Consequences of Interdisciplinary Approaches in the Construction of Knowledge-Bases

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ABSTRACT

The character of interdisciplinarity in planning approaches create a new, intriguing, emerging complexity (Funtowitcz and Ravetz, 1994) in problems and in knowledge-structuring of contexts of planning practices. The key-role played by information systems (IS) implicates a re-consideration of character of knowledge to be used in knowledge-bases. The necessity of considering knowledge domains coming from social, cultural, economical, technical, physical and naturalistic approaches means dealing with different scales of value, with non homogenous parameters. The necessity of managing flexible knowledge rises on the fore as fundamental issue for future information system oriented to supporting decisions. Might information systems be useful in this interdisciplinary approach ? It is necessary to contain in a knowledge-base both quantitative and qualitative information ? Three alternatives are available for a conceptual discussion :
the possibility of identify new approaches, in order to develop information systems able in managing new knowledge;
the necessity of adding new support systems oriented to manage soft knowledge, to traditional geographic information systems (GIS);
the possibility of non using support systems coming from a technological vision of problem for non technical knowledge (Latouche 1996).
The first two paragraphs are due to F. Selicato. The third and the fourth paragraph are due to C. Torre.

1 INTRODUCTION

The arise of information technology allows the use of instruments which are able to manage a great amount of data and to build complex information from simple data. A main advantage derives from the possibility of managing data archives referring to several disciplinary domains, from socio-economic disciplines to physic-ecological disciplines, and to relate theses archives to the same spatial reality for various tasks. In this context, GIS utilised as Decision support systems (DSS) appear adapt for playing a fundamental role for making analyses oriented to environmental planning.

Consequently to the development of the disciplines which interact in the planning process rise to the fore the necessity of representing a reality which is often non linear, o not always strictly quantitative (Futowitcz and Ravetz 1994). In detail, in the context of ecological sciences the need of analysing extremely complex systems is emphasised; for those disciplines, the use of typical geostatistical models of GIS routines risks to lead to a reduction of information, more than an increment.
The question of complexity is to referred both to cognitive domains of natural ecology and human ecology, for which casual and chaotic components lead to the impossibility of building interpretative models which use linear approaches in an exhaustive way. Isabelle Stengers affirms that complexity for these systems is an intrinsic character. The same is affirmed by Maturana and Varela (1980) when speaking of autopoyesis in nature and by Zeleny (when speaking of autopoyesis in economic systems. If it is correct to say that GIS are thought as systems to manage great amounts of data which are expressive of complexity – as in the case of system supporting planning activities – it is correct as well to investigate about modalities of management and capability of giving correct answers for analytical needs.
As above reminded, several GIS routines use linear and probabilistic routines. As above affirmed, it is matter of the amount of available information. A great amount of information describes events, giving various vision of the same events. The more the amount of information about an event is wide, the less the explanation of the event can be reduced to a linear approach. The availability of most information live a small space to probabilistic approaches. A sufficiently wide amount of information should be useful to represent an event in a progressive but non-linear scale of grey which start from what is the event to what is not (Kosko 1993).

2 CONSTRUCTING KNOWLEDGE: WHAT TO REPRESENT AND FOR WHOM?

A initial scope of GIS is to manage wide, complex, range of information, referring to different disciplines. But disciplines are subject to re-discussion, to a change of their cognitive domains which lead to a re-definition of sectorial knowledge. The same modalities of interacting about different expertises are object of debate as well. At the same time, not only about the development of software technology, for research on GIS new directions about the analysis of the relationship which exists between knowledge construction and decisional and planning process. The scenario analysis, for instance, gives the character of DSS to GIS.
In practice, as regards type of knowledge and information, on one hand, we observed the development of systems which are oriented to manage technical questions, (like maintenance of architectural heritage, management of utilities and infrastructure, environmental monitoring) and which constitute a relevant experience, without the need of going in depth in terms of research and innovation. This is probably due to the absence of the necessity of modifying the concept of information in this kind of sectorialisation: the information still appears “objective”, linear, quantitative.

"…GIS and related spatial technologies are suddenly expanding to embrace many traditionally separate functions. At the same time, many other types of software are beginning to add GIS-Iike functionality: spreadsheets and their improved graphics capabilities in handling 2-dmaps and 3-d visualisations are a case in point. In one sense, software is breaking up on the desktop into basic modules which can be hooked together in diverse ways while other software is becoming increasingly generic in that all manner of textual, numerical), and graphical functions are being included under the same rubric. GIS itself is changing as more functions are embodied in hardware and as the vendors increasingly begin to specialise in applications, in data, and in specialist niche markets based on computer services. (Batty 1996, 76)"

Although, as Batty affirms, technological innovation will allow to enlarge the field of implementation of GIS, it appears still not completely defined the field of construction of fuzzy information routines embodied in GIS, more qualitative than quantitative, deriving from the necessity of representing better and more significantly new peculiarities arising from individual and various needs. The progressive increase of fuzzy information and the frequent use of the necessary cognitive heritage constituted by the knowledge of the community, give an important contribution to not only the shape – lines of demarcation of the possible alternatives of the studies, but has also unfocused the limits. The participative approach, in detail, has still more undefined the limits of subjectivity and objectivity, public and private, justice and injustice, beautiful and ugly, the use of the compatible land and the ambiental maintenance, all difficult concepts as reconductable to one unanimous agreement of the community. The human beings react from the base of - , emotions, behavioural models legated to the history, values, needs. The domination of territorial planning, of which the human systems are an essential component, and is – recognised by the characters of complexity, uncertainty and ambiguity (Alexander 1986).
If these are the problematic characteristics with which to measure it is correct to ask if the forms of the traditional representation of the knowledge are adequate.
The attempt of providing more effective modalities of representation of complexity, which is useful for policy making appears to be a convenient field of research for those who are intentioned to build effective and representative planning practices without renouncing the support of automatic process referring to GIS.
This consideration is valued by a dichotomy existing in experimentation on GIS field between the development for commercial scopes of GIS software and the abstraction and the education on GIS. Sectorial GIS supporting technical questions can be considered as market goods. Horizons of researchs can be contained in the short terms, according to the peace of commercial production. GIS which are intended as DSS , are object of study for those scholars which look at the long term research. In the Italian context this second modality of thinking GIS is close with theoretical approach which looks at the relationship existing between planning and geography. The context is frequently poor of structured information - especially in the South (Craglia 1994) - and GIS are necessary for land-use planning and for environmental, spatial and social

planning as well. GIS are intended as instruments which have to provide a various panorama of representations and which can assume a cultural, educational, not only environmental or technical dimension. Cultural dimension of GIS means ethical question about which knowledge is necessary to be acquired and to which user knowledge has to be communicated. When linking the need of participation, which is declared as fundamental task in modern planning theory, to the need of a widespread knowledge of environmental and social questions among non-expert actors of the planning process, the necessity of a non technocratic vision of information management rises to the fore, and gives an ethical dimension to the study on user-friendly interfaces. In other words, information systems which are able to manage different cognitive complexity, which find social components -more than in the past- interested, can provide a equal dignity to each social actors, regards to the representation of a spread knowledge. The guarantee of a conscious participation of weak and strong actors to the planning process can depend on the democratisation of information. In this way the risk that some social groups which traditionally manage political and economic powers make their reasons prevailing, can be reduced.

An experimentation, oriented to modalities of diffusion of knowledge, has been conduced on a plan for a rural park, near the southern Italian city of Matera. Due to its environmental and cultural value, the city of Matera belongs to the Unesco Heritage. The plan of the Park refers to an area -around 8000 hectars- near the city, which is utilised for agricultural scopes, and which is characterised by the presence of relevant religious and rural architectures. The real limited consciousness of the value of the park by the community is not sufficient to obtain the environmental preservation of the area. An hypertext has been developed in order to provide a clear explanation about:

-issues and characters of the Plan of the Park,

-historical, naturalistic and geographic information about the city and the Park,

-reasons for institutional limitations of land-use,

-information on economic incentives for improving auto-sustainable policies in the area.

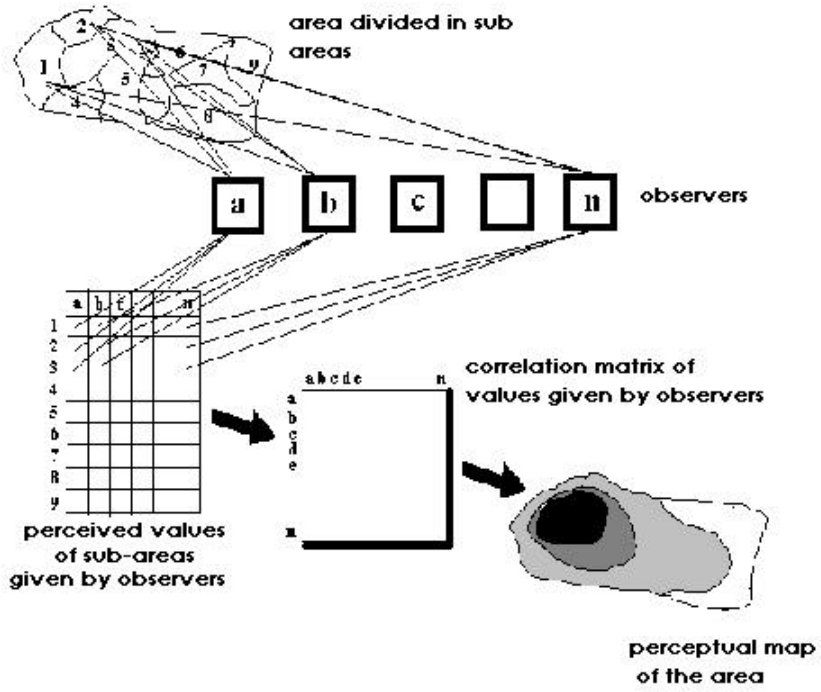
The scope of the hypertext is to make more visible the reason of the necessity of an environmental preservation which can be useful to the economic valorisation of the area. The hypertext is user-friendly interfaced, in order to help the interrogation by common people and to make the same interrogation more attractive.

3 REPRESENTING FUZZY KNOWLEDGE

As already affirmed, the construction of a fuzzy knowledge is another crucial point for future investigations. Experiments about the construction of maps of perceived attributes of spatial context are well-known in scientific literature (Kaplan and Kaplan, 1982; Gould and White, 1986; Lynch and Gimblett, 1992; Douglas Porteus 1996). Perceptive values are due to instinctual factors (Kaplan and Kaplan, 1982), or due to cultural factors (Douglas Porteus 1996): their fuzzy dimension is consequently clear,

and their subjective dimension as well. Some studies are based on the analysis about the statistical correlation between the values expressed by observers using diversified perceptive parameters, regards to the same spatial context (Figure 1).

Figure 1: **Process of construction of a perceptual map**



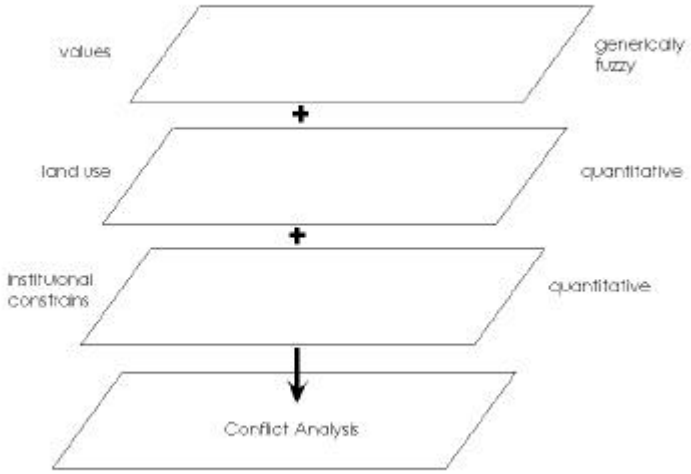
The collection of information is always carried on by interviews or questionnaires, i.e. using direct collection. In some cases the collected information is structured inside a system of information (Lynch and Gimblett, 1992).

The artificial information systems use direct memory and when all the set of information which are useful for determined objectives is imagined, the research and consulting for association is made by searching one alternative at once. In human systems, instead, the associative memory, when collected parallel information, acquires the same information by the attribution of an implicit weight, that is to say that human systems realise weighted implicit choice without a mathematical formalisation. Human systems act by intuition according to mental flows, find answers without finding explanation (Kosko 1993).

A human brain o a community of brains give value to objects in function of knowledge which are made by a process of associative memory. These values, especially when they refer to environmental resources, are the only forms of value which the community is able to own, in an autosustainable process. Conflicts in spatial planning

arise when a contradiction exists among community perceived values, institutional addresses of using the territory and actual uses of territory. The actual uses have a more contingent dimension than community values, because they are due to economic needs. An innovation in using overlays can be helpful to structure information which keep value even if they are qualitative, because they are significant in terms of representation of conflict. The overlay of information referring to land uses, of information referring to institutional limitations of use and information

Figure 2. **Conflicts analysis made by overlay of values, land-use and institutional limitation of use**



referring to cultural-environmental value can be helpful for mapping spatial conflicts (Figure 2). Some of these layers express fuzzy information. By intersection of information about limitation (certain), about actual land-uses (certain) and cultural-environmental values (multidimensional-multilayer and fuzzy) the generated fuzzy map of conflicts assumes a relevance, in terms of decision supports, which is maybe higher than a traditional geographic information.

The approach above explained has been used in an experimental way in the school of Architecture of Bari Polytechnic in reference to some regional contexts of southern Italy.

We're yet far from representing needs potentially referable to a modality which is not the traditional within the socio-economic analysis. The structuring of the information implies not a relevant effort but a new way of thinking.

4 FINAL REMARKS

GIS were born to manage complex knowledge, which is impossible without the support of information technology. The knowledge refers often to different cognitive domains. The re-visitation of the concept of knowledge, referred to the various disciplines gives rise to a re-discussion of the traditional way of thinking GIS. Sectorial GIS exist, which are strictly oriented, which still can move in the traditional vision (see "*what can GIS routines do?*" in Figure 3) , but the academic research is oriented towards the construction of GIS which are able to manage new forms of

Figure 3. **A traditional way versus an innovative way of thinking GIS**

What can GIS routines do? *(Clarke 1990)*	***What will GIS routines do?*** *(Batty 1996)*
Providing a framework for data transformation *Synthesis and integration of data* *Updating information* *Forecasting* *Impact analysis and Optimisation*	*Providing a framevork of qualitative-quantitative, linear-non linear data transformation* *Easy interfacing for communicating information* *Updating information and enlarging by domain* *Impact description for decision makers* *Scenario analysis*

knowledge and of decision support: it could be unethical moving in a vision of competition with GIS produced for the market of information technology.
Moving in the field of introduction of fuzzy knowledge and of a democratisation of information is necessary to develop input modalities and interfacing modalities oriented to improve the user-friendly approach to GIS (see "*what will GIS routines do?*" in Figure 3).
Therefore the investigation about forms of knowledge give a new impulse to the investigation about new mediality.
The structuring of interdisciplinary knowledge means use of soft techniques and investigation about the interaction system-user. As Zeleny affirms (1985) the development of a higher level of technology is matter not only of software and hardware, but of "brainware" as well. Brainware means the new way of thinking which is generated in users of new technologies.
The innovation is both in technology and in technology management.
The use of GIS is relevant even when new way of thinking information systems as decision support systems rise to the fore, and even when the necessity of using soft computing systems is evident. The deal between expert systems (ES) and traditional IS, for instance, is now considerable as a question of past times. ES applications are extremely sectorial, and refer to limited, even if flexible and selflearning, knowledge bases, respect to IS. This means that new soft systems can become routines in wider information systems technologies.

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