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# USING GEOGRAPHICAL INFORMATION SYSTEMS AS AN INFORMATION VISUALIZATION TOOL. A CASE STUDY

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**Abstract**

*The geographical information system represents a branch of information technology that was developed along with the traditional business information technologies. It enables viewing of complex data in a graphical manner easy to understand, providing a more realistic view of the conditions which must be evaluated. The geographical information systems are used in various fields, like geography, geology and all the related fields, public administration, military activities, transportation and infrastructure administration, business, healthcare, social services or land properties management.*

*In this paper we will emphasize how these systems can be used as a powerful information visualization tool in educational environment, taking into account that information visualization makes data easier to understand using direct sensory experience, especially the visual one.*

**Keywords**: geographic information system, data estimation, information visualization
**JEL classification:** C8

## 1. INTRODUCTION

The geographic information systems (GIS) are the most complex ones among the systems designed for the manipulation and mapping of spatial referenced data (Tombargem, 1999: p.146). The geographic information systems have become more and more important for an increasing number of users: geographers, scientists, company managers, sociologists, politicians, risk managers (Măzăreanu, 2010) and IT professionals. In the past years, special attention was granted to the complexity of this field, the geographic information systems being described as the new worksheets of the 21st century (Moyano, 2004, p.394).

The application of geographic information systems has become extremely important in many business and governmental areas where the analysis of spatial information offers considerable advantages. GIS allows visualizing complex data in an understandable graphical manner, providing a more realistic vision on the conditions that must be evaluated; GIS allows users to properly display complex data in order to assess environmental risks and business opportunities (Kuehn *et al*., 1993, p.328) or to formulate better decisions.

In this paper we present the results from analyzing the data gathered from the final exam (bachelor's degree) that took place in 2011 at the Faculty of Economics and Business

Administration from Iasi. It will focus on information reporting and visualization features, in an attempt to identify some characteristics of the candidates (origins, gender). We also want to identify and visualize the geographical distribution of those who studied in the Business Information System field.

## 2. A SHORT INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

It seems that the literature does not offer a standard definition for the Geographic Information System concept. The Handling Geographic Information Report (which is a standard creation body) describes GIS as an information system where data has a geographic dimension (Hawkins, 1994, p.4). What we can understand from this idea is that data can be bound to a very specific point from a geographic map.

A more modest definition was proposed by the Census Bureau: a GIS is a computer system - hardware and software - which helps analysts to discover the relationships between sets of geographic data that could not be seen or understood easily without the help of this technology (Kuehn *et al*., 1994, p.328).

An interesting way to define this concept is offered by Meeks and Dasgupta (Meeks and Dasgupta, 2005, p.179). In their opinion, GIS is a system that includes components such as hardware, software, data, connectivity, procedures and operators. GIS = f {Hardware, Software, Data, Connectivity, Procedures, Operators} where,

- Hardware – all the hardware components of a system;
- Software – operation systems, applications and tools;
- Data – all kind of data;
- Connectivity – components that connect GIS with data sources and other support application;
- Procedures – processes, algorithms, methods necessary in order to use a GIS;
- Operators – annalysts, researchers, users of GIS.

Geographic information systems represent a technique increasingly used in the contemporary world, both in theoretical research and practical activities. GIS software is actually a system that has several informational components in relation to geographic coordinates.

A geographical information system organizes information in layers. Each layer may contain different kinds of information, such as rivers, lakes or highways, specific locations like hospitals or hotels or land properties. A coordination system helps to create a connection between all these layers so that, in the end, one should be able to cumulate all the information into one map. The way that this process works is presented in the figure below (Măzăreanu, 2007).

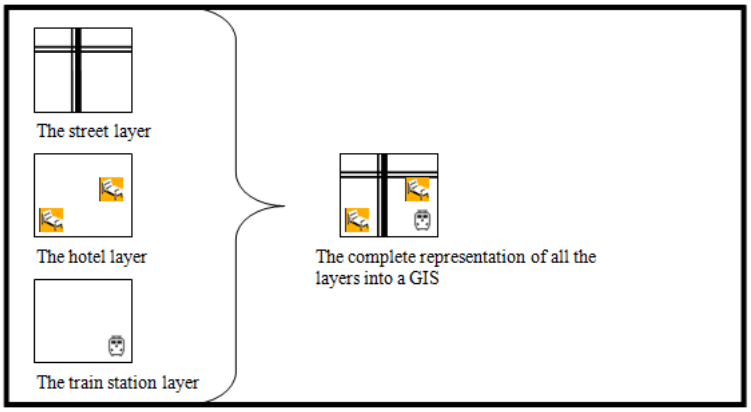


**Figure no. 1 The way GIS works**

The procedures of geographic information systems are applicable to almost all areas. Nowadays, almost all places in the world are represented in a format supported by a GIS. Specific information for a region on the map (e.g. number of inhabitants, average household income, soil type, etc.) is coded with colors, added to the map and then linked to geographic locations. This way, the system provides a more complete picture of a specific geographic area. When all data sources are used and presented in combination (e.g., map, location of land that can be purchased, natural or man-made geographic features, etc.) the system may offer a strong visual representation of an area of interest to potential investors.

## 3. VISUALIZING DATA WITH MAP POINT

An effective way in which geographic information systems can be used in relation to business planning is the ability to view the quantitative information through graphs and charts.

GIS tools allow viewing data that could remain undetected in spreadsheets, charts or other reports. With the help of these systems, data can be analyzed by various methods. Since most geographic information systems are implemented using relational databases, these systems can be queried using SQL phrases. Also, because the system is visual, it eliminates the complexity of understanding the information written on paper or stored in large digital worksheets. Instead, it allows users to navigate logically through data sets.

Presenting the statistical information in the form of images and drawings is considered an effective method, especially when it comes to large amounts of data required to be presented to groups who are unfamiliar with statistical techniques, such as members of boards of directors, the general public or media representatives.

In our analysis we will use Microsoft MapPoint 2009 (Europe), a Microsoft product used for creating maps and geographic analysis. It is an extremely useful tool when you want to analyze data from sales or when you want to achieve a marketing program that takes into account geographic data, because in such situations it is difficult to look at some columns of numbers and to identify trends in data. In these conditions, it can be said that Map Point improves decisional process, making data easy to be understood.

We will not insist on technical details regarding the process of data migration in the MapPoint environment. We would just like to mention that we started from a database consisting of multiple Excel columns *(the fact that we have worked with Excel would be a criti-criticism to the Microsoft Map Point application: it imports only data in xls, mdb, txt, csv, tab, asc, udl and AutoRoute file format)*.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | YearOfBachelo | Sex | AverageYearsMark | BachelorField | County | City |
| 2 | 2011 | M | 6.13 | Management - Piatra Neamţ | Neamţ | Roman |
| 3 | 2011 | F | 5.94 | Management | Iaşi | Iaşi |
| 4 | 2011 | M | 7.72 | Informatică economică | Iaşi | Iaşi |
| 5 | 2011 | F | 6.97 | Economia comerţului, turismului şi serviciilor | Iaşi | Podu Iloaiei |
| 6 | 2011 | M | 6.94 | Economie şi afaceri internaţionale | Suceava | Suceava |
| 7 | 2011 | F | 6.83 | Economia comerţului, turismului şi serviciilor | Botoşani | Dorohoi |
| 8 | 2011 | F | 8.3 | Economie şi afaceri internaţionale | Bacău | Bacău |
| 9 | 2011 | F | 6.97 | Informatică economică | Caraş-Severin | Caransebeş |
| 10 | 2011 | M | 6.83 | Economia comerţului, turismului şi serviciilor - P | Neamţ | Piatra Neamţ |
| 11 | 2011 | F | 7.72 | Administraţie publică | Iaşi | Iaşi |
| 12 | 2011 | M | 6.22 | Marketing | Iaşi | Iaşi |
| 13 | 2011 | M | 6 | Management | Iaşi | Iaşi |
| 14 | 2011 | F | 6.94 | Contabilitate şi Informatică de gestiune | Botoşani | Botoşani |
| 15 | 2011 | M | 7.41 | Economia comerţului, turismului şi serviciilor - P | Neamţ | Târgu Neamţ |
| 16 | 2011 | F | 7.61 | Informatică economică | Botoşani | Botoşani |
| 17 | 2011 | F | 6 | Finanţe şi Bănci | Botoşani | Dorohoi |
| 18 | 2011 | F | 8.27 | Administraţie publică | Botoşani | Botoşani |
| 19 | 2011 | F | 6.47 | Contabilitate şi Informatică de gestiune | Iaşi | Scobinţi |
| 20 | 2011 | F | 6.36 | Management | Iaşi | Iaşi |
| 21 | 2011 | F | 8.66 | Finanţe şi Bănci | Botoşani | Botoşani |
| 22 | 2011 | F | 6.5 | Finanţe şi Bănci | Bacău | Comăneşti |
| 23 | 2011 | F | 6.72 | Marketing | Vaslui | Bârlad |
| 24 | 2011 | F | 8.44 | Economia comerţului, turismului şi serviciilor | Iaşi | Iaşi |

**Figure no. 2 Initial Data Set**

The entire process is simple, assisted by a wizard engine, and the results deserve to be considered. One aspect that needs to be mentioned is that most towns in the database were recognized and mapped. However, there were almost 1050 unrecognized towns, which called for manual mapping.

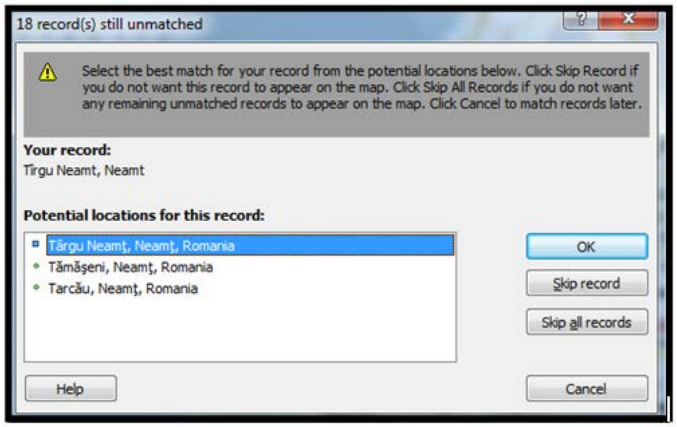


**Figure no. 3 Manual mapping of the cities**

We are particularly interested in information regarding student's address (*City and County*), their gender (*sex*), their graduation marks (*AverageYearMark*) and the study field (*BachelorField)*.


**Figure no. 4 Geographical distribution of the students who attended the 2011 final exam session**


**Figure no. 5 Geographical distribution of the candidates by their gender (green - male / red - female)**

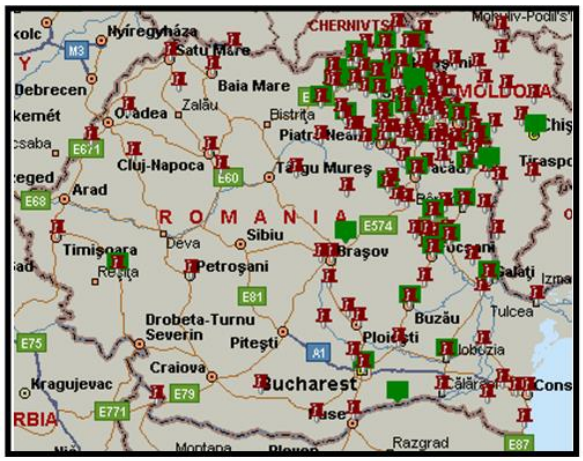


**Figure no. 6 Geographical distribution of the candidates who followed "business information systems" (green balloon – business information systems / red pins – other fields)**

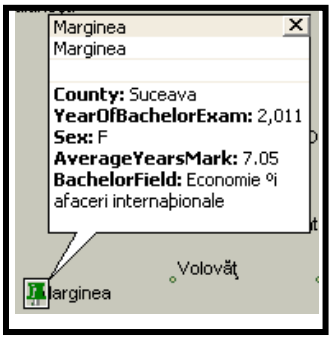


**Figure no. 7 Mining for more information in the case of a specific candidate**

Value maps are powerful decision support tools that illustrate the geography of property values in time and space in a very intuitive manner According to Wyatt (Wyatt, 1996, p.71), a value map is a spatial representation of the statistical data that reflects the value of a property and may be used in planning (to ensure optimal use of land and property), charging systems, identifying areas with high value (investment and development), assisting the public sector to purchase land at low cost, presentation of information about changes in value over time, etc.

Data, information, and knowledge exchange is becoming the key issue in contemporary computer technology (Sireteanu and Sîrbu, 2008, p.235). In social and behavioral sciences, information is often specific to the type of application and must be brought into digital form using one of these methods. Thus, an archaeologist will have to digitize the location of sites or artifacts from maps or such drawings like manuscripts. In other cases, the process of creating the database will take advantage of widely available digital data.

Although GIS is a powerful tool, it can be criticized. And the main limit is that these systems are statically and mostly two dimensional, not being able to display data in a dynamical manner. With other words, these systems cannot store, process and display the time dimension. There are also other weaknesses (Sheppard, 2004, p.6184): limitation in repre-

sentation of the real world or in accessing the right technologies, some legal and ethical implications and impossibility in applying GIS in order to redress social and geographical inequalities.

## 4. DISCUSSIONS AND CONCLUSIONS

Such analysis could have been done in many other environments. Perhaps some will consider this process of "data mining" would have been more interesting to do with, for example, Microsoft SQL Server: Analysis Services, Oracle Discoverer or simply using Microsoft Excel. But those who have worked with these products should recognize that the outcome (e.g. simple spreadsheets, complex tables, windows unwieldy) is quite *"inedible"*.

MapPoint is a quite useful product in quickly creating and displaying reports in the suggested format of thematic maps. Following this analysis one can easily draw a conclusion on the geographic distribution of the students who graduated from the Faculty of Economics and Business Administration in 2011, respectively those who followed the business information systems field. Selecting political map as base layer one can easily see the distribution by county or cities.

Having access to data from previous years, we could superimpose such thematic maps (e.g. 2001 to 2010) to see the differences from year to year. By accessing data from several years we might even discover some patterns regarding candidates' participation and (geographical) preferences for a particular field.

The characteristic procedures of geographic information systems are applicable to almost all areas. In our days almost all places in the world are represented in a format supported by a GIS. Specific information for a region on the map (e.g. number of inhabitants, average household income, soil type, etc.) is coded with colors, added to the map and then linked to geographic locations. This way, the system provides a more complete picture of a specific geographical area.

When all data sources are used and presented in combination (e.g., map, location of land that can be purchased, natural or man-made geographic features, etc.) the system may offer a strong visual representation of an area of interest to potential investors.

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