Registration and Time Updating of Objects in Public Registers and Impacts of These Operations on Spatial Data Integration for the Needs of Creation of the Spatial Information Infrastructure and the Multi-Dimensional Real Estate Cadastre.

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Key words: Spatial Information Infrastructure, cadastre model, multipurpose cadastre, multi-dimensional real estate cadastre

SUMMARY

Nowadays, in the era of computerisation of various public, and not only public resources, databases of spatial objects have been created for many years, together with assigned attributes. The importance of assigning meaningful and sufficient attributes was not always assumed. It turned out after many years of creation and maintenance of parallel spatial registers, that the majority of them became the public registers and their parallel existence in space, one beside another, must have coincided in one place and must have been integrated. Many countries in the world are at the stage of integration of such public registers; other countries have not considered these issues yet, but they are planning to solve this problems in the future, creating such registers every day. It turns out after deep and wide analyses of created public registers, that it is not possible to integrate them without deep manual interventions, concerning particular objects in these registers. The authors of the paper perform the analysis, which attributes should be assigned to spatial objects at the stage of their generation, in order to allow for their integration, without the necessity of the deep manual intervention, what would also allow for creation a reliable spatial information infrastructure and the multipurpose cadastre, while minimizing financial inputs.

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At the beginning let's try to answer the question: what is the public register? The statutory definition of a public register indicates the register as records, a list, a table or another form of records used to implement public tasks, which is maintained by the public entity, basing on separate laws.
The public register is assumed to be created with the use of public funds, so it should be accessible to the public in the electronic way and it should meet the minimum requirements concerning public registers. It means that, apart from its public accessibility in an electronic form, it should ensure timeliness, reliability and accuracy expected from public registers. Hundreds of public registers can be found in every country. The majority of them are not mutually integrated. It is the common situation that every register lives its own life.
One of the most important registers is the real estate cadastre. The primary objective of maintained real estate cadastres is recording rights to real-estate, precise indication of the scope of these rights and their protection. A range of every, physical or legal event, covers a fragment of two- or multidimensional area, which may be associated with different rights; those rights should be respected and protected by pubic registers, which are correctly maintained. Any changes in the field of rights and their scopes should be effective and reflected at the same time by all public registers, which are connected with these changes. An ideal solution would be a real-time recording of these rights, without any delays, which could be a threat for sustainable development in the present age of rapid urbanization.
Considering, inter alia, the correctly developed and maintained cadastre, the international standard called INTERNATIONAL ISO/FDIS STANDARD 19152 - Geographic information — Land Administration Domain Model (LADM) has been established.
ISO 19152 standard has been developed, first of all, to ensure the following functionality:

- to ensure uniformity of definitions of spatial objects definitions, especially with respect to the real estate cadastre, in all countries interested in this model, without a necessity of creating definitions at the level of particular countries, the use of which would enable management of lands in a way that ensures the maximum effectiveness,
- to enable communication between public registers at a countrywide level, as well as between countries, by using the developed models of spatial objects.

As the basis of standard development, the following assumptions can be mentioned:

- it should cover the aspects of space (land) administration at the global scale, depending on a particular country,
- it should ensure the simplicity, which will enable its universal usage at the global scale,
- it should be developed with respect to assumptions existing in the Cadastre 2014, developed by FIG (Cadastre 2014 a vision for a future cadastral system – Kaufmann, Steudler).

Two basic aspects of space administration are important in every country in the world - spatial data in registers concerning the space and land administration should be updated in real time, as the best solution and they should be shared, also in real-time. To meet these two requirements on a country-wide level, as well as internationally, standardization is essential. Unfortunately, in particular countries standardization ends up at the regional level, at the public administration department, or, in the worst cases, which mostly occurs, standardization concerns software environment only and it is not ensured at the country level, in a way, which is independent from the IT environment. On the countrywide level the same database, e.g. the cadastre, has many software environment depending standards.
The assumption during ISO 19152 standard development was to ensure to settle these issues in a way that enables implementation, which ensures uniformity on a country-wide level and internationally. The standard ensures uniform conceptual scheme for many spatial objects in the widely understood multidimensional cadastre, defining, inter alia, the standard concerning spatial objects along with the definition and presentation of the space and spatial data sources, rights, duties and limitations concerning real estates etc. The standard defines two- and three dimensional space with respect to the terrain, buildings and infrastructure.
The standard meets expectations at every level - administrative as well as executive - (acquisition and creation), as well as the presentation of space.
For countries which are at the beginning of the public registers creation process, this standard is the basis for the correct development of these registers, without the need of manual editing, but with simultaneous spatial data integration. Countries which have already created such registers should adapt public registers related to space and space administration during the attempt to integrate these registers or to completely integrate these registers.
A real-time reflectance of changes in public registers would limit and even eliminate all incompatibilities existing between these registers. It would also improve physical and legal, correct management of spatial objects and rights to such objects. These are expectations of users of public registers; expectation of the administrative bodies which create public registers are also similar.
In order to maintain the timeliness of public registers in real time, it is necessary to computerize and integrate them.
Computerization understood in the easiest way, as changing an analog register into a digital one, seems to be an easy and understandable task and, as a technical operation it should not create any fundamental problem. This process is mostly considered in this way by particular departments responsible for particular registers in particular, more or less developed countries of the world.

When a widely understood, Land or Geographic Information Systems (LIS, GIS) appeared, particular countries started to develop such systems at a nearly mass scale. One of the first technical issues concerned the analyses of ways of analog to digital form transformation by means of screen digitization, called also the raster image vectorization. Problems concerning digitization were analyzed, together with problems concerning the possibility to apply manual, semi-automatic and automatic digitization, as well as advantages and disadvantages of particular methods of digitization. Being impressed by technological development of computers we forgot what we computerised and how accurately, focusing on the process of computerization as such, so limiting ourselves to change of analog to digital media and using the fastest possible method of computerization.
During gathering funds for creation of spatial objects in land information systems, every sector has been creating or creates its own databases where the same spatial objects exist but they are described with different attributes or located in different way in the multidimensional space, inter alia, by x, y and z co-ordinates.
The following groups in spatial data environment exist, move, mutually intersect their paths and present packages of mutual expectations:

1. Data provider

A very thin boundary exists in modern public registers between a data provider and a data user. A data provider becomes a data user. In the case of public registers the data provider is always legally authorized. Commonly the data provider is a government or local government authority, acting on the basis of law, established in this field. Public registers are supplied also by data acquired in the course of individual studies of the given thematic scope (i.e. from surveyors, urban planners, architects, builders etc. They supply public registers with individual studies received by these registers).
The government or local government authority, depending on the legal conditions (what activities can be made respecting the country law, which must be applied) may acquire data for public registers in one of ways:
- *independently create public registers data*
There are public authorities developing public registers maintained by them. They employ proper and qualified staff to perform those tasks. However, economic analyses prove that this is one of the most expensive solutions.
- *commission data creation to and individual or a legal entity*
It would be an ideal solution, guaranteeing quality of data, as the public administration body has a full knowledge about individuals and legal entities existing on the market and the quality of services they offer. In the majority of countries this way of ordering services from particular entities is forbidden by legal regulations. One of the major reasons for this is the possibility of corruption.
- *order a database creation according to the public tender procedure*
It is the most frequently applied procedure of the public authority. This is mainly caused by existing legal regulations. Depending on the country the decisions concerning selection of tender contractors are made with respect to the following rules:

- *defining of multiple criteria* to meet and granting of credits depending on the degree of the different criteria fulfillment by the possible contractor - the rule successfully applied by some countries,
- *defining of the lowest price criteria as the only criteria* constituting 100% of score with obligation to meet formal requirements - the most frequently applied rule, causing a lot of harm; following this procedure a department ordering a database creation is obliged to choose a contractor, who offers the lowest price, even if it is well known, that the particular contractor can offer very poor quality of services. But - as this contractor has met all formal requirements and offered the lowest price - there is no reason to reject such an offer.

The last way of choosing the database contractor is the most commonly met and the worst among others, but the ordering authorities, wanting to avoid appeals and suspicions of corruption, choose this method in the majority of tenders. However, this results in poor quality of database acquisition for public registers. The price offered in a tender does not cover the costs of correct implementation of such a public task, as the order cannot be processed for such a low price, since the contractor is not able to employ the qualified- and sufficiently experienced staff. The other issue is that the time assumed for the public order implementation is not sufficiently long. The contracting authority, as the public entity with the insufficient stuff, is usually not able to adequately evaluate the quality of the product, as such an evaluation would require, in the case of complicated databases like i.e. real-estate cadastre, the development of such a product by the inspection team from the very beginning.

2. Data administrator

A data administrator is an individual or a legal entity which makes decisions concerning data storage ways and objectives. The spatial data administrator is mostly a public administration body, which may delegate the responsibility for data storage to an individual or a legal entity or, it may directly administer the data.
The administered data - in particular cadastral data - includes personal data; in such a case the data administration becomes and important issue from the perspective of an individual who has possessed or has specified rights to a particular real estate in the cadastre and who expects the complete data protection in this field. The difference between the data administrator and the data processing unit appears at this moment. Following Article 29 of the DIRECTIVE 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, the working group has been established within the European Union, as an advisory board in the field of data and its privacy. The data administration must clearly and explicitly identify the data administrator in all circumstances, regardless to situation whether the data administrator was formally designated or not and whether this designation has been publicly announced. The practice established in the public and private sectors, according to other areas of law, such as administrative, penal or civil law, should not be neglected. In the majority of cases such regulations include specification who is or who can be the data administrator. In

many countries legal regulations are different in this area. Data which may be fully accessible in one country, even personal data related to property rights, is partially protected or completely protected in other countries. This depends on detailed legal regulations in particular countries. Even in the European Union, the level of personal data disclosure and related rights is different in particular member states.

3. Data user

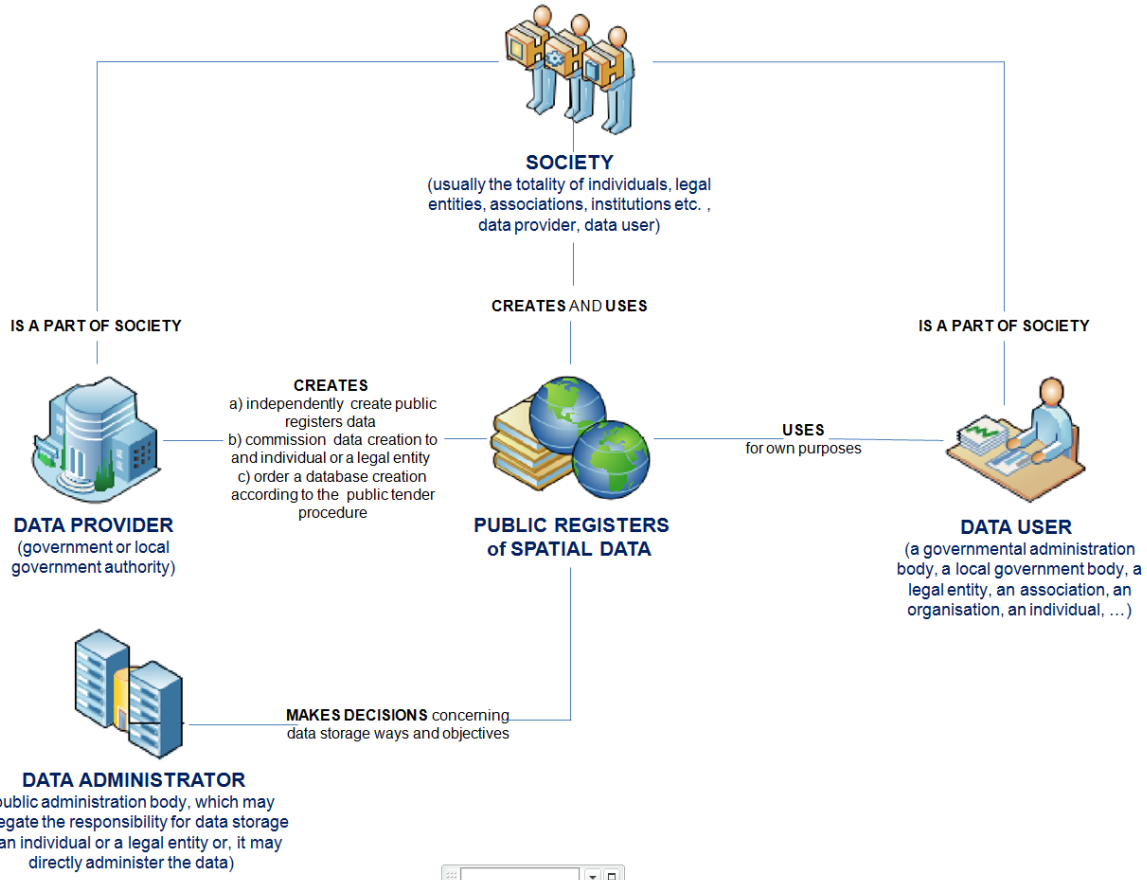
Everybody can become a data user. The data user may be an individual, a legal entity, a public administration body etc. All data acquired in each country may be used by various individuals and bodies, depending on legal rules, which are binding in this field.
The data user may be, in particular:

- a governmental administration body,
- a local government body,
- a legal entity,
- an association,
- an organisation,
- an individual,
- …….

It is important that data is used according to law, without the possibility to intervene in this data, if the data is the public register.

4. Society

It is usually the totality of individuals, legal entities, associations, institutions etc. The difference between data producers and users is hardly defined, since the user becomes the data creator and the creator becomes the data user, data is spontaneously supplied. In the case of public registers data supplies should be controlled and performed in the scope permitted by law. The society should be also understood as the totality, which is influenced by the data by, among others, taxes, which directly and indirectly influence the society, the welfare, the environment and the infrastructure.

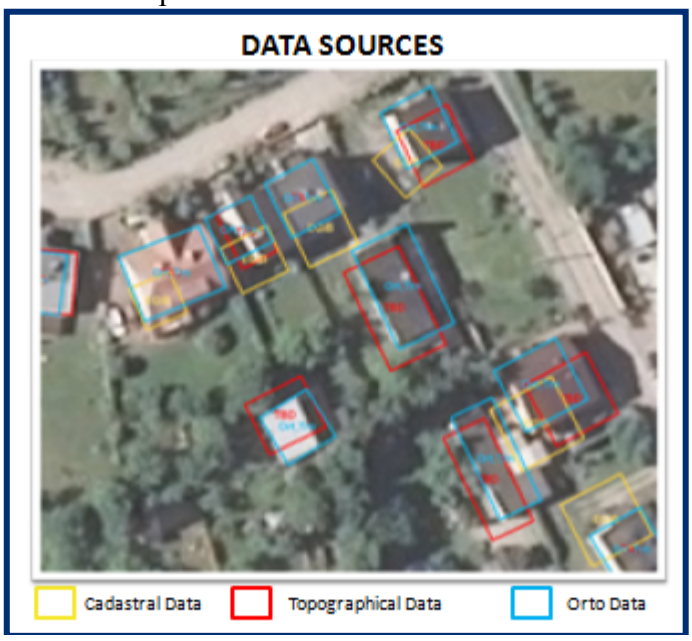


All data in public registers should:

- be complete and cover the entire country,
- be uniformly developed,
- meet the accuracy and legal requirements,
- be of sufficient quality,
- be reliable,
- be update - in the real time, if possible,
- be interoperable.

It should be noted that in the majority of countries, or even in all countries, cadastral data is the most important, and thus, reference data for all public registers. It is the proper idea since cadastral data, as one of spatially related data, are permanently acquired and, in the case of optimum conditions, it is permanently updated, since cadastral data concerns the property rights to spatial objects. The space, public properties, the infrastructure and the environment may be properly administered with the use of spatial data, and, therefore, the sustainable development may be ensured. Cadastral data is also the basis to calculate taxes, since information who and for what is obliged to pay taxes at the specified extent.

Therefore, cadastral data form the basis of all properly administered public registers. The usefulness of incorrectly prepared data is low, such data cannot be integrated in order to ensure the data interoperability.
When the process of digitisation of analogue information is commenced the same mistake is almost always made, when the same data is acquired separately (and duplicated) in many sectors of economy. Many countries store data in particular sectors, where the same data is duplicated depending on the created public register (e.g. a cadastral parcel, buildings, land use, roads, railway lines, water bodies, infrastructure etc.). This data (spatial objects) is often duplicated within the same sector, depending on the created database (cadastral database, topographic objects database, land use database etc.). One should realise that data duplicated in various registers mean also duplicated funds.



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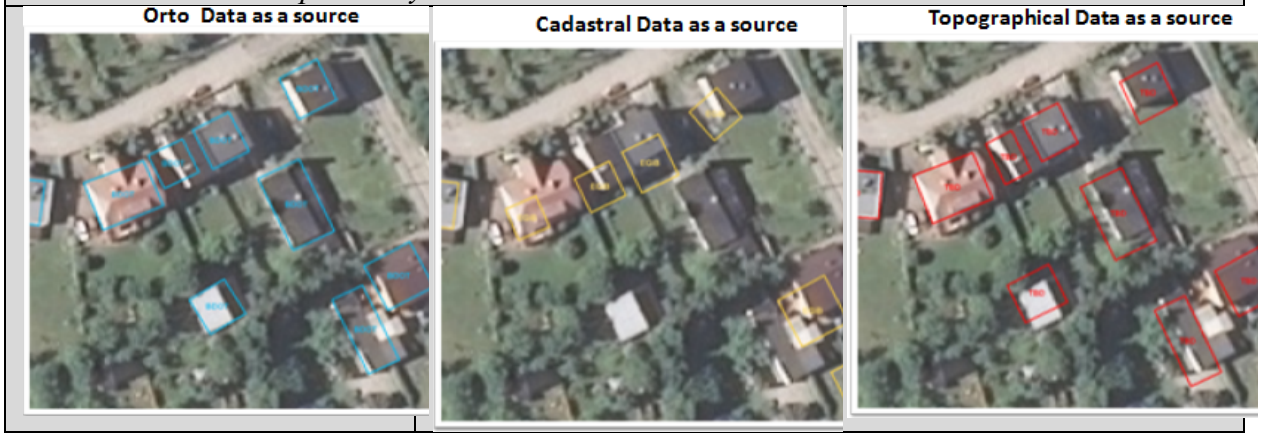

All mistakes, which are made in the course of database creation are visible only when attempts to integrate data are made; sometimes it is not possible to integrate data due to the lack of required attributes assigned to acquired objects, such as:

- the source of the object origin,
- the position error of the object co-ordinates,
- the object timeliness.

Attributes which describe objects are often unreasonably specified, they are incorrectly updated and inexplicitly understood. The timeliness of public register data creates a serious problem; this refers, in particular, to the property register. Such data should be "promptly" updated in the majority of countries. It is relatively comfortable word, which practically means nothing, since "promptly", meaning "without needless delay" is understood by those who maintain public registers, including the real estate cadastre, in many ways, depending on the personnel updating the registers, the administrators etc. Sometimes "promptly" means "on the same day" or ""the next day after the document, which is the basis for updating the register, has been received". But sometimes this operation is performed within weeks or months, or even years. Public register data, which is out of date, results in financial losses due to the lack of incomes from taxes; they also contribute to the decrease of the property sale and purchase, lowering the trust in operations performed with the use of public register data, which, as the public data, should be updated and reliable.
The data timeliness is important, since in the space, in its wide sense, data may lose its timeliness due to its positioning in the multidimensional space (random events such as floods, earthquakes etc.), changes of rights to spatial objects (changes of owners, administrators, possessors etc.), changes of description of co-ordinates of spatial objects, which result from modification of the technology of surveys, the ranges of legal status of objects in space etc. The list of possible purposes is long and it is difficult to mention all of them. All cases, which are mentioned above or not, may mutually overlap in time, may cross each other or may happen in parallel. One cannot be sure about the data timeliness without its integration at the highest possible level; the national level would be the best, and integration and data updating should be performed in the real time.
The countries of advanced computerisation of public registers face the need to integrate them. In order to ensure their interoperability. This task is often impossible to be solved due to mistakes and errors made in the data acquisition process.

- the created databases often do not meet the accuracy requirements; if those requirements are met one does not know which objects do meet them, since it has not been sufficiently described by attributes,
- in particular registers objects are duplicated; due to insufficient attributes one does not which object is correct (reliable, updated) and meets the accuracy requirements,
- the data timeliness is unknown, both, with respect to possible technical and legal documents, and to the field situation,

- the timeliness of property rights is unknown with respect to legal documents (e.g. the owner has been changed by a legal operation, such as the notary deed, but new data has not been recorded in the public register yet).

Therefore the question arises what would be the possible way to obtain a reliable and updated public register or how the existing public registers should be integrated.
It would be the best to integrate spatial data, in its wide sense, including cadastral data, in one system, which could be administered at the country level, which could be updated in the real time and which could store all acquired data, described by attributes, which would allow for process the data into information and rules, which are required for the sustainable management of the space. This requires wide co-operation between the data producer, the data administrator, the data user and the society.
The simple answer to this question does not exist. It could be less expensive to develop some of the registers from the very beginning, in order to ensure their reliability; in other cases it would be sufficient to manually integrate other registers. Anyhow, it is necessary to achieve the status when cadastral data will meet the accuracy requirements and it will be permanently updated. This requirements often lead to the need to develop cadastral data from the beginning. The existing and developed data should be adapted to the standard 19152. This would allow for elimination of standards, which depend on the IT environment, what is profitable exclusively for creators of software environment. They should be forced to apply standards by dissemination of their software solutions against payments. However, this does not happen. The situation results, among others, from keeping the level of selling services which support the maintenance of databases developed in particular software environment.
Countries which are at the beginning of creation of public registers are facing much easier tasks.

Those countries should, first of all:
- computerise the real estate cadastre by creation of the multipurpose cadastre, which would ensure the legal reliability and would meet the requirements concerning its utilisation for fiscal purposes. The created cadastre should respect the property, both with respect to law and the space, which is covered by the particular rights.
- implement the developed standard 19152 in software environment, in which the public register is maintained, including the real estate cadastre and they should not allow for deviations from the standard, depending on the public register or the software environment.
- from the very beginning, they should create the data on a platform, where all data is integrated and not duplicated - duplication of data means duplication of funds.
- introduce the 4D cadastre, with the time as the fourth dimension, in order to ensure the timeliness of the public register, including the real estate cadastre, by introducing changes in the real time. The only way to effectively administer the data in the public register is to utilise the multidimensional cadastre; it allows for assigning the fourth dimension to objects in databases and for maintaining, at the same time, the reliability, accuracy and timeliness of the first three dimensions.

Application of the above rules will allow for creation of the reliable spatial information infrastructure and the real estate cadastre and for minimization of financial inputs.

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