THE USE OF THE NETWORK ANALYST EXTENSION FOR THE ORGANIZATION AND OPTIMIZATION OF TRANSPORT IN ROMAN MUNICIPALITY

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***Abstract**: This paper aims to develop a GIS analysis to simulate public transportation in Roman Municipality. For this purpose, five routes, with minibuses as means of transportation, have been defined. Shared transport was analysed using the attributes inserted in the database and with the ArcMap Network Analyst extension.*
Using ArcGIS Network Analyst, we can identify the area of influence of an economic objective on any location on the map representing the network. The Neighbourhood Determination Function allows establishing the minimum distance between a point on the network and the closest socio-economic objective, by specifying the number of goals to be taken into account and the maximum time spent on the movement. The functions of determining the directions of travel (Driving Directions Function) generate text and map reports, while routing determining functions allow generating routes with specific attributes (time, distance, restrictions and barriers - natural or anthropic) between two or more points, with one or more stops along it and determines the optimum route by ordering points on a track to minimize the costs. GIS modelling is done using the procedures contained in the spatial analysis, which ultimately leads to a decision-making prediction. The operations involved in the modelling can be performed directly on the map layers and in combination with the associated attributes

***Keywords:** Network Analyst, GIS, ArcMap*

1. Introduction

The Roman Municipality in Neamț County, Romania was chosen as the study area. It was chosen because of the many problems and delays of the public transport system.

The town is located at 46°55'48" latitude N, 26°55'48" E in the center of the historical region Moldova, in the Roman depression, to the north of the confluence of Moldova River and Siret River, and is at a distance of 82 kilometers from Iasi, the former capital of Moldova. The city is crossed by the national road DN2 (part of the European road E85, which connects it to north of Suceava city and to south of Bacău, Focsani, Buzău and Bucharest cities. At Roman Municipality, this road intersects with the national road DN15D which connects it westwards to Piatra Neamt and eastwards to Vaslui. (Fig. 1)

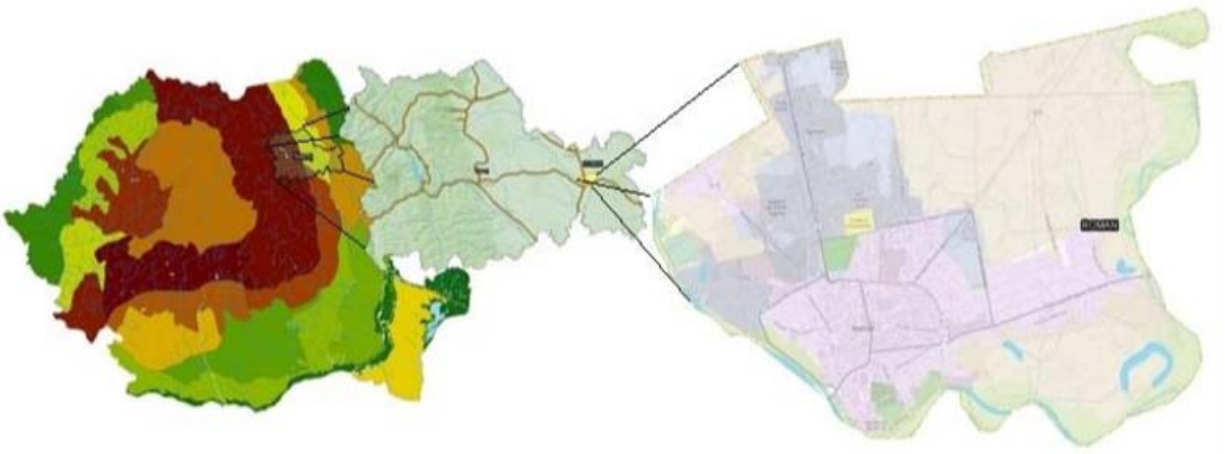

Fig. 1. Positioning of the Roman Municipality

2. Materials and methods

In order to model the possible route of means of transportation, which hypothetically had to pass through all points, on all categories of roads included in the network, from the Network Analyst menu of the list that appeared, the New Route command was selected. The result of this command is the display of a list of items within the themes represented on the map. It has been specified: - on-grid stops - off-grid stops - errors - exceeding the time allocated for transport (if applicable) - barriers - errors - barriers - located on the route of the network - barriers - located outside the route - the final proposed route. (Fig. 2)

Fig. 2. Road network for Roman Municipality

To develop a tool that is generic and transferable, able to accept standard GIS input in the form of spatial data, at any given scale, and perform the generalized cost computation to produce a set of accessibility measures. (Fig.3)

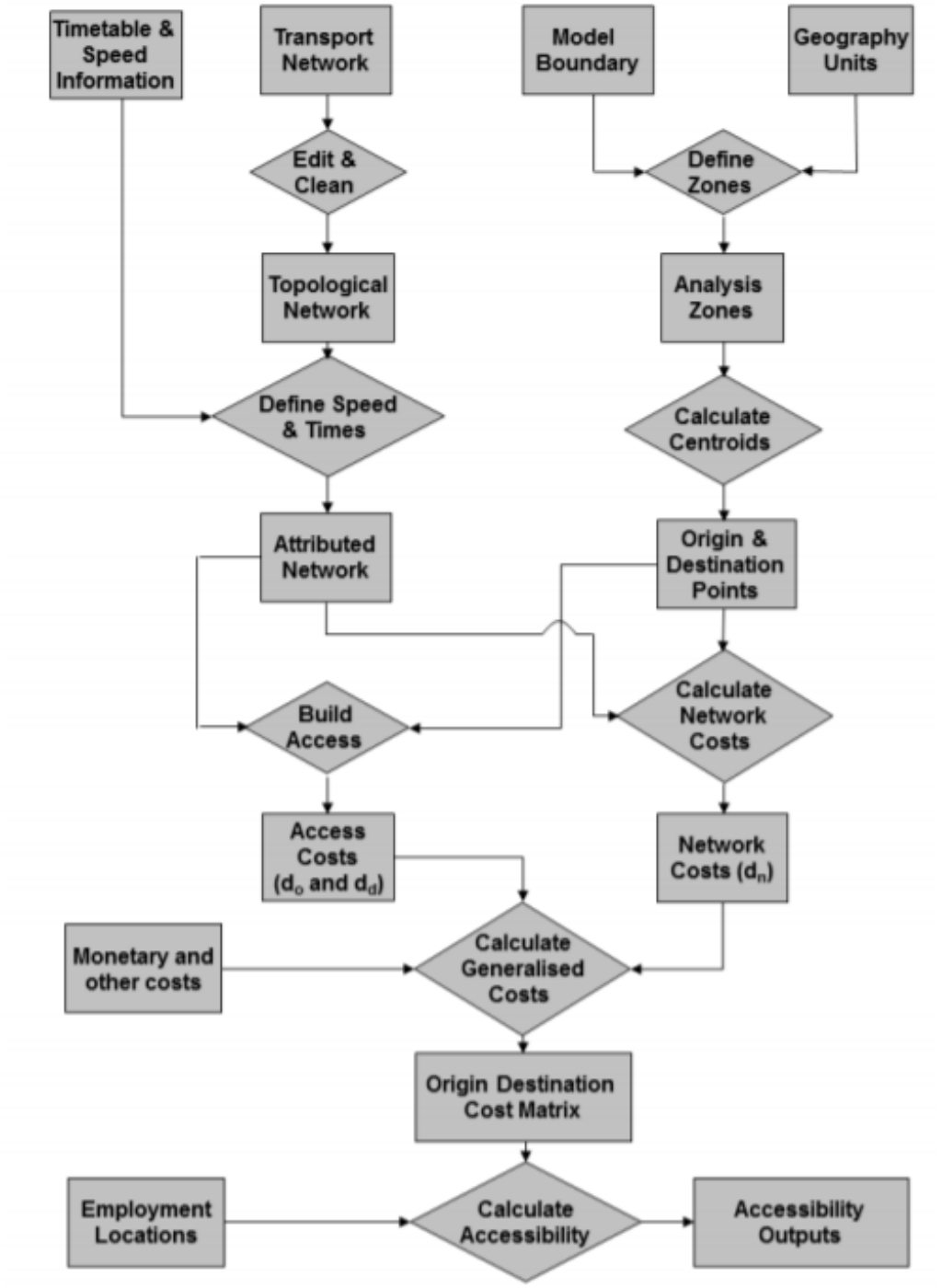

Fig. 3. Computation framework for matrices of generalized cost, and thus accessibility measures.

The design of the database is divided into: conceptual, logical and physical design.

- Five routes have been defined.
- These routes have minibuses as means of transportation

This kind of system is very important because it facilitates the decision-making process and has a high social impact. Among the most demanded features in GIS we can mention those related to the analysis of routes, some examples are as follows:

- What is the shortest path between places *x* and *y*? (Fig 4)
- What is the optimal path between places *x* and *y* considering a certain criterion? (Fig.5,6)
- What is the lowest cost path between *x* and *y* via places $x_1, x_2, \ldots, x_n$?

The basic steps of this classic algorithm are as follows:

- all nodes are initialized so that d (t) = ∞ (infinite or in practice, a very high value) and d (s) = 0;
- for each edge leading from s, the edge length from s to the current path length value at s is added. If this new distance is less than the current value for d (t), it is replaced with the lower value
- the smallest value in the set d (t) is chosen and the current (active) node is moved to this location;
- step 2 and 3 iterate until the target node is reached, or all nodes are scanned.

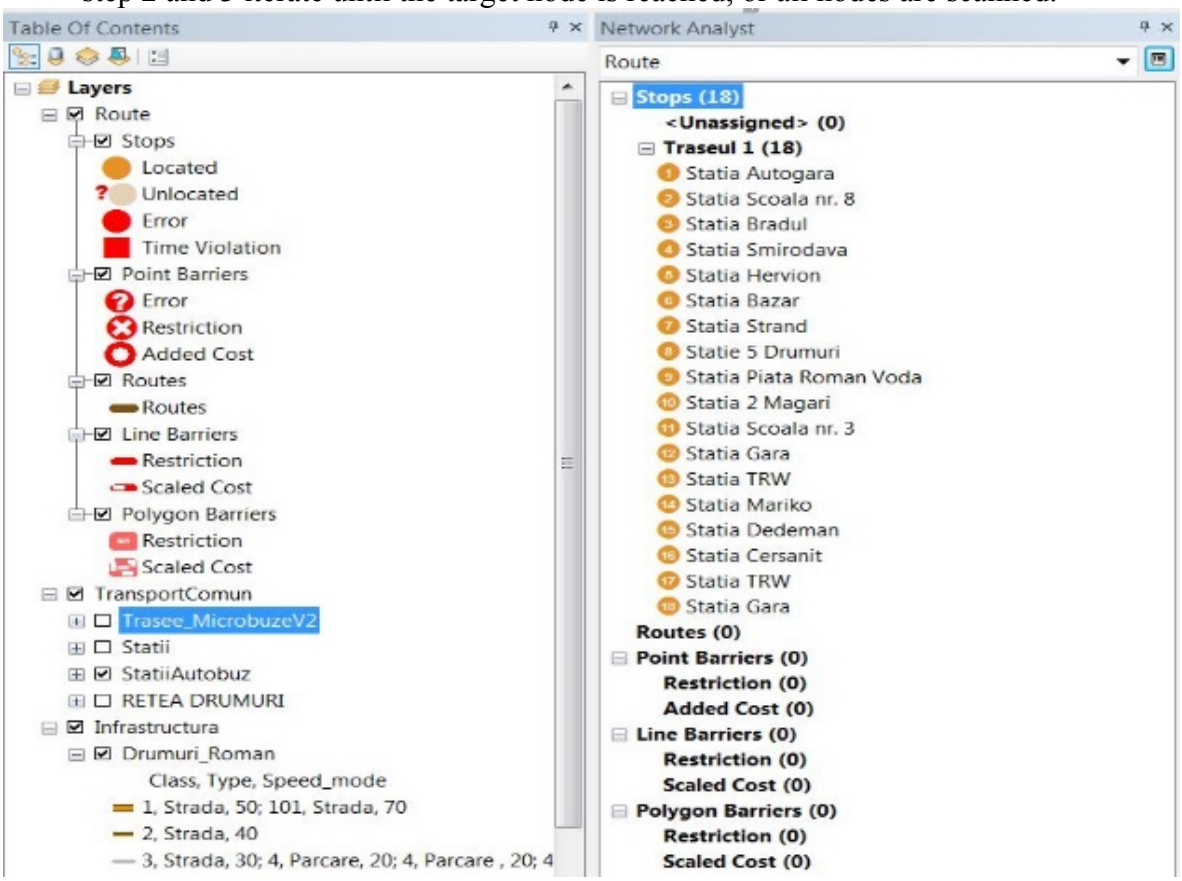

Fig. 4. The analyse layer „Route"

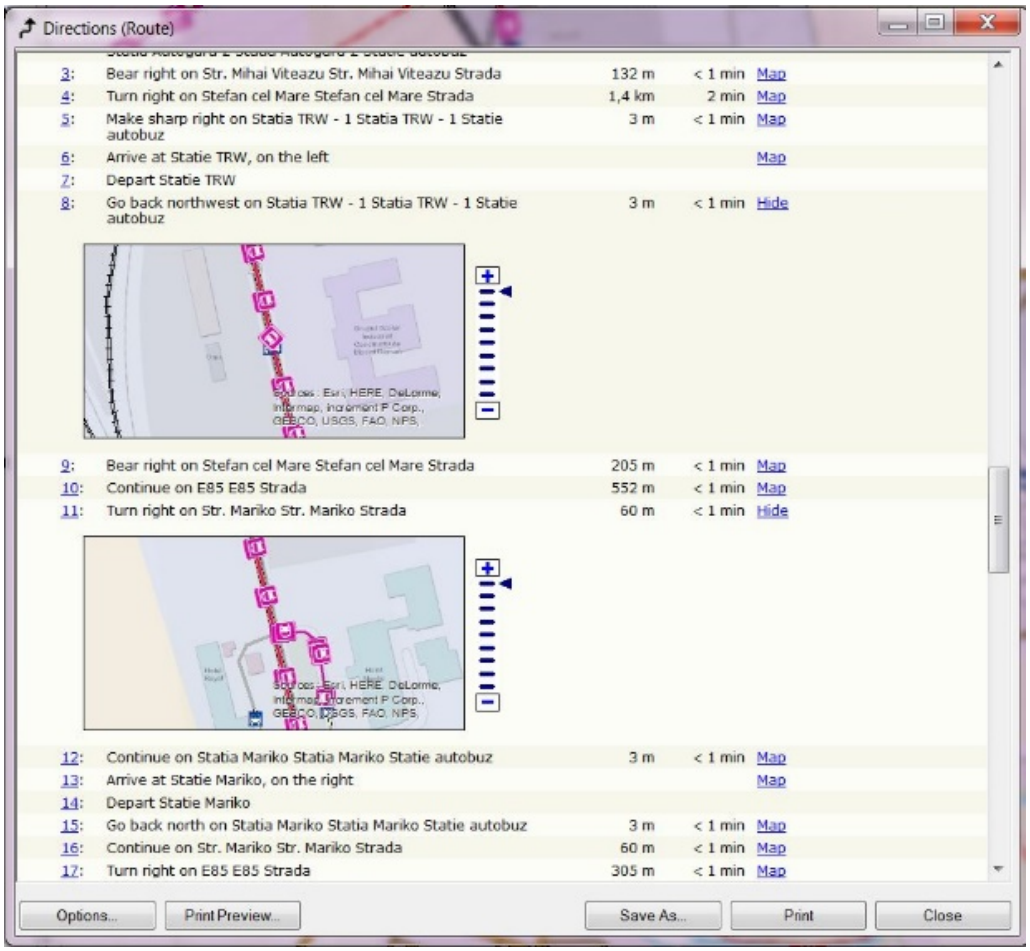

Fig. 5. Itinerary of the route

Name	FirstStopID	LastStopID	Numar_Statii	Total_Minutes	Total_Length	StartTime	EndTime
Traseul 1	195	212	18	26,01432961	14770,38862	2017-08-07 8:00	2017-08-07 8:26
Traseul 2	213	226	14	24,73591303	14075,19033	2017-08-07 8:00	2017-08-07 8:24
Traseul 3	227	240	14	21,04221248	11146,51715	2017-08-07 8:00	2017-08-07 8:21
Traseul 4	241	256	16	25,88269623	16608,55292	2017-08-07 8:00	2017-08-07 8:25
Traseul 5	257	269	13	20,41865975	11828,14496	2017-08-07 8:00	2017-08-07 8:20

Fig. 6. The results of transportations analysis

3. Conclusions

The analysis of road networks is complex and the more variables are taken into account, the harder the problem is to solve. It has been shown that for Roman Municipality, with the help of the algorithms that are implemented in the "Route" analysis, the problem of public transport can be solved. Time framed results obtained on each route can be printed and displayed in each station for the information of citizens that use the means of transportation. Moreover, this information can be implemented in an android application using the Java programming language.

Analysis with the Network Analyst extension is an efficient one, thus proven in the business environment, where distribution is well systemized and transport routes are efficiently chosen for each contracted shop. Similarly, the analysis can be done in countless ways, the difference being made by the data set and the proposed variables.

4. References

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