Major obstacles preventing governmental organizations in Abu Dhabi from implementing GIS

العقبات الاساسية التي تمنع الؤسسات الحكومية في ابوظبي من تطبيق نظم المعلومات الجغرافية

By

Student Name Amran Sulaiman Almenhali

Student ID number 70067

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Faculty of Engineering & Information Technology

Dissertation Supervisor
Professor Khaled Shalaan

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Chapter 1:- Introduction

1.1 Overview

Geographic Information Systems (GIS) have become very popular due to their versatile applications and there is hardly any industry that do not benefit from their implementations. Applications of GIS have spread widely in the last decade, despite the fact that some people who are using this technology may not even be aware of that. This case is true for Google Earth users who may not know the technology and the way it works, but find it indispensable. In the age of information many people and business are looking for ways to do things more effectively and efficiently and looking for the technologies that can help like the GIS technology.

Advancement in technologies like Global Positioning Systems, electronics and software contributed to the wide spread of GIS. For example the advanced in electronics made it possible for people to have Global Positioning Systems in their mobile phones while the advancement in software made GIS programs more user friendly and Google software products like Google earth and map are good example of that. The importance of GIS has also been recognized by governments, which find it very useful in many areas like defense, security, environment and land management. Governmental organizations in Abu Dhabi, which are the topic of this study, have two different stands with respect to GIS. Some of them were among the first adopters of the technology while other resisted the technology and this category is the focus of this study.

The government of Abu Dhabi is aware of the advantages of GIS and therefore we saw many initiatives in the past to push for this technology like the formation of Spatial Data Infrastructure directory, which operates under Abu Dhabi Systems and Information Center

(ADSIC). This center, which receives grate support from Abu Dhabi Executive Council and in particular from His Excellency Mohammed Ahmed Al-Bawardi the Secretary-General of the Executive Council is leading many initiatives to promote GIS and location related projects. The government of Abu Dhabi support for GIS stems from its recognition of the importance of that technology and the role that this technology is expected to play in different fields. Abu Dhabi government aims to copy developed countries, which started to reap the benefits of early GIS implementations in many areas. However, Abu Dhabi government understand that true implementation of GIS should happen in many organizations for true value of GIS to be attained. To achieve this, the government of Abu Dhabi, which is represented by the executive council, gave ADSIC unlimited support to encourage the adoption of GIS among governmental organizations in Abu Dhabi and that effort was rewarded when ADSIC received "Make A Difference Award" in July 2010 in California in ESRI International user conference, the biggest GIS gathering in the world. Despite the international recognition that the government of Abu Dhabi attained it didn't stop its quest to spread GIS especially among governmental organizations.

Although the majority of governmental organizations in Abu Dhabi do have GIS, many organizations didn't move to GIS for several reasons that we will try to identify in this study. These reasons vary from one organization to another, but the effect of this on the GIS future of the emirate is one and it is negative. GIS technology is built on information shearing and if the needed information is not provided in the right time and the right format the GIS technology want be able to deliver what is expected from it and that weakens the GIS implementation in the whole emirate. Therefore the government of Abu Dhabi and ADSIC started to encourage all the non-GIS governmental organizations to adopt GIS even if that

meant that ADSIC will shear some of the cost and will provide expertise. However, that didn't seem to solve the problem as many governmental organizations in Abu Dhabi still don't have GIS and there are no indication that they intend to have GIS in the near future.

Obstacles that prevent governmental organizations in Abu Dhabi from implementing GIS vary dramatically, but since a GIS is a type of Information Systems it is very likely that it will face the kind of obstacles that typical ISs face. For example, employees may see GIS as a form of change that they don't understand and is not necessarily good for them or the organization they work in and therefore they may resist it in favour of the current systems.

Another impediment would be the additional cost that the organizations intend to implement GIS would have to bear, especially those organizations that have limited budgets. The financial obstacle is expected to have the most significant effect, because if the financial resources are available other obstacles can be overcome or at least minimized. For example if GIS could not be implemented due to the lack of qualified people then the financial resources could be used to recruit qualified staff.

Another impediment to GIS that is expected to hamper GIS implementation is organizational culture. Many studies in the past showed that the majority of IT initiatives fail because of people related issues not technical issues. Besides people and culture, communication tend to play a major role in GIS adoption, because without proper communication whether it is between employees or employees and top management GIS want make it to the implementation stage. GIS data is very critical element in GIS implementation and therefore it is expected that data issues like availability, quality and cost could affect GIS implementation.

1.2 The aim of the dissertation

The main purpose of this study is to identify the major implementations obstacles that prevent some governmental organizations in the emirate of Abu Dhabi from implementing Geographical Information Systems (GIS) and to come up with solutions that can eliminate the effect of these impediments or minimize it.

The results obtained at this study can be used by Abu Dhabi Executive Council or ADSIC to improve the GIS capabilities of the emirate by increasing the number of GIS organizations. Many organizations in the emirate are not tapping into their potential GIS capabilities and that deprive the government of Abu Dhabi from lots of the benefits. The study has a list of the obstacles as well as a list of recommendations that can be used to overcome these obstacles.

1.3 Research questions

The government of Abu Dhabi has made a great progress in the GIS field in the past view years and is planning to do more**,** but that task is getting harder year after year. One of the problems that make it very hard for the emirate to achieve its ambition goals is the failure of some of the governmental organizations to make the transition from Computer Aided Design or other legacy systems **to** GIS. This study looks at the major implantation obstacles and tries to come up with recommendations to overcome them. This study tries to identify as many GIS implantation obstacles as possible and finds which of them plays an important role in preventing GIS implementation in governmental organizations in Abu Dhabi.

In order to answer the research question the study looked at the technical as well as the non-technical obstacles to GIS implementation. For example technical issues like hardware, software, cost and data was covered. As for non-technical obstacles, the study covered people role and culture types effect on GIS adoption. To fully answer the research question, the study looked at three sub-questions whose combined answers can address the research question. These questions are

1- What are Information Systems implementation obstacles in generals and GIS implementation obstacles in specific?
2- How would the identified GIS implementation obstacles affect GIS implementation?
3- What can be done to eliminate or minimized the affect of these obstacles?

Chapter 2:- Literature review

2.1 Background

This literature review focuses mainly on implementation impediments to Geographical Information Systems (GISs). It looks at the main obstacles; both the human and the non-human ones. The literature includes a small introduction to GIS and its main components to create a context that enable the reader to understand the implications that prevents GIS implementation. The materials in this chapter are collected from studies and cases of GIS implementations from different part of the world during different periods, in order to identify as many GIS implementation obstacles as possible and check if they are applicable to this case.

A Geographic Information System or GIS in short is an information system that consists of people, process, data, hardware and software and it is used to store, manipulate and retrieve spatial data (Brakel and Pienaar,1993) see Figure (2.1). Some studies show that the use of geographic information could be traced back to thousands of years, to some civilizations like the Mesopotamia and the ancient Egyptians (Brakel and Pienaar,1993), which used it to identify important locations like hunting areas for instance. The first real GIS, however, was “Canada Geographic Information System” (CGIS), which was built in the sixties by Roger Tomlinson the father of the GIS, as he is called by a large number of the GIS community. The purpose of the CGIS was to assist the Canadian government in land management and resource monitoring on its vast land. In 1985 Tomlinson (1985) believed that there were probably more than 1000 GIS in North America and soon UK and other European countries started to have their own GISs.

This literature review is part of a thesis that looks at GIS adoption in governmental organizations in the Emirate of Abu Dhabi, one of the Emirates of the United Arab Emirates. obstacles to GIS implementation that are collected in this study will be tested to check if they

are applicable to Abu Dhabi governmental organizations and to see if there are other obstacles that are unique of Abu Dhabi

GIS components Figure (2.11)

2.2 GIS implementation

Implementing an Information System (IS) is a complicated process and if that IS happens to have a geographical element, as it is the case with GISs then it becomes even more complicated. Besides that, what makes GIS seems like a complicated field is the fact that it is highly interlinked with other disciplines like geodesy, surveying, photogrammetry, Global Positioning Systems (GPS), cartography and remote sensing. As for the GIS data, it is a field by itself and data capturing and maintaining is a tremendous task that is crucial for GIS success. Having systematic ways to address data issues like data accuracy (Positional and attributes accuracy) and compatibility (projection and coordinate system) sets a good foundation for GIS implementation.

2.3 GIS benefits

Since a Geographic Information Systems, as the name implies, are basically information systems that consider geographic location, they are able to offer all the benefits that typical ISs offer plus others that could only be obtained by processing geospatial data. Like the more common ISs, GISs can improve business process in many ways and help organizations to achieve their goals by fastening business process and improve their output. This in turn will produce soft and hard benefits as Brown (1994) put it. The hard benefits are the direct ones that could be easily measured because they are quantifiable, while the soft ones are the indirect ones that could not be captured not to mention being measured and analyzed. The difficulties of measuring the soft benefits like the improved customer service, management control and competitive advantage (Browen,1994) makes it challenging for GIS's project champions to justify the cost for GIS projects for the top management, especially in organizations that relays heavily on hard benefits and cost comparison before reaching decisions.

However, a typical GIS enjoys advantages over non-geographic ISs like storing GIS data in a database called Geo-database or GDB. Many organizations with an enterprise GIS use advanced Relational Data-Base Management System (RDBMS) software like Microsoft SQL Server or Oracle, which offers stability and scalability sought by these organizations. These RDBMS with the help of other GIS software can store spatial data, imageries, attribute data and relationships. Organization with simpler needs settle for common GIS format like shape files and Microsoft Access RDBMS to manage their less complex spatial data. GIS also made spatial process easier. For example data integration (Deane, 1993) had become easier see figure (2.2) (Deane, 1993) . The figure shows that data from different sources like aerial

photography, ground survey and existing paper maps could be integrated providing that they have been digitized and the have they same coordinate system. These advantages of GIS plus others made GIS popular in areas like emergency planning, management of urban areas, land use planning and utilities (Deane, 1993) made GIS an indispensable tool for private and governmental organizations alike.

Many organizations especially those that need location related information would find these capabilities of GIS very useful. Organizations interested in GIS could be seen in the private sector, public sector, military, civilian, environment, utilities as well as many other fields. It is the capabilities of GISs that is behind the wide spread of such information systems.

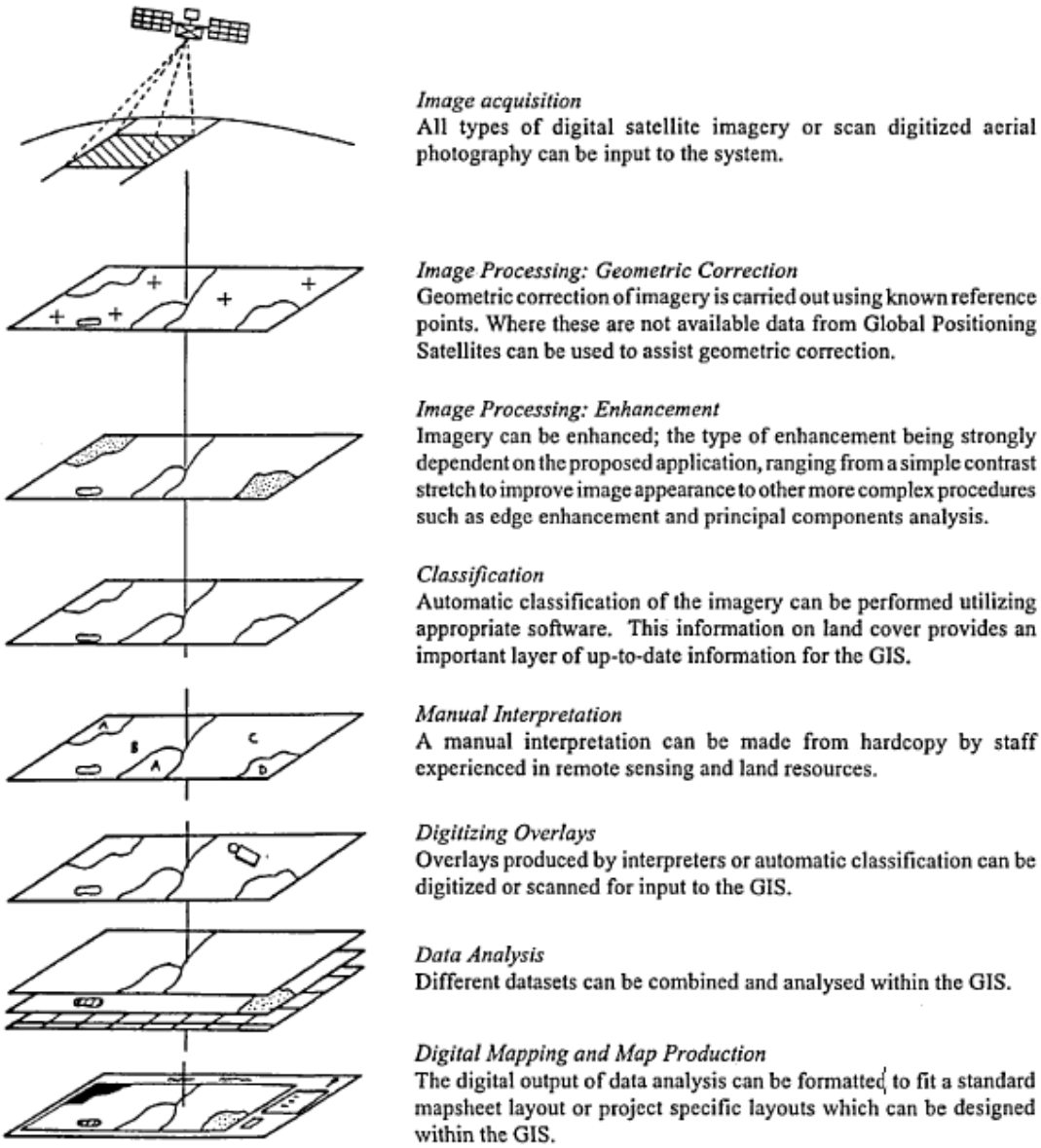


Figure (2.2) example data integration

Data is one of the most critical components of any GIS and it determines the success or failure of a GIS. The usefulness of a GIS is as good as the data it uses (Aronoff,1989), so if the needed data is available and it is of a good quality then it would be very likely that the GIS that use it would deliver useful results. GISs facilitate data integration process for

organizations and links desperate databases that have never been linked before (Gillespie,2000), showing in the process benefits that would not been dreamed of without GIS. Linking different data could be done at attribute level or it could be done by showing them in a seamless layer and in both scenarios interesting pattern and results could be discovered.

Having all the spatial data in one centralized location in a central database or having federated database, which what GISs requires, eliminate data duplicity and all the disadvantage that comes with it like duplication of effort, duplication of money and data inconsistency. In order to have such model GISs are usually structured in a way that facilitates data dissemination as well as data manipulation and retrieval. According to Mark (2000) GISs are ideal tools to facilitate data integration and sharing, providing that a suitable integration method is applied.

GISs are very efficient when it comes to handling spatial data and that can be obvious when comparing the time and the quality of work resulting from GIS handling of a task with that of a non GIS system. For example, calculating cut and fill quantities can be done using Planimetrics maps, but GIS can be more efficient at doing so by utilizing Digital Elevation model (DTM), which produces accurate quick results. The real efficiency of GIS, however, can be seen when multiple divisions of an organization use a GIS in different fields and sometimes multiple organizations share GIS data and services by utilizing open standards like ones promoted by Open Geospatial Consortium (OGC).

Once the data collected from different departments or organizations put together and an

effective GISs is established, organizations can then harness the analytical capabilities of GISs. There is no doubt that analytical capabilities are one of the most popular benefits of GIS. These analytical capabilities, thought come at high cost (Gillespie,2000), make GIS stand out among ISs and makes them indispensable in some fields like decision support systems. Analytical capability makes it very hard for any industry to function properly without taking advantage of GIS either in a direct or an indirect way. Some of the common GIS analytical capabilities are:

1- Overlay analysis: This kind of analysis is simple in terms of computational power especially if the used data layers conform to the same projected coordinate system. In this case displaying different layers can reveal interesting findings. For example displaying the roads layer and accidents location might allow traffic department peoples to discover a pattern that will help them to reduce accidents in the future. The cost of such analysis tools is low according to Gillespie (2000) and only become expensive when the number of layers is high.

2- Network analysis: Could be used to select the best route to be taken by emergency cars to reach a location of an accident to save lives.

3- Digital Terrain Model (DTM): Can be used for identifying flood plains or developing 3D models for built up or non-built up areas.

4- Proximity analysis: could be used in land developments. For example it can assist in selecting land to be used to build a factory. Some parameters that the GIS will consider in this case would be the distance to the nearest airport or sea port.

5- Buffer analysis: this kind of analysis is used some time to locate area that within vicinity of dangerous areas. For example it can be used to find populated areas that are near rivers and could be affected if the river is flooded.

6- View shed analysis: used in different fields that relays on line of sight like finding suitable location to erect a telecommunication towers that needs clear line of sight between it and the area it needs to cover.
7- Impact analysis: usually used to show the impact that a disaster would make or a manmade construction projects like dams or high ways (Gillespie, 2000) would make on the environments.

Despite all the benefits that GIS have may organizations don't have one and may not plan to have, because of many reasons that we will examine in this literature review. The reason behind the rejection of the GIS technology can occur because of many reasons some of them are human related while other are non-human related or technical reasons.

2.4 Main Implementation obstacles

2.4.1 People

There are many obstacles that can prevent organizations from implementing GIS or any other Information system. Among these obstacles people seem to be one of the most popular obstacles. There are two categories of people, who may hamper the adoption of GIS in organizations and they are the management staff and the end users.

Management staffs are fewer in numbers when compared to end users, but their affect in company decisions is greater. Since GIS implementation usually involves high cost, it is very often the management staff's decision that determines whether it could be implemented or not (Sieber, 2000). The support of management staff, especially the top management is critical to GIS implementation not only in the initiation stage, but also in the implementation stage. In fact (Grimshaw and kemp, 1989) put it in the top of the list (See figure 2.3). The reason why

implementation failure is mentioned her as an impediment for GIS implementation is because some organizations don't have GIS not because they don't think they need one, but because they tried to have one in the past, but failed in the implementation so they decide to go without one.

Priority	Factor
1	Commitment from top management
2	Continuing support for users
2	Highly reliable systems
4	Involvement of users
5	Easy to use systems
6	Effective project management
7	Clear cost justification
7	Well proven systems
7	Full training
10	Precisely defined objectives
11	Facilities to meet specific needs
11	Use of pilots or prototypes
13	Organisational change

Figure (2.3) Grimshaw and kemp list

Top management decision is affected, as we will see by human and non-human factors. These factors work together to form the management perception of the GIS initiative and its feasibility.

End users are the people who use the technology and their influence on technology adoption varies from one organization to another. Systems implementation obstacles that are related to people are more than those that are related to technology (Anumba et al., 2006). Some organizations involve end users in the decision making process, especially those decision that directly affect them and that is something that helps in initiatives success (Grimshaw, 1994) (Hellman, 1992). While others make decisions without paying grate attentions to their opinions and that is a major reason behind many technology initiatives' failures. Such

marginzation to end users lead to problems like mismatching between system functionalities and user expectations as well as poor user interface (Anumba, 1998). This kind of outcomes force employee to ignore the new system and use the old, a situation that may force the management to drop the new system in favour of the old one, despite the fact that the new one outperforms the old one technically.

The real influence of the end users can be seen when their opinions is appreciated by the top management. User involvement is known to be one of the most success factor in any initiatives (Amoako-Gyampah,2004) and that is way top management tend to consult user when they intend to impark in any initiatives especially those that directly affect end users. For example, they can give the top management positive or negative messages about the GIS and its suitability for the organization depending on their believes or personal interests. End users can be classified to three categorize in terms of their stand on GIS implementation; pro GIS implementation, against GIS implementation and biased.

The end users who support GIS implementation usually do so because of many reasons such as their knowledge of its capability and their frustration of the way work is conducted using the non-geographical Information system. The majority of this category is made up of young employee who used GIS as part of their education and found it applicable to their work environment, providing that they can convince the management.

The categories of the end users that oppose GIS implementation usually consists of the older generation workers who are used to the older system, which is usually a Computer Aided Design (CAD) system. (Amoako-Gyampah,2004) believes that some employee especially

those who have long experience with the legacy system become intimately familiar with it and oppose any new system, because they think it want be able to fully replace the old system. Having some employees with such mentality will send messages to the management that there is no need to adopt new systems or technologies, and if the leaders of such organization are not aware of the GIS technology they will keep the status quo. Besides that employee with more experience with the old system thinks that having new system means that they have to learn new skills and that some of their skills and knowledge gained over long years might be irrelevant once the old system was replaced. They resist the new system to retain the power of knowledge that they have gained from the old system and therefore they will do their best to keep the old system.

2.4.2 Culture

Organisational culture is the common stable beliefs, attitudes and values within the organisation (Williams et al., 1993). Goldhaber (1990) defines organizational culture as the informal beliefs and values of an organizational that shape the attitudes and practices of its units. Organizational culture can undermine change efforts, resource management efficiency and too a great degree cause organizations to lose their competitive edge (Rose, 2008) and since GIS implementation comes usually as a form of change by suggesting different ways to deal with spatial data shearing and analysis, it ends up sometimes facing cultural obstacles. For example top management, which is one of the key factors in GIS successful implementation, may not approve of GIS project in cultures where change is not encouraged and where there is low tolerance of uncertainty. Also an organization that doesn't promote cooperation and shearing of resources between departments would make it difficult for GIS projects which require significant financial resources, great deal of cooperation and lots of

knowledge and data shearing to succeed. Mitchell (1993) found that cooperation between different departments in an organization is needed to justify the investment in a GIS, because a single department need may not be enough to justify such an investment. Therefore organizations that favour collectivism over individualism are more likely to implement and succeed in adopting initiatives that requires high degree of collaboration (Rose, 2008).

Hofstede (1980) believes that organizational cultures could be described in terms of individualism / collectivism, power distance, uncertainty avoidance, and masculinity / feminity. Organizations that are comfortable with some degree of uncertainty that accompanies the adoption of new ideas are more likely to implement GIS, because GIS create some kind of instability at the adoption stage (Gillespie, 2000), a side effect that not all organizations are willing to accept. A culture that encourage flexibility is essential for effective GIS implementation, because implementing new technology requires addressing old process and that can be done with relative ease in organizations where flexibility is encouraged (Markus,1983). Therefore it is clear that culture of an organization can affect acceptance to new technology, because technology and culture are inter-twined (Davies et al., 2003).

Croswell (1991) and Sieber (2002) believed that the effect of organizational culture can be more significant than the importance of the technical factors on GIS adoption. This point of view is also shared by Somers (2001), who also believes that besides organizational culture, understanding of organizational policy is needed to gain support for the GIS initiative at the initiation stage and later on at the implementation stage. Croswell (1991) listed organizational culture as well as the lack of understanding of GIS, and unpreparedness as major impediment to GIS implementation. This importance of organizational culture made it part of most

strategic studies concerning GIS implementation (Anumba et al., 2006).

2.4.3 Communication

Communication could be seen as an implementation impediment of GIS. For example, when an employee has a case for implementing GIS, but he or she can't present it properly to the management either due to the bureaucracy or any other reasons then the management may not approve of the proposed Geographic Information System. This kind of communication issue might not be faced when implementing more common IS like Enterprise Resource Planning ERP (Amoako-Gyampah, 2004) as the benefits of such systems are well known. It is not only bottom up communication that might that might prevents GIS implementation, but top down communication can lead the same results. Al-Mashari and Zairi (2000) thinks that some time when the management is convinced of the benefits of GIS it might overlook the need to explain them to the end users. This can cause employees to think that having a GIS might lead to reduction in the number of needed employees and therefore cause resistance that could lead eventually to the initiative abandonment. Furthermore, this resistance could take the form of giving unaccurate feedback when asked for opinion or lobbying other employees to resist the GIS.

2.4.4 Cost

Cost is known to be one of the major impediments to IT projects in general not to mention the complex ones like GISs that are very often expensive and require top management approvals to be implemented. Like benefits, cost associated with GIS implementation could be divided into two main categories direct and indirect cost (Giaglis et al., 1999). The direct cost is the cost that could be measured easily and it is usually determined at the beginning of the project or even before the project start as part of the feasibility study. The indirect cost on the other hand is the cost that could not be measured easily nor it can be estimated at the beginning of the project, because usually it is the cost that result from an unticipated project issues that are faced during implementation like change resistance. Organizations usually do their best to make accurate assumptions about both types of cost, but it not only the high cost that make them reluctant about implementing GIS as much as it is the expected benefits that are hard to identify or measure (Ballantine et al., 1994) and (Salmela and Turunen,2003). Some organizations do their feasibility study based on phased approach by witch the legacy system and the GIS system would be maintained for a certain period of time and this expensive approach (Salmela and Turunen,2003) can create a cost impediment to GISs. Since GIS is complex and compromise of many parts, the cost impediment can come from several areas as we will see.

Establishing a GIS requires a large investment in software and web applications. The size of the needed system determines its cost. For example, a small organization may have a very cheap GIS that is comprised of one desktop with a free GIS desktop application, something like Google earth for instance. However, others may have very sophisticated GIS solutions that are made off tens of servers and hundreds of desktops. Such architecture usually

requires many software licences. These licences will be needed for the Operating Systems (OS) like linux which offers stability and scalability unmatched by windows OSs. Also some licences will be needed for Relational Database Management Systems (RDBMS), which are essential component of GISs. Since most major GIS software vendors don't make their software for specific industries, buyers with specific needs usually need to buy software extensions that works on top of their major GIS software to support their specific needs, adding to the overall cost of acquiring a GIS. Another cost that is associated with software cost is the cost of software maintenance which is usually about 15% or 20% of software cost.

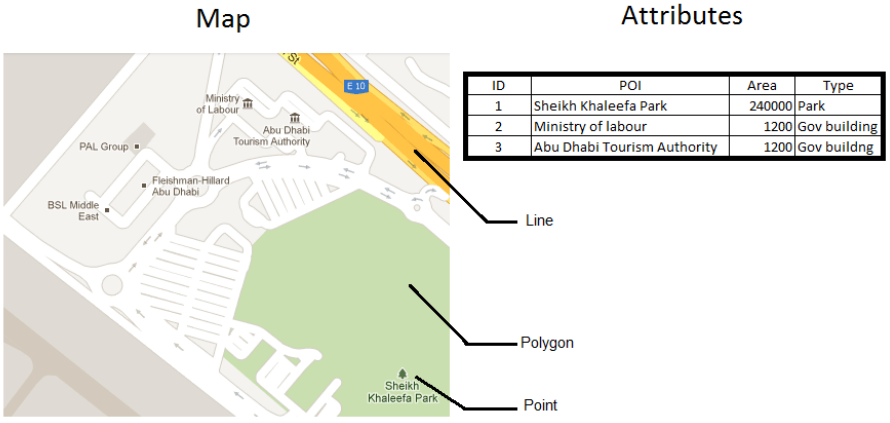
Most organizations nowadays use Commercial of the Shelf (COTS) software products (Somers, 2001) especially the ones developed by the leading software vendor Environmental Systems Research Institute (ESRI) (Raber and Cannistra, 2005). However, some organizations that have large number of users tend to develop their own web application to provide GIS services to their users, because once the development of the web application is completed it become quicker to deploy to client desktop than the typical GIS desktop applications, doesn't require powerful workstation and it could be easily customised to meet users' needs (Somers,2001). The development of web applications can easily reach a six digit number, a cost that not many organizations are willing to pay. One contributing factor to the high cost associated with web applications developments is the relatively low number of skilled software programmers who can perform the needed customization (Salmela and Turunen, 2003). Besides that, Gillespi (2000) found that a slight increase in the analysis capability of a GIS, that usually requested by users, cause dramatic increase in the development cost.

Hardware is one of the five main components of any GIS (Brakel and Pienaar,1993), which can be seen in figuer (2.1). It is usually selected to support the needed software and enable it to perform the desired functionalities in an efficient way. Azad (1993) and Rogers (1995) put hardware and software selection and installation as one of the first critical tasks of GISs implementation, while Somers (2001) believes that software and hardware acquisition comes as the forth step in five steps in his quick guide to GIS implementation. Since GISs are complex Information Systems that need to perform advance analysis, it is critical to have hardware with sufficient capabilities to support the computational power required by the GIS software. Ideally servers and Personal Computers used in GIS needs to have faster processors that support 64bit OS, bigger RAMs to enable GISs to do the analysis more efficiently, dedicated graphic cards to handle the graphics and bigger storage spaces to hold maps and images. Therefore it comes as no surprise when the hardware selection is determined by GIS desired functionalities (Somers, 2001). In other words the level of complexity of the analysis, security, availability and the backup mechanism dictate the type as well as the hardware architecture needed to support the system.

Hardware cost can be divided into three categories; acquisition, upgrade and maintenance (Somers, 2001). Hardware in GIS refers to all the physical components of the system like Servers, PCs, storage devices, backup solution. Uninterrupted Power Supply (UPS), hand held location devices and elements and network. Although the cost associated with hardware and software combined is estimated to be around 15% of the GIS implementation cost (Sieber,2002), this cost can easily reach hundreds of thousands in big GIS projects making organization think seriously before implanting GIS.

Training is one of the major cost areas just like hardware, application development and standardization (Gillespie,2000), (Amoako-Gyampah,2004) and (Crompvoets et al.,2007). Since GIS implementation is not only the acquisition and installation of hardware and software but it also include some non-technical aspects like resource management top management support, adequate staffing and training, organizations have to pay attention to these areas (Crompvoets et al.,2007). The cost of training new Information systems is high and GISs are not an exception. For example the ratio of software development cost to training for new IS can range from 1:3-10 (Cooke, 1997).

There are mainly two types of GIS data (Brakel and Pienaar, 1993); spatial and attribute data. Spatial data is divided into two types. Raster and vector. According to environmental systems research institute (ESRI) raster defines space as an array of equally sized cells arranged in rows and columns, and composed of single or multiple bands. While vector data represents geographic features as points, lines, and polygons. Each point feature is represented as a single coordinate pair, while line and polygon features are represented as ordered lists of vertices. A typical GIS system would usually have the two types of data, because of the advantages every type offers.



ID	POI	Area	Type
1	Sheikh Khaleefa Park	240000	Park
2	Ministry of labour	1200	Gov building
3	Abu Dhabi Tourism Authority	1200	Gov buildng

Figure (2.4) vector data

Raster data usually take the form of satellite imagery, orthophoto and scanned maps. Vector data on the other hand, is the digital representation of maps using points, lines and polygons (see figure 2.4). It is usually produced by digitizing rater data and they are faster to use and essential for advanced analysis and beside that they don't require large storage like the raster data. The other type of data is the attribute data, which the descriptive data that usually comes with the vector data. Attribute data is determined by the data model and they are the vector data's grate advantage. They are most difficult data to acquire, because they require intensive man power and might be collected from different sources. They also determine the kind of applications that could use the data and the type off analysis to be applied on the data.

Figure (2.5) vector and raster data

GISs are well known for their ability to combine spatial data from different sources (Brakel and Pienaar,1993). The role of GISs accede the mere storage and displaying of data to performing complex analysis and generating additional information known as datasets. However, for the GIS to be effective in the data sharing process it requires that the provided data should be organized in a way that makes it possible to be retrieved and used easily. The data must also be managed carefully so that only people who have the right access would be

able to change the data. Mitchell (1993) believes that GIS efficiency in handling spatial data from different sources will not only makes it easy to reveal data duplicity but it will also make some tasks like data retrieval and map production quicker and cheaper.

GIS data can be obtained from different sources like satellite imagery, surveying, existing paper maps (Dean,1993) and orthophoto. The way the data is obtained determines some of its characteristics like resolutions and accuracy, which in turns dictates the way it can be utilized. For example organizations that need high resolution orthophoto imagery, 20cm or 10 cm, to produce accurate base-maps after the digitization process would find satellite imagery, 1m or 0.5m, impractical for the same purpose. Organizations in need of GIS data consider many factors besides applications requirements, these factors could be related to cost, time or ease of use among others.

Despite the fact that technology made using GIS data easier, not all users find some technological products user friendly (Gillespie,2000). Applications such as RDBMSs, which are the applications that are responsible for storing, accessing and organizing spatial data, might only be used by few people in the organizations that implement or intend to implement GIS technology. Although, most RDBMS have the same basic commands, they have different interfaces making it essential for end users, who need to switch from one RDBMS to another to have some training sessions to become familiar with the new one. Making end users using the system without providing them with the proper training insures that the system want be used efficiently. Worst, the system could be used wrongly and thus producing wrong result causing distrust and decline in the number of the users and eventually abandonment of the system all together. Gillespie (2000), argues that system usability greatly influenced by Human Computer Interaction (HCI), Interface design and training. This means that even if the

needed GIS data is available and it is of good quality, organizations might not be able to realize its benefits if the software that provide access to it or the system that host it was poorly designed.

Organizations who intend to implement GIS knows that for a GIS to succeed they need to have large base of users, who usually need to have variety of data to meet there different needs (Greenwald,2000). Since acquiring a large amount of data is of high cost, sharing among entities appears to be the logical solution. However, implementation of such solutions might not be an easy task and that can be attributed to many factors. Data sharing among organizations can be hampered by many obstacles some of which are technical while others are no technical or human related. The technical ones can be liked to data, systems or standards and they are usually easier to solve than the human related ones.

Data sharing among different organizations requires tremendous effort and since data sharing within one organization is not an easy task one can imagine the effort needed to accomplish GIS data sharing among different organizations. The benefits of such initiative are usually recognized by all the involved entities, but that doesn't seem to be enough for such initiatives to succeed. One of the first steps that are usually taken before such ambition initiatives is identifying the data needed to be shared and the custodians of such data. The success of GIS data sharing initiatives relays many factors like the culture of the involved entities, the authority of the organization or organizations leading the initiative as well as the leader ship skills of the people leading the initiative. Leaders of such projects should be prepared to face transparency issues and organizations' politics. Access to data is also a very important topic in data sharing. Some organization will agree on sharing their data with others but will provide limited access to those organizations and by doing so they are undermining the whole

concept of data sharing and lead to the creation of GISs with limited capabilities. Access policy are essential and some data might not be shared, but organizations, which are involved in data sharing projects should do their best to allow maximum possible data sharing without risking the exposure of their sensitive data. Gillespie (2000) believes that access should not only be redistricted to data but can also include access to computational power through open system architecture and can also include training.

The abundance of data can be a problem just like shortage of data. Advancement in technology as well as the competitive prices made the amount of GIS data that some organizations have increase dramatically. One example of such technologies is satellite imagery which became cheaper and better. Another example would be the Global Position System (GPS), which became affordable for the public, sometimes as a function of their mobile phones. Such technology didn't only allow organizations to have more data, but it also allowed the public to create and publish GIS data on the net. The ability of the public to publish proved to be useful especially in disaster response and that is what many sites like "ushahidi.com" are utilizing. The challenge that abundant of data presents is series as the one caused by the lack of data, because not having the needed data means that time and effort is needed to obtain it. Having large amount of data, on the other hand, means that advanced tools are needed (Mark,2000) and it also means resources like money and time will be required too. For example money is needed to acquire the needed tools, time is needed to analyze the data and peoples are needed to do and supervise the whole process.

Data issues are considered to be one of the major challenges in data sharing projects between organizations. Some data issues may cause the failure of such initiatives and therefore may discourage organizations from having their own GISs because they would not be able to realize the benefits of GISs due to the lack of data or the high cost of the data if the

data happens to be available in the market. Lack and cost of data are not the only barriers that can prevent organizations from having their own GIS, because sometimes the data could be available at no cost but it could have quality issues that don't make it suitable of the intended use. Many organizations manage their GIS projects without considering the subsequent use of the data they plan to have or if there are any other governmental organizations that might need the data in the future (Brakel and Pienaar,1993). This short sightedess uncoordinated approach to spatial data collection lead to the generation of spatial data that is of limited use, of short life span and lead too duplicity, because organizations that don't find the collected data useable tend to have their own spatial data collection projects. This issue has been addressed in many countries by the establishment of governmental bodies responsible for what is widely known as National Spatial Data Infrastructure and these bodies oversees all the spatial data related projects in an effort to coordinate efforts and eliminate duplicity.

System integration is the next step in data sharing process and it comes to allow systems from different entities to exchange data in an automated way, so that data from one system could be used by other system to produce some desired results. There are many approaches for systems integration, but according to Markus (2000), the best way for GISs integration is the middleware approach, because it offers two advantages; first it allows GISs to play a central role by allowing them to be connected to databases and applications; the second is it allows GISs to be deployed without replacing legacy systems that might have existed before GISs and this is an advantage that new implementers find very useful. However, he Markus warns that this approach might not be easy to implement and issues like the requirement to modify source system, immature proprietary technology and lack of business involvement

could be faced when this approach of integration is chosen. Besides that, this method of integration is often followed by small projects aiming to address interoperability, data flow between systems, network requirements and privacy and security issues (Bellamy, and Tayler,1996). The idea of running the legacy system and the new GIS system, which is appealing for new implementer, comes at a cost which is the need for more resources (Mitchell,1993). These problems that surround systems integration make organization think twice before implementing GISs and considering systems integration.

Chapter 3:- Research methodology

3.1 Introduction:

The purpose of this chapter is to explain the research approach used in the dissertation and how it intends to aid in the process of identifying the major obstacles that prevent the governmental organizations in Abu Dhabi from implementing GIS. A quantitative approach methodology was used in this study in favor of a qualitative approach because the former thought to be more accurate as it relays on numbers instead of words.

Questionnaires were used to collect the data from the study sample because they are easier to conduct and are not time consuming. The questionnaires that were closed ended liketr types of questions that were designed to elicit accurate answers from the participants of the study. This kind of question are suitable computer processing as the answers obtained by this method could be converted to numbers a format that is ideal for computer analysis.

The research question as well as the sub questions worked as the main factor in shaping the questionnaires, because the answers derived from the questionnaire is expected to assist in finding the answers to the research question and the sub questions. Beside answering the research question, the questionnaire were also designed to get recommendations to overcome GIS implementation.

The questionnaires focused on examining the accuracy of the hypothesis made in the literature review which pointed out that people, communication, culture, data and cost could be the major impediments to GIS implementation. Furthermore, the questionnaires are expected to reveal GIS implementation barrier are unique to Abu Dhabi and might have not been covered in the literature.

3.2.1 Study sample

The study sample used in this dissertation consists of peoples from GIS and non-GIS organizations, despite the fact that the study revolves around finding the major obstacles that prevent governmental organizations in the emirate of Abu Dhabi from implementing GIS. Having employees from organization with GIS may give us a clue about GIS impediments apart from people, culture, communication, data and cost, which were identified earlier in the literature review.

Selection criteria for the study sample was designed in a way that meaks it easy for people and organizations to meet. As for organizations, they have to meet the following criteria.

1- They have to be governmental organizations.
2- They have GIS or should have GIS but don't have one at the time of the study (The main purpose of the study is to identify the obstacles that prevent this kind of organizations from implementing GIS.

Regarding people selection criteria, it is even easier than those of organization selection, as they only have to be employees of the organizations mentioned above and not to have more than 20 participants from a single organization, because that might undermine the result of the survey by weakening data generalization of the study sample. Peoples who participated in the questionnaires distribution process were instructed to diversify as much as possible when selecting the people who make are part of the sampling process. Therefore we can see different categories of participants like men, woman, old, young, people with different qualification and nationalities.

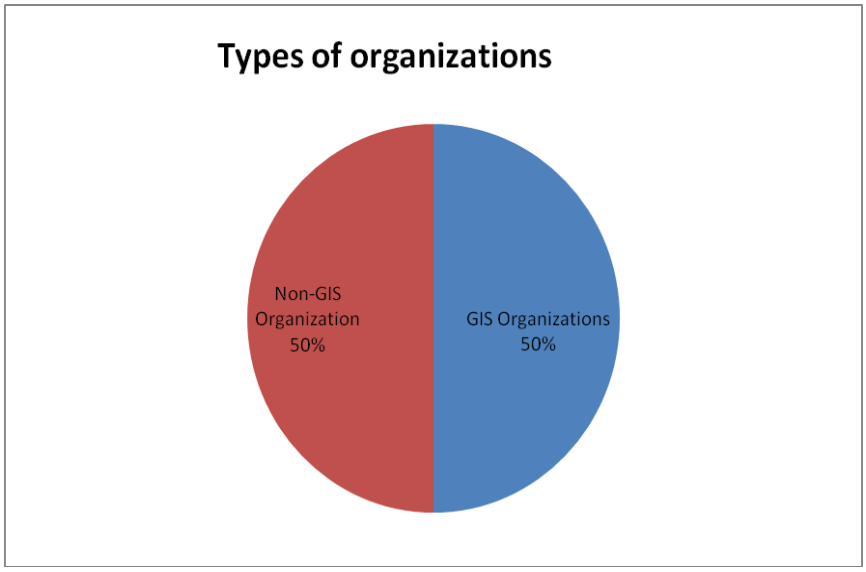
3.2.2 Characteristics of the study sample

In this study there are two types of organizations. The first type is the organizations that needs but don't have a GIS and the second type is the organizations that have already implemented a GIS. The reason for combining these two types of organizations in the study is two compare them so that we may find some clues that would be hard to pin point without comparing them. The number of the organizations that participated in the study is 14. As we can see from the table and the graph below that are sevene organization from each type.

Table 3.2.2 Characteristics of the study sample

Type of organizations	Number of organizations
GIS Organizations	7
Non-GIS Organization	7

Figure 3.2.2 Type of organizations



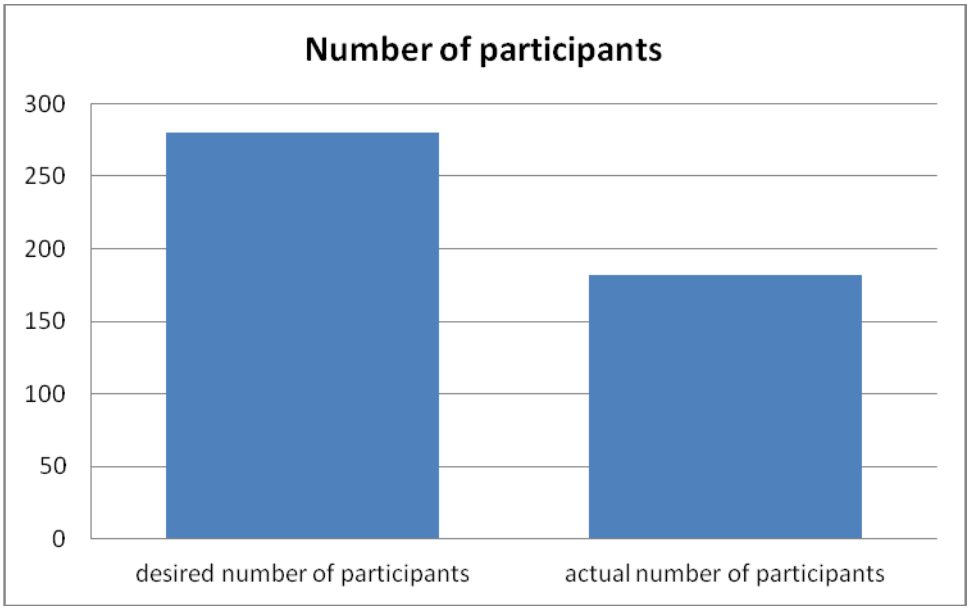
3.2.3 Number of participants

The number of the people who took part in the study is 182, while the desired number was 280, which mean that we were short of 98 participants form the target goal, that is 35% less than desired number.

Table 3.2.3 Number of participants

	Number of participants
desired number of participants	280
actual number of participants	182

Figure 3.2.2 Number of participants



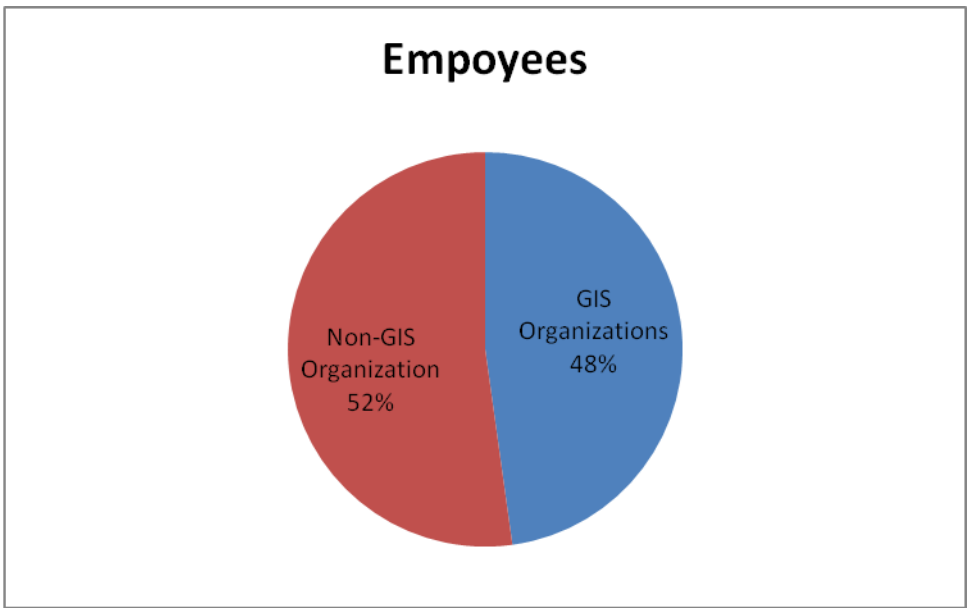
3.2.4 Number of participants from each type of organizations

Ideally the number of participants from GIS and Non-GIS organizations should be the same, 95 participants from each organization. However, since that might not be easily achieved, a slight different of (2%) like the one we have in this survey is acceptable. The larger number of participants from the Non-GIS organizations could be attributed to the attention that was given to these type of organization, as they are the focus of the study.

Table 3.2.4 Number of participants from each type of organizations

Organizations	Number of employees
GIS Organizations	87
Non-GIS Organization	95

Figure 3.2.4 Employees



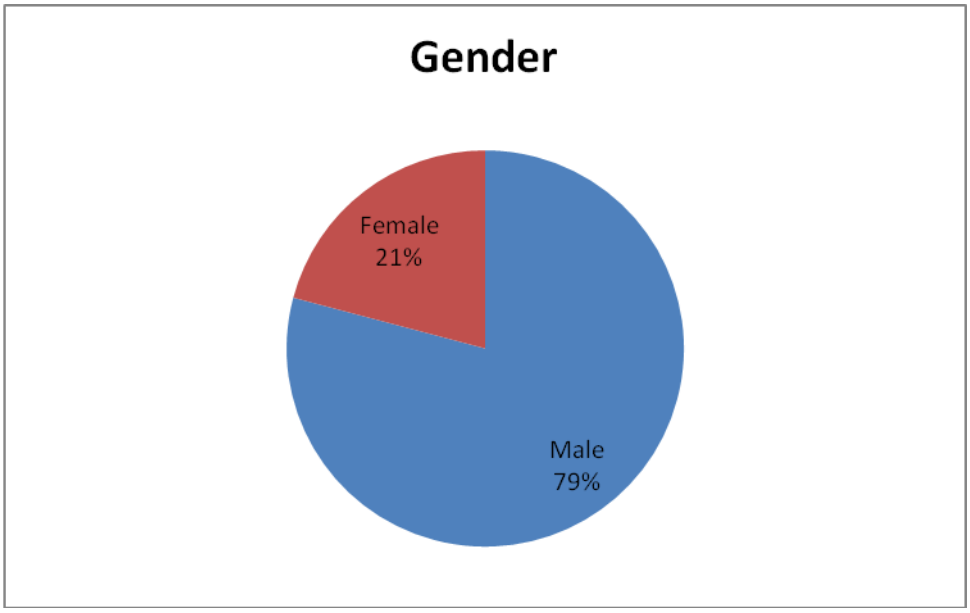
3.2.5 Gender:

As for gender we found that the number of females is 38, which is only 21% percent of the number of the participants in the study. Gender can be used later on the study to find more information about the culture of the organizations involved in the study. Knowing the gender of the participants can also be used as an indicator that the study sample selection was done with consideration of the reality representation of both genders in governmental organizations in Abu Dhabi.

Table 3.2.5 Gender:

Gender	count
Male	144
Female	38

Figure3.2.5 Gender



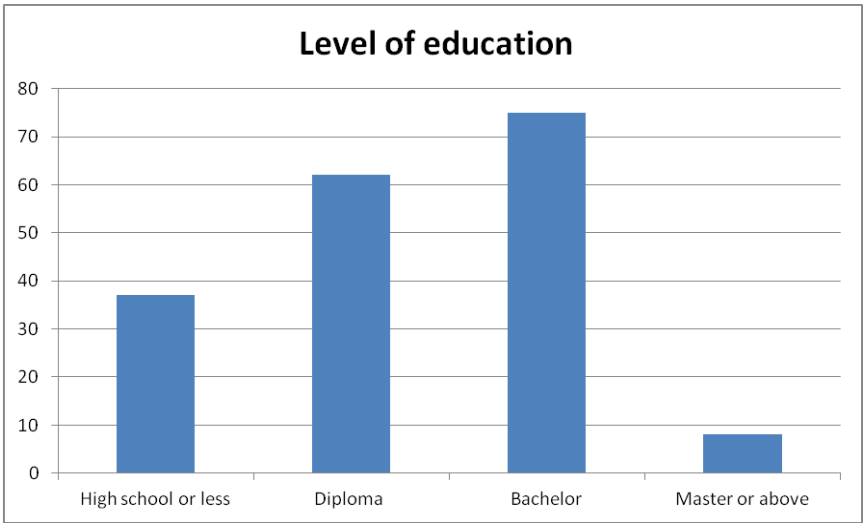
3.2.6 Education

Level of education of the participants is an essential aspect of the study that we expect to reveal interesting findings, especially once a comparison between the two types of organizations is conducted. Education level was divided to four main categories; High school or less, Diploma, Bachelor and Master or above. This broad categorization is believed to give a good idea of the level of education of the participants.

Table 3.2.6 A Education

Education - All organizations	holders
High school or less	37
Diploma	62
Bachelor	75
Master or above	8

Figure 3.2.6 Education



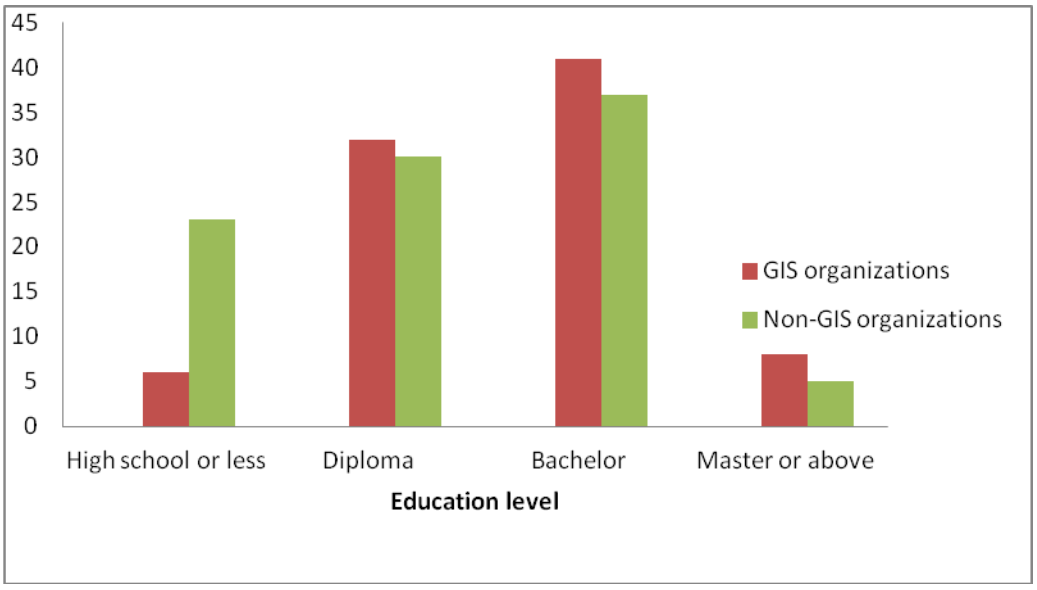
Comparing level of education in GIS and non-GIS organizations is expected to revale new findings. It will also give us an insight about the kind of people that are attracted and retained in each type of organizations as well as identifying the link, if any, between GIS implementation and employees level of education.

Table 3.2.6 B level of education

NON GIS	%
High school or less	6
Diploma	32
Bachelor	41
Master or above	8
	87

GIS	%
High school or less	23
Diploma	30
Bachelor	37
Master or above	5
	95

Figure 3.2.6 B level of education



3.2.7 Study Measures:

Likers five points questionnaires were used in this study to examine the effect of the GIS implementation impediments identified in the earlier chapters of the study. The likers questionnaires are as the following

1- Strongly agree
2- Agree
3- Neutral
4- Disagree
5- Strongly disagree

3.3 Research design

The research in this dissertation took three major phases; the literature review phase, the survey (questionnaires) phase and the finding phase. Every phase of the three phases depends depend either on the one before it or after it so that it can be understood and in the case of the second phase, it depends on the two other phases to be understood, because the first phase explains the factors that has been identified from other previous studies, while the third phase offers in depth analysis of the questionnaire results. This simple approach of the three phases saved time and effort, as it pins point the major obstacles that prevents organizations in Abu Dhabi from implementing GIS, verify of the validity of these obstacles and at the end it comes with recommendations that aim to eliminate or minimize the effect of those obstacles. The contribution of the three phases in the study can be summarized as following.

Literature review phase: establishing a good understanding of the subject by conducting extensive reading to collect subject matter experts ideas about the topic from different parts of the world.

Questionnaires phase: This phase is about examining the data collected in the prevouise phase (literature review) by selecting a study sample to answer a group of questionnaires that are designed to measure the impact of the people, culture, communication, data and cost on the GIS implementation by governmental organizations in Abu Dhabi.

Finding phase: This is the final phase of the study and it is linked to both literature review and questionnaires phases, but its link to the questionnaire phase is stronger, because the biggest portion of the finding phase is about the results of the questionnaires. While the first phase can be seen as a background study for the whole dissertation and the second phase is mainly field data collection, this phase is the most critical part of the study, where the data from the previous phases is collected and deeply analyzed to get solid results and draw conclusions and recommendations that can benefits organizations in Abu Dhabi to implement GISs.

3.4 Hypothisi

This dissertation looks at the major obstacles that prevent governmental organizations from implementing GISs. It achieves that by studying all the obstacles; people, culture, communication, data and cost. In order to identify the role every obstacles plays in preventing GIS implementation, a set of hypothesis have been developed. These hypotheses, which can be seen below, were designed to test the validity of the identified obstacles.

1- People: level of education of employees and top management style has a critical role in GIS adoption.
2- Culture: GIS implementation more likely to occur in organizations, where collectivism and some degree of uncertainty exist.

3- Communication: Communication is critical for GIS adoption and implementation.

4- Data: GIS data issues can act as an impediment to GIS implementation.

5- Cost: Cost has a major influence on organization decision on GIS implementation.

3.5 Limitation

Almost every study has its limitations and this study in not an exception. One of the limitations of this study lays in the study sample, as the number of the participants is relatively small for this kind of studies. Number of the participants in the study is xx which is xx% less than the expected number of xx. The survey took place in the summer, when the majority of employee took their annual leaves. The number of the employee who filled the questionnaires is enough but I would have been better if the target number of employees was achieved, because that will enhance the credibility of the study. Another factor that led to having a small study sample is the fact that the number of organizations that need but don't have GIS in Abu Dhabi is in fact small.

Another limitation of this study is the limited research in the topic either inside or outside the UAE. This lead to a shorter literature review and that could have been reflected on the dissertation results in general, if it was not addressed properly. The impact of the shortage in the research subject was minimized by identifying common areas between GISs and other ISs to find researches that are applicable to GISs to be used in the study. This approach proofed to be very effective, as it helped in identifying many GIS implementation impediments that could not have been identified otherwise. Despite the fact that GISs are different from typical ISs in many aspects, it turned out that many obstacles that prevent organizations from implementing GISs do also act as obstacles to typical ISs.

Chapter 4:- Findings and discussions

4.1 Introduction

In this chapter we will examine the results of the survey with the aid of statistical package of the social science (SPSS). The results may to support or contradict the hypothesis made at the earlier chapters of the study. The survey answer will be thoroughly studied in the hope of revealing findings that will help us drawing link between the five factors namely people, culture, communication, data and cost and GIS implementation.

4.2 Findings

4.2.1 Demography

By conducting basic comparison one can easily spot major differences in the characteristics of the people who work in organizations and those who work in organizations that don't have GISs. Areas like age, qualifications, job tenure and gender tend to differ dramatically in organization with GISs and those without GIS

The first part of the questionnaire was dedicated to the demography of the selected sample and the data collected by this part of the questionnaire showed that the level of education in GIS and non-GIS organization is significantly different, see the fig () below.

Figure 4.2.1 demography

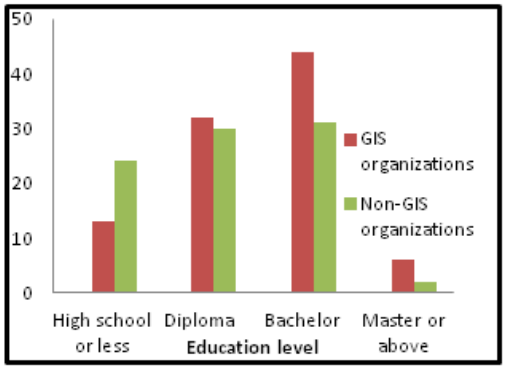


Table 4.2.1 A demography

GIS organization

		Frequency	Percent
Valid	High school or less	11	12.6
	Diploma	30	34.5
	Bachelor	41	47.1
	Master or above	5	5.7
	Total	87	100.0

non-GIS organization

		Frequency	Percent
Valid	High school or less	28	29.5
	Diploma	31	32.6
	Bachelor	33	34.7
	Master or above	3	3.2
	Total	95	100.0

It is clear from the bar chart and the tables that people in GIS organizations hold higher qualifications than their counter parts, who happen to work in non-GIS organizations. Although the number of employees from the non-GIS organization is greater than the ones from GIS organizations, the later have higher percentage of people with bachelor and MSc or above. This can be attributed to the fact that GIS needs people with advanced skills that are usually acquired by people with high qualifications, that is people with bachelor and Master or above.

Table 4.2.1 B Correlation (Nationality and Qualification)

Correlations		GIS Org		Non-GIS Org	
		Qualifications	Nationality	Qualifications	Nationality
Qualifications	Pearson Correlation	1	.457**	1	.361**
	Sig. (2-tailed)		.000		.000
	N	87	87	95	95
Nationality	Pearson Correlation	.457**	1	.361**	1
	Sig. (2-tailed)	.000		.000	
	N	87	87	95	95

Using SPSS we assigned value of 1 to locals and 2 to non-locals and we assigned numbers from 1-5 to qualifications, where 1 is low qualification and 5 is high qualifications. After running correlation between qualifications and nationalities in both in GIS and non-GIS organizations we got the table 4.2.1 B. The table shows us that there is significant correlation between qualifications and nationalities in the two types of organizations but it is higher in the GIS organization as it reaches 0.46 while it is 0.36 in non-GIS organizations. This comes as no surprise because we predicted that organizations with GIS technology seeks more qualified peoples, as GIS is complex filed that has versatile applications compared to other old systems that compete with it. Beside the GIS organizations desire to recruit very qualified people, we expect that there is a mutual desire from qualified people to join GIS organization

because these kind of organizations is expected to provide better growth opportunities.

Table 4.2.1 C Age

GIS		
Age		%
<20	2	2.105263
20-30	34	35.78947
30-40	29	30.52632
40-50	23	24.21053
50-60	7	7.368421
>60	0	0
	95	100

Non-GIS		
Age		%
<20	3	3.448276
20-30	14	16.09195
30-40	25	28.73563
40-50	31	35.63218
50-60	11	12.64368
>60	3	3.448276
	87	100

As for ages, the distribution of ages in the GIS and non-GIS shows an interesting pattern. The table above shows that GIS organizations have younger work force than the non-GIS organizations, as about 53% of the employees in GIS organization are below 40 and only around 34% of the non-GIS organizations are below 40. This age difference is suspected to affect organizations decisions to implement GIS, because as we found in the literature review that member of old work force tend to prefer to use the non-GIS systems that they have experience with than the new GIS systems which is could be as a form of undesired change.

Descriptive Statistics

		N	Minimum	Maximum	Mean	Std. Deviation
GIS Org	JobTenure	87	1	5	3.15	1.308
	Valid N (listwise)	87				

		N	Minimum	Maximum	Mean	Std. Deviation
Non-GIS Org	JobTenure	95	1	5	2.60	1.198
	Valid N (listwise)	95				

Table 4.2.1 D Age mean

GIS is a relatively a new technology and those who use it find it very powerful especially those who had the chance to use old systems, because GIS can perform very complex tasks with limited effort. This ease of use give users since off accomplishment that could not obtained from old systems that do simple tasks and requires grate effort from users. Also GIS users believe that GIS is will replace legacy systems in Abu Dhabi because of it out perform legacy systems in many fields and because leading figures in Abu Dhabi government like the secretary general of the Executive Council of Abu Dhabi H.E. Mohammad Ahmad Al Bowardi as well as H.E. Rashid Laheg Al Mansouri, Director General of ADSIC. Knowing that the GIS is the technology of the future in Abu Dhabi and having the opportunity to work with it means that the employees in GIS organizations can improve their skills and knowledge in GIS technology, which will be great demand in the future and that gives the emploeeys of such organization a feeling of satisfaction. This feeling of satisfaction is reflected in higher job tenure, as the mean jon tenure in GIS organization is 3.12 which when translated to number of years become 3-5 years while the mean job tenure in non-GIS organizations is 2.6 which is equivalent to 1-3 years.

Descriptive Statistics

Non-GIS Orgs

	N	Minimum	Maximum	Mean	Std. Deviation
JobTenure	16	1	5	3.50	1.317
Valid N (listwise)	16				

GIS Orgs

	N	Minimum	Maximum	Mean	Std. Deviation
JobTenure	21	1	3	2.24	.700
Valid N (listwise)	21				

Table 4.2.1 E Descriptive statistics

Job tenure of non-local is different from the job tenure of the whole data set, which forced us to find reasonable explanations. This phenomena could be attributed to three factors; emirtization, type of contracts and knowledge transfer programs. As for emirtization, we think that this factor want play a major role, because all government organizations that is the GIS and the non-GIS would be affected by that and since what we have in this study affected only the GIS organizations we excluded this factor. However, the other two factors; contract type and knowledge transferee seem more likely, since we know that GIS is new technology and therefore it is very like that organizations that implemented GIS would have GIS projects and those projects would involve non-local subject matter expert who will work for the period of the project which is usually less than 3 years. Knowledge transfer on the other hand is what some organizations which wish to increase the knowledge of its employee do by employing experts and shadow them with their employees for a period that they think is adequate and at the end the concerned employee acquire the desired knowledge. As we will see when we come to the training in GIS organizations that top management and employees of GIS organizations believe of the importance of training, and that this kind of programs can easily occurs in GIS organizations.

4.2.2 People

People are one of the main five components, people, process, hardware, software and data, of any GIS and they play the key role in GIS adoption. Their reaction toward technology is a determining factor in technology success or failure. In this part of the study as special attention was paid to examine the role of people in GIS adoption. This role was made clear by comparing people in organizations with GISs and those who work in organizations without GISs. A series of ten questions was designed to gather information about both employees and management members in order to pin point as many GIS implementation obstacles as possible. Peoples were divided to these two categories because of the distinctive role that each category plays when it comes to GIS.

Employees

Correlations

		GIS Orgs		Non-GIS Orgs	
		Age	JobTenure	Age	JobTenure
Age	Pearson Correlation	1	.196	1	.851**
	Sig. (2-tailed)		.069		.000
	N	87	87	95	95
JobTenure	Pearson Correlation	.196	1	.851**	1
	Sig. (2-tailed)	.069		.000	
	N	87	87	95	95

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.2 A Correlation (Age and job tenure)

Employees are the building blocks of organizations and their behavior reflects the health of organizations. Therefore any unusual behavior does usually indicates the existence of a

problem or more and that what was suspected when we found that the job tenure in GIS and Non-GIS organization differ dramatically with respect to age. The older the employee the more they retain their job especially in the non-GIS organization. This correlation is expected in both types of organizations because it is normal that the older someone the more likely that he or she will serve the organization. However, the correlation between age and job tenure in non-GIS organization as we can see in the figure above is more than 4 times that of GIS organizations, which is very up normal. This also means that non-GIS organizations tend to have old employees who have long experience with the old system and this kind of people usually resist new systems like GIS, because they developed good experience with the old systems and gain power from their knowledge of the old system over long years and having a new system to replace the old system would mean that they have to learn new things and they will not have any advantage over the younger employees who tend to be quick learners. Beside that non-GIS organizations as we can see in the bar chart below don't invest in training like GIS organization and that helps to exacerbate the problem, because not exposing employees to new technologies add uncertainty which intensify employees' resistance.

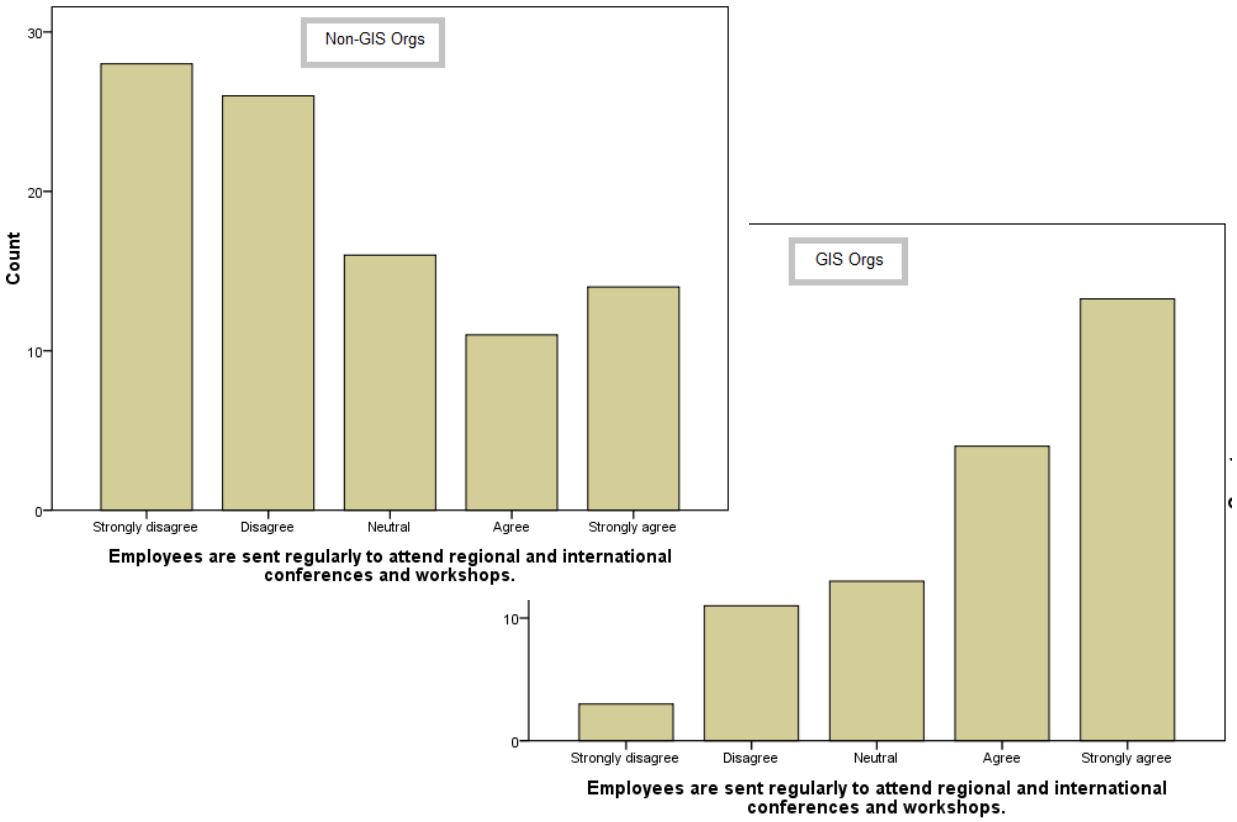


Figure 4.2.2 A Correlation (Age and job tenure)

As for GIS organizations, having less strong correlation between age and job tenure means that this kind of organizations are less likely to have employees who are attached to old systems and therefore less resistance toward new systems. Unlike non-GIS organizations, GIS organizations care about training and they send their employees to workshops and seminars and that helps their employees to stay updates about technology and open to new trends in their fields, which is why people in GIS organization adopted GIS in first place.

Correlations

		GIS Orgs			Non-GIS Orgs		
		The benefits of GIS are recognized by the majority of employees	Employees are sent regularly to attend regional and international conferences and workshops.	Employee job satisfaction is high	The benefits of GIS are recognized by the majority of employees	Employees are sent regularly to attend regional and international conferences and workshops.	Employee job satisfaction is high
The benefits of GIS are recognized by the majority of employees	Pearson Correlation	1	.958**	.681**	1	.299**	-.047
	Sig. (2-tailed)		.000	.000		.003	.654
	N	87	87	87	95	95	95
Employees are sent regularly to attend regional and international conferences and workshops.	Pearson Correlation	.958**	1	.676**	.299**	1	-.006
	Sig. (2-tailed)	.000		.000	.003		.958
	N	87	87	87	95	95	95
Employee job satisfaction is high	Pearson Correlation	.681**	.676**	1	-.047	-.006	1
	Sig. (2-tailed)	.000	.000		.654	.958	
	N	87	87	87	95	95	95

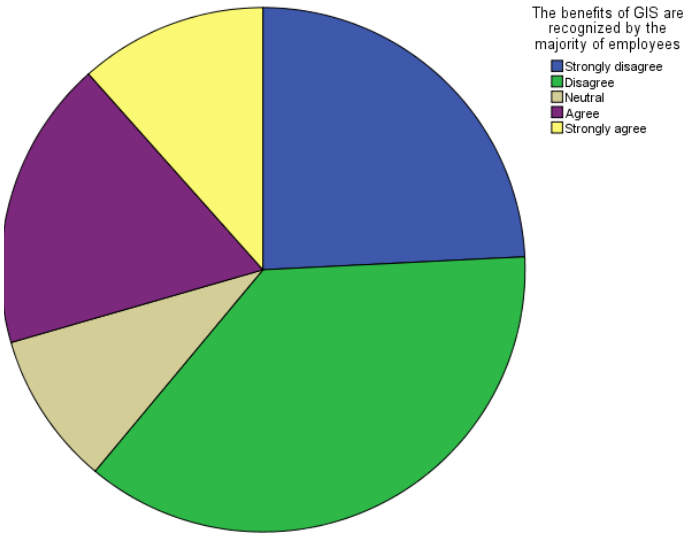
**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.2 B Correlation related to people

Besides age and job tenures, there are many aspects of employees in GIS and non-organizations seem completely different. For example, the correlation between job satisfaction, training and awareness about GIS gave us a clue about the nature of both types of organizations and lead us to what is believed to be some of the factors preventing some governmental organizations in Abu Dhabi from implementing GIS. The result of the questionnaires shows that a large number of employees in non-GIS organizations are not aware of the benefits that GIS could bring to their organizations.

Figure 4.2.2 B Training

In fact around 60% or more of the employees of the non-GIS organizations said that they have not been able to attend enough workshops or seminars concerning their field of study. The same is revealed by examining the correlation between the awareness of GIS benefits and attending GIS workshops and seminars, which



Is 3 times stronger in GIS organizations than in the non-GIS organizations (see the previous table). Also correlation between job satisfaction and GIS awareness is very high in GIS organizations and that is expected because the more people know about their work the less uncertainty they have and the more they like their job. Another reason that could increase job satisfaction among employees of GIS organizations is the perception that working means better growth opportunities because GIS is the technology that will in demand in the future. The employees of the non-GIS organizations are more inclined to have the opposite feeling, which is the feeling of working with obsolete technology that soon will be replaced in many organizations by GIS technology and that can affect job satisfaction of those employees.

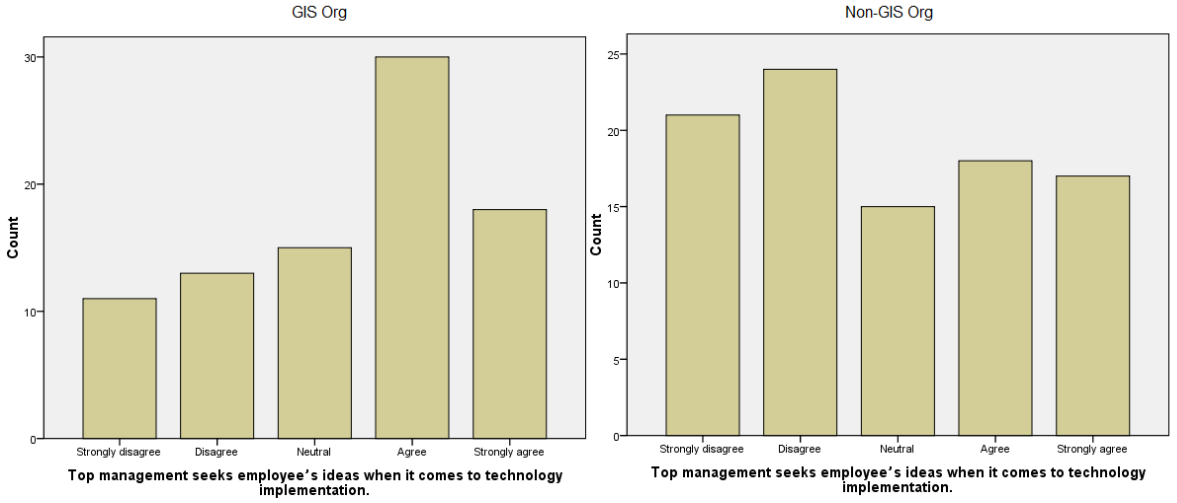
Correlations

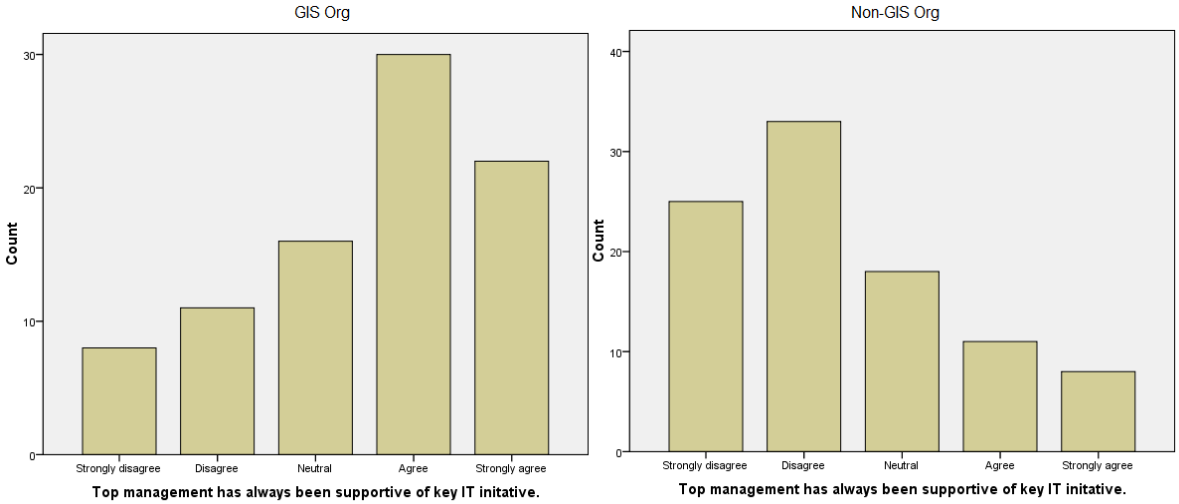
		GIS Orgs				Non-GIS Orgs			
		The current system meets working requirements and there is no need for new solutions	Top management has always been supportive of key IT initative.	Top management seeks employee's ideas when it comes to technology implementation.	Most past IT initiative succeeded	The current system meets working requirements and there is no need for new solutions	Top management has always been supportive of key IT initative.	Top management seeks employee's ideas when it comes to technology implementation.	Most past IT initiative succeeded
The current system meets working requirements and there is no need for new solutions	Pearson Correlation	1	.920**	.926**	.934**	1	.203*	-.057	-.078
	Sig. (2-tailed)		.000	.000	.000		.048	.584	.450
	N	87	87	87	87	95	95	95	95
Top management has always been supportive of key IT initative.	Pearson Correlation	.920**	1	.955**	.950**	.203*	1	.041	-.203*
	Sig. (2-tailed)	.000		.000	.000	.048		.695	.049
	N	87	87	87	87	95	95	95	95
Top management seeks employee's ideas when it comes to technology implementation.	Pearson Correlation	.926**	.955**	1	.981**	-.057	.041	1	.055
	Sig. (2-tailed)	.000	.000		.000	.584	.695		.598
	N	87	87	87	87	95	95	95	95
Most past IT initiative succeeded	Pearson Correlation	.934**	.950**	.981**	1	-.078	-.203*	.055	1
	Sig. (2-tailed)	.000	.000	.000		.450	.049	.598	
	N	87	87	87	87	95	95	95	95

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.2 C correlation between the role of top management

The table above shows the correlation between the role of top management, It initiatives and the current systems performance. It is clear from the table that there is significant correlation (around 0.9) between to management support and the two other areas in GIS organization. This correlation doesn't exist in the non-GIS organizations, which means that the management support is very weak in the non-GIS organizations and that can be seen when comparing top management support bar charts for the two types of organizations (see the figure below).





The result obtained from the correlation table and the bar charts can be represented in the (figure on the right), which shows the role of top management support in the success of GISs in implementation as well as the operation stage.

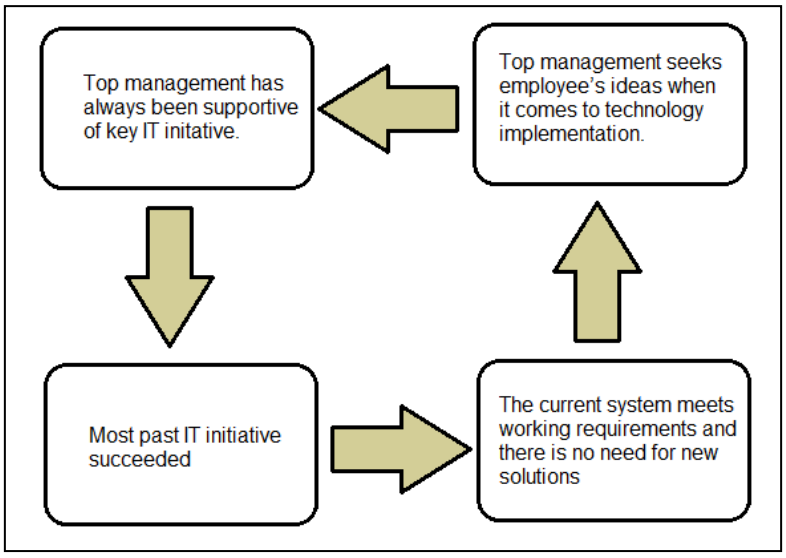


Figure 4.2.2 D role of top management

Management members

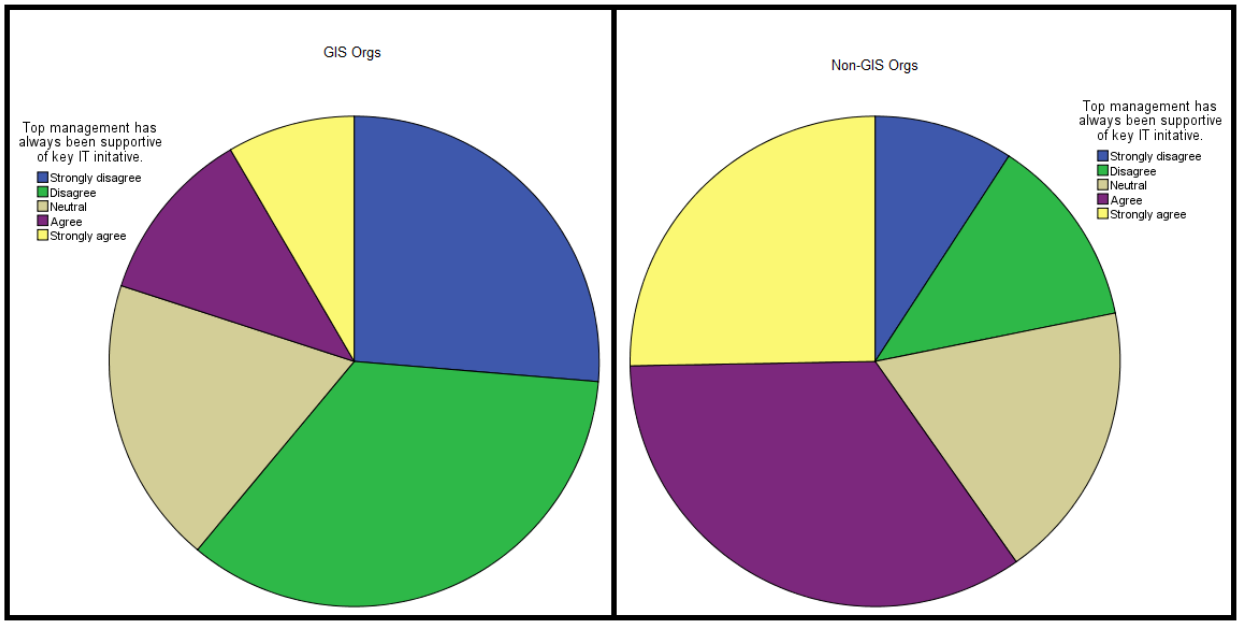


Figure 4.2.2 E top management support comparison

The paragraph above was generated from SPSS and it compares the pie charts of what employees of GIS and non GIS organizations think of top management support. The pie charts support the results obtained earlier by using correlation, as they show that top management support is significantly higher in GIS organizations than it is in non-GIS organizations. Frequencies analysis shows that only 18% of non-GIS organizations employee think that their top management make a serious effort to support key initiatives, around 20% are neutral and around 60% find their management not supportive. In GIS organizations, however, the results are completely the opposite. Unlike employees of non-GIS organizations the majority of employees in GIS organizations, that is more 50%, find their management supportive of IT initiatives in general. Only 20% of the peoples who work in GIS organizations believe that their top management staffs are not supportive enough to IT initiatives and similar percentage are neutral.

After looking the people factor in GIS and non-GIS organization we found that the hypothesis made earlier "of education of employees and top management style has a critical role in GIS adoption" is true, because we found that the top management in GIS organization was very supportive unlike the one in the non-GIS organizations. As for employees, we found that there were distinctive characteristics of employees in the two types of organizations and that effect the overall behavior of the organizations. The employees of the GIS organizations tend to have higher qualifications and were slightly younger, whereas the one in the non-GIS organizations were slightly older and not as qualified as their counterpart in the GIS organizations.

4.2.3 Culture

As we saw in the literature review culture plays an important role in organizations and tit affect technology adoption in a great way. Even people behavior is affected to a cretin extent by the culture they operate within. Therefore culture was covered extensively in the questionnaire in the hope of finding the role it plays in GIS implementation. In this part of the study some aspects of cultures that was mentioned in the literature review like masculinity, hierarchy, collectivism, individualism, and uncertainty were examined to see if they are applicable out data set.

Masculinity

One of the prominent differences between the GIS and the non-GIS organization is the number of woman working in them. Only 16% of the work force in non-GIS organizations is women, while 25% percent of the work force in GIS organizations is women. This indicates that non-GIS organizations are musicales and that could be due to the nature of the

employees in these organizations who tend to be prejudice towards the opposite sex. Since employees tend to be prejudice against woman in these organizations we think that they may also exhibit similar behavior against new ideas like the ideas of replacing a legacy system with a GIS for instance. As we found from the demography of the non-GIS organization, the majority of these organization are old males with substantial experience with the old system, unlike the GIS organization employees who tend to be younger and more likely to be liberal.

Gender

		Non-GIS Orgs		GIS Orgs	
		Frequency	Percent	Frequency	Percent
Valid	Female	16	16.8	22	25.3
	Male	79	83.2	65	74.7
	Total	95	100.0	87	100.0

Table 4.2.3 A Culture - Masculinity

Hierarchy

Correlations

		GIS or NonGIS organizations	Employees and top management staff have informal conversation about work very often	Employees can pass suggestions to top management staff freely
GIS or NonGIS organizations	Pearson Correlation	1	.227**	.285**
	Sig. (2-tailed)		.002	.000
	N	182	182	182
Employees and top management staff have informal conversation about work very often	Pearson Correlation	.227**	1	.041
	Sig. (2-tailed)	.002		.582
	N	182	182	182
Employees can pass suggestions to top management staff freely	Pearson Correlation	.285**	.041	1
	Sig. (2-tailed)	.000	.582	
	N	182	182	182

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.3 B Culture – Hierarchy (Power distance)

It is also clear from the questionnaires' answers that the GIS organizations have less hierarchy or flatter than the non GIS organizations. The table above for example, shows strong correlation between GIS organizations and the treats that characterized flatter organizations like informal conversation between top management staff and employees and the ability of employees to approach management staff when having work related issues. We believe that this makes the GIS organization less centralized and improves communication, which is critical for the success of new ideas like GIS.

Uncertainty

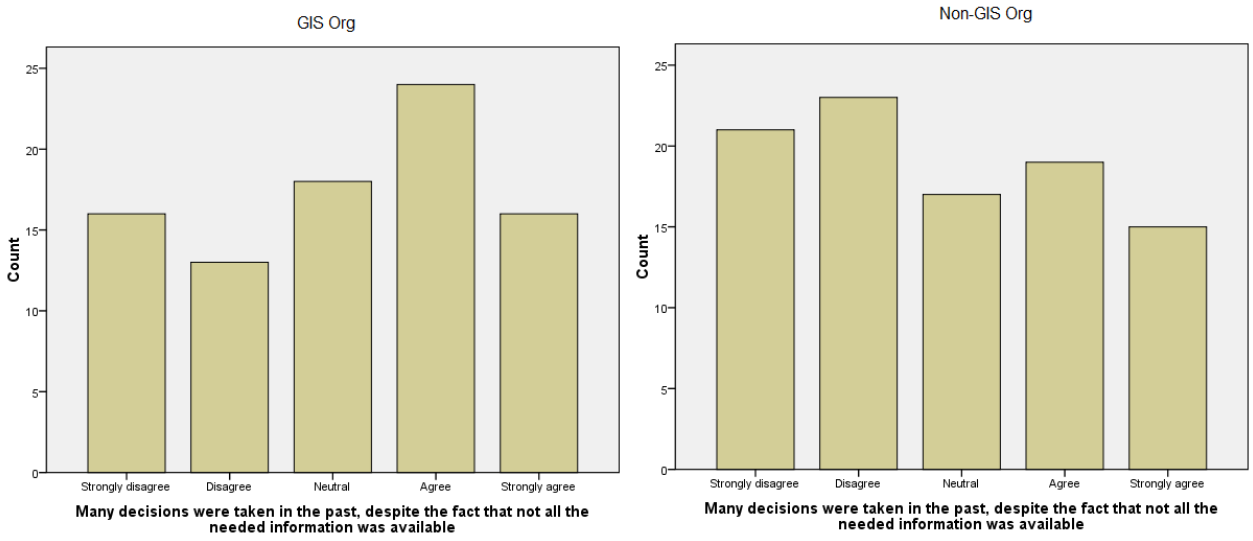


Figure 4.2.3 A Culture – Uncertainty

As for uncertainty, employees of the non-GIS organizations were found to be more uncomfortable with uncertainty than the GIS organization employees and that justify their desire to keep their old system in order to avoid the uncertainty associated with new systems like GISs. However, the difference of in uncertainty was found to be very slim when compared

to other aspects of cultures like masculinityand power disctance.

Change

Change and uncertainty are interlinked in nature and that is why GIS organizations found out to be better at handling change. According to the survey results below, 50% of GIS organizations' employees think that change is accepted a dealt with properly while only 22% of non-GIS organizations' employees agree with this statement.

Changes are accepted and dealt with in a systemic way

		GIS Org		Non-GIS Org	
		Frequency	Percent	Frequency	Percent
Valid	Strongly disagree	9	10.3	26	27.4
	Disagree	18	20.7	30	31.6
	Neutral	12	13.8	18	18.9
	Agree	26	29.9	14	14.7
	Strongly agree	22	25.3	7	7.4
	Total	87	100.0	95	100.0

Table 4.2.3 C Culture – Change

Collectivism

Collectivism is affected by many factors of the culture masculinity and hierarchy among others. For example a culture that doesn't support woman will have lower collectivism and the similar results would be expected in hierarchical organizations. Since non-GIS organizations have these two conditions, we suspect that they may not do as good as the GIS organizations and that what we uncovered when we saw the correlation between organization type and collectivism (see the figure below).

It is clear from the table below that there is significant correlation between collectivism, which is, measured in this survey by group projects, and type of organizations. The correlation is

positive and it is significant, which means that collectivism and GIS organizations are directly proportion.

Correlations

		GIS or NonGIS organizations	Changes are accepted and dealt with in a systemic way	Group work projects are popular in the organization
GIS or NonGIS organizations	Pearson Correlation	1	.350**	.351**
	Sig. (2-tailed)		.000	.000
	N	182	182	182
Changes are accepted and dealt with in a systemic way	Pearson Correlation	.350**	1	.203**
	Sig. (2-tailed)	.000		.006
	N	182	182	182
Group work projects are popular in the organization	Pearson Correlation	.351**	.203**	1
	Sig. (2-tailed)	.000	.006	
	N	182	182	182

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.3 D Correlation (Change and collectivism)

Summary

At the end of the culture study we found that the dominant culture in GIS organization is flatter than the culture on non-GIS organizations, allow some degree of uncertainty, encourage collectivism, not prejudice against women and flexible when dealing with change. The non-GIS organization were weak in this areas and we think that the hypothesis made earlier " GIS implementation more likely to occur in organizations, where collectivism and some degree of uncertainty exist " is valid.

4.2.4 Communication

Communication is one of the areas where GIS and non-GIS organizations differ dramatically. As we saw when we discussed cultures of GIS and non-GIS organizations that the prominent culture in GIS organizations was the flat culture and therefore communication was expected to be better. This part of the study confirms that assumption and also proves that the non GIS organizations cultures are the type of cultures that prevents proper communication of taking place. The correlation table below shows that there is a strong correlation between the existence of strong communication and the type of organizations. The correlation is positive and significant, which indicates that GIS organizations have good communication between their employees and top management, a factor that we think had played an important role in GIS adoption on these organizations.

Correlations

		GIS or NonGIS organizations	Many initiatives that are made by employees are implemented or in the process of being implemented	There is a formal way by which employee can submit a proposals and discuss them with management	Employees are given enough time to explain their ideas to management
GIS or NonGIS organizations	Pearson Correlation	1	.433**	.473**	.424**
	Sig. (2-tailed)		.000	.000	.000
	N	182	182	182	182
Many initiatives that are made by employees are implemented or in the process of being implemented	Pearson Correlation	.433**	1	.708**	.660**
	Sig. (2-tailed)	.000		.000	.000
	N	182	182	182	182
There is a formal way by which employee can submit a proposals and discuss them with management	Pearson Correlation	.473**	.708**	1	.625**
	Sig. (2-tailed)	.000	.000		.000
	N	182	182	182	182
Employees are given enough time to explain their ideas to management	Pearson Correlation	.424**	.660**	.625**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	182	182	182	182

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.4 A Correlation (Communication)

Having the right environment that encourage employees to share ideas among themselves and the upper management has a great effect on technology adoption and that was the survey results have proven, by giving better rating for GIS organizations in terms of communication. The table below shows that top management in GIS organizations explains to their employees the decisions they make and meet regularly with employees to insure common understanding on important issues. In the non-GIS organizations the weak communication could be attributed to the hierarchical culture that prevents bottom up and top down communication. It could also be attributed to the age difference gap that we saw when we looked at the demography analysis early in this chapter.

Correlations

		GIS or NonGIS organizations	Meeting between management and employees are held regularly	Decisions made by management are explained to employees	Employees, whose ideas proofed to improve productivity or quality of work are rewarded
GIS or NonGIS organizations	Pearson Correlation	1	.481**	.359**	.328**
	Sig. (2-tailed)		.000	.000	.000
	N	182	182	182	182
Meeting between management and employees are held regularly	Pearson Correlation	.481**	1	.509**	.588**
	Sig. (2-tailed)	.000		.000	.000
	N	182	182	182	182
Decisions made by management are explained to employees	Pearson Correlation	.359**	.509**	1	.696**
	Sig. (2-tailed)	.000	.000		.000
	N	182	182	182	182
Employees, whose ideas proofed to improve productivity or quality of work are rewarded	Pearson Correlation	.328**	.588**	.696**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	182	182	182	182

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.4 B Correlation (Top management communication)

Summary

GIS organizations seem to pay great attention to communications whether it is bottom up or top down. We also found that communication is effected by culture and that GIS

4.2.5 Data

The results of the survey shows that data and the issues associated with it act as one of the obstacles that prevent governmental organizations in Abu Dhabi from implementing GIS. Some of the data related issues like cost, complexity and quality have been examined carefully in this study in order to reveal the link between GIS implementation and date issues.

Data complexity

The majority of non-GIS organizations that is more than 60% believe that the data that is currently available with their organizations is complex and will take time and effort to be converted to a GIS format, if their companies decided to implement GIS see the fuguer below(). Unlike legacy systems' data, GIS data is very complex and it requires lots of attributes and meticulous QC/QA and by itself is enough to prevent some organizations from adopting GIS.

The data available is complex and will take time and effort to be converted to GIS format

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	5.3	5.3	5.3
	Disagree	11	11.6	11.6	16.8
	Neutral	18	18.9	18.9	35.8
	Agree	38	40.0	40.0	75.8
	Strongly agree	23	24.2	24.2	100.0
	Total	95	100.0	100.0	

Table 4.2.5 A - Correlation (Data complexity)

Beside the effort needed to convert the data, some organizations are faced with the challenge of changing many applications on the organization because many departments relays on the old data in its old format and that makes the transition to GIS a serious challenge. As we can see in the bar chart on the right that more than half of the employees in no GIS organizations believe that the current data is used many applications across several departments.

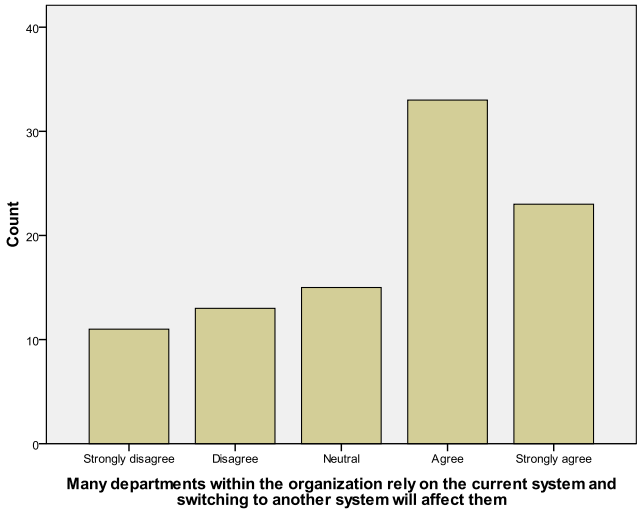


Figure 4.2.5 A Data complexity

GIS data could be obtained through different ways like field collection, from other organization and by converting the existing non-GIS data to GIS data. All of the above methods are expensive especially the field collection method because it means that sending people and equipments to the field. Converting the existing data is usually the easiest way but as we can see from the SPSS pie chart that many employees in the non-GIS organizations think that this task is not an easy one due to the complexity of data and sometimes this method is skipped in favors of the first method. Getting GIS from other organizations, which could be governmental or private organization, is the most practical way even if the data doesn't meet all the requirements.

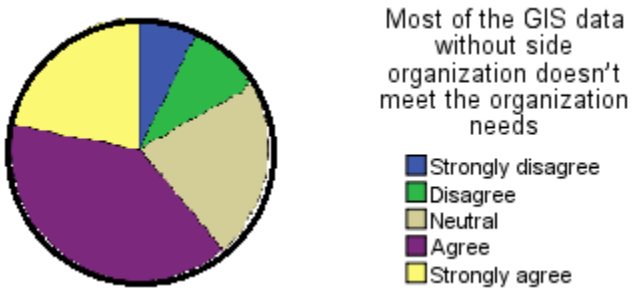


Figure 4.2.5 B Data from other agencies

Since most organizations in Abu Dhabi that concerned with location use GIS, non-GiS organizations data became unneeded and that lead to a state of isolation for these organizations. This point of view is supported by the SPSS bar chart below, which compares GIS and non-GIS organizations in terms of Memorandum Of Understandings (MOU) and Service Level Agreements (SLA). By looking at the bar chart we can see that non-GIS organizations are lagging in the field of data exchange with other governmental organizations and that probably because they are using obsolete technologies.

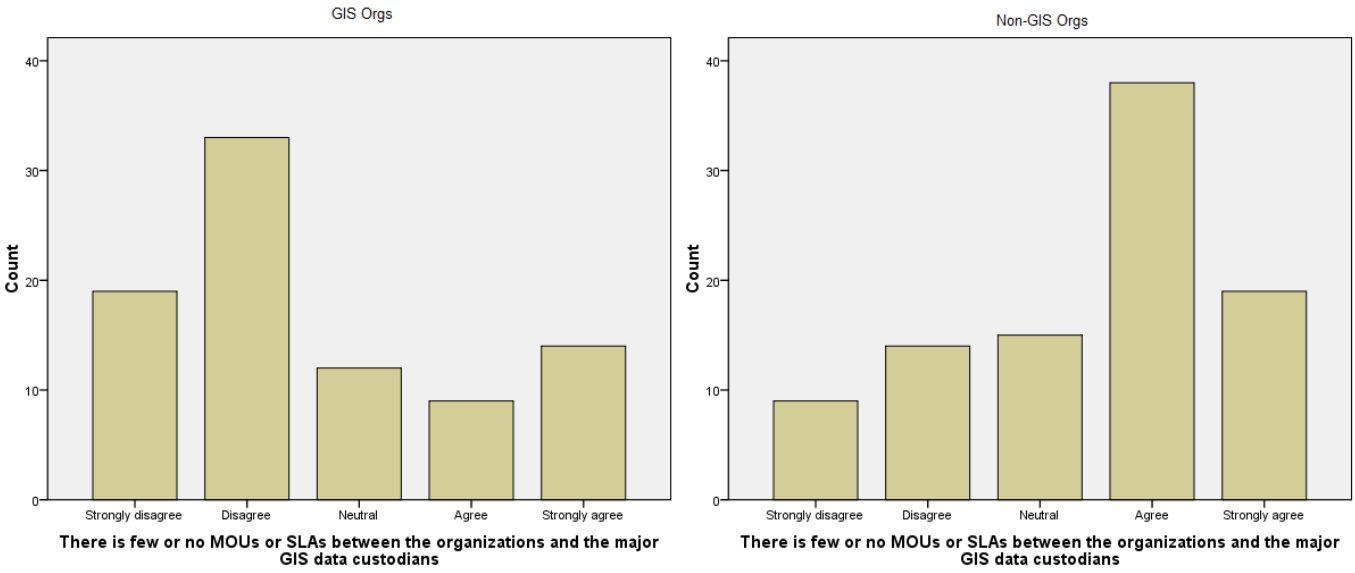


Figure 4.2.5 B Data exchanging

Summary

After examining the data issue of the non-GIS organizations it became clear that non-GIS organizations are in a difficult situation and that for them to move to GIS they need to face the data issue. The subject of data is a difficult one and one that if not considered at an early stage will grow and make moving to GIS technology harder as the time goes.

4.2.6 Cost

Cost is one of the most difficult GIS implementation impediments, because the way to overcome it may lie out of reach for some organizations. Also cost can be associated with many areas like hardware, software, training and data, which makes it very difficult to tackle. However, the organizations in question are governmental organizations in Abu Dhabi and the government of Abu Dhabi has no financial difficulties raising money for GIS implementation. Therefore, such obstacle should be overcome with relative ease if the managements of non-GIS organizations presented their case properly when requesting fund. This part of the study looks at how cost can prevent GIS implementation by examining the results obtained after examining the survey's results.

Non-financial benefits like customers and users satisfaction are considered in project selection

		GIS Orgs		Non-GIS Orgs	
		Frequency	Percent	Frequency	Percent
Valid	Strongly disagree	14	14.7	23	26.4
	Disagree	12	12.6	26	29.9
	Neutral	18	18.9	17	19.5
	Agree	24	25.3	12	13.8
	Strongly agree	27	28.4	9	10.3
	Total	95	100.0	87	100.0

Table 4.2.6 A – Correlation (Non-financial benefits)

The frequency table above shows employees' points of view in GIS and non-GIS organizations regarding the way their organizations evaluate projects. It is clear from the table that the non-GIS organizations way of evaluating projects is limited to financial benefits only and therefore these organizations may not find GIS useful enough to justify the investments required to establish it. GIS organizations, however, tend to consider the intangible benefits of GIS like and that could be one of the reasons behind GIS adoption in these organizations.

Correlations

		GIS or NonGIS organizations	Cost is the main factor in projects and products selection
GIS or NonGIS organizations	Pearson Correlation	1	-.415**
	Sig. (2-tailed)		.000
	N	182	182
Cost is the main factor in projects and products selection	Pearson Correlation	-.415**	1
	Sig. (2-tailed)	.000	
	N	182	182

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.7 A – Correlation (Project selection)

The correlation between organization type and the evaluation methods can be seen in the table above. The correlation is significant and negative because it indicates that GIS organizations don’t consider cost as the main factor as it is the case with the non-GIS organizations. The answer of one of the survey questions "Limitation in budget is why the organization doesn’t implement some solutions" provided a great clue about the link between of cost and GIS implementation as it shows that a large number of non-GIS organizations are prevented from implementing GIS because of financial reasons see the (figure below).

Summary

Limited financial resources which could be caused by top management or external organizations may prevent organization from implementing GISs. GIS are costly and without enough funding many organization want be able to implement them. The hypothesei about cost which states that " Cost has a major influence on organization decision on GIS implementation" seem to be in line with the result of the analysis, as the financial issues seem to prevent GIS implementation in many organizations.

Chapter 5:- Conclusion and recommendations

5.1 Over view

This is the final chapter of the study and that summarizes the findings of the study and suggests solutions to overcome GIS implementation obstacles in the governmental organizations in Abu Dhabi. Limitations of the study as well as the proposed future studies are raised and discussed in order to be solved so that the GIS technology can be utilized by as much governmental organization as possible.

5.2 Results

5.2.1 Over view

At the end of the study, it was found that there were mainly five GIS implementation obstacles, which prevent organizations in Abu Dhabi from implementing GIS. Some of those obstacles were found to be strongly interlinked, which makes hard to tackle each one of them separately. The comparison between GIS and non-GIS organizations proved to be useful as it reveled some of the GIS implementation impediments that would be hard to spot without that technique. The obstacles fall under two categories; human and non human obstacles. The human obstacles are the cultural, communication and employees related. As for the non-human GIS impediments, financial issues and GIS data were the two non-human related implementation impediments.

5.2.2 People

In the study people were classified to two categories, the management staff members and the employees. Both categories were found to have a significant role, especially the management staff members, because they have the final word in technology selection and implementation

approach. The study showed that the management in GIS and non-GIS organization was very different and that these differences were related to GIS adoption. For example management of GIS organizations encouraged user involvement in decisions related to technology as oppose to the management of non-GIS organizations who tend to make decisions regarding technology based on their knowledge and without serious involvement from the employee's side. This obstacle was suspected to be one of the major impediments of GIS implementation, because it was found in the literature review that many IT initiatives fail for the same reason. Another topic that management of GIS organizations and non-GIS organizations approached differently was training. It was found that non-GIS organizations gave less training to their employees than the GIS organizations and that may contributed to increase change resistance and therefore adoption of new systems like GISs.

Beside top managements, employees play an important role, because every project or initiative success greatly depends on employee's acceptance. Employees of GIS and non-GIS organizations differ in many ways and that could be the result of being in different environments. For example employees of GIS organizations have better exposure to technology, because they attend more conferences and workshops. They also showed less resistance to change because of the feeling of involvement that they have, which was much weaker on the non-GIS organizations' employees.

5.2.3 Culture

Many organizational cultural aspects were examined in this study in order to identify the major cultural obstacles to GIS implementation in governmental organizations in Abu Dhabi. The four cultural aspects that were found to be linked to GIS implementation were the change

acceptance, collectivism, masculinity and hierarchy. As for change, the result of the study shows that resistance to change is one of the major cultural aspects that prevent organizations in Abu Dhabi from implementing Information systems including GIS. Another factor that hampers GIS implementation is individualism, which is the tendency of employee to work individually. Unlike collectivism, individualism prevents GIS implementation, because GIS and ICT initiative in general require high degree of collaboration that individualism culture doesn't support. It was found in the study that the non-GIS organizational are very hierarchical and makes them slow when responding to changes like switching from older to newer technology such us GIS technology. Masculinity was also higher in non-GIS organization and that is an indication of prejudice which is very likely to occur against ideas and not gender only. It is clear that many cultural factors in the non-GIS organizations don't create an environment that supports new technology adoption.

5.2.4 Communication

Communications plays an important role in IT initiatives success and lack or absence of proper communication lead usually to series problems. In this study we found that most of non-GIS organizations have communication problem. This was attributed to hierarchical nature of these organizations and to top management actions or inactions. These conditions make it difficult for employees to pass their improvement suggestions to top management and made communication from the management to employees prone to distortion or lose. The findings about communication proof that it is one of the main obstacles of GIS implementation in governmental organizations in Abu Dhabi.

5.2.5 Data

Data that is required by GISs is usually more complex than the data used by the systems that GISs are intended to replace. Since acquiring new GIS data and converting existing data to GIS format is an expensive time consuming process many organizations decide to use their existing systems and avoid the hassle of implementing GISs solutions. In the study we found that some organizations developed wide applications on their non GIS data and those applications are used be several departments and therefore they stick to their existing data to avoid the risk associated with data immigration. In these cases data was found to act as an impediment to GIS implementation.

5.2.6 Cost

Cost is one of the most common obstacles to IT projects like GISs implementations. This study shows that cost of GISs implementation can be very high, as it comes from different sources like hardware, software, training and data. Cost prevents GISs implementation in organizations that relay on project evaluation approaches, which consider only measurable benefits and fail to consider the intangible benefits like customer satisfaction and employees' morals. Cost does also act as an implementation impediment in organizations that have restricted IT budget and don’t have clear understanding of their current and strategic technological ally needs.

5.3 Recommendation

5.3.1 Over view

The numbers of organizations which are adopting or planning to adopt GISs are increasing. According to Abu Dhabi Systems and Information Center (ADSIC) there are more than 50 governmental organizations with full GISs in Abu Dhabi and the number is growing as new organizations join. In fact ADSIC try to encourage some organization to adopt GIS by hosting other organizations' GISs till these organizations build their capabilities and run their own GISs. In fact, the implementation obstacles that face some of the governmental organizations in the Emirate of Abu Dhabi are getting weaker day after day and can be overcome in short time providing that necessary actions are taken.

Government part

Abu Dhabi government can play a vital role in the spread of GISs among the governmental organizations. For example they can fund organizations that have financial limitations and can not have their own GISs. The government of Abu Dhabi can find common grounds between GIS and non-GIS organizations, so that the former can help the later to establish their GISs and the later may provide the former with the GIS data that would result from GISs implementation. The government can make a sense of urgency by asking the non-GIS organizations to switch to GIS and build the needed capabilities to sustain a before a specific date. These kinds of actions fasten the implementation process, because they reflects the government seriousness about GIS implementation. Running awareness programs like workshops and seminars to educate the top management about GISs and their benefits may be one of the affective ways to promote GISs. Targeting top management staffs is very likely to generate good results, as top management can enforce changes like switching from legacy

system to GISs as well as making changes that can affect the culture like creating less hierarchical culture to improve communications or promoting collectivism by encouraging more group projects. As for employees, the government can work in conjunction with educational institutions to grant scholarships to non-GIS organization's employees so that they become a force of change instead of being a force of resistance. This approach which is a top down and bottom up at the same time can increase the likelihood of success of GISs implementation.

Organizations' part

All what GISs need to start and thrive in any organization is the existence of a healthy culture and educated peoples who are aware of the benefits of GIS and are willing to work together and with other organizations to achieve that. However, to have the right culture and people organizations need to take drastic changes that can lead to the formation of a GIS supporting culture and at the same time change the mindset of the people to one that realize the importance of GISs and strive to implement them. Non-GIS organizations should make many changes to their culture so that it become less hierarchical and less resistive to change, because these two characteristic of non-GIS organizations were found to be the main cultural impediment to GIS implementation. As for people, non-GIS organizations should invest on GIS awareness campaigns that inform employees of the advantages of GISs and the role expected from them to facilitate the implementation of GISs in their organizations. This campaign should be customized for management staffs and employees and should include intensive technical, communication and management materials. Non-GIS organizations should consider the non-financial benefits when considering GISs, as GISs have any intangible benefits that can be harnessed over long term.

5.4 Research limitation

There were two limitations of this study. First, the number of employees who took part in the study is small and that affected the credibility of the findings, because the number might not be large enough to make generalization. Secondly, the governmental organizations that were involved in the study were selected only from one of the three regions of the emirate of Abu Dhabi, which may not fully reflect the situation in the other two regions.

5.5 Future research

All the obstacles that prevent GIS implementation; people, culture, communication, data and cost could be the topic for further research, because every obstacle can be a rich research topic. However, human related GIS implementation impediments would make better research topics, as many studies showed that human factors tend to have greater affect on technological initiative success than non-human factors. Therefore, cultural impediment to GIS implementation in governmental organizations in Abu Dhabi would be a good research topic. The research topic could focus on ways to create suitable culture for successful GIS implementation in the governmental organizations in Abu Dhabi.

5.6 Conclusion

The study revealed many interesting findings about GIS implementation in the governmental organizations in the Emirate of Abu Dhabi. It identified five major obstacles, some of which were human related like people, culture and communication while others were non-human related like data and cost. The research question and the sub questions has helped to enrich the study and had an important role in the selection of the mythology. The study also explained the how each obstacle can be identified and overcome and what is the role expected by government organizations and individual in Abu Dhabi to promote GIS and help non-GIS organization to build and sustain healthy Geographical information systems.

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Appendix: Questioners:

Questioners:

Name (Optional):

Type of organization:

A) GIS organization

B) Non-GIS organization

Position (Optional):

Age:

Gender:

A) Male

B) Female

Years of tenure:

Education:

A) High school

B) Diploma

C) Bachelor

D) Master or above

People

1. The benefits of GIS are recognized by the majority of employees

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

2. The current system meets working requirements and there is no need for new solutions.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

3. New IT systems are welcomed by employees – could be culture or people

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

4. High percentage of the employees have substantial experience with the old system

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

5. Top management has always been supportive of key IT imitative.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

6. Employees are sent regularly to attend regional and international conferences and workshops.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

7. Top management seeks employees' ideas when it comes to technology implementation.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

8. Employee job satisfaction is high

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

9. Most past IT initiative succeeded

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

10. Employees who have similar ideas tend to lobby together

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

Communication

1. Many initiatives that are made by employees are implemented or in the process of being implemented

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

2. There is a formal way by which employee can submit a proposals and discuss them with management

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

3. Employees are given enough time to explain their ideas to management

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

4. Employees' ideas are taken seriously

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

5. Meeting between management and employees are held regularly

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

6. There is fear that employees' ideas could be stolen by lower or middle level management

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

7. Decisions made by management are explained to employees

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

8. Employees, whose ideas proofed to improve productivity or quality of work are rewarded.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

9. Employees' concerns are addressed as soon as they surface

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

10. Employees from different departments and levels spend time in common areas like canteens and water coolers.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

Culture

1. Many decisions were taken in the past, despite the fact that not all the needed information was available.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

2. Employees and top management staff have informal conversation about work very often.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

3. Employees can pass suggestions to top management staff freely

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

4. Changes are accepted and dealt with in a systemic way

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

5. There is a high degree of cooperation and data sharing between departments.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

6. Group work projects are popular in the organization

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

Cost

1. Cost is the main factor in projects and products selection.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

2. Sometimes quality is scarified for cost

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

3. Limitation in budget is why the organization doesn't implement some solutions.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

4. Best products and software are bought regardless of their cost.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

5. Current employees are not qualified to run the GIS unless they take extensive training.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

6. The GIS data needed by the organization is not readily available with other governmental organizations.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

7. Cost benefits analysis is one of the main tools in project selection.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

8. Non-financial benefits like customers and users satisfaction are considered in project selection.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

9. Organization's financial resources are limited

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

10. Spending on IT is relatively low.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

11. Studies to understand needed hardware, software, data and training for GIS implementation have been done in the past.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

Data

1. There is no automated way by which the GIS data is exchanged without side agencies.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

2. The organization is asked to meet outside agencies need

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

3. The data available is complex and will take time and effort to be converted to GIS format.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

4. Many departments within the organization rely on the current system and switching to another system will affect them.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

5. There is few or no MOUs or SLAs between the organizations and the major GIS data custodians.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

6. Most of the GIS data without side organization doesn't meet the organization needs.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

7. There is too much GIS information outside that it would be challenging to go through it to find the useful data for the organization.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree

8. Some of the data that is needed by the organization can only be obtained by analyzing data collected from outside organizations.

☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly agree