

SIGMUN: A GIS PROJECT OF LOCAL GOVERNMENT

Eloina Coll
José-Carlos Martínez

***Abstract** –This research seeks to emphasize the importance that geographic information systems (GIS) has for the public administration. Successful introduction of GIS into public sector agencies depends largely on how organizational members accept and utilize the new technology. Personal characteristics, attitudes, and background exert substantial influence on individual decisions about the degree and manner in which GIS is employed to pursue an organizational mission and tasks. This paper explains the first study phase of the research project: Information Systems and local government management (SIGMUN) BIA2003-07914 from the Spanish Government (CICYT) and the European Union (ERDF funds), study has been developed in the Polytechnic University of Valencia (UPV).*

PhD. Eloína, Coll Aliaga
Polytechnic University of Valencia
Camino de Vera S/N, 46022, Valencia, Spain
34963877553, 34963877559, ecoll@cgf.upv.es

PhD. José Carlos, Martínez Llario
Polytechnic University of Valencia
Camino de Vera S/N, 46022, Valencia, Spain
jomarlla@cgf.upv.es

1 INTRODUCTION

Technologies progress and development of the information society are promoting public organisms' information to be showed on the Internet, and even allowing citizens to process official documents through the Internet. [1]. In order to offer it, local governments must widely control databases creation, use and management.

The technologic advances make possible to face an old idea, always postponed considering its highly technical difficulty and its huge cost, but the need of which becomes each day more obvious. This idea is to manage local governments by means of Territorial Information Systems that, from the basis of an existent cartography, would be able to georeferencing the information as well as the municipal management and, also, to offer it to inhabitants through the Internet.

The 80% of the municipal information that is daily managed is georeferenced, (which means that it has a spatial component that can be represented), in addition to a huge volume of databases with alphanumeric information that can be related within this spatial component. Geographic Information Systems (GIS) represent a fundamental and essential tool for the knowledge and management of the territory; the proof is that the biggest Spanish councils and the majority of the public organisms from other countries are already using this tool. One of the problems that can be considered when trying to implement this tool in the Spanish state is the fact that the 85% of the 8.109 existing councils has less than 5 000 inhabitants. Consequently, the main part of these organisms is unable to implement and use this new technology as they have a lack of technical and economic resources. The problem gets worse as there isn't a proper standard for the GIS implementation or the cartography processing. The research project about information systems and municipal management (SIGMUN) [2], which focuses on this line, is carried out by the research group of Cartographic Production and Geographic Information Systems teaching group, from the Polytechnic University of Valencia. The current research is to set the real state of local government, its needs, and the way implementation has been developed in other similar conditions. From this study the basic standards about cartography and geographic information systems will be established in order to make municipal management much easier, to facilitate geographic information research, and cartographic updating and quality. The ultimate benefit from the coordinated GIS developments and database sharing is reduced redundancy and duplication of effort.

2 GENERAL METHODOLOGY

This research sets out from two main support pillars:

Firstly, the experience of the research group, which work, from the last years has been based on local government [3], and the tutorial/leadership of more than 80 final degree thesis based on informatics applications for cases studies and on GIS implementations on councils;

Secondly, an international research based on similar experiences from three countries: United States of America[4], United Kingdom[5], and Australia[6];

The phases of the research project are the following ones:

- Study of the current state of the council, examining lacks and working procedures.
- Study of the true needs from the citizens and the local government.
- Creation of procedures for the geographic compatibility between departments and different public and private organisms that interact with the council.
- Analysis and optimization of management, maintenance and updating procedures of geographic information.
- Creation of other procedures.
- Documents compilation.

On this context, a study [7] is going to be carried out in depth, for all the phases of the project in a council of the Valencian Community, with the following characteristics:

- 1.- Population: around 20.000 inhabitants.
- 2.- Area: 228,0 Km²
- 3.- Localization: Comarca del Camp del Turia. (Valencian Community, Spain)
- 4.- Budget: 12.730.813,32 euros in 2003.

3. GIS ADOPTION DECISIONS

Should top management decide to expand the GIS to serve the entire organization, the original managers may be tempted to apply their rather restricted implementation experience, irrespective of the scale of the new GIS. Almost inevitably, they will encounter problems, both technical and organizational, of a totally different scale and nature. Samples of the issues are:

- Which standards should be adopted for hardware, software and data for the organization, and how can these standards tie in with the infrastructure already put in place by the information technology services people?
- Whose interest will be affected by the introduction of the organizational GIS? What would be their reactions, and to what extent will these reactions affect the success of the GIS?
- What is the best way to persuade the various interest groups in the organization to accept GIS?
- What kinds of policy are needed to establish the legitimacy of the GIS and to encourage people to use the GIS in their routine operations to gain the benefits predicted?
- Are the existing operations amenable to improvements expected by the introduction of GIS? If not, what impact will changes to these operations have on the people?
- To what extent is top management prepared and able to back up the project financially and politically in time of difficulties or conflicts?
- Evaluation of GIS will contribute to a better understanding on how this technology is adapted and used in planning and decision-making processes [8]. Knowledge and insights gained from such evaluation is expected to contribute to:
 - More effective implementation and use of the technology;
 - Developing and applying applications in target areas where they have the greatest impact;
 - Adjusting and adapting the technology to the organization and vice versa;
 - Ensuring that the technology becomes institutionalized within the organization and really leads to a better functioning of the organization.
 - Increase the overall performance of an organization (in terms of time, cost, human resources and quality)
 - Having contact with the universities research
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4. PERSONAL FACTORS

The literature on human factors in GIS concentrates primarily on applying the knowledge about the human mental and cognitive processes toward better design of hardware, software, user interfaces, visualization, and decision-support tools

[9]. Recent attempts to measure the implementation success of various information systems have confirmed the significance of end-users and their characteristics, motivation, experiences, and perceptions of the technology [10].

Nedovic-Budic [8] considers very important the personal factors that affect the individual decisions regarding adoption and future use of GIS technology. It examines the significance of perceived organizational and personal benefits of GIS, values and beliefs about computerized technology, previous computer experience, perceived complexity of GIS, exposure to GIS, computer anxiety, resistance to work-related change, and communication behaviour (i.e., networking). A number of management and organizational factors are also included as relevant contextual and background information of her research.

Furthermore, Harlan J. Onsrud [11] showed in the paper "Diffusion of Geographic Information Innovations" that the geographic information technologies have seen a steady increase in their popularity as more and more public and private organizations are discovering the benefits for their operations from use of these systems. Along with this increased interest has come a heightened awareness of the difficulties that often exist in attempting to introduce these systems within organizations. Unfortunately research, to date, on developing new applications for geographic information systems has rapidly outstripped our understanding of the problems inherent in attempting to introduce and diffuse these innovations within and among organizations. In essence, our efforts have focused so heavily on the technical side of GIS that we have neglected to develop a concomitant understanding of the human side of these systems; that is, we need to learn what is required for people to achieve successful and widespread adoption of GIS within their organizations.

For that reason, our research is not centred in the study of technical problems, but rather it is centred in human problems of the organization.

4.1. Important factors for becoming a GIS user:

The two primary personal factors determining involvement in GIS technology are the perceived relative advantage and the previous experience with computers. Unlike the GIS users' concern with personal benefits, the administrators primarily considered organizational benefits in their decision to support the technology.

Exposure to GIS technology and personal contact with GIS users is also a positive and are also significantly related to "pro-GIS" behaviour and acceptance of the new technology. Organizational conflict detrimentally affected the diffusion of GIS organisational member; especially among indirect users for whom the GIS services received depend on the overall nature and quality of the relationship with other employees.

The GIS technology itself needs to be re-examined with respect to its definition as a true innovation. Treating it as an extension and new capability offered within an existing technological development may be more appropriate.

Advices to organisations that desire a widespread use of GIS by their employees:

1. Provide the means of stimulating and rewarding prospective and new GIS users.
2. Provision of incentives for utilization of GIS technology is the single most significant GIS management activity that will encourage both direct and indirect use of GIS.
3. Provide training for your staff, particularly for those lacking extensive computer experience.
4. Do not assume that everyone is excited about using GIS. Many employees like their job as it is and do not feel the urge to change and switch to a new way of doing it, even when they understand the advantages of the new system.
5. Create opportunities for exposure to GIS technology and contact between GIS users and non users.
6. To secure support from administrators and decision makers, organizational benefits need to be clearly emphasized and demonstrated.
7. Administrators who do not use computers themselves will need an extra enticement to realize the utility of the new tool
8. Beware of the interpersonal conflicts and work hard on understanding and eliminating their causes. The organizational conflicts are the major roadblock to wide diffusion of GIS among organizational members. Non-conflicting environments are much more conducive to mutual support and cooperation needed in GIS technology transfer.

Huxold [13] recommends that GIS proponents need not despair from the projects failure, but rather learn from it. A number of lessons learned from that experience can assist GIS proponents in developing successful organization-wide geographic information systems:

1. An organization is not ready to adopt GIS technology because of its potential alone. It is ready to adopt the technology when it has identified a problem in its own organization and sees GIS as a solution.
2. A common goal that reflects the individual goals of each participant provides a basis for shared GIS development. These goals must be aligned with the overall goals of the organization.
3. The scope of the GIS projects must be clearly understood by all participants, including and understanding of the potential for changes in organizational structures and procedures.

5. STUDY OF THE CURRENT STATE OF THE CITY COUNCIL

The first step consists on distinguish all the council departments, set which are the daily tasks on each one, and which is the horizontal relation between them with questions like: How many times a search to georeferenced data is carried out daily?, Which kind of cartography is used regularly?, And occasionally?, How is this cartography consulted?, How many accuracy is necessary?, Which tasks are the most frequently carried out daily?, Which of the citizens questions is the most complicated or takes more time to perform?, etc. The second step, which is based on the depth research of the municipal organization, began with the schedule for each department. The purpose is to study each person working on the same department almost two days, by means of a researcher that get incorporated into the daily department work, take a list of the accomplished tasks and generates a sample of all the documents from the council that are usually the ones given to the citizen. Each week the documents are presented to the research group, that produces a questionnaire, a small demonstration of the way GIS incorporation would positively affect their work, and prepare, specifically for each department, an introduction to these tools. Afterwards a senior researcher moves to the council to met people from the studied department.

In this way, the implementation is better as each meeting is laboriously studied, knowing perfectly the specific needs of the department, and adding knowledge from other experiences [5] (Table 1).

Table 1. Some applications from U.K.local government

<p>Flexible Mapping</p> <ul style="list-style-type: none"> ▪ Consistent and easy-to-find maps or all services ▪ Automated updating of base maps ▪ Easier map production and plan processing ▪ Seamless customized maps ▪ Base maps plus user overlays <p>Land and Property</p> <ul style="list-style-type: none"> ▪ Land and property gazetteers ▪ Planning applications and local land charges ▪ Planning constraint and policy areas ▪ Land use and terrain analysis ▪ Identifying unused, underused land ▪ Identifying derelict, and contaminated land ▪ Locating sites for housing, schools, etc <p>Network Analysis</p> <ul style="list-style-type: none"> ▪ Roads management ▪ Accesibility and route planning ▪ Coordination of street works ▪ Pipelines and power lines 	<p>Incident Analysis</p> <ul style="list-style-type: none"> ▪ Traffic accidents, holes in the road ▪ Street lighting faults ▪ Drugs, crime, and disorder ▪ Environmental health, noise, litter, and other complaints ▪ Pollution incidents ▪ Health epidemics, and other emergencies <p>Socio-Economic Analysis</p> <ul style="list-style-type: none"> ▪ Population analysis ▪ Citizen profiling (geodemographics) ▪ Facility planning and catchments area analysis ▪ Assessment of housing and leisure needs <p>Environmental Monitoring and Management</p> <ul style="list-style-type: none"> ▪ State-of-the-environment reports and Local Age ▪ Archeology, landscape, and ecology ▪ Listed buildings, sites of special scientific interest ▪ Listed conservation areas ▪ Impact assessments
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Up to now the state in the local government's GIS has been studied through interviews, and this has allowed knowing the general state, the technical readiness, etc. But, for a proper understanding of the real life situation it is important not to focus on GIS in local government only but rather on how GIS can contribute to make the organization function better. GIS should not be seen as 'just a program with which one can make nice maps' but GIS should be an integral part of the whole information system of an organization. GIS should be seen as supporting 'service' for increasing the accessibility and exchange of information within the organization but surely also to the 'customers' of the organizations (citizens in the case of the local government). The success or hampering factors within a local government unit will come conditioned by the acceptance degree.

Our research however, it is based on intense pursuit, "long in the time", and personal: a person is infiltrated in the city council, and he studies for some days each person's work in each department in which the GIS could settle. That person's reports will allow analyzing together with the investigation team the implementation type, the way to present it and to incite to their use, and even to create a small application example in each concrete case. This investigation

system allows to know other outstanding factors that the personnel could not even detect, like they can be the personal relationships and conflicting professionals between different departments and his consequences in the work, the personnel's bias to adopt a new technology and the change of attitude that that involve, or finally the repeated tasks and that therefore when making them in an automatic way they cannot be aware of it. Also, this study type has an evident advantage: most of the personnel of the city council don't know the GIS capacity, and therefore it is not able to imagine the quantity of tasks and aspects and their work that could save him an enormous quantity of time with a GIS. However the research's person is able to detect applications that the workers would not know to recognize, and on the other hand, when knowing the way of use of a centralized GIS, and knowing the personalities, it is able to detect what individuals they will be able to obtain been before, and to crawl to the other ones, or who the would be responsible for the maintenance and upgrade of the information.

6 ORGANIZATIONAL ASPECTS

The city council is organized in 15 departments, apart from the governorship and the secretary. Each one should be analyzed independently to the being of sizes and characteristic very different. The survey owes to ask for the following information:

- Number of personal contract and tasks of each one of them
- Type of people's contract (civil servant or hire)
- Opening hours: Attention to the client
- Information management: type and quantity
- Physical time that the workers make field work or they are in the city council
- Relationship among departments

Based on these parameters, the observation is organized considering the following principles:

1. The number of people hired is not proportional to the number of hours dedicated to the investigation of that department, in other words, we mean to analyze tasks, and if the work volume is divided between two or more people, once the observer feels certain that procedures and the phases, the personal methodology will be observed, mainly in the relative thing to handling of the information.
2. The bias to accept new technologies is very dependent of the type of the personnel's contract, if they know that its work position does not depend at all from the relative bias to the installation of new technologies they will feel fewer motivated. In the same way, they will act with the observer.
3. The way and the place where they are carried out the client attention, the percentage of hours of each department dedicates to the attention with the citizen, if all the workers assist, or only a part, if the person that is from public face is the person that solves the application or he only acts of middleman, etc.
4. The observer shall note how the worker is carried out the information transfer (directly, by means of an application, etc.) with the citizen. It is interesting also to take a long time with each application type, to score (to see as much as he improves the productivity introducing the GIS) which are the most frequent petitions, and to know which is the opinion of the citizens from the client attention in each department.
5. The detailed part of all should be the corresponding to the handling and exchange of the information, so much of information space type as alphanumeric information. Which the channels of information are, who believes it, who uses it, who checks it, each as much as it is upgraded, etc. This part should be completed by means of conversations with the hard-working ones but also through the observation, because it should be known to the precision, and many times the workers are not aware of their job because they make automated tasks. This study will be carried out among workers, and among departments.
6. To organize the methodology it is necessary to be informed of the office hours and the field have the workers, in such a way that the observer carry out to optimize his hours of stay in the city council.

The aim of this step is to perform a deeply research on municipal needs, as well as to turn municipal staff on participants and experts in the implementation process. In this way GIS implementation will not be considered as a compulsory political decision, but as an effort from managers to improve each working area by creating only one cartography, accessible to everyone depending on their needs, with direct connection from each computer; therefore as a way to improve daily work.

Once this stage is finished, a report will be prepared for each department manager, presenting the obtained results. The manager is invited to answer the report and explaining if he agree with it or not, and the reasons. All the answers are revised, and this phase of the research finishes when the true state of the council is known.

7. CONCLUSIONS

It is fundamental to make clear from the beginning how meetings are organized: who presents to the observer?, who helps him?, who impacts on the collaboration?, who puts support?, who informs?. If it is the same one for all the departments (better because it is more objective but worse as he recollects less information), better if he is computer expert and he is open to new technologies, better if he knows the resistance from the workers to the computers, etc.

It is necessary that weekly the person carries out an opinion poll, organizes its notes and summarizes them from a wide perspective. It is necessary to think of alternatives applied each person, always keep in mind other departments and finally catch a copy of each paper and to score which are those more used in the daily job.

The interviewer must have psychology skills to adapt him to the environment. It will have certain rejection, certain idea that the observer is a police officer that then will say it to the superiors. It is necessary to stand out the fact that he is there to learn, because he knows the theory but not the practice. They have to feel necessary for the observer, kind of a symbiosis.

To get workers participating actively and feeling necessary in the project, it is necessary that the observer begins discreetly to ask for them, with small psychological tools. For example, the initial presentation to all the components of the department is better than the council member carries out it in each department and not the mayor.

The observer must have very open eyes, and he has to try to detect the interpersonal conflicts, or at least to detect if there are any, by means of many questions on exchange and relationships with other people of that department or of others.

On the other hand, if the technology and the data are not kept up-to-date, the GIS applications will soon be worthless. Instabilities within the organization, changes in the controlling political party at either local or national levels, and variations in the external environment all have important influences on the continuing implementation of any technology. Indeed, the very essence of implementation is change, and continuous monitoring and review are therefore vital.

We plan continued refinement and extension of this analytic platform with several directions for future research emerging from the experience reported in this paper. The following stage of this work is to be able to develop a strategy so that the whole personnel of the city council accepts these new tools that are developing by means of free software and in that way they are able to have an only reliable and valid information of the graphic data as the database.

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10. ABOUT THE AUTHORS

PhD. Eloina Coll Aliaga
Universidad Politécnica de Valencia
Camino de Vera s/n, 46022, Valencia, Spain
Tef.: +34 96 3877550, Fax: +34 96 387759, email: ecoll@cgf.upv.es

PhD. Jose Martinez-Llario
Universidad Politécnica de Valencia
Camino de Vera s/n, 46022, Valencia, Spain
Tef.: +34 96 3877550, Fax: +34 96 387759, email: jomarilla@cgf.upv.es



Eloina Coll received her laurea degree in Computer Engineering in 1992 and his PhD in Geographical Information System, Geodesy and Photogrammetry in 2001 at Polytechnic University of Valencia, Spain. Her research interests are the videogrammetry, camera calibration and GIS. She is author of more than 30 papers in journals and international conferences. She serves the program committees of workshops and conferences in the software GIS fields, such as the CISCi conferences. Nowadays, she is the main researcher of the project BIA2003-07914 SIGMUN. Research state grant of CICYT cofinanced with funds FEDER of the European Union



Jose Martinez received his M.Sc. degree in Geodesy and Cartography from the Polytechnic University of Valencia in Spain in 1999, and his PhD in GIS (Geographical Information System) and Cartography in 2003. His main research interests include free GIS software, Spatial Databases, 3D Visualization and Photogrammetry. He has collaborated with several industries and research centers, in particular on GIS, interoperability tools and open source projects. He is author of more than 20 papers in journals and international conferences