CONTRIBUTIONS TO THE DEVELOPING OF THE REGISTER OF ADDRESSES IN REPUBLIC OF MOLDOVA

Vasile GRAMA, Assoc. prof., dr., Technical University of Moldova, Department of Geodesy, Cadastre and Geotechnics, Chişinău, Republic of Moldova , vasile.grama@gcg.utm.md,
Livia NISTOR-LOPATENCO, Assoc. prof., dr., Technical University of Moldova, Department of Geodesy, Cadastre and Geotechnics, Chişinău, Republic of Moldova , nistor.livia@gmail.com,
Andrei IACOVLEV, Engineer, PhD student, Technical University of Moldova, Department of Geodesy, Cadastre and Geotechnics, Chişinău, Republic of Moldova , iacovlev.andrei@gmail.com,
Marin PRODAN, Engineer, prodanmn@gmail.com, Technical University of Moldova, Department of Geodesy, Cadastre and Geotechnics, Chişinău, Republic of Moldova

Abstract: *An increase in cross-border economical and social relationship between RM and European Union puts a demand for easy access to the information of the national system of Addresses in order to facilitate the free movement of persons, capital and goods. In the same time the primary objective of creating the Register of Addresses is to create the address system on the RM having a unique identifier and ensure quality support for elections and all companies operating in the republic make use of this system. Developing the register include legal component and technical component based on geographic information technologies. In this article presents a comparative analysis of two approaches 1) using ArcGIS platform module "Attribute Assistant" and 2) Web GIS platform built on open source components MapServer, OpenLayers, PostGIS for collecting, integrating and operating with geospatial data.*

Key words: Registry, address, geographic information technology

1. Introduction

Significant increase exchange of goods, of the degree of mobility and cross-border transactions, mainly of real estate between subjects from Moldova and the European Union, imposes certain specific requirements for easy access to information relating to real estate, their location, configuration and theirs addresses. One of the main conditions in this regard, convened also in the Association Agreement between the European Union is harmonization of national legislation with the EU legislation.

An important element is accuracy and uniqueness of information/data which are used for the public purposes. Thus, thematic data collected are systematized in registers. The term "register" means a notebook, system of sheets which records various data / information and official documents. Law no. 71 of the RM from 22.03.2007, on registers, defines the notion of register, as the totality of documented information, kept manually or by computer systems, collected and organized in accordance with the requirements of the law [3] .

In Moldova is considered authentic and official information which are inscribed in the state register. According to law no. 72. Art. 6, paragraph 2) **State Register is the sole official source of data about objects registered in it.** Data from registry is considered accurate and

true, until proven otherwise. This provides real support for sustainable development, in that the creation and keeping of records of state take into account the following principles and rules:

- o   legality of created register;
- o   protection of rights for individual and legal persons;
- o   protection of personal data of individuals;
- o   continuity to maintaining the register;
- o   use of unique method of creating and keeping registers;
- o   uniquely identify each object registry, using the state system of identifiers;
- o   granting unauthorized access to registry data;
- o   entering data into the register in one language.

In order to improve legislation and adjusting the national legislation to international standards and best practices, it was necessary to create and operate a system of addresses throughout the Republic of Moldova. For the national managements of **Register of addresses** the unification process within the EU has become a major point of developing.

Address is the concept known to the public, and everyone knows their own address. Therefore it is an important key into the other systems, for example juridical registration, condominium (housing cooperative) register or property registers. Address is also an important key to the consumers' registers, post and distribution registers, and other location and position services. All this requires a good and well-functioning system for address provision and management in the municipalities [2].

According to INSPIRE directive, the addresses serve several generic purposes, including: location, identification, jurisdiction, sorting and ordering, and emergency response. *General concept of* address is a spatial object that in a human readable way identifies a fixed location of a property.

For this purpose an address has an identifier, e.g. an address number or a building name, which enables a user to distinguish it from the neighbor's addresses, as well as a geographic position, which enables an application to locate the address spatially. The human readable identifier is in the application schema defined as the address "locator". The geographic position is represented as a geographic point.

The data specification defines an address as: "An identification of the fixed location of a property, e.g. plot of land, building, part of building, way of access or other construction, by means of a structured composition of geographic names and identifiers". In the same time specification on *Addresses* is required to facilitate the interoperability of address information between the Member States. Although all national or local address systems share similar concepts and general properties, differences exist in formal and informal standards, rules, schemas and data models within Europe.

The *addressable object* is the spatial object type which can have instances to which it is meaningful to associate addresses in the context of the INSPIRE scope. Address is characterized by spatiality with the structured description explicitly determining the object of address and showing in a locally accepted form. Objects of the register of addresses is territorial unit, a district of republican importance, city, district within a city, settling, village, micro district, block, area, street, side-street, turn, building, apartment.

In this sense, the system of address, have to be a Geographic Information System, in which the database will include the attributive and graphic components.

2. Findings, purpose and requirements

Currently in Moldova does not exist a well functioning register of the addresses or any other information system of the addresses. Multiple institutions or private and state companies have its own registry of the addresses, or use some old set of data. Significantly, is that each of them supplement or develop its own database of addresses, with the addresses that only know of them. So, each of them has a database completely different from what may have another company. Lack of agreements or protocols on data exchange does not offer the possibility of effective communication between users. In such situations it is questioned absolute correctness of data on addresses.

This situation suggests finding institution responsible for creating and managing address system or address register for RM (ex. Agency for Land Relations and Cadastre of the RM, National Bureau of Statistics etc.). It is important that the responsible institution, besides creating and managing registry, to develop the public services on addresses. In the context of Moldova's integration into the European Union, one of the conditions is to ensure the compatibility of the address system with the rules of the European Convention on the protection of fundamental human rights and freedoms.

The main aim for develop the address register is to create a framework for regulating the conditions and modality for establishing the addresses, including determining the objects for which must be assigned address. Also one of the main conditions is the need for use of uniformity practices across the country, including some mandatory rules to be respected by all actors involved in the process.

The information of address system must be not only a in tabular format (attribute data) but in common with the graphics (spatial data), which is lacking today in many companies. Moreover, today's by applying different kind of software it is possible for collecting and processing different types of spatial and non-spatial data

One the primary objective of creating the Register of Addresses (RoA) is to create the address system on the Republic of Moldova, having a unique identifier and ensure that all stakeholders, companies operating in the republic make use of this system. Changes in this system made to any address have to be seen on all pages at a time. It will be possible to get the post address by giving the address identifier or, vice versa, to get the address identifier by showing the post address.

The Register of Addresses must respond the following general requirements:
- Correct entry of new objects of addresses - upon entering new objects of address (building, street, settling, village, district etc.) into RoA, checking of the cases of their coincidence with other objects in the geographical place of location of these objects should be carried out. If any object so entered coincides with any other geographical objects, operation on the entry of the new address should not be performed and the system must inform about it. Otherwise, the operation should be performed;
    - To make alteration to the existing address;
    - To alter names of buildings or numbers thereof;
    - Change of a buildings relation;
    - Change of names of streets;
    - Change of a street's relation;
    - Change of territorial units' names;
    - Change of relation of a territorial unit;
    - Change of the object's geometric parameters;
    - Retention of the dates of changes made on the objects and rehabilitation of old values;

- Cancellation of existing data from the Register of Addresses:
  - Possibility of cancellation of a selected region should be ensured,
  - Possibility of cancellation of a street should be ensured,
  - Possibility of cancellation of buildings or structures should be ensured,
  - Existing addresses may be cancelled based on mentioned reasons.
- The system have to has the potential of universal inquiry:
  - Search by a user of the objects of address by the attributes of the object;
  - User's ability to choose any attributes of the results of inquiry;
  - Demonstration of the results of the inquiry in the form of a table or a map, depending on the user's wish;
  - Storing by the system of the given inquiry, changing it and giving the new one.
- Storing the information about all changes made to addresses and objects of address:
  - In the system of RoA, record of information about entering new addresses or objects of address. Information about entering a new address or address of object should be stored;
  - Record of information about the changes of address and items of addresses should be carried out in the system of RoA;
  - Record of information concerning the cancellation of an address or objects of address should be carried out;
  - Upon introduction by a user of certain date into the system of RoA, the list of addresses existing on that date should be given by the system to the user;
- To perform the following operations on the map:
  - Performing geometrical operations on the objects,
  - Performing geometrical operations on the objects,
  - Defining the distance between objects,
  - Defining the certain type of object on the map being the closest to the point,
  - Carrying out searches on the map

The purpose of a good address system assume that "Addresses and signs should ensure that everyone easily can locate and identify buildings, homes and other objects or places that it is important to locate. The address should also serve as localisation object and key to relevant information in private and public registries and archives. Entering of addresses into the Cadastre Registry should contribute to a common address system for the whole country".

To succeed in this, there are several important and necessary factors:

- **Logical and easily understandable - a** good address system has to be structured in a logical and easily understandable way and follow the same rules that the address users are used to and comfortable with, while at the same time being common for the whole country. It is of prime importance that it is logical and easy to understand in order to achieve a quick and efficient distribution, which is especially significant for the emergency services "when the seconds count".
- **Use of street addresses - u**sing street or road addresses as opposed to cadastre addresses is important for a well functioning address system.
- **Visible addresses - i**n order to make buildings, houses and other objects or places easy to find, it is important that a requirement to make addresses visible through signs for address names, address numbers, unit numbers etc. is included in the address system regulations.
- **Clearly defined administrative routines -** here must be clearly defined guidelines for the division of responsibilities and tasks within each area of the address work process.
- **Ongoing maintenance - i**t is required that as soon as the decision on the choice, establishment or change of an address name or additional address name is made it

should be registered in the Cadastre. The same requirement applies for assigning or change of an address number, section number, etc.

➢ **Access, distribution and information - i**t is of prime importance to other address users that there is ongoing maintenance of the Cadastre whether they get access. It is also important that routines are in place for how and to whom it is expedient or necessary to give notices or information from the address authority.

➢ **Key information in other systems and solutions - a**ddress is the concept known to the public, and everyone knows their own address. Therefore it is an important key into the other systems, for example register of populations, register or property. Address is also an important key to the consumers' registers, post and distribution registers, and other location and position services. All this requires a good and well-functioning system for address provision and management in the municipalities.

3. Development of methodology

Establishing of the technical specifications on the structure and development of address register in Moldova is expected to be completed after the approval of the law on the system of addresses. It will establish legal aspects including the basic terms:

- *address* - all words, numbers, signs spelling, placed in a certain order, indicating the exact geographical position of the addressable object;
- *the number of address* - the unique number attributed to the object, identifying it and distinguish an object from another;
- *addressable object* - object which can be attributed address;
- State registry of addresses - the automated information system and all its data;
- *the automated information system state register of addresses* - all computer hardware and software designed to ensure functionality of registry of addresses;
- *data base of the Informational system automated state register of addresses* - all registrations, documents and graphic information from the state register of addresses on the addressable objects and other data possessed by local administration etc.

Relevant issues such as categories of objects addressable (space objects), uniform principles and procedure of establishing the configuration, the names of thoroughfares and areas of public circulation, also uniform principles and procedure numbering of objects addressable are established by Regulation on the name of arteries of circulation, public circulation areas and numbering of objects addressable. In category addressable objects, are set the following geographical objects:

a) buildings, including unfinished and in future apparent;
b) main entrances to buildings;
c) spaces, including and in future apparent;
d) parks;
e) squares;
f) rest or recreation areas;
g) sports grounds;
h) authorized parking lots;
i) commercial markets;
j) other items in that can be carried authorized human activity.

The way the assignment of the name, renaming or cancellation of the name of the circulation arteries and/or public circulation areas include the technical and legal procedure:

a) preparation of the project for the addresses or a portion of it, indicating artery configuration and direction of movement and / or public circulation area;
b) drafting local council decision regarding the award of name, renaming or cancellation of the name of thoroughfares and / or public circulation area;
c) registration of thoroughfares and / or public circulation areas.

3.1 GIS software utilization

With growing demand for real-time access to spatial data have prompted the geospatial information providers to make the data available over the internet. Geographic data is complex, and the way it is presented must be understandable and exploitable. Database of Automated Information System "State Register of addresses" is composed of two components characteristic for Geographic Information System (GIS):
1. The attributes (non-spatial information),
2. The graphical (spatial data).

3.1.1 The goals

For the purposes of centralized accounting, keeping and use of address data the Address Register should be created in the Republic of Moldova. To accomplish this task we need web browser based application that will be able to:
1. Deliver address information to the citizens of the Republic of Moldova that Agency of Land Relations and Cadastre decides to be publicly available;
2. Allow agencies, local authorities and private companies to access address data via web browser or via OGC protocols (WMS/WFS/WCS) in an authenticated or public manner;
3. API's that will let agencies local authorities and private companies to embed address information and services into their own web-sites.

3.1.2 Specific requirements

The Address Register should be developed using contemporary technologies keeping in view that the user community uses a wide variety of operating systems, computer configurations, browsers and band width. The portal should be developed with the following functionalities:
1. The Address Register will be developed both in Romanian, English as well as in Russian language, with both static and dynamic pages Static pages to provide general information on environmental resources, scientific documents etc. Dynamic pages may be populated with information from the database to provide data, plots, etc. for building different scenarios;
2. The Address Register should support information in the form of text, maps, satellite images vector data, raster images and multimedia;
3. It should also be based on Open Standards and should be able to consume OGC compliant web services;
4. The Address Register should have several search criteria useful for the user such as searching by spatial extents, timestamp etc;
5. The Address Register should be designed so that, in normal circumstances, no manual intervention by operational staff is required to keep its operation at a high level of efficiency. The administrator should be provided with an easy to use tool to manage the system. The proposed system should be able to prove its efficiency by considering

the system and data management factor. The administrator should be allowed data provisioning wherein the data duplication can be reduced by utilizing and optimizing existing set of data. The administrator should have the ability to add new roles/uses to the system, delete existing roles/users and manage the permissions for each image for each user/role in the system.

3.2 ArcGIS software

GIS technology mainly includes collecting, systematization and analyzing of information/data. Using ArcGIS tools, which is characterized by simplicity of collecting, recording, editing and database updating for spatial objects, may integrate all specific elements of addresses in Geographic Information System. In order to ensure data interoperability, today is operates through Cloud / Server. Systematization of the information includes the steps of storing, viewing and processing:

- Data storage is carried out through a lot of devices. Mostly data can be collected and stored in databases using mobile phones, GPS devices, desktop software;.
- The data visualization can be achieved using web and desktop applications, mobile devices and many other software that can access server data via Internet;
- Processing of the data collected and stored on the server is performed by desktop application that installs on any machine that can perform computational analysis, filtering, management of data collected. Data analysis can also be performed using web applications on mobile devices, tablets and desktops.

To ensure all three components is using ArcGIS Server, powerful tool for creating and managing web services and of the applications with spatial data. ArcGIS Server is largely implemented in the different local systems, which is service oriented for institutions and use a cloud for storing information. The software creates mapping services able to create and edit items directly in the browser space and support the databases such as:

- PostgreSQL,
- Microsoft SQL Server,
- IBM DB2,
- Informix,
- Oracle.

The portal for ArcGIS create applications for different kind of devices. Dashboard, free application that allows viewing real-time status of spatial objects (seconds). The tool is easy to use and requires no special knowledge. It allows to create dynamic reports using widgets to configure and represent the requested information. Important is the ability to create backups or importing other types of data in the centralized database. The backup is done automatically on request.

Systematization of data allow having a user configuration depending of the role of user which can view, update, query and delete objects from the database. Access to the portal is doing via HTTP / HTTPS, which is a secure connection encapsulated in a flow SSL / TLS that encrypt the data transmitted from a web browser access to the server, it ensures data security.

GIS resources such as maps and globes that have been made available on ArcGIS for Server are referred to as services [4]. The purpose of an ArcGIS Server site is to receive requests to the services, fulfill them, and send results back to client applications that need to use them. The GIS server provides a set of tools that allow you to manage the services, for example, you can use the ArcGIS Server Manager application to add and remove services. It's useful to understand how an ArcGIS Server site is put together so that you can build a site

where GIS services run efficiently and fulfill the needs of your applications. The ArcGIS platform is open and interoperable. Significantly is a possibility editing and correcting addresses using models of different symbolization. These models can be created by a GIS specialist or can be downloaded from the official website web www.esri.com www.arcgis.com. Underlying these models the map tool is "Attribute Assistant" which essentially facilitates the operations of correction and editing spatial and tabular (non-spatial) data.

3.3 Open source solution

3.3.1 Web User Interface

With growing demand for real-time access to spatial data have prompted the geospatial information providers to make the data available over the internet. Geographic data is complex, and the way it is presented must be understandable and exploitable. The clients demand a user-friendly interface, proposing intuitive commands with graphic sophistication to facilitate visualization. Clients also want the interface to fit their own requirement, in terms of data relevancy and functionalities. Finally, continuous adaptation to changing scenario is a reality that geospatial information providers have to tackle. To modify user interfaces at any time and customize them in detail efficient tools are required. Re-usable independent components that can be mixed in unnumbered combinations help service providers to offer user interfaces that fulfill their clients' business cases, in a flexible and cost-effective way.

3.3.2 System architecture

Address Register should support the following operating systems on the backend: Windows, Linux. Database should match the following criteria:
1. Spatially enabled,
2. Compliant with OpenGIS Implementation Specification for Geographic information - Simple feature access,
3. Compliant with Simple Features - SQL - Types and Functions,
4. Basic topology support,
5. Data validation,
6. Coordinate transformation,
7. Programming APIs,
8. Support of replication, clustering, and connection pooling.

Data rendering and delivering software should match the following criteria:
1. Advanced cartographic output
   a. Scale dependent feature drawing and application execution,
   b. Feature labeling including label collision mediation,
   c. TrueType fonts,
   d. Map element automation (scalebar, reference map, and legend),
   e. Thematic mapping using logical or regular expression-based classes.
2. Support for popular scripting and development environments, at least one of the languages from the following list: PHP, Python, Perl, Ruby, Java, NET.
3. Support of numerous Open Geospatial Consortium OGC standards like WMS (client/server), WFS (client/server), WMC, WCS, SLD, GML, SOS.
4. Support of the following raster and vector data formats: TIFF/GeoTIFF, ESRI

shapfiles, PostGIS, ESRI ArcSDE, Oracle Spatial, MapInfo File, GML.
5. On-the-fly map projection support to and from WGS84, MOLDREF99, WGS 84/UTM zone 35N.

Frontend library for displaying map data should match the following criteria:
1. Pure JavaScript, should not require additional 3rd party plugins,
2. Supported browsers: Safari, Chrome, Firefox 4.*, Firefox 3.6.*, IE 9.0, IE 8.0, IE 7.0, IE 6.0.

3.3.2 User interface and workflow

For all types of users the interface and workflow will respond to the follows aspects:
1. The application should be available to the users in 3 languages Romanian, English, Russian;
2. Navigation, user should be able to pan the map, zoom into a region, change map scale, zoom to maximum extents;
3. Control layer visibility;
4. Legend of visible layers;
5. Get information about geographical features. For example by clicking on the road it's name, reference, pavement type would be displayed;
6. Search available vector layers by their attributes. For example if the user types *M* and select the layer roads and the attribute name It should display all roads with name containing letter *M*. User should be able to click on each individual feature to zoom into and limit the search to the current map window extents.
7. Measure distances and areas
8. Printing current map layout
9. Share current map layout. User should be able to get an URL that contains information about current map layout (position, zoom, visible layers), if someone will open this link he will get zoomed to exact same position and visible layers.
10. Quick search with auto-complete using address database. This text box should always be available to the user while he is working with the map. By typing the address in this text box user will select from the list of found addresses and zoom to the selected one.
11. Display of metadata for each layer like title, description, data provider, access constraints, contact information, etc.
12. Geolocation, use browser geolocation API if available to determine user's position.

The automated system RoA includes user authentication and data (layers) editing. The Administrator interface and work flow is creating. The information systems have ability to create complex cartographic symbols and manage data (vector and raster). The automated system RoA created on the base of the open source platform was test via application of the Apache HTTP server benchmarking tool [5], the test application was supported the deliverers of more then **300** requests per second for a 256x256 cached tile image of the ortophoto layer and more then **30** requests per second for a WMS request with parameters WIDTH=1280&HEIGHT=1024&FORMAT=image/jpeg of the ortophoto layer. The test was done with a separate machine over gigabit Ethernet.

In context of security content and services should be protected by the user role-based access control configured from administrator panel. Users should be able to access the server via https and application should be tested for the common vulnerabilities like SQL injections, cross site scripting, remote code execution. A firewall should be properly configured.

4. Conclusions

1. State Register of addresses with truthful information, continuously updated and available to the public, is a real support for the sustainable development of RM.

2. The flexible framework and collaborative culture of open source programs are both important characteristics in applied oriented projects (RoA), where the application in question is constantly evolving, therefore the data preparation tools can frequently be altered in turn. It's continually evolving in real time as developers add to it and modify it, which means it can be better quality and more secure and less prone to bugs than proprietary systems.

3. The weakest point of the open-source solution for address register is lack of qualified personnel for the maintenance of the address register system implemented for a rather long period of time in Moldova. Taking into account security reasons, at least 2 persons (administrators who can well enough manage address register information system) should be employed at the address register holder with a rather good remuneration. By solving this issue no more technical problems with open source solution should be encountered.

4. To succsed in developing RoA is necessary 1) clear law on address system and good manual for addressing should be adopted and 2) clear procedure for correcting linguistic errors in street names and abbreviations taking into account peoples register and property register existing data should be established.

5. Data reviewer it's simple to use, who automatically find, record, and track the information from de others features. Data reviewer allows a quickly access and view for a tabular data (non-spatial) and geographical with any operating system, mobile phones, tablets etc. The advantage of ArcGIS instrument is: Achieve Consistent Quality Control, save time, Retain Organization Knowledge, Increase Transparency. [6]

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