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"The Geographic Information Technology support to historic urban centers redevelopment process: towards a communicative approach"

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Abstract

The extremely high value of cultural heritage stored within urban areas of many European towns and cities requires big attention to be paid in historic quarters re-development management. Commercialisation, cultural uniformity and real estate speculation are concurrent factors in deteriorating structure and social life in towns and cities. In historic city centres these strong forces could lead to a loss of identity and cultural heritage.
According to a multidisciplinary approach, urban redevelopment should be supported by constructing a knowledge base about cultural, historic, artistic, historic, social, economic and real estate scenery as aid in policy development, decision making and action management. Geographic Information Technologies has proved to be effective tools in spatially referenced knowledge base management and reliable operative and strategic support tools in planning and action.
The aim of the contribution is to supply a methodological framework for the implementation of a GIS-based help-desk for the redevelopment action management in historical city centres oriented towards historical assets and cultural heritage preservation. The system could become the co-operative multidisciplinary platform for the dialogue among stakeholders with different interests, skills and background. Moreover, the number of different actors taking part to the underlined processes, from the public and the private sectors, professional and citizens, suggest to rely on a WEB-GIS architecture in order to allow distributed access to the system for Information storing, processing, analysing and retrieving, according different customised protocols. Internet widespread diffusion and the development of sophisticated Distributed Geographic Information (DGI) technologies allow, nowadays, the implementation of reliable Geographic Information Technologies for spatial data representation and analysis on the Web. The development of user-more-friendly interface opens the access to geographic Information to a wider public. The epochal change from an economy based on the production of physical goods to a new economy based on the production of Information has boosted the development of new policies leading to forms e-government, transparency, participation.
The contribution reports results of an application developed by the author with reference to the Historic Centres re-development Lab in the City of Cagliari (IT).

Introduction

Planning practice may be considered as an *ensemble* of different activities: analysis, design, decision-making, evaluation, management. Whereas, different theoretical approaches make different the relative weight of each activity in different planning processes, according to the planning paradigm adopted, all of them are characterized by spatial dimension. As a matter of facts, all of these activities deal with objects or phenomena within the geographic space. One might then argue then that Geographic Information Systems, whatever the definition assumed among the very many, as information system devoted to the dealing with geographic dimension, should be "the right tools for planners in the information society". In the arguments between GIS-philes and GIS-phobics, the latter would attack the above provoking statement with the claim that GIS is under-diffused and under-used in planning practice. The numbers confirm this claim. Nowadays, developments in ICT offer reliable tools to support planner's professional practice. While good results have been achieved in spatial management processes, there are still difficulties in developing strategic planning support systems.
In the light of these issues the author aims at reporting the application of Spatial Information Technologies to urban re-development in cultural heritage sensitive historic city centres.
Nowadays in Europe, nearly 80% of the population live in town and cities.
In many European countries most of the urban settlements have very ancient origins and often their centres store a precious cultural heritage. Many centres still shows archaeological assets, like temples, caves, road pavements, or architectural monuments, like churches, castles, city wall, and so forth, but also historic urban fabric with its mass of building which as a whole have been recognised as an extremely valuable part of cultural heritage. Nevertheless, many city centres shows serious symptoms of physical and social degradation and actions are required in order to prevent risks of deterioration and loss.
In historic centres re-development two main issues should be taken into account in policy making and action management:

A. The redevelopment of deteriorated ancient urban district should lead to an higher quality of life according sustainable urban development issues

B. The safeguard of archaeological, artistic and historic remains stoked within the urban built environment as cultural heritage for the future

In facts, European Cultural heritage is considered of worldwide importance as expression of European identity by European Spatial Development Perspectives (ESDP, Commission of the European Communities, 1999).
On the dilemma whether conservation or transformation approach should be adopted the document states" rigorous protection measures, such those envisaged for architectural conservation for certain areas or monuments, can only cover a small part of this heritage. For the greater part a creative approach is required to reverse in a number of areas the predominant trend of neglect, damage, destruction and thus pass the Cultural Heritage, including current achievements, to future generation."

With this premises it is aim to discuss in this paper some advancement in the methodological approach and the description of Geographic Information technologies for cultural heritage management.
The case study of Cagliari *Historical City Centre Re-Development Lab*-GIS pilot project is proposed together with some issues for further developments.

The Cagliari Historic Centre Case Study

A GIT oriented approach has been applied in the case study of the *Laboratori per il Recupero dei Centri Storici della Sardegna* project (Historic Centres re-Development Lab - HCDL). The HCDL were instituted by the art. 7 of the Regional Urban Planning Law n° 45/89; they have been set up by the Councillorship for Local Bodies, Finances and Urban Planning of the Autonomous Regional Government of Sardinia (RAS) with the scientific supervision of the Dipartimento di Ingegneria del Territorio (DIT) at the University of Cagliari. The RAS and the Università degli Studi di Cagliari, Dipartimento di Ingegneria del Territorio (DIT) signed a research agreement and in a period of four years, HCDL pilot projects were implemented in some Sardinian towns and cities. The main objectives of the HCDL are:

A. The understanding the local context by means of the integration of the expert knowledge and the common one;
B. The construction of the environmental framework which preservation, safeguard and re-use action proposals, oriented to economic and social re-development, have to refer to;
C. The knowledge sharing for action admissibility definition;
D. The promotion of coherent actions with the model of local sustainable development.

These objectives demanded a series of tasks to be performed at the HCDL such as:

A. proposal of sectional projects and procedures for action development coherent with architectural typology and local construction materials
B. definition of environmental and infrastructural requirements for re-development actions;
C. set up of standard action models (architectural, economic and administrative);
D. re-development proposals assessment for supporting planning and decision-making.

These tasks were carried out on the base of analytical activities such as:

A. Definition of typo-morphologic attributes for classification of buildings; the output is in form of abacus and becomes the reference for development of a set of rules for preservation, re-development and re-use plans;
B. Definition of an admitted transformation degree as function of indicators of architectural typology, materials and techniques for the objects of urban space;
C. Guidelines proposal for admitted actions for classified objects;
D. Economic evaluation of refurbishing action costs;

Given the HCDL role of advising and control body in the recovery of the historical centres, in the first years after their institution, the activities of survey of historical urban fabric and real estate began in the first Sardinian centres analysed (Figure 1).

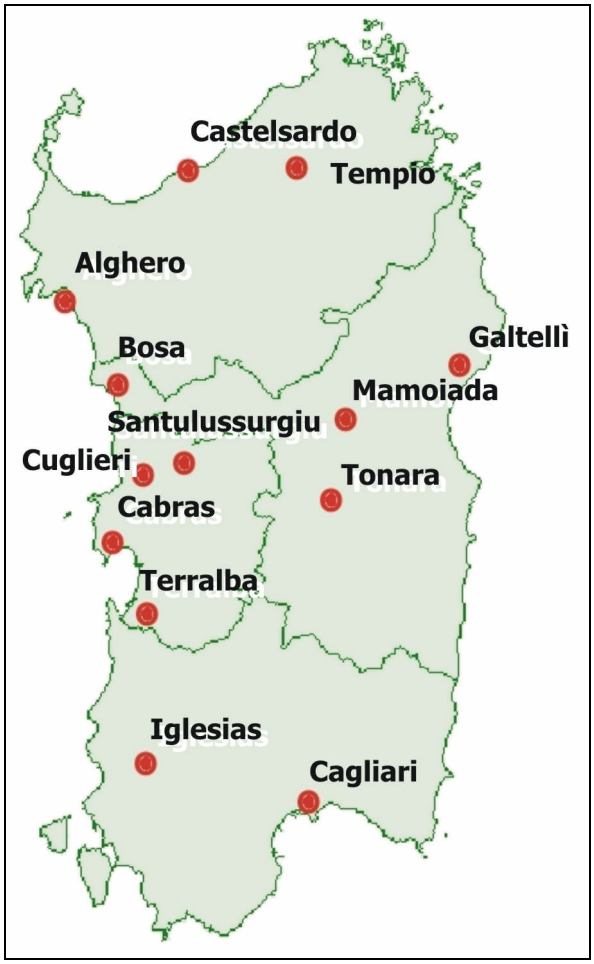

Figure 1: The implementation of HCDL in Sardinia – The first case study.

The size of data and their wide variety of formats together with the characteristic of the survey techniques have demanded from the first phases of the project the opportunity to arrange a set of tools for the digital treatment of the information (figure 2).
The importance of the spatial dimension in the objects measurement and the analysis of the built environment has oriented the choice towards Geographic Information Systems, capable to reference the description of single the objects observed to their position in the real world. Different experimentations have been undertaken at the DIT, therefore, aiming at the development of GIS methodologies and applications for the management of the recovery process. In particular, a prototype has been designed and implemented for the historical centre of Cagliari (Campagna, 2001).
Beside the initial operational requirements of digital cataloguing for the knowledge base acquired during the first years of activity of the HCDL of Cagliari, the pilot project SIRCS (Sistema Informativo per il Recupero del Centro Storico) has been influenced in

its design and implementation by the further procedure of information communication and data management derived from the long terms activity proposed for the HCDL.

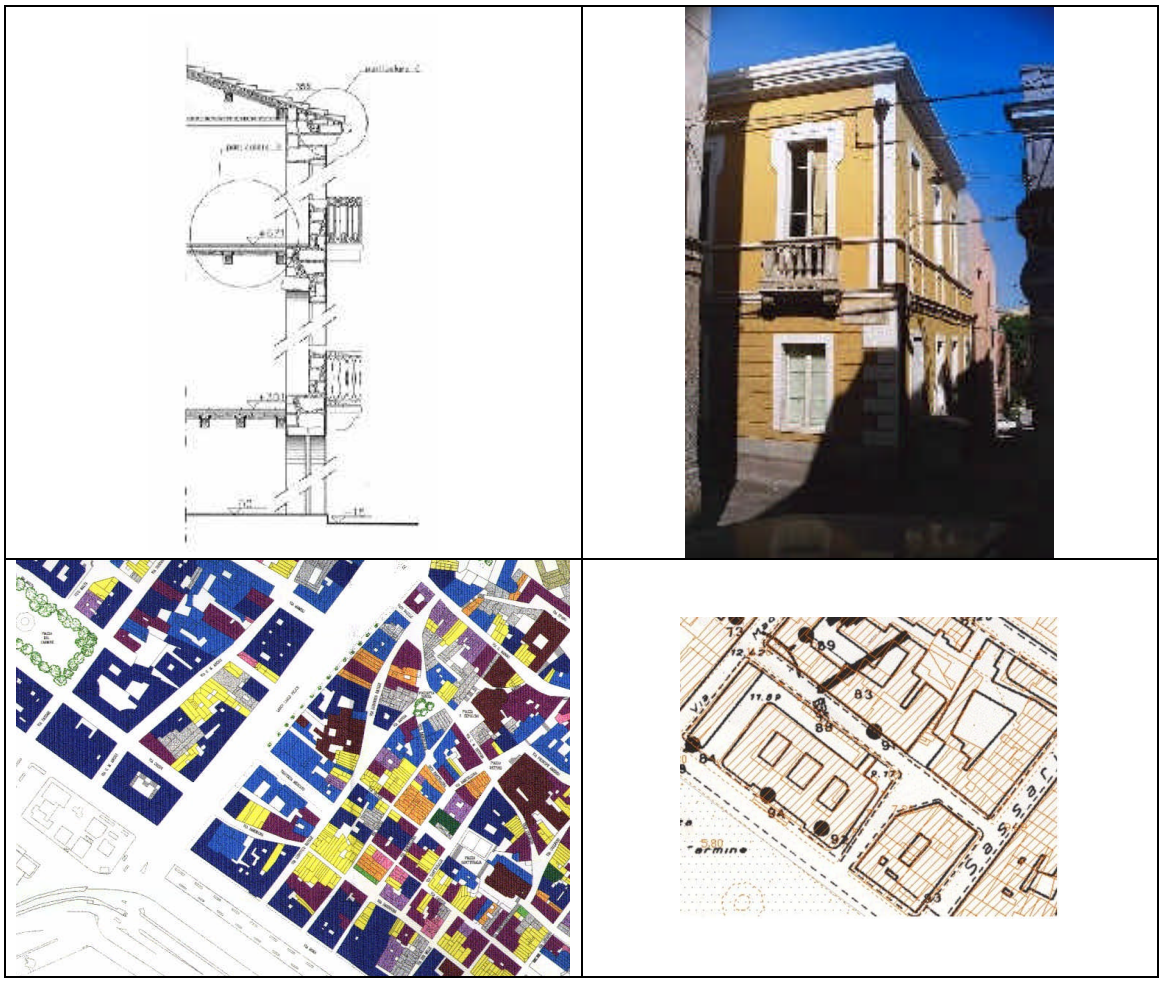

Figure 2: Examples of geographic and multimedia data collected and produced within the HCDL (*Source HCDL*)

The nature of advising body, of development monitoring and project evaluation body of the HCDL, required the knowledge-base access from a wide number of stakeholders involved in the processes of city centres revitalization; this number has increased in Italy in the last years due to the reduction of the public founding for housing supplying and the consequent private investment demand.

A GIS has been implemented which is able to supply the information according to different protocols depending on the various degrees of competence of the various types of final users. The interface derives directly from the architecture of the system is composed by a GIS platform, a RDBMS and a hypermedia database.

The three subsystem components can singularly be used from user with different level of competences and different informational needs. The system as a whole thanks to the procedural relationship allows the knowledge base management and analysis according to differentiated acquaintance processes.

In particular the hypermedia database manages in a flexible manner a wide amount of data in multimedia format, such as extended (Hyper-) text, images, sounds, video, so that it has allowed to implement an user-friendly and intuitive interface suitable for the

common knowledge representation and communication. The hypertext, in other words, concurs to manage an information structure, which does not need, differing in that from GIS, exposure to the fundamental concepts of geography and spatial analysis.
Multimedia GIS could offer a communication tool to foster public participation in those planning processes in which citizens involvement is a key factor for the success of the revitalization actions, such as in historic centres redevelopment. As a matter of fact, in the last decades European historic centres have been marginalized by the Second Post-World-War re-development of the city new expansion. They began to face with socio-economical and physical degradation but nowadays the new interest for historic centres, repository of cultural heritage has grown again. But there are some risk coming from strong interests on them. In order to avoid globalisation forces originated by service sector locational choices and tourism, the involvement of inhabitants is *conditio sine qua non* for a sustainable redevelopment and high level of quality of life achievements in the city. Results from a recent survey carried on by the authors (Campagna and Deplano, 2002) however show that the use of multimedia GIS in not spread so much within Italian public online GISs and it might depend on the bigger weight is still given to the expert technical knowledge rather to the common knowledge in the planning process. However, research undertaken in the last decade has shown the high potential of multimedia collaborative planning support systems (Shiffer, 1995) in community planning processes. One could argue that the reason for the slowness in the diffusion of such systems might be due to the lack of participatory processes in planning and decision-making rather than to technological problems. The case of the HCDL could offer a suitable chance to develop such an application.
One important aspect has been taken into account since the first phases of the of SIRC prototype design and implementation. Although the SIRCS was designed as desktop GIS, it was conceived to be used as an info-desk opened the public. Later on, however, with the widespread diffusion of Internet begun in last decade and the development of several GIS online, favourable socio-cultural and institutional conditions arose for the change from GIS desktop platform to the development of the online system application (Campagna, 2000).
At the beginning of the project development activity the SIRCS system architecture design have been articulated in four subsequent phases. After the analysis of the activities carried out to within the HCDL, the procedures and the necessary dataset and models were defined. In the third and the fourth phases of project suitable off-the-shelf tools for the system implementation were chosen and finally the system was developed. The first two phases are in a certain degree independent from the latter, in the sense that the procedures defined here might be implemented with other instruments, but not completely; this independence grant the migration from the desktop version of the system to the online application. However, in the migration from one typology to the other one it is necessary to keep in mind that the different access protocols demand different interfaces driving, in some cases, to the review of the whole procedures.
The implementation of the system in a distributed network concurs to take full advantage of the effort for knowledge-base collection for various purposes, thanks to the possibility to the information (or a piece of it) to a virtually limitless number of users.
The functionalities of the system are structured in procedures according to the ways by which actors take part to the planning and re-development processes and the relevant activities. Moreover they have been designed according to the user way of accessing

and using the system or its subsystems. The Figure 3 shows the various user access degrees according to the various activities in the case of desktop and online application.

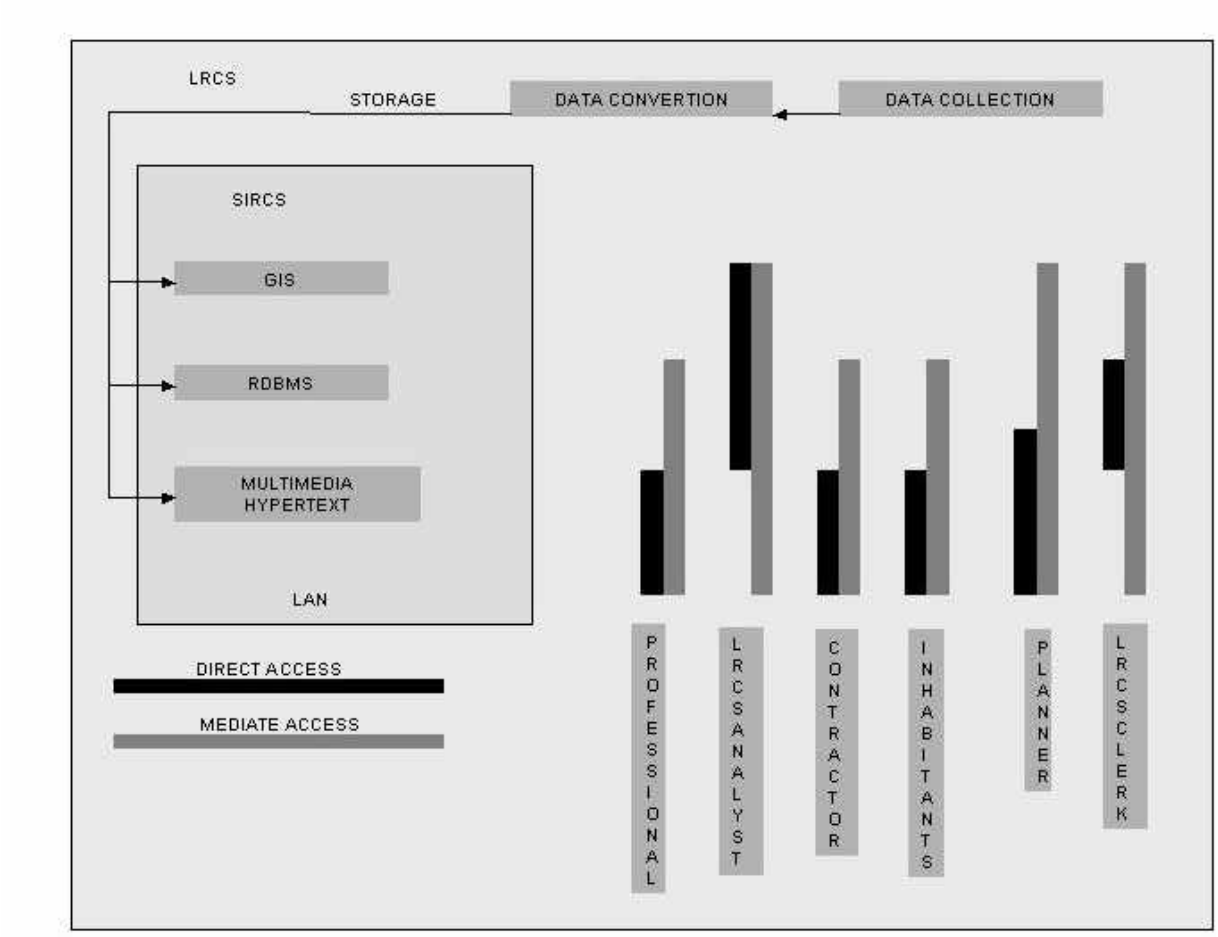

Figure 3: Different users access to the system

Trying to categorise the wide range of UrbanGIS applications they might be classified in three main sets according to the objectives they are conceived for. Perhaps in a simplified way we could distinguish application developed to execute measurements, to apply models or to execute operative management procedures.
Examples from the first set there exist for instance to measure and map ground temperatures from remote sensed data, or other developed to depict possible future scenarios on the base of spatial analyses, which belong to the second set; and exist, also, application developed for spatial management according to processes of re-organization of P.A. facilitated nowadays by the new computer technology.
It is to functionality taken from both sets that we refer if we want to speak about systems for the management of the historical centres redevelopment.
These systems are based mainly on vector GIS engine by which the spatial database entity which represent the objects which constitute the urban environment are connected with their attributes stored as alphanumeric data in relational database. In the SIRCS application the identity of the spatial entities is given to the cadastral parameters. In this way is designed the first informational layer of the system allowing us to select the built objects which constitute the urban fabric. The objects can be characterized on the map according to their geographic characteristics and *vice versa*.

Thank to the linkage of each entity with the aspatial database, moreover, the entities can be characterized according to their attributes (architectural style, typology, age, dimensions, and so forth). While the database structure offers a suitable mean to store quantitative attributes it is not always straightforward to encode qualitative characteristic. This aspect is particularly important in the historical centres, in which, the historical memory, the life styles, the local cultures stratified in slow diachronic processes in the materials and the shapes of the built environment. If we aim at improving the quality of the life in the historical centres we cannot avoid to take into account the safeguard of the identity of the places or we will face the risk of irreversible loss of a cultural patrimony going towards processes which tend to dweller mis-acknowledgement of the places they live with the risk of social, functional and physical degradation.
In the light of these considerations multimedia system allows to integrate the GIS and to analyse the information we need to represent the identity of places and historical memory. While it is straightforward to encode in numerical format a qualitative attribute like the " state of conservation of the building " a photographic image offer an informative level clearly very much richer.

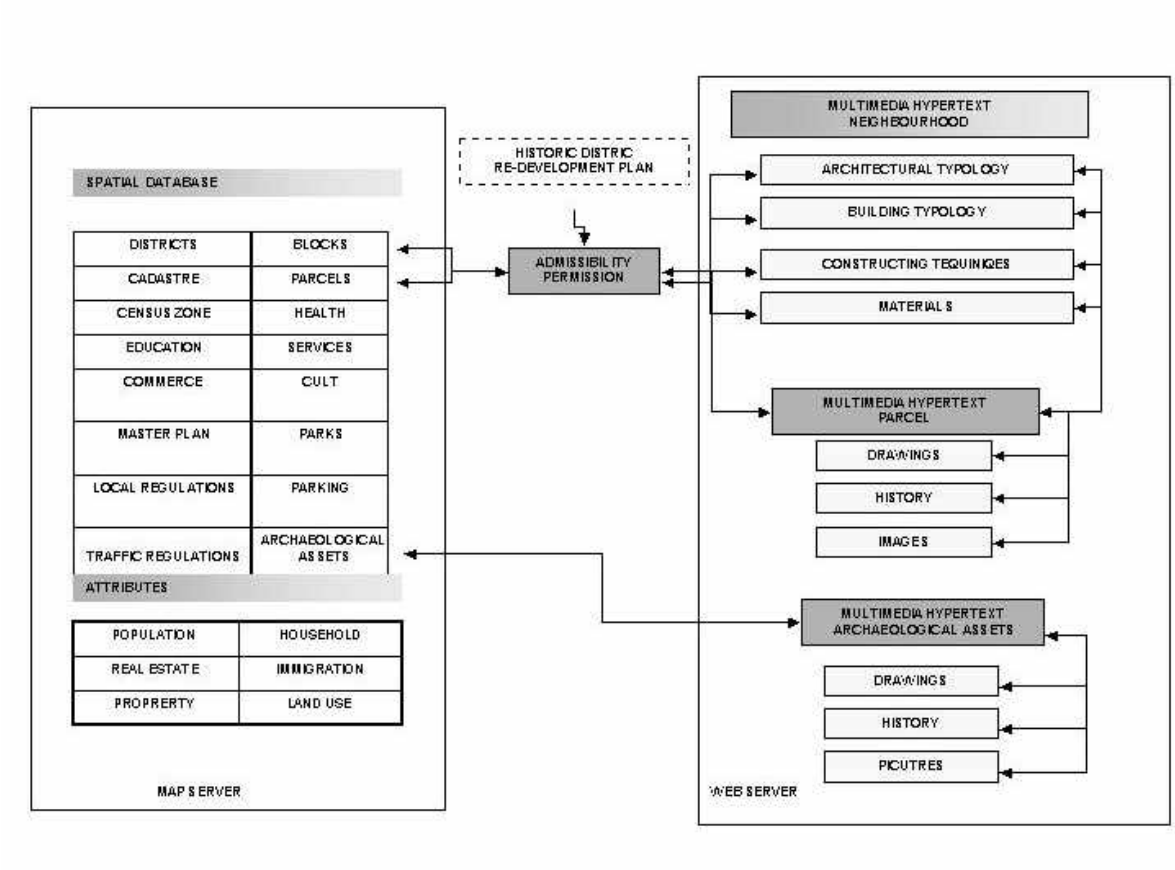

Figure 4: SIRCS Data model

After the construction of the cadastral base it is possible to proceed to the implementation of other information, related to other scale spatial objects, whose representation and analysis supply further elements of evaluation and decisional

support. The number of the feature classes encoded in the spatial database strictly depends on the system procedures. Figure 4 present the general data model implemented in SIRCS. This model could be considered as an Urban Information System tailored to the activities of the HCDL on historic centres.

Conclusions: towards communicative planning support systems.

The issue of historic city centres re-development is not a straightforward.
A knowledge-based approach is required to manage the complexity of a process which aims at achieving better quality of life of inhabitants but which have also to deal with Cultural Heritage preservation in an environment stressed by many unbalanced forces. Integration of different experts knowledge and of the common one should be achieved in order to support planning and decision-making.
Information Technology offers reliable tools to support a more effective organization of the planning and decision-making procedure and the integration of many different bodies, which act on the same environment with different objectives, which should be integrated.
Nowadays Spatial Information Technology (SIT) offers a number of tools to solve complex spatial problems. It is often discussed how to perform a particular task and this is a very useful approach but is very useful as well to search how to apply SIT to every day life.
GIS implementation implies big re-organisational efforts in to be effective. However, many studies and practical experience in urban planning and management show GIS as an effective operational support.
Nowadays IT plays a growing role in the economy and new policies are developed to drive the change. This scenario offers new chances to develop new kind of application aiming at involve a wider number of actors in decision-making processes. In urban planning and management where a high level of public input in required to manage spatial problem the implementation of user friendly Web-GIS application seem to be a useful extension of operational GIS.
The scheme in figure5 shows design requirements according to the different way re-development process actors access the system, which is here represented as a Communicative Planning Support System. Such a name derives from an architecture proposed by the integration of a GIS with other tools and techniques for planning support. The system should be implemented in a shared environment so that it may offer strategic support in planning and decision-making phases while performing management operational procedures. The shared environment can be realized in form of public information kiosk within the HCDL offices or in the WWW, given that the two alternatives are based on the same core technology. While the information kiosk offers public access to the system for people not yet connected or familiar with the Internet, the WWW version allows access to dialogic or negotiative activities differentiated in space and time.

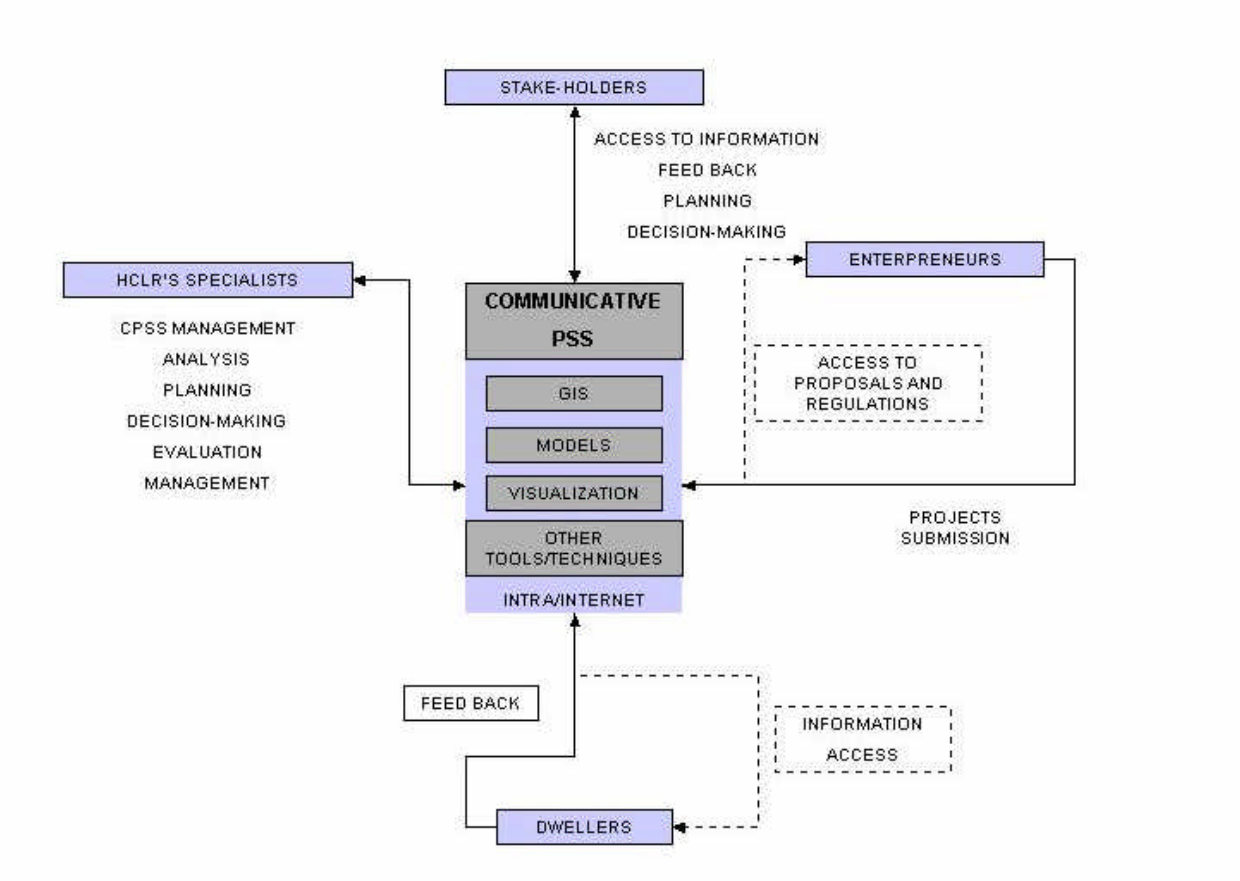

Figure 5 Relational models of a planning support system for a HCDL, its component devices and the target users (Campagna et al, 2002)

According to the model in figure 5 many visualisation and decision support tools and techniques can be embedded into the system to implement the information exchange between the actors involved in the re-development planning and management process, such as:

MCDM-GIS integration - multicriteria decision techniques within GIS (Malczewski, 1999)
VRML/AR - VRML / AUGMENTED REALITY (Smith et al, 1998)
ESDA - exploratory spatial data analysis (Andrienko and Andrienko, 1999)
Hypermaps (Laurini, 2001)
Multimedia (Shiffer, 1995)
Argumaps (Rinner, 1999)
Dynamic Maps (Peterson, 1999)

This set of tools is not intended to be comprehensive but it is proposed here to outline the opportunity to use many different tools within the same Planning Support System, or in general it might be better to say to support the same planning process.
Many other tools are available or might be constructed with those available to manage GI, even small pieces of IT, which are often the most valuable especially for lay-users.

Thus, further research strengths should be devoted to find new ways for the integration of different tools within multi-actors (spatial) decision support systems.
The model proposed here may then be considered as web-based planning support system. Different planning process or the same planning process developed in different socio-cultural context may demand for very different planning support system architecture. Therefore it is suggested that planners should have a better understanding of Geographic Information Technologies tools in order to use it in the most proper way to support planning process. Otherwise the risk would arise to develop expensive systems which may be not very effective for all the actors of the planning process.

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Further discussions on the topic of this paper can be found in the references of the author quoted below on which this synthesis is based.

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