NEW CHALLENGES FOR LAND INFORMATION SYSTEMS IN THE LIGHT OF EUROPEAN STANDARDS

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New challenges for land information systems in the light of European standards

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INTRODUCTION

This book presents new challenges for land information systems (LIS) in the light of European standards and current research on the development of real estate cadastre and other LIS. Particular attention has been paid to the European common requirements and standards.

The passage of the INSPIRE Directive imposed on the government and self-government authorities of individual member states an obligation to implement a common course of action in the area of real property information systems development, including a uniform vocabulary and technology. One of the examples of the changes introduced by the Directive to the Polish real estate cadastre is the overhaul of, among others, the Geodetic Utilities Network System (GESUT). The aim of the initiated changes is to lead to the uniformization of the GESUT system throughout the entire territory of the country. We start discussion on the adaptation of the legal framework in which the GESUT operates to INSPIRE requirements, as well as their significance in the context of the Regulation on the integrated real property information system. Detailed analysis is offered of changes to the powers of the responsible authorities.

A very important issue of cadastral systems and Geodetic Utilities Network System is to identify and register the legal status of the property and the utility networks. Thus the second subject was the analysis of legal status of real properties crossed by transmission devices, using the example of the selected section III of the 800 DN "Przyjaźń" (Friendship) Pipeline and the selected, overhead power transmission line. A real property with the regulated legal status should be considered as the real property for which the land register or a set of documentation is maintained or when other documents exist, which allow for specification of owners of specified material rights to this property. In most cases, the lack of the regulated legal status is understood as the lack of the created land register or – even, if the land register is maintained for the particular property – records included in this register are incompatible with existing legal conditions. The transmission entrepreneurs the right to use the real property for building purposes, and the guarantee of the access to the real property, in connection with the exploitation of transmission devices - should be disclosed in the section III of the land register Rights, claims and limitations.

Staying on the topic of cadastral systems discusses the issues of the third dimension of registered objects. Cadastral system constitutes a very important element of Infrastructure for Spatial Information. It is defined as a multi-purpose system. Built-in GIS tools, it creates some new application opportunities through the use of links between the objects and the analysis. For this purpose, it is indispensable to create models of cadastral structures in 2D and 3D space. From 2012, ISO 19152 Land Administration Domain Model (ADME) presents a conceptual model of a 3D cadastre and is associated with premises in buildings. There is a growing need for 3D space applications that are designed in great detail. With the current geoinformatics capabilities, it is becoming a lot easier to perform. Authors undertook an experiment related to the establishment of GIS set, combining 3D building models, taking into account the premises, descriptive database about premises and communication network. Created sets describe, make a 3D visualization and highlight the communication between them.

Another cadastral topic is the modernization of cadastral spatial data in Poland. Polish law does not guarantee the cohesion of technologically – legal area of boundary points and lines which are recorded in the cadastre. A three-meter deviation between actual course of boundary points and the location recorded in the cadastral base is permissible. The study aims at analysing the proceedings and documentation concerning the procedure for updating the cadastre and additional determination of boundary lines. Authors present also a proposition of procedure for conversion of existing cadastre into cadastre which guarantees the cohesion of technological and legal area of boundary lines.

The next important issue relates to the registration of noise indicators and their presentation on maps. The primary tool for fighting noise is a Strategic Noise Map (SNM), which,
as a system, constitutes an element of information layer in a town. SNMs are generated using characteristics of noise sources while taking into account the topographic profile and the existing development methods. Therefore, for such a vast analysis of the environment condition, it is purposeful to use geo-information data as a methodological basis to create SNMs. GIS data enable implementation of standardized rules for collecting and filing values which characterize the environment state as well as parameters affecting the noise level. Considering the above, the study present a pattern of creating noise maps included in SNM system and a detailed description of creating GIS databases necessary to generate traffic noise maps. Furthermore, the elaboration discusses issues connected with SNM and a notion of the geographical information systems (GIS). Additionally, it depicts a GIS database generated for certain parts of Bydgoszcz town.

The last topic is about the systems of cultural heritage websites. The main goal of cultural resource management is to ensure protection of cultural significance, integrity and authenticity of resources for present and future generations through conservation and sustainable resource utilization. The role of information and communication technologies (ICT) in cultural resource management has been acknowledged in European reports and policy statements. The last study is on the quality evaluation of cultural heritage websites using a multi-methodological approach, utilizing the Website Attribute Evaluation System and the qualimetry methodology. As an example of using the methodology, evaluation of four websites was presented, provided by national heritage agencies in European countries. The evaluation results may be applied to formulation of guidelines for designing websites and introducing new technological solutions.

Enjoy the reading.

Scientific Editor
Agnieszka Dawidowicz
1. The INSPIRE Directive as a factor harmonizing land information systems, illustrated with the example of the Geodetic Utilities Network System

Adoption of the INSPIRE Directive by the European Commission imposed on the government and self-government authorities of individual member states an obligation to implement a common course of action in the area of real property information systems development, including the introduction of a uniform vocabulary and technology. One of the examples of the changes introduced by the Directive to the Polish real property information system is the overhaul of, among others, the Geodetic Utilities Network System (Geodezyjna Ewidencja Sieci Uzbrojenia Terenu, GESUT). The aim of the initiated changes is to lead to the uniformization of the GESUT system throughout the entire territory of the country.

A significant activity across multiple planes proved to be the harmonization of legislation and spatial data sets. These two concepts have found definition in legal provisions and other studies. Harmonization of the law is: 'adaptation of the internal law of member states of the European Union, as well as candidate states, to the requirements of European law.' (KALINA-PRASZNIC, 2007). Surveying and Cartographic Law (Journal of Laws 2010 No 193 item 1287) defines harmonization of data sets. Those are actions of legal, technical and organizational nature intended to achieve mutual cohesion of data sets and their adaptation for joint and combined use. The INSPIRE Directive is a legal instrument which has initiated harmonization in data sets in order to enable them to be used together. Data flow between the various data sets should take place without obstacles posed by technical or functional differences.

The idea behind Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) (OJ L 108, 25 April 2007) came to life in 2001. The aforementioned Directive, just as in the majority of EU states, has had an impact on Polish legislation. The passing of the Directive has led to changes in Geodetic and Cartographic Law. Geodetic and Cartographic Law is the legal instrument regulating a broad scope of issues relating, for example, to surveying and cartography or the national land information system. Geodetic and Cartographic Law came into force on 1 July 1989 and has received multiple amendments since. Thirty-three regulations have been enacted under this law, some of which are significant to the subject at hand, while some others concern issues other than spatial information infrastructure.

1.1. Research method

The research method used in this study is the one that focuses on the analysis of statutory language (OPALEK, WRÓBLEWSKI 1991) and legal parlance with regard to the GESUT. Following in J. Stelmach's and B. Brozek's footsteps, one can accept that methods used in legal science are methods borrowed from other disciplines. Such methods be modified small to make them a better fit for law and its character (STELMACH, BROZEK, 2004). The research also makes use of legal Hermeneutics but only to the extent that linguistic interpretation based solely on analysis and Exclusively was not possible. Legal Hermeneutics is the discipline, and the trend in legal science, Which Reflects theory of interpretation of legal text (http://encyklopedia.pwn.pl). To draw a line Between analysis and Hermeneutics is often do not possible (STELMACH, BROZEK 2004).

1.2. The INSPIRE Directive as a beginning of change in Polish law

Before the Directive came into force, works were being conducted in Poland to create better access to spatial information. The scope of those works included, for example, the Act on Land and Mortgage Register (Journal of Laws 2013 item 707). In 2003, the lawmaker introduced to the legal system two regulations on the basis of which it was made possible to start and keep land and mortgage register books in an IT system. On the basis of legal provisions contained in those instruments land and mortgage register books were migrated, and new ones are now kept in an IT system.
In 2010, the Act on Spatial Information Infrastructure (Journal of Laws 2010 No 76 item 489) (hereinafter the ‘SII Act’) was passed, which transposes the INSPIRE Directive. Two regulations have been enacted under the Act:

- the Regulation of the Minister of Infrastructure and Administration of 20 October 2010 on the spatial data sets and services covered by spatial information infrastructure (Journal of Laws 2010 No 201 item 1333);
- Regulation of the Minister of Infrastructure and Administration of 13 September 2010 on the Spatial Information Infrastructure Council (Journal of Laws 2010 No 183 item 1233).

The SII Act together with the regulations implements the provisions of the INSPIRE Directive in Poland (http://orka.sejm.gov.pl). Through the passage of that Act Poland complied with its obligation to transpose the provisions of the Directive into its internal legal order. Introduction of the Act was preceded by changes to then-current legislation, as well as providing basis for further amendments.

The Supreme Audit Office’s account of its activities in 2012 includes references to implementation of the INSPIRE Directive. The most important conclusion from the SAO’s audit was the following statement: 'The National Surveyor General has achieved the following in particular: establishment of register databases enabling the creation of a land register for the entire territory of the country and digital register map coverage of 91 percent of city space (as at 31 December 2010), adaptation of the national register of boundaries and surfaces of the country's territorial subdivision units to infrastructure requirements, expansion of the topographic object database as part of the 'Georeference Database of Topographic Objects together with national management system' project. The SAO’s report also included censure for the National Surveyor General, who had not taken sufficient action to complete draft legislation implementing the INSPIRE Directive within a short enough time-frame to enable it to come into force by 15 May 2009. The draft Act on Spatial Information Infrastructure was prepared on 8 April 2009, and the bill passed on 4 March 2010, coming into force on 7 June 2010, i.e. more than 12 months after the deadline set in the Directive.

Significant to the subject at hand is the Regulation of the Council of Ministers of 17 January 2013 on an integrated real estate information system (Journal of Laws 2013 item 249). The Regulation sets out the rulers for an integrated real estate information system (hereinafter the 'ZSIN'). The National Surveyor General’s powers in relation to the ZSIN are set out in Article 24b of Surveying and Cartographic Law (hereinafter the 'SCL').

The real state information system fills many roles, among others being necessary for the execution of public administration tasks. The system collects, updates, processes and shares information about lands, buildings and apartments or offices in a uniform (standardized) way for the entire country (WIERZBOWSKI, 2014). It is also of significance to private entities. Those may receive information necessary, for example, for their business activity (e.g. real estate brokerage, real estate consulting, real estate appraisal and more). The system also serves as a source of information for personal use.

In connection with the subject here discussed, it is necessary to understand the expression ‘real property’ and other similar expressions. ‘Real estate’, according to the Civil Code (Journal of Laws 2014 item 121), is a part of the surface of the earth which constitutes the matter of separate ownership. A related concept is constituent parts of real property. Those are items, things, which are located at the property and connected with it in such a way that separating them results in damage being done to either the property itself or the item being detached from that property.

Various real property databases are kept in Poland. Those are operated in an IT system. The lawmaker lays out the nature of such databases, forming part of the national spatial information infrastructure in Article 4.1a SCL. One of the public registers is the GESUT, which is a subject of detailed analysis further herein. Article 2.14 SCL defines the GESUT as: an information system ensuring the collection, updating and sharing of information about land utility networks,
in a uniform way for the entire territory of the country. Article 2.11 defines a land utility network as all sorts of on-ground, above-ground and underground ducts and devices: pipelines, sewage, gas, heating, telecom, power grid etc. (excluding detailed melioration devices), as well as underground structure such as: tunnels, passages, car parks, tanks etc. Copious jurisprudence has arisen around land utility network. The most important theses are shown in the table 1 below.

**Table 1. Chosen theses from the jurisprudence of administrative courts relating to land utility networks.**

<table>
<thead>
<tr>
<th>Judgments</th>
<th>Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judgment of the Supreme Administrative Court in Warsaw of 12 February 2006 (II OW 83/05 LEX no. 193992)</td>
<td>'If pursuant to the prescript of Article 2.11 of Surveying and Cartographic Law a land utility network is all sorts of on-ground, above-ground and underground ducts and devices, including electricity, without distinguishing between connections and “networks proper”, then it is necessary to hold that a connection is — in principle — an element of land utility network, including power grid.'</td>
</tr>
<tr>
<td>Judgment of the Supreme Administrative Court in Warsaw of 12 January 2011 (II OSK. 10/10 LEX no. 952931)</td>
<td>'The household sewage treatment plant which the complainant intended to build includes: an underground tank, sewage pipes leading sewage out to the settling tank and from settling tank to well, from the well to filtration drainage, sewage connection. Hence, the installation comprises underground sewage ducts and devices and a tank, thereby fulfilling the definition of land utility network in the understanding of Article 2 point 11 of Surveying and Cartographic Law.'</td>
</tr>
<tr>
<td>Judgment of the Voivodeship Administrative Court in Szczecin of 9 November 2005 (I SA/Sz 732/04 LEX no. 518300)</td>
<td>'Optical fibre network wires are a land utility network in the understanding of the Act of 17 May 1989 — Surveying and Cartographic Law.'</td>
</tr>
</tbody>
</table>

*Source: Klimach own compilation from the jurisprudence of administrative courts.*

When analysing system changes concerning the GESUT, it is also necessary to refer to the definition of spatial information infrastructure provided in Article 3 item 2 of the SII Act: those are spatial data sets described using metadata, and services, technical means, processes and procedures used and shared by leading authorities co-creating the spatial information infrastructure, other administrative bodies and third persons. Article 3 of the INSPIRE Directive formulates the following definition of spatial information infrastructure: 'metadata, spatial data sets and spatial data services; network services and technologies; agreements on sharing, access and use; and co-ordination and monitoring mechanisms, processes and procedures, established, operated or made available in accordance with this Directive.' (Lang, Maćkowiak, Stefanska, 2013) As follows from the above definition formulated in the INSPIRE Directive, as opposed to the one taken from the SII Act, special emphasis is placed on the implementation of network technologies for the management of spatial information infrastructure. Polish lawmaker addresses these matters in the SCL Act and the new Regulation of the Minister of Administration and Digitization of 12 February 2013 on the land utility network register database, topographic object database and base map (Journal of Laws 2013 item 383). The Regulation lost its force on 13 January 2015 pursuant to Article 14 of the Act of 5 June 2014 amending Geodetic and Cartographic Law and the Act on Enforcement Proceedings in Administration (Journal of Laws 2014 item 897). As of now there is no new regulation to take place of the one that has lost its force. Procedures continue under the repealed Regulation.
1.3. The Geodetic Utilities Network System (GESUT)

The Geodetic Utilities Network System (GESUT) is one of the databases kept in an IT system. It includes information about land utility networks being designed, those still under construction and those already existing, their location, purpose and core technical parameters, as well as entities managing such networks (Article 27.1 SCL). The establishment and management of the GESUT were described in the Regulation of the Minister of Regional Development and Construction of 2 April 2001 on the surveying register of land utility networks and design documentation agreement teams, which was repealed with 12 July 2014. GESUT establishment and keeping is currently regulated by provisions of Surveying and Cartographic Law.

Entities connected with establishing and keeping the GESUT are:

- the National Surveyor General;
- the starost.

The National Surveyor General (the 'NSG') creates and keeps the national GESUT database and is a central government administration authority in matters of surveying and cartography (Article 6.1). Article 28a shapes matters concerning the creation and keeping of the GESUT by the NSG through processing of data and information contained in povyat-level GESUT databases or other materials.

The start keeps the GESUT database for the povyat. The starost's powers also include co-ordinating the location of contemplated land utility networks. A povyat-level GESUT database is created and kept by the starost through processing source materials. Such materials are data and information gathered in the national surveying and cartographic resource, in particular those being the contents of: the surveying register of land utility networks and base map and other large-scale maps. Such materials can also be obtained from other public registers and from the entities managing land utility networks.

Article 28f SCL mandates that the starost may by way of an administrative decision exclude such data concerning land utility networks as are used solely by entities managing land utility networks and are located on lands being in the sole power of such an entity. The entity managing land utility network has an obligation to maintain the surveying register of the network. It is therefore possible to demonstrate that a separate land utility network database (on a per-industry basis) is being created. It is a database kept by entities managing the networks.

Where necessity arises to agree on a new land utility network, provisions of Surveying and Cartographic Law must be followed. Those provisions apply to networks situated in urban areas and in road belts inside already existing or still being designed compact rural settlement. This, however, does not apply to contemplated connections and land utility networks which are intended to be situated solely within the confines of a buildable plot. After receiving a proposal of the location of the contemplated networks, the starost sets the time-frame for a co-ordination conference. Apart from the applicants, other entities are notified about the conference, including entities managing land utility networks, and vogts (wójt) of the municipalities in the territory of which the designed land utility networks are intended to be situated. Other potential stakeholders are also notified, e.g. entities managing closed areas in which the land utility network is to be situated. Subsequently, the co-ordination conference is carried out and minutes are drawn of it. The conference is presided over by the starost or by a person authorized by the starost to do so (Article 28b.5 SCL). After completing the co-ordination conference, design documentation is affixed with an annotation to the effect that the documentation has been the subject of a conference. That annotation is drawn by the president of the conference (Article 28c).

In creating and keeping the land utility network register, entities managing land utility networks have an obligation to co-operate with the starost. Article 28e point 2 imposed on those entities an obligation to appoint representatives to co-ordination conferences. Entities managing land utility networks are therefore stakeholders in effecting GESUT changes. Where the proposal of location is being submitted by the investor, it has been drafted by an authorized entity.
The archival Regulation of the Minister of Regional Development and Construction of 2 April 2001 on the surveying register of land utility networks and design agreement teams (Journal of Laws 2001 No 38 item 455—repealed) contains different provisions from those currently in force. The regulation introduces per-industry land utility network registration. Design documentation agreement teams are also provided for. Section 20 provides that such a team is to be appointed by the starost and include: its chairman — an employee of the starost's office, in possession of professional licences sufficient to act in independent roles in surveying and cartography, and members — employees of the bodies of architecture and construction administration, construction supervision and road administrators reporting to the starost. Section 3.20 mandates that the following participate as consultants: with regard to information gathered in the per-industry register of land utility networks — representatives of units keeping that register; representatives of public road administration bodies other than those reporting to the starost if the installation is to be placed in the road belt of a public road belonging to a road administrator other than reporting to the starost.

The Regulation was repealed in consequence of amendment of Article 28 of Surveying and Cartographic Law. In the document titled: 'Position of the Council of Ministers Committee for Informatization and Connectivity regarding investment process barriers in telecommunication, [https://www.uke.gov.pl](https://www.uke.gov.pl) the following statement was included: 'it is also necessary to eliminate the participation of design documentation agreement teams for land utility networks through enacting a regulation under Article 28.2 of the Act.' In the justification of the draft bill of the act amending Surveying and Cartographic Law [http://www.sejm.gov.pl](http://www.sejm.gov.pl) we read: 'Proposed legal solutions will eliminate unnecessary barriers in the investment process concerning land utility networks, but, at the same time, bearing in mind that land utility networks are in many cases used to transmit flammable gasses and liquids, water and electrical power under high pressure, they will enable preparation of construction designs for such networks in a manner that ensures the safety of people and property in the process of construction and exploitation. In accordance with provisions of the Act of 7 July 1994 — Construction Law, the burden of responsibility for correct and collision-free placement of land utility networks covered by the design rests on the shoulders of their designer. The goal of the proposed provisions is to make it easier for the designer to carry that burden. To this end, it is proposed that the information scope of the surveying record of land utility networks should be expanded to include data concerning objects being designed. Furthermore, proposed legislation should ensure for designers, as well as for the entities to whom ad-rem rights or administrative powers connected with land utility networks belong, access to information fathered in the land utility network register through network services.'

The answer to the above needs and to the requirements of the INSPIRE Directive was the enactment of the Regulation of the Minister of Administration and Digitization of 12 February 2013 on the land utility network register database, topographic object database and base map. As authors mentioned before this regulation is repeal. The Regulation sets out what information is kept in the GESUT database, and it also defines the way in which the base is to be created, updated and shared. Collected in the GESUT database are data (spatial location and characteristics of objects) both about land utility network objects and about entities that manage the networks (§ 3 of the of the Regulation). An object disclosed in the database receives a spatial infrastructure information ID. The entity responsible for creating and keeping the GESUT does so on the basis of source materials described in § 7 of the Regulation. The following actions compose the creation of the GESUT database:

- creation of the initial GESUT database;
- submission of the initial GESUT database to entities managing land utility networks for verification;
- consideration of remarks from entities managing land utility networks, modification of the database;
inclusion in the Public Information Bulletin (of the territorially competent starost or president of a city with povyat rights) of information about the creation of the GESUT database.

Harmonization in the area of legislative provisions referring to the GESUT is contained in the following activities:

- introduction of a common object definition and description method in UML for all databases of the national surveying and cartographic resource;
- introduction of a uniform GML format for all databases;
- linking of the systems, resulting in the acquisition of certain descriptive attributes directly through relationships with other databases.

The purpose of changes in legal provisions and GESUT-related changes is for the entire territory of the country to have a uniform form of database keeping. This is necessary because thanks to it data exchange between databases will take place without need for data adaptation (no entry duplication). Data saving format will be identical already at the beginning of creation of each database.

Adaptation of provisions of Polish law to provisions of European Union law may in the future result in the possibility of combining databases from different countries. Harmonization of provisions of the law has led to making the work easier for land utility network designers and GESUT keepers.

1.4. Conclusions

Analysis of changes to GESUT-related legislation as required by the INSPIRE Directive has allowed the following conclusions:

1) new provisions in Polish legislation gravitate towards the achievement of harmonization of GESET data sets and other real property data from other public registers, thanks to which it will be possible to take advantage of full, integrated real property information;

2) the INSPIRE Directive has had a significant influence on the shape of GESUT and other real property information registers, which arises from drastic changes to the provisions of Surveying and Cartographic Law;

3) the scope of legislative change and speed of implementation proves the flexibility of Polish real property information legislation.
2. Analysis of legal status of real properties crossed by transmission devices

A real property with the regulated legal status should be considered as the real property for which the land register or a set of documentation is maintained or when other documents exist, which allow for specification of owners of specified material rights to this property. In most cases, the lack of the regulated legal status is understood as the lack of the created land register or even, if the land register is maintained for the particular property – records included in this register are incompatible with existing legal conditions.

At present two major legal forms exist which allow for the construction and further exploitation of transmission devices by transmission entrepreneurs. The first form is the transmission servitude – the limited material law. It was introduced into the Polish law by the act of May 30, 2008 on modification of the act – The Civil Code and some other acts. The second form is an administrative decision, issued according to Art. 124 item 1 of the act of August 21, 1997 on real properties management, which limited the ways of the use of real properties.

Both, the first and the second way - which assigns to the transmission entrepreneurs the right to use the real property for building purposes, and the guarantee of the access to the real property, in connection with the exploitation of transmission devices - should be disclosed in the section III of the land register Rights, claims and limitations.

2.1. Objectives of work and research methodology

The subject of the work is the analysis of legal status of properties crossed by:
- the selected section III of the 800 DN "Przyjaźń" (Friendship) Pipeline within the administrative borders of Wólka Zamkowa village, Drohicyn municipality, Siemiatycze district, Podlaskie province,
- the 15kV power supply line in Tuczki village in Rybno municipality, Działdowo district, Warmińsko-Mazurskie province.

Basing on data from the lands and buildings register (updated for May 2014) and analysis of land registers, properties of the regulated legal status were listed together with the specification of related documents. Additionally, the Section III Rights, claims and limitations of the land register was analysed with reference to properties for which land registers are maintained, in order to find records concerning the limitations resulting from transmission devices, existing in the space of those properties.

2.2. A real property and transmission devices - basic issues

2.2.1. Definition of a real property

The Polish legislation defines the term "a real property" according to the approach resulting from the civil code and the land register approach.

According to Art. 46, § 1 of the act of April 23, 1964, the Civil Code (CC) Real properties are the parts of the earth surface which create a separate subject of property (lands), as well as buildings permanently connected with lands or parts of such buildings, if - according to particular regulations - they create the subject of property, separated from lands. Thus, this definition points to three types of real properties:
- lands,
- buildings,
- premises.

Therefore, the basic type of real properties are land properties and (apart from exceptions assumed in the legislation) their components include buildings and other installations and devices permanently connected with lands, trees and other plants, since the moment of seeding or planting (Art. 48 CC). Rights related to the property of a real estate are also considered as the components of a real property (Art. 50 CC).
Buildings and premises may be the subjects of separate property and then they create building or premises properties, respectively. The first case refers to situation when the lands, being the property of the State Treasury or a local government body is transferred to the perpetual lease and buildings and installations located on such lands are the subjects of separate property of the perpetual leaseholder user (Act of August 21, 1997 on management of real estates). Premises real properties (an apartment or another type of premises) are created according to the rules specified in the Act of June 24, 1994 on property of premises. In this case it is necessary to separate the real property with respect to the property right, what results in the necessity to establish the land register and to make appropriate entries in this register. The, so-called, participation in the common real property is related to real properties of the premises type. The common real property consists of lands and parts of the building and devices, which do not exclusively serve for the owners of premises.

Apart from buildings and parts of buildings, which may create the subject of property, separated from lands, if certain requirements are met, the Civil code assumes the possibility in relation to transmission devices, which are understood as devices used for supplying or disposal of liquids, steam, gas, electricity and other, similar devices. According to Art 49 § 1 CC, in the case when such devices are included in the enterprise, they are not the components of a real property. The request to acquire the property of devices by the enterprise may be submitted by an individual who paid the costs of their construction, if an entrepreneur had connected these devices into his/her network, or by the entrepreneur. The property of devices, acquired by the entrepreneur comes into force after remuneration, paid for the current owner (the real property owner). This regulation is highly correlated by the transmission servitude with the limited material law (Art. 3051), which allows the entrepreneur to use the real property to the specified extent and according to destination of devices, which are specified in Art. 49 § 1 CC.

And the definition of a real property according to the land register approach results from the Act of July 6, 1982 on land registers. Following Art. 24 item 1 of this act, For each real property a separate land register is maintained, unless otherwise specified in detailed regulations. This also concerns premises type real properties and such real properties, which include separated real properties of premises type. Thus, the creation of a separate land register for a real property is the formal requirements concerning its separation, providing that - in the land register approach - a real property may be one cadastral parcel, as well as the number of parcels, even if they do not mutually border. However, they must be the subject of property of one entity and they must be located within the area of property of a regional court, respective for the maintenance of the given land register.

2.2.2. Transmission devices

Although the term of transmission devices is commonly used in doctrines and legislation, its definition resulting from legal regulations has not been completed yet.

The following reference to the terms of the technical infrastructure devices may be found in the Polish legislation - construction of the technical infrastructure devices is considered as construction of a road and construction under the ground, on the ground or above the ground of wires or water supply, sewage disposal, heat supply devices, power or gas supply lines, telecommunication lines (Art. 143 item 2 Act of August 21,1997 on management of real estates), or the definition of a linear object - a building object, which is characterised by its length, in particular a road with turnoffs, a railway line, a water supply line, a channel, a gas supply line, a heat supply line, a pipeline, a power supply line, an overhead line, a line located directly in the ground, an underground line, a flood bank and cable channels, providing that cables installed in that channel are not a building object or its part or a building device (Art. 3 point 3a Act of July 7,1994 The building law). And the act of May 17,1989, the law of geodesy and cartography defines the utilities network (SUT) as all types of overhead, on-the-ground and underground lines and devices, such as: water supply, sewage disposal, gas supply, heat supply, telecommunications,
power supply and others (excluding detailed drainage systems), as well as underground constructions, such as: tunnels, passages, parking places, reservoirs etc. (Art. 2 point 11). It also defines the geodetic utilities network - and information system which ensures storing, updating and distribution of information concerning utilities networks, in a unified way for the entire country (Art. 2 item 14). The definition of a device also appears in the act of April 10, 1997, the energy law (Art. 3 point 9), and the definition of a water supply and sewage disposal devices is specified in the act of June 7, 2001 on collective water supply and sewage disposal (Art. 2, point 16 and 14, respectively). The widest definition of all devices, which uses the functionality criterion, is specified in the Civil Code in Art. 49 § 1 (devices used for supply or disposal of liquids, steam, gas, energy and other similar devices are not the parts of a real property, if they are the parts of an enterprise). As it was already mentioned, this regulation directly refers to the definition of transmission servitude (Art. 305 1 CC), and therefore, in this publication, transmission devices should be understood according to the definition included in Art. 49 § 1 CC.

In general, transmission devices may be divided considering their location within the real property space (location in relation to the earth surface), (Table 2). The following types of transmission devices are distinguished:

- underground (located under the ground surface),
- on-the-ground (located on the ground or under the ground in such a way that the clearance between a device and the ground makes the use of the ground impossible),
- overhead (hanging above the ground in such a way that this ground may be used for purposes other than purposes related to transmission or distribution).

Table 2. Division of underground, on-the-ground and overhead transmission devices, due to the functional criterion.

<table>
<thead>
<tr>
<th>Functional criterion</th>
<th>Transmission devices</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>underground</td>
<td>on-the-ground</td>
<td>overhead</td>
</tr>
<tr>
<td>Heat supply lines</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Pipelines for transmission oil and petroleum products</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gas transmission pipelines</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Sewage disposal pipelines</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water supply pipelines</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power supply cable lines</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tele-information cable lines</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power supply lines</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tele-information lines</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Volumetric objects related to transmission and distribution of media</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

*Source: SAJNÓG N. own study.*
Transmission devices may be also divided in international, national and local devices. The first two of those types are usually the public goals and include, first of all:
- pipelines for long-distance transmission of oil and fuels,
- pipelines for transmission of high-pressure gases,
- the electric power infrastructure of the highest voltages, NN -750 kV, 400 kV, 220 kV,
- the telecommunications and tele-information infrastructure, included in public telecommunications networks.

2.3. Legal forms of disposal of a property for the needs of construction of transmission devices

An investor intending to construct a transmission device must submit an application for a building permit along with the declaration on holding the right to dispose of the real estate for construction purpose. (Art.33 item 2 point 2 act of July 7,1994 The building law). This right may result from:
- the property right,
- the right for the perpetual lease,
- administration,
- the limited material law (such as transmission servitude, use),
- obligation relation (e.g. contract of lease), assuming the authorisation to perform building activities.

At present, apart from acquiring the right to dispose of the real estate for construction purpose, the transmitting entrepreneur, is at the same time interested in the acquisition of the permanent title to lands, in connection with the future exploitation of transmission devices (the necessity to perform required repairs, overhauls etc.).

In the past, contracts of lease, contracts of loan for use or contracts of use of real estates were often concluded for the needs of construction of transmission devices. Such solutions met the requirements to acquire the right of disposal of a real estate for construction purpose, however, they did not ensure the permanent rights to the lands. Therefore such methods were only approved due to missing legal regulations in this field. At present, two following, basic legal forms are preferred, which allow for construction and the future exploitation of transmission devices by transmission entrepreneurs:

1. Transmission servitude – the limited material law, which was introduced to the Polish legislation by the act of May 30,2008 on modification of the act – The Civil Code and some other acts.
2. An administrative decision issued according to Art. 124 item 1 of the act of August 21,1997 on management of real estates, which limits the ways of use of real estates.

2.3.1. Transmission servitude

Transmission servitude consists of charging a property for the benefit of the transmission entrepreneur, who intends to construct, or who is the owner of transmission devices, which are discussed in Art. 49 § 1 CC with the right, which allows the entrepreneur to use the charged real estate, within a specified range, according to destination of those devices (Art. 305¹ CC). Therefore, the introduced limited material right may be applied both, to new investments (transmission devices are to be constructed) or to regulations of existing conditions (regulation of the, so-called, events). Transmission servitude may result from:
- the contract,
- the legal decision,
- the acquisitive prescription.

The basic form of establishing the transmission servitude is the civil law contract. Only the lack of approval of any party to conclude such a contract allows the owner and the transmission entrepreneur to submit the request to establish the legal transmission servitude against the
payment (Art. 3052 CC). The condition required for the recognition of acquisitive prescription is the evidence presented by the transmission entrepreneur concerning the permanent and visible use of a device in good faith for 20 years and in bad faith for 30 years.

The content of the established right of transmission servitude should be understandable and point to the charged real estate, by its specification and marking according to the lands and buildings register and specification of its land register number, a set of documents or another document which specifies the right to that real estate. The range of servitude should be also specified in details together with the type of transmission devices, by means of specification of their destination, location in relation to the ground surface (underground, on-the-ground or overhead devices) and by specification of specific attributes, such as the diameter of the oil transmitting pipeline, the pressure in the gas transmitting pipeline etc.).

Transmission servitude is the element of the enterprise and it is transferred to the buyer of the enterprise or the buyer of transmission devices. Usually it is established for an unlimited time; in particular transmission entrepreneurs take care of this, since they intend to ensure the permanent title to lands. Transmission servitude expires together with the termination of liquidation of the enterprise at the latest.

The transmission servitude right should be disclosed in the section III of the land register. The basis for the entry may be a contract, a notarial act, a legal decision or an agreement in court. It should be also noticed that, according to Art. 7 point 5 of the act of July 6, 1982 on land registers, transmission servitude is not protected by the warranty of the public faith.

2.3.2. An administrative decision which limits the way of the use of a property

Following Art. 124 item 1 of the act on management of real estates, the starost, by issuing a decision, may limit the way of using a real estate by assigning the permit to establish and carry out drainage lines, lines and devices used for transmission or distribution of liquids, steam, gases and electric energy, as well as devices for public communication and signalling in the real estate, as well as other, underground, on-the-ground and overhead objects and devices required for the use of those lines and devices. In order to allow that the following requirements must be jointly met:

- the investment concerning the construction of transmission devices must be the public goal,
- the limitation of the real estate must result from the local physical management plan or from the decision concerning the location of the public goal investment,
- negotiations with the owner or with the perpetual leaseholder of the real estate concerning the agreement for carrying out transmission devices, which should end with the negative results.

The limitation of the use of a real estate, determined in the decision, should be characterised by the nuisance for the real estate owner, as low as possible. The owner has the right to compensation for all damages and possible reduction of the real estate value, resulting from the construction of transmission devices; the investor is responsible for the payment of this compensation. However, it should be stressed, that the administrative decision, issued according to Art. 124 item 1 does not create the legal basis for establishing the transmission servitude, however, it assigns the right to the transmission entrepreneur to dispose of the real estate for construction purpose and, at the same time, it is the obligation of the owner to make the real estate accessible for performing activities related to conservation and elimination of possible breakdowns of transmission devices. This obligation is the subject of the administrative execution. The basic difference is also the lack of application of this regulation for regulation of the, so-called, events. Thus, the limitation of the use of the real estate according to Art. 124 item 1 is applicable only for planned investments, concerning the construction of transmission devices. The final decision creates the basis for making the entry in section III of the land register.
2.4. Documents confirming the property legal status

The legal conditions of a real estate are considered as the entirety of rights to a given real estate, providing that the basic and the widest right is the property right. According to interpretation of the application of Art.113 item 6 of the act on management of real estates, a real estate of the regulated legal status is the real estate for which the land register or a set of documentation is maintained or when other documents exist, which allow for specification of owners of specified material rights to this property. Therefore, the following documents are the basis for the establishment of the legal status of the real estate:

- land registers,
- sets of documents,
- binding legal decisions (e.g. acquisitive prescription),
- final administrative decisions (e.g. decisions of expropriation of a real estate),
- notarial acts,
- agreements and consents concluded in court or administrative proceedings,
- other documents, of the force of evidence for establishing the property rights.

Land registers are dominating in the above list, since, according to Art. 1 item 1 of the act on land registers they are maintained in order to establish the real property legal status.

They are created and maintained for real properties which do not have land registers or for which land registers were lost or damaged. They may, but they do not have to be maintained in order to establish the legal status of the cooperative rights to premises. Land registers are the public register, which aims at disclosing the material rights to real estates. Besides land registers, files of land registers are also maintained, which includes documents being the basis for making entries in the land register. Those files are not open to the public, the full access to those files has a person having the legal interest and the notary.

The public openness of land registers and legally binding rules of their operations allow to consider this register as the register, which guarantees the optimum safety in the trade of real estates. The basic rules of the system of land registers are presented in Table 3.

Table 3. Rules of the system of land registers in Poland.

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal openness</td>
<td>A public access exists for every person who intends to become familiar with the content of the register, what results in ineffectiveness of the objection concerning the unawareness of entries existing in the register.</td>
</tr>
<tr>
<td>Material openness</td>
<td>The land register discloses the real legal status of a real estate, i.e. the right entered in the register really exists and the deleted law does not really exist.</td>
</tr>
<tr>
<td>Reliability</td>
<td>The land register is the only proof of the legal status of the real estate, which is disclosed in the given land register, until deletion resulting from legal implications.</td>
</tr>
<tr>
<td>Warranty of the public faith</td>
<td>In case of discrepancies between the legal status of the real estate, disclosed in the land register and the real legal status, the content of the register resolves to the benefit of the party, which acquired the property or another material right, as a result of a legal activity with an authorised person.</td>
</tr>
<tr>
<td>Material legalism or officiality</td>
<td>The entry in the land register is made basing on documents which result in generation, change or expiration of rights being the subject of the entry.</td>
</tr>
<tr>
<td>Initiatives of parties</td>
<td>Entries in the land register are made only after reception of a written application; therefore the power in this field should be assigned in writing; the exception is the official entry.</td>
</tr>
<tr>
<td>Commonness</td>
<td>Land registers may be maintained for all real estates.</td>
</tr>
<tr>
<td>Retroactive power of an entry</td>
<td>Results of an entry precede the moment of the entry; however, the rule of the retroactive power of the entry comes into force when the entry is made in the land register.</td>
</tr>
<tr>
<td>Entry effectiveness</td>
<td>Acquisition, change or expiration of the right, also in the case of constitutive entry comes into force at the moment when the entry is made.</td>
</tr>
</tbody>
</table>

Source: SAJNÓG N. own study basing on Sources of information on real properties, Part I – KONARSKA D.
The land register consists of 4 sections. The section I contains marking of a real estate and entries related to property rights (such as land servitude in relation to the seized real estate, participation of the owner in the common real estate). The section II contains entries concerning the property rights and the perpetual lease. The section III is used for entries concerning limited material rights (excluding the mortgage). The section IV includes entries concerning the mortgage. The structure of the composition of land registers is presented in Fig. 1.

**Fig. 1.** The structure of land registers in Poland

*Source: elaborated by SAJNÓG N.*

According to Art. 26 item 1 of the act on land registers data from a real estate cadastre is the bases for marking a real estate in the land register (an extract from a cadastral map and extract from the lands and buildings register) including data on the location of a real estate, ways of its use, its area and lands, buildings and devices existing in the real estate.

The basis for making an entry in the land register create (Table 4):

- notarial acts,
- administrative decisions,
- legal decisions,
- other documents.

For real properties, which do not have land registers, sets of documents are maintained, which also confirm the legal status of real properties. Although the sets of documents have not been established since 1983, the existing documents are still legally valid.

Remaining documents, which may specify the legal status of real properties, such as binding legal decisions, final administrative decisions, notarial acts, contracts and consents concluded under the court or administrative proceedings are described in Table 4: *Bases for making entries in a land register.*
### Table 4. Bases for making entries in a land register.

<table>
<thead>
<tr>
<th>Basis of an entry</th>
<th>Description (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notarial acts</td>
<td>An official document, which confirms that specific legal action has been performed; the form of a notarial act may be required by law under the clause of nullity of legal action or it may be required by the parties (acquisition of ownership rights, perpetual lease rights, separate ownership of buildings, cooperative rights to premises, certificate on establishing the limited material right)</td>
</tr>
<tr>
<td>Administrative decisions</td>
<td>An administrative act issued under the procedure specified by the Administrative Code or other acts, which regulate the area of individual rights and obligations of citizens (decision concerning expropriation of a real property, decision limiting the way of the real property use)</td>
</tr>
<tr>
<td>Legal decisions</td>
<td>A legal action made by the court in legal proceedings (resolution on establishing the required course, resolution on acquisitive prescription)</td>
</tr>
<tr>
<td>Other documents</td>
<td>They must meet specified requirements - they must have an assigned form, must be issued by an appropriate body, they must have required signatures, official stamps, clauses (certificates issued by bodies and offices according to their properties, legal and administrative consents, surveying documents, documents issued by banks, etc.)</td>
</tr>
</tbody>
</table>

Source: SAJNÓG N. own study.

All documents, which create the basis for acquisition of specified rights to a real property are also registered in the real property cadastre. According to § 12 point 1 of the ordinance on the lands and buildings register, rights of persons and organisational entities to lands, buildings and premises are presented in the register on the basis of:
- entries made in land registers,
- binding legal decisions,
- contracts concluded in the form of notarial acts, concerning the establishing or transferring the material rights to a real estate (excluding contracts concerning perpetual lease of lands and ownership of premises),
- final administrative decisions,
- disposal included in normative acts,
- some contracts for lease.

#### 2.5. Analysis of legal status of properties crossed by transmission devices

##### 2.5.1. Section III of the „Przyjaźń“ (Friendship) Oil Pipeline – Wólka Zamkowa object

The „Przyjaźń“ (Friendship) Oil Pipeline is the largest in the works system of pipelines, which connects Siberia and the Central Europe. The decision concerning the construction of the "Przyjaźń" (Friendship) system was made on December 18, 1958 in Prague. The construction for the first section of the Polish part of the pipeline was commenced in 1960, the construction of the second part - in 1970 and the third one - in 2002 (the latter investment has not been completed yet). The network of pipelines transports oil for the biggest oil producing plants in Poland and in Germany.

The „Przyjaźń“ pipeline consists of three sections (informal division) (Fig.2). The first section runs from Adamowo (located close to the border with Belarus) to Płock, the second section - from Płock to Schwedt in Germany and the third section, the, so-called, Pomerania Pipeline connects Płock and Gdańsk.
The analysed section III of the „Przyjaźń“ (Friendship) Pipeline covers the administrative borders of the village of Wólka Zamkowa in Drohiczn municipality, Siemiatycze district, Podlaskie province (according to data from the real property cadastre 31 cadastral parcels, crossed by the discussed pipeline are mainly arable and forest areas) (Fig. 3).

**Fig. 3.** The cadastral district - Wólka Zamkowa with specification of parcels crossed by the III section of the „Przyjaźń“ (Friendship) Pipeline (violet area)

*Source: District Management Board in Siemiatycze, prepared by SAJNÓG N. own study.*
Table 5 presents the structure of the basis for acquisition of rights to the lands, according to data from the lands and buildings register.

**Table 5.** The basis of acquisition of cadastral parcels according to data from the lands and buildings register for parcels, which are crossed by the Section III of the „Przyjaźń” (Friendship) Pipeline in Wólk Zamkowa.

<table>
<thead>
<tr>
<th>Basis for the acquisition according to data from the lands and buildings register</th>
<th>Number of cadastral parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notarial act</td>
<td>9</td>
</tr>
<tr>
<td>Administrative decision</td>
<td>2</td>
</tr>
<tr>
<td>Legal decision</td>
<td>9</td>
</tr>
<tr>
<td>Another document</td>
<td>11</td>
</tr>
</tbody>
</table>

*Source: SAJNÓG N. own study.*

Notarial acts concerned the ownership rights on the basis of a contract of sale or a contract of donation. Administrative decisions referred to cadastral parcels, which were municipal roads; they were the basis for the establishing the ownership rights by the municipality. Legal decisions mainly concerned proceeding concerning the inheritance. Among other documents, cadastral documentation, concerning the creation of the lands register should be mentioned. It has been stated that land registers were maintained for 22 out of 31 analysed cadastral parcels. (Fig. 4).

![Fig. 4](image-url) **Fig. 4.** The cadastral district - Wólka Zamkowa with specification of parcels, which are crossed by the section III of the „Przyjaźń” (Friendship) Pipeline, for which the land registers are maintained (pink area).

*Source: District Management Board in Siemiatycze, prepared by SAJNÓG N. own study.*
Thus, the performed analysis proved that 71% of reviewed cadastral parcels have regulated legal status, in the land register approach. For other land parcels documents, which allow determination of rights to real properties exist; this should be sufficient for creating the land register.

As a result of the analysis of section III of land registers, maintained for 22 cadastral parcels of the analysed area, it has been stated that entries concerning the established transmission servitude (issued under the procedure of Art.124 item 1 of the act on management of real estates) or the administrative decision, were missing has been stated. Therefore, it should be concluded that the objective investment (construction in the period 2004-2005) was performed basing on contracts concluded between the investor and the owner of lands, which are not disclosed in the land register. As it was mentioned, entries concerning the establishment of transmission servitude, as the, so-called, regulation of events, also have not been found. Besides, the analysis of the ownership structures of lands proved that 29 cadastral parcels (94%) are the property of the private sector - individuals, and 2 cadastral parcels (6%) are the property of the public sector - the Drohicyn municipality.

Table 6. The ownership structure of lands crossed by the section III of the „Przyjaźń” (Friendship) Pipeline in Wólk Zamkowa.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Number of cadastral parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private sector</td>
<td>29</td>
</tr>
<tr>
<td>Public sector</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: SAJNÓG N. own study.

2.5.2. The 15 kV power supply line –Tuczki object

The 15 kV Tuczki power supply line (Rybno municipality, Działdowo district, Warmińsko-mazurskie province) was constructed in the eighties of the 20th century. In 2013, due to the overhaul of this line, the network distributor commenced regulation of the, so-called, events (acquisition of legal titles to lands), by establishing the transmission servitude; it concerned, among others:

- locating the 15kV power supply line in the real property,
- determination of the extension of the transmission servitude belt,
- ensuring the right to enter, passage and thoroughfare to devices in order to exploit and repair them and to eliminate breakdowns,
- interdiction to build constructions and implant trees in the transmission servitude belt.

The transmission servitude was established, every time, against the remuneration for the owner of the charged real property, basing on validation made by real estate experts.

The course of the objective 15 kV power supply line through 16 cadastral parcels, within the administrative borders of Tuczki village is presented in Fig.5.
The performed analysis proved that all 16 cadastral parcels, which are crossed by the 15kV power supply line, have regulated legal status - land registers are maintained for those parcels.

Table 7 presents the structure of the bases of acquisition of rights to lands, according to the analysis of land registers.
The basis of acquisition of cadastral parcels according to the analysis of land registers for parcels, which are crossed by the 15kV power supply line in Tuczki village.

<table>
<thead>
<tr>
<th>The basis for acquisition according to data from the lands and buildings register</th>
<th>Number of cadastral parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notarial act</td>
<td>11</td>
</tr>
<tr>
<td>Administrative decision</td>
<td>3</td>
</tr>
<tr>
<td>Legal decision</td>
<td>1</td>
</tr>
<tr>
<td>Another document</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: SAJNÓG N. own study.*

Notarial acts concerned, first of all, the transfer of property rights, basing on contracts of sale or contracts of donation. Administrative decisions referred to lands being the property of the State Treasury and Rybno Municipality.

Analysis of entries in the section III of land registers proved that 11 parcels have the established transmission servitude, pout of 16 parcels (Table 8), which are crossed by the 15kV power supply line. The limited material right has not been established for lands being the property of the State Treasury and for one real property which is owned by individuals.

The analysis of the ownership structure proved that 10 cadastral parcels (62%) are owned by the private sector - individuals. 6 cadastral parcels (38%) are owned by the public sector, including 3 parcels which are used under the perpetual lease.

Table 8. The ownership structure of lands crossed by the 15kV power supply line in Tuczki village.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Number of cadastral parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private sector</td>
<td>10</td>
</tr>
<tr>
<td>Public sector</td>
<td>6</td>
</tr>
</tbody>
</table>

*Source: SAJNÓG N. own study.*

2.6. Conclusions

The analysis of legal status of real properties, which are crossed by transmission devices proves that - according to the act of management of real estates, this status is generally regulated, what means that the documents exist, which allow for determination of persons, who may exercise the specified material right to a real property. The analysed area, which is crossed by the section III of the „Przyjaźń” Oil Pipeline is characterised by the relatively diversified documentation, specifying the rights to lands (land registers are maintained for 71% of cadastral parcels). Nevertheless, information concerning limitations resulting from the presence of transmission devices in the space of real properties, is not presented in the section III of land registers. Rights to dispose of a real property for construction purpose were acquired in the form of civil law contracts; therefore the base map becomes the only public source of information about the objective pipeline; its course was disclosed after surveying inventory. On the other hand, the analysis of legal status of lands, crossed by the 15kV power supply line, proved that 100% of legal status were regulated in land registers, together with disclosing the most entries in the section III, which concern the established transmission servitude (regulation of the, so-called, events).
As it is presented by the Ministry of Economy (the justification to the act on transmission corridors) the settlement of legal status (regulation of the, so-called, events) may concern:

- approx. 17 million cadastral parcels in relation to power supply networks,
- approx. 3 million parcels in relation to gas pipelines,
- approx. 240,000 parcels in relation to heat supply networks.

In general it should be noticed, that actions undertaken by the real property owners, as well as by transmission entrepreneurs in order to establish transmission servitude, may highly contribute to regulation of legal status of real properties which are crossed by the transmission infrastructure. Those actions are about the establishment of land registers for real properties, for which they had not been maintained or, in the case, when entries in land registers had been updated, and successively disclosed information in the section III on the established limitations in the form of transmission servitude. Such actions should be performed as quickly as possible, since at present, the land registers, which are the public and open register, are the only guarantee of safety for the trade of real properties, as well as transparency of rights and limitations related to a given real property.
3. 3D Cadastre, building 3D models with communication network

CityGML is a common information model for the representation of 3D urban objects. (OGC 2012). It introduces five precise Levels of Detail (LoD 0-4), called the scale of CityGML. The least precise level LoD 0, projects the terrain surface (NMT). LoD 1 depicts simple block models comprising buildings with flat roofs, while LoD 2 is enriched with the facade texture, with differentiated roof and volume structures. The LoD 3 extracts all building elements of a size greater than 0.5 meters. The highest level of accuracy is presented in LoD 4, denoting a complete architectural mapping, both inside and outside the building. Most frequently designed 3D objects are created taking Lod 2 into account, which requires height accuracy equal 1m and horizontal accuracy up to 2m. CityGML is used in such areas as urban land planning, complex and anti-crisis management. CityGML solutions refer to the content of ISO 19152 Land Administration Domain Model (LADM). The standard involves a 3D cadastre construction. It provides a conceptual data model, taking into account the record of spatial units. It also introduces the basic information-related components of 3D buildings modeling (OOSTEROM et al., 2012 ISIGDAK, ZLATANOVA 2009) and describes the methodology of recording geometric units in buildings (spatial representations), including cohesion, neighborhood and topology. Examples of cadastral systems construction including premises have been presented in numerous publications (BOGUSŁAWSKI et al., 2012, 2013).

The undertaken experiment involved performing 3D building models at selected levels of detail, using different methods of premises presentation. It is assumed that all the premises, in different views, will be described with attributive data. In addition, pursuant to the topological data, it was assumed that communication network inside the buildings will be constructed. Network in premises should be also linked to the data on the characteristics of premises. On the basis of created, collected and processed data in GIS system, one can easily search for premises with specific features and find an escape route between the selected rooms in the building. The implementation of this approach was based on the available data on selected buildings at the Faculty of Geodesy, Geospatial and Civil Engineering and available descriptive database on the premises (DABROWSKI et al. 2006).

3.1. Initial data

There have been many attempts to create the information system for Kortowo campus at the Department of Land Surveying and Geomatics. The students’ data sets, obtained during practical field classes or as a part of theses, have been collected and then organized. The stored data set, which was constantly updated, constitutes a testing ground for dissertations. It involves Kortowo campus, on a detail level of a base map at a scale of 1:500. Collected data allow for the presentation of campus on a flat map, using a draft of Digital Terrain Model (DTM) and also for the presentation at LoD 0 (Fig.6). The data which include building blocks, considering their height diversity, enable to show the campus space at LoD 1. They were collected as a part of a thesis performed in 2014 (PUŚKO 2014). Presentation of these data is comprised in figure 6 and 7 in two different versions:

- on a flat map with NMT shading Digital Terrain Model (on the basis of WMS layer (WMS_1 2015)),
- on 2D map with raised buildings,
- at LoD1 level and on the basis of 2D map and NMT draft, as Triangulated Irregular Network (TIN) constructed on the basis of height-points.

The data available on the internet were used for building presentation at LoD 2 (www_1). The author of data, Damian L. made the 3D representation of all the buildings at the University of Warmia and Mazury in Olsztyn available to all users. Downloaded files were obtained thanks to SketchUP programme. They were available in two versions: as SketchUP model, and as KMZ file. Using them in ARCGIS, through adding them to a map, one can change the form of building view from LoD1 to Lod2 (Fig. 8).
**Fig. 6.** Visualization of the experiment area on the basis of available data set from 2D map: a) with the use of WMS- NMT shading (WMS_1), b) with buildings raised on the basis of their height.

*Source: LEWANDOWICZ E. own study*

**Fig. 7.** Building Visualization at LoD 1 (CityGML Level of Detail 1) on the basis of a flat map and with the use of NMT

*Source: LEWANDOWICZ E. own study*
Applying the presentation at the higher detail levels is connected with the comprehensive study of building interior, and most importantly with the premises. Such actions are undertaken during the process of 3D cadastre designing. They are not only useful for cadastral purposes but also for other users, especially those responsible for building management and safety.

Nowadays, many institutions make an attempt to create a 3D cadastre. It is usually connected with the whole system of property management, especially buildings and premises. The information system, including the university campus and building interiors was designed and developed at AGH University of Science and Technology in Kraków (PARKITNY et al., 2013). Similar system was constructed at Delft University (GHAWANA, ZLATANOVA, 2010). Also, an analogous information system for main building of Warsaw University of Technology was developed (ŚLÓWIKOWSKI et al., 2014). In 2014, at the Faculty of Geodesy, Geospatial and Civil Engineering, such attempts were made as the continuation of previous accomplishments.

In 2006, at the Department of Land Surveying and Geomatics, Faculty of Geodesy and Land Management, University of Warmia and Mazury in Olsztyn, some steps towards constructing an information system on premises in faculty buildings were undertaken (DĄBROWSKI et al., 2006). Constructed system was based on C-geo application (SOFTLINE 2014), on the basis of a base map, in a local coordinate system. Collected descriptive data constitute an important source, only partially out of date. In the constructed application, the connection between the descriptive data and graphical data representing the premises was missing. The graphical representation of premises was limited to a point object, placed inside the building, on a flat map. There were only situation sketches of building storeys attached to the base files. The system consisted of the descriptive data about the premises; however, a direct connection between the descriptive data and graphical data was missing. The authors of the experiment decided to modernize the gathered initial data sets and make use of them in the further undertaking.

The building information sets (Fig. 9) and storey drafts (Fig. 10) were obtained from the previous authors of the premises database (DĄBROWSKI et al., 2006). The base map, in the national coordinate system 2000, referring to WGS84 ellipsoid, was available too.
Fig. 9. Initial data in the form of text files containing premises description in the buildings.

Source: Dąbrowski et al., 2006

Fig. 10. Graphic data used in experiment performance: storey plans and base map.

Source: Dąbrowski et al., 2006

3.2. Methodology

The methodology for conducting the experiment, to a large extent, depended on the initial data and on the assumed level of detail of the final project. Collected data were made autonomously and independently. The scenario for the experiment was as follows:

- harmonization of the initial data:
  - transforming descriptive data to GIS standards.
    - adopting the systematics to form buildings and premises identification numbers,
- ascribing georeference to storey plan, on the basis of a base map and NMT
- adopting methodology for creating 3D building models:
  - in CAD tools as frame models,
  - transformation of CAD data sets to GIS,
- determining the principles for premises identification, by:
  - floor surface,
  - premises (solids),
  - premises centroid,
  - centroids of premises entry,
- constructing a communication network model based on topology, centroids and entry centroids,
- links between the descriptive data on premises and the graphical data.
The adopted methodology was associated with the construction of thematic layers which would allow for constructing a system based on relations in the future.

3.3. Realization

3.3.1. Organization and harmonization of descriptive data

At the first stage, the text files describing the premises were updated. Then, an Excel database was created and the data were transferred there. All the premises were given individual and unique numbers referring to the name of the street, ordinal number of the building and apartment number. Here are some of the examples:

- H12_1.05, this number identifies the apartment nr 5, situated on the first floor of the building at Heweliusza 12 Street,
- P15_2.125, this number identifies the apartment nr 125, situated on the second floor of the building at Prawocheńskiego 15 Street,
- H5_1.7, this number identifies the apartment nr 7, situated on the first floor of the building at Heweliusza 5 Street.

Table 9 presents a homogeneous structured set of data describing building units in the objects. Special-purpose places in the building, such as hallways, stairs, toilets were given names in their identifiers. Other data describing the premises were taken over from the initial set; they take the following values, e.g. room type: office, chairman’s office, dean’s office, computer room, a secretariat, a porter’s lodge, and some more.

Table 9. Organized set of selected descriptive data on faculty premises at Prawocheńskiego 15 Street

<table>
<thead>
<tr>
<th>Object</th>
<th>Type</th>
<th>Name</th>
<th>Street</th>
<th>Number</th>
<th>Floor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P15_1</td>
<td>Office</td>
<td>Professor's office</td>
<td>Prawocheńskiego</td>
<td>15</td>
<td>1st</td>
<td>Office</td>
</tr>
<tr>
<td>P15_2</td>
<td>Office</td>
<td>Dean's office</td>
<td>Prawocheńskiego</td>
<td>15</td>
<td>2nd</td>
<td>Office</td>
</tr>
</tbody>
</table>

Table: Lewandowicz E. own study.

3.3.2. Organization and harmonization of CAD graphical data

The second stage of the experiment involved organizing graphical data in AutoCad Map. The figure of each storey (digital sketch) consisted of four layers, corresponding to the selection of objects presenting stairs, entrances, walls and descriptions. The sketches were fitted into the drawing of a base map and set to a topological form. The topological form involved creating centroids of premises surface and relations between the storey objects, noted down in the descriptive tables (Fig.11).
Centroids were attributed premises’ identification numbers which enable (Table 9) to combine the graphical data with the descriptive data in further realization. Structured graphical data were given the level on the basis of data from urban base map and storey height, basing on the data from the descriptive base (DĄBROWSKI et al., 2006)

As a result of organizing the graphical data on building storeys, it was possible to present a 3D model in CAD frame form (Fig. 12). However, this form is not very legible. CAD tools allow to present data in a surface form, it is associated with giving surfaces some texture with the use of graphical tools related to visualization. 3D models can be presented in various forms, in one of the views, e.g. with regard to the edges and surface (Fig. 13).
In CAD, it is possible to combine graphical data with descriptive data using ODBC tools. As a result, for each CAD object, data from a descriptive table were connected. Premises identifiers were used to connect the units, which constitute a foundation for identifying the descriptive and graphical base. After merging of sets through SQL queries, it was possible to identify the units with selected characteristics.

3.3.3. Implementation of the communication network model in the buildings

On the basis of structured 3D building models, communication network in the buildings was constructed. It was based on communication routes (corridors, stairs and entrances to the premises). Network editing based on two methodologies:

- manual editing in 3D space,
- editing based on adopted algorithm pursuant to topology.
Fig. 15. The view of edited communication network with the use of manual method, based on storeys in different visualization.

Source: (Kodzik, 2014)

In the second case, the network based on topological data through data transformation was constructed. Theoretical descriptions of transformation can be quoted from the author’s numerous works (Lewandowicz 2011, 2014). They are described with the use of algebraic transformations of data stored in topological matrices. In practical solutions, set transformations in the form of tables can be applied. Data stored in attributive tables constitute the basis for this implementation. They linked together topological, descriptive and geometric data. First, they were generated from software sets and then processed. Figure 16 with table 2 and 3 presents selected data on premises and doorways centroids. Topological links between the doorways and adjacent premises, constituted a base for drawing the network in table 4 on the figure 16. Obviously, while drawing automatically, only sections between the doorways centroids and two neighboring premises were taken into account.

Fig. 16. Selected data on premises and doorways centroids and relations.

Source: Lewandowicz E. own study.

Tabular data processing allowed for obtaining a geometric communication network on the building storey. Topology-based network has a different shape than that drawn manually. It is...
based on centroids. After attaching the descriptive data, it was possible to seek connections between the two selected premises.

![Diagram](image1)

**Fig. 17.** The view of edited communication network as a result of topological data processing.

*Source: (LEWANDOWICZ, 2014)*

### 3.3.4. Results

The experiment involved performing 3D models of four buildings at the Faculty of Geodesy, Geospatial and Civil Engineering. They are relative to the height of the building foundation and storeys' height corresponds to the initial data (DABROWSKI et al. 2006). It can be used for various applications, especially thanks to the fact that they contain the communication network (Fig. 18-21).

![Diagram](image2)

**Fig. 18.** Presentation of the building at Prawocheńskiego 15 Street.

*Source: (KODZIK, 2014)*
Fig. 19. Presentation of the building at Heweliusza 12 Street.

Source: (Kodzik, 2014)

Fig. 20. Presentation of the building model at Oczapowski 1 Street.

Source: (Kodzik, 2014)

Fig. 21. Presentation of the building storey at Heweliusza 5 Street.

Source: (Kodzik, 2014)
In addition to building visualization, a method for premises visualization is crucial. 3D presentation can be difficult, because it is impossible to preserve all the elements in the visualization. We have to adopt transparency, eg. for external walls (Fig. 22).

![Visualization of premises arrangement on each building storey by setting the facade transparency a) building at Przewońskiego 15 Street, b) building at Heweliusza 12 Street](image)

Fig. 22. Visualization of premises arrangement on each building storey by setting the façade transparency a) building at Przewońskiego 15 Street, b) building at Heweliusza 12 Street

Source: Lewandowicz E. own study.

Various forms of premises identification were adopted. The easiest way to present the premises is by the floor surface view. Other forms of presentation include centroids, and even separate solids. Each premises representation was given a link to descriptive data. Thanks to these data, it is possible to find premises that meet your searching criteria. You can search for a specific type of premises, e.g. computer rooms (Fig. 23).
Fig. 23. Different ways of selecting premises which meet your searching criteria – e.g. computer rooms.

Source: Lewandowicz E. own study.

3.4. Conclusions

It is possible to create sets, which help the user to move inside the virtual space and support the orientation in the real environment. That is why, there is a growing need for GIS applications, which are designed in 3D space and comprise the building interior. With the current technical solutions, it is becoming easier to perform. Creating 3D models of four buildings at the Faculty of Geodesy, Geospatial and Civil Engineering, University of Warmia and Mazury in Olsztyn is the first step forward. The undertaken experiment suggests that it is possible to create a portal consisting of all the buildings in Kortowo campus.
4. Procedure for conversion of the existing cadastre into the cadastre which guarantees the cohesion of technological and legal area of boundary lines

The technological-and-legal area of boundary lines is the two-dimensional space, which consists of two subspaces: the technological and the legal subspaces [Łuczynski, 2009]. The technological subspace is a set of boundary points, which are determined by surveys and appropriate documentation, allowing for explicit restoration of positions of boundary points in the field. The legal subspace is a set of administrative and court procedures, which result in legal confirmation of the specified positions of boundary points and lines. The cohesion of the objective space is the area which creates the common part of the technological and the legal subspaces.

This study will present a model of a technical procedure which will result in conversion of the existing cadastral documentation into the documentation which will ensure that requirements of the technological-and-legal area are met and which will guarantee the possibility to explicitly determine and delineate positions of boundary points and lines.

4.1. Updating the cadastral documentation

This subsection presents the procedure and the technical documentation which has been created as a result of surveying works related to the updating of the cadastral documentation for the rural cadastral district in Poland. Premises did not occur in the analysed area. All buildings within the district were included in land real estates. The analysed and practically performed procedure (results of works were received and approved by the state geodetic and cartographic resources and they were the basis for changes in the real estate cadastre) is very specific since formally it was not the commonly performed modernisation of the land and buildings register, resulting from the Act of 17 May 1989 on Geodesy and Cartography (Act of 1989) and the Regulation of the Minister of Regional Development and Construction Industry of 29 March 2001 on the register of land and buildings [Regulation, 2001]. Twelve stages are distinguished in the analysed procedure (I-XII).

I. At the first stage (after application of surveying works and review of source materials) the inventory of points of the detailed control was performed, the minor control was established, marked by concrete poles with underground marks in the form of concrete plates and topographic descriptions of marked points were made. Points of the minor control (6 survey traverses) were introduced on the general map of the horizontal control and it was submitted to the geodetic and cartographic documentation centre.

II. Field reconnaissance was performed. The content of the cadastral map was compared with the terrain with respect to buildings.

III. Property registers were analysed (KW) together with sets of documents (ZD), which were disclosed in the cadastre or which were disclosed by interested individuals. In total, 263 property registers were analysed; erroneous numbers of registers were detected in two cases, several cases of real estates which were doubly registered in the property register were also detected. Results of research works were presented in the protocol of testing property registers and on maps of legal status, which presented the expanse of real estates, KW and ZD numbers and areas of parcels included in those sets of documents.

IV. External boundaries of the cadastral district were assumed on the basis of the existing documents, which specified the course of boundary lines, with the use of technical documentation of lands of surrounding districts, which were stored at the state geodetic and cartographic resources. In the case when data concerning boundary points of the required accuracy was missing, the course of boundaries was determined by a protocol, and it was preceded by notifications of the owners about the discussed activity.

V. Internal boundaries of parcels were assumed basing on the existing technical documentation, after reviewing their usefulness. In the case when reliable co-ordinates of boundary points were missing (co-ordinates of boundary points determined with the high
accuracy), course of boundaries of parcels was determined by a protocol, including determination of the course of the bank of the Rokitnica River (approved by the decision for the Head of the District, the Starost). AS fragment of the protocol of determination of course of boundaries, is presented in Fig.24.

![Fig. 24. A fragment of the protocol of determination of course of the boundary lines.](image)

Source: photo made by Łuczyński R.


Location of parcels listed in the fragment of the protocol was determined on the basis of coinstantaneous statements of the parties, and it was confirmed by the signatures of the parties. Each page of the protocol was sealed and signed by the authorised surveyor. In three cases, when the parties did not reach the agreement concerning the course of boundaries, those boundaries were presented as conflict boundaries, according to the status of use. The sketch, which fragment is presented in Fig.25 is the integral part of the protocol.
Fig. 25. A fragment of the sketch being an annex to the protocol of determination of the course of boundary lines.

Source: photo made by Łuczyński R.

The sketch (Fig.25) presents, among others, boundary lines and numbers of parcels, as well as numbers of boundary points, which correspond with the list of coordinates of those points, as well as line measures between those points.

A general map of protocols of determination of boundary lines was also developed together with the expanse of archive technical documentation, which was applied during the discussed works. Figure 26 presents a fragment of the map, on which KEM numbers are marked in red (the map register number - a map register book), the numbers of technical documentation, accessible from the state geodetic and cartographic resources.
Fig. 26. A general map of protocols of determination of the course of boundary lines, with the expanse of applied technical documentation.

Source: photo made by Łuczyński R.

VI. Auxiliary surveys of the course of determined boundaries of parcels and outlines of buildings were performed. A fragment of the sketch of measurements is presented in Fig. 27.

Fig. 27. A sketch of measures.

Source: photo made by Łuczyński R.
As it is confirmed by the sketch (Fig.27), direct measurements were performed for parcel boundaries and all buildings, which were not plotted on the basic map as well as all other buildings.

VII. Calculations of parcel areas were performed and their lists were developed. The cartographic database, maintained using the EWMAPA software tool, and the descriptive database, maintained using the EGB84 software tool, were updated. A list of inconsistencies of areas presented in property registers and areas presented in the cadastre together with detected errors, were also prepared. A fragment of this list is presented in Fig.28.

Data concerning PESEL and RREGON identifiers were updated and records concerning objects and subjects of the land and buildings register were amended.

VIII. The field check of lands and soil classes was performed. The results of soil classification of lands were presented during the information meeting to all interested individuals. Minutes from this meeting were prepared and signed by the soil expert and by the head of the village. As it is confirmed by the minutes, during this meeting information about the public presentation of classification documents and about the possibility to present claims, was announced. The annex to the protocol contains: a list of the parcel numbers, lands and soil classes, which were previously presented in the cadastre, as well as the status examined in the field, conclusions of the classification expert concerning the identification of lands and soil classes and the map of changes after the field check. A fragment of this map is presented in Fig.29.
Fig. 29. A map of changes of lands and classes.

Source: photo made by Łuczyński R.

The existing boundaries and symbols of parcels are presented in black (Fig. 29); the previous outlines and symbols of lands and classes are marked in green. Changes have been marked in red.

IX. Datasheets were developed with respect to data concerning buildings; they contained sketches of order numbers of buildings, building functions, years of completion of construction, areas, numbers of storeys and the types of materials used to build outer walls. Cartographic and descriptive databases of the land and buildings register were updated basing on these datasheets.

X. The registers of land and buildings were printed together with the list of parcels and the list of personal data, in the alphabetical order.

XI. The draft descriptive-and-cartographic documentation was prepared; the parties were notified in writing, against the confirmation of reception, about the public presentation of this documentation. The list of parcels, their areas were annexed to the notification together with information about the possibility to present comments and claims.

XII. The draft descriptive-and-cartographic documentation was publically presented; as it turns out from the minutes, 92 eligible individuals out of 216 (i.e. 30%) got familiarised with the draft documentation. Only one comment, concerning the delineation of the municipal road, was presented.

The current fragment of the map presented in the portal www.grodzisk.geoportal2.pl, with the layers of administrative boundaries, districts, parcels, buildings, addresses, lands and classification units, is presented in Fig. 30.
The area presented in Fig.30 corresponds to the area presented on the map of changes after the field check. After clicking the selected parcel, the portal displays information containing the content of the extract from the land register and the extract from the buildings register.

4.2. Discussion of results

Works related to updating the cadastral documentation were performed basing on the design approved by the Voivodship Inspector of the Geodetic and Cartographic Inspection.

As it turns out from the analysis of proceedings and available documentation, performed activities, which aimed at completion of the cadastral database and modification of the existing data according to the requirements specified in legal regulations, in particular, with respect to boundaries of parcels, lands and buildings, prove that performed updating of the cadastral documentation resulted in conversion of this documentation into the cadastral documentation which meets the requirements concerning the cohesion of the technological-and-legal space of boundary lines.

Technical works which were performed in the course of updating, connected with the determination - basing on the protocol - of the course of boundary lines of the district and parcels, with soil classification of lands, surveys of outlines of lands and soil classes and buildings, and further modification of cadastral data, characterised by achieving the cohesion of the cartographic and descriptive parts of the cadastre, strongly influence the achievement of the requirement of cohesion of the technological space. The requirements concerning the cohesion of the legal subspace of boundary lines were met, since the parties signed the protocols of determination of the course of boundary lines, which were then confirmed by the decision of the head of the district (the Starost) and introduced to the cadastral database.

4.3. A model procedure of updating the cadastral documentation

This subsection presents a model procedure connected with updating of the cadastre, which ensures the determination of positions of boundary points with the highest accuracy, assumed by the binding technical standards (REGULATION, 2001).
Following the Regulation of the Minister for Internal Affairs and Administration of 9 November 2011 on Technical Standards of Implementation of Topographic Surveys and Development and Submission of Results of Such Measurements to the State Geodetic and Cartographic Resources, the detailed survey of marks and boundary points is performed in a way which ensures that the position of a mark or a boundary point is determined with the accuracy not worse than 0.10m with respect to the closest points of the horizontal control and the minor control. The present instruments and technologies of surveys allow for surveys performed with much higher accuracy. However, another difficulty may be observed. The position of a mark or a boundary point must be explicitly determined prior to measurements in a way which follows the data, which specifies their position and which is accessible at the District Geodetic and Cartographic Resource. In the case when the documentation which allows for restoration of the boundary point or for determination of a boundary point, does not exist, or it is unreliable, it is necessary to determine the location of the boundary point. According to the binding Polish legislation, determination of boundary lines is possible following the delimitation of real estates (Regulation of the Minister of Internal Affairs and Administration and the Agriculture and Food Economy of 14 April 1999 on the Demarcation of Property) or following the determination of the boundary lines (Regulation, 2001).

A model of proceedings of geodetic works related to the determination of boundary lines - delimitation of real estates, division of real estates, land consolidation, land consolidation and division of real estates - were presented by Łuczyński (2012). Taking into account considerations resulting from the universal solution presented in the above publication, a model procedure of updating the cadastral documentation may be also presented, which ensures that requirements of the technological-and-legal space are met (Table 10).
Table 10. A model procedure of updating the cadastral documentation.

<table>
<thead>
<tr>
<th>O. n.</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Development of the design of updating and settlements with the voivodship inspector of the geodetic and cartographic inspection.</td>
</tr>
<tr>
<td>2</td>
<td>Selection of the contractor of geodetic works, according to the public procurement law.</td>
</tr>
<tr>
<td>3</td>
<td>Commencement of the administrative proceedings concerning updating the cadastral documentation. Public announcement an notification of parties about the commencement of proceedings (written notification of interested individuals involved in the proceedings, according to data presented in the real estate cadastre).</td>
</tr>
<tr>
<td>4</td>
<td>Submission of the geodetic work to the Geodetic and Cartographic Documentation Centre.</td>
</tr>
<tr>
<td>5</td>
<td>Review of the legal status of a real estate with the use of documentation, which confirms the legal status (property registers, notary acts, administrative decisions, court sentences).</td>
</tr>
<tr>
<td>6</td>
<td>Analysis of documentation which specifies positions of points and the course of boundary lines, stored at the state geodetic and cartographic resources and implementation of field measurements which allow for determination of the course of boundary lines.</td>
</tr>
<tr>
<td>7</td>
<td>Determination of the course of parcel boundaries and delineation of these boundaries basing on the existing proofs (documents which specify the position of points and the course of boundary lines, boundary marks and geodetic marks, boundary traces and land management elements connected with the course of boundary lines) - in a way which allows for pointing the course of the boundary lines to all interested parties (e.g. marking with stakes, marking with paints on permanent elements of the land management).</td>
</tr>
<tr>
<td>8</td>
<td>Calling the parties to be present in the field and to familiarise with the course of the boundary lines, determined on the basis of existing proofs.</td>
</tr>
<tr>
<td>9</td>
<td>Measurements of boundary points, which positions were approved by the parties. Signing the protocol of determination of the course of boundary lines.</td>
</tr>
<tr>
<td>10</td>
<td>Notification about the date and place of public presentation of the draft cadastral documentation.</td>
</tr>
<tr>
<td>11</td>
<td>Public presentation of the draft cadastral documentation for interested parties.</td>
</tr>
<tr>
<td>12</td>
<td>Making the protocol concerning the public presentation of the draft documentation with the list of comments and claims submitted by each individual whose legal interest is affected by the data included on the draft documentation and with information concerning the way of examination of those comments and claims.</td>
</tr>
<tr>
<td>13</td>
<td>Transfer of information about the way of examination of comments presented by an authorised employee from the district authorities, with participation of the contractor of geodetic, cartographic and taxation works, to the interested parties.</td>
</tr>
<tr>
<td>14</td>
<td>Acceptance of geodetic and cartographic documents, resulting from performed works - in the form of the technical documentation, and reception to the state geodetic and cartographic resources.</td>
</tr>
<tr>
<td>15</td>
<td>Decision of the relevant body which confirms the draft cadastral documentation.</td>
</tr>
<tr>
<td>16</td>
<td>Updating the cadastral database.</td>
</tr>
<tr>
<td>17</td>
<td>Notifications concerning modification of the cadastre.</td>
</tr>
</tbody>
</table>

Source: Łuczyński R. own study.

4.4. Conclusions

The basic differences between the activities related to modernisation of the land and buildings register, resulting from the binding legal regulations (The Act of 1989 and the Regulation, 2001) and the model of updating the cadastral documentation (Table 10) may be presented as follows:

a) implementation of the procedure of updating the cadastral documentation, to the contrary of the procedure of modernisation of the land and buildings register, is performed in the administrative procedure, what additionally results in the necessity to notify the parties in writing about the required operations, listed in Table 10,

b) resolution of the proceeding is performed following the decision of the Starost, and not in the form of the announcement in the official journal of the voivodship - therefore modifications in the cadastral documentation are performed after validation of the decision and not before the announcement in the official journal of the voivodship.
In all geodetic works, related to the determination of the course of parcel boundaries, an explicit algorithm should be applied, allowing for restoring the primary positions of boundary points with the possible highest accuracy. This algorithm should be based on harmonisation of reference systems, used for the determination of the primary positions of boundary points, recorded as a result of geodetic works, related to establishing the register of land and buildings, performed in the period 1955 – 1989 (DEGREE of 1955 on the register of land and buildings), with the state spatial reference system, binding in Poland (REGULATION OF THE COUNCIL OF MINISTERS OF 15 OCTOBER 2012 ON THE STATE SYSTEM OF SPATIAL REFERENCE).

The algorithm should consider the following assumptions:

1. The boundary point is correctly determined when activities related to the determination were performed basing on the same points of the horizontal geodetic control, which was used for the primary measurements and with the use of observational data, acquired in the course of primary measurements, including control data.

2. In the case of lack of the possibilities to restore the geodetic control, which was the basis for the primary measurements, the existing control may be applied for determination of the boundary points, following the activities aiming at optimisation of the accuracy of coordinates of the restored boundary marks or of the determined boundary points, with respect to the current control:
   a) implementation of surveys which allow for readjustment of the primary control, in connection to the current basic or detailed control, and then, recalculation of coordinates of the points being determined,
   b) transformation of coordinates of the points being determined basing on the sufficient number of tie points, which co-ordinates are calculated both, basing on primary measurements, as well as measurements performed on the basis of the current control, considering the co-ordinate system of the primary measurements, as the primary system, and the co-ordinate system in which co-ordinates of the current control are determined, as the secondary system.
5. Using GIS to create traffic noise maps under SNM

Environment quality in urban space subject to strong industrialization may be achieved by reducing inhabitants’ exposure to excessive noise levels (Szopińska, Kwiecień, 2013). Among all sources of noise, the most troublesome is the traffic noise whose negative action directly affects inhabitants of big cities. In accordance with Directive 2002/49/EC, the Strategic Noise Map (SNM) is a cartographic study presenting in a special manner zones of harmful traffic noise in the environment. Following the directive, SNM is an averaging map of noise emitted by various sources, which is the basis to assess risk of urban areas’ exposure to excessive noised levels and identify causes of its origin (Directive 2002).

A vast analysis of the environment state needed to create SNM indicates purposefulness of using GIS technology as a methodological basis of its completion. SNM is a management tool for urban space while GIS database maintained in the town’s IT resources makes input material for its creation where graphic data (such as location of buildings, road centre lines, contour lines, slopes) and descriptive data (such as building height, communication network characteristics, traffic intensity, demographic data) are used.

Based on the above information, SNM system permits generation of spatial geometric & acoustic models, which in turn enable visualization of a number of traffic noise maps. As a result, immission maps may be created, acoustic conflict rates may be arrived at, inhabitants’ exposure rates to excessive traffic noise may be identified and analyses taking detailed demographic data into account may be conducted. These actions serve to assess acoustic climate in urban space and build a Noise Free Environment Program.

The aim of this study is to discuss basic issues concerning the Strategic Noise Map (SNM) as well as definitions and methods of using GIS to build them. It presents a pattern of creating traffic noise maps under SNM system, where two main actions are detailed (Action 1 GIS database, Action 2 Traffic noise maps under SNM). The paper describes in detail the elements included in Action 1 range, i.e. recognizing the area’s spatial and functional structure, collecting input data and creating GIS information layers. Furthermore, the study shows an example of GIS database for a selected part of a town.

5.1. Strategic Noise Map for traffic noise – background

Noise is a sound phenomenon of any acoustic nature which is not desired in particular circumstances and for a particular individual and which acts through air upon the hearing organ and the other human senses (Szopińska, Krajewská, 2013). Any bothersome sound phenomena arising in the environment are called environmental noise, which pursuant to art. 3 of Directive 2002/49/EC involve undesired or harmful sounds generated by human activity in open air (Directive 2002). The environmental noise comprises troublesome sounds emitted by the following sources:

- road traffic,
- rail traffic,
- tram traffic,
- air traffic,
- noise coming from industrial activity areas.

The most bothersome acoustic sources include road noise where as many as 16% of European population dwelling in urban areas above 250,000 inhabitants are exposed to a harmful level of that kind of noise. For comparison, air traffic and industrial noise amount to 0.1%, where the rail traffic noise to 1.0% (Noise 2011). The primary legislation which regulates protection from noise is Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise – Official Journal of the European Communities L 189 of 18 July 2002. The main purpose of the directive is to harmonize in member states the standard of preventing and reducing harmful effects of noise.
impact upon the environment. The purpose may be attained by implementing actions related to determination of the degree of the environment's exposure to noise and creating a Strategic Noise Map (DIRECTIVE 2002). In Poland implementation of the said Directive is reflected in provisions of the Act of 27 April 2001 Environment Protection Law. Pursuant to article 112 noise protection involves ensuring the best acoustic state of the environment by maintaining noise levels which do not exceed acceptable value for the two groups of indicators and creating SNM system.

According to Kompała (KOMPAŁA 2009, p. 46), SNM contains data used to global assessment of a situation in a particular area or used to make general anticipations about such area based on the acoustic map, which are a collection of data on sound phenomena. SNM is produced for average values and does not show the acoustic situation at a particular time. Assessment of the acoustic climate in SNM system is carried out for all groups of noise sources and its results are depicted in cartographic presentations in form of digital acoustic maps using the values identified with noise indicators $L_{DWN}$ and $L_N$ (MAKAREWICZ 2001; SZOPİŃSKA, KRAJEWSKA 2013), where

- $L_{DWN}$ is a long-term average sound level A expressed in decibels (dB), determined throughout all days in a year,
- $L_N$ is a long-term average sound level A expressed in decibels (dB), determined throughout all night time in a year (understood as time interval between 10 pm and 6 am).

Being concerned about the environment and human health at urban areas, acceptable noise levels were determined the above indicators. Their values depend on the noise source and area designation. For example, for Poland, in accordance with effective laws the urban area is characterized by suitable acoustic conditions for traffic noise when its acceptable values do not exceed the following levels (Regulation 2012):

- for spas and hospitals outside towns ($L_{DWN}=50\,\text{dB}, L_N=45\,\text{dB}$),
- for areas built up with multi-family houses ($L_{DWN}=68\,\text{dB}, L_N=59\,\text{dB}$),
- for areas built up with detached houses ($L_{DWN}=64\,\text{dB}, L_N=59\,\text{dB}$),
- for areas in downtown zones of towns above 100,000 inhabitants ($L_{DWN}=70\,\text{dB}, L_N=65\,\text{dB}$).

SNM understood as a system is a component of the IT layer in environment management (KWIECIEN, SZOPİŃSKA 2013). Its creation involves a time-consuming analysis of demographic data as well as data pertaining to area development and use methods. There exist four methods of making acoustic maps: measurement, model, simulation and prediction methods. Even though the most accurate picture of an acoustic situation is produced by the first method, for practical reasons, SNM is created by means of sophisticated computer software used to model noise in urban space. Acoustic calculations can be made with the following acoustic analysis programs: IMMI, CadnaA, SoundPlan, Mithra, ArcAkus etcs. Based on GIS database (GUESDES et al. 2011; MURPHY, KING, 2010). Digital maps of traffic noise under SNM are generated by using sound source characteristics rather than on-site measurements of noise levels. Additionally, while creating SNM the profile and the current management method are taken into account. Therefore, for such a vast analysis of the environment state, it is purposeful to use geo-information data as a methodological basis.

SNM consists of a number of acoustic maps, where for traffic noise maps the following digital cartographic studies should be mentioned:

- two maps characterizing noise emitted from roads (maps of road noise emission for 24h indicator $L_{DWN}$ and nigh time indicator $L_N$),
- two maps of the environment's acoustic state (maps of road noise immission for 24h indicator $L_{DWN}$ and nigh time indicator $L_N$),
- maps of quiet areas (where the road noise level does not exceed maximum values for $L_{DWN}$ and/or $L_N$),
- maps of areas exposed to road noise (where the road noise level for specified areas of acoustic sensitivity exceeds maximum values for $L_{DWN}$ and/or $L_N$).
The data and findings from SNM serve as a basis to develop and update the Noise-Free Environment Protection Program (NFEPP) created areas exposed to but not limited to negative traffic noise. Its goal is to reduce noise levels to acceptable values. The program specifies and assesses noise emissions from existing road sections. NFEPP takes into consideration noise generated before and after program completion while considering economic and ecological effectiveness of proposed acoustic protection actions.

5.2. GIS database – basic definitions

The Geographical Information Systems (GIS) is an automated system used to gather, store, retrieve, analyze and present spatial data. GIS consists of interrelated elements including hardware, software, tasks, database and users (Kwieciń, 2004). Each element plays an important role in the proper system’s performance, however, the most valuable component is the database. Gathering suitable data to achieve objectives of a particular GIS system is a long process consuming a major portion of costs connected with its development. Subsequent maintenance of the database requires considerably smaller financial investments.

Spatial data subject to analysis in GIS may be understood as physical, economical, social, geographical or historical objects. Location of objects as well as information about their attributes may be subject to change from time to time and therefore time may also be a GIS component. As concluded by Kwieciń (2004), attributes in GIS may be divided into two basic groups: descriptive – answering the question what and spatial – answering the question where. GIS distinguishes point, line and solid objects and 2D objects, for instance area profile or record parcel borderlines. The objects in the system may be described with any type of information such as number, text or graphic data stored in a tabular form. The said data may be characterized by a number of parameters including but not limited to accuracy, variability, validity, reliability or completeness.

In GIS a database usually takes a form of a layered structure where each overlapping layer constitutes an independent set of one-class spatial objects. The layers may contain several types of information while objects located in each class have a separate set of records describing their spatial features. The layered structure enables a spatial review and analysis of data and allows for multi-level designing and analyzing multi-function space systems. The layered structure of the database is shown in Fig. 31.

![Layered structure of the database: a) thematic categories, b) time intervals, c) vertical sections of building. Source: (Kwieciń, 2010)](image)
GIS may be divided into two groups for the data model. The first one is a vector model created by introducing coordinates of points and their integrating into more complex structures. The other one is a raster model where object location and shape is defined through regular basic fields corresponding to map or picture resolution. Data for GIS analysis may be acquired from cartographic presentations, recorder results, surveys, field sketches, statistical data or related research (for instance a census database). The methods and techniques of acquiring spatial area data include direct acquisition of area data by means of traditional optical instruments, modern electronic equipment, and indirect acquisition of area data such as aerial photographs for photogrammetry purposes to produce maps, aerial laser scanning to acquire data about area profile (Kwieciński, 2004).

5.3. Procedure of creating GIS database for traffic noise maps under SNM

Since it is necessary to gather and process a large number of acoustic and non-acoustic data, effective completion of traffic noise maps incorporated in the Strategic Noise Map is possible by using GIS data and a suitable system of relation databases which are going to be starting point to generate a geometrical and acoustic model needed to create digital acoustic maps. The process of creating traffic noise maps under SNM is presented in Fig. 32. It has been divided into two main actions:

- Action 1 GIS database – marked red in the chart,
- Action 2 Traffic noise maps under SNM – marked blue in the chart.

Action 1 details basic elements to create GIS database, i.e. recognizing spatial and functional area structure, gathering input data acquired from various urban information sources or building topic layers. Action 2 presents necessary elements which, based on the created database and specialist software for acoustic analysis, help generate traffic noise maps and present to the public on Internet portals. In the further part details of Action 1 are described.

5.3.1. Recognizing spatial and functional area structure

Building GIS database should be preceded by recognizing the spatial and functional structure of the particular area. To this end, an inventory of the current state should be made. Due to the purpose of creating a database, it is recommended objects in the space be divided into three groups including:

- objects of acoustic nuisance,
- objects of acoustic sensitivity,
- neutral objects regarding acoustics.

The subject of the research is traffic noise. Therefore, the first group should be made of existing road sections. Group two should classify objects where acceptable acoustic standards are lawfully established. Group three includes objects affecting propagation of acoustic waves in space such as construction objects not classified in the second group, forest areas, slopes and area performing temporary functions where colliding areas of transportation and living functions meet, such as service areas, engineering infrastructure areas. Upon defining objects in the space it is necessary to analyze mutual relations between the presented groups, locate places of potential conflict between areas of different purpose and analyze in detail the area for potential acoustic risks.

5.3.2. Gathering input data

Gathering necessary input data to make acoustic calculations is the most difficult part of creating GIS database; often the most costly as well (Fig. 32). Therefore, it is necessary to consider which data and in which institutions are already gathered or will be gathered in the nearest future. While building a GIS database the following input data are suggested to be used:

- data of traffic noise sources (vehicle traffic parameters at individual road sections, information about road traffic organizations, characteristics of road sections),
- cartographic studies including a basic numeric map and a topographic map,
- data from registers of land, buildings and premises,
- data from vital records,
- supplementary data regarding for instance areas of acoustic sensitivity, forests etc.,
- data from planning studies of the municipality level (in Poland, local plans of site development or condition studies and tendencies of municipality site development),
- results of acoustic measurements,
- results of traffic intensity measurements,
- information gained during on-site visit which supplement or update input data.

The more digital material is gathered, the easier and faster a traffic noise map is created while offering better calculation quality.
Fig. 32. A chart of creating traffic noise maps under SNM.

Source: Szopińska K. own study.
5.3.3. Creating GIS topic layers

While generating GIS database it is necessary to create a number of layers presenting objects in the space. For research purposes topic tools should be selected which help:
- create and edit maps by quickly integrating geospatial data in one location,
- exchange descriptive information,
- import databases of various kinds including parameters describing objects recorded in layers of numeric maps.

The basic issue when creating traffic noise maps under SNM is to achieve a vector space map of the area under investigation (such as a town, quarter, estate) with regard to the building height and the layer describing road network and traffic. The resulting base understood as a part of GIS urban system base should include information on the following three layers of detail:
- Level 1 – 2D map of the examined area prepared under 1:10000 to 1:1000 scale and including homogenous road sections (objects of acoustic nuisance),
- Level 2 – 3D map of the examined area prepared under 1:10000 to 1:1000 scale including buildings linked to demographic data,
- Level 3 – maps of acoustic objects including but not limited to objects of acoustic sensitivity and neutral objects in terms of acoustics.

Level 3 helps generate a number of maps including distribution of acoustic fields along main roads taking into account screens in the way of propagating sound waves from the traffic noise source to the object of acoustic sensitivity. Below is a set of data needed to work out three layers of detail under GIS, which are necessary to produce traffic noise maps under SNM:
- Layer 1 – containing the town's basic map,
- Layer 2 – containing the ortophoto map,
- Layer 3 – containing the Numeric Area Model, describing the profile between the traffic noise source and the object of acoustic sensitivity,
- Layer 4 – for urban development describing the type and density of building including living houses, integrated with demographic data,
- Layer 5 – containing the road network describing characteristics of homogenous road sections as well as traffic structure and intensity,
- Layer 6 – for planning, with the area divided for functions resulting from planning studies,
- Layer 7 – containing additional spatial objects with descriptive information such as parking places, green areas, water courses and surface water.

Generation of the presented topic layers is possible due to integration of the digital map with the descriptive database of traffic noise sources, objects affecting propagation of sound waves and objects of acoustic sensitivity. It is suggested to use for this purpose specialist software for spatial analyses which enables integration of all elements of the system to achieve the target results. Classes of objects generated by the software will allow for effective development of the traffic noise maps under SNM. Below are rules of creating individual GIS topic layers.

5.3.3.1. Topographic layer – Numeric Area Model (NMT)

It is the basic layer for creating traffic noise acoustic maps. It is designed to reflect the area's profile and development between objects of acoustic nuisance and object of acoustic sensitivity. Preferably, it should be based on the following elements of the town's digital map:
- elements of height layer, including: spot heights – depending on the location of the spot height (ordinates x, y) the height ordinate (z) should be taken from the spot height's description; contour lines – contact of the elements of the contour line should be considered; slopes, ravines, landslide, washouts and levees – information about specific heights in characteristic points of the objects should be used,
elements of the situation (lower ordinates of flyovers) and elements of the area development as regards use of upper ordinates of ground fittings for all kinds of network. Location of the object \((x, y)\) should be identified according to the symbol placement whereas the ordinate \((z)\) according to the description,

roadway edges for the existing road network should be identified using spot heights from the basic map.

Based on the above data, NMT should be generated. To this end, in the first place a method of profile modelling should be used by means of an triangulated irregular network – TIN model, whose advantage is maintenance of good quality data (BYDŁOSZ et al. 2010). Next, the TIN model should be approximated to a smooth surface of a square regular GRID – GRID model. This model is supported to use to calculate traffic noise maps.

5.3.3.2. Urban layer – buildings

In order to produce traffic noise maps it is necessary to isolate a 3D layer identifying the building type and density. The urban layer should be achieved according to the following rules:

- contour geometry should be obtained from the GeoKataster base and supplemented with the basic map. The building contour should be connected with the contour of the related parcel and related plat,
- building identification should be obtained from the GeoKataster base and from the basic map’s overlay. In order to supplement the data, an on-site interview should be carried out. The data allocated to the contour should include: building area, building registration and ordinal number, street, building function, height and number of storeys,
- building placement in a 3D model should be completed using profile analyses from TIN model. The building height \((h)\) should be calculated using the number of storeys and assuming the height of a single storey (e.g. in Poland \(h=3.1m\), whereas for one-storey building the height of 3.5m is assumed). For manufacturing plant buildings the height should be determined using information provided by the company,
- buildings should be connected with demographic data obtained from vital records. When unsure how to connect an address base with a specific building or in order to update data, an on-site interview should be conducted,
- for health care and education buildings additional data should be obtained regarding the operation’s name and the number of users. For buildings within manufacturing plant premises the plant’s name and the number of employees should be given.

5.3.3.3. Traffic noise data layer – road network

Traffic noise maps require existing road networks to be taken into account. All roads should be divided into homogenous road sections whose noise level parameters are approximately constant. Objects located in this layer should have relevant data in tables of attributed GIS database which enable analysis of the traffic noise level. The data range and description are presented in Table 11. The data presented in tables for each road section may be obtained according to the following rules:

- location of the centreline of existing roads should be identified by digitalizing the basic map and on-site interview,
- for two-way roads the centreline should be drawn in the middle of the road,
- for one-way roads separated with a green strip the centreline should be drawn in the middle of each lane,
- for each road section the traffic intensity and structure data should be provided for three reference times (day, evening and night), as well as speed limit data, the type of traffic and parameters characteristic of such road section.
Table 11. Contents of attribute tables for GIS data layer affecting the traffic noise level

<table>
<thead>
<tr>
<th>DATA RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAD SECTION CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>Location of road centreline in the map</td>
<td>section identifier, section name, street name at the section end, identifier and street name at the section start, junction at section start, junction at section end</td>
</tr>
<tr>
<td>Road category</td>
<td>such as state, county, provincial, municipal, other</td>
</tr>
<tr>
<td>Road type</td>
<td>such as service, main, access, local, other</td>
</tr>
<tr>
<td>Number of lanes and traffic directions</td>
<td>values specified according to the source material</td>
</tr>
<tr>
<td>Lane width</td>
<td>value determined in accordance with the road centreline and road edge</td>
</tr>
<tr>
<td>Type of surface</td>
<td>such as good quality asphalt, field, concrete slabs, poor quality asphalt</td>
</tr>
<tr>
<td>Surface condition</td>
<td>e.g. good, medium, alarming, poor, unmade road</td>
</tr>
<tr>
<td>Traffic lights</td>
<td>YES/NO</td>
</tr>
<tr>
<td>Road location</td>
<td>at area level, in excavation, under flyover, on embankment</td>
</tr>
<tr>
<td>TRAFFIC DATA</td>
<td></td>
</tr>
<tr>
<td>Traffic intensity</td>
<td>source data identifier, type of data source</td>
</tr>
<tr>
<td>Speed limit</td>
<td>for light and heavy vehicles</td>
</tr>
<tr>
<td>Vehicles per hour</td>
<td>values should be identified using direct traffic measurements or data from applicable reports</td>
</tr>
<tr>
<td>Heavy vehicles per hour</td>
<td>values should be identified using direct traffic measurements or data from applicable reports</td>
</tr>
<tr>
<td>Heavy percentage</td>
<td>vehicles</td>
</tr>
<tr>
<td>Traffic flow</td>
<td>such as uninterrupted, signal controlled, accelerating, decelerating</td>
</tr>
<tr>
<td>Average daily traffic intensity</td>
<td>at two-direction sections to the town centre and back</td>
</tr>
</tbody>
</table>

Key: number of vehicles per hour – total light and heavy vehicles specified for the following reference times: day time (peak and non-peak hours), evening time, night time. The light vehicles include all vehicles with allowable total weight up to 3,500 kg. The heavy vehicles include all trucks with allowable total weight above 3,500 kg and buses and slow vehicles. The percentage of heavy vehicles is the ratio of heavy vehicles to the number of real vehicles specified for the following reference times: day time (peak and non-peak hours), evening time, night time. Real vehicles mean all vehicles.

Source: SZOPIŃSKA K. own study

5.3.3.4. Planning layer – sensitive areas

This layer presents the area division for its function in accordance with the planning studies on the municipality level. The functional division corresponds to the list of areas of acoustic sensitivity identified by the state legislator. For Poland the following areas of acoustic sensitivity are identified:

- areas of detached living houses,
- areas of multi-family blocks of flats,
- areas of residence and services,
- areas of hospitals and health care services,
- areas of building related to permanent or temporary stay for children and youth,
- areas of recreation and relaxation.

In attribute tables maximum acceptable traffic noise levels should be allocated to the above areas in accordance with effective legislation in a particular state.
5.3.3.5. Additional information layers

Apart from the above layers, other layers with additional information about the area need to be generated in GIS database. These should include data describing parking places, green areas, surface waters and existing acoustic screens. Parking places above 50 ares or 50 parking places should be entered in GIS database. The data about parking places should be obtained from on-site interview based on the total parking area assuming app. 25m² for one car and app. 80m² for one truck. Information about geometry of existing acoustic screens should be obtained from on-site interview.

5.4. An example of building GIS database to produce a traffic noise map under SNM

5.4.1. Research area

For the research an area located within a Polish town, Bydgoszcz, was selected, which is covered by a Local Site Development Plan for the Akademickie – Wschód residential area in Fordon, Bydgoszcz (hereinafter referred to as the local plan). Due to the fact that production of a traffic noise map under SNM requires the sound level to be taken into account which comes from areas adjacent to the selected local plan, the research area was extended upon the adjacent areas. As a result, the research area covered the plots forming the area for which the said local plan was developed, i.e. plots 337, 338, 341 and 342 within Fordon urban unit in Bydgoszcz.

Bydgoszcz is one of the biggest towns in northern Poland with 360,000 inhabitants. The Fordon urban unit is located in the eastern part of the town. It is the biggest quarter of Bydgoszcz. Fordon’s area takes 18% of the whole town’s area and is inhabited by app. 20% of Bydgoszcz inhabitants. The scope of the local plan involves Akademickie – Wschód residential area. It occupies 94.97 ha and is made up of four zones: 337, 338, 341 and 342. The area is dominated by multi-family blocks of flats from 1980’s embedded in the accompanying green areas made of coniferous trees – self-sown pine trees. Its supplementary function is basic service buildings. The existing railway network in Bydgoszcz together with the research area is shown in Fig. 33. Fordon urban unit is marked grey whereas red marks borders of the local plan.

5.4.2. Spatial and functional structure of research area

On 10 December 2014 the inventory of the local plan was counted. According to its results, residential areas were included in the objects of acoustic sensitivity, which occupy over 25% of the area and consist of multi-family nine, ten and twelve-storey blocks of flats and two-storey detached houses. The objects of acoustic nuisance comprised roads occupying over 40% of the area whose characteristics are shown in Table 12. Mostly these are asphalt roads of poor or alarming surface condition and field roads. Service areas (7.2% of the area) were classified as neutral objects in terms of acoustics and so were green areas (25%) being a part of a mixed forest dominated by self-sown pine trees.
Fig. 33. Road network in Bydgoszcz with marked research area.

Source: Szopińska K. own study

Table 12. Characteristics of road sections forming transportation layout of the local plan

<table>
<thead>
<tr>
<th>STREET NAME</th>
<th>CATEGORY</th>
<th>ROAD TYPE</th>
<th>SURFACE TYPE</th>
<th>SURFACE CONDITION</th>
<th>SPEED LIMIT [KM/H]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaliskiego</td>
<td>municipal</td>
<td>service</td>
<td>asphalt</td>
<td>o</td>
<td>50</td>
</tr>
<tr>
<td>Akademicka</td>
<td>county</td>
<td>main</td>
<td></td>
<td>z</td>
<td>50</td>
</tr>
<tr>
<td>Brzechwy</td>
<td>municipal</td>
<td>service</td>
<td></td>
<td>s</td>
<td>50</td>
</tr>
<tr>
<td>Andersa</td>
<td>county</td>
<td>main</td>
<td></td>
<td>z</td>
<td>50</td>
</tr>
<tr>
<td>Igrzyskowa</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>30</td>
</tr>
<tr>
<td>Forodońska</td>
<td>state</td>
<td>main</td>
<td></td>
<td>d</td>
<td>80, 50</td>
</tr>
<tr>
<td>Szlakowa</td>
<td>municipal</td>
<td>other</td>
<td>field</td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Bydgoskich</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Olimpijskichów</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pałubickiego</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Wardyńskiego</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Stwosza</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Mieszka I</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Wróblewskiego</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
<tr>
<td>Magazynowa</td>
<td>municipal</td>
<td>other</td>
<td></td>
<td>i</td>
<td>50</td>
</tr>
</tbody>
</table>

Key: d – good, s – medium, o – alarming, z – poor, i – other.

Source: Szopińska K. own study

5.4.3. Input data to build GIS database

Table 13 presents format of available input data used to create GIS database for the research area. Apparently, source material take form of vector data, raster data, graphic studies and written documents (in form of tabular specifications, surveys and reports). The following data are available in a digital format:

- Bydgoszcz’s basic map,
- data from the land, building and premises register,
- data from vital records,
• information obtained from the road and traffic management system,
• borders of areas of noise sensitivity from the local government unit responsible for municipality-level planning studies (in Bydgoszcz: Municipal Urban Planning Lab).

<table>
<thead>
<tr>
<th>SOURCE NAME</th>
<th>DATA OWNER</th>
<th>FORMAT</th>
<th>DATA LAYER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bydgoszcz basic map</td>
<td>Bydgoszcz Town Office (Geodesy department)</td>
<td>vector data .dgn,</td>
<td>topographic, urban, road, parking, green, water</td>
</tr>
<tr>
<td>Bydgoszcz topographic map</td>
<td></td>
<td>Scan of traditional maps topographic, model in 1:10000 .tif, NMT</td>
<td></td>
</tr>
<tr>
<td>EGB 2000</td>
<td></td>
<td>GeoKataster,</td>
<td>urban, parking, green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MS SQL Server and Oracle,</td>
<td></td>
</tr>
<tr>
<td>Vital records</td>
<td></td>
<td>text files .xls,</td>
<td>urban</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oracle database,</td>
<td></td>
</tr>
<tr>
<td>Road management system</td>
<td>Bydgoszcz Town Office</td>
<td>vector data .dgn,</td>
<td>urban, road, parking, green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>system based on MGE road standard by Intergraph,</td>
<td></td>
</tr>
<tr>
<td>Supplementary material</td>
<td>Bydgoszcz Town Office, private companies</td>
<td>graphic files .jpg i.tif, text files .xls i.doc,</td>
<td>urban, road, parking, green</td>
</tr>
<tr>
<td>Planning studies</td>
<td>Local Urban Lab in Bydgoszcz</td>
<td>vector files .dgn,</td>
<td>planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>graphic files .jpg i.tif, text files .xls i.doc</td>
<td></td>
</tr>
<tr>
<td>Acoustic measurements</td>
<td>own study</td>
<td>photo documents .jpg,</td>
<td>road, urban, road, parking</td>
</tr>
<tr>
<td>Traffic intensity measurements</td>
<td></td>
<td>text files .xls i.doc,</td>
<td></td>
</tr>
<tr>
<td>On-site inspection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Szopińska K. own study

### 5.4.4. GIS information layers

In order to generate traffic noise maps for the specific local plan, a GIS database was built by means of GeoMedia Professional software by Intergraph which helped generate the following topic layers:

• topographic layer including the Area Numeric Model of the research area,
• urban layer specifying the type and density of building (residential building integrated with demographic data and public utility building, health care building, supermarkets and manufacturing plants) including information about the type of object and number of occupants,
• road layer including a description of road section characteristics and traffic structure and density for existing road sections,
• planning layer identifying the area division into areas of acoustic sensitivity in terms of their designation and method of development. The layer was produced in accordance with the local plan provisions. For adjacent areas, in accordance with provisions of the Study of Conditions and Directions of Bydgoszcz Spatial Development,
• additionally, a layer of parking places including a description of the type and number of parking places, a green layer with location of green areas, including forests and surface water.

The above topic layers were performed according to the rules stated in this study by using source data shown in Table 13 and vector digitalization of objects representing the spatial and functional structure of the local plan. A screen shot of GeoMedia Professional software depicting two pieces of information layer is presented in Figures 34 and 35. A homogenous road section belonging to Andersa street is marked in Figure 34. The attribute table includes data describing characteristics of the section and information about the traffic which are detailed in
Table 11. Figure 35 shows an example of a spatial object along with a descriptive attribute of the urban layer. It is an education & administration building owned by the UTP University of Science and Technology in Bydgoszcz. Apart from the address data, the attribute table contains information about the number of students and employees. Summary information found in GIS database for the traffic noise maps under SNM is presented in Table 14.

The GIS database generated by means of the software for acoustic analysis helps create a number of traffic noise maps.
Table 14. Summary of information included in GIS database for traffic noise maps under SNM

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>STATISTIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fordon borderline</td>
<td>1</td>
</tr>
<tr>
<td>local plan borderline</td>
<td>1</td>
</tr>
<tr>
<td>road section</td>
<td>115</td>
</tr>
<tr>
<td>flyover</td>
<td>5</td>
</tr>
<tr>
<td>parking place</td>
<td>13</td>
</tr>
<tr>
<td>building (total)</td>
<td>987</td>
</tr>
<tr>
<td>living area</td>
<td>31</td>
</tr>
<tr>
<td>supermarket building</td>
<td>9</td>
</tr>
<tr>
<td>supermarket premises</td>
<td>2</td>
</tr>
<tr>
<td>education building</td>
<td>21</td>
</tr>
<tr>
<td>education premises</td>
<td>3</td>
</tr>
<tr>
<td>health care building</td>
<td>9</td>
</tr>
<tr>
<td>health care premises</td>
<td>2</td>
</tr>
<tr>
<td>manufacturing plant building</td>
<td>27</td>
</tr>
<tr>
<td>manufacturing plant premises</td>
<td>2</td>
</tr>
<tr>
<td>green area</td>
<td>34</td>
</tr>
<tr>
<td>surface water reservoirs</td>
<td>2</td>
</tr>
<tr>
<td>measuring point of traffic intensity</td>
<td>34</td>
</tr>
<tr>
<td>measuring point for acoustic measurement of traffic noise total</td>
<td>1302</td>
</tr>
</tbody>
</table>

*Source: Szopińska K. own study*

5.5. Conclusions

The traditional method of producing traffic noise maps involves selection of measuring points of suitable density and using them to identify interpolation range of noise impact in a particular decibel range. At present, pursuant to the European law (Directive 2002), noise in urban areas is determined by means of the digital acoustic map under the Strategic Noise Map (SNM) system. The system is based on acoustic calculations performed with specialist computer software. Digital traffic noise maps are generated using sound source characteristics (parameters describing road sections, traffic intensity and type data) rather than results of on-site measurements of noise levels. Additionally, SNM calculations take into account the profile and method of development. With such vast analysis of the environment conditions, it is purposeful to apply geo-information data as a methodological basis. GIS data enable implementation of standardized rules of gathering and maintaining data characterizing the environment condition as well as parameters affecting traffic noise levels. Furthermore, GIS technology, which combines digital maps of the area and related databases, helps identify a number of acoustic indicators of environmental risk such as the number of population exposed to traffic noise nuisance. Determination of such indicators by means of the said technology is an optimum solution which puts together demographic data and cartographic information included in urban digital maps.
6. Quality evaluation of cultural heritage websites

Cultural heritage as a non-renewable resource that is unique, non-replaceable or non-interchangeable is currently confronted with important challenges related to cultural, environmental, social, economic, and technological transformations that affect all the aspects of contemporary life. The European Union (EU) recognises cultural resource management as a part of sustainable management of city resources. The main goal is to ensure protection of cultural significance, integrity, and authenticity of the resource for present and future generations through conservation and sustainable resource utilization. According to EU guidelines (COUNCIL OF THE EU, 2014), cultural heritage plays a specific role in achieving the Europe 2020 strategy goals for a smart, sustainable and inclusive growth, as it has social and economic impact and contributes to environmental sustainability. In the social field, cultural heritage has the capacity to promote diversity and intercultural dialogue by contributing to a stronger sense of belonging to a wider community and a better understanding and respect between peoples. Heritage has an important economic impact, including that of being an integral part of cultural and creative sectors, as, among other things, it: a) constitutes a powerful driving force of inclusive local and regional development and creates considerable externalities, in particular through enhancement of sustainable cultural tourism; b) supports sustainable rural and urban development and regeneration, as illustrated by initiatives by many European regions and cities; c) generates diverse types of employment. Therefore, this potential should be fully recognised and developed.

The first general principles of heritage management were developed by international organizations, including United Nations Educational, Scientific and Cultural Organization (UNESCO) and International Council on Monuments and Sites (ICOMOS). They were embodied in an international treaty called the Convention concerning the Protection of the World Cultural and Natural Heritage, adopted by UNESCO in 1972. Table 15 presents a list of some of the most important conventions and charters, which are aimed at providing guidelines and methodological frameworks for management of immovable cultural heritage. It is important to review them before starting to design heritage information systems.

Table 15. Guidelines and methodological frameworks for management of immovable heritage.

<table>
<thead>
<tr>
<th>Year</th>
<th>UNESCO Conventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>Convention Concerning the Protection of the World Cultural and Natural Heritage (The World Heritage Convention)</td>
</tr>
<tr>
<td></td>
<td><strong>UNESCO Recommendations</strong></td>
</tr>
<tr>
<td>1956</td>
<td>Recommendation on International Principles Applicable to Archaeological Excavations</td>
</tr>
<tr>
<td>1962</td>
<td>Recommendation concerning the Safeguarding of Beauty and Character of Landscapes and Sites</td>
</tr>
<tr>
<td>1968</td>
<td>Recommendation concerning the Preservation of Cultural Property Endangered by Public or Private works</td>
</tr>
<tr>
<td>1972</td>
<td>Recommendation concerning the Protection, at National Level, of the Cultural and Natural Heritage</td>
</tr>
<tr>
<td>1976</td>
<td>Recommendation concerning the Safeguarding and Contemporary Role of Historic Areas</td>
</tr>
<tr>
<td>2011</td>
<td>Recommendation on the Historic Urban Landscape</td>
</tr>
<tr>
<td></td>
<td><strong>ICOMOS Charters and Principles</strong></td>
</tr>
<tr>
<td>1964</td>
<td>International Charter for the Conservation and Restoration of Monuments and Sites (The Venice Charter)</td>
</tr>
<tr>
<td>1990</td>
<td>Charter for the Protection and Management of the Archaeological Heritage</td>
</tr>
<tr>
<td>1996</td>
<td>Principles for the Recording of Monuments, Groups of Buildings and Sites</td>
</tr>
<tr>
<td>1999</td>
<td>International Cultural Tourism Charter – Managing Tourism at Places of Heritage</td>
</tr>
</tbody>
</table>
An effective heritage management system depends on the type, characteristics and needs of the historical property and its cultural and natural context. Management systems incorporate traditional practices, existing urban or regional planning instruments, and other planning control mechanisms. In recognizing the diversity mentioned above, common elements of an effective management system could include:

- a thorough shared understanding of the property by all stakeholders;
- a cycle of planning, implementation, monitoring, evaluation, and feedback;
- monitoring and assessment of the impacts of trends, changes, and of proposed interventions;
- involvement of partners and stakeholders;
- allocation of necessary resources;
- capacity-building;
- an accountable, transparent description of how the management system functions.

Effective management involves a cycle of short-, medium- and long-term actions to protect, conserve and present historical properties. An integrated approach to planning and management is essential to guide the evolution of properties over time and to ensure maintenance of all aspects of their value (WHC, 2013).

Over the recent years, the role of information and communication technologies (ICT) in cultural resource management and research have increased. A special European report called DigiCULT (2002) is devoted to the potential of ICT in cultural heritage. The Digital Agenda for Europe seeks to optimise the benefits of information technologies for economic growth, job creation and the quality of life of European citizens, as part of the Europe 2020 strategy. The digitisation and preservation of Europe’s cultural memory which includes print (books, journals and newspapers), photographs, museum objects, archival documents, sound and audiovisual material, monuments and archaeological sites is one of the key areas tackled by the Digital Agenda (THE EU COMMISSION RECOMMENDATION, 2011). The necessity of heritage digitization is also apparent from the fact that Internet usage is widespread throughout the European Union. According to data contained in the Measuring the Information Society Report (ITU, 2014) all the countries in the European region exceed the global average the ICT Development Index (IDI) of 4.77 (see Table 16). The first place in the global and regional rankings is occupied by Denmark (IDI 8.86). While the region of EU in general has attained high levels of ICT development, there is a divide within Europe between the lower ranking Eastern and Southern European countries, on
the one hand, and the Western European countries that rank at the top of the regional and global IDI, on the other. The top 20 countries of the IDI 2013 in Europe are shown in Table 16.

**Table 16.** The top 20 of the IDI 2013 in Europe.

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>Sweden</th>
<th>UK</th>
<th>Netherlands</th>
<th>Finland</th>
<th>Luxembourg</th>
<th>Germany</th>
<th>France</th>
<th>Estonia</th>
<th>Austria</th>
<th>Belgium</th>
<th>Ireland</th>
<th>Spain</th>
<th>Malta</th>
<th>Slovenia</th>
<th>Latvia</th>
<th>Italy</th>
<th>Croatia</th>
<th>Greece</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>17</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>28</td>
<td>30</td>
<td>31</td>
<td>33</td>
<td>36</td>
<td>37</td>
<td>39</td>
<td>40</td>
</tr>
</tbody>
</table>

Key: IDI - ICT Development Index, RR – Regional rank (EU), GR – Global rank

*Source: Banaszek A. study based on the data from ITU (2014)*

Around three-quarters of European households have access to the Internet at home. The highest percentage of individuals using the Internet are found in Denmark and Sweden (95 per cent), Luxembourg and the Netherlands (94 per cent) and Finland (92 per cent) (see Fig. 36). All European countries reached the result above the global average.

![Figure 36](image-url)

**Fig. 36.** Percentage of Individuals using the Internet, Europe countries compared to global and european average.

*Resource: Banaszek A. study based on the data from ITU (2014)*

The importance of good decisions in cultural resource management fundamentally requires availability of appropriate information. ICT, including Geographical Information Technologies (GITs), offers enormous potential for recording, documenting, and archiving
cultural materials and sites, enabling new forms of analysis and reconstruction. They can also provide new models of communicating and presenting information that would not otherwise be possible. In doing so, ICT can help to capture the value of heritage, raising awareness of the importance of cultural heritage for our sense of the past and our sense of place (FITZJOHN, 2009).

In order to provide information about cultural heritage are created on-line portals provided by public authorities (in most European countries these are the Ministry of Culture, the National Institute of Cultural Heritage, or the Heritage Agency), local authorities, cultural institutions, museums and non-profit organizations. According to CARUGATI et al. (2005) there are 5 main types of e-services providing heritage information: a portal, archives, an archaeological visit, a virtual-real museum, and a pure-virtual museum. The portal is the most common expression of governmental activities online. These portals provided the point of entry to other initiatives like museums, archaeological sites, folkloristic initiatives, etc. It means that the public agency itself must therefore take responsibility for the quality of their service. The Web has been the fastest adopted technology, yet, the quality of websites is often unsatisfactory. The quality criteria have a double objective: on the one hand, they represent factors for evaluating the quality of cultural heritage sites on the Web; on the other hand, they direct and support the process of design and development of a cultural heritage website (SIGNORE, 2005). In this context, the paper presents a study of the quality evaluation of government websites for cultural heritage.

6.1. Context

The research is concerned with the key issue of quality. Quality is a word with a very broad meaning, and the quality of a website can be viewed in a very subjective way. Having this in mind, it is necessary to investigate it in the state of the art related to Web application quality. A milestone in the exploration of quality issues is represented by the ISO 9126 standard for software quality measurement, called “Software Quality Product Evaluation: Quality Characteristics and Guidelines for their Use”, proposed in 1992. The ISO/IEC 9126-1 defines the quality as “the capability of the software product to enable specified users to achieve specified goals with effectiveness, productivity, safety and satisfaction in specified contexts of use”. The ISO/IEC 9126 series standard introduced a hierarchical model for software evaluation with six major quality characteristics (functionality, reliability, usability, efficiency, maintainability, portability), each very broad in nature. They are subdivided into 27 sub-characteristics which contribute to external-quality, and 21 sub-characteristics which contribute to internal-quality (MINERVA, 2003; SIGNORE, 2005).

There are different approaches for website evaluation defined in different communities (cultural, e-government, research and enterprise environments) but it is difficult to propose a single-standard evaluation instrument. An important initiative towards website quality in cultural environment is the MNisterial NETwoRk for Valorising Activities in Digitisation (MINERVA). To improve accessibility and usability of European digital cultural resources, the Minerva Working Group had defined quality criteria for cultural websites. A website is considered to be accessible when the informational content, navigational modes and all the interactive features present are accessible to all users, regardless of disabilities and independently of the technology used to access the site and of the context in which they are working whilst accessing the site. The definition of usability is defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11). The most common principles of usability are the following: visibility, affordance, natural mapping, constraints, conceptual models, feedback, safety and flexibility (MINERVA, 2003).

Among the publications about evaluation of cultural heritage websites, DigiCULT European Report should be pointed out (2002). This report mentions the following user expectations: applications should be user-friendly, multi-lingual, providing full cultural
information about the stored objects; core information should be written simply and accessibly, without using jargons or making assumptions about prior knowledge; quality and pertinence of the content; 'processes' rather than static artefacts; increased interactivity; fully documented collections presented in engaging ways, richer imaginative experiences; an ability to create personal collections and to surface resources in own working or learning environments. According to MONOD et al. (2006) some of these requirements do point out the considerable gap between user expectations and the current quality of interpretive aids, which most cultural heritage institutions should be able to provide. A service quality model for web-services evaluation in cultural heritage management was proposed by CHIARULLO et al. (2011). The study explores the use of SERVQUAL method to identify and analyse users' preferences and satisfaction for web-services, and to measure service quality gaps. Users of cultural heritage websites and their competences are shown in Table 17.

Table 17. Users of heritage information, their competences, main tasks functions, GIS competences and access modality.

<table>
<thead>
<tr>
<th>Users</th>
<th>National Institute of Cultural Heritage</th>
<th>Municipality</th>
<th>Citizens</th>
<th>Tourists</th>
<th>Researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>User profile</td>
<td>Art historians</td>
<td>Architects</td>
<td>Different backgrounds</td>
<td>Different backgrounds</td>
<td>Architects</td>
</tr>
<tr>
<td></td>
<td>Conservators</td>
<td>Civil Engineers</td>
<td>Conservators</td>
<td>Architects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Architects</td>
<td>Archaeologists</td>
<td>Archaeologists</td>
<td>Archaeologists</td>
<td></td>
</tr>
<tr>
<td>Main functions</td>
<td>Input information</td>
<td>Input information</td>
<td>View-Search-Extract Data</td>
<td>View-Search-Extract Data</td>
<td>View-Search-Extract Data</td>
</tr>
<tr>
<td></td>
<td>View-Search-Extract Data</td>
<td>Data</td>
<td>Input monitoring Information maintenance</td>
<td>Data</td>
<td>Input options of tourists</td>
</tr>
<tr>
<td></td>
<td>Data Management</td>
<td>Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIS competences</td>
<td>Advanced GIS users</td>
<td>Advanced GIS users</td>
<td>No expertise with GIS</td>
<td>No expertise with GIS</td>
<td>Advanced GIS users</td>
</tr>
<tr>
<td>Access</td>
<td>Desktop GIS</td>
<td>Desktop GIS</td>
<td>Web-GIS</td>
<td>Web-GIS</td>
<td>Web-GIS</td>
</tr>
<tr>
<td></td>
<td>Web-GIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: HERAS ET AL. (2012)

Moreover, the websites for cultural heritage conducted by government agencies must comply with the criteria for e-government. The general criteria are presented in the e-government manual ‘Quality Criteria for public-user-friendly and Secure Websites’, prepared by the University of Bremen (QUALITY CRITERIA, 2002). Many experts evaluate e-government on the basis of presence of a government website. The Arizona-based research team, Cyberspace Policy Research Group, for example, has developed the ‘Website Attribute Evaluation System’ (WAES) to assess the contents and format of national-level e-government websites according to two principal criteria: transparency and interactivity (WAES, 1998). The WAES does not simply treat information transparency as a necessity but also exploits the relationship between government departments and citizens through evaluation of interactivity. As NORRIS (2001) points out, it seems more appropriate to compare a government’s online activity with its role in the real world. Therefore, 'government websites should be evaluated in terms of the quality and effectiveness of their informational and communication functions'. LA PORTE et al. (2002) endeavoured to measure the organizational openness in implementing e-government services through cross-national comparison of websites using the WAES that included the following: ownership, contact information, organizational or operational information, freshness, and
interactivity. WAES was used to assessment of the local government websites and local geportals in Poland (Ślusarski, 2012; Porębski, 2011). In the comprehensive analysis of government websites, West (2008) examined 18 measures that focus on the amount of information available and the extent of interaction with users, such as website personalization and e-mail updates of information. Zhang and Von Dran (2001) argued that e-government portals are similar to e-commerce websites because attributes such as ease of navigation, clear layout of information, up-to-date information, search tool, and accuracy of information are playing important roles in providing benefits to users in terms of website quality. According to World Market Research Council (WMRC, 2001), information availability, interface, e-commerce, application serves, and accessibility are the most important indices for evaluating e-government portal performance.

6.2. Research Methodology

The purpose of the research presented in this paper was to provide quality evaluation of government cultural heritage websites in European countries. Because of that, the author has reviewed the websites for cultural heritage provided by public authorities and selected four European countries for analysis: Bulgaria, England, Poland, and Sweden. These countries represent common features of the systems for protection of historical property, but they have different levels of advancement in using ICT for cultural resource management and geographical location in Europe. The choice was also dictated by the ability to reach out to experts. The subject of the study was to compare the following websites:

1) Bulgaria - ninkn.bg, the website of the National Institute for Immovable Cultural Heritage of Bulgaria. It is a public cultural institution, established by the Ministry of Culture. The Institute assists the Minister of Culture in exercising his powers in conducting the state policy on conservation of immovable cultural heritage. It monitors the build heritage, prepares evaluations and expert opinions, has the tasks to propose candidates for protection itself and to assess the proposals by others, and maintains the National Register of Immovable Cultural Property.

2) England - www.english-heritage.org.uk, the website of English Heritage. It is non-departmental public body sponsored by the Department for Culture, Media and Sport. Officially known as the Historic Buildings and Monuments Commission for England. It has a broad remit of managing the historic environment of England and advises the relevant Secretary of State on policy and in individual cases, such as registering listed buildings and scheduled ancient monuments.

3) Poland – www.nid.pl, the website of the National Heritage Board of Poland. It is a state agency, established by the Minister of Culture and National Heritage, that gathers and disseminates information on heritage, sets standards for its protection and conservation, and aims to raise the social awareness on cultural heritage of Poland, in order to save it for future generations in accordance with the strategy for sustainable development.

4) Sweden - www.raa.se, the website of the Swedish National Heritage Board. The Swedish National Heritage Board, which serves as Sweden’s central administrative agency in the area of heritage and the historic environment, is under the auspices of the Ministry of Culture. The Cabinet’s objectives for the Board include encouraging; preservation and protection of the historic environment; respect for the heritages of different groups; appreciation of, commitment to, and assumption of responsibility for one’s own heritage.

At the start of the study, qualitative criteria were determined for evaluating selected websites. In developing a set of criteria, this survey relied on a multi-methodological approach, utilizing the Website Attribute Evaluation System (WAES, 1998). Further studies were carried out using the qualimetry methodology, proposed by Azgaldov et al. (2012). The term ‘qualimetry’ (from the Latin quale, “of what kind”), which designates a scientific discipline studying the methodology and the issues of quantitative assessment of the quality of any kind of object, was first used in 1968. Qualimetry is a scientific discipline which concerns itself with the methods of
quantification of the quality of any object: things or processes, whether natural or man-made, products of labour or nature, whether living or inanimate, etc. (AZGALDOV, 1982). The qualimetry methodology is being gradually admitted into the economic and engineering studies (LOBANOV, 2013; AZGALDOV, KOSTIN, 2011; KAJGORODOVA, 2013). Based on the preliminary qualitative study, five major properties were identified: general properties, social properties, specialized properties, qualitative properties, and technical properties. According to qualimetry, a 'property' is a feature, characteristic or peculiar of an object that shows itself in the course of consumption or operation, use, or application, regarding its purpose (AZGALDOV, KOSTIN, 2012). In these studies, properties have been selected by adapting and expanding the above-mention method, taking into account specific of cultural heritage websites. In effect, 21 complex properties and 52 simple properties were defined. In accordance with the principles of the qualimetry methodology, a property tree was developed. Construction of the tree was based on the following rules: 1. Maximum tree height: the tree should continue to be branched until simple or quasi-simple properties remain at its highest tier. 2. Independence of preference properties in the group: each property, as a part of a group of properties, in relation to any other property of the group, must satisfy the principle of independence of preference. As a result, 5 levels of the property tree were obtained. The final distribution of complex and simple properties at different levels is presented in Table 18.

Table 18. Levels of a property tree.

<table>
<thead>
<tr>
<th>level</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>complex properties</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>simple properties</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>43</td>
</tr>
</tbody>
</table>

Source: elaborated by Banaszek A.

The property tree is presented in the right-hand tabular form (see Table 19). For each property a possible range of values was defined. The property in the content either exists or is absent. As a result, a score of either '0' (minimum value) or '1' (maximum value) is assigned to the specific property. To determine the value of simple properties included in the complex property "Technical Tests" online diagnostic platforms were used, such as the following: www.webpagetest.org, validator.w3.org, www.test-pagerank.com, browsershots.org and suksesstrony.pl.
<table>
<thead>
<tr>
<th>Quality of the cultural heritage website</th>
<th>Usability 71</th>
<th>General properties 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>ownership 53</td>
<td>institution linked with the site 1</td>
<td></td>
</tr>
<tr>
<td>contact 54</td>
<td>date of publication 2</td>
<td></td>
</tr>
<tr>
<td>availability of addresses 3</td>
<td>availability of online eForms 4</td>
<td></td>
</tr>
<tr>
<td>information about the organization 55</td>
<td>graphical organizational structure 5</td>
<td></td>
</tr>
<tr>
<td>mission statement 6</td>
<td>links to subordinate units 7</td>
<td></td>
</tr>
<tr>
<td>links to external sources 8</td>
<td>availability 57</td>
<td></td>
</tr>
<tr>
<td>security and privacy 56</td>
<td>using cookies 9</td>
<td></td>
</tr>
<tr>
<td>using cookies 9</td>
<td>secure connection 10</td>
<td></td>
</tr>
<tr>
<td>availability of online eForms 4</td>
<td>availability 57</td>
<td></td>
</tr>
<tr>
<td>availability of addresses 3</td>
<td>other language versions 11</td>
<td></td>
</tr>
<tr>
<td>availability of addresses 3</td>
<td>iconography based access 12</td>
<td></td>
</tr>
<tr>
<td>availability of online eForms 4</td>
<td>access for disabled people 13</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social properties 66</th>
</tr>
</thead>
<tbody>
<tr>
<td>possibility of putting 'likes' 14</td>
</tr>
<tr>
<td>possibility to add comments 15</td>
</tr>
<tr>
<td>possibility of linking 16</td>
</tr>
<tr>
<td>possibility to log using the social networks 17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialized properties 67</th>
</tr>
</thead>
<tbody>
<tr>
<td>legal basics 58</td>
</tr>
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<td>definitions 18</td>
</tr>
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<td>national legislation 19</td>
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<td>international legislation 20</td>
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</tr>
<tr>
<td>legal 21</td>
</tr>
<tr>
<td>surveying 22</td>
</tr>
<tr>
<td>historical 23</td>
</tr>
<tr>
<td>formal 24</td>
</tr>
<tr>
<td>scope of information 60</td>
</tr>
<tr>
<td>type of historical property 25</td>
</tr>
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<td>subject of protection 26</td>
</tr>
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<tr>
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</tr>
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<th>Qualitative properties 68</th>
</tr>
</thead>
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<td>accuracy 32</td>
</tr>
<tr>
<td>comparability 33</td>
</tr>
<tr>
<td>timeliness 34</td>
</tr>
<tr>
<td>utility 35</td>
</tr>
<tr>
<td>usability 36</td>
</tr>
<tr>
<td>expanded</td>
</tr>
<tr>
<td>cohesion 37</td>
</tr>
</tbody>
</table>

**Table 19. The property tree in the tabular form.**
Every property of an object can be quantitatively characterized with a property weight $G_i$. To determine the values of these weights, two groups of techniques are applied: expert and analytical ones. In these studies, the property weights were determined using expert techniques. At this stage, five experts ($E$) subjectively assigned the property weight for each from 52 properties. On the basis of the results of evaluation by experts, the average coefficient of the each property was defined, as well as the normalized values of each property. The average value was specified on the basis of double surveys conducted among experts for each property and it was given by the following formula:

$$G_i^* = \frac{\sum_{k=1}^{r} g_{i,k}^*}{r}$$  \hspace{1cm} (1)$$

where:

$G_i^*$ - the average coefficient of the property's weight;

$k$ - the expert's number;

$r$ - the number of experts.

In determining the value of a group normalized coefficient the principle $\sum_{i=1}^{n} G_i^* = 1$ was used, which leads to maintaining the relationship: $0 \leq G_i^* < 1$. A normalized coefficient of property weight $G_i^*$, is obtained from non-normalized by the operation of normalization:

$$G_i^* = \frac{g_i^*}{\sum_{i=1}^{n} g_i^*}$$  \hspace{1cm} (2)$$

The next step was calculated the values of group and tiered coefficients of the property weight $G_i$. A tiered coefficient of property weight $G_i$ characterizes the importance of property relative to any other property, not only within one group and one tier, but even to any other property, found in any other tier of the property tree. Moreover, within each tier of the tree
conditions $\sum G_i = 1$ are always provides. The fragment of the table showing the results of the calculations is shown in Table 20.

Table 20. The fragment of aggregated data results of values of coefficients of the property weight $G_i$

<table>
<thead>
<tr>
<th>Position of property in the tree</th>
<th>Values of group non-normalized $i$-x coefficients of the property weight</th>
<th>The values of group and tiered coefficients of the property weight $G_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$E1$ $E2$ $E3$ $E4$ $E5$</td>
<td>The average value</td>
</tr>
<tr>
<td>1</td>
<td>100 100 90 100 90</td>
<td>96</td>
</tr>
<tr>
<td>2</td>
<td>100 90 80 100 100</td>
<td>94</td>
</tr>
<tr>
<td>3</td>
<td>60 60 60 60 60</td>
<td>72</td>
</tr>
<tr>
<td>4</td>
<td>50 50 50 50 50</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>50 40 50 50 50</td>
<td>48</td>
</tr>
</tbody>
</table>

Source: elaborated by Banaszek A.

6.3. Results

In order to realize the quality evaluation of cultural heritage websites was built a comparative table (AZGALDOV, KOSTIN, 2012). For each website identified absolute values of property measures $Q_i$. Value of a property measure is a numeric value of a property measure. In addition to an absolute property measure $Q_i$ every property is also characterized with a relative measure $K_i$ which shows the level of property measure with respect to benchmark $Q_{ref}$ and rejection $Q_{rej}$ values of property measure:

$$K_i = \frac{Q_i - Q_{ref}}{Q_{ref} - Q_{rej}}$$

(3)

It should be noted, that benchmark and rejection values in the evaluation are equal to $Q_{ref} = 1$ and $Q_{rej} = 0$. To express quality numerically, combined quality was used as a relative measure $K_0$, expressed in our evaluation by the function $K_0 = f(\bar{K_i} G_i) = \sum K_i G_i$, $i = 1,\ldots,n$, where $n$ is the number of properties. The estimates of the results showing the numerical values are presented in Table 21.

The analysis shows that the first position among the evaluated cultural heritage websites is occupied by www.raa.se, the website of the Swedish National Heritage Board. Next in the ranking are www.english-heritage.org.uk, the website of English Heritage and www.nid.pl, the website of the National Heritage Board of Poland. The last position is occupied by ninkn.bg, the website of the National Institute for Immovable Cultural Heritage of Bulgaria. The website from Bulgaria gained almost two times less ranking points from the leader. Despite such a clear final result, the partial results of the analysis are no longer so obvious. It turns out that the Bulgarian website has the best score for performance testing because of its simplicity and a significantly smaller scope of information from other websites, whereas the worst score in this category has been gained by the website from Sweden. Detailed results of the evaluation of complex properties by level III of the property tree are shown in Table 22. This level was chosen because of the best aggregation of properties.
Table 21. The comparative table of cultural heritage websites.

<table>
<thead>
<tr>
<th>Property</th>
<th>England</th>
<th>Bulgaria</th>
<th>Poland</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$Q_1$</td>
<td>$K_1$</td>
<td>$K_1G_i$</td>
<td>$Q_2$</td>
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<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0,014</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
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<td>1</td>
<td>0,014</td>
<td>1</td>
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<tr>
<td>3</td>
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<td>1</td>
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</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0,014</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
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<td>1</td>
<td>0,014</td>
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<tr>
<td>6</td>
<td>1</td>
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<td>0,014</td>
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<td>27</td>
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<td>1</td>
<td>0,014</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
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<td>1</td>
<td>0,014</td>
<td>0</td>
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<tr>
<td>29</td>
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<td>30</td>
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<td>0,5</td>
</tr>
<tr>
<td>31</td>
<td>0,5</td>
<td>0,5</td>
<td>0,007</td>
<td>0</td>
</tr>
<tr>
<td>32</td>
<td>0,5</td>
<td>0,5</td>
<td>0,007</td>
<td>0,5</td>
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<tr>
<td>33</td>
<td>1</td>
<td>1</td>
<td>0,014</td>
<td>0,5</td>
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<td>34</td>
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<td>1</td>
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<td>1</td>
<td>0,014</td>
<td>0,1</td>
</tr>
<tr>
<td>36</td>
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<tr>
<td>37</td>
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<td>1</td>
<td>0,014</td>
<td>0</td>
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<tr>
<td>38</td>
<td>0,8</td>
<td>0,8</td>
<td>0,011</td>
<td>0</td>
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</tbody>
</table>
Table 22. Summary of the results of the quality evaluation for complex properties (III level).

<table>
<thead>
<tr>
<th>Complex properties</th>
<th>England</th>
<th>Bulgaria</th>
<th>Poland</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>General properties</td>
<td>0,128</td>
<td>0,074</td>
<td>0,115</td>
<td>0,101</td>
</tr>
<tr>
<td>Social properties</td>
<td>0,041</td>
<td>0,000</td>
<td>0,012</td>
<td>0,041</td>
</tr>
<tr>
<td>Specialized properties</td>
<td>0,169</td>
<td>0,081</td>
<td>0,142</td>
<td>0,182</td>
</tr>
<tr>
<td>Qualitative properties</td>
<td>0,130</td>
<td>0,041</td>
<td>0,081</td>
<td>0,139</td>
</tr>
<tr>
<td>Technical properties: perf.</td>
<td>0,042</td>
<td>0,049</td>
<td>0,043</td>
<td>0,036</td>
</tr>
<tr>
<td>Technical properties: qual.</td>
<td>0,047</td>
<td>0,055</td>
<td>0,063</td>
<td>0,059</td>
</tr>
</tbody>
</table>

As shown in Fig. 37, the most uniform results were obtained for the technical complex properties of websites, so the applied hardware and software solutions. This is due to the fact that the test portals rely on similar technologies. Specialized properties are an important indicator of quality cultural heritage websites for comparing the functioning of the websites. These include: legal information (national and international law for protection of immovable heritage, basic legal definitions), information about the immovable heritage (legal, surveying, historical, formal) and detailed data available on the website about immovable heritage (the type of immovable heritage, concerning protection, age, location, forms of protection and photo documentation). Specialized properties point to usability and availability of information for different groups of website users. The results of the evaluation of specialized properties showed a large difference in the evaluated websites. The highest score for the quality of the complex property has been obtained by the website of the Swedish National Heritage Board. This means the high quality of the agency’s work on the data sharing about immovable heritage. The Board works closely with national agencies and organizations, as well as county administrative boards, regional museums and other local groups. The joint effort gathers and disseminates information about heritage and the historic environment, develops new working methods, and identifies
innovative ways of exploring the relationship between human beings, their surroundings and society at large. The high mark for social properties obtained by the website of the Swedish National Heritage Board confirms the above conclusions. The website of English Heritage takes the second position and the website of the National Heritage Board of Poland occupies third position in terms of the quality of specialized properties. The lowest score was received by the website of the National Institute for Immovable Cultural Heritage of Bulgaria.

The website of English Heritage and the website of the National Heritage Board of Poland achieved the best results in terms of the quality of general properties (such as ownership, contact information, information about the organization, security and privacy, and availability). In view of the basic qualitative properties of the website, such as accuracy, comparability, timeliness, utility, usability, and expanded qualitative properties, such as cohesion, completeness, correctness, availability, uniqueness of information, and credibility, the high estimation was obtained by www.raa.se (0,139) and www.english-heritage.org.uk (0.130). For comparison, the quality of qualitative properties of the Bulgarian website was assigned a rating of 0,041.

Fig. 38 shows the influence of evaluation of complex properties on the final quality evaluation of the websites. It is evident that similar proportions were maintained in all four cases. It should be noted that the website of the National Institute for Immovable Cultural Heritage of Bulgaria does not have any social properties.

![Graph showing quality evaluation of websites](image)

**Fig. 37.** Comparison of the results of the quality evaluation of complex properties.


*Source: elaborated by Banaszek A.*
6.4. Conclusions

Information and Communication Technologies (ICT) slowly incorporated into the cultural resource management have led to develop cultural heritage websites and have contributed to creation of new forms of sharing information about historical monuments and sites. For this reason, a contemporary cultural heritage website must meet the expectations of the modern society. The heritage information acquired serves to ensure identification and classification of objects, to facilitate development of adequate policies for its conservation and maintenance, as well as to promote identity and cultural tourism. A very important role is played here by the websites provided by public authorities. As a rule, government websites are targeting a wide range of users and provide information for specialists in the field of protection of historical monuments and sites, researchers and owners of immovable heritage. A website should allow: spread of knowledge that permits the advance of understanding of the cultural heritage, its significance and integrity; promotion of interest and involvement of the people in the preservation of the heritage through dissemination of acquired information; and informed decision-making for management.

Evaluation of quality websites with special reference to protection of cultural heritage provides an opportunity for formulation of guidelines for development of the website and introduction of new technologies. Evaluating website quality requires appropriate evaluation criteria. As shown in the paper, there are different methods for evaluating the quality of web pages from the point of view of the cultural environment, e-government, technology requirements, etc. According SIGNORE (2005) quality evaluation approaches suffer from several limitations: they are based on qualitative criteria, which can be erroneous, prone, or subject to controversial discussions; there is a general aim to define very general criteria, not addressing the specific type of site or page; criteria are not orthogonal; many evaluation criteria are essentially accessibility or usability biased; and the quality changes is perceived from different user perspectives. And finally, to define a metrics, we need measurable characteristics and a rigorous approach.
This studies aims at defining a quality evaluation model and a set of properties that can be measured by using the qualimetry methodology. Application of this methodology allows some of the above problems to be eliminated. As an example of using the methodology, evaluation of four websites was presented, provided by national heritage agencies. The evaluation results may be applied to development of guidelines to improve cultural heritage websites.
REFERENCES


DĄBROWSKI W., Dąbrowska D., Godlewksa A., Raczkiewicz I., 2006. Database premises of in the buildings belonging to the Department of Geodesy and Land Management at the University of Warmia and Mazury (Baza o lokalach w budynkah należących do Wydziału Geodezji i Gospodarki Przestrzennej Uniwersytetu Warmińsko- Mazurskiego). typescript, project C-geo (in Polish).


http://leidykla.vgtu.lt/conferences/Enviro2011/Articles/6/1369_1373_Lewandowicz.pdf


ŁUCZYŃSKI R. 2009. Prawo, Methadologia, filozofia, teoria prawa (Law, methodology, philosophy, theory of law), Warsaw pp. 149 (in Polish)


ACTS


ACT OF 7 JUNE 2001 ON COLLECTIVE SUPPLIES OF WATER AND COLLECTIVE SEWAGE DISPOSAL Journal of Laws of 2006 No 123 item. 858 (Ustawa z dnia 7 czerwca 2001r. o zbiorowym zaopatrzeniu w wodę i zbiorowym odprowadzeniu ścieków Dz. U. z 2006 Nr 123, poz. 858 in Polish)


REGULATION OF THE MINISTER OF REGIONAL DEVELOPMENT AND CONSTRUCTION OF 2 APRIL 2001 on the surveying register of land utility networks and design agreement teams Journal of Laws 2001 No 38 item 455 (Rozporządzenie Ministra Rozwoju Regionalnego i Budownictwa z dnia 2 kwietnia 2001 r. w sprawie geodezyjnej ewidencji sieci uzbrojenia terenu oraz zespołów uzgadniania dokumentacji projektowej Dz. U. z 2001 r. Nr 38 poz. 455 in Polish repealed)

REGULATION OF THE MINISTER OF INFRASTRUCTURE AND ADMINISTRATION OF 13 SEPTEMBER 2010 ON THE SPATIAL INFORMATION INFRASTRUCTURE Council Journal of Laws 2010 No 183 item 1233. (Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z dnia 13 września
2010 r. w sprawie Rady Infrastruktury Informacji Przestrzennej Dz. U. z 2010 nr 183, poz. 1233 in Polish)

**REGULATION OF THE MINISTER OF INFRASTRUCTURE AND ADMINISTRATION OF 20 OCTOBER 2010 ON THE SPATIAL DATA SETS AND SERVICES COVERED BY SPATIAL INFORMATION INFRASTRUCTURE (Journal of Laws 2010 No 201 item 1333)** (Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z dnia 20 października 2010 r. w sprawie ewidencji zbiorów i usług danych przestrzennych objętych infrastrukturą informacji przestrzennej Dz. U. z 2010 nr 201, poz. 1333 in Polish)

**REGULATION OF THE MINISTER FOR INTERNAL AFFAIRS AND ADMINISTRATION OF 9 NOVEMBER 2011 ON TECHNICAL STANDARDS OF IMPLEMENTATION OF TOPOGRAPHIC SURVEYS AND DEVELOPMENT AND SUBMISSION OF RESULTS OF SUCH MEASUREMENTS TO THE STATE GEODETIC AND CARTOGRAPHIC RESOURCES Journal of Laws 2011 No 263 item 1572** (Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z dnia 9 listopada 2011 r. w sprawie standardów technicznych wykonywania geodezyjnych pomiarów sytuacyjnych i wysokościowych oraz oprawowywania i przekazywania wyników tych pomiarów do państwowego zasobu geodezyjnego i kartograficznego Dz. U. z 2011 r. Nr 263, poz. 1572 in Polish).


**REGULATION OF THE COUNCIL OF MINISTERS OF 17 JANUARY 2013 ON AN INTEGRATED REAL ESTATE INFORMATION SYSTEM Journal of Laws of 2013 item 249** (Rozporządzenie Rady Ministrów z dnia 17 stycznia 2013 w sprawie zintegrowanego systemu informacji i nieruchomościach (Dz. U. z 2013 poz. 249) in Polish


**JUDICIAL DECISIONS**

**JUDGMENT OF THE SUPREME ADMINISTRATIVE COURT in Warsaw of 12 February 2006** (Wyrok Naczelnego Sądu Administracyjnego z dnia 16 lutego 2006 r., II OW 83/05 LEX nr 193992).

**JUDGMENT OF THE SUPREME ADMINISTRATIVE COURT in Warsaw of 12 January 2011** (Wyrok Naczelnego Sądu Administracyjnego z dnia 12 stycznia 2011 r. II OSK 10/10 LEX nr 952931.


**WEB PAGES**


Damian L. Modele budynków Uniwersytetu Warmińsko-Mazurskiego w Olsztynie https://3dwarehouse.sketchup.com/model.html?id=dd61c7ad87f4b7dacc45ee7e37c69504 (Access 14.01.2015)

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