CREATION OF THE ROADS NETWORK AS A NETWORK DATASET WITHIN A GEODATABASE

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ABSTRACT:
For the spatial information regarding the Baciu commune a geodatabase was created. For the road network abstraction, the data together with processes, phenomena, failures and complex problems, should be modeled, in order that it has to behave as close as possible to the real one.
The modeling of the road network was realized using a **Network Dataset** structure in **ArcGIS 9.2.** This represents **a model**, which can be: stored, accessed, modified, updated, analyzed and visualized. It uses network attributes: costs, descriptions, restrictions, hierarchies. Such structured information can then be also used in other works or studies.

Keywords: *roads network, Network Datatset, model, Geodatabase.*

1. INTRODUCTION

Today, at communal level, the mayor is the entitled person who assures the management of the activities related to the existence and sustainable development of the community, the management of human and material resources of that territory. These last decades, the complexity of activities related to the management of a commune and of the environment in which these operate has increased significantly. Among the major causes that led to this increase in complexity we mention: the large number of possible solutions, the difficulty to obtain relevant results due to increased uncertainty, the disastrous effects that may arise or the chain reactions that they can initiate.

The commune's manager is the elect of the respective community. On his intellectual and mental qualities, his physical aptitudes, his cultural and educational universe depend: the development, stagnation or decline of the locality during his mandate. The Romanian saying „man sanctifies the place" substantiates in a few words the importance of the locality city manager.

In order to manage a commune, one needs to know the existent situation, i.e. the stage of commune's development with all complex issues related to it.

Spatial data are organized in structures or models, for their easier management, processing and analysis in order to obtain the information. Thus it was necessary to integrate all the information related to a commune in a digital collection of data, which can be spatial located in the territory and which should be easy accessed and in real time with computer. This performance can be achieved through geodatabase structures operated with geographic informational systems.

According to *Johannesson and Wohed* (*1999*) the advantages of using this type of geographic data bases are:

- The existence of instruments by which rules can be specified and the creation of specialized data sets which simulate the behavior of geographic entities,

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- Structuring, allows the establishing of relations between explicit and maintained data sets,
- Assessment of rules to ensure data integrity,
- The more efficient and consistent management of the relations between datasets.

Starting with the end products that we want to obtain, the structure of database is conceived with minimum attributes which can be introduced, and the types of relationships that may exist between them are outlined.

Based on our study, we believe that this database could be implemented together with the GIS integrated system in the commune's city hall to be used in current activity. GIS allows the representation of data as a unique data model, according to *Mureşan, Tirt and Haidu* (*2006*).

2. CASE STUDY

The first step to achieve efficient management of the commune is to elaborate the General Urban Plan in GIS format. In 2008 this plan was revised for the Baciu commune by the S.C. INFORM NET S.R.L. company. In present, the Local Council is concerned with obtaining the expert approvals in order that the documentation can take effect.

A geodatabase was realized, named **Baciu.gdb** that stores all the information needed for the study, related to the commune, and includes the feature sets and classes given in **Fig. 1**. This data model allows competitive access and editing by several users.

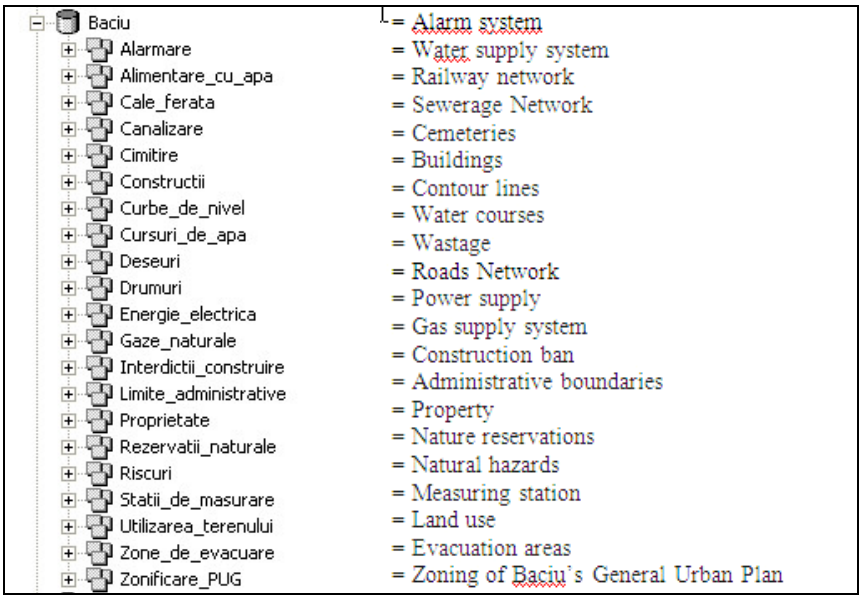

Fig. 1 Structure of the database Baciu.gdb.

A priority area for action and intervention in the management of a commune is that referring to the road network, which can be compared with the human circulatory system For its abstraction, the data together with processes, phenomena, failures and complex problems, should be modeled, in order that it has to behave as close as possible to the real one.

Thus reveals the necessity to interconnect the arcs representing the road network segments into a graph. The abstraction was achieved as a system with interconnected elements: lines and points. These have additional properties that control navigation.

The connectivity of the component elements is of high importance for the movement in the network. Transport networks are not directed, i.e. an arc can be traveled in both directions, and therefore they can be modeled using the **Network Datasets** structure from **ArcGis 9.2.** "To maximize database integrity, a GIS often requires **planar embedding** of the node-arc network" (*Miller and Shaw, 2001*).

A data structure implies the existence of a systematic method to store information in a computer, so that they can be used and managed effectively. Often a good data structure allows also the implementation of an efficient algorithm. There are types of data structures which are specialized to carry out certain tasks, and are used to execute certain applications in informatics.

A Network Dataset is made of feature classes that are interconnected in a source network, has connection rules and associated attributes. In the database Baciu.gdb we implemented the feature dataset Drumuri, and within it we stored the feature class Drumuri_ortofoto.

The existing roads of Baciu commune were digitized on the 1:25,000 topographic maps, and actualized according with digital orthophotos. For each road arc, the following attributes were introduced:

- **Meters**, representing the length in meters,
- **Viteza**, where we stored the average traffic speed on that road section, measured in meters/second,
- **FT Minutes,** the time duration needed to travel the arc from the start node unto the end node, measured in minutes,
- **TF Minutes,** the time duration needed to travel the arc from the end node unto the start node of the arc, measured in minutes,
- **Oneway,** representing the possible directions to travel an arc,
- **Hierarchy** which classifies roads in 3 classes.

The average speed of movement was determined taking into account the state of panic, people's agitation, traffic jams that may occur and the type of road: 40 km/h on national roads, 30 km/h on county roads, 20 km/h roads on communal roads, and 3 km/h for other categories. For hierarchy, the following values were assigned: 1 for national or county road, 2 for communal roads, and 3 for other categories.

The roads network was created with the **ArcCatalog**. Within the dataset **Drumuri** in **Baciu.gdb**, from the vertical contextual menu the option **New Network Dataset** was selected. In the window was introduced the name of the feature set for the roads network **Retea_drumuri_Baciu**, and then was selected the feature class **Drumuri_ortofoto.shp**, which participates in the network. To select the connectivity rule, from the appropriate window, the option **End Point** was marked for **Group Columns** set on the value 1. The object class **Drumuri** has 4 subtypes: national roads, county roads, communal roads and other categories. The button **Subtypes** was accessed to introduce the settings. The arcs were connected from **Any Vertex** (**Fig. 2**) since in Romania a vehicle traveling on any type of road may change its direction at the intersection with another road, and not only at the ends of the road section.

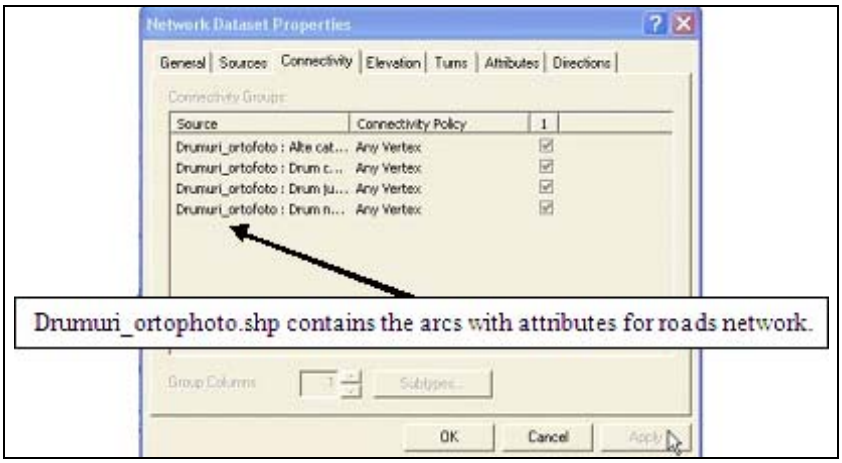

Fig. 2 Setting of connectivity for the roads network.

In the next windows **Yes** was selected, to model in the network the implicit returns of type **U-Turn**, that the system searches in the field **Oneway**. The Help in ArcGis informs us, that if **n** represents the number of arcs connected to a junction, $\mathbf{n^2}$ returns can take place. For the created dataset there are 3 network attributes which are added automatically: **Oneway, Minutes, Meters** (**Fig. 3**).

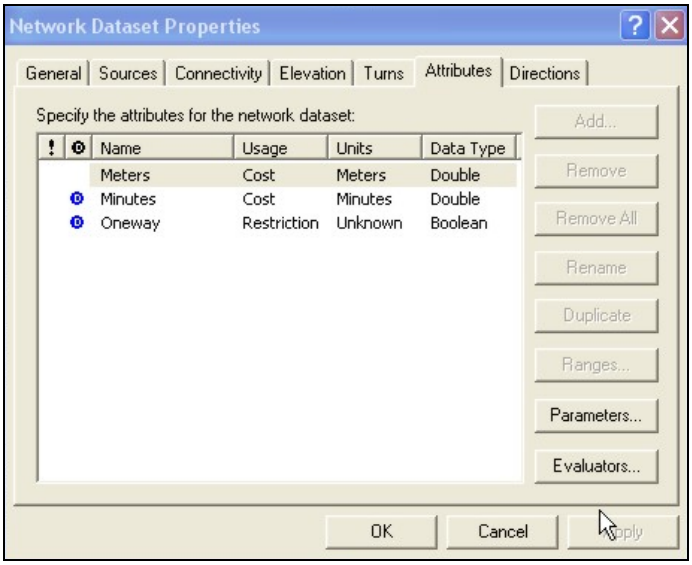

Fig. 3 The network attributes used.

The extension **Network Analyst** uses the Boolean type attribute **Oneway** (with values true or false) to model the restriction of movement on a segment. For this attribute the direction received by the arc at digitization is very important.

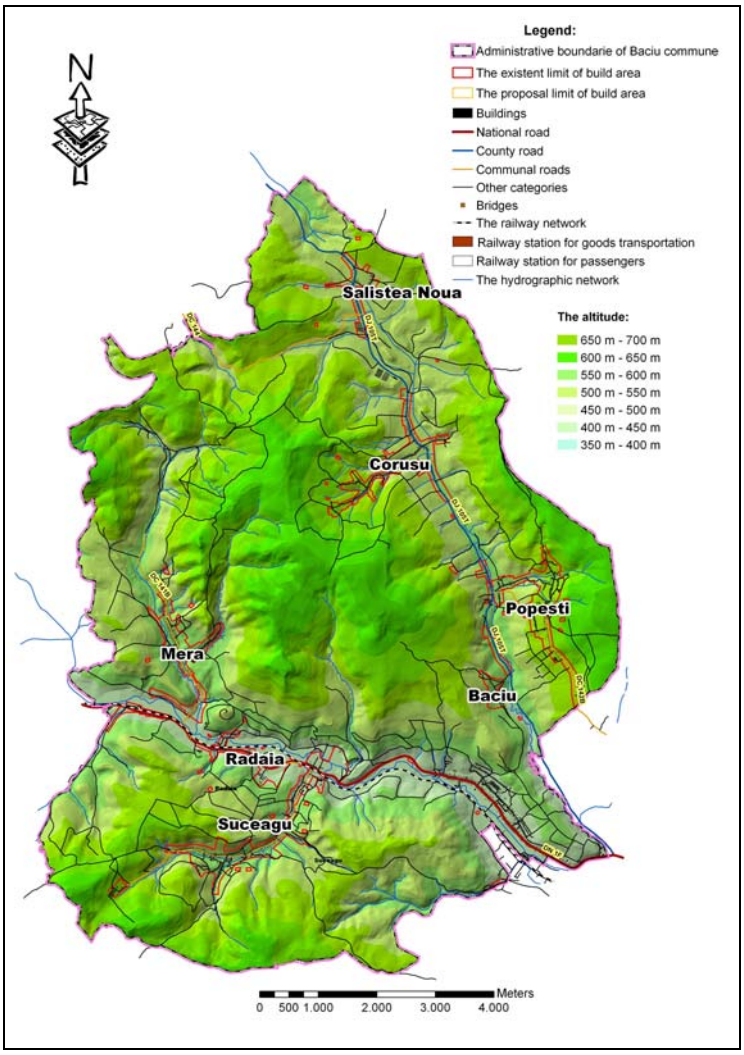

Fig. 4 The roads network of the Baciu commune.

The circulation restrictions can be added later, depending on road conditions at the time of analysis and the set of problems proposed for analysis.

„The **Network Analyst** inspects automatically all sources and tries to assign automatically values for these three attributes" (*Sandhu, Chandrasekhart, 2006*). In the following, the button **Evaluators** was selected, to check if the system identified three attributes of the layer.

After creating or editing a Network Dataset, it must be built, generated. After generation, two new objects were added to the feature dataset **Drumuri**: the created **Network Dataset** and the feature class **Retea_drumuri_Baciu_Junctions**, containing all the junctions of the network created during the building / generation process.

In **Fig. 4** is presented the roads network obtained for the commune Baciu. The total length of road network resulted for the Baciu commune is 642.9 km of which: 33.9 km of

national roads, 41.7 km of county roads, 195.7 km of communal roads and 371.6 km of unpaved roads (earth or dirt roads). Within the limits of the localities built areas are 481.2 km of roads of which in Baciu are situated 51.5 km, 164.6 km in Suceagu, 12.5 km in Rădaia, 168.1 km in Mera, 26.1 km in Popeşti, 46.2 km in Coruşu and 12.8 km in Saliştea Nouă. After the performed analysis resulted the following information: total length of national, county and communal roads is 282.2 km on which the Baciu locality has 25.2 km, Rădaia has 80.4 km, Mera has 4.1 km, Suceagu has 108 km, Popeşti has 33.9 km, Coruşu has 25.5 km and Săliştea Nouă has 5.1 km. Only four localities: Baciu, Suceagu, Rădaia and Mera are situated on national road.

3. CONCLUSIONS

Managing information related to road network, those responsible for commune's management can know the exact situation in the field and can take relevant decisions in this field. Using the geographic information system **ArcGis 9.2.** and the extension **Network Analyst** a modeling of the roads network related to a commune and the appropriate management of data stored in a geodatabase can be performed with medium knowledge in G.I.S.;

1. Road network can be integrated into modal transport model, with layers that are: the rail network, stations and bridges. The structure of data presents the portability benefits, unitary management of information, elimination of redundancies, access based on rights and competences, fast processing, creating history and archives in the form of files easy to use and store.

2. The road network abstracted this way can be used to solve various problems proposed regarding: the state of viability, repair management, establishment of traffic restrictions, optimal transport routes, expropriations, development needs, pollution, the according of transport licenses for private companies to achieve public transportation etc.

3. Some of the previous enumerated data and analysis are needed as well in regular elaborating from 10 to 10 years of the General Urban Plan and in other financial development plans regarding a commune in her time evolution. The history and versioning of database and of the applications ensures the assignment of the fourth dimension to spatial reference data, making possible to obtain the time evolution of the roads network.

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