Protection of the Archaeological Patrimony and G.I.S. The Elaboration of an Archaeological Cartography Aimed at the Problems of Territorial Planning in the Emilia Romagna Region

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The Istituto Beni Culturali (Institute of Cultural Heritage), founded in 1974, is the cultural institution of the Emilia Romagna Region; among its many assignments (management of museums, restoration work, cataloguing and safeguarding of cultural property) is the realization of informative, territorial systems, as a tool to help territorial planning in the cultural field.
In the last few years, the Documentation Centre, of the Institute of Cultural Heritage, has carried out several projects and activities for the elaboration of urban, archaeological cartography, through G.I.S software.

In 1995, the Institute for Cultural Heritage and the Archaeological Superintendence, of the Emilia Romagna Region (the local agency of Ministero Beni Culturali e Ambientali), have drawn up an agreement for the "joint realization of an archaeological, computerized map of the regional territory, for the purposes of knowledge, protection and management of the archaeological heritage, as well as for the support of territorial and town planning activities."

These days, we are renewing and broadening this convention to include the Istituto Centrale del Catalogo e della Documentazione of Ministero Beni Culturali and the Museo Civico Archeologico di Modena.

Our project, called C.A.R.T. (Carta Archeologica del Rischio Territoriale), has been approved and financed by the Italian National Research Council (C.N.R.), that, in 1996, promoted the "Beni Culturali" project. The aim of this national project is the safeguard, improvement, and fruition of our national, cultural heritage, through the application of science and new technologies [GUERMANDI1996, 1997a, 1997b][1].

Therefore, the primary goal of C.A.R.T. is to elaborate a tool, for the management of the complex problems involved in archaeological protection, and problems connected to serious territorial planning. In effect, we want to produce for the town and land-planing government, an effective tool, which is far more necessary, in these recent times, since, at present, there has beguin a generalized resumption of constructive interventions in the territory, especially in the urban sector.
Now, public organizations, concerned with archaeological heritage protection, for the most part, only intervene with emergency procedures, when general policy statements have already been decided. On the contrary, archaeological and cultural heritage, public organizations need to intervene, with effectiveness, and need to anticipate their intervention, when the politic of safeguard of the patrimony is at the outset; in substance, they need to be able to act, when policies are in their initial planing stages; and, in order to be able to do this, it is necessary to possess an informative, updated, exhaustive and reliable system.

In the CART project, the privileged users are the operators of territorial planning; the primary objective is, therefore, to realize a tool, immediately usable by local administrators, when they must program the interventions in the territory.
The C.A.R.T. system is composed of a database, which contains all the archaeological information related to the territory, and that is connected to a digitized cartography, which elaborates archaeological, thematic maps, according to the goals of investigation.

In the database, we record not only the structural or material emergencies, but also the geological and geo-morphological data (as well as toponymical sources, chronological and functional characteristics, data of excavation, cataloguing data of recovered finds, bibliographical data, etc.). The cards, that are the pivot of the informative system, also contain information about, for instance, Roman land division and still recognisable road layouts.

In our project, the first area investigated was the urban territory of the city of Modena (the Roman Mutina): this was a project, elaborated by the Museo Civico Archaeologico Etnologico of Modena, with the collaboration and financing of the Institute of Cultural Heritage. The Museum of Modena is now completing the database, as concerns all the provincial territory [GUERMANDI 1995; CARDARELLI 1996; CATTANI 1997].

The realization of the Modena Archaeological Museum has been recovered from the Institute of Cultural Heritage and from the Archaeological Superintendence, where a new survey model, for the constitution of the informative territorial system has been elaborated, and which is currently being applied to the urban territory of Faenza (Roman Faventia, along ancient via Aemilia).
The first two areas investigated, Modena and Faenza, were selected, above all, because the towns' administrations have shown a great sensibility and availability, concerning the problems of the protection of the archaeological patrimony. In addition, these municipalities have furnished us with the

[1] The location of Web site of CNR "Beni Culturali" project is: http://www.culturalheritage.cnr.it/

digitized cartography of the two urban centers, on the scale of 1 to 2000.
From the point of view of survey data methodology, the Institute of Cultural Heritage adopted the cataloguing models, predisposed by Central Institute of Cataloguing and Documentation (ICCD).

As we said above, one of the principal aims of the C.A.R.T. project, was the elaboration of an archaeological map, of the preventative risk type; we know very well that in the actuality, an updated cartography of existing archaeological records, in computerized form, can be a tool of great effectiveness for land planning requirements, and, we are also sure that a map of the risk could provide additional, dense, and conclusive information, essential for making choices for operations to be conducted in the territory.

The object of analysis is not only existing and documented knowledge, but also, above all, the archaeological *datum* that has not been directly certified, but which archaeologists are able to foresee.

We think that the definition of "archaeological risk" could be the sum of, not only archaeological, but also geological data.
In the cartography, elaborated in C.A.R.T., data, from negative and archaeological "empty spaces", will be inserted.
In this way, in order for our tool to be as useful, for town planning purposes, as possible, we have introduced the idea of archaeological gaps, or *lacunae*: an archaeological gap is an area, that is deprived of archaeological remains, or an area that archaeologists think, for many reasons and previous research, could be deprived of ancient finds. An archaeological gap, or *lacuna*, could be the result of erosive factors, or preceding excavations or destructive events, or could be determined by geological factors or geomorphology. In substance, the archaeological gap is an ideal area to program new interventions on the territory, because it is safe, from the point of view, regarding archaeological presence.

At this level, however, we feel that risk cartography cannot be carried out, only using the results of archaeological studies, based on the collected data; i.e., the complexity and the quantity of all of this data makes the necessary synthesis, to identify high risk areas with absolute reliability, extremely difficult, in many cases and situations.

At this stage, therefore, it is very useful to employ spatial analysis and predictive modelling procedures, which are able to effect analysis on a vast and very diversified body of information, while giving a more effective reading on the territory, if not, also, a reliable, anticipatory valve. With these techniques, a first, interpretative reading on the territory is possible, that is to say, an "intelligent" and complete as possible, reading on the territory.

But, we also must remember that in the definition of risk areas, the last word is that of the archaeologists.

Only archaeologists will be able to define the areas of risk and establish their different gradations, using the data (archaeological, geological, spatial analyses, etc.), at their disposition.

As concerns the software used for this project, the Civic Museum of Modena chose a program, that could run on a PC: *Odysseus*; this was the same software adopted by our Institute, for the management of the regional system of museums, and, in specific, for the cataloguing of the cultural heritage in museums.

In short, *Odysseus* is an information retrieval system, with a series of modules, which contemplate the georeferencing of the data: Odysseus uses the map as a bacground and has a description of the vectorial elements, of archaeological interest, in the database. Odysseus possesses, therefore, a database, in which both vectorial and archaeological data are included and it uses Eikon to visualize the results of the searches (Eikon is a module for the visualization of vectorial and raster images).
The choice of a software, like Odysseus, running on personal computers and very easy to manage, was determined by economical and logistical problems; but, with this system, archaeologists now possesses the advantage of maintaining the project management, also from the technological point of view.

In the case of C.A.R.T., the use of G.I.S software and procedures doesn't simply mean a concession to technological fashions, rather we consider that GIS technologies and computerized cartography, in general, now offer a series of advantages, for instance:

- the possibility of getting as much thematic cartography, as deemed necessary, depending on the query possibilities of the data base. In our case, with Odysseus, we had the possibility of using sophisticated search functions and, as a consequence, we were able to elaborate cartographies, on the basis of more selective and punctual criteria, compared to those possible with traditional techniques and also compared to those possible with other G.I.S. software (for instance: the chronology, which in almost all traditional cartografic realizations is limited to a general time range (prehistory, Roman period, Middle Ages), and that in our system could be represented with extreme detail, also by century, or with a more specific range [Tav.1].
- with this kind of system, also, it is possible to maintain a constant updating of the data: that is to say that the updating and the revision of data, is an essential feature for the effectiveness of these tools, having goals for territorial planning.

Currently, with Odysseus, we manage a database, that contains a rather articulated series of data, related to the archaeological evidence: such a database interacts with the cartographic database and can also be enriched with images of excavation and of archaeological objects, as well as with maps of the investigated sites. The architecture of our archaeological system can be seen in the scheme, at the end of this paper.

The system has been divided into 3 modules, from the broadest to the most specific.

The "archaeological complex" is the more interpretative level, where researchers gather the information, comprised of the more advanced results of archaeological analyses. At this level, all of the data is collected from excavations, surveys

and other methods of investigation, that allow a complex reading, of the archaeological situation under examination to be made. This level is divided into three different forms:

- archaeological complex. At this level, we recognize, for instance, a public building from Roman age.
- complex of the archaeoenvironment.
- complex of the archaeological void.

The second level contains the data from investigation of the archaeological evidence (e.g., each cognitive intervention; for instance, any intervention of archaeological excavation, provides different evidence). This level is divided into four modules:

- archaeological presence.
- archaeological absence – gap.
- archaeological finds reused.
- archaeoenvironmental element, that constitutes the detail of the archaeoenvironmental complex .

The third level contains the information, relative to the individual structures of the archaeological evidence, or to the complex of the materials, or to the individual finds. The data at this level, are those established from the ICCD, on their cataloguing cards. The forms into which this level is divided are the following:

- *US / MA (Unità Stratigrafica / Monumento Archeologico).* This contains, for example, the data relative to walls, floorings, etc.
- *finds management.* On this card, information on the museum or archive location, of the materials, is recorded.
- *TMA (Tabelle di Materiali).* This form contains the information on the materials, gathered for classes and typologies.
- *RA (Reperto Archeologico).* This form contains all of the detail data, from the analysis of individual finds.
- *safeguard restriction.* This form sums up the information on the safeguard of the archaeological heritage.
- *bibliography.* This form contains the bibliographical information for all of the texts quoted, on the other cards.

From the technological point of view, the C.A.R.T project has a particularly innovative objective: we are trying to develop software, for the management of informative territorial systems, beginning from a developmental environment, as specified above, like an information retrieval system; in this way, we could develop a software that will be able to be associated to the typical potentialities of the G.I.S. (production of digitized cartography and its elaboration, through procedures of spatial analysis), the advantages of information retrieval, running on a PC, and that can also manage heterogeneous data (textual, numerical, images, thesauri), and elaborate very sophisticated searches on the database.

A software of this type allows the use of modest hardware and has a very user-friendly approach, difficult to find with most common G.I.S tools. Our system allow, in the final analysis, a fundamental reduction of the resources necessary for the realization of computerized cartography projects, with high standards.

Thanks to the particular flexibility of the adopted software, our methodological and operational model will be improved and adapted to other realities, and according to new demands that can emerge in the process of our projects realization.

Our resources are already assigned to the evolution of the Odysseus software, in this direction, with the introduction of spatial analysis procedures, which can provide us with a more accurate and specific reading of the introduced data.

As a whole, there are three goals, towards which we are working, using the currently available resources. These tree goals are the following: the amplification of the geographical base to other areas, both at territorial and an urban level, the evolution of the software, and the training of archaeologists, from a technological information point of view.

Another aim is towards the uniformity of results and the compatibility of the data, between different experiences: the coexistence of these, in fact, is an element of the modular system we have currently adopted. In substance, thanks to the flexibility of the technological support, the system will fit different demands of time, since in time, it will be exposed to different users, but will still maintain its fundamental unity, due to its alignment to the same standards; in other words, the technological support could change, but the cataloguing and cartographic standards will be the same for all the pertinent areas, even if these areas are exposed to change, with time.

As said above, with the C.A.R.T project, Istituto Beni Culturali and the Soprintendenza Archeologica dell'Emilia Romagna want to be the point of reference for the manifold activities of search, census and territorial analysis, that habitually are realized at the local level, throughout the region. In this way, we hope to coordinate the flow of information and resources.

In the sector of training, we want to instruct several young archaeologists to handle the system, as a whole, not only as a cataloguing system, but also as a software system, because we want the different areas of the regional territory to be self-sufficient, and to be assured of the steadfast updating of the data base.

The operational model, that IBC is now pursuing, includes the direct involvement of local administrations from the first stages; we think that this involvement represents the first and most effective element, for a real relapse of the results at the level of land and town planning.

In this way, IBC and the Superintendence want, therefore, to change "from discussion to the dialogue" with local administrations, because we think that an effective safeguard can only be realized by joining the resources, of all those parties involved in operations on the territory, even if their aims are different.

The primary aims of the C.A.R.T project can be summarized as follows:

- to develop a more effective tool for the global interpretation of the settlement mechanism, in ancient times.

- to take part in town and landscape planning policies, as protagonists.
- to improve the relationship with the local administrations .

In the future, we are planning to make the C.A.R.T. data available through the INTERNET, even if only partially, and we want to establish some standards of diversified access, according to the users of the C.A.R.T. database[2].

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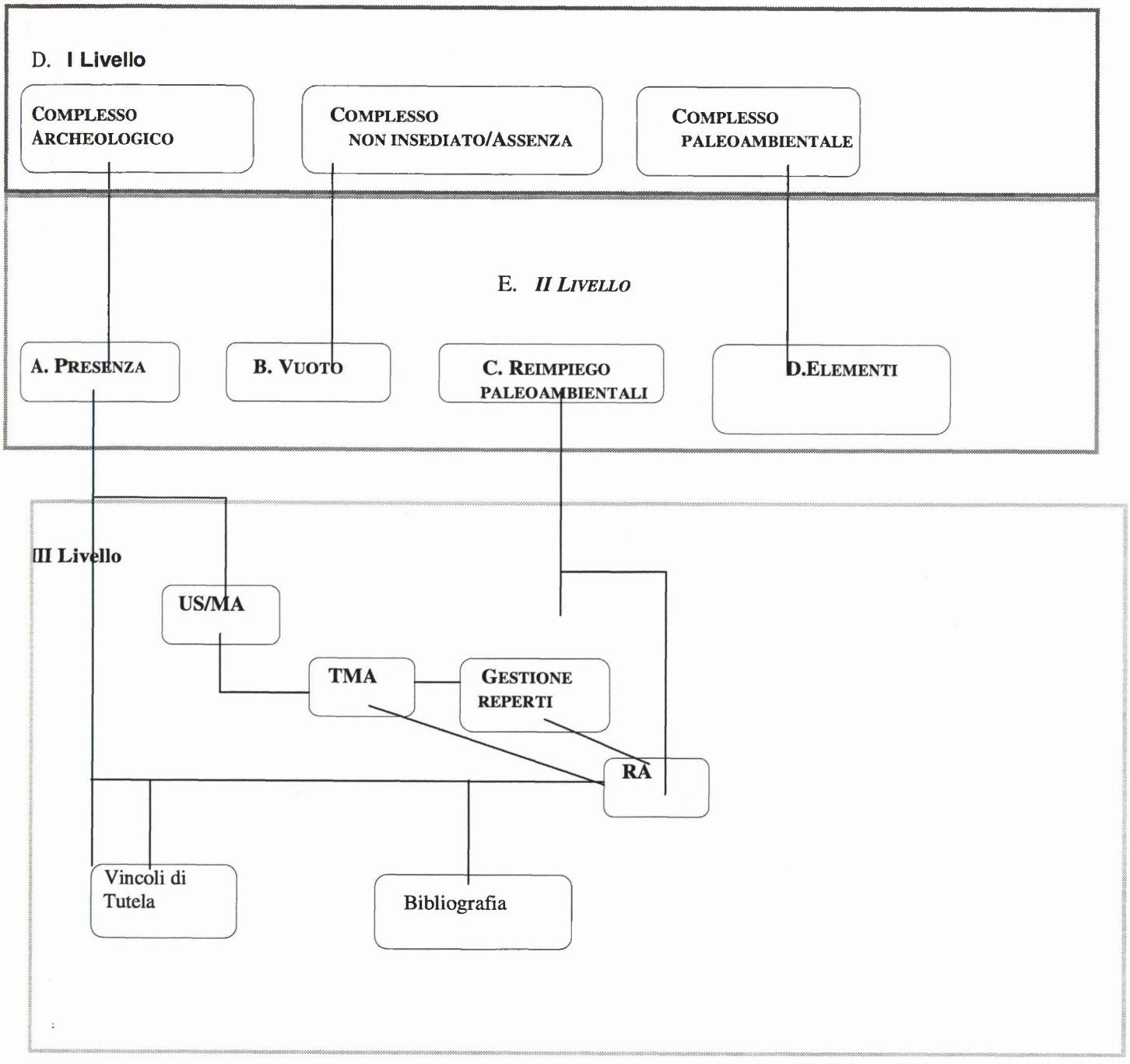
Tab. 1. Faenza: a thematic map, where archaeological presences are represented by chronology. In this case, Roman archaeological structures and finds, from I century B.C. to II A.C.

[2] At the moment you can find an Internet site about C.A.R.T. at this address: http://www.ibc.regione.emilia-romagna.it/notizie/index.htm


D. I Livello
COMPLESSO ARCHEOLOGICO
COMPLESSO NON INSEDIATO/ASSENZA
COMPLESSO PALEOAMBIENTALE
E. II LIVELLO
A. PRESENZA
B. VUOTO
C. REIMPIEGO PALEOAMBIENTALI
D.ELEMENTI
III Livello
US/MA
TMA
GESTIONE REPERTI
RA
Vincoli di Tutela
Bibliografia