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ROMANIAN ROAD NETWORK AND GIS, A NECESSITY TO ENGENDERING SUSTAINABLE DEVELOPEMENT

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Abstract: *Making decisions based on geography is basic to human thinking. Where shall we go, what will it be like, and what shall we do when we get there are applied to the simple event of going to the store or to the major event of launching a bathysphere into the ocean's depths. By understanding geography and people's relationship to location, we can make informed decisions about the way we live on our planet. A geographic information system (GIS) is a technological tool for comprehending geography and making intelligent decisions. In recent years, Geographic Information Systems (GIS) and spatial database technology are fast spreading across the tight circles of experts, working in the fields of geodesy and geography. In the first wave, GIS functions have been built into engineering applications, which were not just GIS cantered (as for example road design, emission calculation, building site-plan, environmental management etc.). The use has been accelerated through the component technology, which simplifies the insertion of GIS components into a variety of applications-including administration. We describe the need of creating and upgrading of the information system for Romanian road administration: basic application user interfaces were enriched with a specialized GIS component, which enables a fast and clear (geo) graphical view of the data about the selected part of the road network. Sustainable development is the balance of meeting humankind's present needs while protecting the environment to ensure the fulfi llment of future generations' needs. The growing human population and its demands on the earth's resources generate a need for sustainable practices. Implementing these practices often requires collaboration between different organizations. ESRI's commitment to developing interoperable technology sets the stage for cooperation between organizations so that they can make well-informed decisions. GIS software allows users across the globe to share ideas on how to meet their resource needs, plan efficient land use, and protect the environment to guarantee the survival of future generations.*

Key words**:** *GIS, Sustainable Development, Road Network, Urbanization, Digital map.*

INTRODUCTION

In recent years, Geographic Information Systems (GIS) and spatial database technology are fast spreading across the tight circles of experts, working in the fields of geodesy and geography. In the first wave, GIS functions have been built into engineering applications, which were not just GIS cantered (as for example road design, emission calculation, building site-plan, environmental management etc.). The use has been accelerated through the component technology, which simplifies the insertion of GIS components into a variety of applications-including administration. We describe the need of creating and upgrading of the information system for Romanian road administration: basic application user interfaces were enriched with a specialized GIS component, which enables a fast and clear (geo) graphical view of the data about the selected part of the road network. The simplicity of using this intelligent digital map (as we named this specialized component) makes it possible to effectively and clearly display the relevant information, which is so necessary in the process of decision making.

The 21th century is related to the phenomenon of rapid urbanisation. By 1900 13% of the world's population was urban. During the next years, improvements in medicine and science allowed higher city densities. According to UN reports, the urban population increased from 220 million in 1900 to 732 million in 1950 (29% of the world's population). By 2007 50% of the world populations were living in cities (Figure 1).

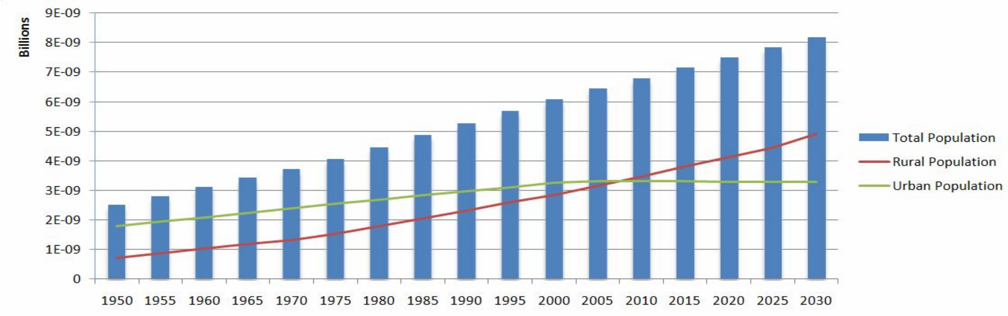

Figure 1: The urban and rural population of the world. (Source: UN Population Division)

According to latest predictions, 4.9 billion people, or 60% of the world's population, are expected to be urban dwellers by 2030 (Table 1). Investigations show significant differences in urban population change between the more developed regions and the less developed regions.

Traffic and road models demand large amounts of data - some of which are: traffic network topology, traffic network data, zone-data and trip matrices, etc. GIS is a natural tool for handling most of these data as it can ease the work process and improve the quality control.

If we are asking what is a GIS maybe the answer can be this: A Geographic Information System, or GIS, is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information. Or, in simple terms: A computer system capable of holding and using data describing places on the earth's surface.

Many computer programs, such as spreadsheets, statistics packages or drafting packages can handle simple geographic or spatial data, but this does not necessarily make them a GIS.

In short, a GIS doesn't hold maps or pictures - it holds a database. The database concept is central to a GIS and is the main difference between a GIS and drafting or computer mapping systems, which can only produce a good graphic output. All contemporary geographic information systems incorporate a database management system.

A GIS gives you the ability to associate information with a feature on a map and to create new relationships that can determine the suitability of various sites for development, evaluate environmental impact, identify the best location for a new facility, and so on.

If we are specking about GIS components, a GIS is a very powerful tool that can be used to capture, store and analyze geographic data but it is not, by any means, a stand-alone system. You need several other very important components to design and project a GIS: People, Hardware, Software, Data.

The heart of any GIS is the database through which questions such as what a feature is, where it is, and how it relates to other features can be answered. The Volusia County digital map library is designed to allow any user on the GIS network to view county wide geographic data from a common source. The map library also provides an efficient and secure means of maintaining the database.

MATERIAL AND METHODS

Data representation is a core research topic of GIS. Before a GIS can be used to tackle real world problems, data must be properly represented in a digital computing environment. One unique characteristic of GIS is the capability of integrating spatial and non-spatial data in order to support both display and analysis needs. There have been various data models developed for GIS.

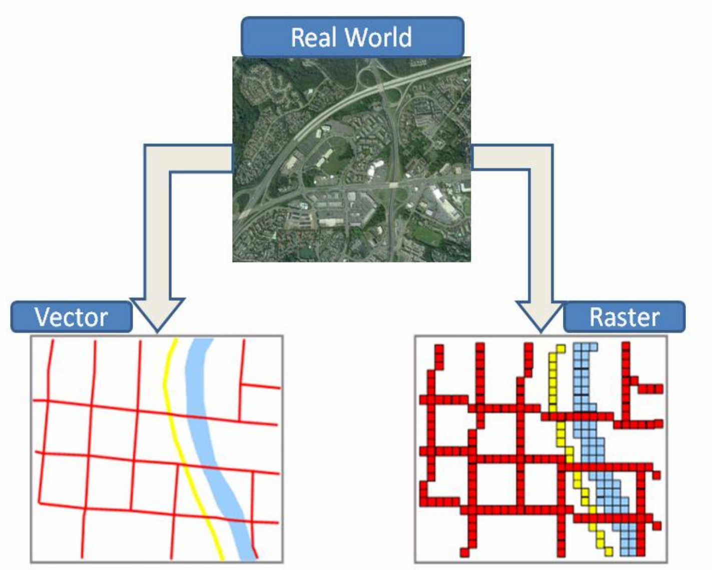

Figure 2. GIS Data Models

Taking account of the principles of sustainable development therefore involves the early stages of project and a broad approach in which transport is neither dissociated from the regions it passes through, serves and structures, nor the population it affects whether users or residents, nor the public bodies which finance it.

Traffic and road models demand large amounts of data - some of which are: traffic network topology, traffic network data, zone-data and trip matrices, etc. GIS is a natural tool for handling most of these data as it can ease the work process and improve the quality control.

Concluding, Geographic Information System (GIS) is an information system specializing in the input, management, analysis and reporting of geographical (spatially related) information. Among the wide range of potential applications GIS can be use for, transportation issues have received a lot of attention (figure 3).

The four major components of a GIS according figure 1 are encoding, management, analysis and reporting, have specific considerations for transportation:

- Encoding. Deals with issues concerning the representation of a transport system and its spatial components. To be of use in a GIS, a transport network must be correctly encoded, implying a functional topology composed of nodes and links. Other elements relevant to transportation, namely qualitative and quantitative data, must also be encoded and associated with their respective spatial elements. For instance, an encoded road segment can have data related to its width, number of lanes, direction, peak hour traffic, etc.

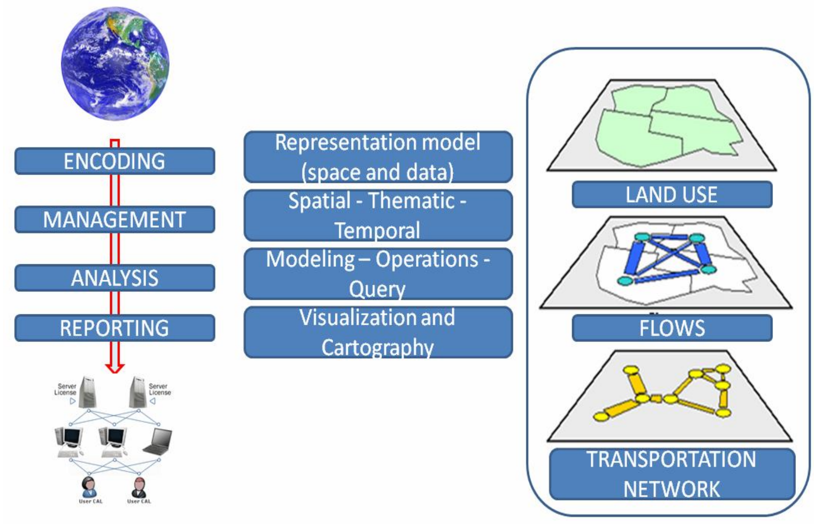

Figure 3: The four major components and layers of a GIS

- Management. The encoded information often is stored in a database and can be organized along spatial (by region, country, census units, etc.), thematic (for highway, transit, railway, terminals, etc.) or temporal (by year, month, week, etc.) considerations. It is important to design a GIS database that organizes a large amount of heterogeneous data in an integrated and seamless environment such that the data can be easily accessed to support various transportation application needs.
- Analysis. Considers the wide array of tools and methodologies available for transport issues. They can range from a simple query over an element of a transport system (what is the peak hour traffic of a road segment?) to a complex model investigating the relationships between its elements (if a new road segment was added, what would be the impacts on traffic and future land use developments?).
- Reporting. A GIS would not be complete without all its visualization and data reporting capabilities for both spatial and non-spatial data. This component is particularly important as it offers interactive tools to convey complex information in a map format.

A GIS-T (GIS for Transportation) thus becomes a useful tool to inform people who otherwise may not be able to visualize the hidden patterns and relationships embedded in the datasets (potential relationships among traffic accidents, highway geometry, pavement condition, and terrain).

The great appeal of GIS stems from their ability to integrate great quantities of information about the environment and to provide a powerful repertoire of analytical tools to explore this data. The example above displayed only a few map layers pertaining to urban transportation planning. The layers included would be very different if the application involved modeling the habitat of an endangered species or the environmental consequences of leakage from a hazardous materials site.

RESULTS AND DISCUSSIONS

GIS-T applications have benefited from many of the standard GIS functions (query, geocoding, buffer, overlay, etc.) to support data management, analysis, and visualization needs. Like many other fields, transportation has developed its own unique analysis methods and models. Examples include shortest path and routing algorithms (e.g. traveling salesman problems, vehicle routing problem), spatial interaction models (e.g. gravity model), network flow problems (e.g. minimum cost flow problem, maximum flow problem, network flow equilibrium models), facility location problems (e.g. p-median problem, set covering problem, maximal covering problem, p-centers problem), travel demand models (e.g. the four-step trip generation, trip distribution, modal split, and traffic assignment models), and land use-transportation interaction models.

While the basic transportation analysis procedures can be found in most commercial GIS software, other transportation analysis procedures and models (e.g. facility location problems) are available only selectively in some commercial software packages. Fortunately, the component GIS design approach adopted by GIS software companies provides a better environment for experienced GIS-T users to develop their own custom analysis procedures and models.

It is essential for both GIS-T practitioners and researchers to have a thorough understanding of transportation analysis methods and models. For GIS-T practitioners, such knowledge can help them evaluate different GIS software products and choose the one that best meets their needs. It also can help them select appropriate analysis functions available in a GIS package and properly interpret the analysis results. GIS-T researchers, on the other hand, can apply their knowledge to help improve the design and analysis capabilities of GIS-T.

One exemple of a functionaly GIS data base is Timisoara City GIS (figure 4).

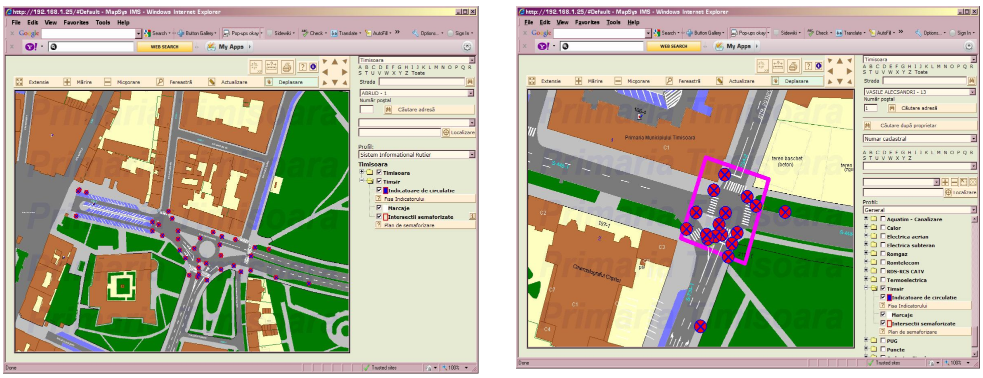

Figure 4: Interrogated model of Timisoara road networks

CONCLUSIONS

The paper presents a method based on Geographical Information System (GIS) maps in making an efficient location service and routing protocols for in-road information networks. The main goal of this network is to transfer traffic data and improve the safety of the road transportation.

Implementing a collaborative system like the one described above offers advantages at multiple levels. For individuals it offers a faster and cheaper transit solution without the hassles connected to complicated maps and diagrams. For public man-agers, the system will offer a reduction in car traffic as well as a reduction in the costs associated with road maintenance, allowing easier implementation and more flexibility in terms of varying public policies in the field of transport.

GIS-T is interdisciplinary in nature and has many possible applications. Transportation geographers, who have appropriate backgrounds in both geography and transportation, are well positioned to pursue GIS-T studies.

It is clear that GIS can be used for a wide range of applications in the transportation sector. Merging GIS with telematics seems to open up a whole new array of possible real-time applications in the transportation sector.

What all these applications have in common is that GIS plays a major part, providing the spatial reference, but can the system still be called a GIS application? It may be argued that this system is no longer GIS, but a technology that dissolves GIS into something new. This is probably the largest potential for the future of GIS in transportation: GIS will no longer be a stand-alone product, but fully integrated with other business information systems.

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