survey on the master plan

Required by : head of organizing department (eng.)

Name: .....

Error tolerance	**Impact on benefits**	**Result of error**	**Possible occurrences**	**Type of error**
5%	Waste time and reduce efficiency	False identification of feature	Wrong street name/parcel number	**Referential**
---	---	---	---	**Topological**
0.50m	▪ waste time and effort. • decrease credibility. • unfair decision making.	• wrong conclusion	• Inaccurate structure position/coordinates within the master plan.	**Relative**
0.50m	• decrease credibility.	• wrong conclusion	Displacement in features positions	**Absolute**

	• unfair decision making.	• useless data		

❖ **Frequency of use**

Title: overlaying a field survey on the master plan Required by : head of organizing department (eng.) Name:			
Function	number	Frequency per year	Number per year
Data input	5	40	200
File/Data transfer	2		80
generating features (points, lines and polygons).	4		160
graphic over-plot	2		80
symbolization	4		160
data editing and display	5		200
plot	2		80

6. (IP6) To obtain data about elevation changes of terrain

It is a necessity for infrastructure planning to have data about elevation changes either along certain line such as road, sewage line or electricity line or within general view to the entire area to select a suitable location for a water tank or sewage treatment plant. elevations and their changes all over the town are a core input for identifying the catchment area for the design of storm water infrastructure.

25. Map requirements

- digital elevation model
- roads
- monuments

26. tabular data requirements

- three dimensional coordinates (x,y,z).
- heights

❖ Data and functions

Title: To obtain data about elevation changes of terrain Required by : project planning dep. (eng.) Name:		
Description	**Data needed**	**Functions needed**
• staff member (eng.) needs information about elevation changes along road path to study and plan road construction project in terms of cost, time and other resources required.	• Map show elevations • Roads	• Generate points along the road segment. • Display heights.

7. (IP7) To obtain information about transportation network

The transportation network consists of existing roads, roundabouts, traffic signs and parking stations. however existing roads doesn't coincide with planned roads in all the cases, as well as most roads are not opened in the full width, they need widening, so it is not enough to adopt the roads as it is in the master plan but it is important to collect data about the actual status on the ground and call it existing roads.

❖ **Map requirements**

- parking complex
- road edges
- road centerlines
- roundabouts
- traffic signs
- road names and numbers

❖ **Tabular data requirements**

1. parking complex

Title: parking complex data

Required by : movement department (eng.)

Name: .....

List # 1

Headings	**Name**	**Capacity**	**Bidya-**	**Bidya-**	**Bidya-**	**Bidya-**	**Bus**	**Internal**

			Nablus	**Ramallah**	**Salfite**	**Qalqelia**		**service**
Typical entries	Bidya complex	40	20	10	6	4	4	5

2. parking complex

Headings	**Name**	**Area (m2)**	Construction date	**Cost ($)**	**Funded by**	**contractor**	**supervisor**
Typical entries	Bidya complex	2500	2010	15000	municipality	xxx	xxx

3. Road centerlines

Title: roads data

Required by : projects department (eng.)

Name: .....

List # 1

Headings	**ID**	**Number**	**Name**	**Width**	**Status**	**Services status**	**Notes**
Typical entries	1	20	Tunis	10	Bad	Yes	Full width open

4. road centerlines

Title: roads data

Required by : projects department (eng.)

Name: .....

List # 2

H	**ID**	**Number**	**Name**	**Opening date**	**Rehabilitati**	**Cost**	**Contractor**	**Donor**

eadings					**on date**	**($)**		
Typical entries	1	20	Tunis	2009	2013	60000	xxx	xxx

5. Traffic signs

Title: traffic data

Required by : movement department (eng.)

Name: .....

List # 2

Headings	**ID**	**Road Name**	**Type**
Typical entries	1	Tunis	Stop

6. Roundabouts data

Title: roundabout data

Required by : movement department (eng.)

Name: .....

List # 2

Headings	**Number**	**English Name**	**Arabic name**	**Diameter (m)**	**Construction date**	**Cost($)**	**Fund source**
Typical entries	1	Al shohada'	ميدان الشهداء	22	2012	150000	municipality

❖ **Data and functions**

Title: To obtain data about transportation network

Required by : project / movement/dep. (eng.)

Name: .....

Description	**Data needed**	**Functions needed**

• staff member needs to compare the degree of coincidence between a planned road and how it is actually constructed on ground.	• master plan. • existing road edges and centerline.	• overlay of planned roads map to the existing road edges and centerline map. • symbolization • edit and display • print
• to know the number and distribution of traffic signs (for fixed assets record update)	• traffic signs location maps. • road edges	• attribute query to identify signs and the roads at which they are set up.
• staff member needs to make a report that show the length of roads constructed during a certain year and the sums paid for road rehabilitation or construction during a certain period of time.	• existing roads map. • attributes about date and cost of construction.	• attribute query by road year of construction. • edit and display. • print
• municipality needs to spread road names and numbers for people.	• map of existing roads • aerial photo • road names and numbers (annotation)	• map navigation through web page.
• municipality needs to store and	• transportation network	• map navigation

retrieve data of parking complex and spread data for public.	map with location of parking complex	through web page with privileges to access to attributes.

8. (IP8) To obtain information about electricity network

It is essential for a municipality to store data about electricity network elements and be able to retrieve that data any time for different purposes such as: knowing the number of power lines connected to certain transformer, the kinds of loads on it, element properties such as kind and specifications, date and cost of installation and many other essential information.

The responsible eng. needs to know the most proper way and source of electricity for an applicant depending on the distribution of loads, and specifications of lines and other elements.

It is good for the eng. to know the acquisition date, date and nature of repair actions applied on an element to help in problem diagnose if happened, these data also help in budget planning through maintenance expectations depending on status of these network components.

Data about network components is required for financial purposes such as fixed assets assessment which include (kind of asset, date and cost of acquisition, quantities and specifications and general notes).

❖ **Map requirements**

1. source point
2. Transformers
3. Towers
4. switches
5. Poles
6. Cables of medium voltage (hanged)
7. Cables of medium voltage (ground)
8. Cables of low voltage
9. Distribution Panel
10. subscriber connections
11. Lighting panel
12. Light units

❖ **tabular data requirements**

Each of the above electricity element need different descriptive data as follows in the attribute tables below.

Title: transformer data

Required by : head of electricity department (eng.)

Name: .....

List # 1

Headings	**ID/ No.**	**St. name**	**type**	**Installation date**	**Acquisition cost($)**	**Installed by**	**Capacity KV**	**Maintenance actions**	**No. of feeders.**	**Donor**	**Knife key**	**Lightning rod**
Typical entries	1	Tunis	elevated/ Fuji-	1992	22,000	SATCO company	600	1999 2008	3	Pecdar	Yes	Yes
	2	Al Shohada'	Ground/ xxx Turky	2009	30,000	Municipality staff	450	-	4	Japan	Yes	No
	3	Sarta		2013	25,000		450	-	2	Gov.	No	Yes

1. **Transformers**
2. **Towers**

Title: Tower s data

Required by : head of electricity department (eng.)

Name: .....

List # 1

Headings	**ID/No.**	**Height**	**Type/ Brand**	**Insulator type**	**Installation date**	**Connection type**	**Installed by**	**Donor**	**Cost $**
Typical entries	1	10			1992	22,000	SATCO company	Pecdar	1500
	2	14			2009	30,000	Municipality staff	Japan	2000
	3	10			2013	25,000	Naserko	Gov.	1800

3. Switches

Title: switchs data

Required by : head of electricity department (eng.)

Name: .....

List # 1

Headings	**Switch No.**	**Tower No.**	**St. name**
Typical entries	1	10	Tunis
	2	14	Al shohada'

4. Poles

Title: poles s data

Required by : head of electricity department (eng.)

Name: .....

List # 1

Headings	**ID/No.**	**type**	**No. of subscribers**	**Connection type**	**Ground cable**	**Network type**	**Light unit**	**Cost $**
Typical entries	1	Iron	4		Yes		Yes	1500
	2	Wood	2		No		yes	2000

	3	ladder	3		No		No	1800

5. Medium voltage cables

Title: cables data

Required by : head of electricity department (eng.)

Name: .....

List # 1

Headings	**ID/No.**	**type**	**Cross sectional area**
Typical entries	1		4
	2		2
	3		3

6. Low voltage cables

Title: cables data

Required by : head of electricity department (eng.)

Name: ..... **List # 1**							
Headings	**ID/No.**	**type**	**Cross sectional area**	**material**	**No. of cables**	**Acquisition date**	**Acquisition cost**
Typical entries	1		4		Yes		Yes
	2		2		No		yes
	3		3		No		No

7. Distribution boards

	Title: distribution board data **Required by** : head of electricity department (eng.) **Name**: ..... **List # 1**							
Headings	**ID/No.**	**Tower No.**	**No. of feeders**	**Connection type**	**Has meter**	**Has light circuit**	**Acquisition date**	**Acquisition cost**

Typical entries	1	10	4		Yes	Yes	1998	
	2	35	2		yes	No	2003	
	3	8	3		No	No	2010	

8. light units

	Title: cables data **Required by** : head of electricity department (eng.) **Name**: ..... **List # 1**

Headings	**ID/No.**	**type**	**power**	**No. of arms**	**Panel number**	**Pole No.**	**Acquisition date**	**Acquisition cost($)**
Typical entries	1			1	1	20	Nov. 2013	120
	2			1	2	22	Nov. 2013	120
	3			2	2	24	Dec. 2013	120

The electricity service data table stores information about subscriptions in each building. The information in this table is either extracted from the billing system or edited to the system via a web based GIS application to be used by collection department.

9. Subscribers data

Title: subscribers data

Required by : electricity dep./ collection dep./ finance dep.

Name: .....

Headings	**Typical entries**
Building Number	15
Subscriber Name	xxx
Subscriber Number	1220
Meter No	1200
Meter type	prepaid
Last Reading Date	1.9.2014
Last Reading	125450
current Reading Date	5.10.2014
current Reading	125800
Consumption Amount	350
Average Consumption Amount	400
Total Debts	5000

❖ **Data and functions**

Title: to obtain information about electricity network

Required by : head of electricity department (eng.)

Name: .....

Description	**Data needed**	**Functions needed**
▪ staff member (eng.) wants to know the power **load** on a certain transformer, in order to make a decision relating a new critical electricity subscription.	▪ map contains buildings and electrical network elements (scale:1:2500) ▪ table shows details of lines and participants on the expected transformer or main line).	▪ network analysis.
▪ staff member needs to know the lengths of cables, number of poles (or any other feature) of certain type installed during a year (this is needed for fixed assets record update).	▪ map contains buildings and electrical network elements (scale:1:2500) ▪ table shows attributes of electrical features.	▪ attribute query ▪ lengths measurement / find totals

▪ to know the lengths of cables, No. of poles and towers within an area, neighborhood.	▪ Electricity network map	▪ map overlay ▪ spatial query
▪ to view the distribution of electricity lines fed by certain transformer.	Map contains transformers , network lines and buildings scale 1:2500	▪ network analysis
▪ to view the subscribed buildings fed by a certain transformer.	▪ Electricity network map ▪ Buildings ▪ Orthophoto	
▪ to view lines and subscribers affected by switch close.	▪ Electricity network map ▪ Buildings ▪ Orthophoto	▪ network analysis
▪ to have a list of subscribers fed by certain transformer or affected by switch close.	▪ subscribers (service) database. ▪	▪ network analysis or attribute query
▪ eng. needs to compare electricity network to land parcels, buildings, roads, walls... to take a certain decision.	▪ map contains buildings and electrical network elements (scale:1:2500) ▪ master plan features ▪ aerial photo.	▪ overlay of electricity network to master plan or an aerial photo. ▪ display ▪ print out as hard

		copy.

❖ **Error types and tolerances**

Title: to obtain information about electricity network

Required by : head of electricity department (eng.)

Name: .....

Type of error	**Possible occurrences**	**Result of error**	**Impact on benefits**	**Error tolerance**
Referential	Wrong element name or ID	Wrong identification of element	Wrong analysis results	1%
Topological	Breaks in network	Wrong analysis results such as longer routes than it can be or wrong electric load distribution	Wrong analysis result and then useless system	0%
Relative	• Inaccurate positions of features. • inaccuracy in	• inaccurate lengths of cables • excavation in a	• inaccurate data • waste time	0.30 m

	ground cables positions	wrong position for repairs • wrong overplot maps.	and cost	
Absolute	---	---	---	---

❖ **Frequency of use**

Title: to obtain information about electricity network

Required by : head of electricity department (eng.)

Name: .....

Function	**number**	**Frequency per year**	**Number per year**
Data input	4	150	600
attribute query	4		600
network analysis	3		450
measurement	4		600
Edit and display	6		900
Create features	6		900
symbolize	5		750
plot	3		450

27. Logical linkages

The electricity network should be built and modeled as a geometric network to facilitate analysis processes, in a geometric networks model, relationships between different network feature classes must be established perfectly by well-defining the

connectivity rules between edges (lines) and junctions (nodes) , and the direction of flow in each element should be identified in order to represent and model the behavior of the network infrastructure in the real world.

28. Wait and response tolerance.

It is noticed that different information products could be produced by the electricity network model, for the system to be efficient the accepted response time is up to 10 seconds

29. Current cost

The analysis of a 30 km long electricity network with about 2500 subscribers is extremely complex using manual methods, and impossible under the complete absence of a network map. This is the current case at Bidya municipality, it has no kind of maps available for the electricity network, neither digital nor paper maps. the staff face a great difficulty to obtain information that is 80% accurate and waste time and effort which directly affects service applicants whose transactions are postponed.

The lengths of cables, number of towers and poles are estimated roughly, no precise estimates could be extracted.

The current status has no base for decision making relating electricity issues whether technical or administrative matters, this fact bears the municipality the results of the wrong decisions.

examples of wrong decisions:

- Unsuitable selection of a new transformer location leads to inability to take the maximum benefit from the transformer in terms of number of beneficiaries which means wasting part of the power and so part of the transformer cost and may be higher installation cost as a result of longer selected rout, knowing that this is a frequent case.

- unsuitable distribution of loads might load to increase of unneeded transformers which means waste money and resources.
- inaccurate studies results because of lack of data.
- lack of tools and data needed for services planning.

Benefit analysis.

1. save costs which come from wrong decisions and make suitable allocation of resources.
2. save staff time and effort and then offer a better service quality through prompt response to citizens.
3. the use of web published GIS maps facilitate access of public to data and reduce work pressure on municipality staff and also save time and effort of public.
4. the availability of electricity network and attributes for public through a web page helps business men and investors in their project studies and selection of projects locations.

9. (IP9) To obtain information about water network

It is essential for a municipality to have data base for water network and be able to retrieve that data any time for deferent purposes such as: knowing which valves can stop water from certain segment to make repairs or checks, to know where to add valves in order to prevent water from the lowest number of citizens in case of maintenance.

Properties of lines and other elements are very important such as: type of pipe, diameter, installation date and cost, history of breakdowns and maintenance.

it is essential to keep data about participants connections on certain line, and kinds of these connections (domestic, industrial, agricultural or commercial) to help in avoiding pressure losses due to overload.

- **Map requirements**

1. tanks
2. pipes
3. valves
4. participants connections

- **Tabular data requirements**

1. Attribute data for tanks

Title: water tanks data

Required by : head of water department (eng.)

Name: .....

List #1

Heading s	**Tank ID/No**	**address**	**type**	**Construction Date**	**Capacity (m3)**	**Water pressure**	**Inlet Dia.**	**Outlet Dia.**

Typical entries	1	Al-mosarsar	Concrete elevated tank	2002	500	12 bar	10	8
	2	Al - moallaqa	Concrete elevated tank	2013	1000	12bar	10	8

Title: water tanks maintenance data

Required by : head of water department (eng.)

Name: .....

Tank # 1 - Al mosarsar

List #2

Headings	**maintenance date**	**Maintenance action**	**Cost ($)**
Typical entries	2014	Plastering and paint	20,000

	2010	Valve replacement	5000

2. Attribute data for pipes

Title: water pipes data

Required by : head of water department (eng.)

Name: .....

Headings	**Segment No.**	**Road name/No.**	**type**	**Date of installation**	**diameter**	**material**	**Tank No.**	**condition**
Typical entries	1	Tunis	main line	2002	8 "	steel	1	good
	2	Tunis	distribution line	2003	4"	steel	1	bad

Title: participant connections data

Required by : head of water department (eng.)

Name: .....

participtic	**address**	**Participant name**	**Date of installation**	**Segment No.**	**type**	**Dia.**	**Water pressure**

ipantNo.							
1561	Al-shohadaa' St.	Ahmad Salameh	1995	3	domestic	1 "	12 bar
1210	Al-shohadaa' St.	xxxx	1999	3	industrial	2"	12bar

3. Attribute data for valves

Title: water valves data

Required by : head of water department (eng.)

Name: .....

Headings	**valve**	**address**	**Diameter**	**type**	**installation**		**Manhole**	**Condition**

	No.				**Date**	**Manhole type**	**depth** m	
Typical entries	50	Salah Edden St.	4"	Gate	2002	Cast in place	2	good
	51	Assalam St.	3"	Air release	2011	precast	2	fair

Water Services Data Table

The same as electricity service, the water service data table stores information about water subscriptions in each building. The information in this table is extracted from the billing system.

4. Water subscribers data

Title: water subscribers data

Required by : electricity dep./ collection dep./ finance dep.

Name: .....

Headings	**Typical entries**
Building Number	15
Subscriber Name	xxx
Subscriber Number	1220
Meter No	1200
Meter diameter	3/4
Meter type	size

Service type	domestic
Connection diameter	3/4
Last Reading Date	1.9.2014
Last Reading	125450
current Reading Date	5.10.2014
current Reading	125800
Consumption Amount	350
Average Consumption Amount	400
Total Debts	5000

❖ Data and Functions

Title: to obtain information about water network

Required by : head of water department (eng.)

Name: .....

Description	**Data needed**	**Functions needed**
▪ staff member needs to view the distribution and length of pipes of certain diameter.	▪ Water network map ▪ pipes diameters as attributes	▪ attribute query by pipe diameter. ▪ display ▪ print
▪ staff member needs to know the distribution and length	▪ Water network map ▪ pipes diameters as attributes	▪ attribute query by pipe diameter and year of installation.

of pipes of certain dia. during a certain year.	▪ date of installation as attribute.	▪ display ▪ print
▪ staff member needs to view the distribution and number of valves of certain diameter.	▪ water network map ▪ valves diameters as an attribute.	▪ attribute query by valve diameter. ▪ display ▪ print
▪ staff member needs to make a report to show the cost of network extensions during a period of time.	▪ Water network map ▪ date of installation as attribute. ▪ cost of installation	▪ attribute query by year of installation with total cost. ▪ display ▪ print
▪ staff member needs to prepare a report about projects funded by certain donor or self-funded projects and cost.	▪ Water network map ▪ source of fund as attribute	▪ attribute query by source of fund and cost. ▪ display ▪ print
▪ staff member needs to know the number and distribution of valves within a	▪ water network map. ▪ boundaries of wanted area.	▪ spatial query ▪ display ▪ print

certain area.		
▪ staff member needs to know which valves to close to stop water from certain segment.	▪ water network map "pipes and valves".	▪ network analysis functions.
▪ to view coincidence of water network with other spatial features such as roads, sewage, electricity ..etc.	▪ water network map	▪ Overplot of water network map with other wanted layers. ▪ measure ▪ display ▪ print
▪ to update and manage data over time.	▪ network map and attributes	▪ spatial data input to new features. ▪ attribute data input associated with spatial features. ▪ symbolization ▪ add logical connectivity relationships.

❖ **Error types and tolerances**

Title: to obtain information about water network

Required by : head of water department (eng.)

Name: .....

Type of error	**Possible occurrences**	**Result of error**	**Impact on benefits**	**Error tolerance**
Referential	Wrong element name or ID	Wrong identification of element	Wrong analysis and query results	1%
Topological	▪ Breaks in network	Wrong analysis results such as wrong water flow	Wrong analysis result and then useless system	0%
Relative	• Inaccurate positions of features. • inaccuracy in pipes positions	• inaccurate lengths of pipes • excavation in a wrong position for repairs • inaccurate overplot results.	• inaccurate data • waste time and cost • wrong decisions	0.30m
Absolute	---	---	---	---

❖ **Frequency of use**

Title: to obtain information about water network Required by : head of water department (eng.) Name:			
Function	number	Frequency per year	Number per year
Data input	10	120	1200
attribute query	4		480
Spatial query	4		480
symbolization	5		600
Edit and display	6		720
generating features	6		720
network analysis	4		480
Plot/ print	3		360

❖ **Logical linkages**

The water network should be built and modeled as a geometric network to facilitate analysis processes, in a geometric networks model, relationships between different network feature classes must be established perfectly by well-defining the connectivity rules between edges (lines) and junctions (nodes) , and the direction of flow in each element should be identified in order to represent and model the behavior of the network infrastructure in the real world.

❖ **Wait and response tolerance.**

It is noticed that different information products could be produced by the electricity network model, for the system to be efficient the accepted response time is up to 10 seconds

❖ **Current cost**

Bidya municipality has a map for part of the water network stored in a Cad file format, it shows pipes and there diameters written on pipe segments, the benefits from this map is very limited because:

- The map represents part of the actual water network of about only 60% of the whole network.
- The network elements doesn't include water valves and manholes.
- The only available attributes are pipe diameters.
- Very slow and hard way of calculating pipe lengths at certain area. one needs to take out each segment length of a pipe from its properties and then add all segments lengths together to obtain the amount of pipes of a certain diameter within a certain area, with high probability of mistakes
- No consideration given to pipe positions within road width during the map build process.
- no consideration to segment connectivity, there are many random breaks occurred during the map drawing.

The water network in Bidya is about 30 km long with about 2200 subscribers. the staff face a great difficulty to obtain information, the accuracy of information is relatively low, it does not exceed 75% for some info. and 45% other info. The staff waste time and effort which directly affects service applicants whose transactions are postponed.

The lengths of pipes, number of valves are estimated roughly, no precise estimates could be extracted.

The current status has no base for decision making relating water issues whether technical or administrative matters, this fact bears the municipality the results of the wrong decisions, as a result of lack of data. here are examples:

- wrong excavation positions for repair actions, which costs the municipality large amounts of money yearly, especially that the water network is totally underground not like electricity network which is mostly seen.
- wrong excavation positions is very annoying issue for the road users.
- inaccurate reports and project studies because of lack of data.
- lack of data reflects negatively on service planning.

❖ **Benefit analysis.**

1. save costs which come from wrong excavation positions, these costs come from damage to road infrastructure and wasting staff time.
2. save staff time and effort and then offer a better service quality through prompt response to citizens.
3. the use of web published GIS maps facilitate access of public to data and reduce work pressure on municipality staff and also save time and effort of public.
4. the availability of water network and attributes for public through a web page helps business men and investors in their project studies and selection of projects locations.

10. (IP10) To obtain info. about sewage Network

Bidya municipality doesn't have complete sewage network, it has a pilot project of 1200 meter long sewage line which flows into a treatment plant, municipality tries to extend the sewage infrastructure and service, so this information product represents the basis for sewage data management.

Water department needs a system to store data about the current sewage infrastructure and add any extensions to the project, and to be able to retrieve data and store reports about lab. test results of purification degree which is applied periodically to monitor the treatment plant performance. There is no billing system for sewage service at Bidya municipality, fees are collected monthly as lump sum amount data about subscribers is important.

- ❖ Map requirements
- pipes
- manholes
- treatment plant
- pumps
- house connections
- ❖ Tabular data requirements

1. Attribute data for pipes

Title: sewage pipes data

Required by : head of water department (eng.)

Name: .....

Headings	Segment No.	diameter	Length m	type	thickness mm	Road name/No.	Date of installation	Cost $
Typical entries	1	8"	140	PVC	4.6	Tunis	2002	5600
	2	6"	120	PVC	3.8	Tunis	2003	3600

2. Attribute data for manholes

Title: sewage manholes data

Required by : head of water department (eng.)

Name: .....

Headings	manhole No.	diameter cm	depth m	No. house connections	Road name/No.	installation Date	Cost $
Typical entries	1	80	3	3	Tunis	2006	800
	2	100	2.5	0	Tunis	2006	600

3. Attribute data treatment plant

Title: sewage treatment plant data

Required by : head of water department (eng.)

Name: .....

Headings	location	capacity	No. of	Area (m2)	Construction date	cost $	contractor

			beds				
Typical entries	Abu Zen valley	25m3/day	4	2500	2006	150000	Duracom company

4. Subscribers data table

Title: sewage subscribers data

Required by : head of water department (eng.)

Name: .....

Headings	**Sub. No.**	**Sub. Name**	**Bldg. No.**	**Manhole No.**	**subscription date**	**Street name**	**Subscription Fees/month $**
Typical entries	1	xxx	10	5	2009	Tunis	10
	2	xxx	13	6	2009	Tunis	10

5. Outflow lab. tests results

Title: outflow test results data

Required by : head of water department (eng.)

Name: .....

Headings	**Test No.**	**Date**	**Deg. of purification**	**Testing agency**	**Supervisor**	**Recommendations**
Typical entries	1	Sep.2014	88%	Al Najah	xxx	Good

				lab.		
	2	Nov.2014	82%	Al Najah lab.	xxx	Good

❖ Data and Functions

Title: to obtain info. about sewage network

Required by : head of water department (eng.)

Name: .....

Description	**Data needed**	**Functions needed**
▪ staff member needs to view the distribution and length of pipes of certain diameter.	▪ sewage network map ▪ pipes diameters and lengths as attributes	▪ attribute query by pipe diameter. ▪ display ▪ print
▪ staff member needs to know the distribution and length of pipes of certain dia. during a certain year.	▪ sewage network map ▪ pipes diameters as attributes ▪ date of installation as attribute.	▪ attribute query by pipe diameter and year of installation. ▪ display ▪ print
▪ staff member needs to view the distribution and number of manholes of certain diameter.	▪ sewage network map ▪ valves diameters as an attribute.	▪ attribute query by valve diameter. ▪ display ▪ print

▪ staff member needs to make a report to show the cost of network extensions during a period of time. Always needed for budget planning.	▪ sewage network map ▪ date of installation as attribute. ▪ cost of installation	▪ attribute query by year of installation with total cost. ▪ display ▪ print
▪ staff member needs to know the length of extension during a certain year.	▪ sewage network map. ▪ attributes about date of installation.	▪ attribute query ▪ display ▪ print
▪ staff member needs to know the number of subscribers connected to certain manhole.	▪ sewage network map "pipes and manholes". ▪ Number of subscribers as attribute	▪ network analysis functions.
▪ to view coincidence of sewage network with other spatial features such as roads, sewage, electricity ..etc.	▪ water network map	▪ Overplot of water network map with other wanted layers. ▪ measure ▪ display ▪ print

▪ to update and manage data over time.	▪ sewage map and attributes	▪ spatial data input to create new features. ▪ attribute data input associated with spatial features. ▪ symbolization

❖ **Error types and tolerances**

Title: to obtain information about sewage network

Required by : head of water department (eng.)

Name: .....

Type of error	**Possible occurrences**	**Result of error**	**Impact on benefits**	**Error tolerance**
Referential	Wrong element name or ID	Wrong identification of element	inaccurate analysis and query results	1%
Topological	▪ Breaks in network	Wrong analysis results such as wrong sewage flow	Wrong analysis result and then useless system	0%
Relative	• Inaccurate positions of features. • inaccuracy in	• inaccurate lengths of lines • excavation in	• inaccurate data • waste time	0.30m

	pipes positions	a wrong position for repairs • inaccurate overplot results.	and cost • wrong decisions	
Absolute	---	---	---	---

❖ **Frequency of use**

Title: to obtain information about water network Required by : head of water department (eng.) Name:			
Function	number	Frequency per year	Number per year
Data input	10	5	50
attribute query	4	20	80
Spatial query	2	10	20
symbolization	5	5	25
Edit and display	6	10	60
Plot/ print	1	15	15

11. (IP11) Obtain information about professions and crafts licenses

Municipalities have the responsibility of crafts, professions and trades license issuance, it is important for the responsible person to make count for licenses in certain classification, such as light industries, heavy industries, agricultural firms, trades, services, crafts, professions...etc, or classification by type and environmental impact,

counts by owners (from inside the town or outside the town), count of laborers and percent workforce inside the town, he needs counts of newly issued licenses in certain period, theses counts are important for budget planning to expect revenues, and to give indications about economic status in the town, and its development and so future expectations and needs.

❖ **Map requirements**

5. roads
6. buildings
7. land use areas
8. boundaries of MP

❖ **Tabular data requirements**

- activity type
- class of the activity
- name of the owner(investor)
- investor ID No.
- building name and No.
- road name
- town/city of investor
- No. of laborers
- establishment date
- last license date
- license fees

Title: crafts license data

Required by environmental health department

Name: .....

Headings	**Activity type**	**category**	**Owners' name**	**Owners' ID**	**Bldg No.**	**Road name**	**Investor's origin**	**No. of workers**	**foundation date**	**Last year license**	**License fees (JD)**
Typical entries	Blacksmith	industrial	xxx	xxx	23	Assalam St.	Qalqilia	6	2007	2013	25
	Aluminum	commercial	xxx	xxx	7	Al-shohadaa' St.	Qarawah	5	2009	2014	0
	Carpentry	service	xxx	xx	16	Tunis St.	Bidya	30	2005	2014	25

- Attributes for crafts licenses

❖ Data and functions

Title: crafts license data Required by environmental health department Name:		
Description	Data needed	Functions needed
▪ staff member needs to know which activities haven't renewed the license for the last year, and there locations on the map.	▪ map contains roads, building ... (scale:1:1000) ▪ table shows details of data needed.	▪ attribute query by last year ▪ identifying these activities on the map ▪ display ▪ print table or map. ▪ generating features and input attributes to update data .
▪ staff member needs to know the No. the distribution of industrial workshops within a certain area to enhance a certain study and support a decision making.	▪ map contains buildings, roads, areas, classification polygons ... (scale:1:2500)	▪ spatial query by area as required. ▪ overlay of crafts layer with land use polygon ▪ display ▪ symbolization ▪ print table or map.
▪ staff member needs to know number of activities of certain class, type, foundation	▪ attributes of needed data	▪ attribute query by type, class, date, ...as needed. ▪ create list or report with

date or collected amount of fees per year....		alphanumeric outputs ▪ drawing graphs & diagrams ▪ print on paper
▪ staff member needs to prepare a report to show collected revenues earned from crafts licenses during a certain year.	▪ attributes about license fees and dates	▪ attribute query by license category and fees
▪ staff member needs information about revenues earned from certain category.	▪ attributes about fees and categories	▪ attribute query by license fees
▪ staff member (development planning officer) needs indicators about the economic activities and the town attraction to investors	▪ all attribute data mentioned in the table of attributes above.	▪ attribute query to know the increase in economic firms. ▪ attribute query to know the number of investments from outside the town. ▪ attribute query to know number of workers.
▪ urban planner wants to make a study about industrial activities transfer to a new planned industrial area	▪ data about crafts and industrial plants and their number, type and spatial distribution	▪ spatial query by category of activities. ▪ attribute query by owners.

	around the town.	
▪ staff member needs to approve clearance for a citizen, he wants to know if the citizen has a craft plant and if so he needs to ensure license issuance.	▪ attributes about owners names and IDs ▪ attributes about	▪ attribute query by citizens' ID. ▪ display last license date and fees
▪ staff member needs to know information about crafts or commercial activities in a certain building.	▪ the attribute should include a field of bldg number.	▪ attribute query by bldg No. to display a list of crafts and their attributes.
▪ staff member needs to know the number and description of plants out of the structural plan boundaries i.e. area(C)	▪ a map of the commercial activities distribution.	▪ spatial query ▪ display ▪ print

❖ **Error types and tolerances**

Title: crafts license data Required by environmental health department Name:				
Error	Impact on	Result of error	Possible occurrences	Type of error

tolerance	benefits			
2%	Waste time	▪ Wrong location identification ▪ Inaccurate statistics	▪ Erroneous building No. / road name. ▪ erroneous ID number/ name	Referential
---	---	---	---	Topological
---	---	---	---	Relative
5m	Inaccurate reports	Inaccurate spatial query results	Displacement in position	Absolute

❖ **Frequency of use**

Title: crafts license data

Required by environmental health department

Name: .....

Function	number	Frequency per year	Number per year
Data input	2	300	600
attribute query	2	10	20
Spatial query	2	10	20
symbolization	3	5	15
Edit and display	4	20	100
generating features	1	10	10
Adding attributes	6	400	2400
create list	1	10	10

drawing graphs & diagrams	1	5	5
plot	1	10	10

❖ **Logical linkages**

1. Relationship between lists of attributes of crafts and professions licenses and the building or structure geographic location is the building number, so one can know the number and type of profession by building number searching order.

2. Relationship between maps or map layers is the unified coordinate system used for all maps and themes.

3. Relationship between attributes: building number is the link which is used to obtain a list of attributes for all crafts located in a certain building.

❖ **Wait and response tolerance.**

It is noticed that different information products could be produced by the electricity network model, for the system to be efficient the accepted response time is up to 10 seconds

❖ **Current cost**

Bidya municipality doesn't have an accurate number for crafts and professions and commercial activities which are set up in the town in spite of its responsibility of that, there are some facts which helped in this:

- some plants are set up within administrative area (C) according to Oslo agreement classifications which prevent municipality from issuing licenses, and then fail to be recorded.
- heavy industries like stone crushing plants, stone quarries, marble plants, galvanization plants and many other types are not licensed and fail to be formally licensed because of its environmental impact, so it is not recorded.

- On the contrary of the above facts, the records of issued licenses contains unreal commerce licenses issued for some citizens to help them get permissions to work in areas behind the green line.

So the records of licenses don't give an accurate number of the actual plants and economic activities in the town. it is a good idea to link the professions with their location at a map regardless of the license status.

At the current status, the municipality has no software to record the issued crafts licenses, so even the available inaccurate licenses records couldn't be queried efficiently, and manually the process is very difficult and time wasting.

Benefit analysis.

1. By adopting an efficient tool like the GIS system, all reports could be prepared by the current staff, no need for employing new staff member.
2. By getting the needed reports, many valuable planning quantitative indicators could be concluded and help in making good decisions.
3. Because the economic context is a very important issue, the information which could be obtained from the GIS system might enter changes to plans and resources allocation and infrastructure planning which reflects obviously on investors and citizens.
4. Published information to the public through web pages which includes data about crafts, professions and industrial plants help investors and those who intends to establish new workshops, trades or professions to have the data required for market studies needed to complete feasibility studies.
5. The data and reports obtained from the GIS system are good base to enforce project planning process and enhance project ideas and proposals and then help in fund raising.

12. (IP12) Obtain information about municipal properties

Municipal properties of lands and buildings should be maintained in a way that show location and attributes with the ability to be accessed by interested employees of the municipality, this information are needed by projects department, statutory planning department, finance department and municipality director office.

municipality staff members needs a tool that enable them to view all municipality lands or buildings and their distribution on a map with the possibility to get any features' attributes immediately and scan any documents attached with any property.

1. Map requirements

- municipality owned land parcels
- municipality owned buildings
- municipality owned structures
- roads
- monuments
- land use polygons
- blocks
- boundaries of MP

2. Tabular data requirement

- number (ID)
- type
- note
- street
- location

- acquisition year
- acquisition cost
- area
- notes

Title: Obtain information about municipal properties

Required by: project planning dep.

Name: .....

Headings	**number**	**type**	**Street**	**location**	**Acq. year**	**Acq. cost (JD)**	**Area (m2)**	**notes**
Typical entri	1	land	Assalam St.	Khallet larez	2009	20000	1200	undeveloped
	2	building	Tunis St.	Al shofeet	2006	1500000	4800	unused
	3	structure	Al-shohada' St.	Town center	2002	-	500	Old unused pool

e s								

- **Property attributes**

3. Text document requirements

Title: Obtain information about municipal properties **Required by** : project dep. (eng.) **Name**: ..... **Scanned document display**			
Data set name: municipal properties			
Document title: municipal properties doc.			
No of pages per retrieved document		Typical : 5	Max. 10
Search keys (all) **Spatial :** parcel number **Attribute** :owner's name / ID			
Data elements (required to be seen) : **7. property deed** **8. implementation agreement (buildings)**			
Action	√	Visually observe	read only
	√	Copy whole	hard copy
	√	Copy whole	digital
Change		Copy part	hard copy
		Copy part	digital

		Add data	none
No Change Permitted	√	Delete data	none

❖ Data and functions

Title: Obtain information about municipal properties **Required by** : project dep. (eng.) **Name**:		
Description	**Data needed**	**Functions needed**
▪ staff member wants to know information about certain property. (area, acquisition cost...)	▪ map show municipal properties locations. ▪ data and doc. of property deeds ▪ attributes	▪ attribute query to identify feature ▪ identify feature attributes ▪ display ▪ print.
3. Staff member needs a list of all municipality properties and their attributes.	▪ map show municipal properties locations. ▪ data and doc. of property deeds attributes	▪ open attribute table of the properties layer. ▪ display ▪ print list

❖ Error types and tolerances

Title: Obtain information about municipal properties **Required by** : project dep. (eng.) **Name**:				
Type of	**Possible occurrences**	**Result of error**	**Impact on**	**Error**

error			benefits	toleran ce
Referen tial	Wrong ID No.	Wrong identification of feature	Waste time Incomplete benefit of system	0%
Topolog ical	----	----	----	-----
Relative	• Inaccurate boundaries positions/coordinates of the parcel • shifts in positions	• Inaccurate location within the master plan. • misleading results for the applicant. • inability to continue process.	▪ wasting time and effort ▪ getting wrong answers /no answer. ▪ social problems	(0.3)m
Absolut e	Wrong coordinates	Displacement of position	Wrong boundaries	0.50 m

❖ **Frequency of use**

Title: Obtain information about municipal properties

Required by : project dep. (eng.)

Name: .....

Function	number	Frequency per year	Number per year

attribute query	9	10	90
Edit and display	4	5	20
generating features	3	3	9
Adding attributes	6	3	18
create list	1	3	3
plot	1	10	10

13. (IP13) Information about available services

Bidya town represents a service and trade center for most of the surrounding towns and villages of about 40,000 inhabitants, who come to Bidya to receive different types of services in several areas: medical, educational, emergency services as well as banking and distinctive purchasing services, and because services are in continuous development, Bidya municipality wants to spread data about services types and distribution for public and keep it up to date.

❖ Map requirements

- roads
- road names and numbers
- landmarks
- services centers

❖ Tabular data requirements

Title: information about public services

Required by: planning/ public relations dep.

Name: .....

Headings	Number	Category	Type	Name	Bldg No.	Street	Tel. No.
Typical entries	1.	medical	Dentist	xxx	15	Al-salam St.	xxx
	2.	medical	emergency	xxx	20	Al-shohada'	xxx
	3.	Educational	Private school	Al-mostaqbal	12	Tunis St.	xxx
	4.	Cultural	Sport	Bidya club	2	Al-shohada' St.	xxx
	5.	governmental	Ministry of interior office	Ministry of interior office	5	Al-shohada' St.	xxx
	6.	governmental	Ministry of social affairs	Ministry of social affairs	18	Al-shohada'	xxx

			office	office		St.	
	7.	transportation	Taxi	Al-Baha'	25	Abu jehad St.	xxx

❖ Data and functions

Title: information about public services

Required by: planning /public relations dep.

Name: .....

Description	**Data needed**	**Functions needed**
▪ staff member needs to have information about services in terms of type and distribution to be used for urban and development planning and to enhance studies and publications.	▪ map shows services centers ▪ buildings ▪ roads and landmarks ▪ aerial photo.	▪ attribute query ▪ edit and display ▪ print.
▪ public relations need to provide the public with database about available services .	▪ map shows services centers ▪ buildings ▪ roads and landmarks ▪ aerial photo.	▪ navigate the map through a web page with access and query privileges to attributes

▪ a user needs to navigate a web map to know about available services and their locational distribution, or a new service provider wants to add data about his services	▪ map shows services centers ▪ buildings ▪ roads and landmarks ▪ aerial photo.	▪ Attribute query ▪ Navigation ▪ Edit ▪ Print

14. (IP14) Clearance issuance

Clearance is needed to be issued for every citizen who wants to receive a service from the municipality, a citizen should be clear in order for his transaction to be begun, any transaction for any citizen should be started from the public services department, so the municipal officer wants an efficient way to know all liabilities of that citizen towards the municipality and tell him if any, in order to pay any due amounts.

The potential liabilities could be:

- electricity, services subscriptions
- water services subscriptions
- sewage services subscriptions
- professions and crafts licenses
- financial penalties
- taxes
- violations in the owned properties

❖ **map requirements**

- buildings
- parcels
- profession workshops or plants.
- master plan elements (planned roads, classifications, MP. boundaries)

❖ **Tabular data requirements**

- Electricity subscribers and debits
- Water subscribers and debits
- Sewage subscribers and debits
- Property and Ownership data (for taxes and violations)
- Profession licenses data
- Building licenses data

❖ **Data and Functions**

Title: clearance Required by: public services dep. Name:		
Description	Data needed	Functions needed
▪ check electricity and water debits.	All spatial and attribute data mentioned in the electricity & water subscribers tables	▪ attribute query by owner name/ ID ▪ spatial query to identify the applicant subscriptions

		▪ edit ▪ display ▪ print
▪ check professions licenses debits	▪ all spatial and attribute data mentioned in the professions licenses IP	▪ attribute query to identify any license refers to the applicant. ▪ Spatial query to identify the location on the map. ▪ View data related to the profession if any. ▪ Attribute query to notice violations or penalties if any.
▪ Check any due taxis.	▪ Buildings ▪ Parcels ▪ Ownership data (official).	▪ attribute query to identify any property owned by the applicant. ▪ Spatial query to identify the location on the map. ▪ Display buildings data or parcel data ▪ print
▪ check any building violations	▪ Buildings ▪ Licenses data	▪ Attribute query by applicant name to identify

	▪ Violations data ▪ Master plan elements	owned buildings. ▪ Display the list violations by building numbers. ▪ Display license data and building characteristics. ▪ print
▪ check financial debits.	▪ Financial data list	▪ Attribute query by applicant name /ID in the financial data list to identify the amount of debits if any.

❖ **Freuency of use**

Title: crafts license data Required by environmental health department Name:			
Function	number	Frequency per year	Number per year
attribute query	2	3500	7000
Spatial query	2	3500	7000
symbolization	1	3500	3500
Edit and display	4	3500	14000
print	5	3500	17500

❖ **Logical linkages**

4. Building number & parcel number are the most important links that should be used in this duty in addition to citizen's name or ID.

5. Relationship between maps or map layers is the unified coordinate system used for all maps and themes with the same scale.

❖ **Wait and response tolerance.**

It should be very effective, the accepted response time is not more than 5 seconds at the max.

❖ **Current cost**

- The only available data are those related to the prepaid system of electricity. Building licenses are kept manually using paper files, and not easy to be retrieved.
- Professions licenses neither kept manually nor automated, so very difficult to be checked.
- Violations of building provisions are scattered and some are recorded using Word software, so very difficult to be retrieved.
- No system available for recording general probable violations related to incompliance to laws and provisions in the different sectors.

❖ **Benefit analysis.**

- The very efficient way of detecting liabilities on certain citizen, or on all citizens from one point by connecting with a unified database.
- This efficiency help to free the different employees to their important work, and

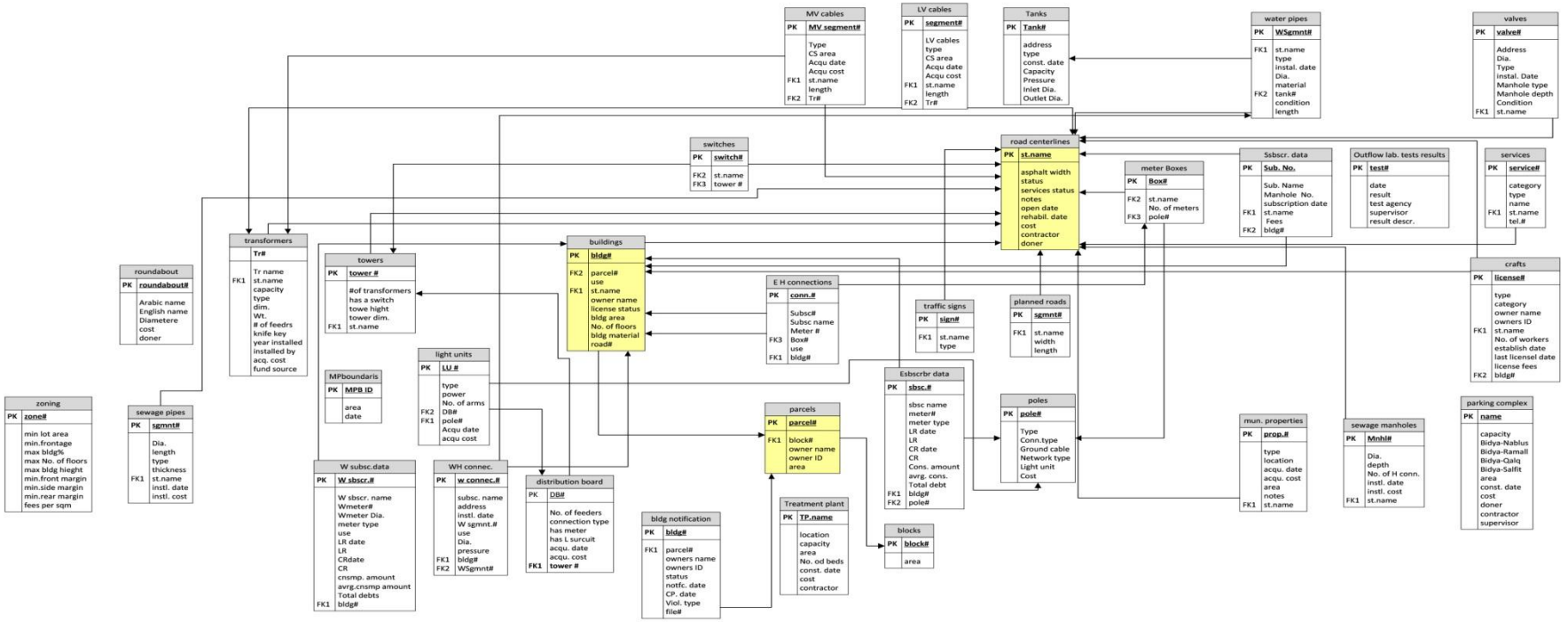
facilitates citizens' transactions instead of delaying their work perhaps with no reason.

- Revenues mobilization by activating the collection process through linking the service provision with clearance issuance.

ANNEX – C

Figure:5.1: Database Schema for Bidya Municipality

source: prepared by the researcher



جامعة النجاح الوطنية

كلية الدراسات العليا

تخطيط نظم المعلومات الجغرافية للبلديات الفلسطينية:
بلدية بديا كحالة دراسية

إعداد

سناء يوسف "محمد شريف" قاسم

إشراف

الدكتور علي عبد الحميد

الدكتور ايهاب حجازي

قدمت هذه الاطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في هندسة التخطيط الحضري والإقليمي بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس – فلسطين

2015

تخطيط نظم المعلومات الجغرافية للبلديات الفلسطينية:

بلدية بديا كحالة دراسية

اعداد

سناء يوسف "محمد شريف" قاسم

اشراف

الدكتور علي عبد الحميد

الدكتور ايهاب حجازي

الملخص

مع التزايد المستمر في عدد السكان والطلب المتزايد على الخدمات العامة والموارد، جنبا الى جنب مع التطور المتسارع في الحاسوب وانظمة المعلومات ، فان البلديات بحاجة الى ادوات ووسائل فعالة ونظام ذكي لإدارة هذه الموارد والخدمات، بحيث تتسم بقدرة كبيرة على حفظ المعلومات مع امكانية التعديل والمعالجة والاسترجاع والعرض وكذلك امكانية ربط هذه المعلومات بالمواقع الجغرافية الخاصة بها. تعتبر انظمة المعلومات الجغرافية اداة جبارة للقيام بتلك المهام، لكنها بحاجة الى امكانيات كبيرة من حيث الموارد المالية والموارد البشرية التي تتمتع بمهارات عالية في هذا المجال بالإضافة الى القدرة على الحصول على المعلومات بالدقة المطلوبة. ولان اعتماد مثل هذا النظام في البلديات سوف يستهلك جزء لا يستهان به من موازنتها فان هناك حاجة ماسة للتخطيط الجيد والدراسة المستفيضة للمشروع الملائم للتمكن من تبرير النفقات التي ستترتب على تبني هكذا نظام. ان دراسة معدة مسبقا لنظام المعلومات الجغرافي هي في غاية الاهمية لتحديد ما هو المطلوب بالضبط من النظام ان يوفره وذلك لتجنب أي جهد او تكلفة غير لازمة، وهذا بالتأكيد سيوفر في الكلفة ويزيد من الفوائد المحتملة للنظام، كما ان المعرفة المسبقة بالفوائد والتكاليف ستدعم القدرة على اتخاذ القرار بتبني هكذا نظام او عدمه.

هذه الدراسة تبحث في مدى الحاجة لأنظمة المعلومات الجغرافية في البلديات وكيف يمكن

الافادة منها في البلديات الفلسطينية وقد تم اتخاذ بلدية بديا كحالة دراسية. وللقيام بذلك فقد تم اجراء دراسة عملية معمقة ومستفيضة على سير العمل للمعاملات المختلفة التي يقوم بها طاقم البلدية في كافة الاقسام والدوائر فيما يسمى "بوصف منتجات المعلومات" والذي يشمل بشكل اساسي فهم شامل ودقيق لكافة المعلومات المكانية والوصفية والوظائف الحاسوبية التي تلزم لا نتاج كل "منتج معلومات". وبالاعتماد على وصف منتجات المعلومات الخاصة بكافة اجراءات العمل في البلدية فقد تم بناء مخطط قاعدة بيانات شامل (Database schema) للبلدية بشكل كامل بحيث يشمل كافة الاقسام والادارات مع التكامل والدمج مع انظمة المعلومات المتوفرة حاليا لدى البلدية، ويعتبر مخطط قاعدة البيانات هذا هو اهم نتائج هذه الدراسة . خلال اجراء هذه الدراسة التطبيقية فقد تم اكتشاف بعض المحددات لاعتماد انظمة المعلومات الجغرافية في بلدية بديا، لذلك فقد تم اقتراح خطة عمل مرحلية وجدول زمني للتغلب على تلك الصعوبات والمحددات والتوافق مع خطط البلدية ومواردها المالية.

ان الاستنتاج الرئيسي الذي يمكن التوصل اليه من هذه الدراسة هو التأكيد على ضرورة التخطيط لاي مشروع GIS بشكل مستقل لدراسة الخصوصية التي تتمتع بها أي مؤسسة واخذها بعين الاعتبار مع التأكيد على ان انظمة المعلومات الجغرافية مشروع لا يمكن توريده وتشغيله بشكل اعتباطي.

وبناء على نتائج هذه الدراسة يوصى بإجراء دراسة تشخيصية شاملة لواقع البلديات الفلسطينية كافة وذلك للتعرف على مدى جاهزية البلديات لتبني واعتماد انظمة المعلومات الجغرافية وفقا لمعايير معدة مسبقا، وذلك كمقدمة او اساس لإيجاد السبل اللازمة للتغلب على المعيقات والمحددات التي تعترض تبني مثل هذه الانظمة من خلال خطة استراتيجية وطنية.