Use of Geographic information systems in analysis of telecommunication market

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***Abstract*—The paper presents utilization of the Geographic information systems (GIS) as a tool for analyzing the telecommunication market. The location of points of sale of different telecommunication operators is in focus of research. Visualization which is attainable through the application of GIS gives results that can be used to create better distribution of points of sale for mobile operators.**

I. INTRODUCTION

The main goal of the paper is to find how the geographic information systems could be used in analysis of telecommunication market. The specific goal is to find how the GIS could be used for efficient location of points of sale for mobile operators. Task of the paper is to animalize overlapping of zones around points of sale of two mobile operators in Novi Sad by using GIS as software application for visualization. The result of analysis will give some recommendations for the relocation of points of sale which could give better economical effects and principles of future locations of new points of sale. Conclusion is that GIS can be powerful support for visualization and decision making about market configuration, simple and fast.

II. LITERATURE OVERVIEW

The geographic information systems are family of software for visualization of geo referenced data. They could be used for different analysis which offers visualized solutions. Geographic referenced data which are visualized are more acceptable for human use. Geographic location is the element that distinguishes geographic information from all other types of information. Without location, data are termed to be non-spatial and would have little value within a GIS. Location is, thus, the basis for many benefits of GIS: the ability to map, the ability to measure distances and the ability to tie different kinds of information together because they refer to the same place.

The paper [1] communicates the richness and diversity of GIS in an accessible format. It reinforces the view of GIS as a gateway to science and problem solving. Reference [4] gives a contextualized professional development approach for geographic information technologies as a project-based science.

Innovative approach for analysis by using GIS is described in articles of reference [5].

Geographic information systems (GIS) are presented and explained as decision support in the papers referred in [7, 8].

Mobil operators are drivers of big income for telecomm companies. Reference [2] is making analysis of their income drivers and is discussing many tools and market possibilities of GIS as a useful software to reach valuable decisions.

There are many telecommunication operators' challenges and roles. Authors in reference [3] are creating some sceneries for perspective of mobile commerce value chain by using information technologies but without visualization of results.

Some European economists are giving a good presentation of competition in two sided markets of two groups of operators as referred in [6].

III. GEOGRAPHIC INFORMATION SYSTEMS

Due to the increasing development of science and technology and development of human society, the importance of information becomes larger and extends from the information about idea to the information that can cause change of the space that is surrounding us. More and more, information is deeply connected to the location within the space. Therefore, there are developed different survey methods to collect spatial data, and the different ways of collecting, storing and sorting them, and better analyzing according to various criteria. The base is visualization which people are familiar with and which offers fast recognition of the situation or problem and easier solving them and visual presentation of the solution.

The spatial data describe the location, shape and orientation of objects in space. They are known as geospatial data. Geospatial data can describe the characteristics of many different types of objects on the surface. These objects can be tangible, physical things such as an office building, landscape or abstract forms such as the imaginary line that marks the political

boundary between the states.

From the moment when first started collecting spatial data and displaying them on maps, there is a tendency for them to be systematized and made available. Over a long historical period, the most effective way to display spatial information was analogous to the map. Map was the forerunner of the original spatial database, the original spatial information systems, and in some ways a forerunner of spatial data infrastructure. Map is important to display the spatial distribution, connectivity and interaction of objects and phenomena, as well as qualitative and quantitative alteration of the condition over time.

Technologies of GIS are the "main culprit" for the change. Geographic information integrated into other products and software applications have become mass-market product. Forerunner of spatial data infrastructure in today's terms it is probably the concept of integrated mapping of different thematic layers of data from the sixties. Thanks to information and communication technologies, conventional way of presenting information about the space is the past. Today, spatial data is usually collected, stored, processed, analyzed and presented in digital form through a number of applications. Spatial data types provide fundamental abstraction mechanisms for modeling the geometric structures of spatial data, their attributes, operations on them, and the relations between them.

"A GIS is a collection of software that allows you to create, query and analyze geospatial data. Geospatial data refers to information about the geographic location of an entity. This often involves the use of a geographic coordinate, like a latitude or longitude value. Spatial data is another commonly used term, as are: geographic data, GIS data, map data, location data, coordinate data and spatial geometry data." [9] .

GIS is a system for managing spatial data and their associated properties. In the strictest sense, it is a computer system capable of integrating, storing, editing, analyzing and displaying geographic information. In a broader sense, GIS is a "smart card" that gives users the ability to set interactive queries (user created surveys), analyze spatial information, and edit data. The technology of geographic information systems can be used for scientific investigations, resource management, property management, development planning, regional planning, mapping and infrastructure planning. GIS is often used for the purposes of market research, then in geology, civil engineering, but also in all areas that use data related to the map.

A. Work in GIS

Spatial data on artificial and natural objects are subject of GIS presentation and analyzing. These are, for example, infrastructure facilities, housing, sports and other buildings, woods areas, river flows, land use, elevation terrain data, geological data, traffic lines, political borders etc. They are called features in GIS. Each feature has its attributes. If feature is a mobile telecomm operator in Serbia, than the attributes could be: number of users per towns, number of different services per area, income per town, mobility of users per area ...

GIS data must be georeferenced and presented within spatial areas.

Spatial maps can be configured in the form of:

- Grid or raster and
- Vector.

Grid is consisting of rows and columns of cells, called pixels, where each cell has a single, particular, digital value. In the case of images, the numerical value represents the number of colors (colors are coded with numbers). The pixel value can not only present the color but also can represent the spatial data. For example, in some areas there have been excesses in the form of emission of toxic gases. Raster that shows the amount of pollution, consisting of pixels whose numerical values carry spatial information on the concentration of toxic substances in the air in each fraction of the space.

Displaying information in vector form refers to the geometry of the shape (length, height, and shape), either in terms of point, line or polygon entities and their spatial position (the position of the coordinate system).

Example: noise can be spatially displayed in the form of irregular polygons (polygons entity) and non-spatial data tied to this can be information about the types of trees, their numbers, percentages, different types, etc.

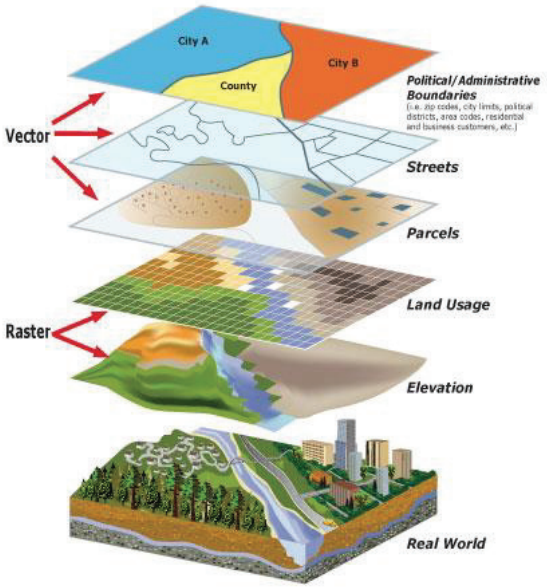

Figure 1: Example of vector and raster layers in GIS

B. Application of geographic information systems

GIS is an essential tool in all areas of design, planning, management and analysis. Around the world, used by electrical, mechanical and civil engineers, architects, bankers and economists, journalists, teachers, geodetic engineers, environmentalists, politicians, criminologists,

planners, health professionals and others.

Business people see the world as a collection of information about sales, customers, warehouses, demographic profiles and much more. The basis for all of this information is the address, sales region, or transport routes of delivery which can all be displayed and interactively operated on the map.

The planning and engineering tasks that can be easily solved with the help of GIS must go through the following steps:

- defining a problem
- collecting data (georeferenced)
- visualization,
- analysis,
- supervision and monitoring for a long-term period,
- corrections,
- new solutions.

Competitive pressure and new legislation causes an efficient and responsible management. This requires access to information based on a geographically distributed elements and operations. In today's world, competitive, successful management requires the maximum of all the resources, people, equipment and information. Using GIS to integrate geographical with other relevant data, gives the system fully equipped for this task.

C. Analysis with GIS

Not only presentation of existing geo referenced data is advantage of GIS. GIS also enables to put them into different layers and to overlap them. This makes possible to follow the trends of some features, for example increasing rate of citizens' number in a state within the timeline. There are many other GIS analyzing tools. Some of them are described:

Extract

• Clip: Extracts input features that overlay the clip features. It is as feature is like a cookie cutter, selecting only the part of the data set to be clipped that are within its boundaries.

• Select: Extracts data based on attributes. For example, if there is a map of all countries in the world, that contains a field giving each country's continent. The select utility can be used to select only those countries with the continent field equal to "Europe."

• Table Select: Extracts selected table records or features from an input table or table view and stores them in a new output table.

Overlay

Erase: Creates a feature class by overlaying the input features with polygons of the erase feature. Only those portions of the input features falling outside the polygons of Erase features are copied to the outside feature class.

Intersect: Computes a geometric intersection of input features. Features or potions of features which overlap in all layers will be written to the output feature class.

Spatial join: Creates a table join in which fields from one layers attribute table are appended to another layers attribute table based on the relative locations of the features in the two layers.

Union: Computes a geometric intersection of the Input features. All features will be written to the output features class with the attributes from the input features, which it overlaps.

Proximity

Buffer: Creates buffer polygons to a specified distance around the input feature which presents zone. Due to different demands GIS can make intersection, revised intersection or different.

IV. USE OF GEOGRAPHIC INFORMATION SYSTEM IN ANALYSIS OF TELECOMMUNICATION MARKET

This chapter describes investigation of locations of sales points of mobile operators VIP and Telenor in Novi Sad in order to increase profitability of them. This case is an example how GIS could be used in analysis of telecommunication market. The task was to find the best way to see interaction of sales areas surrounding the points of sale of two competing mobile operators: VIP and Telenor in Novi Sad.

To do this the following steps were performed:

1. Definition of the problem:

-To increase profitability of points of sale

2. To solve the defined problem, it was decided to find interaction between areas about location of point of sales of two operators and to analyze their interaction in two ways:

- to find locations which are covered by only one operator

- to find locations which are covered by the both operators

To do the previously tasks by using GIS it was necessary to perform the following:

1.To collect locations with postal addresses of points of sale for VIP and Telenor.

2.To present these locations within the map of Novi Sad in two layers: one for Telenor and second for VIP..

3. To create areas of customers gravitation. It was done by creation of new two layers which present areas surrounding locations where customers are oriented towards certain point of sale. These areas are called buffer zones in GIS:

-for Telenor and

-for VIP.

4. To create new layer which presents gravitation areas which are covered by only one operator (or first or second).

5. To create new layer which presents gravitation areas which are covered by the both operators (their intersections).

6. To discuss results and give conclusion.

The use of geo referenced data, their visual presentation and analysis based on GIS tools should have

given solutions for better profitability of both operators. The authors tried to create a tool for better localization of sale points having in mind the locations of competition. Figure 1 shows location of sale points of operator Telenor and Figure 2 of operator VIP.

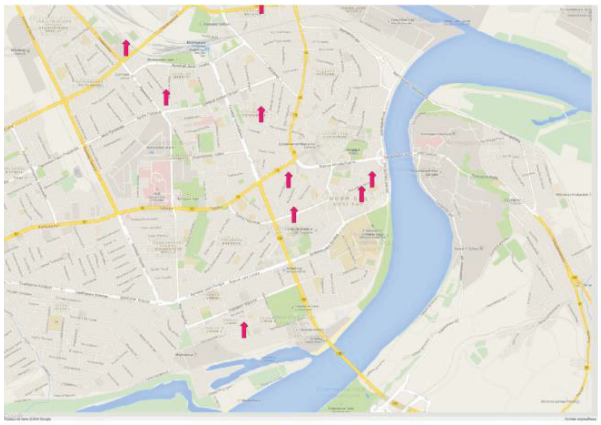

Figure 1. Locations of Telenor sale points

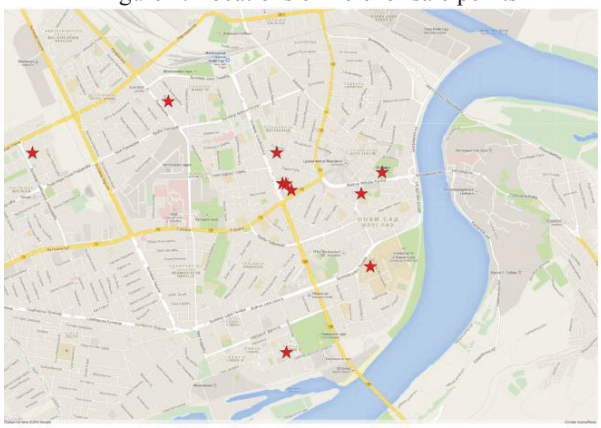

Figure 2. Locations of VIP sale points

By using buffer analyzing tool of GIS authors created Figure 3. which presents areas covered by sale offices of VIP.

Analysis are presented in Figure 4 and Figure 5. Figure 4 presents areas covered by only one operator, VIP or Telenor. Figure 5 presents locations which are covered by the both operators.

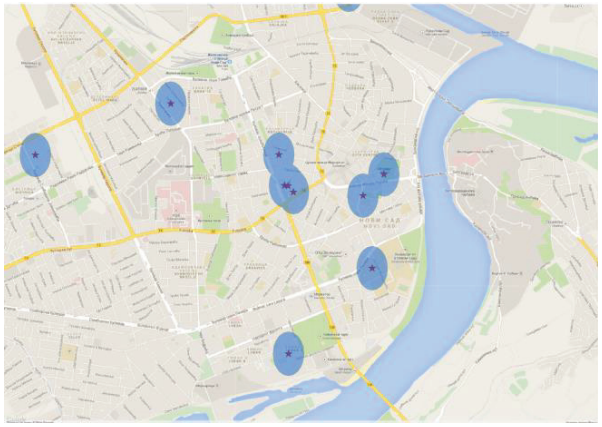

Figure 3. Locations of VIP sale points with areas surrounding them - zones buffers

Figure 4. Areas which are covered by only one operator

Figure 5. Areas which are covered by the both operators

Use of GIS as tool for analyzing mobile operators market gave visible results which could be directly implemented and which contributions could be measured by economical indicators. The paper presents small contribution in analysis of areas of sale points. Results show that sale areas of both operators are in many cases overlapping each other. Also, there are many areas covered by the both operators. Small areas are covered by only one operator and large space is not within sale areas

of any of them. This indicates lack of spatial research of areas of sale in telecomm market. Visualization which is attainable through the application of GIS gives significant results that can be used to create better distribution of points of sale for mobile operators. Recommendations for the relocation of points of sale which could give better economical effects are:

- stay located in the same zones as concurrency if profit is satisfactory, if it is not, points of sale should be moved
- try to move points of sale into "empty" areas. Select those "empty" areas where the density of citizens is the highest. This could be done by adding layers which presents density of citizens what would assist to select the right locations.

To locate new points of sale should be done the following:

- create layer with existing distribution points of operators
- create layers with density of citizens according to spatial zones
- create other layers with data of interest
- create decision rules
- overlap layers and find solutions.

V. CONCLUSION

Geographic information system should be implemented into the analysis of telecommunication market because of its visualization possibilities and possibility to overlap different layers. It will enable to do cross cutting analysis of different factors, to follow the behavior of other attributes at the market and to investigate effects of their own changes. Conclusion is that GIS can be powerful support for visualization and decision making about market configuration which will bring significant economical benefits for the actors of telecommunication market.

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