Chapter 2
Nature of Geographic Knowledge Bases

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ABSTRACT

In many domains such as environmental and urban planning, experts need to make reasoning and propose solutions. However marketed GIS software products are limited to store, display geographic information together with additional tools such as in spatial analysis, but they do not offer users the real functionalities which are useful for territorial intelligence. This first step is to propose novel models to represent this kind of knowledge needing not only to integrate geographic aspects, but also be independent of data acquisition technologies (satellite images, laser, crowdsourcing, etc.) and able to be used in different languages. After the definitions of geographic ontologies (to organize geographic feature vocabulary) and gazetteers (to structure toponyms in various languages), various examples will be presented in order to extract geographic semantics. A special attention will be devoted to geographic rules.

INTRODUCTION

In comparison with information systems in companies, gradually passing to business intelligence, it could be interesting to provide local administrations and local politicians with tools for territorial intelligence. Territorial intelligence, sometimes called geographic intelligence combines human collective intelligence with computer intelligence to reach sustainable development for any territory, a country, a region or a city. In the case of cities, the expression "smart cities" is very common.

There are several definitions for territorial intelligence. Girardot (2010) claims that "Territorial intelligence is the science having for object the sustainable development of territories and having for subjects the territorial communities" and then emphasizing the importance of Multidisciplinary knowledge. For its part, Bertacchini (2007) explains that "Territorial Intelligence can be compared with the territoriality which results from the phenomenon of appropriation of resources of a territory; it consists in know-how transmissions between categories of local actors of different cultures." Miedes Ugarte (2008) declares that there are three components in territorial intelligence, cognitive, socio-political and organizational-technological. The last includes new tool kit for analysis, monitoring and territorial communication. As a sort of synthesis, let me define territorial intelligence as the composition of collective human intelligence allied to artificial intelligence for sustainable development as illustrated Figure 1.

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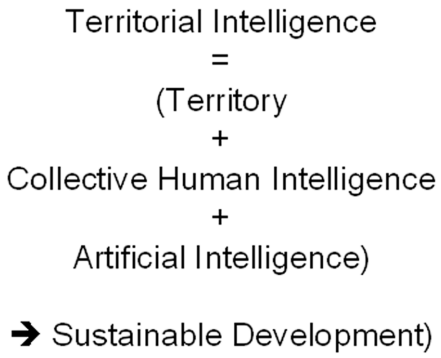
Figure 1. Definition of territorial intelligence



Presently, even if GIS tools are very used and efficient, few experiences have been made to use geographic knowledge for urban and regional planning. One of the reasons is the misfit of geographic data and information: they need to be revisited to able to use in automatic reasoning. Among the criteria, let me mention:

- Independence from data acquisition techniques,
- Independence vis-à-vis scales,
- Independence from computer data representation,
- Independence from human languages,
- Robustness vis-à-vis errors,
- New visualization techniques more adapted to decision-makers by offering synthetic overviews in contrast with data atlases,
- Etc.

Consequently, in this chapter, in order to design new tools for territorial intelligence, it is necessary to propose a generic model for geographic knowledge. But before presented a consistent and exhaustive model, the semantics of geographic objects and of geographic rules must be identified and categorized. The targeted applications deal with urban and regional planning, environmental analysis and planning, transportation and more generally all applications for which a geographic information system (GIS) is used can be revisited to see whether geographic knowledge can lead to better tools.

In other words, the goal of this chapter will be to explore the nature of geographic knowledge so to propose novel models to be efficiently used by computers.

BACKGROUND

Few research laboratories include geographic knowledge into their guidelines. People working in geographic data mining as (Mennis-Guo 2009) are only trying to extract so-called association rules in which co-localization rules are a good representative.

Several works have been in spatial knowledge, essentially based on topology (Egenhofer 1991, 1994; Clementini 1993) especially as a basis for topological reasoning. But generally, extensions to deal with geographic reasoning are very limited.