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THE GEOGRAPHICAL DIMENSION OF DSS APPLICATIONS

Dinu AIRINEI[*], Daniel HOMOCIANU[**]

Abstract

Nowadays many Decision Support Applications tend to combine the multi-criteria decision analysis of historical data with new reporting facilities as alerts and some corresponding to key performance indicators that describe so well a new field and approach called Business Intelligence. Moreover GIS and DSS applications altogether become more relevant to most business than as distinctive parts.

This paper justifies with many arguments the association between such approaches and technologies. To support that we have decided to give some practical examples of geographical queries with efficient results lunched in classical applications based on the interaction with a dedicated GIS system.

Key words: DSS, GIS, SDSS, Spatial Decision Problems
JEL classification: D79

1. Introduction to DSS and GIS

Decision Support Systems (DSS) represent both a theoretical and applicative area of information systems (IS). Although since Gorry and Scott-Morton (1971) there are many definitions of a DSS, we have to agree that those systems are meant to support decisions within a specific field rather than replace the human decision making processes and their components usually include an interface and some data and model components strictly required. There are many types of DSS depending on the importance of these components. As example we remind model-driven and data-driven DSS. They both can be built using spreadsheets. Solver add-ins are very popular for building the first type based on optimization models while the second type can be built on a small-scale using pivot table capabilities.

A Geographic Information Systems (GIS) is a specialized information system having all the basic possibilities of an information system as query, reporting and data storage and retrieval. The recent growth in GIS applications is due to a couple of major factors. These refer mainly to the improvements in network and mainstream technology allowing the increasing availability of appropriate spatial data and also to the decreasing cost of the

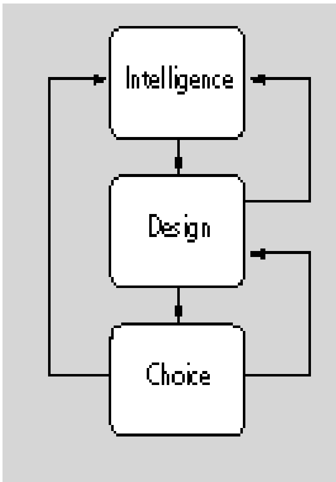
[*] **Dinu AIRINEI** (adinu@uaic.ro), PhD, Professor of Business Information Systems, Department of Economics, Quantitative Analysis and Information Systems, Faculty of Economics and Business Administration, "Alexandru Ioan Cuza" University.

[**] **Daniel HOMOCIANU** (daniel.homocianu@feaa.uaic.ro), PhD, Researcher in Business Information Systems, Faculty of Economics and Business Administration, "Alexandru Ioan Cuza" University.

required technology. This growth tendency associated with a greater use of spatial information has also conducted to some mapping functionality being included in many software products available on market. A simple example points also to the spreadsheets although it is very unlikely that such a solution would offer the full range of spatial query operations associated with a fully functional GIS.

2. SDSS or GIS?

A Spatial Decision Support System (SDSS) usually relies on a GIS that have the additional capability of dynamically displaying any query, report or piece of information in the system as a map. But GIS have limited capabilities to support the design and choice phases of the decision-making process (figure 1). This way a SDSS becomes a more complete system for solving problems spatially, designed to answer questions the decision maker would have prior to making a decision. In addition, SDSS often includes integrated solutions for security, communication and adherence to organizational procedures. The interface of SDSS is optimised and user-friendly so that a decision maker, without being very technically skilled, can retrieve information quickly.



Source: [Malczewski, 2005, 13]

Figure no. 1. Simon's decision-making model

Both SDSS and GIS use geospatial technology and the difference from other types of information systems is their capability to display information. In a GIS almost any type of data can be stored, analyzed spatially and modelled across time. The geospatial technology is not a new one, but it is becoming more wide used.

3. Spatial decision problems - a specific scenario

The main characteristics of spatial decision problems usually refer to [Malczewski, 1999, 392]: many alternatives, spatially variable consequences of the decision alternatives, alternatives evaluated on the basis of multiple criteria (some qualitative others quantitative with the inclusion of an explicit geographic component), more than one decision maker (or interest group) involved in the decision-making process, decision makers with different preferences on evaluation criteria and decision consequences, and decisions often surrounded by uncertainty.

In this crisis context, we can easily imagine a decision support application meant to assist the decision to eliminate some stores of a chain starting from certain economic criterions (profit, profit rate, expenses) that are aggregated in a general score (serves also as final descending sort criteria) using the decisional utility method (indexes compared to their maximum value) and keeping into account some weight factors associated to every criterion.

In this example, all the components of the chain (stores), all the components chosen to be closed permanently or for a period of time, respectively a certain store, all can be localized using some facilities of a GIS software product.

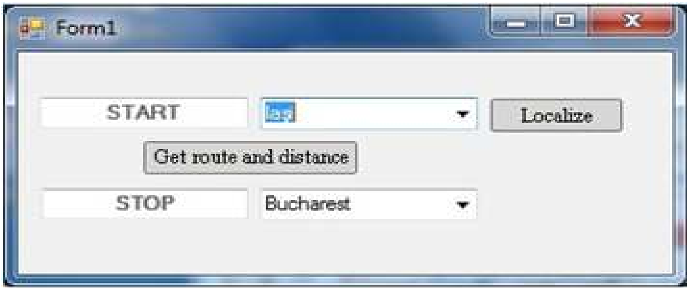


Figure no. 2. The structure of a simple Visual Basic form intended to interact with Microsoft MapPoint 2006 (translation)

Moreover, if an user wants to take under consideration additional criterions as store position in relation with certain interest area (cities with warehouses, harbours, navigable rivers, airports), the GIS dedicated software (in this case MapPoint 2006) would natively provide the possibility to query, locate, represent and compute distances between different points on a map.

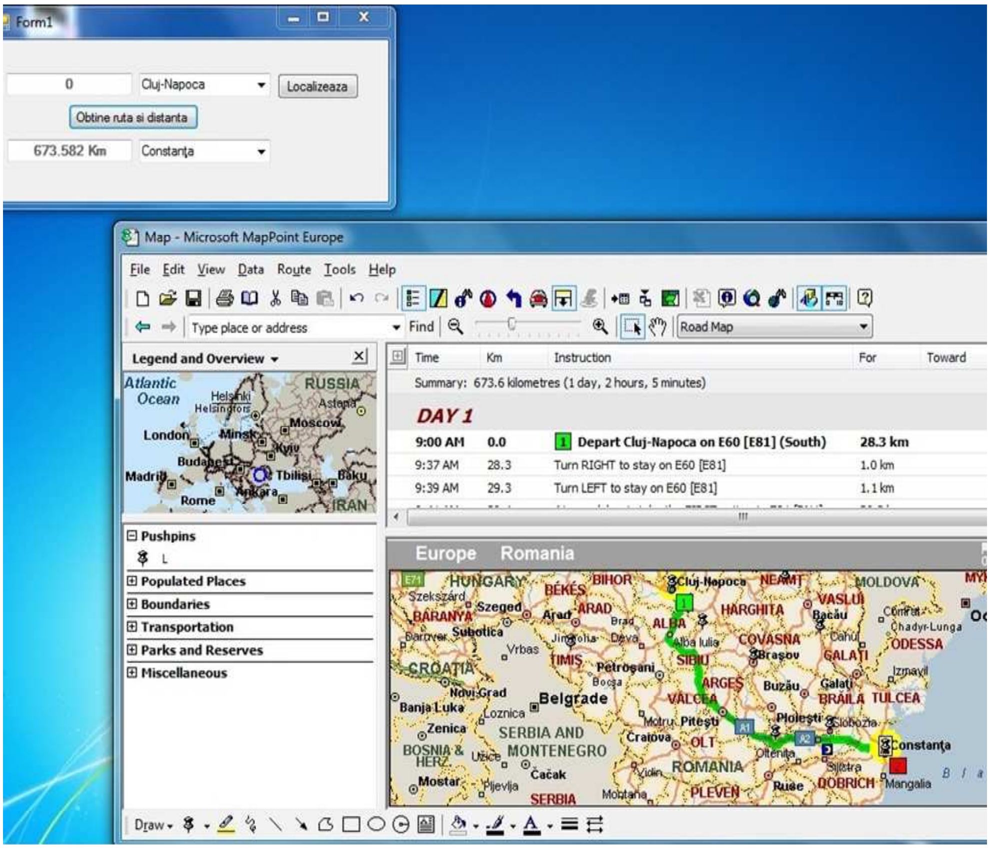


Figure no. 3. VB form querying MS MapPoint 2006 about location, route and distance

Afterwards, their corresponding values could be transformed in utility values, also having the possibility to write them in a spreadsheet report file as an additional decision criterion (see figure 4).

G5 | Distance (score)

	A	B	C	D	E	F	G	H
1			First 3 firms to be closed:					
2								
3		weight:	x	y	z		w = 100%-(x+y+z)	
4								
5	Store_city	Store_name	Expenses score	Profit score	Profit Rate score	Distance from Constanta harbour (Km)	Distance (score)	Total score (C*x+D*y+E*z+G*w)
6	Constanta	Store 0	-0.066897543	0		0	0=0/max	to be filled automatically
7	Cluj-Napoca	Store 5	-0.0049896	0.0362784	0.249073281	673,582	0,328=673,582/max	to be filled automatically
8	Bucharest	Store 2	-0.000514883	0.0349192	0.24918566	to be filled automatically	be filled automatically	to be filled automatically
9	Tulcea	Store 14	-0.000525299	0.0355357	0.249675764	to be filled automatically	be filled automatically	to be filled automatically
10	Sibiu	Store 22	-0.000654764	0.0407797	0.25	to be filled automatically	be filled automatically	to be filled automatically
11	Medgidia	Store 18	-0.023809603	0.1758573	0.2482926	to be filled automatically	be filled automatically	to be filled automatically
12	Mediaş	Store 9	-0.030134475	0.1933067	0.248247474	to be filled automatically	be filled automatically	to be filled automatically
13	Satu Mare	Store 20	-0.003794655	0.1677183	0.247816131	max(column F)=2050	1	to be filled automatically
14	Bicaz Chei	Store 23	-0.002566973	0.1732959	0.248033892	to be filled automatically	be filled automatically	to be filled automatically
15	Feteşti	Store 1	-0.055329052	0.4096258	0.247997758	to be filled automatically	be filled automatically	to be filled automatically
16	Tudora	Store 4	-0.05642231	0.4168817	0.247562028	to be filled automatically	be filled automatically	to be filled automatically

firms to shut down | Sheet2 | Sheet3

Ready 100%

Figure no. 4. Spreadsheet report automatically generated with VB using Business Intelligence alerts and populated also with distance information

Anyway, the computation facility of those distances and of their associated utility values could be transferred to a complex SDSS application (see figures 2, 3) that does it automatically exempting the user effort to introduce/export all needed data.

```
Private Sub bt2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles bt2.Click
    txt2 = Me.cbo2.SelectedItem
    txt1 = Me.cbo.SelectedItem
    txt.Text = CStr(0)
    Dim objApp As New MapPoint.Application
    objApp.Units = MapPoint.GeoUnits.geoKm
    objApp.Visible = True
    objApp.UserControl = True
    Dim szconn As String
    Dim oDS As MapPoint.DataSet
    Dim objPin1, objPin2 As MapPoint.Pushpin
    szconn = "d:\L.xls!Sheet1!R4C1:R16C6"
    oDS = objApp.ActiveMap.DataSets.ImportData(szconn, , GeoCountry.geoCountryRomania, GeoDelimiter.geoDelimiterTab, 0)
    objPin1 = objApp.ActiveMap.FindPushpin(txt1)
    objPin1.Select()
    objPin1.Highlight = True
    objPin2 = objApp.ActiveMap.FindPushpin(txt2)
    objPin2.Select()
    objPin2.Highlight = True
    oDS.ZoomTo()
    Dim oRoute As MapPoint.Route
    Dim oLocation1 As MapPoint.Location
    Dim oLocation2 As MapPoint.Location
    Dim oWaypoint1 As MapPoint.Waypoint
    Dim oWaypoint2 As MapPoint.Waypoint
    oLocation1 = objPin1.Location
    oLocation2 = objPin2.Location
    oRoute = objApp.ActiveMap.ActiveRoute
    oWaypoint1 = oRoute.Waypoints.Add(Anchor:=oLocation1)
    oWaypoint2 = oRoute.Waypoints.Add(Anchor:=oLocation2)
    oRoute.Calculate()
    textbox.Text = CStr(oRoute.Distance) & " Km"
End Sub
```

Figure no. 5. The source code behind “Get route and distance” button

As seen above (figure 5), the source code needed strictly to represent the route between two located points and also to obtain the corresponding distance within a textbox will not exceed 33 lines. This partly justifies the efficiency of the whole solution.

4. Conclusions

Starting from the fact that GIS products are moving to a greater level of integration with other types of software (spreadsheets, DSS and SDSS), and greater modularity, this paper underlines many technological possibilities in the attempt to better support the decision-making process of any successful business.

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