



MASAR WORKING PAPER

MUNICIPAL GIS BEST PRACTICES AND LESSONS LEARNED

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MASAR implementing partners



In collaboration with



UNIVERSITY OF
BALAMAND

1 BACKGROUND AND RATIONALE

The implementation of GIS technology is of strategic importance for the Lebanese municipalities. The main objective from this implementation is the development of a Spatial Data Infrastructure (SDI) in an attempt to become more efficient and effective as related to data retrieval and analysis and in making informed decisions. Within the specific context of Lebanon, setting up an SDI at the municipal level is highly significant because it assists in overcoming the current high centralization of the government. The core SDI consists of mapping the built-environment (parcels, buildings, streets, urban areas, zoning, cadastral boundaries, landmarks, utilities, etc) and linking them to the municipal database especially citizen information system, members catalog, and address system. Additionally, other information can be overlaid with these base maps such as population density, household income, and various economic indicators. This information can be used for a variety of purposes. For example, they can be used for tax revenue collection, inform other governmental projects and enable mayors to make better decisions thus facilitating the spatial decision-making process.

The compounded crises that hit Lebanon over the last couple of years from the revolution, the banking crisis that caused the deterioration of the Lebanese pound, the corona pandemic, the Beirut Blast, and the political crisis that all together led to a severe economic and financial crisis and the deterioration of the public services. The crises intensified the need for GIS at the local level as unions of municipalities and municipalities are increasingly challenged to become the main service providers to citizens. Additionally, with the intensification of the financial crisis, municipalities needed information associated with a geographic location to promote economic development to improve the living conditions of citizens within their jurisdictions.

In this paper, three case studies were selected to identify the main factors that led to the successful implementation of GIS and its sustainability within various Lebanese municipalities. Lessons learned from these case studies can be a game-changer for the GIS implementation approach to ensure the sustainability of GIS. The case studies presented in this paper are selected based on the following criteria:

- The GIS implementation emerged internally from a vision or a need and was not advocated.
- GIS implementation was evolutionary and phased.

- A participatory approach to GIS development with the involvement of volunteers.

These case studies are the Municipality of Batroun, the Municipality of Btourtij, and the Union of Municipalities (UoM's) of Jurd el Qayteh.

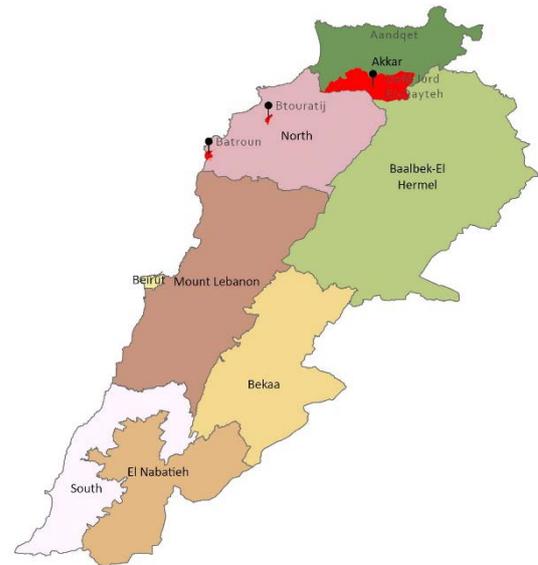


Figure 1: Geographical Distribution of the Case Studies

2 Case Studies

2.1 Batroun Municipality

Batroun city is the administrative capital of the Batroun caza in the North governorate. Over the last few years, Batroun District has witnessed enormous growth in development. Batroun City is a major sea attraction with a vibrant nightlife that includes pubs and nightclubs and a tourist destination with many historical landmarks.

This municipality was selected as a case study for GIS best practice since they institutionalized GIS and made it central for all the municipal daily operations, and managed to sustain it even after the financial crises.

In 2014, the Municipality of Batroun decided to develop GIS to ensure citizen services are fully met, increase its financial income, and support the burst in economic development. The municipality, having the proper funding, decided to outsource the GIS development and hired a private company to do the job. However, the GIS operation was inefficient due to many challenges:

1. The inability of municipal employees to operate the GIS system as the GIS is not an intuitive software and it is not easy to use and requires a constellation of a specific set of knowledge.
2. The lack of technical support to properly operate the GIS system.
3. The low commitment of municipal employees to GIS operation as they were loaded with other tasks and not fully dedicated to GIS operation.

All these reasons combined led the GIS to become idle.

2.1.1 GIS Institutionalization

The president of Batroun municipality was very persistent to pursue his vision to implement GIS. In 2016, he decided to establish an engineering unit and appointed a young and enthusiastic GIS entrepreneur from the city of Batroun to develop and operate the GIS. The newly appointed GIS young specialist was empowered and fully supported by the Batroun Municipal President who allocated the necessary funds to revitalize the GIS system. Within a year, the GIS bases maps of Batroun city were developed including the property maps, sewage network, street network, zoning maps, and the municipal archiving database linked to the parcels.

The first GIS application at the Municipality of Batroun was linking all the building permits to the digitized building footprints to monitor all the violations. Violations created a good source of income for the municipality. Additionally, the data for taxpayers were displayed on the GIS maps to increase tax collection and revenues to the municipality. The advertisement billboards were also located on GIS for taxes and revenues were generated from them. The sewage network was mapped to plan further expansion to accommodate for the urban growth. Over two years, GIS became the Center of all municipal operations and became fully institutionalized.

2.1.2 GIS for Local Development

Once the GIS was fully institutionalized within the Municipality of Batroun, GIS was upgraded to promote local development. The house addressing and street numbering and naming for the city of Batroun was developed using GIS. The signage was installed in place, hence laying the proper infrastructure that enabled the city of Batroun to better promote tourism and become a tourist destination. From a citizen welfare and local development point of view, every citizen currently possesses an address on the GIS system, that enables fast communication between both parties in case of any complaints or infrastructure problem that requires maintenance. The addressing system helped the municipality in the proper organization of festivals that attracted thousands of tourists to the city of Batroun. Additionally, the GIS unit used GIS in urban planning to organize the economic activities within the pedestrian historical old city of Batroun where all the commercial and service activities cluster.

With the economic crisis, the Batroun municipality focused on promoting the City of Batroun to attract tourists and revitalize the economic and commercial activities. All the touristic

attractions within the city of Batroun with their narratives were mapped. In summer 2021, the Municipality of Batroun launched the Uncover Lebanon service in collaboration with the Batroun Traders Associations and many other stakeholders to attract tourists to Batroun and promote local development. All the points of interest such as hotels, clubs, restaurants, and other attractions were also mapped to provide guiding documents for tourists.

With the fuel crisis, a GPS was placed on all municipal cars and trucks to monitor their movement on GIS to optimize their fuel consumption. The GPS was funded by donors for that purpose.

Currently, the core operation of the municipality revolves around GIS from the daily work related to data archival, service provision to the citizen, urban planning, tourism, and local economic development. The future strategy for GIS update and upgrade plan is based on adding more GIS layers according to local development needs.

2.1.3 GIS Sustainability

The factors that ensured the sustainability of GIS operations are:

- The unlimited support from the visionary President of Batroun Municipality. In parallel, the re-election of the president of the municipality for a second term played a vital role in the sustainability of GIS operation as the commitment, vision, and support from top management were constant.
- The availability of funds for the continuous upgrade of the GIS layers was an essential factor. Unlike small municipalities that are short in funds, the Municipality of Batroun possesses the proper financial resources and GIS contributed to increasing the financial revenues of the municipalities which allowed more funding to other GIS activities before the crisis. Currently, the GIS specialist is trying to secure funds from various funders to sustain GIS for well-defined GIS projects in scope and objectives.
- The appointment of a motivated, well-capacitated GIS specialist as a dedicated employee at the municipality of Batroun is the key to the sustainability of GIS. With the financial crises that hit the whole country, he sustained the GIS operations through interns and volunteers from the city of Batroun. He is keen on keeping GIS central to all projects implemented by the municipality to sustain it.
- Continuous training and technical support are ensured through a web of connections and partnerships that the GIS specialist established.

To conclude, GIS operations cannot be sustained without having the institutional human, financial, and technical elements all together.

2.2 Btouratij Municipality

Btouratij is a small village located in Koura Caza in the Northern Governorate. Btouratij Municipality doesn't have a president since 2018 and the District Commissioner (Kaem Makam) of Koura is responsible for its operation.

This municipality was selected as a case study for GIS best practice since they institutionalized GIS and made it automatically linked to the municipal information system. They managed to update it and upgrade it and use it in the current crisis to resolve problems that will increase citizens' welfare.

The District Commissioner was unable to support efficiently the municipality or execute any projects since no information or maps were available. To overcome that, the District Commissioner took a proactive initiative in 2018 for the digitalization of the municipality. The first step was the implementation of a Municipal Information Management System (IMS) that transformed all the papers and data within the municipality into digital format with a digital archiving system, and a full financial system linked to the members' catalogue. The part related to GIS was not accomplished due to the high cost of implementation by private companies. The District Commissioner approached the GIS Center at the University of Balamand to support her in the development of a GIS database (parcels, buildings, streets, water network, sewage network) and the purchase of a high-resolution satellite image. The objective of the GIS development was to establish a link between the financial component in the IMS and the GIS to improve tax collection and increase the financial revenues to the municipality. The GIS Center welcomed this initiative and engaged volunteer engineering students from the municipality of Btouratij in developing the maps as part of the community service program.

Once all the base maps were developed and linked to the IMS, the District Commissioner initiated the second step in 2019 to conduct detailed surveys related to building occupation details, and to all economic activities within the village. A smart survey form was developed by the GIS Center, and three surveyors from the village carried out the data collection. The GIS Center managed the data collection and the quality control process as no GIS staff was available within the municipality. The District Commissioner also signed a long-term

agreement with the GIS Center at the University of Balamand to oversee the GIS operations and provide training and technical support to the municipal employees to properly operate the system. Given all these facilities, the GIS was not operational as:

- The municipality had only one employee responsible for carrying out all the municipal tasks.
- The employee lacked technical knowledge.
- The inability of the municipality to appoint a dedicated staff for GIS operations.

2.2.1 GIS Institutionalization

The District Commissioner appointed a new employee with a defined scope of work from the beginning to work on the IMS and was responsible for the GIS. The employee had no GIS background; however, she had this intrinsic motivation towards GIS and eagerness to learn. The employee received explicit training at the GIS Center at the University of Balamand but she was always asking for more. Over the last year, the employee was able to carry on GIS operations with the continuous support provided by the GIS Center. The first project was related to solid waste management. The GIS employee located garbage bins and collection routes. According to the GIS employee:” the use of GIS facilitates their daily tasks in a cost-effective and time-efficient way”. Many GIS projects are currently under development related to infrastructure based on the availability of funds. Furthermore, they are looking to map more objects such as advertising billboards to increase financial income.

The sustainability of GIS in Btouratij Municipality is due to:

- The District Commissioner's support was crucial as every decision in the municipality requires her approval.
- Volunteers to minimize cost.
- The partnership with the GIS Center to provide training and continuous technical support.
- The appointment of a dedicated and motivated employee who is eager to learn GIS.

2.3 The Union of Municipalities of Jurd El Qayteh

The Union of Municipalities of Jurd El Qayteh is located in the eastern part of the Akkar governorate. The UoM of Jurd El Qayteh is composed of fifteen villages of an area of 98 km² approximately.

This UoM was selected as a case study for GIS best practice since they adopted a participatory approach to municipal GIS development at the Union level. Additionally, the development of GIS was phased where small projects were accomplished based on the Union's urgent needs. The scope of GIS implementation was very clear from the beginning, hence all the projects implemented by the UoM were consolidated into GIS, and all the funding organizations approaching the Union were directed into funding GIS.

The UoM of Jurd El Qayteh started developing GIS in the year 2018-2019 for a funded solid waste management project with ISWA and received GIS training with the American University of Beirut. They used GIS for landscape character assessment (LCA) studies to locate suitable land within the area for building a sorting factory. The whole approach to GIS development was participatory with the help of volunteer engineers from the area. Basic training was given to volunteers to develop the GIS layers. The Union now has two sorting facilities and they are working on building a transfer station.

In 2019, SKL- International in partnership with the GIS Center at the University of Balamand decided to pioneer a GIS project in the UoM. Three areas of interventions were prioritized: 1- Street Addressing; 2- Touristic Map; 3- Social Statistics. During phase one of the project, surveyors from the union with the GIS Center senior GIS engineer used a GNSS machine to map all the roads. Then the roads were numbered in collaboration with the municipal engineer. In parallel advanced and detailed training was given to these engineers to capacitate them and enable them to update the work whenever needed.

In 2019, when the Corona pandemic hit Lebanon the GIS Center at the University of Balamand in partnership with SKL- International developed the Salamati App for the fast detection, tracking, and tracing of corona cases to contain the spread of the virus using GIS and location intelligence. The UoM of Jurd El Qayteh was one of the early adopters of GIS technology through the use of the Salamati App in their fight against Corona. Trained volunteers went door to door to fill in the Salamati App. In case the respondent was diagnosed as high risk, an email will be directly sent to the GIS engineer at the UoM for fast intervention and PCR testing.

For the touristic map and the social statistics that require enormous funding to locate the point of interest for touristic attractions and gather social information with such depth and breadth, it was decided to adopt a participatory approach relying on volunteers and active citizens. Hence it was decided to bring in partners:

- Non-Governmental Organization: SKL – International is the foundation responsible for the funding of development projects specifically in the UOM of Jurd El Qayteh.
- Private Academic Institution: The University of Balamand GIS Center, which developed the smart survey.
- Public Institution: UOM of Jurd El Qayteh is represented by the head of the Union who provided volunteers. A major challenge in these local communities was to build trust between the surveyor and the local community members to share information. Therefore, the provision of volunteers from the local community was a key to the success of field data collection. Volunteers from each municipality were recruited for data collection. Volunteer engineers who already received GIS training were also involved in the management of the data collection. This participatory approach made the engineers and the citizens within the municipalities more involved in the process of GIS development which created a sense of ownership over the GIS project.

The GIS development projects for the UOM of Jurd El Qayteh is a phased work that spanned over a year and a half approximately and resulted in constructing a comprehensive socio-economic-demographic GIS for the deprived region of Jurd El Qayteh to be used for purposes of development.

The main factors that led to the successful implementation of GIS within the UOM of Jurd El Qayteh are:

- Head of UoM unlimited Support and commitment to the GIS development.
- Having clear objectives for GIS development.
- Funds were secured from international donors.
- Continuous GIS Technical training and on-the-job coaching.
- The establishment of the technical unit and the involvement of a dedicated and enthusiastic engineer who is the UoM engineer and participated in the development of GIS.
- The involvement of the UoM GIS engineer in the data collection process so he can manage future data collection tasks.

- Continuous technical support from the GIS Center.
- Availability of the technical infrastructure from ArcGIS software license with a workstation for carrying the GIS work.
- The participatory approach to GIS development through the engagement of volunteers.

3 GIS in Lebanese Municipalities: The MASAR Approach

MASAR for Local Governments is a program funded by the EU MADAD Trust Fund. The program's overall aim is to strengthen the long-term resilience of targeted Local Governments and their host communities, refugees and Displacement Populations." The program aims to develop the institutional capacities of Local Governments to have effective management to their territories and increase their preparedness for crisis and uncertainties.

MASAR worked through its implementing partners ACCD, PCPM, and VNG-I in different regions as shown in

Figure 2. One of the components under MASAR is Planning and GIS development within UoMs.

MASAR established GIS Units (GUs) within all the UoM's who are responsible for

managing, maintaining, updating, and upgrading the geospatial data, in addition to providing strong GIS technical support to the municipalities in spatial-based planning and data-driven decision-making. The GUs are also responsible for data stewardship, data acquisition, and data sharing among municipalities.

MASAR in collaboration with the GIS Center at the University of Balamand followed a new approach to GIS implementation. It worked beyond the initial phase of the GIS implementation life cycle and extended to the post-implementation phase. Hence, what makes the GIS implementation process with MASAR-Lebanon different from any other initiative is the emphasis on the grey area during the first few months of the post-implementation phase (Figure

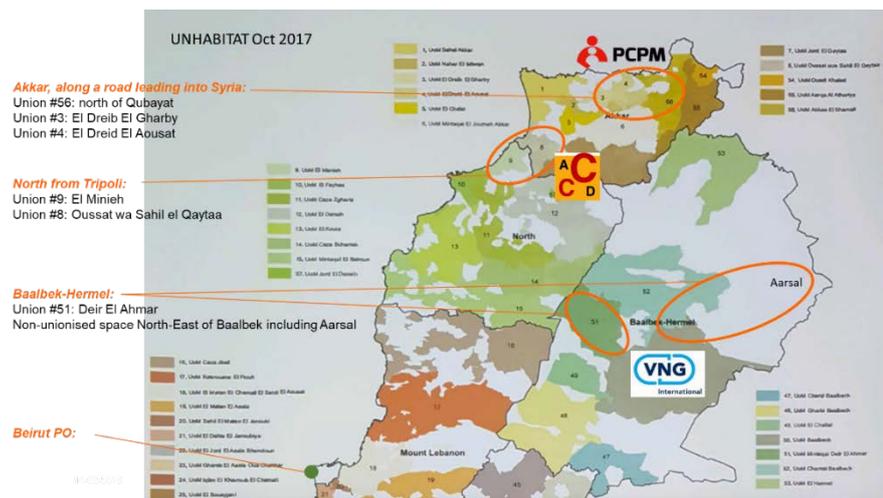


Figure 2 - GIS Pre Post Implementation Phases

3). Usually, exactly after the Go-Live¹ time of the GIS implementation, the role of the implementing partner becomes marginal. The period between the GIS Go-Live until GIS reaches its maturity during the post-implementation phase is considered critical for the success of any GIS initiative. Unfortunately, this period is always overlooked by implementing partners. During this period, employees feel demotivated and unsupported with no clear daily operational tasks, no funds, and no strategic plan. Additionally, during this period the benefits from using GIS will not be shown to top management leading to their lack of commitment.

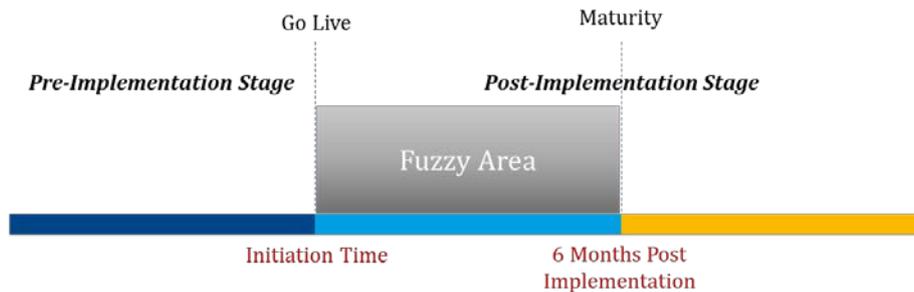


Figure 3 - GIS Pre Post Implementation Phases

MASAR's approach to GIS implementation added one more phase (Phase 5) as shown in Figure 4 to the GIS implementation lifecycle, especially during the post-implementation phase which so far proved to be crucial for the efficient and effective operation of GIS within the GUs.

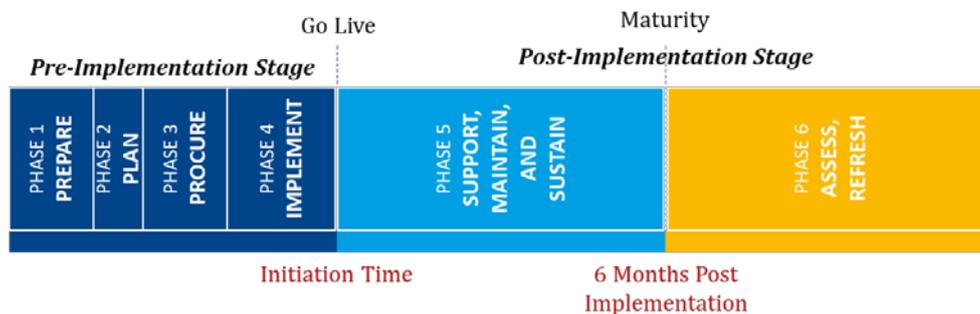


Figure 4 - MASAR GIS Implementation Life-Cycle

Best practices for this phase include:

- Establish standard operating procedures (SOP)/standard operating guidelines (SOG) and update as needed to meet GIS Technical Teams needs
- Provide continuous on-the-job coaching and mentoring for the GIS employees.
- Develop and implement a well-structured GIS update and upgrade plan.

¹ The point of time when the hardware, software, and data are readily available for GIS operations and employees are trained to start using the GIS system put in place.

- Execute a GIS project for the UOM that can show the value of GIS to the Head of the UoM and the mayors.
- Motivate GIS employees and follow up weekly on their work progress.

3.1 GIS Critical Success Factors

The following is an initial list of critical success factors derived from the development and operationalization MASAR GIS within the Lebanese UoMs:

Institutional

- Proper long-term planning is crucial to the success of any GIS project, and many implementation problems can be traced back to inadequacies in this process.
- Establishing a clear goal and vision for GIS in GU 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.
- GIS Governance strategy formalization is an essential first step for the sustainability of GIS implementation within the GU.
- 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.
- The active support of senior management/decision-makers 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.
- 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 GIS Unit.
- Establishing operational procedures and a clear GIS update and upgrade road map is crucial for the GIS staff to exactly understand their daily operations.

Structured Data

- GIS base maps acquisition is essential due to their high cost.
- 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.
- Data Collection is necessary as any GIS system without the proper information associated with maps cannot lead to data-driven decision making.

Expertise/ Human Resource

- Recruitment of skilled staff. Recruiting the right personnel at the GU is essential for the success of GIS implementation.
- GIS technical support availability is vital for the success of any GIS initiative.
- On-the-Job coaching is beneficial to bridge the gap between technical GIS training and real-life GIS operation

Training

- Training for the GIS personnel is extremely important for the success of GIS. the training will be both formal and informal. However, in-house and ongoing informal training are essential for the sustainability of GIS as it builds the technical skills of the employees.

Hardware/ Software

- 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.

Financial

- The availability of funds is crucial as the initial cost of GIS development is high and can only be secured from funding agencies. Afterward, the GIS operational cost related to data collection for update and upgrade is relatively low and can be minimized by making use of volunteers.

In a nutshell, a GIS Technical Unit cannot be bought ‘off the shelf’. Rather it is an assemblage of hardware and software that becomes useful only when it is properly placed in an organization and supported by expertise, structured data, and organizational routines. These factors can guide any GIS implementation project to become fully institutionalized and more sustainable.

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