CONVENTIONAL AND UNCONVENTIONAL GIS APPLICATIONS

Cătălina CRISTEA, PhD. Teach. Assist. Eng. – Technical University of Civil Engineering of Bucharest, Faculty of Geodesy, cristea_catalina@ymail.com

***Abstract**: The founder memeber of ESRI, Jack Dangermond, one of the most important personalities in the GIS industry, highlighted even from the beginnings that „…The application of GIS is limited only by the imagination of those who use it".*

GIS applications currently made by the specialists from our country and abroad sustain the huge possibility of using the GIS technology to various fields, some of them traditional, with a direct and immediate geographical relevance, other unconventional.

In this article the author wanted to highlight some of the vast and various applications where the GIS technology can be used, focusing on unconventional applications.

***Keywords:** GIS, unconventional GIS, GIS application*

1. Introduction

Human actions over the components of the environment, like water, air, elements of soil and subsoil generate complex situations that need an efficient management system to solve the problems. This management system requires powerful tools that should be able to use in an efficient way the available resources. Also these management systems should be used to protect the existing resources and prevent disasters from happening. The GIS technology was developed precisely for this purpose: to process many new data with various origin and the results to be used in order to create models of the environment in usual and unusual situations.

The GIS technology processes and analyses both the descriptive components of natural or anthropic elements – many of these data are usually stored in tables- and the geometric representation of these elements – that had been previously rigorous georeferenced

The GIS software is equipped with powerful tools for processing and representation of data and of the results. An expressive example in this case is the land surface modeling. This modeling can be realized in an easy way and the visual impact of the results is significant.

The rapid development of GIS – Geographical Information Systems – led to the existence of several definitions. According to some experts, Kraus K included, GIS has to be defined as a particular case of **SIS** – *Spatial Information Systems*. The SIS is a Geographical (with reference to the territory) Information System (GIS), which does not give an idea of the multi-dimensional or spatial concept [6]. The spatial information systems relate to three categories of maps: cadastral, topographic and geographic. According to these types of maps, Kraus considered appropriate the following classification of the information systems:

a) LIS – *Land Information Systems* – are the systems that are going to be used for managing the cadastral information. They use as a starting point a cadastral or technical map at a large scale 1:500-1:5.000.
b) TIS – *Topographical Information Systems* – are the systems that are going to be used to describe natural or anthropic surfaces. In this case the third dimension is going to be

taken into account, e.g. the altitude, needed to develop the digital model. The base maps for this category are the ones with a scale from 1:2.500-1:100.000.

c) GIS – *Geographic Information System* – Are the systems that are going to be used to describe natural or anthropic surfaces, creating a model of the relief containing many thematic elements, at a certain generalization scale. The sources of data for this kind of systems are multiple. The data have various origins or come from different thematic or geographic maps at different scales. The system can be better named according to the domain where the application is going to be used, e.g. meteorological information system - if weather is concerned.

The diagram below synthesizes the way that Kraus, K., considered as most appropriate for the classification of Information Systems.

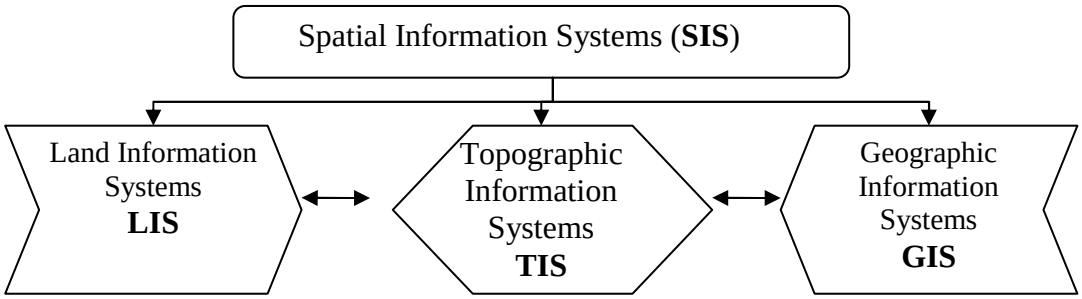

Fig. 1 Classification of SIS, according to Kraus, K. [6]

2. Classification of GIS applications

One must distinguish between a GIS and a GIS application. *A GIS* is a software package that can be generically used in order to create different GIS applications. *A GIS application* represents a punctual use – for a specific subject – of a GIS software package. The same software – the data base created for the first application included- can be used for other applications as well. As an example we can consider an application that can determine the wind speed in winter months. The same software package can be used to determine the "wind quantity" per year or the number of windy days in a given month.

GIS can not be rigorously framed in a certain category. Moreover, due to the growing number of applications of GIS technology in various fields can be found in the literature several attempts to classify geographic information systems, according to various criteria. We can consider that all these classifications are temporary and can be taken into account only from the documentary point of view.

A first way to classify the GIS applications can be realized according to the general purpose for which the system is created. The largest GIS application class consists of applications that had been created to fulfill a certain objective. This type of applications have a well defined purpose .The projects for which they had been created have a life period *a–priori* defined. As en example for this type of applications we can consider a feasibility study for a proper placement of a dam. These types of applications are called *project-based GIS applications.* On the other side we find the *institutional GIS applications*[2]. The period of use for these applications is not a-priori defined. They are used mostly as a way of data stocking and correlation, or for obtaining certain reports – with simple data, but for various topics.

Another classification we could make is that the GIS applications are separated into conventional and unconventional. What does a conventional GIS application mean? In order to define this concept we should take a look at the origins of the GIS technology. We should

than observe that this technology was invented and developed as an alternative to classic cartography, where a thematic map was a difficult task, especially if multiple different scale products were required. Taking into account this idea, we can consider that conventional GIS applications are the ones that have a strict and direct geographic relevance. (E.g. refers to flora, fauna). We could say that initially the GIS technology had been applied especially in areas related to land occupation and exploitation of soil and subsoil resources. The first large scale application recognized for its importance is the **C**anada **G**eographic **I**nformation **S**ystem – *CGIS*- developed by Roger Tomlinson to help him analyze and handle data collected by the **C**anada **L**and **I**nventory – *CLI*. On the other hand, we consider as unconventional GIS applications the ones that do not have a strict, direct and obvious geographic relevance. We can include here the latest GIS applications such as webgis. As the conventional GIS applications are obvious and easy to recognize, in the paper will be presented some unconventional GIS applications: medicine, crime analysis, archeology and renewable resources.

3. Unconventional GIS applications

The fact that the Geographic Information Systems is an interdisciplinary technology means that it can create a proper working space for many domains. Each of these domains has its own special techniques and methods for solving the problems. A GIS, or better said a GIS specialist, has to be able to use the keys that are already defined by the GIS software package, but also to add and mold the supplementary data, so that the requirements from the user to be accomplished. Most areas are direct applications of spatial references, but there are cases when the main pawns are other data already molded on these references.

Not accidentally I chose *medicine* as a prime example of unconventional GIS applications. Most of the literature point at John Snow's map as a first example of spatial analysis. It is interesting that this map was created in 1855, about one century before the begging of GIS. In 1855, Doctor John Snow had the brilliant idea of mapping the position of water pumps to determine the cause of cholera cases in Soho district, London. Even if the "bad air" was considered to be the cause, Snow analyzed the spatial distribution of cholera cases and water pumps and came to the conclusion that a certain pump from Broad Street was the problem. Closing the pump stopped the illnesses, thus demonstrating both that the conclusion of the geographic analysis was correct and that this sort of analysis is needed.

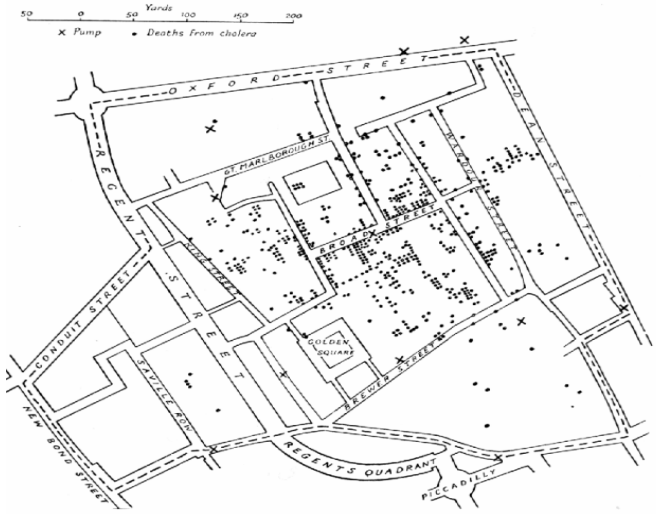

Fig. 2 Reconstruction of John Snow's map

The influence factors for health can be divided into four classes: inherited conditions, environment- with its two major aspects: physical and socio-economic, lifestyle and the care for ones health.

Each of these four factors have a specific geographical relevance determined by the common characteristics of both groups of individuals that inhabit a certain territory (traditions about diet, level of civilization and learning, genetic data, etc..) and specific characteristics of that territory (air quality, water quality, climate, vegetation, etc..). General technical principles and GIS applications dedicated to people's health have been extended and generalized to other organisms, and now they are used with great success in monitoring and analyzing the health of animals and plants.

The presence of GIS technologies in *archeology* was a huge step forward. Besides the specific spatial analysis functions and the ability to represent spatial data on different layers, the archeology GIS achieves superior possibilities for a detailed, complete and suggestive cartographic representation. A first way of using the GIS techniques in archeology is the *predictive modeling* based on regression statistics[3]. As a principle, this kind of application tries to establish causal relations between some environmental parameters, such as the relief, natural barriers against the attackers, the availability of water supplies or food supplies, and already known locations of archeological sites. Once such a model had been established, it can be applied for new territories, or better said territories that had not been tested yet, in order to detect possible new archeological sites.

In addition to predictive modeling one can find at least two more ways of using GIS in archeology. The most obvious application would be *the simulation* and representation of changes that occurred over time in the geographic configuration of human settlements and the related facilities, such as roads, housing and defense buildings. But one of the most interesting applications is the one that relates to an intra-site analysis, which refers to the establishment and representation of spatial relations- both on horizontal and vertical layers – between different artifacts found during excavations made at different periods of time.

Fig. 3 The MEGA – Jordan project – Large scale and intra-site analysis (Ajlun Castle)[9]

One of most eloquent example of archeological GIS is the **M**iddle **E**astern **G**eodatabase for **A**ntiquities – **Jordan**, also known as the MEGA- Jordan project, which tries to monitor all the archeological sites for different degrees of particularization. The project launched in 2010 succeeded in inventorying, monitoring and managing thousands of sites placed within the country's territory. In Fig. 3 are presented two degrees of particularization obtained using different MEGA-Jordan queries – sites from all over the country and an intra-site analysis.

Another example of unconventional GIS analysis is related to *crimes analysis*. This type of analysis is the systematic study of crime and antisocial acts in conjunction with socio-demographic, spatial and temporal facts, in order to help police officers to identify and capture criminals, reduce crime and antisocial facts, or to prevent and evaluate crime.

Crime analysis has three levels of development and the GIS technology is offering for each level the necessary applications. First we have the *tactic level* where the GIS application is supposed to provide information to the operational staff (police patrols, investigative officers) in their work for an immediate identification of the characteristics of the crime (trends, patterns, series, concentration) allowing the establishment of the main lines of investigation and resolution of cases. The *strategic level* is concerning long term aspects of different crime patterns – the predictive model. A strategic analysis includes editing statistical reports (including geographical or spatial disposition), establishing the necessary resources to combat crime, setting the allocation of those resources (spatial arrangement). The last level and the highest is the *administrative* one. At this point the GIS applications focus on giving proper information to the local administration regarding economic, social, and geographic data of the crime phenomenon.

The last example presented in this paper is one of the most common our days: GIS application for renewable resources. In developing systems for unconventional domains one must usually take into account both the digital terrain model, obtained from different data sources and data connected with the studied domain. Therefore, these types of systems can be classified according to the criteria presented above in geographical information systems.

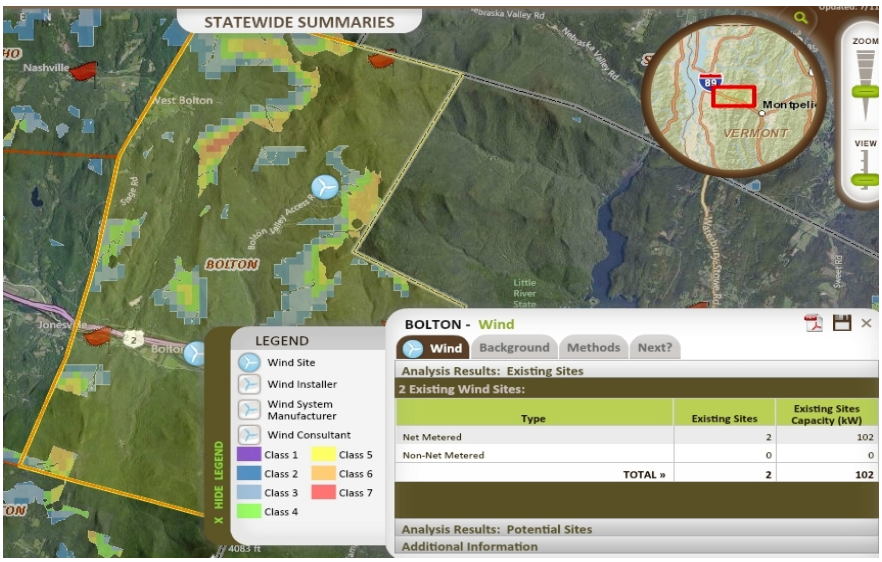

Fig. 4 GIS application for renewable resources[5]

In general, you can highlight several directions for use of GIS technologies related to renewable energy. Highlighting the potential of different areas for a certain renewable energy resource is a very important point. Alike the soil resources, the renewable resources have their

prolific and ungenerous areas; it is the prolific areas that we are looking for. A GIS renewable application also needs to be able to distribute reports on how much of a certain resource is used for a considered small or large territory, but also to offer technical specialized support for designing and exploitation of facilities for renewable sources. A proper example of an application of the GIS technology on renewable resources can be seen in Fig. 4.

Use of renewable energy is not a new idea, but one continuously developing. Geographic systems can be used to create an imperative link between two problems: ones related to the growing need for energy constrained by the diminishing reserves of fossil fuel, and others coming from the solution that the renewable(solar, wind, biomass) have to offer.

4. Conclusions

Rigorous classifications cannot be created when it comes to GIS applications. In this paper the author simply wanted to draw the attention on various possibilities that the GIS technology has to offer and not to enumerate – not that this thing is possible – all the unconventional GIS applications created so far by different specialists. However, must be taken into account that no matter if the studies are made on the natural elements or anthropic entities, the best way to analyze complex data remains the GIS technology. As Jack Dangermond said, "... *The application of GIS is limited only by the imagination of those who use it* ...".

5. References

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