UNIVERSITY OF BALAMAND

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GIS CAPACITY BUILDING EXPERT FOR UNION OF MUNICIPALITIES IN AKKAR AND NORTH LEBANON

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GIS OPERATIONALIZATION AND SUSTAINABILITY PLAN

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MASAR
MAINTAINING STRENGTH AND RESILIENCE FOR LOCAL GOVERNMENTS IN LEBANON

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GIS OPERATIONALIZATION AND SUSTAINABILITY PLAN

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ACCD Catalan Agency for Development Cooperation

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ABBREVIATIONS

Acronym	Description
ACCD	Catalan Agency for Development Cooperation
COTS	Commercial Off-The-Shelf
DBMS	Database Management Systems
ESRI	Environmental Systems Research Institute
GIS	Geographic Information Systems
GTU	GIS Technical Unit
GUI	Graphical User Interface
IT	Information Technology
MDL	Master Data List
ODK	Open Data Kit
OSS	Open Source Software
QGIS	Quantum Geographic Information System
SMART	Specific, Measurable, Attainable, Reachable, Timely
SOP	Standard Operating Procedures
ToR	Terms of Reference
UoM	Union of Municipalities

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EXECUTIVE SUMMARY

A holistic GIS implementation strategy is vital for the operationalization and institutionalization and the long-term sustainability of GIS within the GIS Technical Unit at the UoM of Oussat wa Sahel al Qaytaa and the UoM of Menieh. The holistic implementation plan consists of three-phase that must be followed in sequence. The first phase is the establishment of a GIS strategic plan, the second phase details a GIS implantation plan that encompasses the four components of GIS, and the third phase includes pragmatic action plans to be followed for the operationalization and institutionalization of GIS. The report also tackles the issue of GIS sustainability and identifies three dimensions that must be carefully planned: financial, organizational, and strategic sustainability. The plan also sets a procedure regarding data sharing policies. Thus, a GIS implementation plan is needed to reduce mistakes and integrate the management of the various aspects of data issues, personnel, and GIS skills needed.

1 INTRODUCTION

This report was prepared under the Scope of Work for the project entitled "GIS Capacity Building and Institutionalisation for Union of Municipalities" agreed between the Clients, the Catalan Agency for Development Cooperation (ACCD), and the Consultant, GIS Center at the University of Balamand.

The geographic scope of the assignment is the Union of Municipalities (UoM) of Oussat wa Sahel al Qaytaa located in the Governorate of Aakkar and the UoM of Menieh located in the Governorate of North Lebanon.

As stated in the ToR, the objectives of this assignment are (1) To support the UoMs in institutionalizing the GIS and the Technical Unit within the current socio-economic situation, (2) To support the UoMs in managing the GIS to fill the existing gaps in data, coordination, operations, decision making, and scenarios planning, and (3) To build the institutional capacity of the local governments and better equip them to retain their human resources in the current economic crisis.

Five outputs have been specified for this assignment:

- **Output 1**: Set Up the structure for the Capacity Building Programme
- **Output 2:** Implement the GIS Capacity Building Programme
- **Output 3:** Workshop with mayors on GIS for decision-making
- **Output 4:** Roadmap for data collection and Municipal manual
- **Output 5:** Operationalize the GIS Technical Unit

This report corresponds to deliverables number 9, 11, and 12:

9. Sustainability plan for the GIS management for each UoM.
11. Action Plan for the institutionalization and operationalization of the Technical Unit.
12. Final Report of the mission with recommendations on the sustainability plan.

2 INSTITUTIONALIZATION AND OPERATIONALIZATION

This section intends to develop an action plan on how to institutionalize and operationalize GIS within the GIS Technical Unit (GTU). The plan elaborates on the implementation process and the actions that should be taken to achieve the strategic objectives of the GTU. A strategy may be good, but if its implementation is poor, the strategic objective for which it was intended may not be achieved. For a strategy to be successfully implemented, it requires two things: (1) Operationalization and (2) Institutionalization. Operationalization of strategy refers to developing operational plans and tactics through which an abstract strategy will be implemented. Operationalization ensures that the GTU's daily activities and work efforts directly relate to the strategy. Operational strategy is more specific, concrete, and short-term in nature. It spells out what will be done immediately or within short periods (e.g. yearly periods) by the GTU. Institutionalizing strategy is a matching strategy to the institutions of the organization. Whatever is required to implement a strategy must be built into organizational institutions such as structure, leadership, culture, support systems, processes, and policies.

Hence, to operationalize and institutionalize the GTU, the starting point is to set up a GIS strategy with *Specific, Measurable, Attainable, Reachable, and Timely* (SMART) objectives. The next step is to develop a GIS implementation strategy and then transform it into an executable action plan as shown in Figure 1.

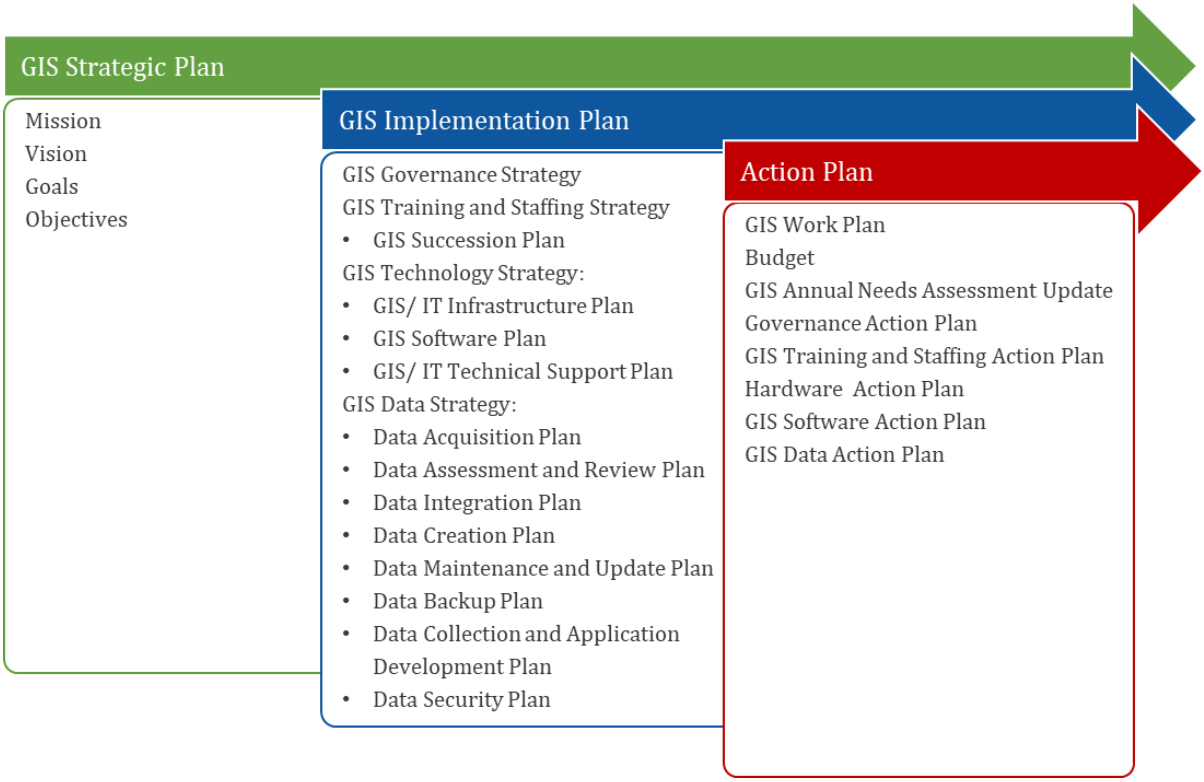

Figure 1 - Process to GIS Operationalization and Institutionalization

2.1 GIS STRATEGIC PLAN

The first step in any successful GIS implementation is to set up a strategy with a well-drafted mission, vision, and goals that must be translated into SMART objectives and a set of activities with a specific schedule of implementation. A GIS strategic implementation plan is a ***plan of action*** and it is crucial to the success of any GIS implementation strategy. It is highly advisable to annually update the strategic plan to stay relevant to the GTU's vision and the practical aspects of implementation.

Hence, it is important to articulate the overall mission and vision of GIS for the GTU of the UoM of the Oussat wa Sahel al Qaytaa or the UoM of Menieh. These statements help define the purpose of a GIS and give it its identity and can help as a road map for the activities that must be carried in the short and long run. In general, *the mission is what people do to achieve the vision*. It is the ***how*** (mission) versus the ***why*** (vision).

2.1.1 Mission Statement

The mission statement of the GTU is a declaration of what they do every day with GIS. It defines the day-to-day activities of their GIS work. The mission statement must be developed by the Head of the UoM of the Oussat wa Sahel al Qaytaa or the Head of the UoM of Menieh. The heads of the unions are the ones responsible for this task as they need to translate their long-term vision of what they want to achieve with the use of GIS into a concise statement that will create a road for setting goals and for the GIS implementation plan. Each UoM can have its mission statement to reflect its vision. The mission statement must be written before the start of the implementation and it serves as a guide for the implementation process.

A potential mission statement for the GTU is to: "*Provide accurate and comprehensive Geographic Information System for better managing municipal resources, improving analysis, making informed decisions, and enhance work processes to better serve citizen*".

2.1.2 Vision Statement

A vision statement creates a direction for what the GTU wants to achieve with GIS in the future. Practically, a lack of vision is like driving down a road without a map. Hence, the GIS Coordinator and GIS Technician may be moving forward but without having a clear idea of

what do they want to achieve or reach with the use of GIS. Hence, a good vision statement will create that much-needed direction and will express that direction's importance.

The Head of the UoM of Oussat wa Sahel al Qaytaa and the Head of the UoM of Menieh must develop the vision statement for each GTU based on what they envision they will reach with the use of GIS in the future. The vision statement must be written before the start of the implementation process.

The following vision statement is suggested for the GTU of the UoM of the Oussat wa Sahel al Qaytaa and the UoM of Menieh: "*The GTU's geospatial initiative is envisioned to govern, coordinate, and implement an integrated union-wide GIS to support the effective, practical, and innovative use of GIS*" or "*The GTU's geospatial initiative is envisioned to support the overall vision and goals of the municipalities*".

2.1.3 GIS Goals and Objectives

It is the responsibility of the Head of the UoM of Oussat wa Sahel al Qaytaa and the Head of the UoM of Menieh to define the goals and objectives of the GTU. It is highly recommended that the Governance Committee and the GIS Coordinator review the goals and objectives to ensure that they can be achieved and meet the needs of municipalities and other stakeholders.

Since the GTU's GIS effort should focus on acquiring, converting, integrating, maintaining, documenting, analysing, coordinating, and distributing geographic information to all the municipalities within each UoM and various stakeholders based on their needs. The goals and objectives must be developed before the implementation process starts.

Below are six overarching GIS goals with SMART objectives that the GTU must be striving for and can form a base to build on.

2.1.3.1 Goal #1: Accurate and reliable GIS data

- Objective 1: Enforce a centrally managed, unified, and standardized geographic database.
- Objective 2: Establish standards and procedures for the development and maintenance of data.
- Objective 3: Create and develop new GIS data.

2.1.3.2 Goal #2: GIS data management and maintenance

- Objective 1: Establish and enforce accuracy standards, update procedures, and database compatibility for GIS data.
- Objective 2: Coordinate data sharing with municipalities, and other stakeholders.
- Objective 3: Use GIS as a tool to provide timely and accurate data to decision-makers.

2.1.3.3 Goal #3: Accessible GIS data

- Objective 1: Establish effective access to geospatial data.

2.1.3.4 Goal #4: Integration with existing systems

- Objective 1: Integrate GIS with existing systems.

2.1.3.5 Goal #5: Implement an optimal GIS governance model

- Objective 1: Institute a clear and understandable strategy for GIS governance with policies and procedures for the effective management and utilization of GIS.
- Objective 2: Develop inter-governmental agreements to facilitate data sharing and cooperation among various stakeholders.

2.1.3.6 Goal #6: Develop data collection application, projects, and analysis

- Objective 1: Develop custom applications for data collection.
- Objective 2: Implement specific GIS projects for analysis and inquiry of new GIS information;
- Objective 3: Perform complex GIS analysis.

2.2 GIS IMPLEMENTATION PLAN

The plan proposed hereafter intends to make GIS implementation at the GTU a goal-driven, rather than technology-driven, process. That is, the emphasis is on the GTUs' or municipalities' operation needs and how they can be addressed more efficiently and effectively using GIS, rather than on GIS technology itself. Therefore, it is essential to understand the various elements that form GIS and how they are interrelated.

GIS is composed of four components that are indispensable for a successful GIS implementation:

1) **Organizations and institutional policies and procedures** must be prepared that are conducive to (or at least do not present obstacles to) the successful implementation of GIS. Hence a GIS governance strategy must be developed.
2) **Useful and accurate data** must be available. These data should be well documented with adequate metadata to facilitate data sharing and simplify their usability. The projection must be also well defined. Hence a GIS data strategy must be developed that includes a data acquisition plan, data assessment plan, data integration plan, data development plan, and data collection and application development plans.
3) An efficient **computing environment that encompasses both hardware and software** must be configured to manage data and perform analysis effectively. Hence a GIS technology strategy must be developed that encompasses both software selection plan and hardware selection plan. Additionally, a technical support plan must be set in place to wash out any technical difficulty.
4) **Trained Personnel** are needed to develop, use, analyse, and maintain the GIS applications. Hence, personnel must be recruited and a training strategy is needed. Hereafter, a training plan must be developed.

Figure 2 shows that GIS technology cannot be implemented properly if the key elements are isolated from one another. Insufficient attention to any of these four components can lead to implementation failures. For best results, the four components must be considered systematically, with particular attention paid to their interaction.

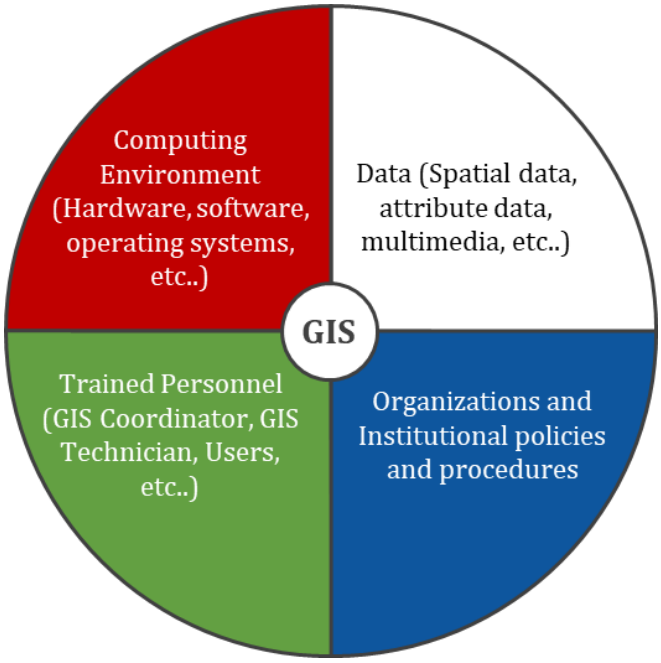

Figure 2 - GIS Components

The order in which these four components are addressed and implemented at the GTU is important. Figure 3 shows the two interacting paths for implementing a GIS at the GTU.

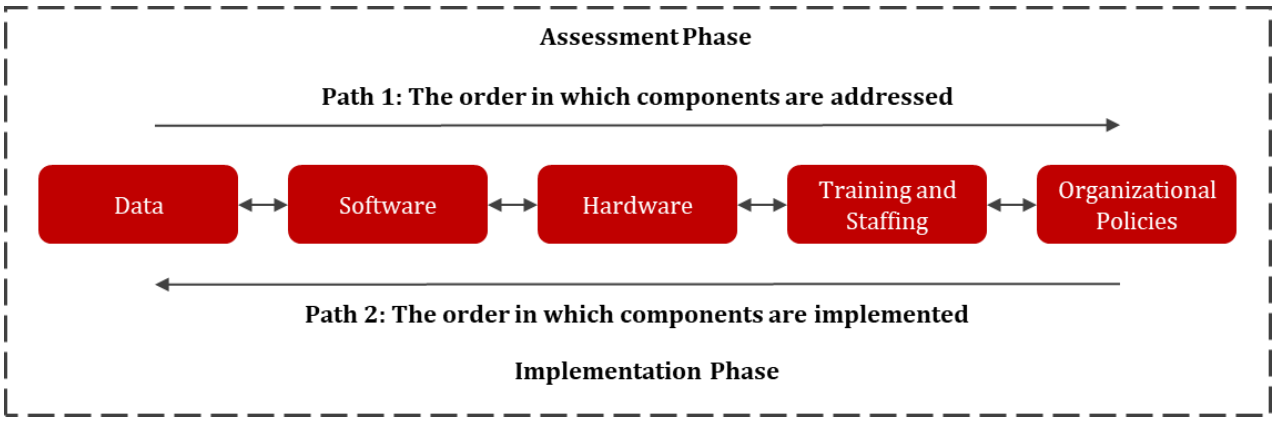

Figure 3 - The whole Process of Implementation GIS at the GTU

The first path is the assessment path of GIS implementation, in which existing resources (computing environment, data, staff and skills, and organizational policies and procedures) and limitations are analysed and some potential GIS activities are identified and selected. The first step in the assessment path (Path 1) is to study existing resources and assess the different levels of user needs at the GTU. The second step is to identify the expected products or outputs that can satisfy the GTU needs. The third step is to identify the data (attributes, accuracy, scale, detail, etc.) required to produce the desired output. Data requirements influence the type of software and hardware required for data processing and management. The software, and data inputs, as well as required future applications, will determine the personnel skills needed to develop, use, and maintain the GIS application. Finally, organizational policies are required to ensure that the whole system is developed and works in a coherent, consistent manner. These various components can be addressed concurrently, but it is important that they cannot be handled in reverse order. The assessment phase is already done by the ACCD consultant and the recommended software, hardware, data, training, and organizational structure were reported. Additionally, data were acquired and purchased by the same consultant.

The second implementation path (Path 2) is based on the results of the first path, but the order of components is reversed. First, organizational policies are established to provide a suitable environment for the implementation of GIS. Second, personnel must be trained or hired to develop, use, and manage the system. In this project, a pool of trainees is selected and received intensive GIS training. Outstanding trainees will be recruited at the GTU. Third, hardware must be acquired, and software must be installed. Fourth, data are acquired, developed, and loaded

into the system. Finally, specific applications can be developed to serve the needs of the GTU such as projects related to solid waste management and road safety. The acquisition of the data can be concurrent with the training and hardware and software purchase and installation. However, data development must happen at the end of the process.

Hence the key factors that are considered the secret ingredient for success for any GIS implementation strategy are enumerated in the following section.

2.2.1 Component 1: GIS Governance Strategy

GIS governance is described by the following tasks with all the key components for a sustainable, and enduring GIS solution in the GTU. All these tasks must be transformed into actionable steps.

- A formalized governance model: A governance model lays outlines of responsibility and the hierarchy of decision-making power within the GTU. These lines connect the Head of the Union with the GIS Coordinator and GIS Technician and more broadly the stakeholders. Formalizing a governance model allows the GTU to maximize accountability and efficiency. A GIS governance strategy is already been proposed by ACCD GIS capacity building consultant. However, the strategy must be formalized by the Head of the UOM to be deployed.
- Job description and classifications: The various positions within the GTU should be well described and classified according to the formalized governance model. These job classifications denote the skill set, decision-making power, hierarchical standing, and overall responsibilities of a given position within the GTU. The GIS Coordinator and the GIS technician exemplify standard job classifications at the GTU. Keep in mind that these job classifications may need adjustment during the GIS implementation process.
- GIS authority and clear lines of responsibility: A line of responsibility describes the vertical chain of liability and authority at the GTU based on the proposed organizational structure. A line of responsibility formally lays out who is responsible for what and to whom. The GIS governance strategy details the authorities and the lines of responsibilities within the GTU and with the municipalities and the Head of the UoM.
- Coordinated and centralized GIS enterprise: A coordinated GIS enterprise refers to a situation where the GTU's GIS governance model allows for the GIS Coordinator to

oversee and coordinate all GIS projects centrally at the GTU as if they were part of the enterprise. That is to say, all GIS projects are managed by a centralized person at the GTU. Though they interact with other municipalities daily, the GTU holds the ultimate responsibility for administering, monitoring, and developing their GIS.

- Sponsor and champion: Experience with successful GIS implementations has revealed the presence of two key individuals called the "sponsor" and the "champion". The sponsor is part of the top management that could be the Head of the Union or one of the municipality mayors. The sponsor must create the appropriate conditions for champions to work properly and must be able to support them. The sponsor has executive powers especially for deciding future GIS directions, allocating budget, and exercising coercive power over the GTU employees (both the GIS Coordinator and the GIS Technician). Champions in the GTU are the GIS Coordinator and/or the GIS Technician. The champion is responsible for designing and implementing GIS to reflect the vision and goals set by the sponsor. Both sponsor and champion must be involved and work in synergy for the technology to fit the needs of the municipalities well. Hence, it is essential to identify the sponsor at the beginning and involve him in the implementation process. Also, the recruitment of the champion to work at the GTU must be done carefully as they impact the success of any GIS implementation process. The recruitment must occur early in the implementation process since the GTU employees must be involved in every process.
- GIS technical committee (volunteer trainees): The GIS technical committee will be composed of the trainees who successfully finished the GIS training. The role of the committee is to help the GIS Coordinator and the GIS Technician in overcoming the technical challenges of GIS at the GTU and to oversee its implementation. It will also assist in various GIS tasks related to data collection, map digitization, and specific project development. Most of what this committee does is related to GIS database development and other data collection-related work. The technical committee must be established at the beginning of the implementation process.
- Stakeholder/Governance group or committee: A Stakeholder/Governance group should consist of those who use, create, and have sets of rules and requirements for the data to be stewarded. They also have insight on issues related to data accuracy, content, and use of the data within the data community. Hence, selected personnel must be appointed by the mayors with the proper IT background in DBMS, data standards, and data quality

to be part of the governance committee. The GIS Coordinator must work closely with the governance committee to create data standards related to metadata, spatial accuracy, and publication of the data standards. This is considered an essential step to unify the data. Most of what this committee does is related to drafting data governance strategies, policies, and procedures.

- GIS collaboration agreements: A formalized agreement between parties or entities to cooperate. GIS requires collaboration between various stakeholders for sharing of data. Often, memorandums of understanding (MoUs) guide the formal collaboration where multiple organizations share data. The GIS Coordinator must seek to establish these agreements with the head of the UOM.
- A GIS culture of collaboration: A culture of collaboration refers to an attitude that is expressed by stakeholders in their relationships with one another, as it pertains to an enterprise GIS. It is an unquantifiable web of positive interpersonal interactions that facilitates creative problem-solving and resource sharing among individuals and municipalities to achieve commonly held goals at the GTU. Even this task is not tangible, it is essential. It is achieved by the positive attitude of the municipal mayors who should endorse and support the collaboration with the GTU. In general, all the mayors in both unions, except for the municipality of Merkabta in UoM of Minieh, are endorsing a collaborative culture.

2.2.2 Component 2: Training and Staffing Strategy

The following list details the GIS training and staffing plan. The training plan must not only be limited to the formal GIS capacity building but also must incorporate a plan for continual training due to the depth and breadth of GIS tools and the fast-paced in developing new tools and the constellation of peripheral technologies that are integrated with GIS. Additionally, the recruitment of the GIS Coordinator and GIS Technician must be very rigid and based on technical expertise, and merit.

2.2.2.1 Training Plan

- Formal GIS training plan: A formal GIS capacity building was conducted between January and March 2021 over eight weeks. Sixty-Four hours of GIS training were given to 33 trainees. The training was grouped into three-level: beginner, intermediate and

advanced. The training covered both the GIS theory and the software tools. The reason behind the theoretical part is to allow trainees to migrate to any GIS software easily as long as they know the theory behind it. This approach will ensure the sustainability of GIS in the long run especially with the rapid change in technological tools. Formal exams and a real-life project that encompassed data collection application development and data display and analysis were given to trainees. The training resulted in 19 trainees successfully finishing the training.

- Informal ongoing GIS training plan: It is **vital** to have an ongoing informal training plan for the GIS Coordinator and the GIS Technician and some of the trainees in the GIS Technical Committee, considering that GIS is a rapidly evolving technology, and organizational needs are ever-changing. Online free resources are readily available and can be deployed easily by the GTU employees since they have the proper theoretical knowledge in GIS. The informal training must be ongoing and the **Governance Committee must oversee this process** and ensure that the GIS Coordinator and the GIS Technician did not lose pace with the rapidly evolving technology. Some strict measures must be taken by the Head of the Union, like contract termination, in case the GTU employees did not invest time in informal training.
- Knowledge transfer: The collaboration between various GTUs, GIS departments, GIS management units, and GIS committees is essential for knowledge transfer. Knowledge transfer constitutes an important element in gaining technical expertise and sharing best practices and contributes to the technical development of the GIS employees within the GTU. The GIS Coordinator must maintain this knowledge transfer network and must work on increasing this chain.

2.2.2.2 Staffing Plan

- Recruitment of GIS personnel: The recruitment process of GIS employees is crucial for the success of any GIS implementation initiatives. The skills and the technical background of the employees are very important factors for the selection criteria. Additionally, personality traits must also be evaluated especially for the GIS Coordinator position since his role requires establishing communication channels with various stakeholders.
- GIS staff participation in implementation: GIS staff involvement and participation in the implementation process especially in the design and the development of the new

system is considered essential for him to gain a hands-on practical knowledge that promotes the long-term sustainability of GIS at the GTU.

2.2.2.3 GIS Succession Plan

- Succession planning refers to an organization's strategy for filling essential but vacant positions with experienced employees. Part of the GTU sustainability is to ensure the succession of the GIS Coordinator and the GIS Technician. Hence, the involvement and the ongoing training of the GIS Technical Committee personnel is essential. The GIS Technical Committee contains a pool of trained and skilled personnel that are essential in succession planning to ensure GTU sustainability.

2.2.3 Component 3: Computing Environment Strategy

The computing environment refers to the hardware, software, Information Technology (IT) infrastructure, technical support, and developments that support the GTU's GIS activities and processes and leads to its long-term sustainability. Hence, a strategic computing environment plan describes an organization's current and future relationship with GIS technology (both hardware and software) and outlines how this technology will further the goals of the GTU.

2.2.3.1 Hardware Plan

The hardware plan is not only about the computers, the operating system, or the network but also it must encompass the various processes that support the policies and procedures that maintain sustainable GIS operations at the GTU. Hence the following plans must be considered:

- Hardware selection: The number of desktop computers, scanners, printers, and hard disks along with their specifications were identified during the assessment stage. However, they were modified and upgraded to better ensure a longer life span and better operational and storage capabilities. The hardware is under purchase and will be ready shortly within the GTU.
- GIS backup plan and storage plan: GIS backups are a protective measure that preserves the GTU's centralized data on a data storage. Data storage refers to digital information stored locally on premises and/or in the cloud like using Google Drive or OneDrive. Hence, the GIS Coordinator must decide on various data storage plans especially.

Parallel to that, daily or weekly backup procedures must be developed by the GIS Coordinator.

- Hardware replacement plan: A hardware replacement plan is a formal plan for upgrading and maintaining the hardware resources in the future. Budgetary concerns, goals, and long-term objectives must be considered. This is very important especially with the financial crisis in Lebanon and the deterioration of the Lebanese pound monetary value. Hence, due to the tear and wear of the hardware, and the high value of purchase a replacement plan must be developed with items in the budgets to ensure the sustainability of the GTU.

2.2.3.2 Software Plan

GIS software provides the functions and tools needed to store, analyse, and display geographic information. Key components of GIS software always include:

1) Tools for the input and manipulation of geographic information.
2) A database management system (DBMS).
3) Tools that support geographic query, analysis, and visualization.
4) A graphical user interface (GUI) for easy access to the tools.

Today, there is a wide range of GIS software packages on the market. The objective here is to create an optimum and cost-effective software deployment strategy.

- Software evaluation and selection: During the evaluation phase, two software were debated. The ESRI ArcGIS and the QGIS (GIS commercial off-the-shelf (COTS) versus open source software (OSS)). It would seem that ESRI is the de-facto local government standard and offers a comprehensive toolset for municipalities and governments across the world. However, its cost especially in Lebanon is relatively high as it is charged in fresh US dollars. ESRI offers a variety of licences and software packages from basic to advance. QGIS offers a wealth of GIS functions, provided by core features and plugins. ArcGIS provides more functionalities and capabilities and is more stable than QGIS. Note that trainees at this stage can be considered professional in ArcGIS and they can easily use QGIS since the training covered both the theory and the software tools. So, they can easily migrate between software when necessary.
- Data collection tools: Various data collection tools exist that can be either open source or commercial. ArcGIS Survey123 is used to develop forms for data collection under

the ArcGIS Online license. KoBoToolbox and Open Data Kit (ODK) are open source and free tools for designing forms and field data collection. The GIS capacity building covered the KoBoToolbox for designing a survey, collecting data, and displaying them in ArcGIS.

- Database Management Systems: Most GIS packages have a database management system, either bundled internally (Geodatabase within ArcGIS, or PostgreSQL with QGIS that requires coding knowledge) or interfaced with an external, third-party database management system (DBMS). The focus for recommending a DBMS should be on better integration of the recommended GIS package and the DBMS. At the same time, the recommended database software can easily be accessed by the GIS users. It is better to use the DBMS that comes with the GIS software rather than to purchase a commercial DBMS for sustainability. The ESRI ArcGIS geodatabase is easy to create as it does not require any coding knowledge and can be used in QGIS.

2.2.3.3 GIS/IT Technical Support Plan

The GIS Coordinator and the GIS Technician often need help or encounter problems while working with GIS technologies. Hence, a GIS technical support agreement is essential to walk users through issues and provides readily available troubleshooting information.

Parallel to that, an IT support plan must be also considered to ensure the maintenance of the computers and the various equipment within the GTU. A contract must be negotiated on yearly terms and the value of the IT support must be accounted for in the budget.

2.2.4 Component 4: GIS Data Strategy

All of the key data and database components of an enterprise, sustainable, and enduring GIS solution in local government.

- Data acquisition plan: After the initial assessment conducted by ACCD consultant, certain data were acquired such as the satellite images, the cadastral maps, and the zoning. Additionally, layers related to road centrelines, land use land cover, and contours lines were also available. However, based on experience in municipal GIS development the acquisition plan must follow certain steps as per the following recommendations:

Step 1 – Identifying the main GIS municipal tasks that will be carried at the GTU. The tasks could be:

1. Digitalization of property maps and land records
2. Digitization of existing spatial entities such as buildings
3. Property tax assessment
4. Infrastructure database development such as water and wastewater network solid waste, electrical network, road network
5. Survey of demographic data, point of interest, car accident location

Step 2 – Determining GIS standard operating procedures: Standard Operating Procedures (SOP) are the GTU's formally ratified blueprint for actions to be taken in pursuit of the desired objective. They are step by step, formulaic, and repeatable primary GIS operations related to the tasks performed by the GTU. Five primary GIS operations related to the above-mentioned tasks are stated as follow:

1. Data entry
2. Manage, transform, and transfer data
3. Query and analysis
4. Display and report
5. Data collection application

Step 3 – Creation of a Master Data List (MDL) enumerates all of the critical data layers that GTU needs for performing the tasks. The various critical data layers should be detailed by type and source and assessed in terms of their quantities, accessibility, and formats. Critical data layers for the above-mentioned tasks are:

1. Parcels
2. Building footprints
3. Street Centrelines
4. Infrastructure datasets
5. Contour lines
6. Satellite images

Step 4 – Data acquisition. Once all these steps are performed, data acquisition can start to fit the needs of the GTU work operation.

Step 5 – Database design. Once all the data are acquired, a database is created to populate all the GIS data layers in a central repository. Pooling data in this manner allows for ease of maintenance, and monitoring.

Step 6 – Metadata creation. Metadata is essential to be created to details how, when, and where data has been created or collected along with its documents scale, accuracy, resolution, and other properties.

- Data assessment and review plan: Data assessment is vital to examine and evaluate the accuracy, completeness, and overall health of the acquired data layers for the GTU. Once the data are examined, gaps and weaknesses are identified and subsequently improved. It is vital to refer to a neutral party for the assessment and review. It is recommended that the GIS Technical Committee perform this task neutrally without being influenced by anyone.
- Data integration plan: Integration describes the process whereby information is gathered from various municipalities into the central data repository at the GTU. The plan also encompasses the policies and procedures related to data exchange between various stakeholders.
- Data creation plan: New data creation procedures must be developed to create standardizing guidelines by which the GTU's new data are created and stored in the central repository database at the GTU. This is an important set of procedures, as it protects against redundancy and needless work, both of which reduce overall cost-effectiveness.
- Data maintenance and update plan: Data maintenance and update procedures are a subset of SOP that designate how to monitor and keep current and update the massive amounts of data that are created and stored within the GTU. The GIS Coordinator must draft these procedures and define the period for data update. It is advisable to update the data quarterly to ensure their timeliness.
- Data backup plan: Data backup procedures are a subset of SOP that designate how to backup the GIS data within the GTU. The GIS Coordinator must draft these procedures and define the period for data backup. It is advisable to back up the data on a daily/weekly basis to avoid data loss if any technical problem occurred.
- GIS data collection procedures: GIS data collection procedures are a subset of SOP detailing how data from the field must be collected. The data collection road map along with the data application development was covered extensively in the GIS capacity building. However, standards procedures must be developed by the GIS Coordinator to ensure a unified process for data collection.

- Data security policy: Data stewards is the responsibility of the GIS Coordinator and the GIS Technician who are responsible for the administration and securing the GTU GIS datasets. They are custodians in that they monitor the security of departmental data and give the necessary rights for the various GIS employees.

2.3 GIS IMPLEMENTATION ACTION PLAN

2.3.1 Governance Action Plan

Vision: Implement an optimum GIS Governance Model that centralizes technology and decentralizes users.

Goal: Provide management with understandable strategies for the effective utilization of GIS technology. In addition to improving overall governance, this strategy should include clear lines of responsibility and facilitate stakeholder's decision-making.

Task 1: A formalized governance model

Adopt and ratify an enterprise governance model that supports a sustainable GIS.

Task 2: Job description and classifications

Modify the job descriptions and titles for staff who are involved with the implementation of GIS technology. Job titles are important designators for staff, and deploying the correct label can have a positive effect on personal accountability and technological engagement.

Task 3: GIS authority and line of responsibility

Support ratified governance model with clear and concise lines of responsibility, accountability, authority, and custodianship of the digital data layers.

Task 4: Coordinated GIS enterprise

Emphasize a governance model and staffing structure that centers on the coordination of the GIS enterprise.

Task 5: Sponsor and Champion

Have a team of sponsors for the initiative, headed by the UoM heads, and from the active mayors. The Sponsors must meet o a monthly basis with the GIS Coordinator to facilitate the GTU operations.

Task 6: GIS technical committee

Establish the responsibilities of the technical committee that are formed from the trainees and integrate them within the GTU.

Task 7: GIS Governance committee

Formalize, promote, and organize a governance committee from a multidisciplinary background that will meet on a monthly or quarterly basis to discuss various functional and technological issues related to the GTU issues.

Task 8: GIS collaboration agreements

Work closely with municipalities, and outside stakeholders to promote coordination, save resources, and foster cooperative attitudes.

Task 9: A GIS culture of collaboration

Create a culture of collaboration throughout the GTU and all external stakeholders. Accomplish this by improving communication.

2.3.2 GIS Training and Staffing Action Plan

Vision: Train, recruit, educate, and promote knowledge transfer among all staff members.

Goal: Develop a training plan that promotes effective knowledge transfer. Recruit the appropriate GTU staff, improve the GIS knowledge base within the GTU. Encourage the effective utilization of GIS technology.

Task 1: Formal GIS training plan

Implement a formal, sustainable GIS training plan.

Task 2: Informal ongoing GIS training plan

Provide informal GIS training to staff regularly. Utilize GIS online education and free training resources for all the staff.

Task 3: Knowledge transfer

Establish a GIS user group network as a knowledge transfer opportunity.

Task 4: GIS staff recruitment

Recruit GIS Coordinator and GIS Technician.

Task 5: GIS user involvement

Involve GIS users in the implementation process.

Task 6: Succession planning

Develop a strong GIS user base via training, and proactive succession planning from the GIS technical committee.

2.3.3 Hardware Action Plan

Vision: Select, deploy and utilize the proper hardware and IT infrastructure to support an enterprise, scalable, and sustainable GIS.

Goal: Create and continually evaluate the GTU's hardware and IT infrastructure to sustain enterprise growth and change.

Task 1: Hardware selection

Select the necessary hardware that can ensure proper operation of GIS.

Task 2: GIS data storage

GIS has historically been a space hog. Select the proper storage.

Task 3: GIS backup plan

Enterprise GIS backup is a prerequisite for any enterprise GIS deployment. Confirm that the GTU has the procedures, storage, and protocols for all the required data storage.

Task 4: Technical Support

Establish a service contract agreement with hardware providers for maintenance.

Task 5: Hardware replacement plan

Understand the hardware replacement strategy within the GTU. Integrate it into the budget.

2.3.4 Software Action Plan

Vision: Make GIS software accessible throughout the GTU.

Goal: Deploy a GIS software solution across the enterprise.

Task 1: GIS Software evaluation and selection

Evaluate various GIS software (COTS and OSS). Select the one that increases the efficacy of GIS operations at the GTU.

Task 2: Evaluate and select data collection tool

Evaluate various data collection tools (COTS and OSS). Select the one that facilitates the field data collection.

Task 3: Evaluate and select a Database Management System

Review the DBMS available for free and that comes with the GIS software and deploy it.

Task 4: GIS technical support

Establish agreements with GIS research centres for GIS technical support. Involve the GIS Technical Committee in the GIS technical support.

2.3.5 GIS Data Action Plan

Vision: Design, build, update, collect, and maintain reliable and sustainable GIS data layers.

Goal: Use a GIS standardized data model for the future growth of the GTU. A standardized data model should be used to build and maintain accurate, consistent, and reliable geographic data.

Task 1: Data acquisition

Determine the main GIS tasks and identify the critical data layers that are essential. Acquire the data layers.

Task 2: Database design

Create a database and populate all the acquired data layers. The design must ensure interoperability, scalability, and sustainability of GIS.

Task 3: Metadata creation

Establish and enforce SOP for metadata-related activities.

Task 4: Data assessment

Perform a comprehensive assessment of the quality, quantity, and completion of all digital data layers.

Task 5: Data integration

GTU needs to supplement and integrate its existing digital data repository with new data from other municipalities and stakeholders.

Task 6: Data creation procedures

Develop uniform standards for the creation of all new digital GIS data. Essentially, this implies a new formal SOP and may include multiple methods for new data creation.

Task 7: Data maintenance and update procedures

Develop all procedures and protocols for the maintenance and update of digital data by the GTU custodian.

Task 8: GIS data collection procedures

Develop policies and standards operation procedures for data collection.

Task 9: Data backup

Backup the GIS data daily/weekly on a hard disk to ensure sustainability.

Task 10: Data Security

Security and permission settings will allow the ownership and stewardship of every digital data layer. The GTU must house all GIS data and the GIS Coordinator must give rights to GIS users.

Task 11: Stewardship

Clearly define data stewardship roles within the GTU governance model. Include an agreement between all municipalities regarding the ownership of every digital data layer.

2.3.6 GIS Annual Needs Assessment Update

It is necessary to conduct an annual need assessment to sustain the use of GIS at the GTU. The need assessment will set new goals that must be accomplished in the future that enables the growth of the GIS database and enhance the work operations at the GTU. It is the responsibility of the Head of the Union with the Governance Committee and the GIS Coordinator to carry the need assessment. The need assessment will lead to an annual update to the strategic plan, vision, and goals.

2.3.7 GIS Work Plan

Based on the annual need assessment, an annual detailed GIS work plan is developed. It proposes the schedule and budgeting for a specific project. It not only offers a step-by-step description of the ways that a plan will be enacted but also projects a timeline and explains how funding will be deployed within the plan's framework. The work plan associated with a GIS initiative should be updated on an annual basis to reflect the evolving needs and priorities

of a GIS at the GTU. Essentially, it lays out a work plan for the GIS team as it relates to the priorities of the GIS set by the Head of the Union.

2.3.8 GIS Budget

To execute the work plan, once the implementation phase is accomplished, the annual budget must be developed. However, the following items must be taken into consideration:

- A GIS budget or funding model: A funding model is a methodical and institutionalized approach to building a reliable revenue base to support an organization's core programs and services. In our context, an organization's funding model explains how the geospatial technology initiative will be funded. Initially, ACCD will fund the GIS implementation process. However, the GIS budget and funding model must be generated for the coming years to ensure sustainability.
- Grants and funding initiatives: A funding initiative allows the GTU to diversify the funding for its GIS initiative. The GIS Coordinator at the GTU should hunt all opportunities for grant funding to support the GIS initiative.
- Revenue generation: Revenue generation is a policy whereby the GTU can charge for GIS data and services. Essentially, this is when the GTU charges a fee above and beyond just cost recovery. The philosophy is that a price can be set for GIS services to essentially pay for the entire cost of implementing and maintaining its GIS program. Many sources of revenues can be explored such as hunting opportunities for data collection to NGOs, developing GIS applications to other municipalities, etc.

2.4 IMPLEMENTATION TIMELINE

The following diagram shows a tentative timeline for GIS implementation at the GTU.

The timeline reflects what has been done already and what needs to be done.

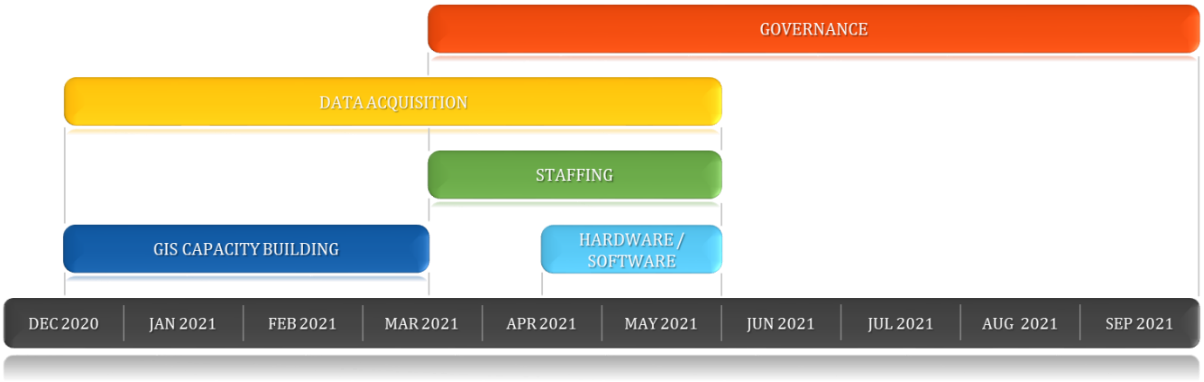

Figure 4 - GIS Implementation Timeline

3 GIS SUSTAINABILITY PLAN

It is essential to draft a sustainability plan that not only maintains the GTU after the seed fund but also leads its continuous growth and be capable to respond to emerging community needs.

The sustainability plan will include:

- ***The strategic dimension of sustainability***: this part will set the realistic vision and strategic goals for the GTU. Hence, the strategy must be very realistic to achieve the vision and goals. However, this is essential to create development milestones for the GIS work.
- ***The financial dimension of sustainability***: this part will identify the possible sources of income or funds to ensure the GTU's financial independence, or at least to partially cover some of the expenses such as employees' salaries, daily operation costs, etc. Hence, funding strategies must be well-drafted based on realistic expectations.
- ***The Organizational dimension of sustainability***: this part is related to personnel sustainability and employee retention cost or succession plan. Hence, it is impartial to identify ways to retain GIS employees at the GTU. The cost of employees' turnover in the GIS field is very high since it is directly related to the high cost of training and the scarcity of GIS expertise. Additionally, a strategy related to succession so the work will not be interrupted in case the employee left. The employee's continuous training in the field of GIS and technical support are vital in this dimension.

3.1 STRATEGIC SUSTAINABILITY

Ensure realistic vision and strategic goals for the GTU.

If these are not realistic, then the GTU employees will have no direction for the GIS operations and likely they intend either to overachieve or underachieve. As a result, it is very likely to lose direction and eventually the failure of the GIS implementation initiative. The Head of the UoM must take this step very seriously and they must seek all the help they can get from the Governance Committee to develop the strategy.

Ensure realistic strategies to achieve the vision and goals.

Even if the vision and goals are realistic, if the efforts to achieve them are unrealistic, then the GTU will have the same problems as mentioned above.

Modify the vision, goals, and strategies to remain realistic when implementing plans.
One of the most important parts of a plan is often forgotten – procedures for how to change the plans. Consider extending deadlines to achieve goals or dropping them altogether if that is what it takes to ensure long-term sustainability.

3.2 FINANCIAL SUSTAINABILITY

3.2.1 Budgeting, Operation, and Maintenance Cost

This is an important part of the financial sustainability plan. Preparing a yearly budget for the operation and maintenance costs is essential to ensure that the available sources of funds can cover the expenses. A GIS operational budget will change over time as a system matures. The three primary components of an operational GIS budget include staff, goods and services, and equipment and software.

A rule of thumb is to decrease expenses to sustain the GIS Management Unit. This can be done by:

- Decreasing the GIS software yearly maintenance cost to zero by using open-source software or freeware.
- Decreasing the data collection and data update cost by relying on volunteers or collaborations through a memorandum of understandings with technical schools and universities that require training as part of the graduation requisites. Additionally, collaborations with volunteers from the Lebanese Red Cross can be very beneficial especially in field data collection which can be a win-win situation for both parties since they can share ownership of the data and each can make use of it according to their needs.
- Optimizing the number of full-time staff at the GIS Management Unit. Municipal employees can be working on a part-time basis in the unit. Another scenario can be that the salaries of employees are funded equally by all municipalities and not from the GIS Management Unit budget.
- Decreasing printing cost. It includes paper and ink that can be easily optimized by reverting to digital communications and formats.

Other operation costs that must be accounted for are:

- Internet cost can be shared with the UoM especially if the GTU is established within the UoM. Else, the cost is inevitable.
- Equipment maintenance cost is directly related to the lifecycle of its parts. First-year maintenance cost is usually free of charge and included as part of the equipment purchase. It is usually low during the first couple of years and it will increase due to wear and tear. A service contract must be negotiated with some local providers to get a yearly service at a minimal cost.
- Daily operation costs such as electricity, water, and office supplies are inevitable costs.
- Technical support costs must be optimized. This can be done by establishing a memorandum of understanding with GIS research centers at universities such as the GIS Center at the University of Balamand that can provide technical guidance at a minimal cost.

3.3 ORGANIZATIONAL SUSTAINABILITY

Ensure GTU staff has sufficient expertise, training, and resources to expand their use of GIS.

Even if the vision, goals, and strategies are realistic and the GIS is designed and implemented well, staff members have to continue to operate high-quality GIS. Often, that is a matter of staff members having strong expertise, getting training, and having sufficient resources. The GIS Coordinator must induce the GIS Technician to participate in ongoing GIS training that can be available online to build their GIS capacity.

Ensure GTU staff members are using all of their resources to provide GIS outputs.

This is a matter of effective supervision. Ensure there is effective delegation to staff members (setting goals, sharing feedback, adjusting performance) and evaluation of staff such that members are always doing their best. Hence the Head of the GIS Union must always inspect and evaluate the work of the GIS Coordinator who in turn must evaluate the work of the GIS technician. The evaluation process must be done quarterly to ensure the efficiency of the work and its sustainability.

Ensuring redundancy and succession planning for GTU staff in case people leave.

The GIS operations at the GTU would be damaged significantly if involved staff members like the GIS Coordinator or GIS Technician suddenly were no longer available. Hence, the Head of

the Union needs to ensure that key staff members at the GTU have suitable “backup” personnel who also can do much of their jobs and that guidelines and procedures exist for jobs, as much as possible. As such, the involvement of the GIS Technical Committee in the daily operation of the GTU is essential to ensure succession and the long-term sustainability of the GTU.

4 LIST OF RECOMMENDATIONS

The following is a list of key recommendations for the operationalization, institutionalization, and long-term sustainability of GIS at the GTU.

1) Proper strategic planning is crucial to the success of any GIS project, and many implementation problems can be traced back to inadequacies in the strategic planning process. The lack of an adequate GIS plan can be considered one of the main reasons for difficulties and problems at various stages of GIS development and operations. The purpose of strategic planning is to create a framework within which the complexity and interdependency of GIS implementation can be managed. Also, strategic planning provides a long-term view of the operations and objectives.
2) Establishing a clear goal and vision for GIS in GTU while initiating the GIS project, is critical to its success. It is crucial that all participants fully understand and share that vision, as they will be responsible for making it a reality. Developing a common vision and ensuring that everyone fully understands it may be time-consuming, but the benefits are well worth the effort. Many GIS problems and failures can be traced to a single source – conflicting ideas concerning what the GIS should be.
3) GIS Governance strategy formalization is an essential first step for the sustainability of GIS implementation within the GTU.
4) Active communication between the GIS Coordinator, the mayors, and the Head of the Union is essential for successful GIS implementation. All involved parties in the GIS project must be kept in the communication network from the time they are first contacted through the entire project implementation stage.
5) The active support of senior management is essential for acquiring the financial and political support needed to initiate the GIS project and to ensure continued support and effective use of GIS in the future. Lack of full support by senior management often results in insufficient funding and low implementation priority.
6) Recruitment of skilled staff. Recruiting the right personnel at the GTU is essential for the success of GIS implementation.
7) GIS staff participation and engagement in the implementation process especially in the design and the development of the new system is considered essential for the long-term sustainability of GTU.
8) Training for the GIS personnel is extremely important for the success of GIS. Early implementation of GIS within the GTU will be more formal and provided by ACCD.

However, in-house and ongoing informal training is essential for the sustainability of GIS by building the technical skills of the employees.

9) GIS Data acquisition by ACCD is necessary due to its high cost.
10) Data accuracy is a very critical issue within the GIS implementation process. Accurate information can only be generated by the system if the data on which it is based is accurate, to begin with. If the data is inaccurate or incomplete, the use of sophisticated GIS technology will only be an expensive graphic and spatial version of ―garbage in, garbage out.
11) GIS technical support availability is vital for the success of any GIS initiative. A very common behaviour of GIS and IT vendors is to deliver hardware and software only. Therefore, the continued support of the vendor is necessary for the long-term success of a GIS.
12) The selection of appropriate GIS hardware and software is critical to the success of the GIS project. An inappropriate selection strategy of GIS hardware and software can lead to adverse effects and the system will not be able to fulfil the required functionalities.

The following diagram shows the recommendations grouped into critical success factors that are the secret ingredient for any efficacious GIS implementation within GTU.

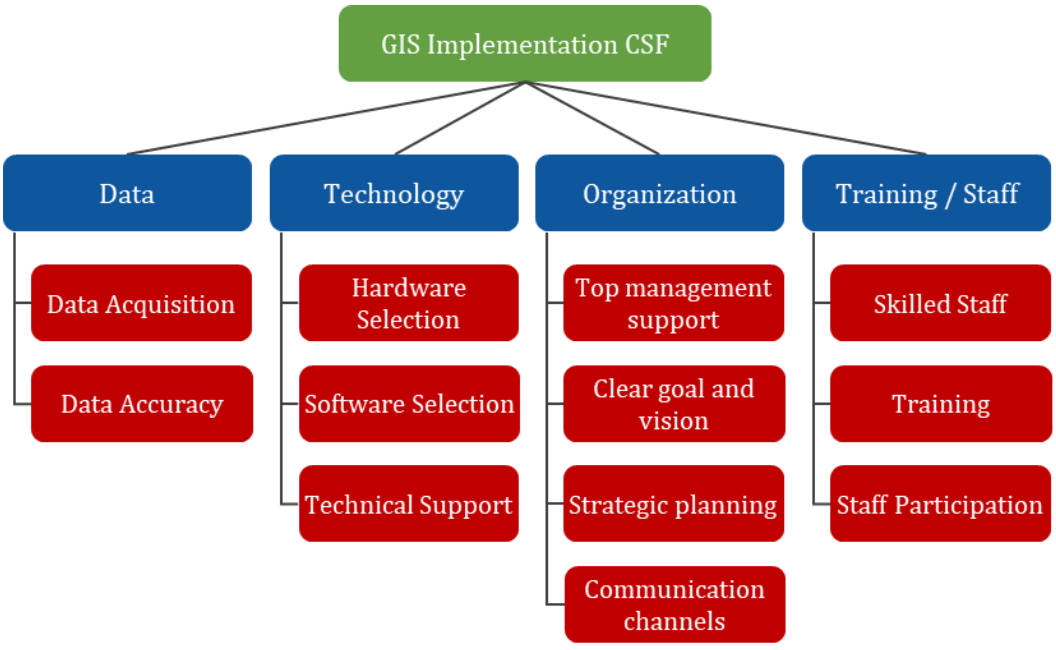

Figure 5 - GIS Implementation Critical Success Factors

5 CONCLUSION

The long-term sustainability of GIS and its proper operationalization and institutionalization within the GTU involves not only the information technologies themselves but also the personnel and skills needed. The organization and institutional arrangements that govern the patterns of management and information flow are also critical and must be managed interactively. Since GIS-related information technologies are updated rapidly, it can be difficult to predict the future. Thus, a GIS implementation plan is needed to improve the chances of successful implementation. The plan presented here can help reduce mistakes and integrate the management of the various aspects of data issues, personnel, and GIS skills needed, creating a solid base for dealing with the unexpected and for the sustainability of GIS.