

GIS Use in Landscape Archaeology

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INTRODUCTION

Information technologies (ITs) entered and irreversibly changed the discipline of archaeology during the last 20 years of the second millennium. The first experiments involved databases and alphanumeric data processing, then in the late 1980s GPS technologies, associated with spatial data processing, were first tested to locate archaeological objects in the geographical space. Computer-aided design (CAD) software has progressively replaced the traditional procedures of topographical and architectural design, while “New Archaeology” and “Processual Archaeology” focusing their attention on the quantitative aspects of phenomena (Binford, 1989; Binford & Binford, 1968; Clarke, 1968; Clarke, 1977) adopted “spatial technologies”, consisting of computer-based applications concerned with the acquisition, storage and manipulation of spatial information (Wheatley & Gillings, 2002).

This process came along with the elaboration of the new concept of “cultural heritage”, which gained popularity among specialists as well as among the general public. Since then, artifacts and monuments are no longer considered the only objects to preserve, and they are not extrapolated from their geographical context anymore, but every trace that the past has left in our environment is seen as a unique testimony of our history.

To understand cultural landscapes in their diachronic evolution it is essential to find an efficient system to store all archaeological and ecological information in a suitable way, so as to examine vertical and horizontal relations between different archaeological sites and other landscape features, like geomorphologic setting, hydrological assets, soil types, raw materials availability, and so forth, in time and space. This instrument has been found in geographic information systems (GIS), defined as a set of computer-based applications aimed at storing, transforming, manipulating and analyzing spatially distributed data. The development of these systems began around 1980. They were used in many

fields concerned with mapping, analysis and modeling of spatial data, including geology, geography, and environmental sciences (Douglas & Boyle, 1982; Evans & Daly, 2006).

The introduction of GIS technologies in historical sciences and in cultural heritage management (known as well as cultural resources management “CRM”) has supplied the society of knowledge with a formidable instrument to fully understand the evolution of its habitat and to preserve its environmental and historical patrimony.

The impact of these ITs in our discipline has been so powerful that an animated debate is still going on about whether GIS should be considered as just a tool or whether it is a science in its own right (Conolly & Lake, 2006; Wright et al., 1997). Periodical as well as occasional meetings, congresses, workshops, and conferences take place regularly all over the world, and more and more specialized series of volumes and periodicals are being published in traditional or electronic form, about the relationship between archaeology and computers, or more specifically about GIS in archaeology (e.g., the Proceedings of the Annual Conferences on *Computer Applications and Quantitative Methods in Archaeology*, edited in the BAR International Series; the Journal of GIS in Archaeology on the ESRI Website: www.esri.com/library/journals/archaeology). Still, in spite of the fact that new GIS products are available on the market almost every day, and that the existing software is continuously implemented and updated, notwithstanding that new and more complete manuals on digital archaeology are regularly edited, we could state that the basic deontology of the discipline has been defined and the correctness of basic procedures fixed. This also means that the most updated or recent achievements or studies are not always to be considered as a substantial contribution to the literature and a progress of the discipline.

The goal of this article is therefore to review a series of GIS-based archaeological projects, presenting different approaches and results, mostly taken from the

geographical context of southern Europe, and to try to evaluate, in an objective way, which are the pros and cons, and the problems involved. Instead of presenting just one case study, we prefer to refer to a selection of good examples and some personal experience.

BACKGROUND

The first historical accounts for the use of GIS in archaeology date back to the early 1990s, but experimental applications of GIS in archaeology were undertaken already in the mid-1980's in the USA (Allen, Green, & Zubrow, 1990; Harris, 1986; Kvamme, 1983; Lock & Stančič, 1995), with a dominant interest for Cultural Resources Management, while some of the first European experiences in the late 1980's were already approaching landscape analysis (Lock, 2003; Lock & Stančič, 1995). Over the last few years the applications have developed spectacularly, both in the availability and capabilities of software, and in the quantity of relevant projects and case studies (Berger, Bertoncello, Braemer, Davtian, & Gazenbeek, 2005; Forte, 2005; Gillings & Alii, 1999; Lock, 2000; Petrie, Johnson, Cullen, & Kvamme, 1995; Slapszak & Stančič, 2000).

As stated earlier, this increasing importance is partially due to the development of the concept of "cultural heritage," extended now to include cultural landscapes, and to the more widespread interdisciplinary approach that landscape archaeology has embraced, adopting methods and instruments from geography, geology, earth sciences, information technologies, topography, remote sensing, geo-physics, spatial analysis, and so forth. Nowadays it seems almost impossible, and surely outdated, to tackle archaeological matters without the support of a GIS, but unfortunately the growth in availability of GIS technologies has not always been associated with a parallel increase in the knowledge and technical skills of archaeologists.

GIS IN ARCHAEOLOGY

The innovation and the power of GIS lie in the capacity to link mapped objects to a database, combining the graphical display of archaeological records with database query and analysis tools. Archaeological

elements can be examined in their spatial distribution, related and overlapped to environmental factors, such as soil type and quality, land suitability for agriculture and stock raising, micro-climate aspects, and so forth, in order to determine which environmental factors most influenced human occupation patterns, and to develop a diachronic model of habitat for each phase.

The archaeological map production within a GIS environment has enormous potential for combining disparate data sources: archaeological data, topographic information and historical cartography, satellite images, aerial photographs, orthophotomaps, administrative boundaries and cadastral maps, urbanization areas, soil type and geological maps, hydrology and water resources. This is the crucial point—a GIS differs radically from a computer-aided cartography production system (CAM = computer-aided mapping), because it stores information "thematically" (Wheatley & Gillings, 2002, pp. 25-28). By way of comparison, a geographical or topographical map contains a wide range of data related to many different aspects of the present landscape, and links elements of the natural morphology (slope, hydrology, soil quality and geology) to the elements connected with the human presence (road-networks, waterways, buildings, agricultural land-use, political boundaries, etc.). Instead, GIS stores different levels of information in different layers, that can be overlapped selectively—they can be "turned on or off", according to the query being pursued. Thematic maps are then produced without the problems normally connected with the many different scales and projections of the data sources (Cowen, 1987).

The research undertaken by the University of Cassino (Italy) and the University of Ghent (Belgium) in Corsica, in and around the Roman town of *Mariana*, is a case study for some of the possibilities that such an integrated work can offer for field archaeology. Here the historical and archive data, historical maps, old and present day cadastral maps, old site plans and early aerial photographs are integrated with data from recent field survey, geomorphologic observations, geological and soil maps, oblique aerial photography, geophysical research and excavations (Corsi & Vermeulen, 2007). The overlaying of all these data, spatially referenced in the GIS, allows us to deeply evaluate the stratigraphy of rural and urban landscape, to identify much information on the monumental setting of the town and its street network, to recover many elements of the

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