AN ARCHAEOLOGICAL APPLICATIONS USING GIS

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***ABSTRACT**: Topographical survey activities involve both field activities* **-** *such as charting archaeological research units, surveying details of archaeological interest and setting up topographical surveys if they have not already been digitized* **-** *, as well as office activities – such as downloading data from topographical equipment through transfer software, data calculus and processing, designing plans and creating a GIS project in order to manage topographical and archaeological elements which are going to be used.*

Keywords: *topographical work, digital recreations, GIS projects destined for archaeology.*

INTRODUCTION

Archaeology, in common with all disciplines concerned with the interpretation of geographically located material, has witnessed an unprecedented transformation of the methodological tools it uses for spatial records and analysis.

THE GIS PROJECT

The spatial data sources

In general, the spatial data can come from different sources:

- measuring equipment (total station);
- photogrammetric methods (based on sky photos);
- GPS (global positioning system);
- underground radar (when the location of underground objects is unknown);
- laser scanning methods (land digital models only);
- video cameras;
- scanning plans in an analogical format, implicitly turning them from a raster to a vector system through graphic referencing;
- registers and files;
- atabases executed with compatible or conversion-ready programmes.

The non-graphic data sources

In the case of a GIS in archaeology, namely sistematic, preventive and salvage archaeological excavations, the non-graphic archaeological data sources are excavation reports, site logs, overview photographs regarding archaeological research units (surfaces, panes, sections, boxes) and detail photographs of archaeological clusters and various artefacts discovered in the excavation, archaeological publications, legal data regarding he archaeological legislation in force, data related to service providing contracts for archaeological discharge, statistics, results, etc.

Establishing layers within the GIS application

The layers to be included in the GIS project will be shown within three points. The manner in which the layers mentioned below will be selected and displayed will be based on the field data.

A. Topographic measurements: support network, matching new points, surveying network.

B. Geographic data*:* contour lines, access routes, hydrography, land improvements.

C. Archaeological data: properties subjected to archaeological research, archaeological research units, and archaeological clusters.

Data import and point view

The points forming the "gross" database were collected with the total station Leica TC 302, then downloaded with the transfer software Leica Survey Office into pre-defined formats (txt, idx, scr, raw). Leica Survey Office also opens the coordinate file ARCHEO.idx for data viewing and preparing for a Microsoft Excel conversion. Next, we open Arc Map and execute the data import through Add Data and selecting the *.dbf file as points.

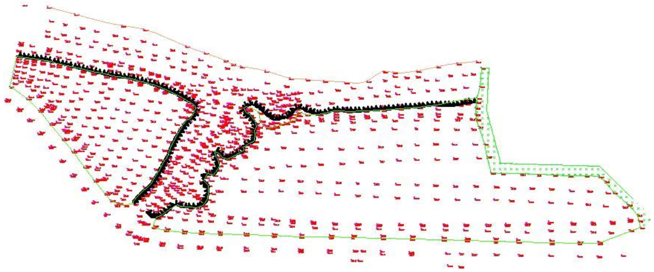


Fig.1. Point view in Arc Map

Designing the database

The database design implies determining the study area, the used coordinate system, the layers necessary to the study, the data included in each layer, the attributes necessary to the description of each data, the manner in which attributes are encoded and organized. For instance, the following fields were entered for this shapefile.

Similarly, all the shapefiles were created within the GIS project of integrating topographic and archaeological data.

Data feed

The spatial data will be integrated using the CAD tools made available by GIS technique, and, with this process, non-graphic (textual) data can be introduced by using the attribute tables.

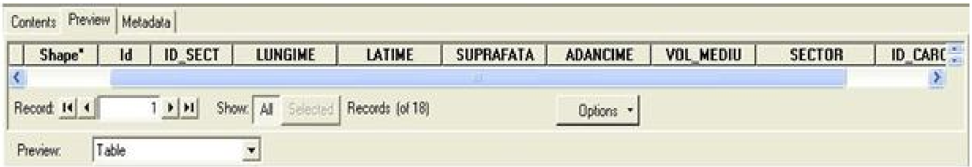
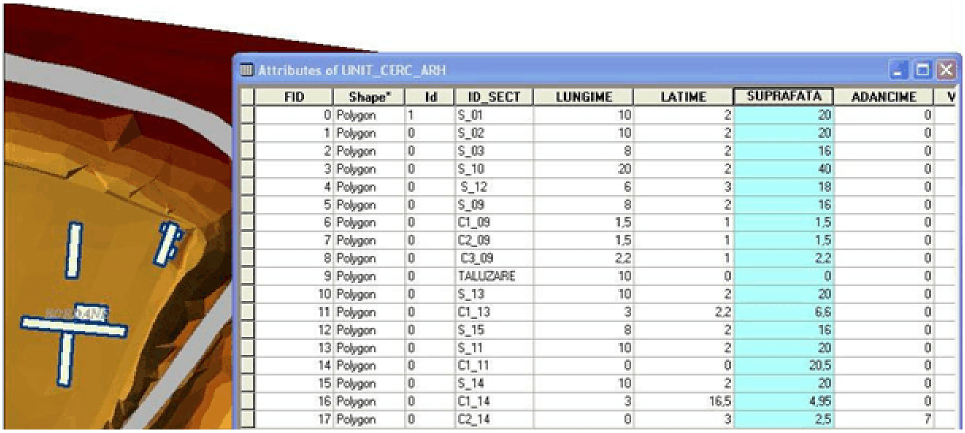


Fig.2. Arc Catalog – fields available for UNIT_CERC_ARH



FID	Shape*	Id	ID_SECT	LUNGIME	LATIME	SUPRAFATA	ADANCIME	V
0	Polygon	1	S_01	10	2	20	0	
1	Polygon	0	S_02	10	2	20	0	
2	Polygon	0	S_03	8	2	16	0	
3	Polygon	0	S_10	20	2	40	0	
4	Polygon	0	S_12	6	3	18	0	
5	Polygon	0	S_09	8	2	16	0	
6	Polygon	0	C1_09	1,5	1	1,5	0	
7	Polygon	0	C2_09	1,5	1	1,5	0	
8	Polygon	0	C3_09	2,2	1	2,2	0	
9	Polygon	0	TALUZARE	10	0	0	0	
10	Polygon	0	S_13	10	2	20	0	
11	Polygon	0	C1_13	3	2,2	6,6	0	
12	Polygon	0	S_15	8	2	16	0	
13	Polygon	0	S_11	10	2	20	0	
14	Polygon	0	C1_11	0	0	20,5	0	
15	Polygon	0	S_14	10	2	20	0	
16	Polygon	0	C1_14	3	16,5	4,95	0	
17	Polygon	0	C2_14	0	3	2,5	7	

Fig.3. Arc Map – filling in the attribute table with data corresponding to the polygon

Creating links

A system of links between the database and connected files belonging to a structure other than GIS can be set up so as not to overload the database with additional elements that do not require special attention in a first phase. Thus, a unitary system is achieved.

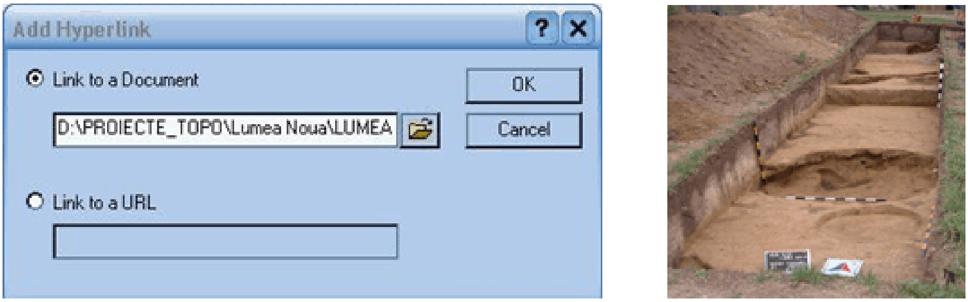


Fig..4. Arc Map – Add Hyperlink

Creating digital models in Arc GIS

The use of digital instruments and computerized data for topographic research is an advantage for a more flexible recording of site morphology and of the topographic context as compared to static plans, so that Arc GIS allows rendering 2D solid and 3D digital models (DTM – digital terrain modelling). Thus, a digital 2D solid model of the investigated area can be shown, which provides a easier interpretation of data connected to land morphology.

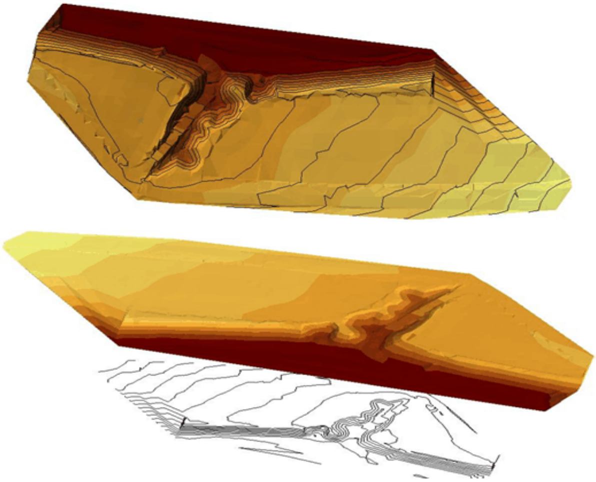


Fig.5. 2D and 3D solid models of the archaeological site

Database queries

Data queries identify elements and show them as a graph, a spreadsheet. It can also identify all the elements that satisfy a certain condition. Spatial queries can be created, namely finding all the elements that are found within an area or a selection of topics depending on their positions related to the elements of another topic.

An example of numeric data interrogation in an attribute table

We take for instance the attribute table of the topic UNIT_CERC_ARH (archaeological research units). We open the table of attributes and we want to find the total surface for the field SUPRAFATA: right click on the field SUPRAFATA – choose ∑? Statistics; certain indices that are relevant for the field will be presented here – minimum area, maximum area, area sum, an area average depending on the frequency of distributions and a standard deviation. Below is a graph presenting the frequency of distribution on the area values.

Thus, we were able to find out the total surface, which is of 245.750 square meters.

An example of simple symbology query

Inside the topic COMPLEXE_ARH (archaeological clusters), we can observe the symbols of the type point attributed according to types of archaeological clusters: right click on COMPLEXE_ARH – Properties - Symbology – Categories – Value Field (ADANCIME).

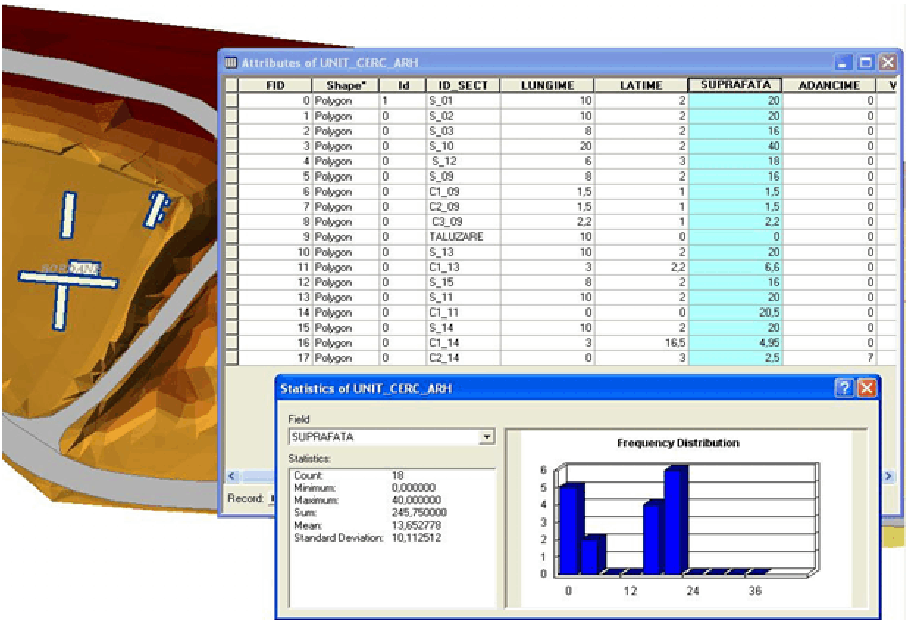


Fig.6. Arc Map – query model through statistical methods

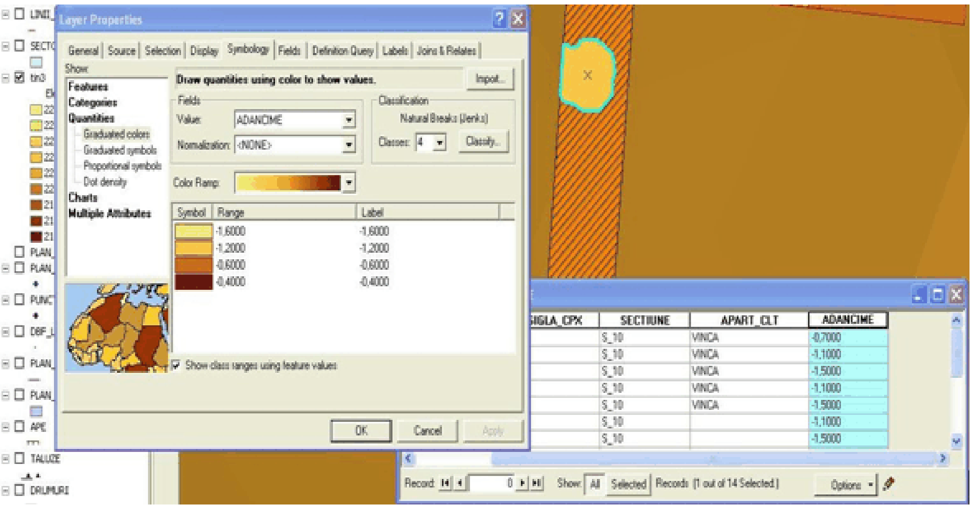


Fig.7. Arc Map – a simple symbology query model

Finding elements through a SQL expression search

For a query of the type –" how many archeological sections have the surface more than 20sqm" we will follow the steps: Selection – Select by Attribute – click on Layer, choose the layer UNIT_CERC_ARH – double click on the field SUPRAFATA – click on an operator (=) to add it in the textbox of the expression – select Verify button to check the syntax or if the criterion that we have introduced will select any element – OK.

We will notice that the query produces an answer. This is signalled in the attribute table and on the map.

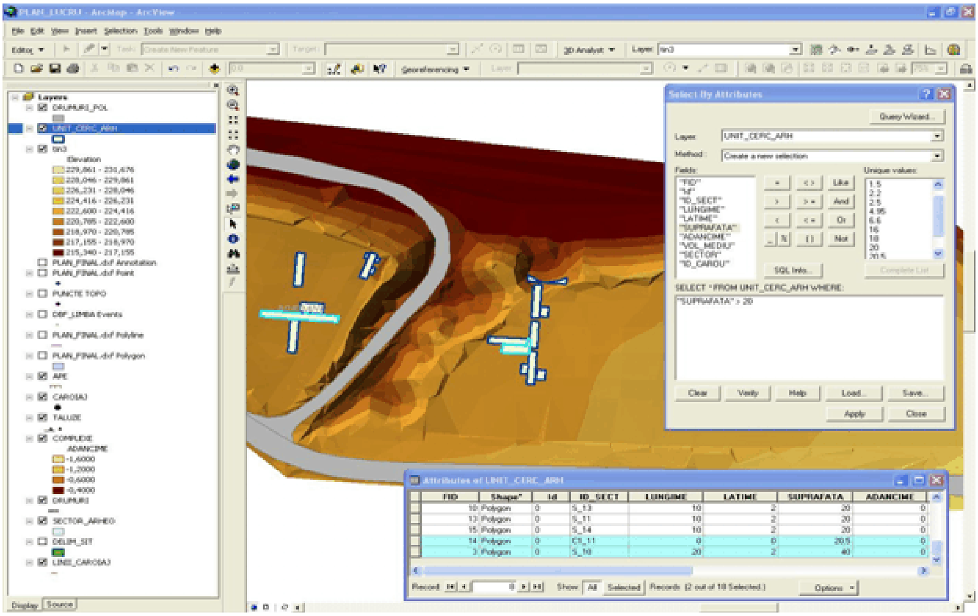


Fig.8. Arc Map – finding VATRA clusters through a SQL expression search

CONCLUSIONS

The high importance of topographical work, digital recreations and GIS projects destined for archaeology resides in the following aspects:

- an easier handling, storage and management of information in a digital system as compared to the analogical system;
- the possibility to list and visualise maps at different scales in a digital format, and the advantages of correcting digital maps;
- the possibility of generating 2D solid and 3D digital models;
- the possibility to associate graphical elements and their image (obtained through digital photography or photograph scanning in an analogical format);
- the possibility to comprise in a GIS project graphical and non-graphical data in a unitary form, with well determined connections and access in both directions – from a graphic element to a database registration and from a database registration to a graphical element.

The research would be advisable to continue in an interdisciplinary manner, with the results materialised in a more complex GIS project, following subsequent archaeological work on the spatial distribution of a type of object discovered and correlations between objects found on different treading levels, percentage analyses regarding the presence of objects or archaeological clusters on layers, on spread levels or areas, analyses to determine the limits of an archaeological site, through digging, drilling, geophysical prospecting, geological and soil analyses, proximity analyses resulting in the source areas of materials.

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