

Informational System of Green Spaces using GIS

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Abstract

Many years ago Bucharest was considered the city of gardens. Today, in the XXIst century Bucharest encounters, like many other major cities of the world, many urban problems, which affect more and more the life quality of its inhabitants.

One of the great failures of Bucharest administration is linked with insufficient green spaces. It is a real "crisis" - which was accentuated after 1990 - when the "fever" of construction significantly reduced the "green" urban environment.

The purpose of this application is to create a basis for inventory of green spaces in the Lacul Tei Boulevard, which will be constituted as an informational GIS system. This database includes:

- The inventory of green areas with analysis and functional connections;
- Qualitative and quantitative description of vegetation;
- Highlighting the type of property and administration type.

The inventory will result in a proper management of green spaces with the potential implications on the quality and safety of life, ensuring the creation of a monitoring system of green spaces and degraded land. The advantage is that – based on this inventory – all these pieces of land can be recovered as green spaces, to ensure environmental quality, as well the health of the population.

Keywords

GIS analysis, informational system, green spaces, functional relationships, ArcGIS, spatial analysis, development

6. 1. Introduction

The green represents the living element, must be considered the guard element which has a significant role of control in the city's image.

"Public space is an essential part of urban heritage, a strong element in the architectural and aesthetic appearance of the city, plays an important, educational role, is ecologically significant, it is important for social interaction, supports community development and it is encouraging for the objectives and economic activities. It has an important role in the provision of the facilities for the recreational and leisure needs of the community and has a major value in improving environmental conditions, helps economic revival of cities, not only by creating jobs but also through an increase of the city's attractiveness, as a place for investment and business and residential areas in demand." (Recommendation on Urban Space 86/11, 1986, quoted in urban green space and Parks, CIWEM)

However green spaces offer a variety of benefits in terms of environmental, social but also economic and the present application helps their maintenance and development.

"Informational System of Green Spaces using GIS is an application which can provide any user information about the health of the vegetation from an area of interest ((in this case the perimeter bounded by Lacul Tei Boulevard, Barbu Vacarescu Street respectively Ștefan cel Mare Road). Also, this application can be a source of information for organizations that are primarily designed to protect the environment by maintaining the health of vegetation in green areas. (<http://www.spatiiverzi.org.ro/>).

This database can serve the real estate system by providing information on the environmental quality to the potential buyers of properties in a given area.

The application created can be also used as support for the inventory system of green spaces. (REGVER). Evidence aims to organize their rational use, effective regeneration and protection of them, with exercising the systematic control of qualitative and quantitative changes, as well as providing information about the green spaces.

Informational System of Green Spaces using GIS,
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2. Green spaces problem

The restriction of green spaces in urban ecological risks strongly accentuates the negative impacts of the quality of life and health status of the population. Bucharest has a net loss of green space average surface, i.e. 9,67 m²/inhabitant, compared with the standard of the European Union which is 26 m²/inhabitant.

It is estimated that Bucharest has lost since 1990 and to date, over 1.5 million trees, green areas extinction rate is estimated at 100 ha / year, which explains halving the green spaces of the capital's city area (National Journal no. 4658 / April 24, 2008, p. 5).

The term green space is defined as – “the green zone within cities and municipalities, defined as a system of semi-natural ecosystems whose specificity is determined by vegetation (wood, tree, shrub and herbaceous Flowerly)” (Law 24/2007) “which contribute to improving the quality of urban environment, by satisfying the need for recreation and rest of the urban population, by producing oxygen and absorbing pollutants from urban air by changing the aesthetic appearance and improving the microclimate” (Dinca C., 2008).

Negative aspects affecting the quality of life of the population of Bucharest city leads the reputed architect Gheorghe Leahu to call it "a maimed, assaulted and humiliated city", in which "We the people are marked by urban chaos that surrounds us, of noise pollution, of destruction of green spaces...." (Romania free no. 5660/14 October 2008, p. 5).

In Europe, on 11 January 2004 the European Commission adopted the Communication COM (2004) 60 "Towards a Thematic Strategy on the Urban Environment" which defines the Commission's ideas on the Thematic Strategy on the Urban Environment which was adopted in December 2005. Communication identifies the problems facing Europe's urban areas, focusing on four priority themes:[6]

- environmental management in urban areas, addressing issues such as the role of (NGOs) and civil society in local planning new administrative systems;
- urban transport refers, inter alia, the issue of transport management, general trends in the evolution of traffic;
- sustainable construction concerns the legal basis on building regulations, efficiency in using energy and resources, etc.;
- the urban design concerns, for example, the issue of green spaces, the relations between central cities and suburbs, the state of historical buildings.

In the Member States of the European Union, the issue of green spaces is regulated by specific legislation and by the decisions and actions of local public administration.

Internationally, the need for regulation of green spaces in urban areas is provided in the documents and in international conventions such as:

- Brundtland report (1987) that extends the concept of sustainable development and management of cities, and the ONU General Assembly recommended that Member States

should provide at the basis of their national strategies and policy the principles and the criteria of sustainable development.

- Agenda 21 (Rio de Janeiro, 1992) detailing the actions that must guide the concerns of local authorities in shaping the city's prospects;

- The Istanbul Declaration, signed at the United Nations Conference on Human Settlements (Habitat II) in 1996, establishes the need for the sustainable development of human settlements in a world of increasingly urbanized.

International Conventions to which Romania is a party, namely:

- The International Convention for the protection of vegetation, Rome 6.12.1951;

- The Convention concerning the protection of European landscapes, Florence 2000.

3. Solving the problem

Computerized solution for the management of lands with green destination is constructed as the management information system of urban GIS [1] in accordance with provisions of the normative acts concerning the management of green spaces in urban areas.

It has as general objectives the providing of information for:

- protection and preservation of green spaces to maintain their biodiversity;
- maintenance and development of the green spaces protection on maintaining landscapes in order to protect public health, environmental protection and to ensure the quality of life;
- regeneration, expansion improvement of the composition and of the quality of green spaces;
- development and application of a complex of measures for bringing and maintaining green spaces in in the proper condition of their functions;
- identification of deficient areas and carrying out works for the expansion of areas covered with vegetation.

IT solutions goals:

- creating geospatial database of green spaces;
- development of some opportunities of analysis to identify lands with green space, deficient areas in order to establish the necessary of improvement works;
- identification of degraded areas;
- information regarding the correlation between the green spaces with urban development projects;
- track of planting, cutting / pruning activities and works specific to the management of green fond of the municipality of Bucharest;
- create a database containing isolated and protected trees;
- proposals of planting some shrubs, with protection role against pollutants from cars.

Legislation:

- Law No. 24 of 15 January 2007 on the regulation and management of green spaces in urban areas; [8]
- Order No. 1549 of 4 December 2008 on the approval of the technical Rules for setting up the Register of local green

spaces; [9]

• Law No. 313 of 12 October 2009 amending and supplementing Law No. 24/2007 regarding the regulation and management of the green spaces in urban areas. [10]
The concept of urban management information system [5] of green spaces (Fig.1):

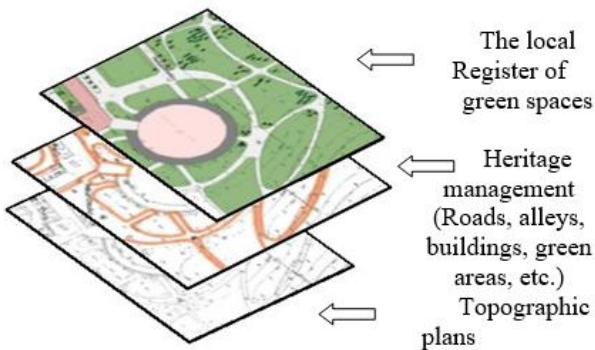


Fig. 1. Concept of urban management

The general functionalities are:

- introduction functionalities and update of geospatial database containing lands with green spaces destination;
- visualization functions of green spaces superimposed over the basic plan of administrative territory in vector format and combined with raster data sets; [2]
- functionalities of analysis and filtering of the lists containing green spaces.

The specific functionalities are:

- input type Hyperlink external links;
- identification of lands destined for green space and their associated data analysis, address, delimitation of green space, and view the site map of green spaces. The application allows the user to identify a field by easy search engines depending of the user requirements. Includes facilities to respond to various questions, such as:

- Where is the object A located?
- Where is the position of A to the position of B?
- How many appearances are of type A, the maximum distance D to B?
- How big is B (surface or area, perimeter, number comprised etc.)?
- What is the result of the intersection of different types of spatial data?
- What is in the points X 1, X 2, ...?
- What objects are near the objects that have certain combinations of attributes?
- Reclassify the objects that have certain combinations of attributes. [5]

Queries - examples

- The management of the land with highlighting keepers and owners, with the outlining the type of property and the way of managing the lands- allow users to view the owners, the management of green space, the type of the property. Based on this information it can be identified any time the

occupied area of green space owned or managed by an entity, information can be grouped by owner, administrator, type of property. In Fig. 2 is highlighted function "Query Builder" with which has been made a classification of green spaces depending on their address, the result is shown in Fig. 3.

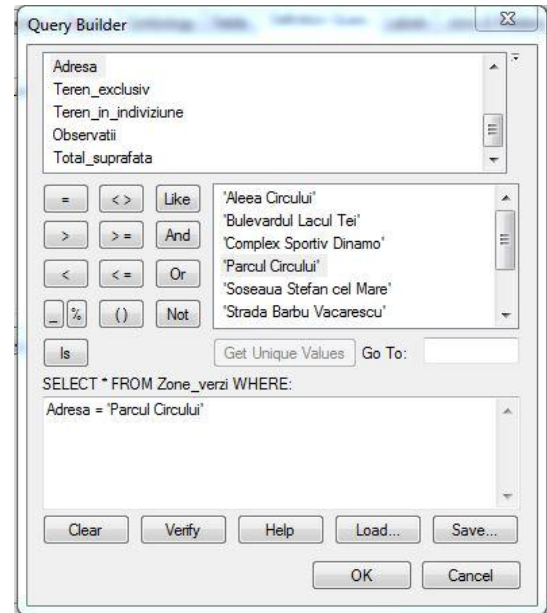


Fig. 2. Function Query Builder

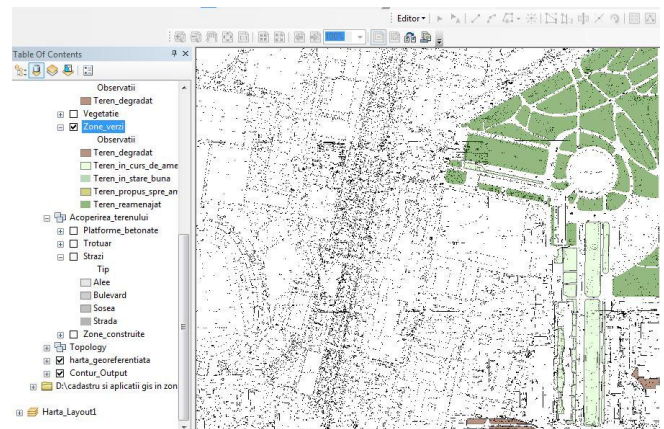


Fig. 3. The result of query

- management of built-up areas, arteries, alleys and sidewalks;
- geospatial data management specific to green spaces - all the information contained in the green space sheet, are introduced in database, using separate fields, differentiated by the type of green space (park, sports, square, street alignments), and are associated to the lands which have green spaces destination, to keep in touch with the identification data of the land;
- data management concerning the existing vegetation on the green space land;
- data management specific to the isolated and protected trees concerning the location, the specie, diameter, stem and crown, height, degree of grooming, age, presence of diseases;

The application allows to do geospatial analysis for the identification of :

- built-up areas, the traffic arteries, of pathways;
- lands defined as green spaces;
- distribution of trees;
- detailed information retrieval (Fig. 4) on:
 - existing vegetation by species, location, diameter, height, degree of maintenance (100% trimming, 75% trimming, 50% trimming, 25% trimming), disease (yes / no), crown diameter, property type (public / private), age, type (isolated / hedge / shrub / hedge);
 - green areas by owner, property type (public / private), address, land state (land degraded, land under development, good land, land proposed for landscaping, playground refurbished).

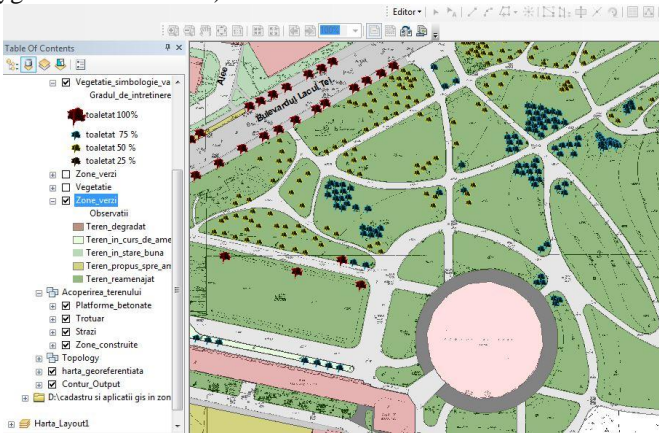


Fig. 4. Detail information

It was made a classification according to the number of trees on the green space (Fig. 5), the light colour representing the green spaces that include a smaller number of trees, intensifying with the increasing of their number.

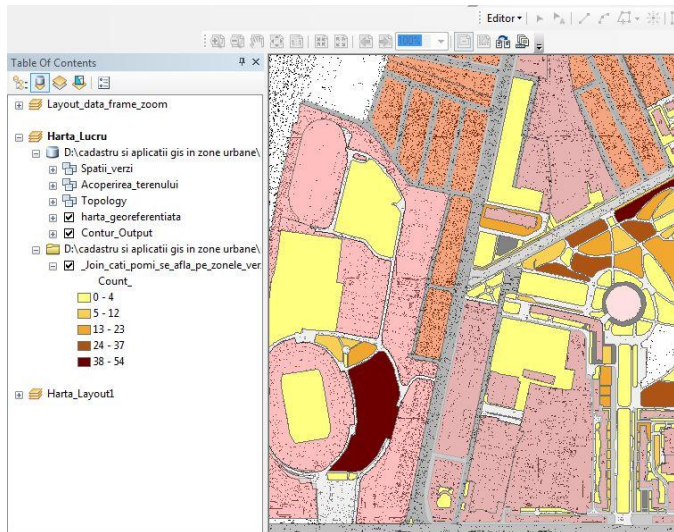


Fig. 5. Classification according to the number of trees on the green space

Based on the data and information collected will be generated graphical reports [12], thematic maps (Fig.6),

diagrams or text in order to:

- a) database maintenance;
- b) regular updating of local Register of green spaces;
- c) ensuring decisional support of public authority in the management of village green fund, cutting, trimming, replanting, etc.
- d) provision of a record and track of documentation related to the activities of cutting/grooming or other administrative measures specific to the village green fund management.

Analiza Geospațială a spațiilor verzi - Zona Lacul Tei

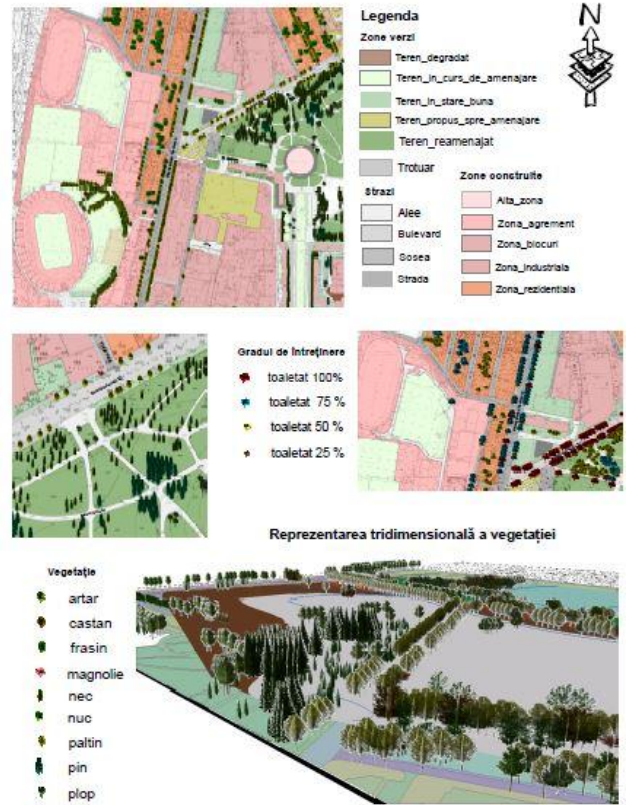


Fig. 6. Thematic Map

In figure 7 is presented the approach of information for solving the proposed application.

In terms of organization and modeling of data structures we started from the provisions of Order No. 1549 of 4 December 2008, concerning the approval of technical rules for setting up the local Register of green spaces.

Pursuant to Law no. 24/2007, track green spaces aims organizing their rational use, their effective protection and regeneration, with the exercise of systematic control of qualitative and quantitative changes, insurance enterprises, institutions, organizations and citizens with information about green spaces.

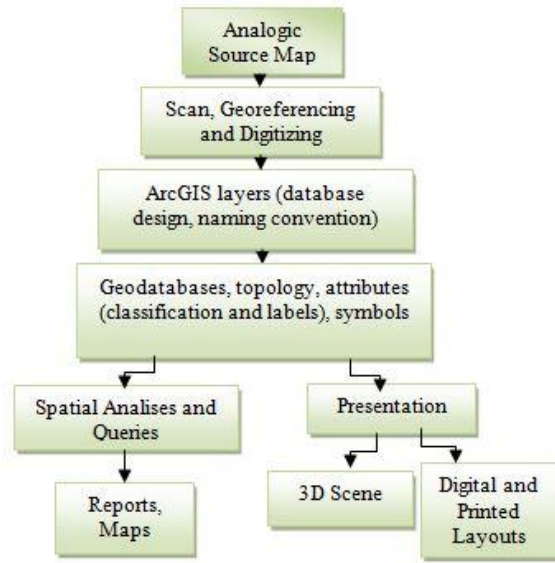


Fig. 7. The base model.

The main objectives provided by developing local registers of green spaces, [4] according to Law No. 24/2004, are:

- a) protection and preservation of green spaces for the maintaining of their biodiversity;
- b) maintenance and development the functions of protection of green spaces concerning waters, soil, climate changes, landscape maintenance in order to protect public health, environmental protection and quality assurance of life;
- c) regeneration, expansion, improvement of composition and quality of green spaces;
- d) development and application of a complex of measures concerning bringing and maintaining green spaces in the proper condition of their functions;
- e) identification of deficient areas and carrying out works for expanding the areas covered with vegetation;
- f) enlargement of the areas occupied by green spaces through the inclusion in the public green spaces category of lands with ecological or socio-cultural potential.

In accordance with the Law No. 24/2007, the scope of the present technical norms include :

- a) green spaces located on the lands belonging to the public/private domain from built-up area;
- b) lands in built-up area may be rehabilitated and redeveloped as green spaces;
- c) isolated trees (diameter, height) planted beside traffic arteries, on the lands of educational institution, housing kits, small-scale places of worship, cemeteries and others too;
- d) protected trees, regardless of health status and their dimensions.

A conceptual model of the database for the green spaces register, is represented in Fig.8.

Through this project, is pursuing the inventory and the transposition on the map in GIS format of green spaces and of existing trees species in Bucharest, as well as the qualitative and quantitative characteristics of these.

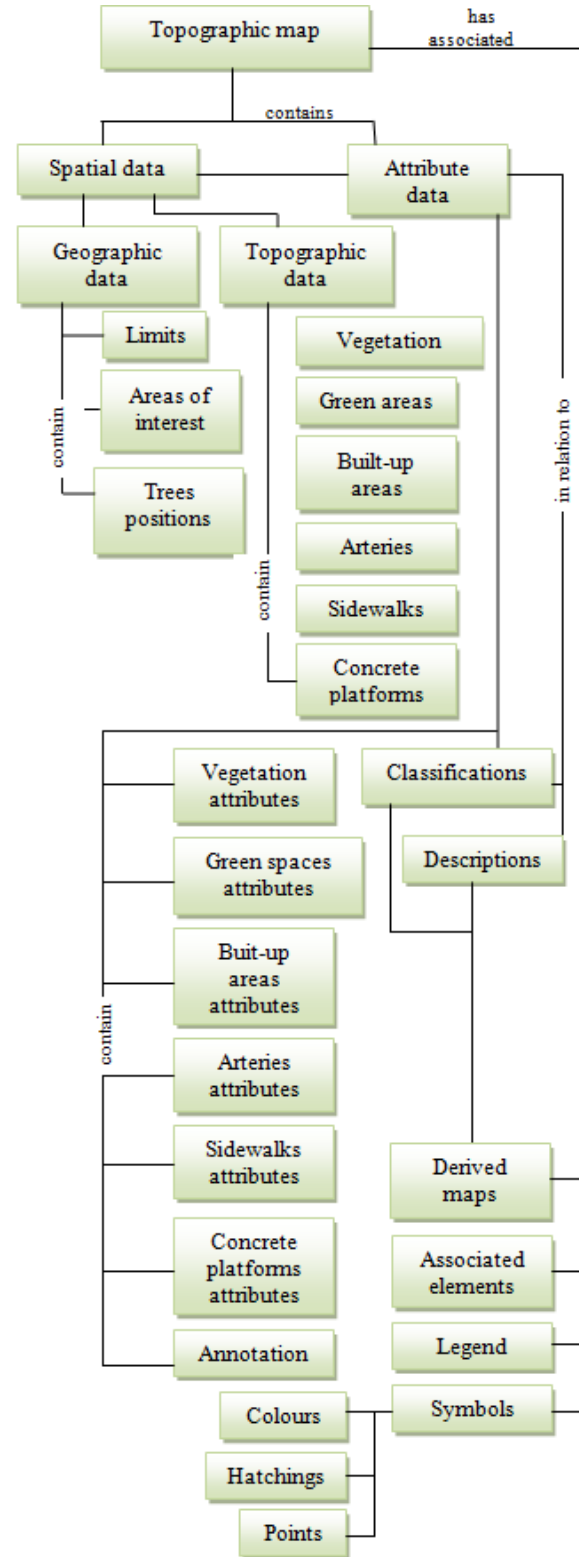


Fig. 8. The conceptual model.

This project represents a step in the sustainable development of the municipality of Bucharest having direct effects in ensuring a healthy and consistent environment under the functional and cultural report, in terms of

preserving the balance towards natural capital resources in the area.

Creating a network of green spaces in connection with the ecosystems of the territory, and raising the standard of living in urban areas, are among the most important strategic objectives of sustainable development, balanced and healthy in the urban areas.

The importance of this project derives from the necessity of a management system of green spaces [12] and existing tree species in the municipality of Bucharest, for a better management of their potential, with implications on both the ecological balance (ecosystems) as well as the safety and quality of life of the inhabitants of the municipality of Bucharest.

In Bucharest there are about 40 parks, some of which, by their landscape or historical value, confers identity to this great city. [7] In addition to these, there are also numerous small green areas, so-called squares, which represent a category of urban "green", with unlimited access, frequented or crossed by many inhabitants of the capital.

The main objectives which are intended to be tracked by using the present application are:

- identification of green spaces which are in disrepair to propose a proper fitting;
- identification of the lands for which is requested sanitation;
- identification of degraded forest vegetation, which require special care an grooming, as well as the identification and the maintenance of protected trees;
- making proposals for better planning and equipping of some parks;
- complaints about cutting the trees of green space of streets and between blocks in the purpose of arranging parking and proposals in order to avoid complete destruction of the green space;
- proposals for setting up new green spaces;
- proposals to plant some shrubs, with protection role against pollutants from cars.

4. Conclusions

By the data and the specific functions, geographic information system is an indispensable tool in urban management from the perspective of a decision support system.

Processing and synthesizing information [11] from the spatial database offers clues and indicators needed to understand the existing situation which together with analysis and simulation applications support urban planning on the short term, medium and long and at the same time allow space views useful for understanding by lay persons in the urban of spatial elements necessary for decisions.

By using GIS data can be more easily managed, modified, supplemented, can achieve further changes. [3]

GIS database can be managed on a dedicated server, where the information can be viewed and edited concurrently by

several users, so that it matches the reality on the ground.

Database attributes can be developed with new types of data, linked in relational way database, which can help to achieve specific queries that generate the final new maps.

Information system of green spaces as result of work measurement, identification, inventory and mapping of defined lands as green spaces and to collect specific information on species of existing vegetation and trees, with the determination of qualitative and quantitative indicators, will include digital map type GIS, database on green spaces, specific nomenclatures lists.

References

- [1] Gomarasca, M.A., Basics of Geomatics, Ed. Springer Science+Business Media B.V. 2009;
- [2] Ian, M., Francois, S., Gis Difussion, Ed. Taylor and Francis, 1996;
- [3] Badea, A .C., Badea, G., The Advantages of Creating Compound GIS Functions for Automated Workflow, 2013, 13th SGEM GeoConference on Informatics, Geoinformatics And Remote Sensing, www.sgem.org, SGEM2013 Conference Proceedings, ISBN 978-954-91818-9-0 / ISSN 1314-2704, June 16-22, 2013, Vol. 1, 943 - 950 pp DOI:10.5593/SGEM2013/BB2.V1/S11.043;
- [4] Technical Rules for the application of Law No. 24/2007 on the regulation and management of green spaces in urban areas, the Ministry of Development, Public Works and Housing, 2008, (http://www.mdrl.ro/_documente/transparenta/consultari_publice/consultare61/norme.pdf), (accessed Jan.2015);
- [5] <http://sig.trei.ro/part1.htm> (accessed Jan. 2015);
- [6] <http://www.revistacalitateavietii.ro/2009/CV-3-42009/03.pdf> (accessed Jan. 2015);
- [7] <http://www.ps2.ro/> (accessed Feb. 2015);
- [8] Law no. 24 of 15 January 2007 on the regulation and management of green spaces in urban areas;
- [9] Order No. 1549 of 4 December 2008 on the approval of the technical Rules for setting up the Register of local green spaces;
- [10] Law No. 313 of 12 October 2009 amending and supplementing Law no. 24/2007 regarding the regulation and management of the green spaces in urban areas;
- [11] Clinici, T. S., Badea, A .C., Badea, G., Aplication of Topological Rules and Spatial Analysis for Identification of Cadastral Issues, 2012, 12th International Multidisciplinary Scientific GeoConference, www.sgem.org, SGEM2012 Conference Proceedings/ ISSN 1314-2704, June 17-23, 2012, Vol. 2, 973 - 980 pp, DOI: 10.5593/sgem2012/s09.v2007;
- [12] Badea, A .C., Badea, G., Cadastru, bănci de date și aplicații GIS în zone urbane, Editura Conspress, 2014, ISBN 978-973-100-310-8, <http://www.agir.ro/carte/cadastru-banci-de-date-si-aplicatii-gis-in-zone-urbane-121878.html>