

## **FROM THE GUIDE OF GEOREFERENCING CULTURAL HERITAGE FOR THE MAP OF RISK (REGIONE LOMBARDIA) TO THE GEOREFERENCING AND TROUBLESHOOTING IN HISTORICAL SITES**

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### **ABSTRACT**

Beginning from the “guide of georeferencing cultural heritage for map of risk”, the research has carried out the aspects connected to the georeferencing and the spread of the data about historical sites. In fact, in the point of view of a rising necessity of an organic data and realized analyses management, the research wants: to join the GIS characteristics for georeferencing with the creation of cartographic DataBase suitable with CTC scale, by using cataloguing methodology for buildings analysis on urban scale that regards the principal constructive technologies, the materials, the state of fact, the instability and deterioration conditions; to set up one modality of data use able to grafting a patrimony valorisation politics, in a logic of a support for the programmed maintenance and the compatible use.

The work was articulated in various phases: historical centres census data structuring, cartographic structuring of Cantù historical cadastral maps, historical centre GIS predisposing and formulating of 2D-3D thematic maps of the state of fact that put in relation, of time in time, multiple and different buildings data.

Then the research wants to set up and to experiment: a digital survey of one portion of facades in support at the realization of thematic mappings and at the development of an open source WEB-GIS interface for the On-Line publication of the historical centers GeoDatabase; WEB-GIS will be structured on different access levels, based on segmented users: citizens, professional men, sectors and offices of the commons.

### **1. INTRODUCTION**

The evolution of cataloguing concept<sup>1</sup>, which is today directed towards the drafting of Risk Map<sup>2</sup>, project that started on regional scale for example by Lombardy Region, opens many considerations and is closely related with parallel researches on complicated themes of maintenance and programmed conservation, of individualization of suitable methodologies for analysis and intervention politics, executed on architectonic scale (1:200, 1:50 and detail scales) but correlated with ambits on larger scale.

Today “a new role for Risk Map is taking shape, able not only to emphasize the risks, but also to point out the exploitation and development chances that cultural heritage, constitutive factor of various territorial identity<sup>3</sup>”, offers.

The principal purpose of georeferencing is the creation of geographic visualization of territorial objects distribution, finalized to make a map of architectonic heritage and to value the territorial danger; this danger is the result of the comparison between location of buildings and vulnerability-risk elements.

Therefore, a GIS including thematic mapping of dangers becomes a common reference and relation basin of territorial-environmental data and objects data.

In order to attain this aim, it must structure shared data bases to succeed in getting descriptive informations, useful to create reliable and updated lists of buildings, places, historical centres, archaeological objects, courses, routes. So the data bases have to be structured in geodbase, i.e. archives of georeferenced data. The construction of open organic archives, beginning from a common identified module, has to guarantee the compatibility with cataloguing standards (ICCD, ICR) and to connect capillar demandes of regional-local data gathering and synthesis requirement (for example ICCD card A). Defined fields structure of base module (open and close fields), relating to the geographic and administrative location, to the objects (type, etc.) and to the denomination, allow the relation both with geographic base and with other databases, beginning from a common identified module.

### **2. GEOREFERENCING AS AVAILABILITY OF SPACE-TEMPORAL DATA**

#### **2.1 Data collection and geographic information system: general remarks and analytic elements**

Open and updated information system can become an aid for processes of city planning and territorial government, a preliminary cognitive instrument for better conservation programming of monumental or not buildings. Moreover it helps to start focalization processes of elements and incentives for “possible transformations”, in according to logics of sustainable development and active-participated protection.

In fact a collection and an organic management of the knowledges represent the fundamental presupposition for a right politics of integrated conservation of cultural heritage, which has to be considered as a precious resource for the development of local communities and for the preservation of their identities.

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<sup>1</sup> [www.regionibeniculturali.it/leggi/altro/dwd/cat\\_bbcc.doc](http://www.regionibeniculturali.it/leggi/altro/dwd/cat_bbcc.doc);  
[www.iccd.beniculturali.it](http://www.iccd.beniculturali.it)

<sup>2</sup> P. Petrarola, Premessa in R. Brumana, C. Monti, 2004. La Carta del Rischio del patrimonio culturale in Lombardia. Guida per la georeferenziazione dei beni storico-architettonici. Guerini e Associati, Milano.

<sup>3</sup> CulturAlp project, approved within community Interreg III B program (one of the leader is Lombardy Region), is finalized to the valorization of historical alpine centres.

The thorough methodologies of buildings readings, integrated with geographic correlated techniques, moves in belief that it's not possible statically and exhaustively to represent the complex city reality.

So the conviction is that every reading not deterministically descends from innumerable and often casual relations of data, which are continuously in transformation and interaction.

If becomes indispensable to create open and updated system, it's also important to identify transversal and not pre-determined ways of readings of data, which have to be correlated and confronted on different and open to further deepening levels.

In the georeferencing of complex aggregated objects, as historical centres, it's not enough to write perimetrical rules, in the sense of a quantitative extension or a drop scale. The term is characterized by other implications: relation system between web data, open and shared system, information access and distribution.

In georeferentation the temporality component could represent one of the factors of opening in the direction of interrelate information availability, by characterizing a process that otherwise could induce an undifferentiated and flattened georeferenced entities.

## 2.2 Methodologies, connection and data structured in a geographic archives

From some years in Italy there are multiple researches on possible methodologies of georeferentation, localization and valorisations of cultural heritage, carried out in famous and minors historical centres (for example the experiment of historical centre of Genoa).

Speaking of "complex objects", as historical centres, means to study and to analyze a land made of various aggregation and different entities.

The management of structured data levels, based on logic aggregation, from one side has to start from the definitions of objects and their individualization (it's the case of objects classification in according to hierarchical connected classes), to the other side has to get into data reality, objects, monuments, architectures.

It's not possible semplicitically to exhaust the systematization of data collection but it's necessary to mature the consciousness that the lists, also the new ones, are not static elements; in consequence of this question it's not always simple and immediate to decide what is considerable complex object and what are its components. Sometimes only from a more deepened reading could emerge aggregation characters of buildings and their parts; just that characters are the fine principal connective tissue of historical sites.

The experiments conducted in this field from our research group, represent the starting point for further articulation of georeferencing detailed lists of historic-architectural heritage, in the way of a progressive involved of different categories of objects.

The proposed methodology starts from definition of physics and geometric consistence of the objects to georeference: the three different modalities (punctual, linear or areal – P,L,A) have to be chosen in relation with cartographic scale, time reasons, costs and objectives of georeferencing.

Inside geographical archives, hierarchically structured, it proposes to classify objects in conformity with the three classes fixed by compilation standards of "Card A – historical building unit, Risk Map", developed by ICR (Central Institute for Restoration): individual objects, component and complex. In particular, it was examined the flexible adaptation problem of structuring procedures to peculiar objects (complex objects

without elucidation of their component objects, component objects without the complex object, adjacent components, complex objects with relative component objects, individual objects).

At last, the use of *region based* procedures permits to aggregate more entities, adjacent or not, in a unique geometric entity, to which may be assigned a common identity code.



Figure 1. Objects sampling in Milan. Georeferencing level structured in individual objects, component and complex. Cartographic data base: CTR scale 1:10000, CTC raster 1:2000, vector cadastral map scale 1:2000.

## 3. CASE STUDY: STUDY AND DATA COLLECTION ORIENTED TO ANALYSIS OF THE HISTORICAL CENTERS OF CANTÙ, CASCINA AMATA, VIGHIZZOLO AND RURAL COUNTRIES OUTSIDE CANTU' (CO)

### 3.1 Objectives and methods

The main aim of this research<sup>4</sup> is the study and data collection organized in form of Geographic Information System, finalized to support the knowledge and the analysis of historical and architectonic heritage.

It's important to emphasize the nature of this 'historical centre', not formally and architecturally characterized by 'traditional canons': in fact they are a part of the wide world and rich horizon of 'historical centre' of which is studded our Country, often defined in the past as 'minor'.

The interest in their conservation and valorisations has the point of view of an attention to territorial scale of the historical-documental-environmental stratified values. It has many

<sup>4</sup> The research, starting within a contract with Commune of Cantù, entitled *Study and data collection oriented to analysis of the historical centers of Cantù, Cascina Amata, Vighizzolo and rural countries of communal region*, will be develop inside Prin 04 *Evolved structure of Numeric Cartographic for GIS and on the WEB* (coordinator prof. R. Galetto), Unity B - Polytechnic of Milano *Web GIS: sharing of GeoDBase and interoperability of systems for distribution of services in city ambit* (responsible prof. R. Brumana).

Professor P. A. Croset guided a part of base cataloguing. Prof. T. Mannoni and arch. D. Oreni partecipati to study and definition of problems, analysis methodologies of historical sites, cataloguing and stratigraphic studies.

purposes: artistic heritage protection and rediscovery of identity and collective cultural roots, in the conviction that the building patrimony is not only an economic and social resource, but it can become one chance of improvement of the quality of “urban living”.

The setting out of our research subtends some questions: what are the forms of sighted but also extended and systematic data collection and the organizations of GIS informations that could create an useful instrument for the knowledge and the protection of historical sites?

How is possible not to create an useless and unproductive data census destined to remain in the drawer?

The data collection, realized during the phases of inspection, has to be considered limited, just only a starting point for further researches and projects on a punctual level of deepening. Like that, the use of historical cadastral maps represents one of possible geographic-cartographic layers useful for sites reading.

### 3.2 Data collection, threshold of attention and consideration elements

The activities of the research were the followings:

- determination of a methodology on which to plain a GIS, support for the programming of maintenance and possible-compatible-sustainable use;
- start of a georeferencing data collection on reference cartography and compilation of base cards useful immediately to individualize city planning lines;
- georeferencing of geo-cartographical data and historical cadastral maps; correlation with database generated on data collection and on different nature and formed informations;
- coordination and activation of thematic researches;
- use of digital methodologies of relief and fronts representation (rectified images and orthophoto), to support thematic maps, studies and simulations of aimed interventions;
- georeferencing on CTC scale 1:2000 of historical-architectural heritage and rural sites characterized from particular historical-environmental-typological interest.

The purpose of the individualization and of the systematic nature of georeferenced data - crossed with historical and current cartographical informations – was to signal attention thresholds useful for future studies on building scale (1:50, 1:20, ...); in case of intervention that studies have to be activated in the programmatic and maintained phase of city planning.

In particular, in the SIT georeferenced cataloguing were signalated the following themes:

- *The ancient courses.* Signalling of tracts of ancient pavings, of flights of steps and of passing elements to internal courts.



Figure 2. Cantù: ancient routes and courses inside historical centre.

- *Typologically plant and distributive organization.* Individualization of different typologies articulated on recurrent type-archetype. Individualization of internal vertical-horizontal distributive organization of different solutions (arcade, external-

internal stairs, balcony,...), used materials and aggregative logics (courts).



Figure 3. Arcades of rural buildings and farmsteads.



Figure 4. Vighizzolo: the stairs characterize the fronts of buildings and the internal distributive organization of the places. In the buildings with balcony generally the stair has only one external flight, which is set or parallel to the front or in connection between two perpendicular blocks; seldom the stair is inside buildings. In the farmsteads the stair, often made of wood, sits inside arcades.

- *Structures.* Signalling of constructive technologies more utilized in the past (wooden floors, building structures, roof covering,...) and georeferenced in GIS.

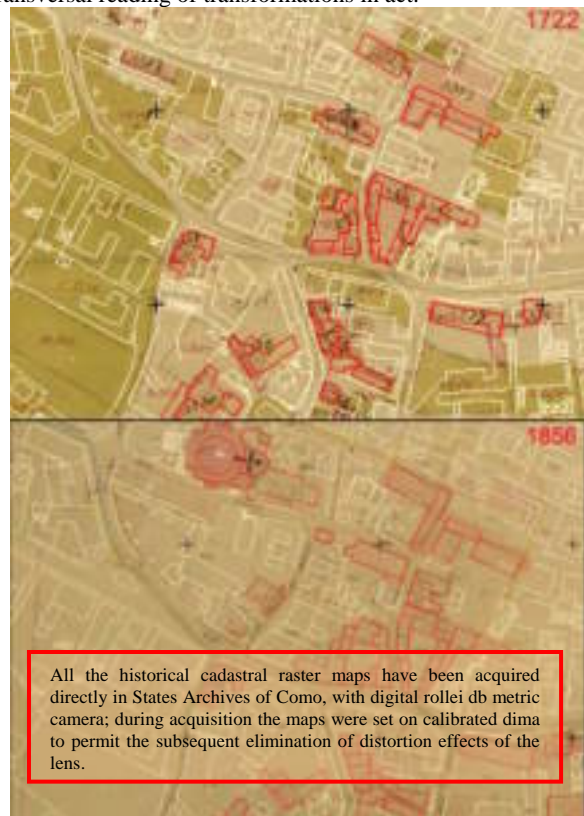
- *Abacuses of openings, windows, banisters.* Signalling of abacuses and typologies of principal constructive elements.



Figure 5. Typologies of prevalent openings.

### 3.3 Georeferencing of historical cadastral maps and data collection: creation of thematic maps

The georeferencing of historical cadastral maps on CTC was a supporting instrument for knowledge of reality and for transversal reading of transformations in act.



All the historical cadastral raster maps have been acquired directly in States Archives of Como, with digital rollei db metric camera; during acquisition the maps were set on calibrated dima to permit the subsequent elimination of distortion effects of the lens.



Figure 6. Vighizzolo: mapping of different historical thresholds, starting from the georeferencing of cadastral maps (Teresian cadastral 1722, updatings 1856-1874- 1898). The selection of buildings highlighted with red colour is the result of a crossed reading of CTC (ochre colour), georeferenced cadastral maps and cultural mapping of buildings, realized during the phase of inspection.



Figure 7. Cantù: courses already existing in *Disegno della Pieve di Cantù* (designed between 1579 and 1582).



Figure 8. Cantù: georeferencing of *Disegno della Pieve di Cantù* (1579 - 1582) on CTC scale 1:2000. It was utilized Georeferencing module of ArcMap by using at least 15 homologous points. On CTC are highlighted still legible ancient courses with red colour, route of destroyed boundary wall with orange colour.



Figure 9. Cantù: located of courses and flights of steps (image on the right) already existing in 1722 Teresian cadastral map (image on the left).



Figure 10. Cantù: historical centre evolution. The simultaneous reading of CTC scale 1:2000, of georeferenced cadastral maps (1722-1856-1874-1898), and of data taken on place, was interrelated with transformation level of the buildings.

The possibility to create 2D and 3D thematic maps of reality, putting in relation from time to time different informations on objects, allows an immediate reading on large scale of the various events in act.

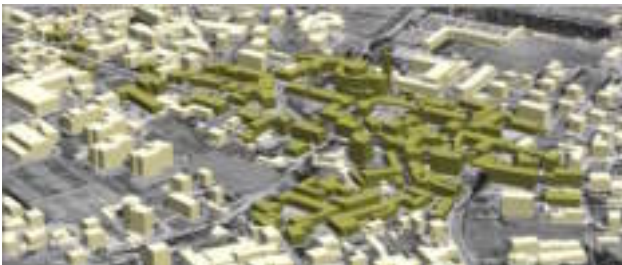


Figure 11. Vighizzolo: 3D GIS of historical centre, with specification of buildings catalogued (green colour).

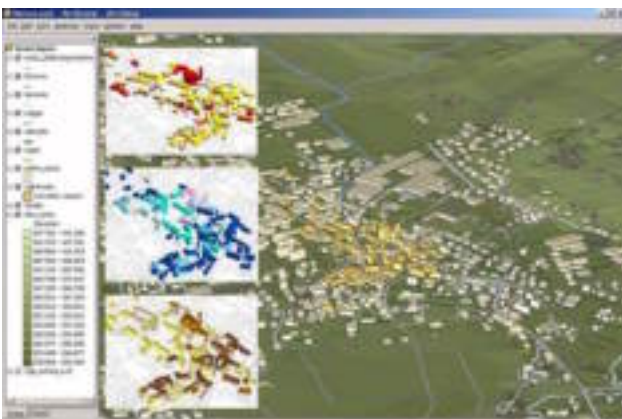


Figure 12. Vighizzolo: 3D GIS of historical centre with its analysis, level of maintenance and transformation of buildings.

3D view with located catalogued objects and some elements as streets, rivers, streams, pertinences. 3D model of the territory was 'shaped' on DTM, realized beginning from ascii files that contain terrain coordinate points, extracted from digital cartography.



Figure 13. 3D Orthophoto of Vighizzolo. Georeferencing on CTC scale 1:2000 of buildings catalogued in DataBase (yellow colour). It was realized 3D orthophoto beginning from 3D simplified model of territory; aerial photos were realized during 1987 fly.



Figure 14. 3D representation of a Cantù block with superimposition of rectify images of some fronts in front of the street.

#### 4.CONCLUSION: TOWARDS INTEROPERABILITY AND DATA CONDIVISION

The future development of our research will be a project of distribution and easy access to data relatives to historical centres objects of this study. WEB GIS technologies will be used to create a prototype and to develop a WEB GIS interface on open source platform, finalized to publish on line the geodatabase.

The aim of research is to deepen the topic of use of all the data that can enter in the georeferencing process of a good, through dynamics interpretation of the wealth of the single contributions and data bases (PRG, Archivist's Office, General Registry Office,...).

The contents of georeferencing will have to interact with other possible regional information system.

(buildings, streets, water nets, PRG, environmental bonds, services map, bonds map,...).



Figure 15. Individuation diagram of possible interactive functions. Objects geodatabase and list of the principal offices concerned.

The GIS and WEBGIS technologies and their use for georeferenced archives producing, will become an important vehicle of diffusion, sharing and access for different users. The hierarchical accesses will consider large classes of objects, georeferenced data and users: citizens, professional men, sectors and offices of the Commune, external institute (f.e. Soprintendenze).

Within information system, the development of modern technologies, based on GML3-SVG standards for 3D geographic database and web publication, will guarantee interoperability of data, subjects and systems in exchange, access and remote sharings between different platforms and geodatabase on line.

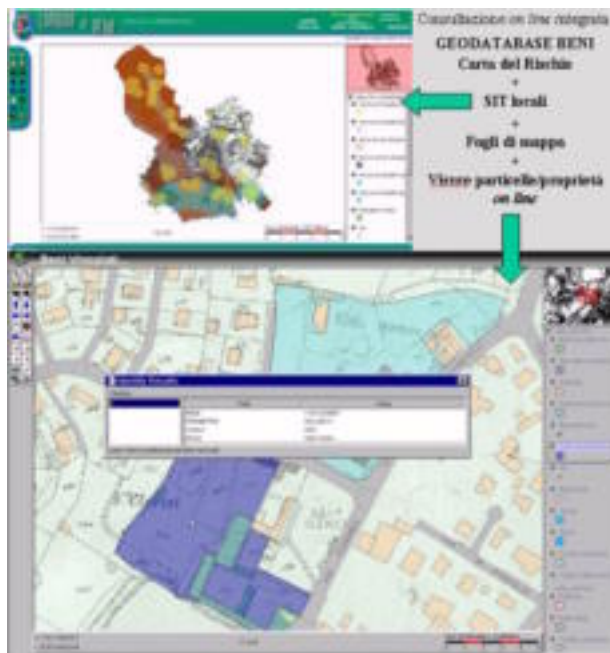


Figure 16. Commune of Erba: WEB GIS OBJECTS integrated with local SIT, which is published on line

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