Geographic Information Systems (G.I.S.) for the Analysis of Historical Small Towns

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INTRODUCTION

The physical, anthropological, biological and ethnic backgrounds of a territory represent the most evident characteristics of its landscape . However, the perception of the landscape itself depends also on the observer and his life. In the *European Landscape Convention*, also known as *Florence Convention*, it is clearly established that *landscape" means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"* (European Community, 2000).

This agreement defines also a series of countermeasures that Member States should undertake for the recognition and safeguard of landscapes. In particular, the agreement contains the policies, objectives, the preservation and management of the landscape which is recognized as a fundamental component of the European heritage and a key element for ensuring the quality of life.

The safeguard of landscape is not dependent on generally prescribed standards of beauty or originality, being determined by peculiar aspects such as magnitude of the territory, cultural, environmental and social characteristics and, last but not least, historical frame. Some regions are in fact characterised by a unique combination of human and natural landscapes where many small historic towns are located in a peculiar geomorphology. Being aware that these centres are authentic "places of memory," as they result from a slow economic and cultural process and preserve the identity of communities, each analysis is performed trying to relate each element of the cultural heritage to the surrounding natural and environmental context. These historical towns, most of which established during the medieval age, are often exposed to human factors of degradation including, among others, the risks of soil overexploitation and natural factors such as the physical vulnerability determined by considerable seismic and volcanic activities, and by the peculiar geomorphological and hydrogeological pattern of the territory. These risks need to be mitigated by means of a careful analysis of the criticity levels in the different geographical areas and by developing strategies based on requirements and operational guidance (Pelliccio, 2013).

Starting from the idea that a damage generally involves complex systems, with large numbers of variables, determining physical and social consequences, the risk assessment cannot be just started from statistic data or from the analysis of "harm post event." The quantification of these criticity levels is based on a holistic analysis of the landscape, in which elements are regarded as open sets and continuous dynamic relationship are established among them. The holistic approach allows to analyze both the quality of the visual perception and the physical features and the cultural peculiarity of landscape or, in addition, all the factors which make these realities particularly vulnerable and prone to degradation.

In order to achieve this goal, an investigation procedure has been set up where the results of large and small scale analyses are included in a flexible and easy to use tool, able to combine information of different nature. The operational support for this study is provided by the information technology and, more specifically,

DOI: 10.4018/978-1-4666-5888-2.ch306

by the Geographical Information Systems, nowadays considered as the most innovative tools to figure out and manage realities made of a variety of multiple factors. The information systems include more and more rigorous methods, to be differentiated according to the different scales of representation used to join dataset to geometric model of spatial shapes (Aspinal, 1999): the 3D capabilities of these systems, creates elementary or complex spatial shapes for the architectural or environmental models on which a multidisciplinary analysis can be performed. In this way, the Information Systems are valuable tools for the management, representation and visualization of heterogeneous data. They are able to control the transformation processes in which the landscape is continually subjected.

Concluding, the safeguard of landscape passes through the knowledge of a lot of environmental data and through its identification and monitoring, so the GIS are capable of quantifying the environmental quality in order to provide the local governmental agencies with maintenance plans where priorities are clearly defined.

There are some precedents for such specific application but very few applications are tested on historical small towns and above all on single historical buildings with a particular view from large and small scale of representations.

The main goal of the research consists in setting up a general methodology for vulnerability analysis of similar historical small towns. To this aim, a careful survey is necessary on the place to gather all data which are numerically expressed and stored in a G.I.S. Once these system are setup and consistency of information is ensured among each other, assessment of data is possible by means of 3D graphical models, where values are relatively analysed in comparison with their position. In this way the GIS displays with different colours a ranking of risk of individual historical buildings and it establishes priorities for action to safeguard them.

BACKGROUND

The definition of a Geographical Information System (GIS) depends on the specific application, and its use is defined via a link between the database and digital cartography [geo-localized]: in particular the data, alphanumeric and iconographic, are linked to vectorized cartographical units [point, line, polygon] or to raster elements [centre of pixel].

These systems offer the advantage of managing, representing and synoptically visualizing a large number of data of different nature. For this reason, GIS have been used in the past for the monitoring of environmental factors and the use of the land. Many examples can be found regarding the management of territory, the development of technological networks, the mapping of geological risks such as those induced by earthquakes, hydro-geological events etc.

Such kind of structures, if properly designed, represent a dynamic and integrated source for the ongoing management of information on the part of territory to which they refer. In addition, they enable to promptly capture the possible transformation occurring to the region. As the dawn of civilization, the man still needs to represent the surrounding reality in order to visualize, know and understand it and then to plan a set of management activities: this demand is the basic principle of GIS and its strong characterization lies in the innovative way of representing reality itself . Through a process, known as "overlaying," the GIS enables to represent a multiplicity of information pertaining to the real world on the same map sheet.

The major advantage of these systems is then to create maps of the territory with different themes to which the GIS is able to associate dataset (with its attributes and its locational information): the result is the possibility to establish a "cross-correlation" among the different data and return a full view of the results without sacrificing readability.

For the design of a GIS it should be considered that "the complexity of the territory consists not only of metric parameters, such as dimensional and formal aspects, or on the management of digital models taken directly from photographs or derived with some manipulation, but another large part of complexity lies in the field of non-visible phenomena, which transform the territory and which determine the quality of living and the environment" (Maurelli, 2006). In fact, these systems are trying to increase the link between the information and more thrust modelling of shapes space or territory; they are also providing more and

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