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STUDIES ON POLLUTION MADE BY THE INDUSTRIAL WASTE DUMPS

BY

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Abstract. This study presents the method of monitoring the dumps of wastes resulting from the iron and steel industry and their impact on the environment. The case study carried out at a metallurgical group of enterprises emphasizes the negative impact of the waste dumps on the environment. The monitoring was performed on the following fields: the wastes storage in the environment, the operation of the dump, the impact on the environment etc. The analysis carried out referred to the dumps running and the ones in conservation. The present paper analyzes also the new regulations regarding the environmental agents monitoring and the ecologic reconstruction of the area.

Keywords: dump; industrial waste; monitoring; environment; ecologic reconstruction.

1. Introduction

Pollution is a process by which the biotic and non-biotic environments are altered but which affects also the values created by the human society being caused by human activities. Furthermore, contamination may also involve an environmental degradation caused by natural agents. One of the 13 domains

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regulated by the environmental IQ is represented by the vast and complex domain of "waste management" which comprises specific regulations regarding industrial waste dumps:

Industrial waste dumps must be endowed with control and measurement equipment in order to measure the parameters considered in the analysis. The behavior in time of the running dump should be monitored following the new regulations adopted in the field. Due to the high construction, operation and monitoring costs of a controlled waste dump both during its filling and during its conservation, a cost - profit analysis is expedient. This analysis will represent a criterion in selecting the storage area and the construction solution of the dump. According to the provisions in force in the European Union the storage prices should cover the closure, operation and monitoring costs for a period of minimum 50 years after the dumps closure.

2. Pollution Induced by the Industrial Waste Dumps

Important quantities of waste more or less toxic, depending on their nature which cause big problems in what regards their processing and storage, result from the industrial processes carried out within the S.C. ARCELOR MITTAL S.A., Galaţi. Their valorization was performed periodically, the useful substances being recovered and used for other purposes. In many cases these wastes were deposited in inadequate conditions, without previously preparing the ground; the wind and rains often transported these wastes to large areas and infested the underground waters and the surface waters, the environment being thus seriously damaged.

The slag dump analysed is located in the Western side of the metallurgical group of enterprises and neighbors Mălina Bog to the North and the exploitation road of Sendreni Mayoralty to the East. The location of the dump starts at an altitude of 10.00 m on a table land situated between Cătuşa and Mălina Valleys and the farm lands of the localities Smardan and Movileni.

The dump occupies a surface of approx. 110 ha. The average height of the dump is of approx. 50 m. The height varies surface-wise depending on the dump exploitation degree. In some sectors of the dump holes were formed due to the slag exploitation. The surrounding land, situated outside the perimeter approved for storage is partially and even totally covered with wastes.

The dump, which is situated in the Western part of the unit, first occupied the Eastern side of Mălina Lake and advanced towards other directions covered with water. The advance was horizontal, but also with a continuous slope and if in the beginning the elevation marks were 40…46 m height they reached 60 m in the unloading faces area.

The construction of the slag dump started in 1968. The wastes resulting from the technological process of the Metallurgical Group of Enterprises Galaţi (Fig. 1) were stored there.

The execution project based on which the waste dump was built is no longer available.

Fig. 1 – The industrial waste dump in operation phase.

The analysis carried out within the dump for 5 years pointed out the following risk situations:

a) there is no natural or artificial waterproofing;

b) the waste dump has no drainage system for the leachate collection and treatment;

c) there are no collecting channels for meteoric water;

d) the waste dump has no gas collection and disposal system;

e) the dump slopes are instable;

f) meteoric waters infiltrated into the dump are not collected and drained through an appropriate drainage system;

g) the subsurface waters are polluted by uncontrolled infiltrations from the waste dump;

h) the access in the dump is free, etc.

The metallurgical group's operation is in direct relation with the evacuation and storage of the wastes. Due to the quality parameters but also from technical-economical reasons the wastes cannot be revaluated.

The wastes have been stored there for a lot of time and this is why a relief currently called slag dump appeared next to the unit.

36. 0 mil. tones of blast furnace slag and approx. 14. 0 mil tones of steel plant slag were deposited on the slag dump location during the 1968,…,2006 years. They were stored on the surface of the dump on a more or less selective basis. Initially the surface of the deposit was smaller but by successive deposits the actual surface exceeded the designed one. Despite this, there have not been taken neither waterproofing measures for the extended base of the dump nor measures meant to ensure the leachate draining and disposal system.

3 mil. tones of blast furnace slag, 1.50 mil. tones of steel plant slag and 600,000 tones of other wastes have been deposited in the dump during

2003,…,2006 years. An estimated share of the stockpiled materials is shown below:

a) blast furnace slag – approx. 47%;

b) steel plant slag – approx. 30%;

c) refractory wastes and other – approx. 23%.

The volumetric density of stockpiled material has an average of approx. 2,100 kg/m^3.

The industrial wastes dump and the technological processes carried out on site do not generate residual waters. The used water resulting from the slag granulation is collected by the sewage system of the metallurgical group.

The meteoric waters infiltrating into the material stored infiltrate into the soil too where from they get into the ground water and then into the emissary (Mălina Bog). At the same time the waters draining on the dump slope determine its erosion, whereupon they draw off into Mălina Bog. Part of this water is absorbed by the mass of the dump or by the soil in the adjacent area. The infiltrated water influences the quality of the subsurface water and of the water in Mălina Bog.

Mălina Sud sludge bed situated in the Southern part of the dump, helps the used waters from the blast furnace and steel plant slag taken over by C8 collector discharge in Mălina Bog.

Since there is no draining and collecting system of the leachate generated by the percolation of the dump by the meteoric waters, the slag dump through its position influences both the quality of the subsurface water and the emissary (Mălina Bog).

Because the storage and distribution surface of the industrial wastes has exceeded the Western bounds of the dump, the escarpment of the dump registered some landslips between 2004 and 2005. This phenomenon generated silting processes and even the obstructing of the sewer in Mălina Nord area.

In order to deposit the wastes in the slag bank the automotive transport is used for the blast furnace and steel plant slag. In order to deposit the refractory and industrial wastes, the railway transport is used. The blast furnace non-granulated slag, cooled and solidified is transported and deposited in the slag dump on platforms, a new stage being thus created the access being possible on the previously deposited wastes.

The truck unloading face is situated in the NW side, on the marginal line of the slope. The bank slope is consolidated only by the compaction exercised by the trucks weight. The waste trucks are side-tracked, blocked and then dumped. When the slope has achieved its back angle and the wastes no longer slip towards the base, a dozer compaction is performed and the infrastructure towards the area of the new slope is prepared (Fig. 2).

The infrastructure of the new unloading railway face is made of various types of wastes with different granulations. This procedure is adopted because the effect of the slope upon loading is unknown and slide surfaces may appear. It is worth mentioning that in the access area where the wastes transport is done

by railway, the storage was not selective. Various types of materials and wastes are met in this area.

Presently the wastes storage is done on a surface of 84 ha, with the recommendation that the present limit of the dump should be observed.

The waste storage dumps are hydrotechnical constructive structures which involve some special technical – economical and social aspects, such as:

a) ensuring the stability and preventing the possible accidents which may take place by the industrial wastes displacement as well as by their forming structure breaking;

b) collecting the surface and subsurface waters with their treatment where necessary;

c) preventing the contamination of the environment with substances carried off from the dumps;

d) the reintegration of the land used for deposits into the economic and ecologic circuit.

Fig. 2 – Unloading face for the industrial wastes.

The existent legislation on which governs the design, the operation and closure (abandon or conservation) of the dumps (waste bank) is very vast, the most important being:

a) GUO 244/2000 amended and completed with the Law 466/2001 regarding the safety of the dams;

b) 426/2001 Law for the approval of the Government Urgent Ordinance no. 78/2000, regarding waste regime;

c) the Order of the Minister of Waters and Environment Protection no. 1147/2002 for the approval of the Technical Standard Regarding Wastes Storage – the construction, running, monitoring and closure of the waste dumps;

d) 867/2002 – the Order of the Minister of Waters and Environment Protection regarding the definition of the criteria that wastes must fulfill in order to appear on the national list of accepted wastes from each class of waste dumps;

e) 162/2002 – The Decision of the Government regarding the wastes storage.

The existent environment legislation regarding the construction, monitoring and closure of the waste dumps, includes specific recommendations regarding the necessary data and information for each stage of the dump life cycle.

3. Results of the Environment Agents Monitoring

The technological monitoring is carried out during the entire operation duration of the dump and is essential for its good running. Thus the risk of accidents and destruction of the waterproofing bed is reduced. The working order of all the dump components should be permanently controlled: the access road and the one in the precincts, the condition of the existent endowments, the degree of settlement and the stability of the dump, the control of the waste entrances (consignment notes, making the conformity analyses), etc. (Fig. 3 and 4).

Fig. 3 – The pollution of the Mălina Valley.

For a strict supervision of the wastes bank running the strict monitoring of the liquid, gas and solid emissions is necessary. Its object is to check if the emissions comply with the competent authorities' requirements (the environment authorization, the water utilization authorization).

The monitoring process of the subsurface waters is carried out for the following parameters: pH, suspensions, fixed residue, CCOCr, chlorides,

sulphates, nitrates, ammonium, Fe, Ca, Mg, phenols, cyanides, Cr, Zn, Mn, Pb, Ni. Each month samples are taken from the observation drillings executed on the site and in the neighborhood. The samples are analysed and the results are compared with the values imposed by the existent standards and norms.

Fig. 4 – The industrial waste dump in operation phase.

In order to monitor the underground water, two drillings executed down to the depth of 21.0 m are used.

The quality of the environmental agents from the influence area of the wastes dump is controlled having in view:

a) the registration of the meteorological data obtained from the local weather station on a monthly basis in order to establish the quantity of precipitations, the temperature and the prevailing direction of the wind;

b) determining the concentrations of the specific markers in the environmental air from the dump influence area (sedimentation powders – monthly, aerosols – monthly samples);

c) determining the noise level during the operations which require blasting and during the wastes unloading and ecologyzation works (two quarterly determinations);

d) determining the specific concentration of pollutants in the soil from the dump influence area (pH, SO_4, Cd, Mn, Pb; four samples taken from the four cardinal points per semester).

Due to the nature of the wastes and the storage technology used, the material which makes the structure of the slag dump is very inhomogeneous both physically and chemically. On the other hand, the dump has impressive dimensions both in horizontal and vertical plane. Therefore, a characterization of its physical chemical composition by lab analyses would take a lot of time and the conclusions would be irrelevant and uncertain. Consequently, it seemed expedient to take samples from the material stored, the wastes being characterized by the analyses performed by the producer.

The soil samples were taken from the neighboring area next to the bank from 4 points (two samples for every one: a surface one and one 30 cm deep) situated approximately on the four cardinal directions in respect to the dump. The dump position as well as the predominant wind direction in the area was considered. The choice of the four sampling points allows the analysis of the polluting effect of the dump activity on the soil.

Considering the nature and the chemical composition of the wastes deposited and the recommendations in annex 3.1 to the MAPPM Order 184/1997, the lab analysis of the soil samples aimed to determine the heavy metals (Pb, Cd and Mn), sulphates and pH concentration.

In order to value the wastes dump contamination effect, the results of the analyses performed on the soil samples taken from the East side of the location in June July 2006 are presented in Table 1.

Table 1

Contamination Effect of the Wastes Dump

Soil sample code	Determined parameters				
	pH	Cd mg/kg	Mn mg/kg	Pb mg/kg	SO_4^{2-} mg/kg
Less sensitive possessions (inside the metallurgical unit)					
E/ (surface)	8.18	1.42	1,370	53.2	460.2
E / (30 cm)	8.20	1.58	1,399	46.7	880.2
Normal values (Ord. 756/1997)	-	1	900	20	-
Alert threshold (Ord. 756/1997)	-	5	2,000	250	5,000
Intervention threshold (Ord. 756/1997)	-	10	4,000	1,000	50,000
Less sensitive possessions (outside the metallurgical unit)					
E/ (surface)	8.26	1.61	1,270	38.2	601.4
E / (30 cm)	8.22	1.83	1,184	37.5	909.8
Normal values (Ord. 756/1997)	-	1	900	20	-
Alert threshold (Ord. 756/1997)	-	3	1,500	50	2,000
Intervention threshold (Ord. 756/1997)	-	5	2,500	100	10,000

From the analysis of the data results that the soil samples have a pH value of over 8, 0, what confers to the soil in the area an alkaline character. The concentration of the lead in all the analysed samples exceeds the normal values without exceeding however the intervention threshold for the sensitive utilities.

Considering the position of the sampling points with respect to the slag dump and the predominant direction of the wind the negative effect of its activity on the soil is obvious.

Presently S.C. MITTAL STEEL S.A. manages selectively the slag wastes. Distinct areas for wastes storage were arranged. In the following period the utmost utilization of the wastes will be achieved by the excavation and processing of the slag in the dump, without affecting

however the stability and safety of the dump. The wastes which cannot be valuated shall be stored in a distinct area in a controlled and selective manner, according to the technology.

During 2005…2006 year the granulation of the blast furnace slag was done up to more than 70% of the slag quantity produced so that no slag would be stored in the dump.

4. The Post Closure Monitoring and the Ecologic Reconstruction

In order to comply with the environment protection requirements regarding the closure of the slag dump, the following measures should be taken:

a) the final coverage of the dump under safety conditions considering the previous land utility and the landscape framing;

b) monitoring the emissions into the environment after the actual closure of the dump for minimum 4 years until the complete stabilization of the wastes.

The layers of the covering system must ensure

a) the stabilization of the wastes;

b) the subsequent use of the land;

c) waterproofing layer;

d) layer for collecting and disposing the rain waters;

e) vegetal soil layer.

According to the legal provisions, the dump operator is obliged to ensure the post-closure monitoring for the period established by the competent environment authority (min. 3 years). The post-closure monitoring system shall be performed for 4 years and shall comprise the meteorological data, the concentrations of pollutants in the soil, underground water and air, together with a careful monitoring of the subsurface water quality parameters. At the same time, topographical studies on the stability of the slag dump shall be performed by using the landmarks mounted on the dump platform and on the slope.

After turning to good account part of the slag dump, ecologization technologies shall be applied for the volume remained unvalued after extracting the iron. The works include putting back the slag dump into the forest circuit and shall be done by stages.

The ecological reconstruction of the wastes dump shall be considered completed based on some evaluation criteria regarding

a) the quality of the environment agents;

b) the wastes settling;

c) Possibilities of subsequently using the ecologically rebuilt land.

The subsequent use of the location shall be done considering the specific conditions and restrictions imposed by the existence of the covered dump depending on the stability of the land and the degree of risk it may present for the environment and human health.

5. Conclusions

1. In order to make the industrial waste dumps safe the regulations in the field correlated with the European law provisions shall be observed.

2. The slag dumps resulting from the metallurgical and syderurgical groups require special attention due to the components included. They influence significantly the stability and circulation of the surface and subsurface waters.

3. The dump safing must be carried out during the operation stage by adopting measures meant to allow a controlled expansion and super elevation of the dump but without affecting and polluting the environment of the location. The research carried out in this case study indicates various contamination stages of the surface and subsurface waters.

4. During the operation and conservation stage the permanent monitoring of the parameters specific to the dump as well as of the location environment should be performed in order to reduce to a minimum the environmental contamination.

5. Both during the dump operation and conservation stage the location area should undergo an ecologyzation.

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STUDII PRIVIND POLUAREA DIN HALDELE DE DEŞEURI INDUSTRIALE

(Rezumat)

Acest studiu prezintă metoda de monitorizare a haldelor de deşeuri rezultate din industria siderurgică şi impactul acestora asupra mediului. Studiul de caz a fost efectuat la un grup metalurgic de întreprinderi si subliniază impactul negativ al haldelor asupra mediului înconjurător. Monitorizarea a fost realizată pe următoarele domenii: depozitarea deşeurilor în mediul înconjurător, exploatarea haldei, impactul asupra mediului etc. Analiza efectuată face referire la haldele ce sunt in funcţionare şi cele în conservare. Lucrarea de față analizează de asemenea, noile reglementări privind monitorizarea agenților de mediu şi reconstrucția ecologică a zonei.

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SOIL MACROPOROSITY DETERMINATION WITH THE HELP OF ELECTRONIC MICROSCOPE

BY

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Abstract. Soil texture and structure determine porosity. This feature has a direct effect on the movement of air and water, and also on the migration of chemical compounds in the soil. Soil porosity through its multiple functions, is presented as a particularly important feature for soil fertility. In this context, the authors of this paper present the results of experimental research done on soil porosity and surface characterization, with the help of electronic microscopy.

Keywords: electronic microscope; soil; porosity; soil surface characterization.

1. Introduction

Soil texture and structure greatly influences the infiltration of water, permeability and the water retention capacity of the soil. Air and water through soil is very important because it affects the supply of air to the roots and the plant nutrients available for absorption.

Soil structure entails two major elements: porosity and aero-hydric regime of soil. That means that this conglomerates leaves some gaps between them, were water and air can circulate.

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It goes without saying that the ground water and the air are in opposite relationship (one increase and the other one decrease), usually water predominates in the deep areas and the air on surface layer. Knowing soil porosity is very important because the whole dynamic of soil depends on her.

In this context, experimental researches were carried out on soil samples taken from Podu Iloaiei town, and consisted of analyses made with the Quanta 200 3D dual beam microscope.

2. Experimental

2.1. Materials

Quanta 200 3D dual beam electronic microscope (Fig. 1) is a combination of two systems:

a) SEM is an electron microscope that produces zoomed images of a variety of samples giving a magnification of 100,000x at a high resolution in digital format;

b) FIB is an ion beam that is capable of rapid and accurate grinding of different geometry (µm) of the sample material, revealing the structure of the sub-surface sections obtained, deposition of layers, etc. Ionic system also provides a high resolution image.

Fig. 1 − Quanta 200 3D dual beam electronic microscope.

The integration of the two systems provides a powerful analytical tool to obtain any information from any sample in three dimensions. Users can switch between the two beams for quick and precise navigation and grinding.

The convergence SEM and FIB at a short working distance allows a “slip on” section and accurate analysis at high resolutions. The workstation provides optimum between processed materials, resolution and automation.

2.2. Methods

With the electronic microscope we can get images of surface morphology, surface topography, compositional contrast images, qualitative and quantitative compositional analysis and distribution of elements on the surface samples.

The soil samples were analyzed at various resolutions (Fig. 2), obtaining SEM images, which were processed after with the software ImageJ.

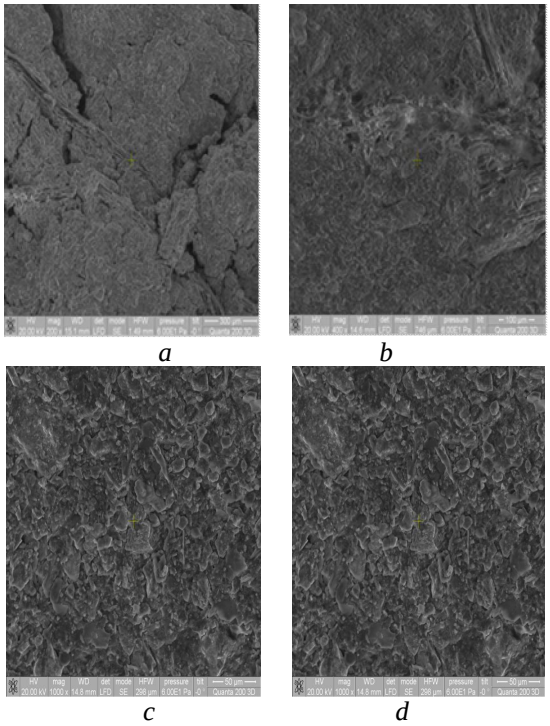

Fig. 2 – Increased soil sample image at: *a* – 200x; *b* – 400x; *c* – 1,000x; *d* – 5,000x.

3. Results and Discussions

SEM images were processed using ImageJ which allowed us to calculate porosity. We analyzed samples of the same type of soil on three different layers. SEM images generated by Quanta 200 3D dual beam microscope, helped us to find medium, minimum and maximum porosity values.

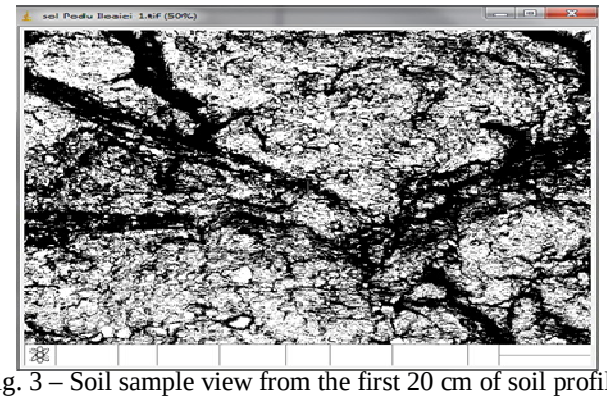

Fig. 3 – Soil sample view from the first 20 cm of soil profile.

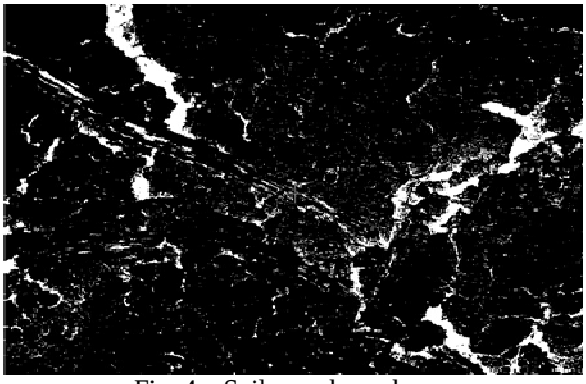

Fig. 4 – Soil sample analyses.

After the images were processed we obtain the following histograms of soil samples. They are a simple frequency chart that can express the percentage of entities (classes). On the *Y*-axis we have the variation of number of pixels in the image and on the X-axis we have the variation of gray. In section 0 we have black and in 255 we have white.

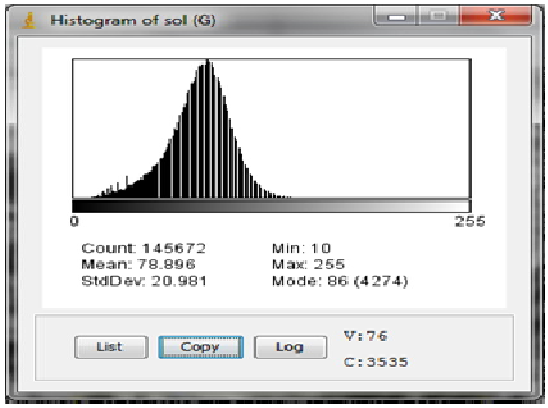

Fig. 5 – Soil sample histogram.

In the following table (Table 1) we have the porosity values calculated using the program.

Table 1

Porosity Values for the First Soil Sample

Results

File Edit Font Results

	Area	Mean	Min	Max
1	416	78.962	23	183
2	380	44.726	7	207
3	470	74.030	23	223
4	514	62.704	23	207
5	396	49.242	15	191
6	434	29.304	7	111
7	472	68.441	7	215
8	284	85.958	23	191
9	180	49.844	7	175
10	256	64.906	15	159
11	400	33.720	7	151
12	398	41.472	15	127
13	448	29.792	7	143
14	460	104.096	23	207
15	466	25.283	7	191
16	320	18.175	7	119
17	247	33.105	7	143
18	315	85.654	23	223
19	121	57.645	31	111
20	232	57.483	23	143

We made the same thing for the 2 and 3 soil samples taken from 40 and 60 cm of the soil profile. We observed that the analyzed soil presents a favorable porosity regime, meaning that transport of water and gas exchange is achieved easily, thus having a positive effect on the crops. Changes in the pore space leads to the reduction of mobility and accessibility of water.

Our samples were homogeneous and undisturbed, taken from natural settlement, so they were not submitted to compaction, therefore presents a good porosity regime.

4. Conclusions

Macro porosity, number of macropores, length, continuity, pore size distribution, tortuosity and connectivity are considered the most important features that influence the transport of water and soil solutions.

Natural and artificial processes induce significant changes on soil porosity. If the soil is subjected to a uniform pressure, it loses from macro porosity. An uneven pressure exercised over ground, causes various effects on porosity, namely fewer large pores, increasing fine pores, complete closure of macropores and closure of pores between aggregates.

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DETERMINAREA MACROPOROZITĂȚII SOLULUI CU AJUTORUL MICROSCOPULUI ELECTRONIC

(Rezumat)

Textura şi structura solului determină porozitatea. Această caracteristică are un efect direct asupra circulației aerului şi a apei, precum şi asupra migrării compuşilor chimici din sol. Porozitatea solului prin funcțiile sale multiple, este prezentată ca o caracteristică deosebit de importantă pentru fertilitatea solului. În acest context, autorii acestei lucrări prezintă rezultatele cercetărilor experimentale efectuate asupra porozității solului, cu ajutorul microscopiei electronice.

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INTEGRATION OF THE INFORMATIONAL LAYER ON THE USE OF LANDS IN GĂICEANA HYDROGRAPHIC BASIN, WITH GIS TYPE SOFTWARE

BY

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Abstract. This paper sets out a segment of a GIS project which focused on agricultural land degradation by erosion processes, in the hydrographic basin of Găiceana, Bacau County. Is presented a methodology integration to layer information on the use/land cover in a spatial database of GIS.

The information layer on the use/coverage of the lands has a special importance in the assessment of erosion-related degradation in the reviewed basin due to two issues: presence of vegetation and monitoring of existing agricultural crops (structure of crops).

Keywords: land degradation; water erosion; layer; agricultural crops; GIS.

1. Introduction

The monitoring and management operations related to a territory imply a significant volume of data and processing and analysis means thereof.

In this context, the determination of the soil quality and in particular of

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those impaired by erosional degradation processes gain a special importance both for the farmers and for the decision makers in the agricultural management field.

For large areas, these actions are possible by means of the GIS techniques; through the special evolution of acquisition techniques of data characterizing a certain territory (including remote sensing) and information technology. The association of the acquisition system with a simulation model provides the possibility to set out scenarios for the selection of the most appropriate actions for the protection and preservation of soil, mitigation of the alluvial effluence, mitigation of torrentiality etc.

The data acquisition and storage in numerical (digital) form, computerized processing, analysis and afterwards the display of obtained information in various forms (maps, charts, tables, text etc.) provide certain special advantages, among which:

a) the possibility to handle large, multi-layer, heterogeneous databases, with spatial reference;

b) the possibility to interrogate these databases on the existence, location and characteristics of a large number of objects on the land surface;

c) high flexibility for the interrogation or actions on the system, in an interactive manner;

d) large flexibility in the configuration of the IT system in order to adjust itself to a wide variety of applications and users;

e) the possibility to integrate knowledge on various objects;

f) analysis of the information acquired through the computerized processing of the initial data;

g) diversified presentation (display) or edit of information.

2. Research Grounds

Vegetation has a direct and importance impact on the erosion process, representing a factor that mitigates this process at all times, by: dissipation of the impact force of raindrops, mitigating the discharge speed, increasing the soil roughness, increasing the soil porosity and cohesion, improving the soil structure, ensuring a protective bed for the surface discharges.

In order to calculate the “umbrella” effect (rain interception), Horton R.E. (USA) proposes a formula depending on the crops type:

$$F = \frac{a}{2.54} + \frac{b}{6.45} m \times h, \tag{1}$$

where: h is the height of the rain layer, [cm]; a and b – coefficients experimentally determined depending on the crop specifics; m – height of plants, [cm].

3. Development Stages of the Informational Layer in Order to be Integrated within GIS

3.1. Geographic Location of the Reviewed Hydrographic Basin

The reviewed area consists of the catchment area of Gaiceana agricultural – fishing accumulation, located in the hydrographic basin of Berheci river, (right) arm of Bârlad river, Bacău County, in the vicinity of Târgu Găiceana locality.

A first stage consisted of framing the reviewed hydrographic basin in plan sheets (trapeze) at 1:5,000 scale, with the limits thereof in geographic coordinates (Fig. 1).

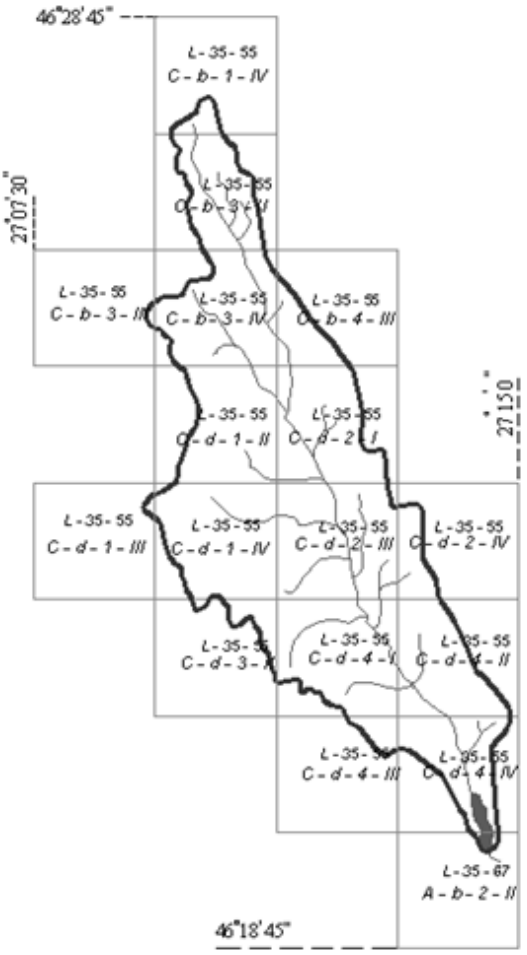

Fig. 1 – Framing of the reviewed basin in the plan sheets at 1:5,000 scale.

In the GIS system (namely Geo – Graph software) used herein, the geo-referential data is displayed in the form of layers, fact that facilitates the analysis of spatial variables and of the distribution of entities on the reviewed surfaces, and the overall analysis of the acquired information, which implies the concomitant approach of several layers, was performed through the so-called "***overlay"*** technique.

The "overlay" technique is based on overlaying or combination operations of several layers (based on specific algorithms – determined within the project), which generate new layers and, consequently, new data and attributes. ***The "overlay" technique*** enabled the performance of certain multiple spatial analyses because it referred to the spatial entities and databases belonging to an unlimited number of layers.

With a computation module of the Geo – Graph software we changed the geographic coordinates into flat Cartesian coordinates (by applying the method of constant coefficients)

The finality of this stage pursued at framing the perimeter of the hydrographic basin, reported to a system of axes (either in STEREO 70 system, or in a local system – Fig. 5).

3.2. Raster – Vector Transformation of the Plan

The layout with the land coverage (mapping of uses) at 1:10,000 scale was scanned with a Mutoh scanner (extended A_0 width, unlimited length) with a 300 dpi resolution. Almost all CAD (**C**omputer **A**id **D**esign) systems enable us to digitize „on – screen" a raster image.

This procedure is more convenient in case of small sized surfaces or perimeter lines as line segments; but in case of a large volume of graphic elements (as in this case) the "*on – screen"* digitations is no longer benefic: the execution time is extremely long and the vectorization accuracy is not always the envisaged one, depending on the attention and skills of the operator (the human factor).

In this case, the raster → vector conversion took place automatically by means of the Corel Draw 10 software, OCR Trace module.

Corel OCR Trace has the special vectorization option for maps, but own vectorization coefficients can also be imposed. In this case such parameters were selected based on the result acquired following the process.

This module vectorises the raster lines by setting out the X and Y coordinates for each scanned pixel. Following the vectorization, the file is saved in vector format (standard CAD) ***.dxf*** (**D**ata **E**xchange **F**ormat).

The obtained vector format file is imported under Geo – Graph software.

Fig. 2 – Mapping the uses in b.h. Găiceana – vectorial plan.

3.3. Setting out the Cartographic Limits of the Vectorial Drawing

The new system of axes the plan reports to can be fixed by means of a function accessed from the main menu of the Geo – Graph software: *„Update"*; by means of the "*Coordinates transcalculation*" button one can perform the automatic translation of the axes system origin (Fig. 3). The same button will also be used in the further applications when the vectorial plan needs to be rotated.

The window commands enable us to select the transcalculation points (between the vectorial plans), one point for each (the „select" button). The

"Scale" button enables us to apply a correction coefficient and is used in particular for bringing the vectorized images from scanned raster images at scale.

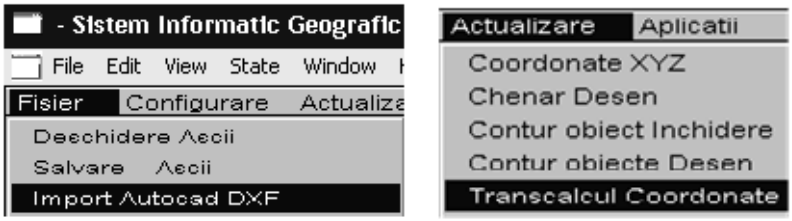

Fig. 3 – Import vector plan and transcalculation menu of the plan.

The commands enable:
- translation for each axis or for both axes („*transl*" button);
- translation and rotation („*tr_rot*" button);
- image inversion in X axis („*Invert*" button).

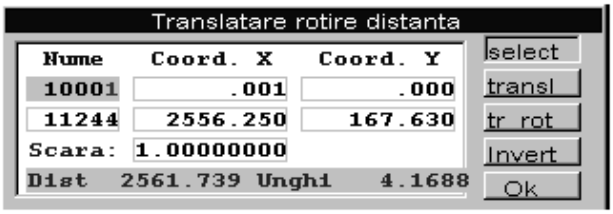

Fig. 4 – Sequence of the „*Coordinates transcalculation*" menu.

The displayed distance is useful in order to see the size of displacement to be applied. The gradient is useful in case of applying the rotation command.

The figures represent the minimum and maximum framing limits of the vectorial drawing in the active working window of the system, but also represent the lengths and widths along the axes of the reviewed hydrographic basin (in meters).

The coordinates of these four corner points will be automatically saved in the ASCII file. Of course, the plan can be reported to a standard projection plan at all times (for instance STEREO '70).

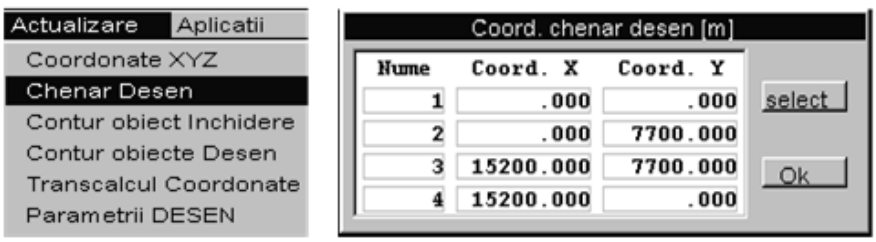

Fig. 5 – Automatic computation menu of the vectorial drawing border.

At the end of the operation, through ***ASCII saving***, in the "*xyz*" file (Fig. 6.) all points of the perimeter of vectorized polygons will have *XY* values.

In order to avoid the re-reading of the three file types *(.xyz, .con, .icx*) for the next uploads of the graphic drawing, and consequently to significantly reduce the required time, we recommend the use of the ***binary saving*** („*.cof*") as well.

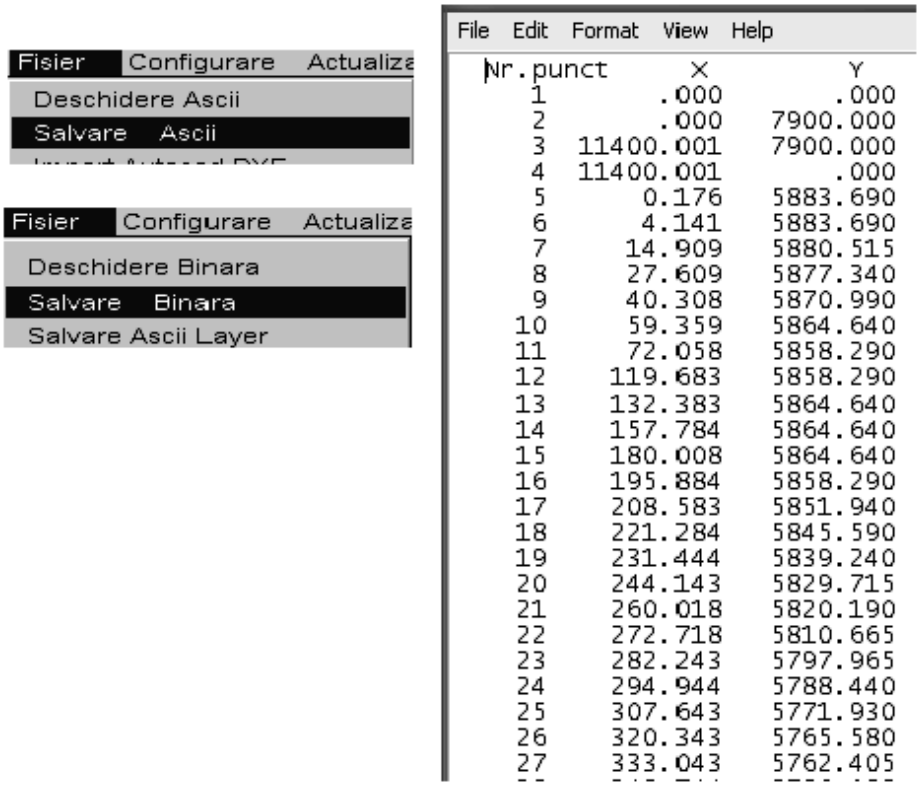

Fig. 6 – Sequence fin ASCII file.

If required, the binary format can also be exported to other GIS-type softwares: Arc/View (ESRI), Microstation or Geographics (Bentley), AutoCad MAP (Autodesk), GeoMedia (Intergraph), provided that, under certain circumstances, the color configuration by layers may not be complied with.

The importance of the set out operations consists of the fact that all coordinates of the file points have positive values, but in particular of the fact that this border is a control method for the correct overlay of plans in the IT system (the other plans will have the same reporting system).

The integration of the IT layer on the use of lands at b.h. Găiceana, through the Geo-Graph software, pursued:

a) the inventory of the current categories of use (Table 1);

b) the possibility to forecast the erosion-related soil losses by means of various scenarios (different crops);

c) the selection of the most appropriate soil protective and preservation actions.

Table 1

Use Categories of Lands at b.h. Găiceana

Use	Catchment area of Găiceana accumulation	
	Area, [ha]	%
Ploughable	1,227.8	26.31
Pasture	886.2	18.89
Meadow	52.5	1.12
Orchard	19.8	0.42
Vineyards	33.7	0.72
Forest	2,195.2	47.05
Constructions	196.7	4.21
Non-productive	19.8	0.42
Land under water	4.1	0.08
Various	29.1	0.62
TOTAL	**4,665**	100

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INTEGRAREA STRATULUI INFORMAȚIONAL PRIVIND FOLOSIREA TERENURILOR ÎN BAZINUL HIDROGRAFIC GĂICEANA, CU SOFTWARE DE TIP GIS

(Rezumat)

În cadrul acestei lucrări este prezentat un segment dintr-un proiect GIS care s-a axat pe evaluarea degradării terenurilor agricole prin procese de eroziune, în bazinul hidrografic al acumulării Găiceana din județul Bacău.

Este prezentată metodologia de integrare a stratului informațional privind folosirea/acoperirea terenurilor într-o bază de date spațială de tip GIS.

Stratul informațional privind folosirea/acoperirea terenurilor prezintă o deosebită importanță în cadrul evaluării degradării prin eroziune în bazinul studiat prin prisma a două aspecte: prezența vegetației şi monitoringul culturilor agricole existente prin structura culturilor.

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KNOWLEDGE DISCOVERY BASED ON SPATIAL DATABASES

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Abstract. In the last years we faced a storing process of huge quantities of data, in databases, data warehouses, geographic information systems or other forms. It is obvious that, currently, these data quantities increase rapidly.

In the given context, the data mining (DM) and knowledge discovery in databases (KDD) became research fields of high interest. In essence, *these imply the discovery of interesting knowledge, unknown previously and implied from large databases* [FPSU96], and are located at the intersection between several research fields, including automatic learning, database systems, statistics, recognition of shapes and the theory of information.

Keywords: spatial; databases; information system.

1. Introduction

Many organizations have built data warehouses able to store hundreds of data terabytes concerning the exploitation of natural resources; the databases in the astronomy area have the size of terabytes; it is estimated that the Earth monitoring systems can send up to 50 gigabytes per hour. These issues represented a challenge for the traditional data analysis methods able to extract information and knowledge.

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In addition to the various studies on knowledge discovery in relational databases, or in transaction-related databases, the spatial data mining, which refers to the *extraction of implied knowledge, of spatial relations or of other patterns which are not expressly memorized in the spatial databases,* was contemplated by several research studies (Ester *et al.*, 1995; Knorr & Ng, 1996; Koperski & Han, 1995; Yhang *et al*., 1996).

The spatial data has a series of distinctive characteristics from the relational databases. We mainly refer to the fact that these contain topological or distance information, use multidimensional spatial indexation structures, are accessed through specific access methods and often require geometrical computation and knowledge representation spatial techniques. Consequently, the spatial data mining requires the integration of data mining technologies with those specific for spatial databases. One of the sensitive issues of spatial data mining consists of the efficiency of used techniques, due to the work with important volumes of complex data and with spatial access methods.

The spatial data mining can be used in order to display the spatial databases, to understand this type of data, to discover the spatial links and the relation between spatial data and the non-spatial data, to reorganize the spatial databases, optimize the spatial interrogations etc. The results of such research works find their application in geographical information systems, in mining the databases of image type, in navigation and in any other fields operating with spatial data.

This paper intends to be an overview of spatial data mining, used techniques, with the pros and cons thereof, enforcement manners and related challenges.

2. Use of Relational Database Exploration Techniques

One of the first attempts of spatial data analysis was conducted in 1993 by Major and Mangano, who used a commercial instrument in order to mine a database related to a tropical storm, in order to forecast whether this would reach the US. The data describing the hurricane was decomposed into observations at various points, and such observations were memorized in a relational database. Attributes of the following types were used: position of the hurricane, speed, circulation direction, gradient from the coast etc. Because the description of the hurricane at various points was memorized of several tuples, certain data was interdependent. Such interdependencies generates a number of shortcomings because the used algorithm implied the independence of data. A GIS system was used as support of the selection for the best rules.

The conclusions of this study were that it is required to extend the data mining traditional techniques towards the mining of spatial data for an appropriate analysis of complex spatial objects and phenomena.

3. Process of Knowledge Discovery Based on Spatial Databases

The experience of the last years showed that the knowledge discovery in huge databases implies more than the mere application of sophisticated data

mining algorithms to a preset set of data.

One of the major problems of the research related to knowledge discovery in data refers to the KDD understanding as a "***non-trivial process of identifying the valid, novel, potentially useful and ultimately intelligible patterns from data.***" (Fayyad *et al*., 1996).

From this point of view, the concept of pattern is understood in a very general manner. A pattern is what a data mining algorithm can extract or generate from data, such as a model which classifies a group of data or a multitude of association rules based on a decision tree or a neuronal network.

The knowledge discovery from spatial data can be modeled through the architecture (Matheus *et al*. , 1993), set out in Fig. 1.

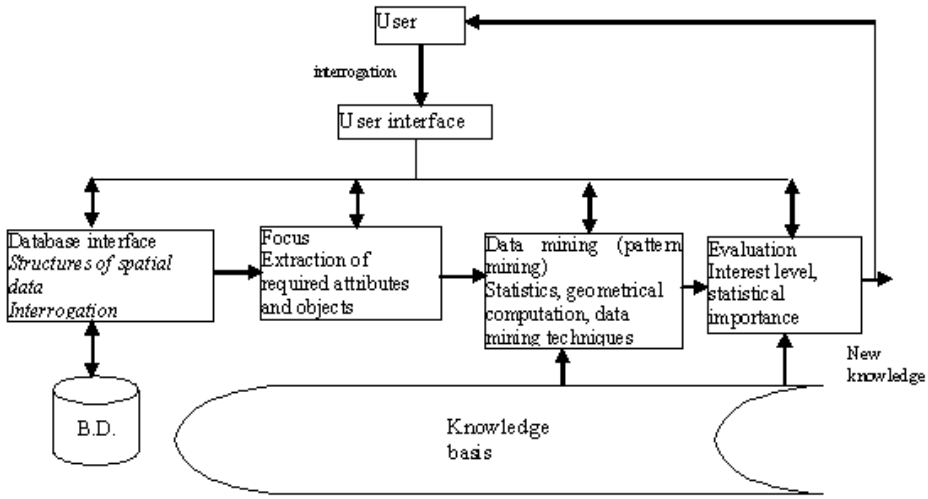

Fig. 1 – Model of knowledge discovery from spatial data.

The experience up to date lead to the conclusion that the process of knowledge discovery is not reduced to a "simple touch of a button", but on the contrary, is complex, iterative and highly interactive. Human presence is felt on each stage thereof through the user (or analyst) who decides the contents of the next stage, if the current stage is to be resumed or if one should revert to a previous stage.

Briefly, the knowledge discovery takes place as follows: the background knowledge, such as the hierarchy of spatial and non-spatial concepts or information related to the database is memorized in the knowledge base. The data is extracted from the storage media by means of the database interface which enables, inter alia, to optimize the interrogations. Indexes can be used for spatial data, for an efficient processing thereof. *The focusing component* decides which data parts are useful for the recognition of patterns. For instance, one can decide that only certain attributes are relevant for the knowledge discovery task or may extract objects the use of which guarantees

the best results. The rules and patterns are discovered during the data mining techniques stage performed by the module bearing the same name. This can use statistical procedures, automatic learning methods and classification and grouping techniques in conjunction with geometrical computation algorithms, in order to discover rules or links. The importance and significance of the discovered patterns is determined by means of the evaluation module which can remove the already existing or redundant knowledge. The discovered knowledge is ultimately provided to the user for review purposes.

4. Exploration methods and techniques of the used data

The knowledge discovered in spatial databases may have different forms, namely: rules characteristic for the description of spatial data, discriminative rules for differentiating a class of spatial data from other classes, association rules which associate one or more characteristics to a distinct set of characteristics, deviation and evolution rules for describing the time changes or rules which describe special structures. All these can be set out in various forms and may be used in order to describe the spatial objects.

Because data mining requires many challenging issues for research, the direct application of methods and techniques developed by related fields, such as automatic learning, statistics or databases cannot solve the problems. This requires the conduct of dedicated studies in order to identify new integrated methods or techniques for an effective mining. As a result, the data mining became a distinct research field.

As component of the knowledge discovery from data, data mining implies the iterative application of certain specific methods, in particular of specific algorithms.

Two types of targets can be identified for this stage, namely: *verification*, in which case the system is used to verify the presumptions of the user, and the *discovery*, when the system autonomously finds new patterns. Furthermore, discovery can be divided into: *forecast* if the system finds patterns in order to forecast the future behavior for certain entities, or *description* when the system finds patterns in order to provide these to a user, in an intelligible form.

The objectives of forecast and description, respectively, are achieved through the following primary data mining methods:

a) **classification**: finding a function which includes a data item in one of several preset classes.

b) **regression**: is used in order to forecast the value of a continuous variable based on the values of other variables, implying a linear or non-linear dependency model. Logical regression is used in order to forecast the value of a binary variable. It is a classification tool used in order to determine the value of a variable, such as, for instance, “is an individual is a buyer or not”, and is also

used in order to determine continuous variables, such as: "the likelihood of an individual to go shopping".

c) **clustering**: identifies a finite set of categories or clusters in order to describe data. Closely related is the method of estimating the probability density, which consists of estimation techniques from data of the probability function associated for all variables/fields of a database.

d) **summary:** identifies a compact description for a subset of data.

e) **dependencies modeling:** identifies a model which describes the significant dependencies between variables.

f) **identification of changes and deviation:** discovers the most significant data changes in the time frame between two consecutive measurements.

Based on the data mining fundament, the data mining can be classified into mining based on generalization, mining based on patterns, mining based on mathematical and statistical theories, integrated access etc.

5. Exploration Based on Generalization

The data and items in the databases often contain detailed information at the level of received concepts. In this case it would be advisable to make a summary of the data sets in order to present them through higher level concepts. For instance, can be summarized the detailed data o temperatures and precipitations of a region in order to provide the general climate pattern. This implies a data mining based on generalization, in which case the first stage performs a generalization of a significant volume of relevant data from a low level concept to a relatively high one, and afterwards extracts the knowledge from the generalized data. This implies the existence of fundamental knowledge in the form of a hierarchy of concepts, expressly provided by the experts in the field, which can be automatically generated through data analysis.

In case of spatial databases, two categories of concept hierarchies can be defined: *non-spatial and spatial*. Once the concept hierarchies is imposed, the information becomes more and more general, but still consistent at lower concept level. In case of spatial data, an example of hierarchy in the generalization process could be the following: the regions representing regional-administrative units can be united into counties, which can be united into stated etc.

The attribute-oriented induction is an efficient data generalization technique (Fayyad *et al.*, 1996). First of all is considered a data mining interrogation expressed in a SQL similar language, (for instance DMSQL) which collects the relevant set of data in a database. Afterwards the generalization takes place by increasing the generalization hierarchy and by summarizing the connections between the spatial and non-spatial data at higher level concepts. In case of non-spatial data, this takes place by: increasing the concept hierarchy when the values of attributes in a tuple are replaced with generalized values, by eliminating the attributes when it is impossible to

continue the generalization and there are too many distinct values for an attribute and by coupling the identical tuples. The induction continues until all attributes are generalized to the intended level. During the process of uniting the identical tuples the number of coupled tuples is memorized as a meter. In addition, the aggregated values of certain quantitative attributes may also be memorized in order to enable the quantitative presentation of the acquired knowledge.

Generalized data can be expressed in the form of generalized formulas or data cubes which can be subject to other operations in order to be turned into various forms of knowledge. For instance, the "drill-down" and "roll-up" operations enable the display of data at various generalization levels; the generalized relations can be transposed into summary tables, maps or charts for viewing and presentation purposes, characteristic rules or discriminating rules may be extracted etc.

The attribute-oriented induction was also extended on spatial data. Lu *et al*. (1993), sets out two generalization algorithms: in case of spatial data dominance and in case of non-spatial data dominance.

The generalization algorithm in case of spatial data dominance enables the description of space regions by means of high level attributes. First of all the regions are united in compliance with the special hierarchies and this generates a map with a low number of areas. Afterwards, a non-spatial description of each area is performed, by means of the attribute-oriented induction technique. The reply of an interrogation is the description of all regions through the disjunction of few attributes which characterize each of the generalized regions.

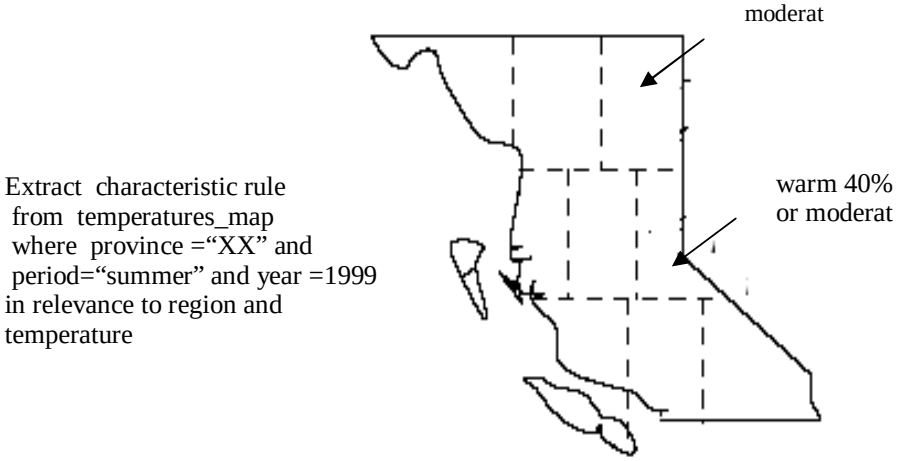

Fig. 2 – Interrogation and obtained result by applying the generalizing algorithm with spatial dominance.

The generalization algorithm for non-spatial dominant data generate maps which consist of a low number of regions with the same hierarchical level of non-spatial description. This algorithm begins with the non-spatial attribute-

oriented induction and the generalization thereof to higher conceptual levels. After that, the neighboring areas with the same values for the generalized attributes are united. Approximation can be used in order to ignore the small regions with different non-spatial descriptions. The next figure shows an example of the mentioned applied algorithms. It shows the interrogation in the generalization algorithm with spatial dominance, as well as the obtained result.

5.1. Mining of Spatial Associations

The above mentioned method enables the identification of characteristic rules which describe spatial objects based on the non-spatial attributes thereof. However, under certain circumstances, it is intended to discover the spatial association rules, which are those rules associating one or more spatial objects with other spatial objects.

The concept of association rules was introduced by Agrawal *et al*. (1993) in order to mine large transaction databases, and by Koperski and Han (1995) was extended to spatial databases.

A spatial association rule is noted:

$$X \rightarrow Y\ (c\%),$$

where: X and Y are sets of spatial and non-spatial attribute sets and c% is the confidence degree of the rule.

An example of such rule is as follows:

is (x, school) $\wedge$ *close_to (x, sport_center)* $\rightarrow$ *close_to (x, park) (80%)*

This rule mentions that 80% of the schools located close to a sport center are also close to a park. There are different types of spatial attributes which can generate spatial association rules, among which: topological relations, such as *intersection, overlaying, disjunction* etc., or distance information, such as *close_to, far_from* etc.

The large databases may contain many associations between objects, but most of them either apply to an extremely low number of objects, either have a low confidence degree.

For instance, a user may not be interested in a relation which associates 5% of the houses with a certain school, but may be interested in a rule applied to at least 50% of the houses. There are two thresholds, the *minimum support and the minimum confidence degree* which are used in order to control the filtering of associations describing a small percent of objects or low confidence rules. These thresholds may be different at each level of non-spatial descriptions of objects, because the use of the same threshold might not find the interesting associations at low hierarchic level because the number of objects which meet the same attribute may be low.

The mining process is initiated through an interrogation which describes a class of objects S using other classes of objects relevant for the proposed task and a multitude of relevant connections. For instance, a user

might want to describe the parks of a town by representing the connections between the parks and other objects, such as: railways, restaurants, zoos, streets etc. Instead, the user may determine that is interested only in the objects of an area with one kilometer width from the park edges. In order to mitigate the cost of spatial computations, the algorithm uses various approximations and applies the most detailed spatial computation, which is more expensive, only to those patterns with an appropriate support at the considered approximation level.

5.2. Data Clustering

Spatial clustering, which associates similar spatial objects in classes, is an important data mining technique, which can be used in order to identify the similar resource mining areas, in merging the regions with similar climate characteristics etc.

Can be used as a freestanding instrument in order to better understand data distribution, to notice the characteristics of each cluster and to easily focus on a certain set of clusters for further analyses, or may be a preparation step for the classification or characterizing algorithms which operate on the identified clusters.

Due to the fact that the cluster analysis was an active data mining research field, efficient clustering methods were developed in the last years. These can be classified into: partitioning methods (Kaufman & Rousseeuw, 1990; Ng & Han, 1994; Bradley *et al*., 1998), hierarchic methods (Kaufman & Rousseeuw, 1990; Yhang *et al*., 1996; Guha *et al*., 1998; Karypis *et al*., 1999), density-based methods (Easter *et al*., 1996; Ankerst *et al*., 1999; Hinneburg & Keim, 1998), grid-based methods (Wang *et al*., 1997; Sheikholeslami, *et al*., 1998; Agrawal *et al*., 1998) and model-based methods (Shavlik & Dietterich, 1990; Kohonen, 1982).

5.3. Use of Approximates and Aggregations

The clustering methods can provide answers for questions such as "which is the location of clusters in spatial databases". However, there is also another aspect of the problem, namely "why are the clusters located there". This can be rephrased as follows: which are the characteristics of clusters, based on the features on contained objects. The problem refers to the measuring manner of the aggregation proximity because an allegation such as "90% of the cluster houses might have characteristic X" is more interesting and contains more information than the allegation "one house definitely has X characteristic". The aggregation proximity is the proximity measure of the cluster set of objects to a certain characteristic as opposed to the distance between the cluster borders and the limits of a characteristic.

Knorr and Ng (1996), sets out a method which enables the fast identification of a characteristic close to the cluster.

5.4. Mining of Raster Databases

The mining of raster databases, such as the image type ones, is a particular case of spatial data mining. The studies in this field include POSS II (Second Palomar Observatory Sky Survey) which uses the decision trees in order to classify galaxies, or other cosmic objects starting from approximately 3 terabytes of cosmic images and Magellan study, which analyzes approximately 30000 high resolution radar images of the surface of Venus planet, in order to identify the potential volcanoes.

5.5. Future Challenges

In the years of transition to an information society it is useless to prove the necessity of a research field such as the one of data mining from large volumes of geographic data.

Nonetheless, what should be mentioned is the fact that there still are research issues which require the extension of studies. Some of these issues refer to: identifying certain additional methods such as classification, mining based on patterns or similarities, specially dedicated to geographic data; analysis of interactive data mining opportunities by using visual reactions, and analysis of possibilities to design a language dedicated to spatial data mining; the mining of data originating from distributed sources (Internet/Intranet) and memorized in various formats. A real challenge consists of combining the spatial data mining methods with the advanced spatial databases (object-oriented spatial databases or spatial-temporal databases) and with the technology of expert systems in order to generate the so-called smart GIS systems.

6. Conclusions

In this paper we reviewed the methods used for data mining, understood as a stage of the knowledge discovery process from spatial databases. This is a current topic and also an attractive one which aims at providing the geographic information systems with the power to discover knowledge and adjust the new GIS applications to the future requirements.

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DESCOPERIREA DE CUNOŞTINŢE DIN BAZE DE DATE SPAŢIALE

(Rezumat)

În perioada ultimilor ani am asistat la un proces de stocare a unor cantităţi uriaşe de date, în baze de date, depozite de date, sisteme informaţionale geografice sau sub alte forme. Este evident faptul că, în prezent, aceste cantităţi de date cresc cu o viteză uluitoare.

În contextul dat, explorarea datelor (DM – data mining) şi descoperirea cunoştinţelor din date (KDD – knowledge discovery in databases) s-au impus ca domenii de cercetare de mare interes. In esenţă, *acestea implică descoperirea de cunoştinţe interesante, anterior necunoscute şi implicite din baze mari de date*, şi se află la confluenţa mai multor domenii de cercetare, incluzând învăţarea automată, sisteme de baze de date, statistică, recunoaşterea formelor şi teoria informaţiei.

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A NEW CAPITALIZATION OF SLAG HEAPS, FROM A SUSTAINABLE DEVELOPMENT PERSPECTIVE

BY

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Abstract. In the context of complex actions on environment protection and capitalization of natural resources, this paper highlights certain opportunities provided by the slag heaps for the prosperity and dynamics of certain localities or areas where these are located. It is mentioned that these opportunities can be considered as interactive and indispensable components for a sustainable growth. Special references area made to the slag heaps related to the mining coal field industry in Charleroi region, Belgium.

Keywords: slag deposits; protection; stability; environment.

1. Introduction

The mining activity has left behind traces which shapes the landscape: the slag heaps. These have been sometimes erased, and sometimes capitalized and remodeled and wooded, or abandoned, forgotten and recovered by nature, or even by the inhabitants. Nowadays, the old mining basin is scattered with mounds more or less wooded. The name “Black country” tends to change.

“Some things are going to fall over”. The slag heaps became important supports of the positive identity and development of districts, of highlighting

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the different opportunities provided by the slag heaps for the redevelopment and boost of a town or region.

It is particularly based on key examples of revitalization of symbolic sites in our country and in the neighboring territories.

Above all, this refers to the ambition of bringing the potential public and/or private partnerships to perform a cross program of large scale regarding a chain of slag heaps, in the context of sustainable development.

When various organizations activate in parallel for developing and conducting projects at European level or more local action plans, it seems, on the contrary, that joint efforts would ensure a more fruitful basis for mobilization at all levels. The development of such project and raising funding at communal, province, regional or even European level as of 2007.

2. Territorial Approach: Scene of the Mining Basin

In Europe, the "industrial growing", a specific landscape which extends from London to Prague

The coal is the result of fossilization of huge quantities of living plants, for more than 300 million years in the lagoons of North-Western Europe (Fig. 1), subject to tropical climate.

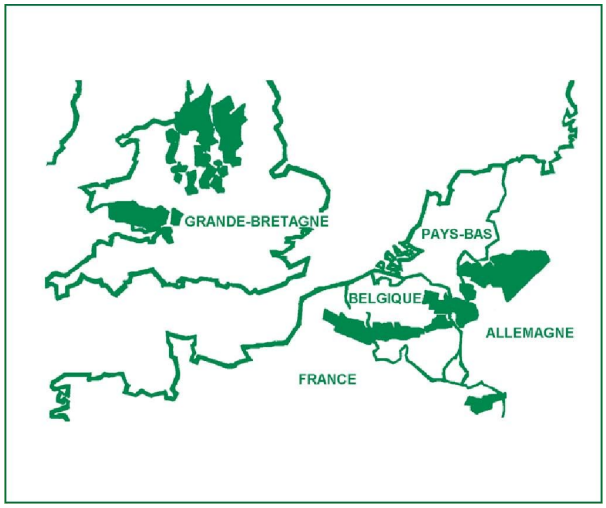

Fig. 1 Location of main oil deposits in North-Western Europe

Exploited since the Middle Age, the successive veins were the fortune of the Western countries at the beginning of the industrial revolution.

Two countries record this type of development: UK and Belgium.

The Walloon valley is covered with coal mines surrounded by mining estates and scattered with industrial castles. The region is prosperous and the overall economical benefits f the country are significant.

The exploitation techniques bring at surface the fuel, as well as the non-usable materials mixed with the coal. These residues are stored in the vicinity of the extraction areas and the materials deposit of deposit naturally set up a more or less high hill and more or less sharp, called slag heap or coal tip, depending on the region.

Upon discontinuation of the slag heaps loading, a new life begins for these abandoned debris, which are covered by vegetation, and sometimes turn into real forests in the middle of towns.

Nowadays, these represent the most visible relics of the mining exploitation and will remain there for long time. The slag heaps are considered as an essential connecting thread, appreciated within this mining region and for the entire history thereof.

2.1. Territory, Urbanization and Landscape of Charleroi (Belgium)

The great landscape and geographical units

A recent study of Conférence Permanente du Développement Territorial (CPDT) on the Walloon landscapes highlight the importance of slag heaps in the landscape of Charleroi agglomerations: "landscape of dense urbanization where the loud habitat and industry are intertwined with scattered slag heaps and green areas".

It is true that, for few decades already, the slag heaps play an important role in this indispensable third dimension of the landscape composition. They point out the landscape, catching attention, closing the perspectives, enclosing the districts.

First of all they are reference points, which can be recognized by their size, shape and the characteristics of their vegetation.

Nowadays they are anchored in cross programs of Charleroi 2020 as *natural values o be preserved*. The slag heaps are transformed and improved, and become "eco-symbols".

Fig. 1 – Images of tailings deposits.

Thanks to this rehabilitation, through the slag heaps the city of Charleroi recovers its past and even better, is anchored for the future.

The slag heaps become the expression of Charleroi and currently represent an ecological, landscape and environmental capital relevant as

freestanding in a range of approaches: sensitive, historical, sociological, nature-related, touristic, geographical.

The conjugation thereof can only be built across the concept of "***landscape ecology"***.

This concept should be implemented in the future analyses on the capitalization of slag heaps. The ecology of the landscape should apply with respect to each approach concerning a slag heap.

The ecology of landscape is an interdisciplinary orchestration, a "Russian dolls" analyzing method, enabling us to determine a diagnosis for various opinions.

2.2. The Landscape Charter

A tool specific for the sustainable development to be created

In 1992, the Rio conference on environment and development attracted the attention of all countries on the decrease of biodiversity.

We consider that one quarter of the world biodiversity might be lost in the next 30 years, whereas 150 to 200 species disappear every year and 10 million of forest hectares also disappear every year. It was found concerning natural resources that the problem of biodiversity depletion was huge. If the biodiversity is endangered throughout the world, this could happen here as well.

Or, despite the obvious urban positioning, in Charleroi exist a large number of semi-natural environments which, currently, foster a botanical and faunal diversity. Among these areas listed by P.C.D.N., the slag heaps with significant areas have important functions in the ecological network and densely canvas the territory of Charleroi.

The slag heaps are perceived as "savage" and "natural" environments, fact that differentiates them from other green areas – parks and gardens – perceived as of an "organized" nature.

For about ten years, the concept of nature has widened and now also includes the slag heaps. The slag heaps, merely alone, have an important biodiversity capital. For instance: only at the slag heaps of Martinet à Roux, more than 200 plant species and 50 species of birds were listed, without counting the insects, amphibians and others. All 50 hectares are reclaimed by an original vegetation of various biotopes, wetlands, sources, pioneer and grassy areas, forest… so many different biotopes united as a whole.

The slag heaps, with the surface and volume, have a significant importance in the improvement of the biological and landscape diversity of Charleroi of Wallonia in general. The degradation of their landscape structure would automatically generate the loss of existing ecosystems.

Or, an ecosystem represents health and thus is sustainable. In a landscape marked by a hard industrial inheritance, the preservation of sustainable ecological health makes us think about the future preservation of slag heaps.

The Walloon region committed to implement the European convention on Open landscapes signed in Florence, on October 20, 2000, and ratified through a Decree on December 20, 2001.

The study of a landscape map of Charleroi will become a public action with various influences: the ecological knowledge, but also the history of the place, the singularities and diversity of the players; it is crucial to favor a shared and always renewed vision of the territory.

3. The Strengths of Slag Heaps

The slag heaps are everywhere, the clusters have a name: environmental strengths, living environment improvement, restoration of biodiversity, social cohesion and dynamics, touristic, patrimonial, cultural strengths. In this context, the roots of people and cultural landscapes remain deep and the family ties are obvious.

3.1. Ecological Strengths

a) *Nature and city, a semi-natural environment*

With industry as root, Charleroi is currently covered by forests as a result of slag heaps. The slag heaps, symbol of the city, are servicing the general public. The slag heaps are taken over, inter alia, as usability places, participating in the animation of certain districts.

The Black Country is over, this is a world of forces and energies associated with reborn nature which states the living nature of the slag heaps.

b) *Richness and diversity of environments*

Wide and large spaces emerged from this artificial black slag dumps consisting of a mix of waste generated by the extraction of oil.

The slag heaps are expressive, they indicate the geography, the manifestation of life, flowers, insects, birds, rodents, plants, trees and reeds.

Fig. 2 – Images of deposits under rehabilitation.

Here take place many complex exchanges and influences. We are talking about the ecosystem of a slag heap.

The ecosystem of a slag heap depends on:

- the existing place and environment;
- the orientation and gradient of the slopes, the erosion or stability thereof, the humidity and texture of the soil;

The slag heaps, through their structure and morphology, represent a biotope with extremely special, sometimes rare microclimates.

c) *P.C.D.N. and the legitimacy of slag heaps protection*

Since 1998, four letters are recorded at the level of nature development in Charleroi : P.C.D.N., for the Communal Nature Development Plan.

This represents a response to a cry of alarm concerning the important losses of the biodiversity and the establishment of the 3 dimensions: economical, social and environmental of sustainable development.

In 1998, the city of Charleroi committed to take the way of P.C.D.N.

The city of Charleroi covers an area of 10,207 hectares for 15 old communes.

Despite the very urban nature thereof, this entity has an important and diversified natural patrimony.

One could say that Charleroi has the capacity of an ecological network and the natural patrimony is overall satisfactory and sometimes remarkable.

The old industrial sites and the old industrial lines, as well as the waterways hold a position of great biological potential.

It is important to identify long-term preservation solutions for these sites with such biodiversity.

3.2. Social Strengths

The slag heaps and the catalyzing role thereof in the community social dynamics have shaped strong cultural identities

The slag heaps represent indispensable borders between an industrial world and a residential district.

The fight for the preservation thereof as buffer area are pro rata with the height and the surface of these slag heaps.

The slag heaps, their slag heaps, become fundamental references in their “sanitary” balance, “ecological indicators”, in a district a bit “heckled” by the dust fallout, smells and vision of neighboring industries.

An original social action in response to the district needs was initiated by organizing horse riding courses, adjusted to an educational project on human respect for animals.

And the last, but not least aid was provided by the city of Charleroi by means of a gallop track on the slag heaps site of St Charles. This was possible following the permit to capitalize the slag heaps of St Charles and Bayemont issued to Société Exterbel, which was bound to implement compensatory measures such as the site sanitation, cleaning, supply of soil, leveling.

Mashed and locked up in the shade of slag heaps prior to the exploitation, the equestrian center and the road now benefit from an open space and a better accessibility.

Fig. 3 – The recreation area after rehabilitation.

The exploitation of slag heaps and the related consultative process were made public, generated a work of environmental comprehension and interpretation, source of collective mobilization for a better world and the improvement of their living environment.

The slag heaps are considered differently as landscape or gift of the nature. The wild life is considered as means of defense, is subject to elaborated inventories conducted by scientists. The slag heaps are green and should remain open to the district inhabitants.

In 1997, the city of Charleroi acquired the 52 h, preserved them as such prior to their classification as "nature reserve" and prior to classifying them in category A "unexploitable". A new life begins, the one related to the promotion and arrangement thereof as an "eco-educational site".

On the huge industrial part which still exists, Sambre, after few specific arrangements non restricting for the industry, but secure for the use of cyclo-pedestrians, might change the appearance and might reconnect with the trades and animations of the central city as well as with Maison du Hainaut (quay of Brabant) and Maison du Tourisme of Charleroi.

3.3. Touristic Strengths

Charleroi has a relatively recent touristic development compared to other Walloon cities.

Between the two great openings of the two delimitating streams, the industries in the center, the history of labor and the slag heaps thereof, the physiognomy of Charleroi has its contrasts. City of social nature, born during the industrial revolution, Charleroi intends to capitalize its present and laborious past by means of new touristic attractions.

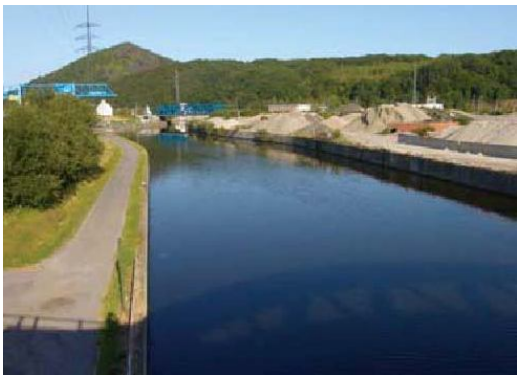

Fig. 3 – The recreation and touristic area.

3.4. Patrimonial Strengths

a) *A landscape shaped by the industry, witness of the hard work and sweat, material component of the current society construction*

The density of slag heaps throughout the territory of Charleroi witnesses the intense mining activity with its peak in the 19th and 20th century. The deposit was distributed among various concessions, each with several pits. Most of the exploitation sites have been decommissioned in the '60s, the slag heaps remaining the sole current vestige.

Fig. 4 – Protection of vegetation on slopes.

Vegetation covered the shale, but the slag heaps are there as a witness of this glorious past and in the memory of people who made them. One should notice that the patrimonial interest of the slag heaps is recognized by the classification of some of them as sites in the context of monuments and sites protection policy: this is the case of St Charles (site of Bois du Cazier) and slag heaps of Martinet.

b) *Buildings of coal mining, infrastructures*

Classified as social patrimony (site and monument) and reinstated as museum of the industry (and also of glass), Bois of Cazier à Marcinelle should become an important touristic pole. This represents the most exhaustive local example of an ancient coal mining with the chassis with knobs, the establishments and pits heads thereof.

We should also mention the rehabilitation of old workshops and stores of coal mining of Monceau-Fontaine à Monceau-sur-Sambre through the actions of social economy.

c) *The habitat and places witness of the social movement*

The estates have traced the urban framework and in particular of the Charleroi city.

The mining companies undertake the edification of houses in order to accommodate the working population at the production locations.

Erected by the same promoter, these houses for workers have the same appearance, a sober architecture, few differences in terms of brick colors, for instance – and quality comes from the homogeneity of series instead of brutal transformations.

3.5. Cultural Strengths

The industrial landscape is quite present in the Museum collections.

Currently it is updated by artists sensitive to the identity of a region and to traces of industrial activity (slag heaps, former industrial sites and abandoned factories), left behind by one of the most extraordinary adventures of modern ages.

Following an exhibition organized in 2001, by the Museum of Fine Arts, on the topic “steel in sculpture”, a project of placing a monumental work of art on the slag heaps.

Fig. 5 – Cultural tourist area.

4. Conclusions

1. For certain countries, such as UK, Germany and the Netherlands, since the announced closure of coal mines, the authorities, without nostalgia, have programmed the scraping thereof and decided the reuse of the sites in a very diverse manner, for a new start.

2. Most slag heaps were capitalized or remodeled in order to merge and mingle with the environment landscapes.

The slag heaps became green areas and turned into parks sometimes on significant areas, with various purposes.

3. In other regions, as in France, the evolution of old "oil" companies generated the "regionalization" of many old mining sites and slag heap, fact that enabled the authorities to plan the future thereof with special attention.

4. For the chain of slag heaps of Nord-Pas-de-Calais region, the new stage of capitalization, social and environmental, consists of the importance granted to the candidature file of the mining basin for the international patrimony of UNESCO. The inclusion thereof in the big family of international patrimony would represent a label and an additional strength for the instauration of a collective preservation charter for the next years.

Many of the old coal mining companies turned into real estate agencies and other are undergoing liquidation or curatorship. The future thereof is uncertain and it is likely that these unprofitable formal industrial sites will be decommissioned and turned into green areas.

5. Knowing their due date would enable us to develop capitalization programs and would provide the time required for joining the competences of local associating dynamics.

6. The preservation of nature and landscape plays an important role because if guarantees biodiversity. This role should also be taken into consideration with respect to public actions.

7. The participation of citizens within the district committees and the affirmation thereof concerning the preservation and adoption of slag heaps. Anchored in the community, historical and cognitive life, this is defined as genuine social treasure which should be used as a criterion of democratic validity. These elements represent three interactive and indispensable components of sustainable development.

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O NOUĂ FORMĂ DE VALORIFICARE A HALDELOR DE ZGURĂ, DINTR-O PERSPECTIVĂ DE DEZVOLTARE DURABILĂ

(Rezumat)

În contextul acțiunilor complexe de protecție a mediului și de valorificare a resurselor naturale, în prezenta lucrare se evidențiază unele oportunități pe care le oferă

depozitele de steril pentru prosperitatea şi dinamismul unor localităţi sau zone în care acestea se găsesc. Se arată că aceste oportunităţi pot fi considerate drept componente interactive şi indispensabile pentru o dezvoltare durabilă. Se fac referiri în special la depozitele de steril aferente industriei miniere/carbonifere, din zona Charleroi, Belgia.

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GIS SOLUTIONS FOR SUSTAINABLE DEVELOPMENT IN AGRITOURISM

BY

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Abstract. The sustainable development and agritourism mainly developed in the last half of the century, but as mass social-economic phenomenon is among the basic activities in many countries, being one of the economic branches with the highest growth perspectives in the future.

The current growth of the Information Society requires the agritourism industry, as well as other financial and trading sectors to develop certain new methodologies based on Internet technology and on modern telecommunications technologies. At European level are already launched support projects for research and design activities in the field of integration and interoperability of suppliers, sellers and consumers of travel services in different geographical areas which ultimately generated open systems, system architectures and protocols which use the new technological facilities and set new business rules.

This paper aims at presenting a GIS/AVL solution in order to support the performance and development of travel services by means of current technologies, by providing maps and information and travel orientation services in a dynamic manner, depending on the tourist’s location. He should be provided with a GPS technology location device and with a device connected to the Internet (laptop and Zapp cell phone or PDA device with GPRS).

The solution was integrated in a mobile communications platform based on GPS technologies (Global Positioning System), GSM, Zapp and Internet, and in

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a Portal Internet type application. The pilot area selected for the experiment has a special tourism potential, including the Suceava – Bucovina area, with the Bucovina, Câmpulung Moldovenesc and Vatra Dornei based monasteries. The solution was tested on the move in Suceava County, with good results.

For the implementation of the GIS Internet solution we used Studio.NET Microsoft platform, Microsoft MapPoint Europe2002 product, vectorial maps in ESRI format representing Suceava Municipality.

Keywords: mobile communications platform; GPS technology; GIS; tourism.

1. Introduction

Within this project are developed and capitalized revolutionary information and communications technologies, as re the satellite positioning technologies (GPS) and the voice and data radio communications ones (GSM, GPRS, WAP, Zapp). Outstanding results and solutions were obtained through the integration of these technologies in remote information services via the Internet or via the networks of mobile operators. AVL technology (Automatic Vehicle Location) represents the integration of GPS and GSM technologies for the automatic location of vehicles.

These conditions required the upgrade and expansion of GIS, from the desktop systems to geographical data and service (applications) servers, provided to the general public via the Internet. The need for mobility and remote communication stimulated the mobile operators to replicate at a lower scale the functionality of personal computers and of the Internet, to provide specific services, and the mobile device manufacturers to develop new types of equipment, some of the most remarkable being the assistant type devices (PDA) and PocketPC integrated with GPS positioning devices and GPRS remote data communication.

The mobile systems and applications serve nowadays the development of GIS, through the collection and transfer of data from the field.

The solution set out in this paper, drafted by ITC-Bucharest and SSIB Bucovina, focused on the extraction and provision of geographical information on the Internet as maps, and on the development of a relatively cheap GIS application, which would not increase the cost of final services to the users.

2. Tourism Services in the Modern Perspective

The touristic potential comprises all attraction factors of the most different nature (natural or anthropic) and the landscape elements where these factors are located, everything forming a touristic offer.

The touristic offer reflects the touristic potential and is subordinated to the touristic demand. **The touristic offer has a certain location which cannot be changed**. The touristic offer has a certain positioning and partial location,

reported to the territorial distribution of the touristic demand (of the region of origin) and acts on two areas: emission and destination. Various ratios of forces are established between the two areas (emission and destination).

With respect to the touristic areas, there are highly requested touristic areas and extensive requested touristic ones (or diffuse). The potential area of a touristic area "expands" as a result of the higher circulation radius following the upgrade of communication paths and introduction of ultraspeed circulation means. Also, through the expansion of urban centers, these turn from touristic emission centers into wide emission areas.

Also in the case of destination area, complex subordination relations are set up between the nodal center of the cluster, which can consist of a resort location, and the attraction centers and objectives existing in the neighboring area and which can be covered by the tourist in one day, starting from the nodal center.

In this case also intervenes: the relative distance in kilometers, the type of communication path, the means of transport, the time assigned for visitation. From this point of view, the destination area can also be delimitated by certain areas of concentric nature.

In addition to the position and location of a touristic area, one should also consider the accessibility reflected in the tourists' structuring, based on age ranges, incomes and even behavior thereof. The accessibility, connections in the area, type of transport, are mainly important, in particular for weekend tourism, at small distance, in the peri-urban area.

Among the current trends in the growth of international tourism we would like to mention the mass nature of tourism; the internationalization of tourism due to the traveling facilities from one country to another; the diversification of touristic motivation, reflected in new types and forms of tourism; the more and more frequent short-time and short distance recreational tourism, in the peri-urban area of large agglomerations, which generates a specific form of tourism – the weekend tourism.

A variety of tourism forms are practiced within Suceava County, in close interdependence with the existing touristic resources.

The *cultural-religious* tourism is characteristic for Bucovina, favored by the existence of monasteries and other cult establishments. Religious tourism can be seen in two forms:

a) religious cultural tourismreligios;

b) pilgrimage tourism.

Other different forms of tourism can also be noticed, among which the rural tourism (agritourism) with a significant share.

The cultural estate of Suceava County includes:

a) 160 historical monuments and archeological reservations;

b) 11 memorial buildings;

c) 14 artistic monuments of memorial value;

d) 5 architecture reservations.

3. Motivations for GIS Application in Agritourism Services and Sustainable Development

In this new millennium, the climate of modern business is determined by the revolution of information technology. The companies use technological innovations for economic benefits. Often technology is used in a formal manner, because it exists, is trendy and can potentially improve the image, without previously setting the **necessity to solve a problem** set in the functionality of the existing system.

Knowing the business specifics, on the one hand, and the facilities provided by technology, on the other hand, can lead to remarkable **solutions** for the improvement of business climate and new customer serving methods.

The analysis and solution implementation field was tourism.

A. Specifics of the tourism orientation information

Tourism orientation implies, for an area of touristic interest, the correlation of the following types of information:

i) **basic information** (address, geographic coordinates, vicinities) – positioning-related (tourist, objectives) on a map;

ii) **thematic information**, intended for highlighting the geographical potential, the cultural, ethnographic, social value of the objectives;

iii) **infrastructure information** (condition of the road/river/maritime/ airway access roads, **telecommunications**);

iv) **information on related services** (healthcare, car service units, traffic police)

in order to optimize the selection of a route and also to assist the tourist under emergency situations.

B. Complexity of the touristic information

The touristic orientation information is a complex type of information because in fact includes several categories of information, generally originating from various sources. In order to achieve its purpose, such information should be the answer to a dynamic, customized demand.

Or solution intended to answer the requirements on the integration of geographic data with the non-geographic and location ones (acquired through the AVL technology) and on the data provision as a public service, in a dynamic manner, depending on the geographical location of the tourist and on the touristic interest thereof.

4. GIS Services on the Internet

GIS Internet applications are **new solutions** which enable the data analysis and processing to take place in the web browser, leading to flexible and interactive applications. There are three approaches in this respect: a) GIS extensions for the Internet browsers (*plug-ins*); b) assistant type software (*helper/wizard*); c) ActiveX controls and Java *applets* (small interactive software).

The new GIS Internet solutions are conditioned by the Internet connection bandwidth (limitation of data volume and processing speed).

The client solutions are divided into two classes:

- Thin client;

The data processing on the server and the provision of static, non-interactive imeges to the client;

HTML/ASP (*ActiveServerPages*), JSP (*JavaServerPages*) languages can be used.

The VBScript and JavaScript script languages at the client can provide low customization (resizing the image).

- Thick client;

The data processing on the server and the transfer to the client of vectorial data locally processed by a browser extension, loaded prior to running the application, or by "smart" vectorial data, namely in XML, GML, SVG (*Scalable Vector Graphics*) format. The vectorial data enable to perform at the client detailing, running operations, local change of the displaying parameters, local performance of interrogations (at the client).

This type of solutions use on the client's side: a) browser extensions (plug-ins); b) ActiveX controls; c) Java applets in combination with server applications written in HTML/DHTML/ASP/PHP/ColdFusion or using Java technologies (Java, Java servletsa application servers).

A more recent alternative for interactivity, the reduction of Internet traffic and server occupation degree, is provided by SVG standard.

SVG is a standard developed by WWW Consortium (W3C). It consists of a XML grammar for the 2-D graphic description (shapes, raster images, animation, text). Can be processed by usual XML basics– validation parsers, XML editors, browsers supporting XML. It is use to be transferred on the Internet in compressed form (svg). Enables the overlapping on raster images (GIF, JPEG, PNG). Enables the dynamic handling with Java scripts. Is extensible with server-side technologies (Java servlets, JSP, ASP, PHP, Pearl). Adobe Company developed a free SVG viewer for Internet Explorer. The smart maps developed with SVG enable the immediate connection of graphic elements to non-graphic elements.

A. GIS Internet solutions available on the market

The applications which provide geographical location services on the Internet can use GIS platforms in order to develop the applications and generate maps or customized vertical solutions:

The offering of traditional manufacturers of GIS development media (companies ESRI, MapInfo, Intergraph, AutoDesk) is intended for both the desktop type applications and GIS Internet. Certain manufacturers provide solutions for the integration of GIS applications in the tracking systems (MapInfo, AutoDesk). The offers can be summarized as follows:

- **GIS applications development platforms, which include**;
- Map/spatial data servers with the possibility of addressing map requests in languages derived from XML (*e.g.*, ArcXML);
- Authoring tools for the websites;
- Views for Internet browsers (as plug-ins or ActiveX controls);
- GPS tracking servers;
- Platforms for mobile devices.
- **"Vertical" products with dedicated functions (e.g., for transport), which include:**
- GPS tracking server;
- Customized functions.

B. Offering of Microsoft Company

- MapPoint2002 application, which enables the expansion of functionalities by means of COM technology (*Component Object Model*) or the Internet posting by means of Microsoft ActiveX Document technology;
- Structured service (XML Web Services) MapPoint.NET, hosted on Microsoft servers, for the integration in applications based on location services. Provide services for a fee.

5. Presentation of the General Solution

Our solution contains the following main components (Fig. 1):

- AVL mobile platform
- Internet portal
- GIS application server
- Several types of information access devices (PC, laptop, PDA, cell phone)

The used platform is Microsoft Windows 2003 or V. 2007.

A. Mobile platform

The development of the following mobile hardware platform was required in order to **take over the location information**:

- Laptop provided with the serial interface RS232 and USB port;
- GPS Trimble Lassen SK II receiver connected to the serial interface RS232 of the computer, set to send messages in NMEA standard;
- ZAPP mobile terminal connected to the USB port of the laptop and supplied by means of this port, in order to ensure the mobile Internet connection based on CDMA technology and with TCP/IP protocol.

In order to **geo-encode the objectives** we used an AVL mobile unit which contains a GPS receiver, a GSM modem and RAM memory for the

storage of coordinates and further decoding thereof. The coordinates are received by couple unit located at the premises of our companies.

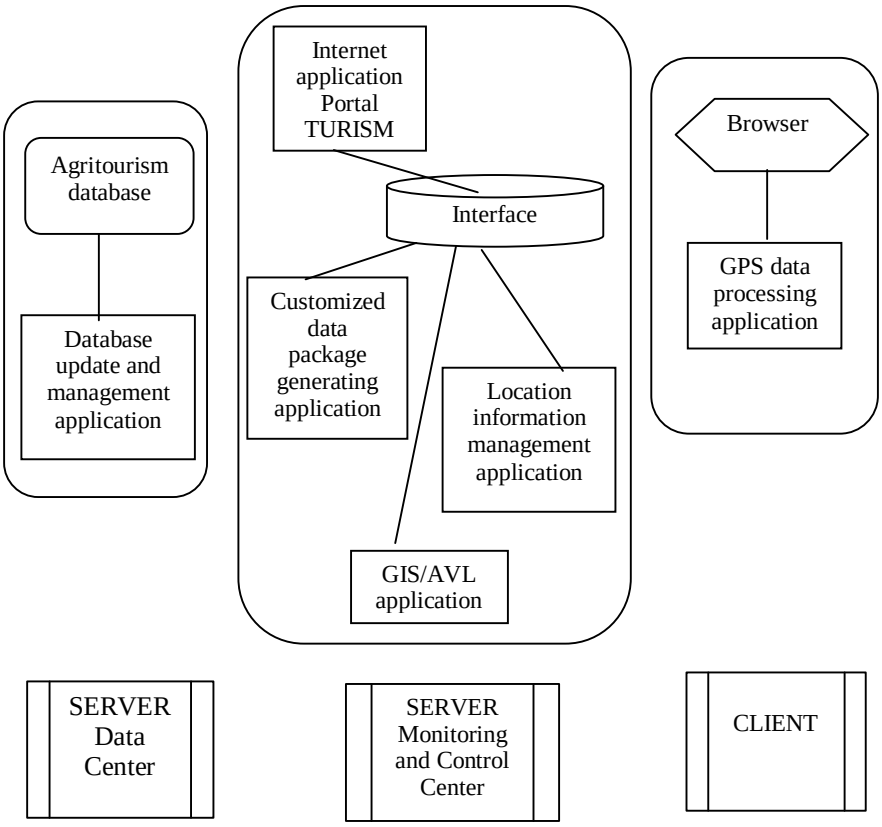

Fig. 1 – General functional architecture.

B. The IT portal

The design of the touristic database for TurismAVL project started from the following premises:

- should contain the information required for online touristic orientation, supporting the tourists in their cars, in remote areas;
- should comply with VATGI European standard (Value Added Thematic Geographical Information) on the exchange of touristic information, in order to ensure the fundament of an open software platform enabling the integration of Romanian values in the international circuit;
- the structure of the database should adjust to the specifics and abundance of Romanian touristic information.

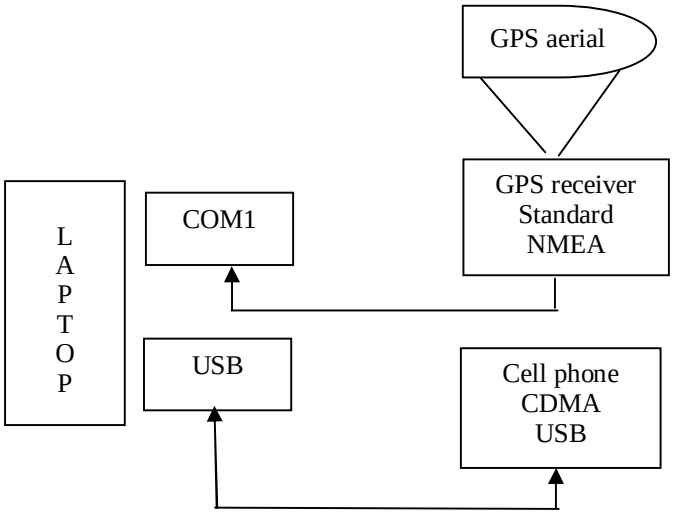

Fig. 2 – Schematic presentation of the GPS data reception hardware platform.

6. Grounds for the Selected Gis Solution

6.1. MapPoint Europe 2002 Product

The MapPoint product is a GIS desktop with reduced development facilities, but with facilities of ***programmatic handling*** of geographic and non-geographic information. The MapPoint Europe 2002 product contains detailed information of European states as well as maps of the other continents.

The geographic coordinates are in **WGS84** (World Geodetic System 1984) format.

MapPoint product contains a **layer** with localities, main and local roads, railways, main and secondary airports, over which the following can be overlapped; **a layer** with topographic (landscape) information, with demographic information and **several layers** of imported data or dynamically linked to the application.

MapPoint product provides the following types of maps through the overlapped several layers:

- Transport routes
- Non-geographical data (demographic, touristic objectives, geographically encoded user data)
- Transport routes and non=geographical data
- Political
- Physical

The possibility to import own geographical data is low, in particular due to the use of a proprietary format (*.ptm). However, it is possible to import vectorial files of shape type in **ESRI format**.

Other characteristics:

- Geo-encoding takes place at the level of geographical coordinates, street addresses, postal codes, demographic data, political data.
- The import of user data takes place in the form of Excel sheets, Microsoft Access database tables or other types which enable the connection via the Universal Data Link (OLE DB, ODBC).
- For mapping can also be used incomplete, inaccurate or non-geo-encoded data. Generally, the data is successfully mapped up to 80%-90%; when the data cannot be mapped, MapPoint displays a list of possibilities.

Microsoft MapPoint2002 provides an objectual programming model and ActiveX control (**MapPoint Control).**

We should mention that Microsoft MapPoint is not a classic geographic system, and furthermore is dedicated for desktop. However, taking into consideration the specifics of the touristic application and the intended GIS functionalities, we **chose Microsoft MapPoint2002 product** due to the following reasons:

Programmability

- integration with the platform and other Microsoft products;
- possibility to use it as OLE server and develop an own GIS application server.
- programmatic control of the application: GIS location/positioning functions, types of maps, characteristics of maps, multi-symbol representation;
- extension of the functionality and/or automation of certain MapPoint functions by creating extensions based on COM technology (*Component Object Model*);
- easy integration with Microsoft products (*Access, Excel, Outlook, Internet Explorer*);

Provided characteristics

- does not require the development of maps, includes the map of Europe;
- possibility of geo-encoding the user data;
- static and dynamic connection to the user data;
- flexible search engine;
- route analyzing and optimizing algorithms;
- module of orientation and route planning extremely detailed, by hours, days, interim stops, cost computation, extremely useful for the touristic application;

Connection to a GPS device

- integrated communication with the GPS receiver, can be used for tests and data collection.

Short time for processing

- Short time for computations, due to the fact that does not require special computation resources, the geographical data being integrated (does not refer to external geographical databases, does not perform conversions).

6.2. Mappoint Concepts

The MapPoint programming model is model-oriented, and contains objects and collections of objects, methods and features of the objects.

The most important objects are *Application, Map, Locations, DataSets, Pushpins, Route, Directions*.

Pushpin

The localities and points of interest on the map can be marked by means of certain objects called "Pushpin". This contains an icon, a label, a locality or a non-geographical data and an identifier defined by the user.

Can be used in order to mark a locality, which can represent a location on the map, an address or any location defined by latitude and longitude or can be a location defined by the user from a database imported in MapPoint.

Are organized in collections, can be accessed sequentially based on a meter of the collection. At its turn, is part of the DataSets collection, which contains all data imported from a database.

Route

A route may include a specification, a set of indications, and/or the representation of a calculated route. The indications can be used in order to create an itinerary and contain information on the distance between segments, the traveling time, the route costs.

Routes can be optimized by time or distance.

7. Presentation of GIS/AVL Solution a ND Results

The GIS solution consisted of:

- identification of GIS services appropriate for the touristic services via the Internet under mobility conditions;
- development of a GIS application server (GIS dispatcher), taking over and servicing the GIS service demands from TurismAVL portal;
- development of the interface between the GIS dispatcher and the portal by means of a Microsoft SQL SERVER database;
- parametrization of the GIS service demand;
- development of an ActiveX component which can be loaded in the HTML client page, taking over the geographical coordinates from the GPS receiver;
- development of HTML pages, sending requests to the GIS dispatcher and displaying the maps;

- geo-encoding of touristic objectives of the pilot Bucovina area by means of the own AVL platform;
- development of ESRI vectorial maps in WGS84 format geographic coordinates, representing the street network of Suceava Municipality and the import thereof in the MapPoint product for touristic orientation in the town.

The GIS dispatcher is an own application which uses Microsoft MapPoint as OLE server.

The dispatcher sequentially services the requests from the portal clients, identifies the type of calling device (PC or mobile device) and provides a map specific for the requested GIS service. The maps are saved as GIF images, of sizes adjusted based on the calling device, which are included in the HTML page of the user.

The client's location takes place through the transmission in the GIS demand parameters of the geographic coordinates of the target area, corresponding to the tourist's position or center of the interest area.

The MapPoint database was not used for the display of touristic objectives because it is incomplete and cannot be dynamically updated, but **own data services**, dynamically linked to MapPoint. The display of objectives on the map was ensured by means of the symbols provided by MapPoint.

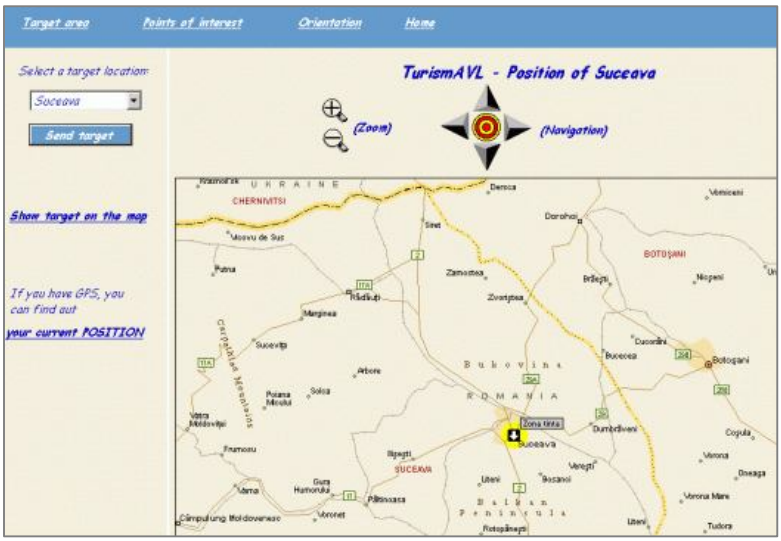

Fig. 3 – The first obtained map from applications.

❑ Implementation manner

The GIS functions are developed with VisualBasic.NET and with the functions library Microsoft MapPoint9.0 Object Library (Europe), available by

means of the ActiveX MapPoint Europe 2002 control. Microsoft MapPoint9 Utilities 1.0 TypeLibrary is also used.

- Implemented GIS services

A. Location Services

The service will have as result a map sector containing the ***target area, target point***.

B. Data Services

Ensure the map representation of touristic interest objectives, by using data provided by the Web services implemented under TurismAVL project. The data is obtained through the interrogation of existing data within 50 km around the target area.

Fig. 4 – The second obtained map from applications.

The objectives are represented with symbols and sensitive areas when pointing the mouse, also called as *"hotspots"*. The objectives are marked on the map with various symbols, which will have attached labels with general information: name; distance from the ***target point***.

C. Map Handling Services

A map centered on the target area is obtained in an implied manner. Through the map handling services, the user is provided with 2 types of ZOOM (detail/perspective) and map moving functions on the 4 cardinal points (PAN functions).

Fig. 5 – Other obtained map from applications

D. Orientation Services

Complex services for obtaining the best route to a certain touristic objective.

All points of the route should be known: the departure point, the destination point, interim stop points, stopping time, envisaged optimizing criterion.

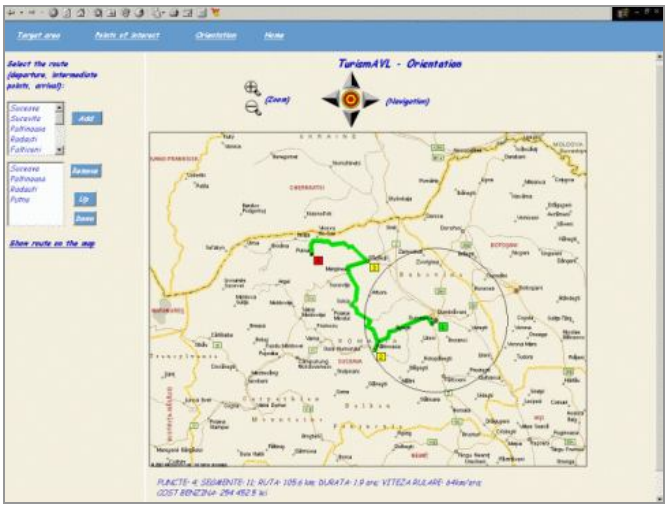

Fig. 5 – Other obtained map from applications.

8. Conclusions

The set out GIS solution is an applicative one, selected based on price and efficient development reasons. Based on Microsoft MapPoint as cheap solution, we depend on the data sources acquired by Microsoft company. Following the test of the system we could find certain accuracy deviations of the geographic data, but we can hope that in the future the data sources for Romania will be of higher quality and provided by local suppliers.

The application which integrates GIS solution is highly complex, but benefits from special support at Suceava County level, required for the geo-encoding of all touristic objectives and the supply of touristic databases.

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SOLUŢII GIS PENTRU DEZVOLTARE DURABILĂ ÎN AGRO-TURISM

(Rezumat)

Dezvoltarea Durabilă şi Agro - Turismul s-au dezvoltat cu deosebire în ultima jumătate de secol, însă ca fenomen social-economic de masă se numeră printre

activităţile de bază în numeroase ţări, fiind una din ramurile economice cu cele mai mari perspective de dezvoltare în viitor.

Actuala dezvoltare a Societăţii Informaţionale impune şi industriei agro-turismului ca şi celorlalte sectoare financiare şi comerciale, necesitatea dezvoltării unor noi metodologii bazate pe tehnologia Internet şi tehnologii moderne de telecomunicaţii. La nivel european s-au lansat deja proiecte suport pentru activităţi de cercetare şi proiectare în domeniul integrării şi interoperabilităţii furnizorilor, vânzătorilor şi consumatorilor de servicii turistice din zone geografice diferite care au avut ca finalitate crearea de sisteme deschise, arhitecturi de sisteme şi protocoale ce folosesc facilităţile noilor tehnologii şi stabilesc noi reguli ale afacerii.

Lucrarea îşi propune să prezinte o soluţie GIS/AVL în sprijinul realizării şi dezvoltării de servicii turistice utilizând tehnologiile actuale, prin oferirea de hărţi şi servicii de informare şi orientare turistică în mod dinamic, în funcţie de localizarea turistului aflat în mobilitate. Este necesar ca acesta să fie dotat cu un dispozitiv de localizare prin tehnologie GPS şi cu unul de conectare la Internet (laptop şi telefon mobil Zapp sau dispozitiv PDA cu GPRS).

Soluţia a fost integrată într-o platformă de comunicaţii mobile bazată pe tehnologiile GPS (*Global Positioning System*), GSM, Zapp şi Internet, respectiv într-o aplicaţie de tip Portal Internet. Zona pilot aleasă pentru experimentare are un potenţial turistic deosebit, fiind vorba despre aria Suceava – Bucovina, cu mânăstirile din Bucovina, Câmpulung Moldovenesc şi Vatra Dornei. Soluţia a fost experimentată în deplasare prin judeţul Suceava, cu rezultate bune.

Pentru implementarea soluţiei de Internet GIS au fost utilizate platforma Microsoft Studio.NET, produsul Microsoft MapPoint Europe2002, hărţi vectoriale în format ESRI reprezentând municipiul Suceava.