Logical framework for information retrieval and conservation project. Geo-referential querying in integrated catalogues and notified cultural heritages

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ABSTRACT
The design of an information system based on cataloguing actvities in a conservation project is istrumental for the operating aspects and procedures. Its definition is an example of some of the fundamental parts of a general project for the modernisation of Public Administration concerning cultural heritage. The main objective is not only to put together the different catalogues, but especially to enlarge then through access to heterogeneus documents, also trough access to multimedia application, and to all these economic informations that will be useful for the management of the patrimony. The cultural heritage conservation requires both planning and programming measures and operational activities. At the same time it requires the support of information system that can gather and distribute the information of 'values' and motivation for recovery, conservation and restoration are based, so that the different actors and the different administrations delegated to the task can operate as much as possible along to the same strategic lines. The definition of the logical criteria and conceptual design for the informatic storage of the cultural heritage inventory is based on the description of the operators and on the procedural needs of each in order to optimise the use of the software tools. That means to analyze the theme of information technology and Gis for cultural heritage through integrations of three aspects: the information system; the study of competences and rules of procedure about cultural heritage; the project and implementation of prototypal information system based on georeference.

KEYWORDS: catalogue; cultural heritage; gis; information technology; urban and regional planning

INTRODUCTION
Although the construction of an information system suitable for different users groups is based on a series of machines and programmes capable of managing large amounts of heterogeneous data, it also requires careful analysis of data and their functional aspects with a view to permitting not only geo-referential

querying but also intelligent and friendly management. Overall, the logical framework for information retrieval is neither marginal nor banal, requiring the development of research capable of combining both theoretical approaches to the conservation project and database design capability.

The national programme entitled *Conservation Project: Methodological Guidelines For Preliminary Analyses, Action and Feasibility Control,* co-financed by the Ministero dell'Università e della Ricerca scientifica e tecnologica (Ministry for the University and Scientific and Technological Research) between 1998-1999 [1], represented an opportunity not only to retrieve results and solve problems resulting from previous activities connected with cultural heritage assessments, but also to combine different interdisciplinary points of view in order to consolidate these aspects by evaluating the knowledge acquired from a point of view of an information system project.

CONCEPTUAL PLANNING OF THE GEO-REFERENTIAL INFORMATION SYSTEM FOR ARCHITECTURAL AND ENVIRONMENTAL HERITAGES

The construction of an information system for territorial and environmental management and planning must fall within the Public Administration's general information system project, meaning that these should include different elements ranging from cultural heritages to real estate systems (buildings and land), from healthcare to traffic and transport, from use of urban to territorial or environmental land use.

This assumption involves not just interpreting the system as an expression of a particular point of view which employs a multi-user common database, but also depicting it, first and foremost, as a "public" information system, i.e. designed for information exchange between a number of users dealing with the same objects, although perhaps from different viewpoints.

Incidentally, three assumptions may be made:

- By definition the "public" information system is in direct opposition to the "private" information system, which is designed and used by a single user or by a homogeneous group of users.
- Although the information system is used for the management of standard procedural activities (files and procedures) and, at times, supports decision-making processes, it is, however, necessary to remember that this is based on knowledge that does not necessarily derive entirely from said procedures.
- Unlike corporate systems, the Public Administration's information system, must be open on two fronts: one for other Public Administrations and another for citizens and businesses.

These assumptions demand that the project not only responds to the logic of providing certified data, utilising clear, coded formats, managing standardized exchange protocols, utilizing standard updating criteria or adopting database integrity tests (not to mention security), but also that it may be structured on the basis of three analyses: the first on Public Administration work processes, divided according to specific skills; the second on identification of alphanumerical databases that have been distributed for use and management purposes; and the third, on identification of the detail levels necessary for geo-referential querying of objects and territorial transformation processes.

The *first analysis* represents the keystone of the project, in that it provides access to existing archives allowing not only for standardization of various information requirements but also of various transactions between work groups.
The *second analysis* highlights how the same object may be viewed by many work groups, but, in each group, with only part of the data: the project must ensure *database* consistency, avoid redundancy and permit the amalgamation of data from different groups.
The *third analysis* deals with the question regarding other aspects linked to cartography and geo-referential querying of objects: with regard to the above, it is necessary to dwell on a few fundamental questions, such as the need for "overlapping" between the following archive levels: regional cartography, provincial cartography, municipal cartography, land office cartography (ecographic code), ISTAT cartography (Registered sections and 2001 Census), where, in reality "overlapping" actually implies "geo-reference".

Benefits of the Information System

The success of the creation of an information system project depends on how useful it actually is. Although principles pertaining to data safety, integrity and ability to update are important in the decision-making process, actual implementation of the decision strongly depends on its utility both for the entire administration as well as the individual departments or individual officers.
System utility will depend on its compliance with office procedures, simplifying data access and transactions with other departments (for example, file transmission) and using efficient, intuitive, effective interfaces, commonly referred to as "user-friendly". However, interfaces and architecture respond to something that is secondary to the substantial question concerning system content and archive quality. Information systems related to real estate (buildings and land) must be seen as the result of a critical revision of databases normally used for management of same and, consequently, on the basis of the interaction between procedures and information sources.
Since territorial government bodies actually represent a unitary organization having specific tasks and skills, just as the territory is in fact a *unicum,* it would be reasonable to hypothesize that data should be able to be aggregated or split-up according to the possibility of territorial interpretation differentiated by the various points of view of the governing territorial bodies (State, Region, Province, Municipality, Park, Basin Authorities, Mountain Communities and similar bodies) with the aim of clearly reconstructing various territorial usage.

Feasibility Project Factors

The first step in the construction of the geo-referenced information system feasibility project is a "state of the art" study, the aim being to collect and assess a few examples of public administration information systems, with particular reference to the above mentioned problems, targeted at identifying success factors.
A second step is the strong identification of objectives and aims of the information system with a view to specific user groups, so that each group of users may define the procedures, while skills contribute to the definition of user groups. This phase considers existing distributed databases, ones that can either be retrieved or constructed.

The third step is the definition of the gradual implementation phases, which although conceived for individual user groups nevertheless allow for the expansion and sharing of information criteria and the data structure.
In any case, the information system feasibility study for building heritage management includes two criteria: the first is based on identifying new procedures or revising the concept of existing procedures; and the second on adopting compatible and reciprocally compliant development strategies for information sectors that are connected or undergoing transformation.
As elements of development, the geographical information sector can include land office reforms and the ISTAT Census, flanked by the results that are likely to emerge from the State-Regions Agreement currently being negotiated also with regard to cartography.
When designing the information system, the feasibility study must take into account the conceptual phase in order to subsequently deal with the logical and physical phase of the project, with the definition of IT aspects (hardware, software, data structuring and designing of system architecture) employing and maintaining a typical public works approach right up until tendering, construction and implementation. The *corpus* of information be specific i.e. related to the analysis of institutional tasks of the various public bodies, responsible, in some way, for architectural and environmental heritages; the study of the regulations in force is the first step along this path.
The second step consists of assessing the contents and layouts of a few samples of sheet drawn up by the regional, provincial and municipal bodies, the aim being to verify their utility as a source of information in proceedings concerning territorial organization and management. When the existing archives are vast, retrieval of same could prove to be so onerous that it could act as a deterrent to current management activities.

APPLICATION CASES [2]

Objectives and prototype implementation

The aim of the project is to build prototype work-stations based on GIS (*Geographical Information System)* and multimedia environments. These prototypes will serve to verify congruency between the definition of the general project framework and the effectiveness of the solutions, also with regard to the quantity of memory occupied, simplicity and speed in transactions and enquiries and the quality of the hardware and software architecture. The operation phases can be summarized as follows:

1. Analysis of competencies and administrative procedures within the provincial and municipal spheres;
2. Identification of internal and external databases: structure and interconnection analysis;
3. Conceptual database organization;
4. Logical planning of the information system according to the different levels of geo-referential querying;
5. Identification and standardization of queries;
6. Specific definition of geo-referencing;
7. Data access levels;
8. User interfaces.

Interpretation of the project has been applied to two cases in Lombardia, the Municipality of Monza and the Province of Lodi, through the construction of two GIS prototypes developed using Windows Microsoft with ArcView 3.1 (Esri) GIS software.

These are two studies which share a few common elements and objectives: both in fact deal with the geographic based consultation of cultural heritage as well as verification of the utility of this type of tool, the catalogue, within the context of Public Administration activities related to the management of historical towns and buildings.
The first objective pursued concerns the analysis of the possible integration of different databases on cultural heritages. The study starts with the analysis of contents and data structures and ends up by defining the relationships between different archives.
The purpose of accessing heterogeneous data banks through geographical querying and visualisation derives from the concrete possibility of integration with Public Administration activities: numerous diagrams with different layouts and different dates are used to assess the same building and the same P.A.'s, during the study and editing phases of town-planning tools which, in turn, promote specific surveys on building and environmental heritages. The phase related to prototype construction is targeted at their testing in order to assess their operating elements and updating possibilities.
The basic cartography for the two prototypes is the CTR (*Carta Tecnica Regionale* Regional Technical Map made by Regione Lombardia) 1:10,000, used as a reference to identify the heritages. This support is now considered a standard and is adopted both on a regional as well as provincial scale also for specific projects on cultural heritages.
Although the digitalized subjects relate to different topics, they are, nevertheless of specific use for inventory purposes, such as, for example, buildings assessed by the A(i) sheet, buildings present in regional databases, such as buildings where intervention measures are financed by special projects (e.g. those of the Regione Lombardia Frisl), boundaries of the Iccd territorial and town-planning forms, and summary elements of the town-planning scheme or roads. The catalogued subjects are combined with the census sheets, as well as other types of information, such as, for example, a photographic image or the reproduction of different documents relating to the building, or to a portion of territory.
Furthermore, the data concerning movable objects can be combined with the building housing them, the aim being to permit management of such heritages by also considering the territorial aspect of their conservation, useful also for reconstructing the entire collections scattered across the territory and for controlling their management. The diverse nature of the specific objectives falls within this context/general premise and is defined in relation to the specific competencies of the Municipal body in one case, and the Provincial body in the other.

Local level: a municipality (Comune di Monza)

Construction of a prototype for the Comune di Monza is underway for the management of files relating to the building heritage based on the analysis of relations between the main Public Administration offices involved: *Ufficio nuovo piano regolatore, Ufficio gestione urbanistica, Ufficio Edilizia privata* (New Town-Planning Scheme Office, Town-Planning Management Office and Private Buildings Office) [3].

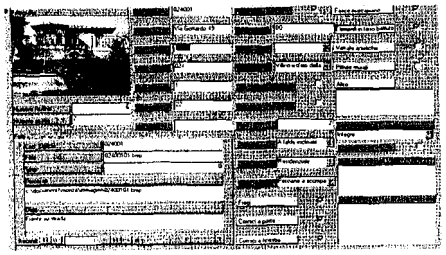

Figure 1: Data-entry layout (Access'97) of the "Valori storico-testimoniali" cardcatalogue, designed for the Monza master plan

The alphanumerical and geographical databases contained in the prototype are partly drawn up by various bodies (Comune di Monza, Provincia di Milano), partly newly-compiled or revised via re-elaboration of existing data, within the research framework.
In particular, cardcatalogue on "historical-cultural heritages" promoted by the *Ufficio Nuovo PRG* (New General Town-Planning Scheme Office) on the occasion of the drawing up of the Town-Planning Scheme in 1997 with the intention of including those government offices under restraint by the Scheme variation still for ratification, have been careful analysed as regards their conceptual structure, which has brought about the creation of a *database* using *Access'97 (Microsoft) software* that will serve to assess the possibilities of integration and use of the Gis functionality databases with regard to the activities that are in course at the Municipality's *Ufficio Nuovo Prg*. In this case, the cartography for geo-referential querying on the buildings has been obtained from municipal aerophotogrammetrical records (vectorial). Other information levels aiding in defining specific querying or creating themes refer to the cadastral cartography records (Land Office) and those of the General Town-Planning Scheme, both in numerical format. Furthermore, integration with contents of the specific cultural heritages databases [4] has enabled checking of overlapping of information on the same building deriving from different projects.

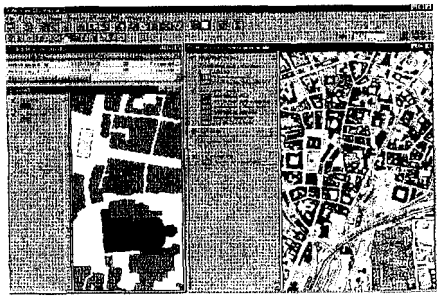

Figure 2: Elaboration of data relating to the census of the Provincia di Milano according to the typology of the catalogued properties.

The intermediate level: a Province (Provincia di Lodi)

The study's objective as regards the Provincia di Lodi consisted in analysing the Provincial body's specific competencies in the sphere of knowledge and management of cultural heritages and activities connected with co-ordinating the cataloguing activities in its territory, especially in view of the latest regional regulatory measures.
The project, drawn up and involving the Town-Planning and Cultural Activities Sectors, has an essential premise forming the basis of the definition of the prototype specifications in the study of the government body's specific competencies. Here too, analysis of projects and specific archives on cultural heritages relating to the examined territory proved fundamental, particularly exemplified by the Comune di Maleo [5]. Analysis of the databases existing for the territory under

examination [6], some in cardcatalogue, others in computers, represent the basis of the territorial information system.

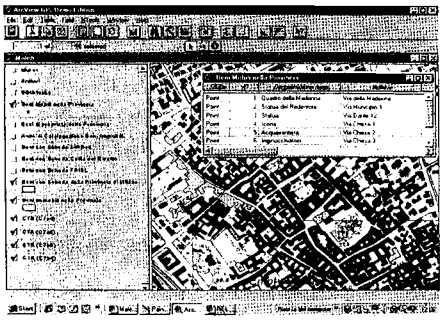

Figure 3: Maleo, architectonic heritages in the Provincia di Lodi inventory [7]

The prototype's logical project includes connecting ArcView and the various databanks, mostly set up using Access'97 [8]. The main cartographic queries and themes indicate how many times a property has been registered and with which kind of sheet, the year of the latest sheet and a visual photographic image. Also, the prototype experiments the connection with the SIRBeC application, the programme managing the data banks of the catalogued cultural heritage in the Regione Lombardia.

ORIGINAL RESULTS OBTAINED FROM SOFTWARE APPLICATIONS AND POSSIBLE DEVELOPMENTS

Theoretical in-depth studies and experiments have given rise to some reflections on the "state of the art" in the field of Gis software applications, which actually greatly involve the town-planning area, the choices made and strategies of intervention measures in the territory.

Situations which call for wide margins of improvement are pointed out as follows:

- The existence of numerous projects on knowledge of architectonic and environmental heritages, in some cases indirectly connected with specific utility objectives.
- The lack of knowledge of such surveys on the part of local government bodies and in sectors involved in town-planning.
- Increased interest in the potential of increasingly powerful, user-friendly and economical Gis software, which does not move at the same rate as clearly development of needs , requisites, performance of the system which has to deal with configuration, construction and implementation.

The problem of connection and integration of the different archives is not so much technical as qualitative, namely on the contents side, data validity, data comparability when deriving from different sources and data updating.

As regards this latter aspect, it is also noted that the same nature of some census operations, promoted by public administration bodies with a chiefly cultural type of mandate and not targeted at the management and control of the transformations, or of a fiscal nature, can in time become lacking insofar as updating is concerned. Definition of the method of querying must always bear in mind the heterogeneous nature at the start, trying to make as explicit as possible data search paths within the same "unit", but within the different databases. With regard to data structure a certain migration on the part of various lombard government bodies has been noted in favour of the Iccd standard sheets, at times integrated and improved as regards layout, in relation to specific information needed by the same government bodies.

Added to all this is the geographical

element, considered fundamental in the querying approach, which some archives do not combine nor hold in consideration.
The unifying factor for the various census operations is the geographical location of the registered property. The importance of geo-referential querying on the property is emphasized further if examined in relation to the scale of detail; immediateness in data searching, consultation, geographical identification of the property, represents the unifying factor and connection for combining heterogeneous data relating to the same object.

Constructing an information system: prospects

The experiments carried out using the two prototypes have largely confirmed the technical feasibility of the construction of a geographically-based information system project for cultural heritages.
Those requisites, which are still outstanding and important in order to really accomplish an integrated system that is distributed throughout the territory and for the use of different groups of users, concern strictly primary conceptual aspects:

Possibility of updating the system. Particular attention to the need to update the system, which is valid only if shared and continuously updated, if it is really used continuously for economical appraisal in the phases of planning and intervention implementation.

Integration with geographically distributed databases. Possibility of integration with external data banks (ISTAT, Land Office, Town-Planning Offices, Superintendence departments) in a hypothetical sharing of data, which requires specific methods of access to data and recognition of data ownership. The archives are different and belong to government bodies that have collaborated in creating them; archives that are managed, administrated and updated by the government bodies/owners, but are accessible to public and private users. To this end, the study of an easy and highly reliable user interface acquires primary importance.

Possibility of geo-referential or multimedia querying. The system must be accessible online and available to a wide range of users.
The possibility of making specific information accessible to an ever-increasing public is one of the priority objectives in an area that privileges P.A.'s improved functioning both internally, as well as in its relations with citizens, through the supply of increasingly efficient services.
On-line consultation via Internet, already implemented in some regional and local offices, has been appraised in the prototype definition verifying the opportunity of producing theme cartography with mininum interactive play which, apart from visualisation of the cartographic data also enables consultation of combined alphanumerical data, as well as images.

Standards and data certification. The last aspect, yet quite a central theme in the data structuring project and among those aspects still to be resolved and common to the archive complex examined, is a problematical aspect, which consists in explicitly identifying standards or rulings adopted, the registration year and eventual updating, as well as criteria for compilation and selection of the realties registered. Prior to considering this aspect a "data-processing standard", it must be intended conceptually as a data characteristic and that it can be certified.
In conclusion, logical structuring of

information together with the enormous potential of new technology has brought to the fore that the essence is, above all, a theoretical issue oriented to design an effective information system to gain maximum efficiency.

1. The research project (co-ordinated by prof. Amedeo Bellini, Politecnico di Milano) comprises ten work groups engaged in research applied to different disciplinary fields. Further information is available on the website allocated to the research programme:

http://file-server.cilea.it/beni-culturali

2. All the government bodies are thanked for having made available and/or permitted consultation of part material examined and processed in the course of the research.

3. This study has been the subject of a stage within the framework of an agreement between the Comune di Monza and the Politecnico di Milano (stager: Anna Pietrocarlo, an undergraduate of the facoltà di Architettura). The workshop, of a month's duration, reviewed the activities of the Town-Planning and Programming Sector of the Municipal Administration.

4. Regione Lombardia-Politecnico di Milano, *Inventario dei beni culturali immobili e delle loro pertinenze, prosecuzione (schede A/I e PG/I).* The archive contains about 1,300 A sheets (architectonic works) and PG sheets (historical parks and gardens) relating to properties situated in Monza. (onsite investigation year: 1996). Provincia di Milano-Isal, about 400 sheets are historical buildings and environmental heritage registered in Monza.

5. Prototype study and construction is the subject of a degree thesis: *Un sistema informative territoriale quale strumento per l'espletamento delle competenze provinciali in materia di beni culturali – Un prototipo per la Provincia di Lodi,* authoresses: Nesta Ruth Sangermano, Marta Moraschi, (tutors: prof. Luca Marescotti, arch. Maria Mascione), Facoltà di Architettura – Campus Leonardo, Politecnico di Milano, 1999-2000.

6. The following catalogues have been appraised for use in the prototype: SIRBeC, Carta del Rischio and Frisl elaborated within the Regione Lombardia's projects, catalogues of the Provincia di Milano and of Provincia di Lodi, this last elaborated with the SIRBeC layout.

7. The image is part of the degree thesis *Un sistema informativo territoriale ...(op. cit.).* The authoresses are thanked for their collaboration in this work.

8. Software used in SIRBeC project, Carta del Rischio and Frisl.

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