THE PROBLEM OF ADJUSTING POLISH SPATIAL INFORMATION RESOURCES TO THE STANDARDS OF THE INSPIRE*

Monika Balawejder, Ph.D.
WSI-E Rzeszow School of Engineering and Economic
Department of Cadastre and Geodetic Spatial Planning
Rzeszow, Poland
e-mail: balawejder@wsie.edu.pl

Tomasz Adamczyk, Ph.D.
AGH University of Science and Technology
Department of Geomatics
Cracow, Poland
e-mail: tomasza.adamczyk@agh.edu.pl

Marcin Cygan, M.Sc.
Geokart-International Sp. z o. o.
Rzeszow, Poland

Abstract:

Problematic aspects concerns the development problems and difficulties encountered in adapting Polish Spatial Information resource to the standards prevailing in the European Union, introduced by the INSPIRE Directive, ratified by the European Parliament in 2007.

The study demonstrated that the differences between the application diagram database of Geodetic Registration of Infrastructure Networks included in Polish regulations, and the target model proposed by European guidelines, limit the possibilities of exchanging data without modification, which is inconsistent with the provisions of the INSPIRE Directive.

On the basis of the existing normative acts, which are the legal basis for creating a database of Geodetic Registration of Infrastructure Networks they presented their main aims and objectives implementation. Brought closer definitions and characteristics of Geodetic Utilities Network System by provisions which determined the shape of the previous years, and which are already in Poland do not apply. The principles to be followed when working on the creation of object-oriented databases of Geodetic Registration of Infrastructure Networks contained in the existing normative acts. An example, popular in our country system, optimized for creating, updating and sharing of databases. Describes the methodology to carry out this process, depending on the source of the materials obtained. It shows the process of creating spatial databases, and the problems and difficulties that this brings. Brought closer the subject of interoperability created databases and harmonization of Polish law with respect to European guidelines.

Keywords: *INSPIRE, Geodetic Registration of Infrastructure Networks (GESUT), Infrastructure of Spatial Information, interoperability, UML, GML.*

Introduction

In recent years in the Polish law on issues of surveying and related to him there is considerable dynamics (BIEDA et al., 2013). The Polish government has announced legislative acts concerning the registration of land and buildings, registration of cities, streets and addresses, as well as conducting basic map. At the same time the previously used technical manuals have been obsolete. Standards for creating and maintaining spatial data resources have a very big change (BYDŁOSZ, BIEDA, 2013). Behind the confusion associated is ratified by the European Parliament on 15 May 2007 INSPIRE Directive (DIRECTIVE INSPIRE, 2007) - Infrastructure of Spatial Information

* This work is financed from funds science realized at AGH University of Science and Technology, allocated for the year 2016, no 11.11.150.006.

in the European Community. Its mission is to create a system to support environmental protection in the Member States (PARZYŃSKI, CHOJKA, 2013). For this purpose, it refers to the life of Spatial Information Infrastructure, uniform standards writing, data sharing. It allows the adoption of such data formats to the European Union were published in the model available for all users (KUBIK, 2009).

Transposition of the European Parliament adopted the Directive on the basis of the Polish Law of 4 March 2010 on Spatial Information Infrastructure (ACT, 2010). It introduces standards for INSPIRE, in laying down ways of storing and sharing of spatial data. They also relate to the creation of databases that make up the content of the basic map, among other things, registration of land and buildings (EGiB), a database of topographical elements (BDOT500) and Geodetic Registration of Infrastructure Networks (GESUT).

The basis of the idea of INSPIRE is the concept of interoperability. Its definition found in the art. 3 points 7 of the Directive: "Interoperability means the possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the added value of the data sets and services is enhanced" (DIRECTIVE INSPIRE, 2007).

The Directive therefore requires not only the use of universal exchange formats for spatial information. The structure of these data must be identical (PARZYŃSKI, CHOJKA 2013). The way to achieve such a high level specifications for data harmonization, which the directive is defined as follows: "The actions of a legal, technical and organizational, designed to bring about the mutual consistency of these collections and their adaptation to the common and the combined use of" (DIRECTIVE INSPIRE, 2007).

INSPIRE is therefore the basis for the creation of elaboration in the field of numerical cartography in Poland and theoretically guarantee its compatibility with European counterparts. This involves interoperability and harmonization of data, allowing the interchangeability between different administrative bodies at national and European level. Experience shows, however, that despite the efforts there are some problems with the implementation of the Directive standards in our country.

Implementing the standards of the INSPIRE Directive

Regulation of the Minister of Administration and Digitization on the database of Geodetic Registration of Infrastructure Networks , databases of topographic objects and basic map (REGULATION, 2013), promulgated pursuant to art. 19 paragraph 1 point 7 of the Act Law Geodetic and Cartographic (ACT, 1989), obsolete previously used technical instructions - on the basic map K-1 (INSTRUCTION, 1998b) and geodetic network utilities G-7 (INSTRUCTION, 1998a), introducing new standards conducting resource information included in the content of the basic map (REGULATION, 2013). The procedure and rules for creating, updating and sharing of data adapts to the rules in line with the INSPIRE Directive (DIRECTIVE INSPIRE, 2007) and the Law on Spatial Information Infrastructure (ACT, 2010), by introducing an obligation to collect data in a universal and uniform form the whole country of object-oriented databases. Standard their creation has been defined in the regulation as the application diagram UML and GML (REGULATION, 2013).

Regulation (REGULATION, 2013), now repealed, in the idea of INSPIRE, was to unify the standards of resource spatial information, among other important from the point of view of environmental protection. Database-driven application GML schema are created in order to ensure interchangeability of data between public administrations, as well as interstate level within the European Community (BALAWEJDER et al., 2015). However, the legislation in question was very much criticized (IZDEBSKI, 2013) since its inception, for appearing in the errors and inaccuracies (ADAMCZYK et al., 2014).

Regulation (REGULATION, 2013) can be used as a reference confirmation of this principle because the excessive expansion of the document and repeating in several places of the same data resulted in irregularities. An example could be codes columnar objects which differ from each other, as shown in Table 1.

Table 1. Codes of selected objects.

Regulation (Regulation 2013, 2015a)	Technical Guidelines INSPIRE (Brönnimann and others 2013)
SM01 lantern	SM01 lantern
SM02 lighting mast	SM02 lighting mast
SM03 telecommunication mast	SM03 telecommunication mast
SM04 pole	SM04 pole
SUSM05 connected pole	SUSM05 connected pole
SUSM06 lattice pole	SUSM06 lattice pole
SUSM07 railway traction pole	SUSM07 traction post
SUSM08 tram traction pole	SUSM08 wind turbine
SUSM09 trolleybus pole	SUSM09 telecommunication tower
SUSM010 wind turbine	SUSM010 other pole or mast
SUSM011 telecommunication tower	
SUSM012 other mast	

Source: own analysis.

The differences between the Regulation (REGULATION, 2013), and Technical Guidelines INSPIRE (BRÖNNIMANN et al., 2013) is quite important, if we consider them in view of the directive. Established on the basis of Spatial Information Infrastructure was to provide opportunity for international interchangeability of data. However, some information from the Polish resource, due to the different structure of the database is difficult or impossible to adapt to European conditions. Polish Regulation (REGULATION, 2013) repealed the beginning of 2015, and in its place created two new Regulation on GESUT (REGULATION, 2015a) and Regulation BDOT500 with a basic map (REGULATION, 2015b). Over whether the new document will explain these inconsistencies have wondered many authors among others SIKORA, ZYGMUNIAK (2015), who led the research in this field. The confirmation of the fact that they are still no accuracy in this respect is the list of codes of selected objects, as shown in Table 1. The first column is presented by codes under Regulation GESUT, BDOT500 and basic map (2013) the same recorded in the regulation of GESUT (2015a). However, in the second column we see the same codes by Technical Guidelines INSPIRE (BRÖNNIMANN et al., 2013). We observe that the same code number are stored in other objects. We can also see that this has not been changed in the new regulation on GESUT (REGULATION, 2015a).

Regulation (REGULATION,, 2013), which was to introduce a higher level of implementation of IT geodetic solutions in Poland, met with a cold reception. From the beginning it was predicted a quick end, and further changes in the regulations. However, in this during much documentation centers adapted their information systems to the new standards. Actually taking decisive steps in terms of changes in regulations, allows them only on minor adjustments.

By introducing two new regulations (separately on GESUT and separately BDOT500 with a basic map) (REGULATION, 2015a, 2015b) in place of (REGULATION, 2013), those provisions did not change significantly. Hasn't diminished the vastness of documents, and further increased the illegibility and ambiguity, because the graphic representation of the elements found in the GESUT Regulation on BDOT500 and basic map (REGULATION, 2015b).

Principles and methodology of creating GESUT databases

GESUT according to the Regulation

GESUT database stores information about the utilities network (pipes, technical devices and entities managing them). Its territorial scope is of the cadastral unit.

Regulation (REGULATION, 2015a) you can also find a lot of tips, useful in establishing and running the database stuff in the introduction of spatial information and descriptive objects GESUT. This is more difficult than before, since the individual network elements (line segments) are not related to any dependency from the point of view of the application. Connected to consistent geometrically and information database object.

In the course of setting up a database GESUT used hierarchy by source of spatial information. First base is introduced data from direct measurement, referred to the warp state and which meet the requirements of precision. If after these operations remained basic map being developed area of the elements disclosed in the database GESUT, completes the missing objects by digitizing paper map or vectorization of digital maps (REGULATION, 2015b).

The basic GESUT elements are cable network utilities. Its graphical representation are the line or surface (contour), if the diameter of the pipe exceeds 0.5 meters. For power grid and telecommunications may be only a line. Network cables should be topologically related to the columns, technical equipment and protective tubes. Changing the position of these objects will

also need to modify the line with them. This principle also applies to the relationship connection with buildings. Geometric representation of technical devices to your network utilities may be a point (for example hydrant, grate, outlet channel), line (drainage line), or surface (settler sewer local, transformer station). In contrast, objects such as the hatch, tank introduced by:

- the point (symbol) - if all the dimensions of its cross-section does not exceed 0,50 m;
- line - where one of the dimensions of its cross section is greater than 0,50 m;
- surface (contour) - if all the dimensions of its cross-section in excess of 0,50 m.

It is associated with the development of legibility after printing the finished map. Outline of the hatch with a diameter of 40 cm on the basic map in 1: 1000 scale would be difficult to identify. It is associated with the development of legibility after printing the finished map. Outline of the hatch with a diameter of 40 cm on the basic map in 1: 1000 scale would be difficult to identify. Then the circle will be the single point of taking into account the thickness of the line.

The height of wires and technical equipment is introduced as a separate object, topologically linked to the element to which it refers. It is determined with an accuracy of 0,01 m, in addition to the wire as measured by electromagnetic detectors and flexible lines, such as power cables and telecommunications equipment. Their elevation height is determined with an accuracy of up to 0,1 m (REGULATION, 2015b). The use of objects in the construction of the database structure GESUT creates a problem of segmentation. This issue is the cause of many inaccuracies, because the information contained in Regulation (REGULATION, 2015a) are unfortunately laconic. The basic principle is to divide the objects border cadastral unit and branching points of the wires of the same type (for example type of network, functions conduit). The piping segments fittings network or lines, or other parameters type, as shown in Fig. 1.

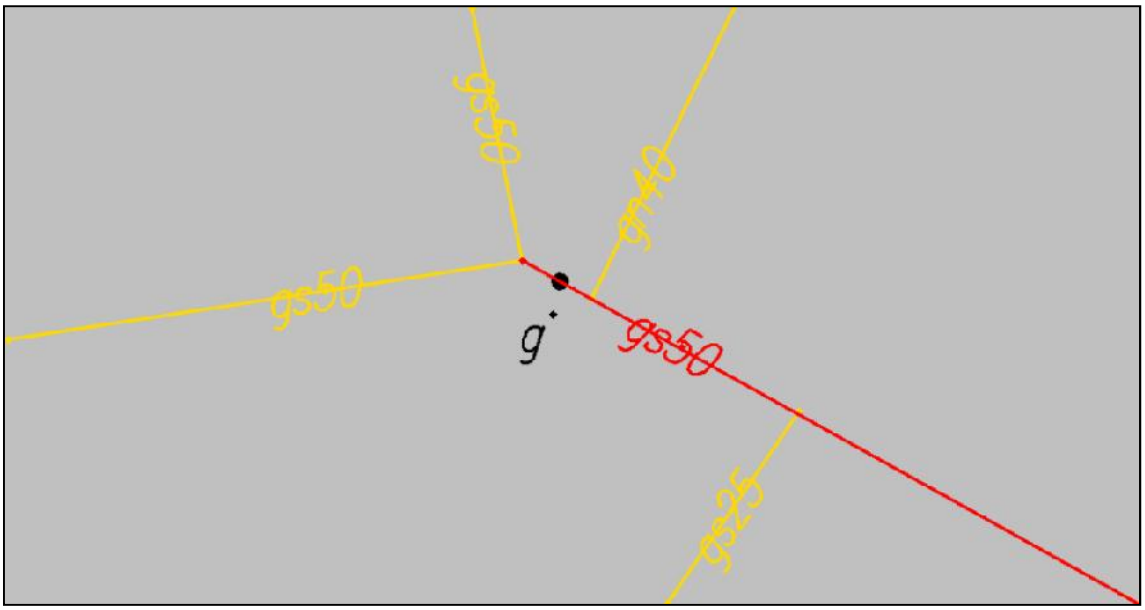

Fig. 1. Principles of linear object segmentation on the example of a gas network pipeline. *Source: own analysis.*

Also apply the principle of primacy, that is: the cable acting as the "connection" does not share cable with the annotation "distribution" (Fig. 2). However, you may encounter situations in particular just in terms of the relationship between the function of the segmentation and when these general guidelines are inadequate and could use a wider comment.

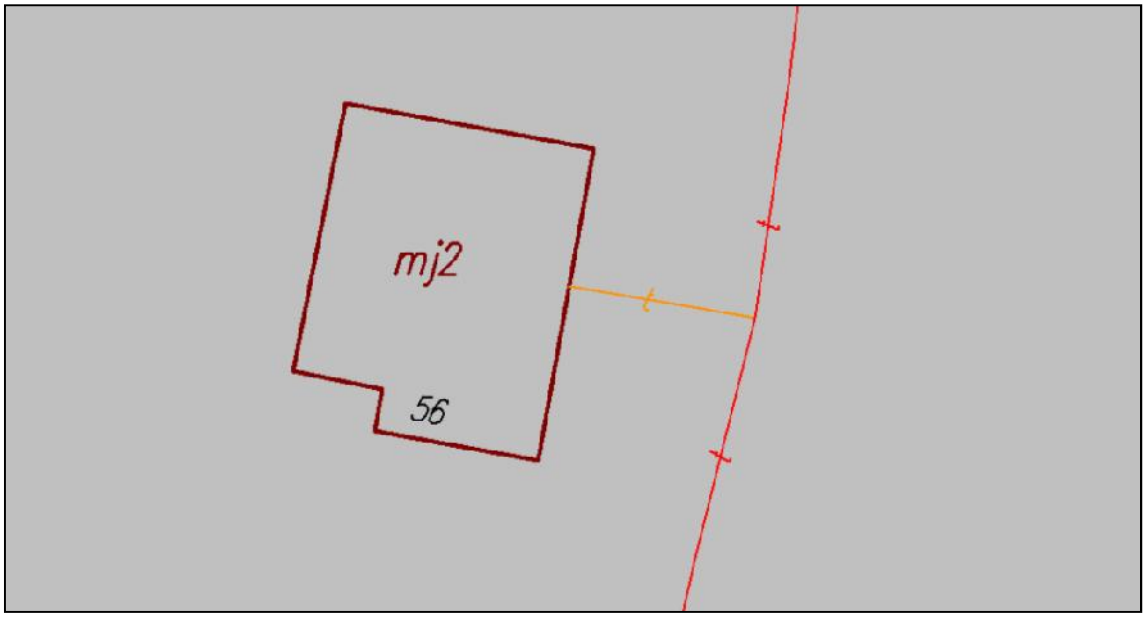

Fig. 2. Principles of linear object segmentation on the example of a telecommunication network cable.
Source: own analysis.

No precisely formulated solutions in the guidelines for the introduction of objects causes inaccuracies that usually are explained at the level of agreement between the governing authority resource and the contractor assuming database GESUT (surveying company). Such arrangements, depending on the payer are usually different from each other, causing unwanted variations in the development of database records among different documentation centers.

For this example, often supplementation in creating GESUT idea is to introduce the drains with a function defined as "distribution" until the last hatch in front of the building, marking a "connection" before the final stretch between the manhole and buildings, as shown in Fig. 3. This rule is contrary to the accepted rule that no armature wire segments. This is due to the characteristics of the construction of drains and other regulations.

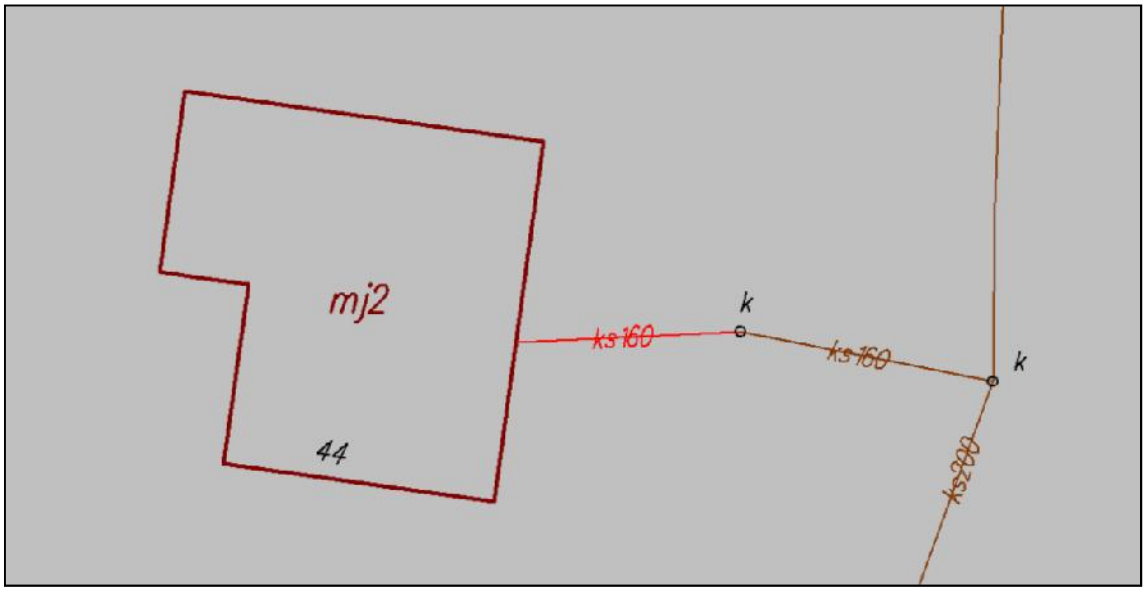

Fig. 3. Anomalies in the principles of linear object segmentation on the example of a drainage system pipeline.
Source: own analysis.

A similar situation, although much rarer, is also in the case of the power grid. Typically, the underground conduit leading from a power pole of the building adopt the attribute "connection" if doesn't have any branches. Sometimes, however, this function is suitable only a fragment of the line from the pole to the cabinet cable to the building. The rest of the cable will be denoted as "other". The logic of this solution results from the approach because of possession. The section between the

pole and the power cabinet cable connection is made by the administrator of the network to the plot, and the continuation of the cable is under the supervision of the property owner. The same principle may apply to other networks in the same way.

The rules of segmentation defined by Regulation (REGULATION, 2015a) small lead to the occurrence of the base of a very long line facilities. This applies in particular for the transmission lines, which even extend for many kilometers, between the boundaries cadastral unit. This phenomenon is due to several reasons. The insertion of the object of a large size is inconvenient and easy in the case of error. Some problems also makes modification, because the editing and saving changes can be observed some difficulties in the smooth functioning of the program, due to the large amount of information needed to be checked and approval. Finally also the issue of the base portion of the contractor geodetic works in order to update it if the subject line passes through the study area will be exported in their entirety. With the excessive size of the object considerably and unnecessarily Increase the size of files to be modified.

The methodology of establishing object-oriented databases

Long before the entry into force of the GESUT Regulation, on BDOT500 and basic map (REGULATION, 2013] has been written about the need for analysis of the structure of GESUT data (PARZYŃSKI, 2014), for checking the possibility of their automatic transition to the target model, consistent with the requirements of the INSPIRE Directive (DIRECTIVE INSPIRE, 2007). This would take place on the basis of a specially created for this table the translator, defining the transition from one structure to another. Paid attention to the circumstances that may stand in the way of automating the process of creating modern databases, and which, as it turned out, eventually influenced the methodology of this work (PARZYŃSKI, 2014).

Information related to the Geodetic Registration of Infrastructure Networks were previously stored in the form of maps, not directly associated with descriptive information concerning the individual elements, which in itself creates the need to build a database GESUT from the beginning. In addition, existing digital maps are unfortunately difficult or impossible to automatically implement a new data model, due to differences in the structure of graphic elements.

Examples of such discrepancies is at least a few. For example, a local settler sewer on the maps numeric prepared according to the instructions K-1 is usually introduced as the symbol (INSTRUCTION, 1998b). Regulation (REGULATION, 2015b) gave us the opportunity to bring this type of facility only as a surface. A similar situation we have in the case of aboveground power lines and telecommunications. Directions lines were previously marked with symbols (INSTRUCTION, 1998b). Now, however, they are in the form of a linear objects, which significantly alter their characteristics and causes often lack the possibility of introducing elements of pre-existing map (Fig. 4). The pole combined, was introduced by two symbols of a single column, is currently the subject line (REGULATION,, 2015b).

Fig. 4. An example extract of the basic map. The apparent lack of the telecommunication post, whose existence is suggested by the line direction symbol. *Source: own analysis.*

Previously they had created to develop have not been so thoroughly checked for correctness of topological because they lacked the tools to perform data validation. Therefore, you have to reckon with the frequently encountered errors arising not only from the accuracy of the creators of maps, but also with frequent modifications to the current map update by the local surveying contractors. Therefore frequently encountered drawbacks of older maps are inaccurate numerical interconnected lines, uncut to the edge of the buildings wires utilities or inaccurately connected to the network technical devices.

Another difficulty limiting the ability to automate the creation of database GESUT which need to be addressed, there are errors in creation the maps, such as the lines put on the wrong layer digital map. It may happen cable whose label suggests designation as a data source "measurement on the warp," but is drawn on a layer of digitization. There are also some ambiguity in defining the type of cable. An example would be the lead local sewerage system or water supply. Usually at this layer, draw lines located on the farm, creating a local network linking local technical devices, such as settler sewage and local wells, the building and not connected to any network overall. However, there are other cases of their application, which must be separately explained and interpreted. Figure 5 shows the water supply pipe, the label describes him as introduced based on industry data. City water (dark blue) passes smoothly in the southern part of the local (light blue). Taking into account the explanations stated above, the topological relationship of these two types of wires denies the definition of the local water supply.

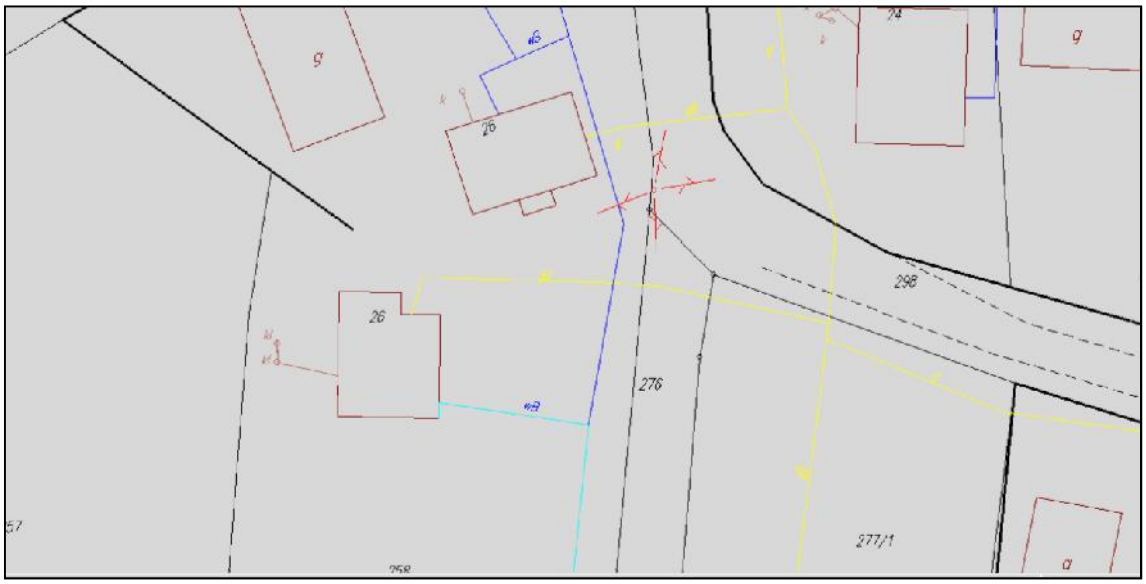

Fig. 5. An example extract of the basic map. Water supply line partly introduced on a urban layer and partly on the local level. *Source: own analysis.*

Mention at this point it is worth the problems more specific to another database, also related to the content of the basic map. Objects such as carriageways, sidewalks or lawns that are part BDOT500, should be introduced as a closed surface (REGULATION, 2015b), but with even a cursory analysis of the source of digital maps, it turns out that most of the routes is not drawn by a broken line closed. Often you can meet with individual edges, as shown in Fig. 6. A similar situation occurs with the outlines of wire utilities infrastructure.

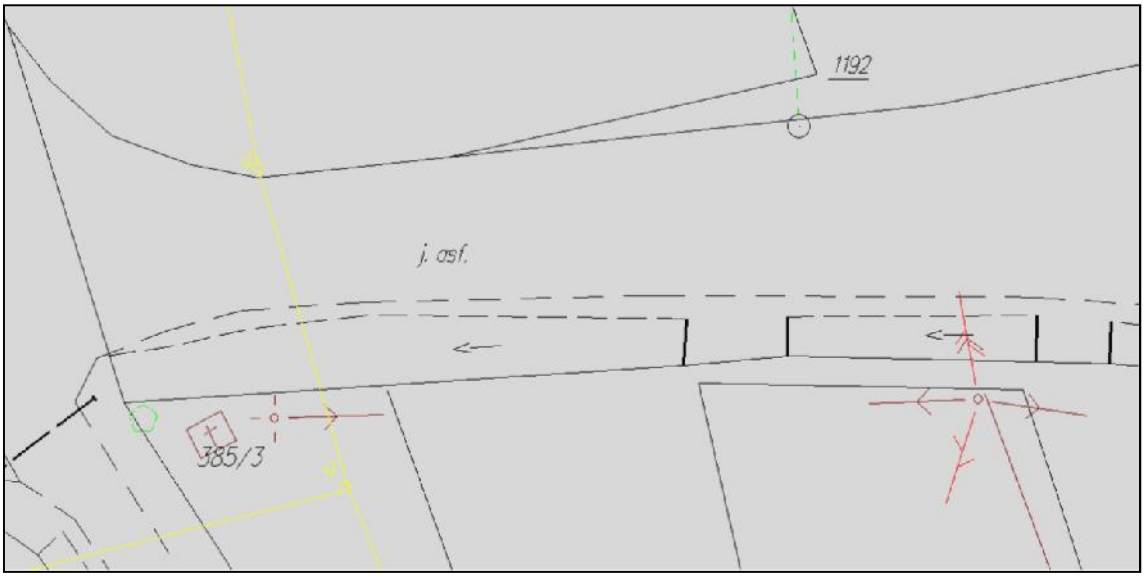

Fig 6. An example extract of the basic map. Only one edge of the road with description. *Source: own analysis.*

It also happens that the edges theoretically the same object surface are drawn on different layers of digital map, for example, one edge of the road is a layer of measurement, the second layer of digitization. Contrary to appearances, this situation occurs relatively often. Unfortunately, this complicates the automation object creation. Just like practice drawing surface elements directly adjacent to another surface using only the outer edge. An example might be the sidewalk next to the building, where the default limit is the house wall, as shown in Fig. 7. Termination of good from the graphic, but the point of view of the correctness of the database – manifest error.

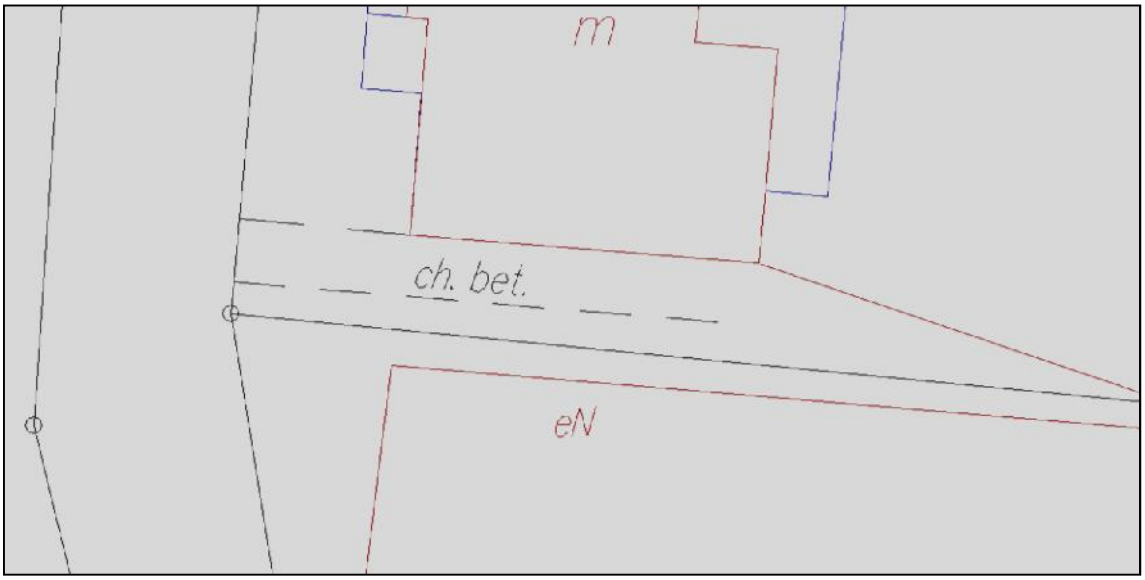

Fig 7. An example extract of the basic map. Visible edge of the sidewalk beside the building. *Source: own analysis.*

There are many of the shortcomings associated with existing and functioning every day in the district centers of documentation numerical maps, very limited capacity to carry out automated data transformation GESUT to the target model. Some of them are the result of too large differences between the structure of studies created by the principles of technical instruction K-1 (INSTRUCTION, 1998b) and modern databases. Others are the result of careless create the digital map. This does not mean, however, that it is useless for creating a database GESUT. On the contrary, still plays a key role and its existence for a given unit of the register is for the contractor work very handy.

Conclusions

In conclusion it should be emphasized that the in issue of newly introduced legislation important is the scale of the significance of these differences between the Polish legal standards (REGULATION, 2015a, 2015b), and the European target model (BRÖNNIMANN et al., 2013). Problems arising from them are related to the same as anomalies in generating the correct files GML based on already developed the data contained in the conceptual model, ie the interoperability between the various levels of the European system of Spatial Information Infrastructure. The creation of a national system that is not compatible to his counterparts in other member states of the European Union puts its creators before the question about the meaning of its introduction.

This is because the Regulation (REGULATION, 2013) and Regulation (REGULATION, 2015a, 2015b) have been introduced in Poland by the law on Infrastructure of Spatial Information (ACT, 2010), which is the transposition of the INSPIRE Directive of the European Parliament (DIRECTIVE INSPIRE, 2007). In this document you will find many expressions relating to the need to ensure the interchangeability of spatial data between the various levels of administrative, aimed to help in achieving key objectives related to environmental protection.

Directive (DIRECTIVE INSPIRE, 2007) in their assumptions speaks directly about "interoperable spatial data", which are assumed to be used at different levels of public administration, with a focus on interchangeability and sharing, also in the "Community and transboundary context." The problem is that the differences between European and Polish standards, creating spatial databases, such as GESUT, significantly hinder this type of action. In the same way ambiguity in generating GML based on the already finished studies may hinder communication between public authorities.

Without a doubt, the work on informatization of spatial information resource will be conducted in our country with the activity of not less than before. The more that the approaching deadlines for the work provided for in the Geodetic and Cartographic Law (ACT, 1989). According to Polish law the authorities could lead map basic in analog form until 31 December 2013 at the USTAWA (1989). However, many documentation centers use the opportunities in the form of raster maps, which vector data supplemented systematically. This is possible by the end of 2016. After that period, according to the Act (ACT, 1989) all documentation centers in the country should base its work on databases of spatial information in accordance with Directive of the European Parliament (DIRECTIVE INSPIRE, 2007).

As is clear from the research conduct basic map in the form of analog creates far fewer problems. However, in a few years it may prove to be the difference in the specification of data from the Polish resources, and their counterparts from other member states are too large and prevent the implementation of projects requiring the integration of spatial data on a European scale.

Work on the creation of spatial databases, including GESUT are very tedious and time consuming. Currently, due to the lack of appropriate tools to automate this process, most of the line and point you need to redraw. This situation entails costly implementation of IT solutions. For work related to the establishment of object-oriented databases GESUT and BDOT500 Head Office of Geodesy and Cartography announced allocation of 79 million zł (GEOFORUM, 2016). This will be complemented by another million from the Regional Operational Programmes. The same Subcarpathian Voivodeship provides nearly 270 million zł to improve the efficiency and availability of e-services, including Subcarpathian Spatial Information System, which has to get the most out of 190 million zł. This project provides, inter alia, establishment of databases GESUT 139 units of registration (GEOFORUM, 2016).

In the face of such exorbitant sums which are used to adjust geodetic standards INSPIRE, it is hard to understand the slowness of the work related to the harmonization of Polish law with European guidelines, which are essential and most important in the European Directive (DIRECTIVE INSPIRE, 2007).

The process of implementation of IT solutions of the Infrastructure of Spatial Information is difficult, time consuming and expensive, but also very necessary to carry out. Improves access to the required data enables the implementation of large-scale projects and reduces the cost of doing resource. Standardization of storage and data exchange initiative is good and right. In Poland so far we have been on this issue quite a big problem, because the provisions on geodetic left a lot of room for interpretation. INSPIRE Directive (DIRECTIVE INSPIRE, 2007) and the need to harmonize Polish regulations (REGULATION, 2013, 2015a, 2015b) in order to ensure interoperability of spatial data at national and international level is a chance to organize and standardize the performance of geodetic works in our country.

Work on the foundation of object-oriented databases GESUT are hampered by inter alia errors in source materials and scarce resources to optimize the process. However, there are obstacles with

which you can cope by, for example, fine-tuning applications used to control it. The creation of additional functions enabling the automation of certain tasks performed by setting up databases of spatial information undoubtedly would improve the efficiency of performing work associated with them. It would reduce the number of errors resulting from the need to re-repeating the same steps to manually enter information into the database.

As it turns out, the biggest problems in the implementation of standards, the creation of the Infrastructure for Spatial Information, as defined in the INSPIRE Directive (DIRECTIVE INSPIRE, 2007), causing irregularities in the Polish legislation. There are some errors resulting from careless when created confusion and excessive spaciousness. Unfortunately, they do not provide interchangeability of spatial data between the member countries of the European Union. In the future, non-refined can lead to the need for upgrading databases created in accordance with their guidelines in order to adapt to the structure proposed in the application UML diagram contained in the guidelines INSPIRE (BRÖNNIMANN et al.,2013). Most likely however, this will not happen and the data of the Polish resources will be adapted to European specifications using a specially created for this purpose, although such activities are not consistent with the spirit of INSPIRE.

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