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CULTURAL DIFFERENCES IN GIS: A BASIC APPROACH

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ABSTRACT
Studies in "cultural differences" are rapidly becoming an important GIS research topic, because cultural differences may limit the future diffusion of GIS technology. Even the commercial sector has recognized that use and diffusion of GIS are strictly related to the ability to deal with specific cultural situations, and this means often to speak English and to be familiar with the American stile of life.
Cultural differences *per se* are an extremely wide problem and reach from programming standards to issues related to administrative rules. Further specifications of basic aspects are needed before the issues become approachable. A review of current approaches shows the broad spectrum of possible points of view. From the survey follows a number of definitions for "cultural differences" and a framework for research approaches. We conclude with some suggestions on how research may approach the problem.

1. INTRODUCTION

"Cultural aspects" is a generic way to define differences in designing, using and interacting with GIS by different communities. In our understanding they correspond to the **contextual** translation in "objects and situations" of the relationship existing among: spatial processes, territorial structures and technologies enabling us to relate to both. This is a very comprehensive definition and includes the GIS and its use as a tool for spatial planning, environmental monitoring, etc. The use of "context" follows the definition given by Bateson (1979), Winograd-Flores (1986), Varela et al. (1991).

Recently "cultural differences" in designing and using GIS is becoming an acknowledged research issue (Mark et al. 1989; Goodchild 1992). For long it has been hidden in many statements, critiques, claims and aims that appear in the GIS folklore of reports of experiences with particular system. It was often seen as a particular aspect of a specific system or poorly defined problem of some data collection activities. Now we address this as problem in its own right, that includes many aspects of GIS development and application.
Sentences like: "GIS are very widely used tools but still difficult to learn", "GIS requires a very long training before an user is able to move alone", often hide some cultural issues, but rarely

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they have been openly declared. There has been a kind of reluctance to acknowledge cultural issues in GIS as in other technological field. This may be because very often 'cultural aspects' are considered 'uncontrollable variables' or a part of some subjective categories by "hard" sciences. However 'cultural' has many different aspects. The awareness about multiple viewpoints confuses what should be clear and simple (Golledge 1983; Aangeenbrug 1991). Technology usually makes us believing that real situations are simpler than they actually are. This paper therefore concentrates on providing a list of differentiated aspects of 'cultural issues in GIS'.

GIS have characters that make the cultural issues difficult to treat even from the point of view of marketing management, where it is most obviously a factor to consider. The world wide diffusion of GIS would require distributed know-how in order to include cultural variables in GIS development. A deep awareness and understanding of cultural factors of GIS local implementation would be needed. However, this understanding is a difficult task to accomplish, because the GIS world is composed of a multinational users community and by a designer community essentially still mono-linguistic. While the scientific community may consider standard English as the language of communication about GIS research, this is not the case for the different national and regional administrations involved in the integration of GIS in their every-day procedures.

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Existing contributions on cultural aspects of GIS show different approaches. It seems that as GIS has several definitions, so the "cultural differences" have been considered from several points of view. In this paper some of the most relevant approaches will be described and discussed. Further we propose a particular view of the cultural aspects of GIS based on the on-going researches on human spatial conceptualization and reasoning (see also te discussion in the U.S. National Center for Geographic Information and Analysis research initiative I10, I2 and I13).

2. NEED FOR CULTURAL ISSUES IN GIS

The idea that moves (and compels) GIS toward implications in cultural issues is actually very simple. A GIS manages spatial information always linked to a large variety of issues as: territorial forms, landscapes morphology, administrative rules and common attitudes, ownership, control, interpretations of environmental changes at the micro and macro scale, methodologies of research, disciplinary standards, etc. The interpretation is always made within a precise professional or scientific fields (i.e., academic, administrative, scientific, political, economical, historical, etc.), or within a culturally defined everyday-life contexts (e.g., concepts of ownership of land versus the concept of land as a free good). Statements and meanings become consistent if they are expressed in an appropriate context. But they are not 'universal' and do therefore not necessary transfer to another context. Even professional contexts are culturally defined. In fact, communication must be supported by sharing basic cultural concepts rooted mainly in the tradition of the areas in which they are used.

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GIS is a technology in extreme need of a cultural perspective during their development. This might not be clear when GIS are considered as a simple tool to be applied by a professional, and thus all the burden of cultural transformations is shifed to the user. But this is not a useful point of view that leads to a better understanding of the problems. It behooves us to assess the different roles and the levels of these transformations from one to another culture, because it affects the use of the tool. There is a branch of Human Computer Interaction, the so called 'ecological approach', whose core essay is "Thought is shaped by tool" (Payne 1991). GIS are much more flexible than what can be considered a simple tool - a GIS is not as simple as a hammer - and aims at spatial integration of data. It thus hits problems of cultural differences squarely.

3. APRROACHES TO CULTURAL DIFFERENCES IN GIS

There are multiple viewpoints one can embrace to address cultural aspects related to GIS. Each viewpoint will lead to a particular set of research questions, research methodologies and results but without separation and clear labeling what is discussed only confusion results.

3.1 DESIGN AND USE OF GIS SOFTWARE

We see first a set of issues related to the design and use of GIS software. One can study the cultural background of GIS designers, their education and professional background etc. and compare it with the same variables in the users of GIS software. One can also study the methods used for the production of GIS software, issues of standardization, transfer etc. In each case, it involves basic research traditionally belonging to Human Computer Interaction. It assumes the existence of a strong influence of specific cultural models at the basis of GIS software and its components, like: data structures and models, internal representation of data, user-system interaction, colors sets, symbols sets, etc.

Examples for this level of concern are the commands selected by the designers (e.g. "zap") that are typical for the cultural environment of software engineers in the USA, but hard to understand for an outsider. In the same group are the 'side effects' of a command, which are only obvious when one knows the underlying data structure.

3.2 USE OF GIS IN A CONTEXT

Second, one can consider the subject of data representation (structural condition of land, types of existing sources of data, traditions in land information mapping, etc.) and how the data are used for a single task. It then only depends on how data are collected, represented, managed and how the process uses them. The cultural aspects are not directly related to GIS software (the GIS tool), but primarily to the process made possible by using this tool.

Examples here relate to methods of urban planning or the Environmental Impact Assessment plan [Pozzana - Campari 1992], the proper definition and classification of data, interaction with the data collection method etc.

3.3 HUMAN SPATIO-TEMPORAL CONCEPTUALIZATION

Till now, few contributions in literature are clearly about different approaches to "cultural" issues along these lines. We rather find a group of work, tending to assess cultural differences in human spatio-temporal conceptualizations. These approaches involve and affect the two issues listed before, namely:

- the design and use of GIS (Mark-Frank 1991; Couclelis 1992; Campari 1991; Frank 1992; Egenhofer-Herring 1991; Kuhn 1992);
- the methodologies of GIS integration in various scientific and disciplinary contexts (Campari 1992);

and they contribute to the experiments and on-going researches in Cognitive and Environmental Psychology.

Between basic concepts the spatial ones play a noticeable role. They give expression to the spatial reasoning even of the professions and sciences. Spatial concepts affect the design of the various landscapes (rural, urban, coastal, etc.), the administrative rules to govern the territory, the methodology to scientifically approach the environmental issues inside academic disciplines, etc.

This approach interacts with topics of cognitive sciences related to the Human Computer Interaction. GIS researchers only recently paid attention (Mark - Frank 1991; Mark et. al. 1989; Frank 1992; Mark 1992; Frank et al. 1992) to this important relationship. How humans conceive space and time and how they use spatio-temporal notions in order to organize their every-day life are core questions of this approach (Golledge 1983, 1992). The theoretical framework is based on work on cognitive psychology and linguistics (Lakoff 1987; Lakoff-Johnson 1980; Rosh 1973, 1978; Herskovitz 1985, 1987; Jackendoff 1983). NCGIA researches initiatives, especially the initiative 2, 10 and 12, have made substantive progress in applying the results of this work to the GIS field.

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3.4 CULTURAL DIFFERENCES IN MODELING REALITY FOR ADMINISTRATIVE PROCEDURES

A few researchers have pointed to the role of cultural differences in geographic (Campari 1991; Salge' et al. 1992) and administrative (Campari 1990) reality, and how they affect the building of inter-regional geographic databases and data banks and also how they affect the design of geographic data models. This work contributes to the organization of the data collections at different institutional levels.

3.5 CULTURAL DIFFERENCES IN THE SENSE OF HUMAN TERRITORIALITY

Sack has pointed to the differences in the sense of human territoriality (Sack 1986). Differences here reach far, from cultures that lack a proper concept of 'private ownership in real estate', to cultures that consider land a 'free good' and there are extensive discussions of the clashes when such different cultures come into contact (as the history of the U.S. west demonstrates). Of course such more fundamental differences in cultures then affect the appropriate administrate procedures but also affect the design and use of the software.

Human territoriality has cultural roots, and it plays a fundamental role in keeping basic differences in shaping and organizing space. In fact, it affects the perception of lived space, the interaction with it, the way to organized it in a legal meaning accepted by specific communities sharing the attribution of a set of functions to space (Taylor 1978). An extension of the concept of human territoriality to the conceptualization of spatial information in GIS is discussed in Couclelis (1992).

3.6 CULTURAL DIFFERENCES IN THE MATERIAL CULTURE

In some respect, and at different levels, GIS is an artifact and as such part of the material culture. This is very obvious for computers and all the related information technology. In this realm, history of science and technology can already provide us with studies that could apply similarly to the GIS and its introduction.

There were discussions about the role of scientific theories in developing technology and we are not claiming an original role of basic disciplinary theories in GIS "artifacts". It was claimed (Pylyshyn 1991) that only seldom the theories has substantially been suggesting the technical practice, not to mention engineering (Lewis 1991). Human Computer Interaction considers the information processing devices as artifacts built and used by humans. GIS is also one of this device. This calls for an involvement of discipline like Psychology in order to conformably understand the interaction between artifact and man and also between potential artifact and its designer. Norman (1991) has called complex artifacts as "cognitive artifacts", that partially fits with some characters of GIS.

4. TWO EXAMPLES OF CULTURAL GIS DEPENDENCY

4.1 THE LANGUAGE ISSUE

A special issue of cross-cultural GIS dependency should be discussed here in particular, namely the language issue. This is because it is probably the most obvious one, but it is by far not the only one.

GIS communities are currently heterogeneous and multinational. They involve multiple professions and cultures. Profession and culture provide users with vocabularies to express their own conceptualizations of space. The GIS task is to describe and analyze places through the representation of spatial processes. The processes and their formalizations belong to few professionals (perfectly able to communicate with each other at a very low level of detail), while the knowledge and understanding of places should be approachable by anybody interesting in it, even if he/she is not participating in the usual professional context. The main character of GIS users is the coexistence in their background of different constraints to think about space, together with commonsense reasoning about it. The users expresses their own conceptualization of space through professional languages as well as through the every-day common language.

It has been claimed that differences between languages express the cultural dependency of the spatial conceptualization (Whorf 1956; Rosh 1978; Lakoff 1986; Johnson 1987). GIS communities express such cultural differences both in designing and interacting with the systems (Mark-Frank 1991). Spatial commonsense and professional formation of the designer of a GIS impact the user through the GIS interface and when reading the documentation (i.e. manuals). There may exist serious language barriers, if the designer and the user do not share the same spatial experience. This is the regular condition for GIS: designed prevalently in English speaking countries, but used largely in not English speaking ones. For the latter ones, understanding what GIS is performing through the interface and the command language is mainly a conceptual issue rather than lexical. In fact, the major problem concerns the translation of spatial concepts from the Anglo-Saxon cultural domain to another one. In many cases the use of traditional bilingual vocabulary does not help to understand the rich spatial content of verbs and nouns used in GIS. The cross-linguistics approach may augment the power of conceptual analysis (Mark et. al. 1989; Campari, Frank 1993).

In this context GIS is one of the concrete applications of the results of the interdisciplinary method of research in a spatial information science domain. Artificial Intelligence, Linguistics, Semiotics, etc. concur to develop basic ideas on which to base 'human oriented' GIS. Issues that have been for long relevant only in Human Computer Interaction research are now becoming fundamental also for thinking about new interdisciplinary principles for the spatial information management.

This approach is human centered and somehow also "contextually grounded" (Carroll et al. 1991), with regard to both GIS designer and user. The designer is seen as the potentially transferor of cultural models in artifact he/she designs. The user is seen as a potentially collector and interpreter of those models. Essentially for this account is how GIS is understood, perceived and interpreted by the users and conceived by the designer rather than how it actually works.

4.2 SPATIAL DATA ORGANIZATION AS CULTURAL-CONTEXT DEPENDING

During the last ten years a large number of projects of national and regional data banks have been built using GIS. They provide examples for a particular problem, namely the dependency of data on the cultural context in which they are collected.

Some of the international data banks are very limited and seldom used. They were sometimes filled without any coordination. Each country applied in the design of these data banks its own traditional rules, existing sources, local criteria to collect data and to justify these activities. The absence of sufficient coordination has made evident some national difference in buildings local geographical data banks. These differences are not due to the GIS. Usually the data banks have been built exploiting existing information. Differences come from deep traditions of each country in administration and controlling the territory. The most common topic in the geographical data bank is the administrative subdivision, which relates to the way the territory is organized and controlled. The administrative information based on the hierarchical land subdivision or the form of land ownership are not a-cultural at all. The hierarchical administrative subdivision may have various origin: religious (see Portuguese Freguesias), laic (see Italian Comune), ethnic, etc. Land parcels may instead have origin in taxation needs that do not follow the same rules in all countries. GIS may technically treat this data in the same way. The origin of a boundary-line does not matter for its acquisition. But the semantic differences are present in the final results of the processing through GIS and may affect the result.
The strong and till now unavoidable differences in data banks have made some authorities wondering about their usefulness in a period in which the problems tend to be seen globally (Salge' 1992; Masser 1992). However, if on one side problems as the environmental ones should be faced globally, there are others, mainly in Europe, that will continue to be tied to the fragmentation of the political (i.e. cultural and ethnic) situation. As a historic irony, some of the 'national' databases from last year have become 'international', given the recent changes in European borders.

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5. CONCLUSION

We have linked a number of problems in GIS design and usage to the general problem of 'cultural differences' in affecting GIS. This collects a variety of diffuse problems under a general subject. The discussion of 'cultural differences' has gained some attention recently, addressing the issue from many different points of view. Unfortunately, the problem is too broad and requires urgently some subdivision in particular aspects that can be described and investigated individually. In this paper we have separated the following aspects of cultural aspects related to GIS software:
- differences in the cultural background between GIS designers and users,
- differences in how software is built and standardized,
and the two aspects related to the process in which GIS is used:
- differences in the definition, collection and representation of spatial data,
- differences in the administrative process that uses the spatial data.

Form a more scientific point of view, several other subcategories can be identified.

There is an active area of research, dealing with how people conceptualize space, which affects both, the way GIS software is designed and used. A different strand of work relates to:
- the differences in the administrative tradition and how it affects the construction of geographic data models,
- cultural differences in the sense of human territoriality, and
- GIS as part of the 'material' culture, in particular the perception of information technology and how it integrates with other technologies.

It remains to stress how large an influence these cultural differences have and how little studies are available. Much remains to be done, but from the view example, it becomes completely clear, that cultural differences affect the economic viability of GIS in many situations and thus influences the industry in a substantive way.

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