CONTRIBUTION TO THE SETTING UP OF A GEOGRAPHICAL INFORMATION SYSTEM FOR THE LOCAL MANAGEMENT

Technical aspect of the Systemic approach

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KEYWORDS : G.I.S, Spatial Information Sciences, SRT, Cartography, Internet/Web, Urban, Acquisition, Analysis.

ABSTRACT :

What has been noticed at the time of these last years, that the power of domination from all over the world pass inevitably by the restraint of the technology of information. Today, we are too full of us even because of the thick volume of data (therefore of information) that we arrange; but don't forget that the man won't be able to dominate them that if he knows how to manage them, and in particular those relative to his space. To fill this hiatus Algeria tempts since some years to apply this technology of the geographical information at the level local. Researchers and students are invited to actually contribute to the stake of this attention. The survey that confided, enrolls in a work of span and that I will clarify under the term of "*Contribution to the setting up of a GIS for the local management*". It milked to the GIS Communal and the exam of possibilities offered by the use of this important tool. It has for main objective, and in a vision tool of knowledge and understanding of this geographical space, to conceive an analysis and a modelling of data. Let's place us to the basis of such a survey, and let's retail phases to clear to lead it to term. It is necessary to first of all study the problematic of the cartography to the local scale, that asks for a collaboration with the different administrators of the township. Then, the solution of the problematic and the approach adopted to generate a pilot model of realization of a GIS Communal based on the systemic representation of the territory prove to be necessary. In short and to assure the feasibility and the relevance of our conceptual development the last phase articulates to the validation of the methodology proposed on the township of Arzew (North-Western of Algeria). Our subject is not therefore to provide a product, but rather to determine, to specify and to formalize stages to follow and rules to respect to organize data of a GIS Communal. The method of modelling of the local territory that we proposed rests on a systemic analysis. This last is made of it a way of language permitting a reading of the reality through the notion of system. By this work one tried to demonstrate the feasibility of interfaçage of the local territory and actions of development done on this territory and its visual simulation on a cartographic picture by the slant of the GIS tool.

RESUME :

Ce qui est remarqué ces dernières années est que le pouvoir de domination du monde entier passe inévitablement par la maîtrise de la technologie de l'information. Aujourd'hui, nous sommes trop imbus de nous même du fait du gros volume de données (donc d'informations) que nous disposons ; mais n'oublions pas que l'homme ne pourra les dominer que s'il sait les gérer, et en particulier celles relatives à son espace. Pour combler cette lacune, l'Algérie tente depuis quelques années d'appliquer cette technologie de l'information géographique au niveau local. Chercheurs et étudiants sont invités à contribuer à la mise en réalité de cette attention. Notre étude s'inscrit dans un travail envergure et que j'expliciterai sous le terme de « *Contribution à la mise en place d'un SIG pour la gestion communale* ». Elle a trait au SIG Communal et l'examen des possibilités offertes par l'utilisation de cet important outil. Elle a pour principal objectif, et dans une vision outil de connaissance et de compréhension de cet espace géographique, de concevoir une analyse et une modélisation de données. Plaçons-nous à la base d'une telle étude, et détaillons les phases à franchir pour la mener à terme. Il faut tout d'abord étudier la problématique de la cartographie à l'échelle communale, laquelle demande une collaboration avec les différents gestionnaires de la commune, à travers des enquêtes. Ensuite, la solution de la problématique et l'approche adoptée pour générer un modèle pilote de réalisation d'un SIG Communal basé sur la représentation systémique du territoire s'avère nécessaire. Enfin et pour assurer la faisabilité et la pertinence de notre développement conceptuel, la dernière phase s'articule à la validation de la méthodologie proposée sur la commune d'Arzew (Nord- Ouest d'Algérie). Notre propos n'est donc pas de fournir un produit, mais bien plutôt de déterminer, de préciser et de formaliser les étapes à suivre et les règles à respecter pour organiser les données d'un SIG Communal. La méthode de modélisation du territoire communal que nous avons proposée repose sur une analyse systémique. Cette dernière est en fait une sorte de langage permettant une lecture de la réalité au travers de la notion de système. Par ce travail nous avons essayé de démontrer la faisabilité d'interfaçage du territoire communal et les actions de développement effectuées sur ce territoire et sa simulation visuelle sur une image cartographique par le biais de l'outil SIG.

1. INTRODUCTION

The growth of the local territory comes with informations multiplication describing this territory and whom live in it: activities localization, transportation mean facilities, fundamental and patrimonial management, etc. These informations set gives by a way or another an attribute of localization, accessible either under a precise localization form or under an available aggregation form according to predefined carvings. Their visualization under plans or maps form remains one of the simplest way to understand them. This double imperative, from an information management to the increasing complexity and territorial visualization of its extension and dynamic, imposes a rationalization gait of storage and access to localized data.Currently, this since more than 15 years, one of the best possible choices for organizing the technical and social information of the city is called the Geographical Information System (GIS).

⇨ WHY GIS

Townships own specialized plans without scales concordance, proper each service (land registering, PTT, forest services, hydrography services, control services and the network road maintenance, water network franchisees , purification and gas…) and not always actualized. Searching information is difficult for the elected people, administrations, companies, citizens. Networks knowledge is random and often tributary to human memory (elected people, technical agent, secretary of town hall, etc…). Decentralization laws and notably those relative to expertises transfer have given increased power to the territorial collectivities in the space management and soils occupation domains. Townships need simple use tools to help taking decision and giving answers to the territory problematic management, road infrastructure improvement, water management and environment protection.

More and more, numerous townships, even of modest size, endow themselves of a GIS. This latter is part of the new tools of help to management and decision susceptible to answer to collectivities needs. These last years, the situation has evolved a lot: the computering tools are more and more rife and therefore less and less expensive, software is more and more easy to use.

The digitalization of land register is mastered today. It is structured, normalized, independent from software and easily exchangeable to serve as plan funds to the different actors of Township territory.

2. GIS AND EXISTANT COMMUNICATION TECHNIQUES (INTRANET / INTERNET)

The function of consultation and geographical data diffusion on an Intranet - Internet is a considerable technological advance in terms of information diffusion, an advance that we probably do not measure all its effects yet. The functions are at a time simple diffusion functions and functions dressing a more technical character. They allow :

- To consult existing information;
- To extract the mass plans in view of amenities projects or particular analysis;
- To update the textual informations on certain objects whose user has the direct mastering;
- To communicate graphic annotations to server's operator for an ulterior graphic modification.

3. PROCEDURE OF REALIZATION OF A GIS COMMUNAL BY THE SYSTEMIC APPROACH

Facing the increase difficulty of the management of the local territory, actors of this territory are in search of effective tools to help them in their tasks. They turn more and more toward the GIS of which the interest, in the context of the planning and the management of the territory, resides mainly in three aspects. First of all, a GIS is a system of information whose particularity is to treat information that possess a spatial reference. It is therefore composed of a database of spatial reference (BDRS), what confers it big capacities for the storage and the management of large set of data. Then, a GIS possesses tools of treatment and analysis of georeferenced data that facilitate the synthetic information obtaining. Finally, by its possibilities of regrouping and relating information, a GIS can be an appropriate place of meeting privileged for the different partners whom take care of this territory.

The development of these system types requires an architectural diagram of the different information of this system. We can compare to those that would have an entrepreneur if we asked him to construct a building without providing him an architect plan and a gait of realization. And the same case appers in geomatic: more the work or the system to achieve are complex, more the plan becomes necessary and inevitable to its construction. the systemic representation of the territory is to the local GIS what is the architect's plan to the building.

3.1 Territory Systemic Representation Approach

The development of the Systematic Representation of the Territory (SRT) rests indeed on a systemic approach and ensue from the fusion of the different models of explanation of the real world in a coherent interdisciplinary representation. The systemic is the survey of systems. Many authors consider it like a science with its rules and its vocabulary.

It is founded on taking into account the interactions and feedbacks and puts the accent on the determination, the definition and the description of phenomena and their relations. It also tries to define a unitary language of as very natural system representation according to the existence of common properties between these different systems [WALLISER, 1977]. Following this definition, we are obliged to put in evidence the notion of system.

According to Walliser (1977), consider a system like a constituted non separable unit of components in interactions, as an indivisible unit cannot be reduced to the sum of its parts. As he has formed a system in three fundamental categories: components, relations and the all. Let's note here that deepening in the theory of systems is not the goal of this communication.

Schwars (1994) bases on the three fundamental categories of Walliser to propose a new formalisation for a general system. On this latter, we inspire the systemic modelling of our territory. Schwars (1994) put that all existing system, that it is a bacterium, a family or a road network, possess three plans of existence (Fig. 1) :

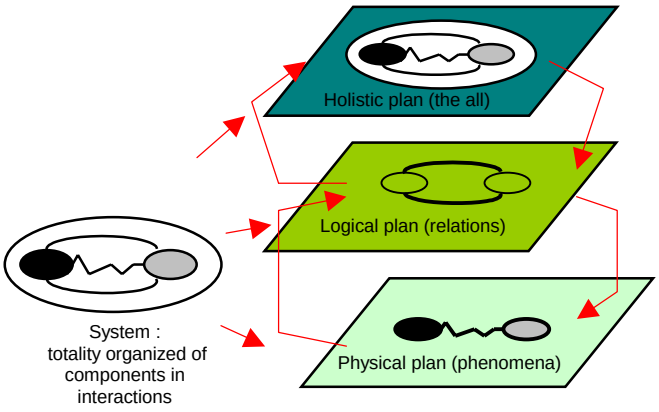

Figure 1. The three plans of a general system (adapted from Schwarz 1994)

- A physical plan that includes the components, either, in the case of the territory (elements or facts);
- A logical plan, non visible by our senses, that is the one with relations between components, that determines the working and the evolution of the system;
- A holistic plan that is the one where the system is considered like a complex all, an indivisible unit without which components and relations would not produce the observed evolution. Say otherwise, the all, either in a way the identity of the system that emerges from interactions between components, gives a sense to these interactions.

3.2 Application Of The Systemic Approach To The Territory

If we apply the systemic approach to the territory, we can distinguish the three plans of existence of a system plan :

- The physical plan that contains systems (or subsystems) composing the territory, as well as the human's actions on this territory;
- The logical plan or concepts that are composed of theories and models that we make from reality, as well as methodologies that we conceive to intervene on;
- The holistic plan that represents the territory in its proper identity, its directionnalities, its values.

3.3 Application of the systemic approach to the GIS

A GIS is a type of system constituted of computer components - material and software - of data, procedures and methods, of resources - financial human or scientific - that interact to do some tasks, to answer to requests and to produce information. We can also distinguish there above the three plans of existence of a system such as definied below :

- the physical plan that contains data acquired from observations or measures, digital maps or documents, of pictures integration or orthophotoses, as well as the useful information notably to the development of projects, to the decision making or the simple information of the population;
- the logical or conceptual plan that is composed of models shaping the different architectures of a GIS (organization, technique and information), which permit to elaborate processing methods (statistical or spatial analysis for example) and of exchange principles (diffusion modes or rating for example);
- the holistic plan that represents specific identity of the GIS and that expresses its privileged values (the exchange between partners for example), its finalities (to be a helpfull tool to the consultation, the management and the decision).

The SRT can be defined as follows: The Systemic Representation of the Territory is defined as an interdisciplinary model of the territory (interdisciplinarity = multi - partners vision) based on the determination of phenomena and relations that composes it and that are applicable in the setting of the management, the planning and the scheduling of the territory. it takes into account their temporal evolution to avoid redundancies and incoherences. From this fact, it is considered as the most adequate to represent a territory in a GIS. The SRT constitutes a setting of reference for making an exchange network between partners possessing cartographic data (geographical information) and being called to work together in the setting of the planning and the management of the local territory.

3.4 Hierarchical organization of the SRT

The Systemic Representation of the Territory recognizes six hierarchical levels of organization for its components (domain, sector, activity and element, thema, class of entities, entity). This organization is not exhaustive. it covers aspects of the territory that we well know (according to investigations) or those for which we could take advantage of the specialist contribution (for what concerns natural habitations, activities, infrastructures, and the regional development).This organization has also a merely operational goal, which is to facilitate the access to informations, hence it plays the role of a of a navigation tool within the GIS.

3.5 Access Management according to the hierarchical organization of the SRT

Some data are of confidential type and cannot be consulted by all the system users. These data remain under the exclusive responsibility of partners that provided them. The control of accesses first of all rests on the definition of groups users. These last are based on the administrative organization of partners. A specific group is formed of the set of users possessing the same privileges of consultation and modification of information of the system. If a group has access to a specific class (buildings for example), it also has access to the set of entities of this class (the set of buildings of the territory). However, it does not necessarily have access to the set of attributes describing this entity (Fig. 2).

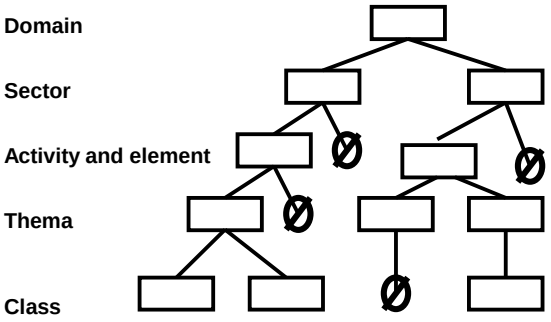

Figure 2. Example of a tree associated to rights of information consultation

Therefore, it is necessary to return some legible or illegible attributes according to the user. Three types of access have been defined :

- A reading and writing access, reserved to the administrator of information solely;
- A reading access for groups having a consultation right;
- No access to information: In this case, one distinguishes the case where the user has the right to know that information exists even though it cannot consult it, and the case where the same existence of information must remain confidential.

4. THE SETTING UP OF A LOCAL GIS ACCORDING TO THE SRT

To pass from SRT abstract state to the concrete state, only the computer representation can play this role; otherwise to pass to the stage of the implementation of the Communal GIS. Concretely, the realization of this passage rests on two complementary steps.

The first issue on the development of a flat shape of exchange between partners and this to facilitate tasks of professions in the setting of the planning and the management of the local territory. The material architecture of this platform is based on the concept of making in relation servers and customers with the mean of telecommunication networks (TIC). In technical term, this architecture is based on a dedicated server (geographical server) that plays the role of a tool facilitating exchanges as well between the varied users internal as external to the collectivity (Fig. 3). It has functions of storage and protection of data, of management of competitor accesses, opening on the varied formats and interfaçages with the existing applications, data funding geographical or alphanumeric.

One of the major functions of a geographical server is its capacity to converse operational and transparent manner, exchanges of data with other graphic software and the software GIS by interfaces recognizing the main formats of the market [ex: DXF, ASCII]. Concerning funding of data one of the main functions is to assure the follow-up of the differential between the external updatings and the real state of data.

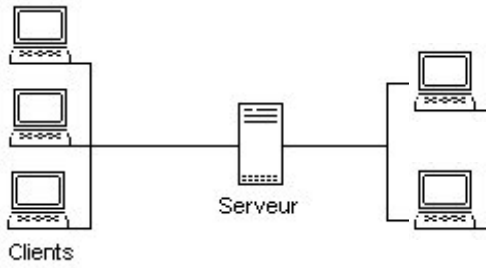

Figure 3. Client/Server Architecture

The second gait is about the realization of an environment permitting the access, the consultation and the easy extraction of data. This environment constitutes a tool of research and identification of the following elements :

- The available data through a definition and a description of classes of entities of the local territory and their attributes;
- Means of consultation and access to data through a hierarchical organization of entity classes;
- The existing projects, under realization or intended;
- The available products (national cards, cadastral plans, satellites pictures, orthophotos, etc.);
- The different servers depositories of data of the Communal GIS;
- The different active partners on the local territory with reference to elements that are associated to them (data, project, products, servers).

The different modules of this environment that are conceived according to the systemic representation of the territory, permit to answer to the following fundamental questions: What are the existing data? , Who possesses them and manage them? , Where they are localized? , How can we reach them? and what are the conditions to get them?

The different menu organization within the environment of the Communal GIS rests on the SRT. This environment of manipulation on the Communal GIS and is thus able to offer a common language of description of the local territory after their installation on the different servers of partners.

The development of this language or this interdisciplinary model of the local territory that we called SRT in the setting of this work, result a gait including the set of partners who have for tasks to give a definition and a common description of entities and relations that are going to represent all the process of the management of the local territory that is especially based on the geographical information.

5. EXAMPLE OF REALIZATION: APPLICATION TO THE TOWNSHIP OF ARZEW

Arzew, is a socio-industrial Algerian township of average size, delimited by parallels,: 35° 45 ' 38 " and 35° 54 ' 35 " North in latitude and the meridian 00°S 15 ' 37 " and 00° 20 ' 27 " West in longitude, situated on the first terrace above the wilaya of Mostaganem between the township of Béthioua and the township of Gdyel, at less than 45 km of the Oran city (Fig. 4).

Figure 4. Geographical situation of the Arzew township

5.1 THE INSTALLATION OF A GIS FOR THE TOWNSHIP OF ARZEW

according to the available data and the existing means the realization of the Prototype Communal GIS of Arzew takes the three following phases as a basis :

5.1.1 Data Organization Phase

The organization of data and their modelling rests on the SRT, as presented in the section (§. 3) of this publication. In this context the data base on the Communal GIS of Arzew includes several data, that are represented under shape of layers according to the available initial data :

General data :
- *Plan of the structure*
- *Plan parcels*
- *Parklands*
- *The postal addresses*
- *Topographic plan*
- *Aerial photo*

Data of networks :
- *Plan of axes of streets*
- *Networks of drinking water*

5.1.2 Data Seizure Phase

Maps and the existing plans are the essential sources to the construction of our GIS, and to the creation of the different layers. The geometric whole is constructed from the different information numérisation representing on these plans and that appearing to be useful for our application.

Before their definitive storage and their use in our system, the spatial data underwent pre-treatments: conversion of data structure, unification of the projection system.

5.1.3 System implémentation Phase

In accordance with our identified needs, vector GIS, DBMS Relational Multiconnexion and a footbridge to stock and to manage data multi-users georeferenced. And in order to validate the retained solution, the application will be driven under the following environments :

1 - Software Arcview® 3. 2 : The choice carried on this GIS because, on the one hand it offers the possibility to adjust to our problematic and the available data, on the other hand, it is available to the CNTS. Besides, it gives the possibility of the access as customer to the distant data according to architecture client/server (Fig. 3).

2 - Software Oracle® 8i: Multiconnexion Relational DBMS, constitute an operational platform of production, permitting to publish a data base easily on the network, assuring an optimal transition traditional of the client/server thus toward network architectures. It also allows files of all nature to benefit from the security and the integrity of the data base (§3. 5).

3 - ArcSDE® 8. 0. 2: (SDE: Spatial Database Engine) It is the footbridge between the Multiconnexion Relational DBMS and the software GIS. The SDE permits to stock the spatial geometry (points, lines, polygons. . .) and data attributiveses within a same relational data base, Oracle, Informix, IBM DB2, Sybase or SQL Server. It lets then to the Relational DBMS the care of the management and add it a certain number of specific geographical operators. it allows the relational data bases to understand and to exploit the spatial information.

To concretize the proposed solution we worked to the side Client ArcView® 3. 2, with its own Avenue® programming language to create a convivial work environment (Fig. 5), this last permits of :

- To facilitate the access to information;
- To execute requests according to the right of access;
- To assure a fast and convivial communication for the client (user of the local geographical information), either locally either to a distant data base.

In order to keep the set of clients (group of partners) in the same work context, this environment of work has been created like being an extension(1) supplementary for the software ArcView®, its gives the possibility to transfer this environment on the set of clients joined to the network and connected to the Oracle RDBMS.

(1): Extensions permit to share personalizations, documents or all other object, independently of a project. Extensions can be easily, intuitively used and created by all person knowing the language Avenue [ESRI 1996].

The main menu, allows the user to reach in a simple manner and predefined to data that interest him, while placing at its disposal the set of functions allowing him to do its tasks. it is composed of five elements :

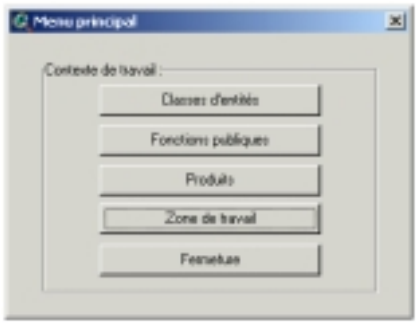

Figure 5. The Main Menu

Classes of entities : allows the user to choose the entity on which he wants to visualize or to do requests.

Public Functions : to see the available and responsible public functions on classes of entities selected.

Products : maps of the township, the cadastral plans, the aerial photos, orthophotoses, etc…, with which the user wants to work.

Zone of work : allows the user to define the geographical zone of the township, in which he wants to select and to visualize data, to do its treatments or its cartographic reproductions, precisely. According to the available data for this application, we divided the zone of work in five under zones: Complex zone, Zabana zone, the center city, Plateau zone and the industrial zone.

Closing : this function permits to leave the application, with a registration of modifications under the index of work named ARZEW in the user's disk root.

5.2 THE INTEGRATION OF THE BIG PUBLIC TO THE LOCAL GIS OF ARZEW

Since the present speed of the computer means evolution, the transmission of data by networks of telecommunication and the apparition of the Internet these last years, we have the attention to integrate inhabitants of the township in the different phases of development. Of this effect and after the reserved phase use to specialists, the Communal GIS is called to be consulted by the big public.

In this context and in order to actually put this attention, we worked on the setting up of Web interface on Internet for the township of Arzew, in order to inform and to sensitize inhabitants to changes and developments of their local territory (Fig. 6).

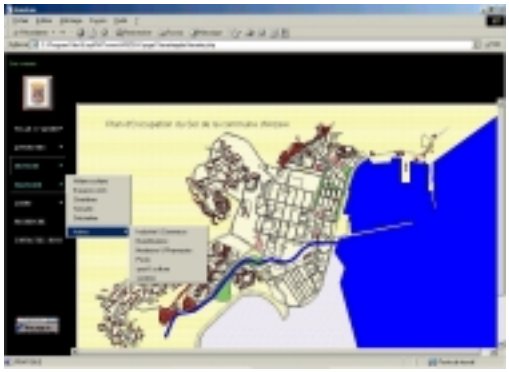

Figure 6. Excerpt of an Internet window

6. CONCLUSION AND PERSPECTIVES

More the township evolves, more it becomes complex and more we need to mark ourselves in its space, to situate phenomena or events and to plan evolutions. The local collectivities are in this situation. They evolve very quickly and are expecting a new cartography to help them in their space management.

Today, A township desining undertaking a thought about its geographical, topographic or fundamental heritage, is confronted to many types of problems, that is ominous to reduce only for the choice of a moreless powerful GIS platform, either effictive or developed. The prime objerctive of this study is enrolled in this context.

We have showed in the present survey the importance of a systemic approach to model a local territory in order to better master its complexity, and better understand how it works and the reasons of its evolution. This put in evidence the growing needs of harvest, management, treatment and diffusion of a considerable mass of data and information.

Also, We have demonstrated that coherence and well working of such system needs the design of an architecture covering the geographical information domains, technique and organization.

Finally, concepts application and the developed approach for elaborating a prototype local GIS of the township of Arzew permitted to test, affinate, adapt and validate the different phases related to obtaining a systemic representation of the local territory.

This conclusion shows our contribution to solve the studied problem and makes a synthesis of the principal results obtained, we can say that the setting up of a local GIS is a promising gait on the technical and organisation plan, howver, the local GIS remains heavy operation that requires means, good will and time; especially who it is related to different services, persons and responsibles.

This work opens perspectives is both application and research domains. It stresses on the aspects to develop at the geomatic, spatial reference data base and localized information diffusion domains.

In the domaine of geomatic application, this work could help geomatic communitry waiting to enlarge this study on a larger territory than a local territory.

For the research domain, the systemic representation of the territory can be implemented in the future on data bases predetermined on the different available SDBMS in the market.

Actually, especially for our country, many questions remains asked, notably in the internal management of services, the computering tools are not sufficient at the level of our services, but we can reasonably estimate that our administrations will not stay insensible and they will make these tools professional ones.

On the other hand, problems of organization will probably remain delicate to solve and, won't especially support the same standardization wished for the technical means. Their solution remains indeed closely bound to the administrative structures, to people, to the financial means, to the political priorities and the local conditions.

Even if a lot remains to do to make operational the set of elements presented here in, we wish that the reflection on the local territory modelization and it insertion to elaborate a local GIS make progessing the knowledge and the practice of the geomatic, also will make easy the management of the territory, oriented to the promotion of a lasting development for our townships and for our country.

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