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GIS and policy management for regional planning; a case study in Sardinia, Italy

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Abstract

Regional planning is usually characterized by a high level of complexity and uncertainty. The overlay of a number of instruments that affect land use, such as master plans, urban planning laws and regulations, leads to many difficulties linked to the interpretation of their meaning and the particular distribution of their impacts. In this scenario, it is necessary to find an instrument able to speed up the phase of the analysis for planning, by means of an automatic link between alphanumeric information and a set of geographic objects. The Italian Center of National Research funded in 1998 a project concerning the regional planning state of the art, with the main goal of understanding the basic outline and the underlying development strategies for Italy. The research project, named QUATER, comprises a series of local research Units.

The aim of the paper is the presentation of an activity report issued by the Unit of the Region of Sardinia, at the Department of Territorial Engineering, Cagliari, Italy. Particular attention will be given to the construction of a GIS able to manage spatial information and an alphanumeric data set in order to provide shared, public and transparent information for policy and planning management.

1 Introduction

Planning activity is deeply affected by knowledge representation and management. This has been evident in the past, when planners and geographers worked together defining problems and assessing policies on a paper based cartography; still it is evident and even more important in our time, when digital progress and computer graphics development allows the management of a huge piece of information.

Recently Paolillo (1999) has claimed that an important gap divides simple data set from information itself. As a matter of fact, information stems from the structuring of data according to a project of knowledge and representation. In this respect, meta-data generation rules are crucial, because they provide a description of how data have to be processed in order to enter a particular information system. In the paper quoted, Paolillo refers to a clear statement made by Yeung (1998). While data is defined as "a body of facts and figures, which have been gathered systematically for one or specific purposes" in the form of linguistic, symbolic and mathematical expressions or signals, information is defined as "data which have been processed into a form, that is meaningful to a recipient and is of perceived value in current or prospective decision making". Information is really useful, when it is "relevant to its intended purposes and with appropriate level of required detail, reliable, accurate and verifiable by independent means, up to date and timely, depending on purposes, complete, in terms of attribute, spatial and temporal coverage, intelligible, consistent with other sources of information, convenient/easy to handle and adequately protected".

The design of the system of relationship among data is the underlying principle of information generation; therefore any project of accurate data acquisition and structuring can be named as relational information system. In the advances of information technology, this process aims to provide structured advice to decision making. GIS offers the capability of processing data, generating information, by means of links between spatial and alphanumeric data. In this respect, SDSS are designed to show complex information and to retrieve immediately description about options and alternatives for future settlements or assets. Also a SDSS allows what now is particularly requested in Italy: transparency of information and visibility to each component of the decision process. Claims to bottom-up planning approach query for stakeholders involvement, in patterns that do not admit any disparities in information display during the decision process. Researches about new planning forms and protocols (Piroddi, 1999, Deplano, 1999) point out a reaction against the traditional hierarchy among plans set forth by national law n. 1150/4, and shed light about a plethora of plans. These acts are of different nature: they can be collaborative agreements, such as integrate zonal programs, territorial pacts and urban recovery programs, environmental projects, such as European Structural Funds based programs named "Life" and "Urban", sustainability agreements, such as

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recent urban recovery and sustainable development programs, greater areas planning intentions, such as metropolitan plans.

1.1 The research project "QUATER"

The overlay of traditional plans and of "new stream" plans becomes sometimes very complicated and needs to be interpreted, through data coding and geo-referring. Data interpretation helps planners and decision makers, who have to face many layers of concurring information, embedded in different plan propositions.

According to the purpose of information delivery, share and management, the National Center of Research (Italian acronym "CNR") has funded in 1998 a project, called "Coordinated Project QUATER". Besides, the Territorial Coordination Direction (Italian acronym "DICOTER") of the Ministero dei Lavori Pubblici, has fostered the development of QUATER project, towards the achievement of a synoptic description of strategic planning in Italy. " In Italy sector and special national planning and recently also regional planning have excited a process of wide area planning, that involves the Italian territory as a whole. The instrument are, for instance, landscape and environmental plans, according to national law n. 431/85, and provincial coordination plans, according to national law n. 142/90. A part from these acts, National and Regional Natural Parks, the General Coordination Regional Plans display their effects into the territory. This is a imperfect system, both in its redundant architecture and in its overlays and unresolved gaps. Important State policies of big infrastructures building and of historic built heritage and natural environment protection encounter great difficulties in decoding plans of different level, that draw alongside or intersect each other without a clear dialogue" (Ministero dei Lavori Pubblici, 1999). [...] "Urban regional laws, excepted Liguria and Basilicata, do not imply interregional planning instruments and the concept of co-planning is not included into the rules in mandatory forms, such as Planning Conferences, Preliminary Documents and evaluation protocols" (Ministero dei Lavori Pubblici, 1999). "This framework can be defined as a puzzle dimension of wide area planning and contains the logic of the dialogue and interpretation: the construction of a puzzle begins from the borders, according to what has been done already and proceeds by means of intuition of lacking pieces and joints. QUATER starts from the acknowledgment of this imperfection and propones the representation of the plans" (Ministero dei Lavori Pubblici, 1999).

In the current phase, the joint project DICOTER-QUATER aims to manage digital information and construct a GIS able to:

up to date information and screen of on-going processes;
interact with interested stakeholders (from citizens to administrative bodies);
deliver spatial analysis and thematic synthesis;
link cartographic to alphanumeric data about any single plan.

1.1 The aim of the paper

According to last developments of the QUATER-DICOTER project, the aim of this paper is to present the activity of the Local Research Unit of University of Cagliari about wide area planning in Sardinia.
The description is divided into the following parts:
presentation of the Tables and Schemes referring to the state of the art of regional planning in Sardinia;
discussion of the GIS project;
proposition of future developments.

2 Data Coding: QUATER system of representation

QUATER system of representation leads to a unified format, by means of portraying in three principal "Tables" the whole system of Italian wide area planning. The Sardinian Local Unit has issued the following "Tables" referring to the Region of Sardinia:
"Table 0", which depicts planning instruments focusing on their legislative effectiveness;
"Table 1", which refers to infrastructure policies;
"Table 2", which reports environmental policy and planning.
"Table 0" refers to planning instruments, that may have operative effects on land use planning, through their strategic options for the development. The prescriptions embedded in these planning acts are already included into regional and national laws. On the other side, "Table 1" and "Table 2" focus more on planning procedures, that affect human settlements by means of non codified regulations. In these Tables it is possible to infer the overlay of a complex set of land use prescriptions on the "official planning system".

The description the whole coding system adopted in the "Tables" will be available in a publication by the Department of Regional Planning, Cagliari (forthcoming). Figure 1, instead, portrays a part of "Table 0", referring to the planning system of south western Sardinia, an area rich of environmental emergencies. Each symbol refers to a single category of plans.

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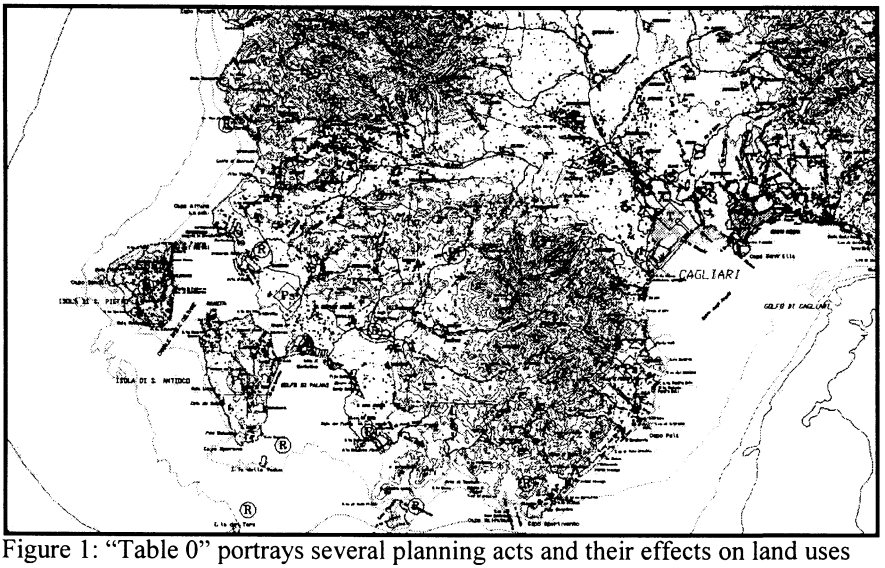

Figure 1: "Table 0" portrays several planning acts and their effects on land uses

Besides, data are coded into "Charts" referring to each planning act. According to a unitary "Repertory of Plans", each "Chart" lists the following items, with reference to a single plan: denomination, stakeholders, area, number of inhabitants, financial assets, population and settlement forecast, legal status, natural vinculum comments.
The set of "Tables" and "Charts" constitutes what can be called a paper based knowledge management system.

3. Assessing a GIS design

Transition to GIS approach requires that spatial and thematic data be coded in the a different way. Dynamic representation and analysis, such as overlay mapping, buffering and other advanced spatial procedures, allows processing data, that otherwise were statically stored into the paper based knowledge management system. In other words, data structure is to be re-coded, according to a logic typical of GIS.

	POINT	LINE	POLYGON	
CONTOURS	CITIES	ROADS	PROVINCES	DENOMINATION
COASTLINE	INDUSTRIAL SETTLEMENTS	RAILROADS	COMMUNES	POPULATION
RIVERS	PORTS		NATIONAL PARKS	LEGISLATIVE EFFECTIVENESS
LAKES	AIRPORTS		REGIONAL PARKS	DIMENSIONAL FORECAST
INTENSIVE AGRICULTURE ZONES	RAILWAY STATIONS		INDUSTRIAL DEVELOPMENT AREA PLANS	BUDGETING
SYMBOLS	HOSPITALS		LANDSCAPE TERRITORIAL PLANS	ADMINISTRATIVE BODIES INVOLVED
	SCHOOLS		NATURAL RESERVES	STAKEHOLDERS
			BIOITALY ZONES	HOUSES
			REGIONAL FORESTS	HOUSEHOLDS
				WORKERS
				EMPLOYED
				UNEMPLOYED
				INCOME
				VALUE ADDED

Figure 2: The display of data categorization

Figure 2 describes how data are organized into common categories. The first column describes contains data that are used digital data, like a background information. The second refers to the topologies system, and is divided into three items: point, line and polygon topology. The third column describes the principal elements included into the data set.
It should reminded that this GIS is designed for a specific goal. The ultimate task is the production of structured advice for decision making in a regional planning environment. This reason leads to the inclusion of selected items into the category of "Topology". Overlay and spatial topology are framed to produce advice, selecting wide area plans affecting studied zone.

A prototype has been assessed for data management of the south western part of the Island, that is a zone affected by a large number of plans and management act. This is linked to its geo-morphological nature and to the economic activities, that have transformed natural and cultural landscape.
Figure 3 shows the polygon topology "Communes" overlaid to the whole set of drawings representing physical geography and settlements. This provides digital information about the geographical characteristics of the area.

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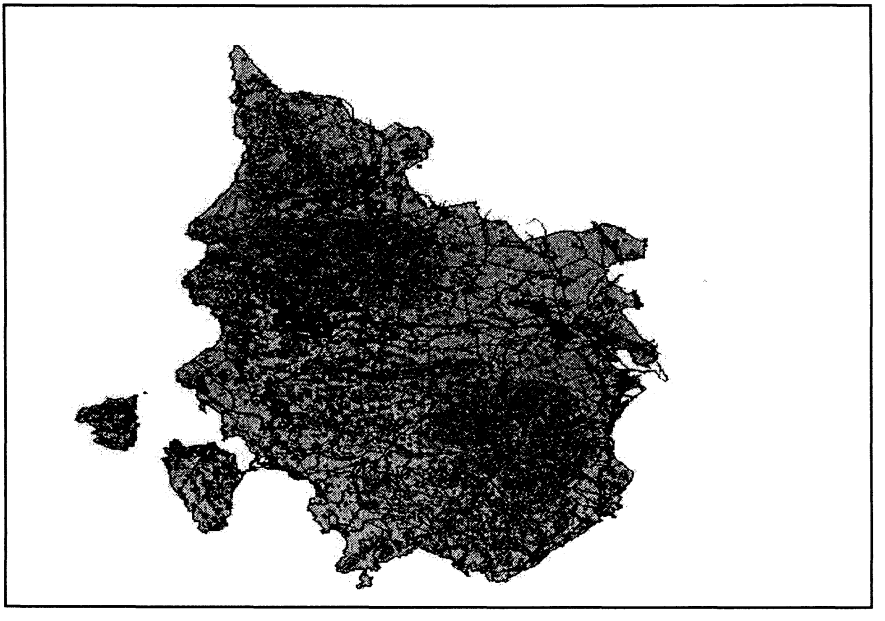

Figure 3: The topology "Communes" and the set of drawings

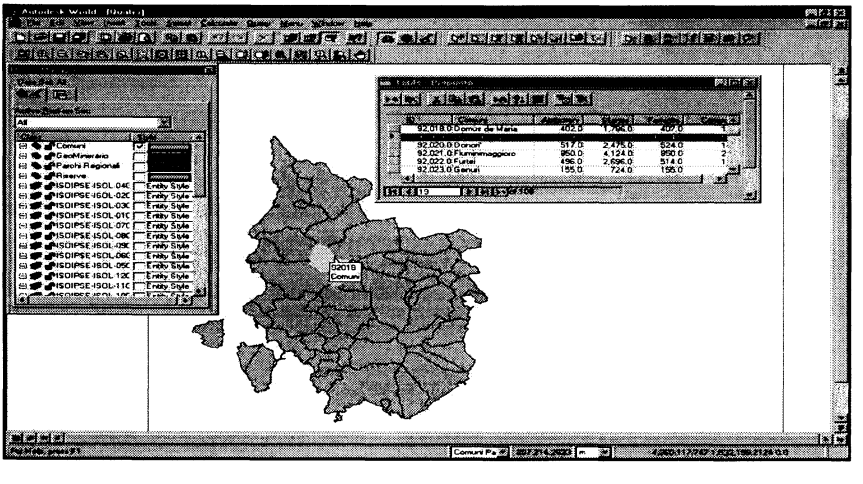

Figure 4: Each Commune is "linked" to the set of data contained in Tables

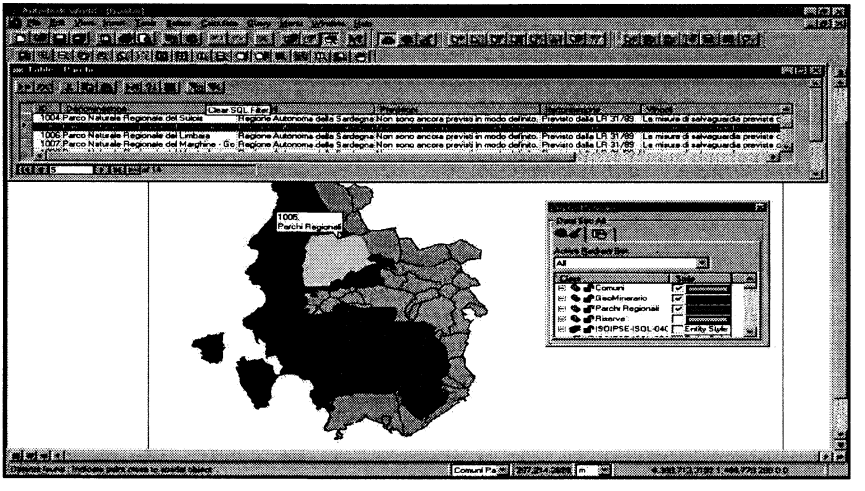

Figure 5: Topologies for the system of National and Regional Parks

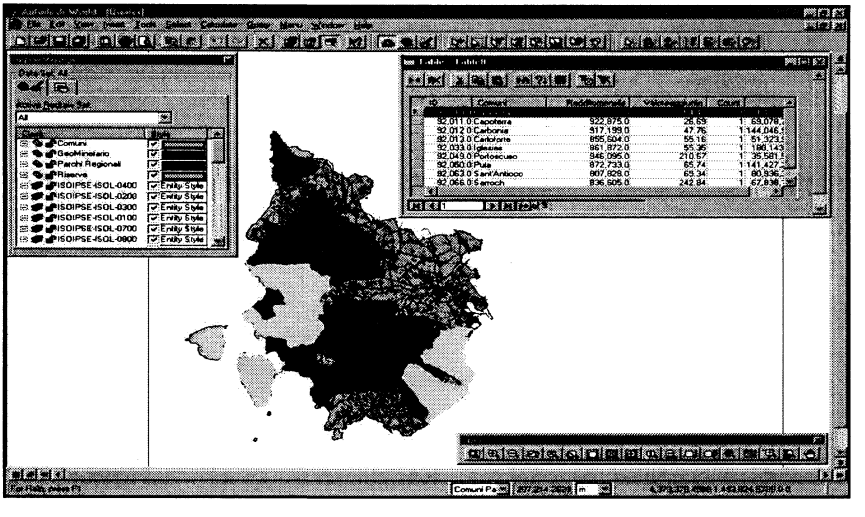

Figure 6: A complex query based on spatial and alphanumeric crossed data

Figure 4 indicates how the GIS is able to exploit the link between the topological grid of the Communes and the set of data. Figure 5 reports a display of the link between the topology of Regional and National Parks and the data set of the "Charts". Figure 6 shows how the contemporaneous use of spatial topology and of alphanumeric data may allow the efficacious selection of items interested by

particular phenomena. In this case, GIS has been able to select among the Communes included in the Geomining, Historic and Environmental Park of Sardinia (the red filled area), whose monthly income per capita is higher than 800.000 Italian lira (approximate to 400 USD).

4. Future development of the research

Future research development suggests the extension of the last category to specific information, such as environmental and water management and energy information. This may lead to a GIS able to manage not only regional planning, but also environmental policy and planning. Such a system should be designed to allow spatial complex filters of geographic information: a structure base for impact assessment and plan evaluation.

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