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A FEW IMPRESSIONS ABOUT GEODESY AND PROFESSIONAL ORGANIZATIONS OF SURVEYORS ON THE 100TH ANNIVERSARY OF THE ASSOCIATION OF POLISH SURVEYORS

KILKA IMPRESJI O GEODEZJI I ORGANIZACJACH ZAWODOWYCH GEODETÓW Z OKAZJI 100-LECIA STOWARZYSZENIA GEODETÓW POLSKICH

Summary: *The role and importance of a given field of human activity in the life of nations can be assessed from different perspectives, but in the end the most important thing is to determine to what extent the life of given society depends on this field and – as a consequence – to what extent its development paths affect the quality of life of the inhabitants. Individual parts of this activity always take a formal form, since the citizens of a given country must know and understand the rules of behavior as well as benefits and losses resulting from its application or omission. Poland built from basics during the release of captivity for many years had to establish and implement these rules on a living organism glued from three parts of the nation. Therefore, the achievements of the partitioning powers known to particular groups of inhabitants were used, but ultimately they had to set own path of development – a modern and safe path, giving all residents equal rights and setting similar tasks. In this light, the role of geodesy appears, as part of its broad definition, as a part of socio-economic life responsible for order in the description of space and for support for all activities that deal with care for this spatial order and its development.*

In the context highlighted above, Polish geodesy has such tasks as:

- *establishing the rules for the geometrical description of the elements of the economic space and attention to their correct application,*
- *geometric definition of the country's territorial division,*
- *description of the limits of ownership and the basic principles of belonging of the land to individual persons or institutions, as well as the form of its presentation and methods of sharing,*
- *determining the actual state of land use and overseeing its proper development,*
- *a geometric description of the location and shape of objects permanently associated with the area,*
- *location of designed objects in the area,*
- *assessment of the geometric state of objects related to the earth's surface and examination of changes in that state.*

Throughout the last century, the above tasks have been the concern of successive generations of surveyors. This care was institutionally implemented by appropriate offices representing administrative and self-government authorities, supported by the world of science and professional self-government associations of surveyors. Among these associations, the Association of Polish Surveyors played a special role as a continuator of the 100 years of activity of the surveyors' professional movement. This publication covers selected from the above-mentioned tasks, which, according to the author, constitute the achievements of geodesy as an area of socio-economic activity with a significant impact on the development of Poland in the period of 100 Years after regaining independence.

Key words: *history of surveying, basic map, cadastre, professional training, surveyors association*

Streszczenie: *Rolę i znaczenie danej dziedziny aktywności ludzkiej w życiu społeczeństwa można oceniać z różnych perspektyw, ale w ostateczności najważniejsze jest określenie na ile życie społeczeństwa zależy od tej dziedziny i – w konsekwencji – w jakim stopniu jej drogi rozwoju rzutują na jakość życia mieszkańców. Poszczególne działy tejże aktywności zawsze przyjmują postać sformalizowaną, gdyż obywatelom muszą być znane i zrozumiałe reguły postępowania oraz korzyści i straty wynikające z ich stosowania lub pominięcia. Polska budowana od podstaw w czasie wychodzenia z wieloletniej niewoli musiała te reguły ustanowić i wdrażać na żywym organizmie sklejonego z trzech części narodu. Korzystała zatem ze znanego poszczególnym grupom mieszkańców dorobku państw zaborczych, ale ostatecznie musiała wytyczyć własną drogę rozwoju – drogę nowoczesną i bezpieczną, dającą wszystkim mieszkańcom równe prawa i stawiającą podobne zadania. W tym świetle ukazuje się rola geodezji, w ramach jej szerokiej definicji, jako części życia społeczno-gospodarczego odpowiedzialnej za porządek w opisie przestrzeni i za wsparcie dla wszystkich aktywności, które zajmują się dbałością o tenże ład przestrzenny i jego rozwój.*

W tym kontekście, przed geodezją polską rysują się takie zadania jak:

- *ustalenie reguł opisu geometrycznego elementów przestrzeni gospodarczej i dbałość o ich poprawne stosowanie,*
- *geometryczna definicja podziału terytorialnego kraju,*
- *opis granic własności oraz podstawowych zasad przynależności gruntów do poszczególnych osób lub instytucji, a także forma jego prezentacji i sposoby udostępniania,*
- *ustalanie faktycznego stanu sposobów użytkowania gruntów i nadzór nad poprawnym jego rozwojem,*
- *geometryczny opis lokalizacji i kształtu obiektów trwale związanych z terenem,*
- *lokalizacja w terenie obiektów projektowanych,*
- *ocena stanu geometrycznego obiektów związanych z powierzchnią ziemi oraz badania zmian tegoż stanu.*

Przez cały okres minionego wieku powyższe zadania były przedmiotem troski kolejnych pokoleń geodetów. Troskę tę w sposób instytucjonalny realizowały odpowiednie urzędy reprezentujące władzę administracyjną i samorządową, wspierane przez świat nauki oraz związki samorządu zawodowego geodetów. Wśród tych związków szczególną rolę pełniło Stowarzyszenie Geodetów Polskich jako kontynuator sięgającego 100 lat działalności ruchu stowarzyszeniowego geodetów.

Niniejsza publikacja obejmuje wybrane z wymienionych wyżej zadań, które zdaniem autora stanowią o dorobku geodezji jako obszaru aktywności społeczno-gospodarczej o znaczącym wpływie na rozwój Polski w okresie 100 lat po odzyskaniu niepodległości.

Słowa kluczowe: *historia geodezji, mapa zasadnicza, kataster, kształcenie zawodowe, stowarzyszenie geodetów*

1. The role of geodesy in the life of the state

Together with the development of the life of the societies, the structure of the land management and its development becomes more and more complicated; as a consequence, a need arises to describe the mentioned structure in a precise way and to control its development on a regular basis. The specified tasks have been found in the competences of geodesy and cartography – the domain dealing traditionally with the collection, processing and making the spatial information on the Globe surface and the permanently attached objects available. To implement the discussed task in the efficient and correct way, geodesy has developed many activities, commencing from the description of the Globe's shape as a whole, and then, the methods of its management, the ways of its measuring and cartographical presentation, and finally, the methods for determination of the new objects in the site of their planned location. Each of the mentioned tasks requires the appropriate methodological approach, including the choice of the adequate measuring and computational techniques, implemented according the specified principles, with the consideration of the uncertainty management methods and service of more and more advanced collections of spatial data. The discussed methods have been developed since the most remote times, what was preserved in a form of primitive graphical artefacts (pictures made on the rocks) and in historical periods – prototypes of maps of a given territory (Mesopotamia) and traces of the division of land (state of ancient Egypt), the effects of constructional activity in ancient Greece and Roman Empire and, also, literature, illustrating the development of scientific activity, oriented to engineering and economic applications. The traces of the historical records illustrate the ideas, connected with the description of the Earth's shape, division of the agricultural land on the floodplains of the Nile river, building of irrigation systems, aqueducts, roads and constructions, becoming more and more developed in respect of size, shape and form. Together with the development of culture and organization of social life, including also its military aspects, the particular sectors of science and engineering activity were developing; they created commonly the activity, being called once surveying and specified to-day as geodesy and cartography. The presented spectrum of applications places the discussed domain of human activity among the main factors, having a direct impact on the development of the societies.

In effect of its development, the modern geodesy and cartography include the following groups of activities:

- Measuring techniques, developed with the aim to reach their automation, increase of precision and control of the quality of the measurement results;
- Computational techniques, including the calculus of coordinates, calculus of errors (uncertainty, reliability) and adjustment calculus,
- Cartographic techniques, and, in particular, large-scale cartography, adopting presently the numerical, database and ICT form.

The mentioned activities were developed in the 19th century in a form similar to the present one; nowadays, they are dynamically developing in effect of intensification of scientific and creative activity, technological development and abundant practical experience.

In the background of the discussed phenomena, the history of our Fatherland was running; it has been very complicated in the contemporary fates what was also reflected in the necessity of struggling with many problems, a lack of stabilised administrative, scientific and practical structures together with the expected abundance of their achievements, patterns of good practice and historically stabilised institutional base. In parallel, the awareness of surveyors in respect of their responsibility for the effects of land-measuring based elaborations, was increased; it was also referred to the need of joining the efforts towards integration of the professional environment in striving at the creation and improvement of the appropriate legal framework on the one hand, and supporting the betterment of professional qualifications and competences, on the other hand.

When entering the period of regaining the independence, Polish technical concept had to refer to the achievements of the past invaders and from the technological viewpoint, it was based upon the achievements of the developed countries with the stabilised, multi-annual economic development. In the present paper, the selected key aspects (in the opinion of the author) of development of Polish geodesy and cartography during the period of 100 years of the independence of our Fatherland and of our profession in the institutionally and professionally organized form such as the Association of Polish Surveyors were outlined. The important effect of the association activity, as a driving force of geodesy, on the social and economic life of Poland has been indicated.

2. Geodetic elaborations for the state and society

2.1. Geometric framework of the description of social-economic space

The basis for the implementation of the tasks, based upon the description of the space includes a definition, implementation and care of the technical state of the geometric frames, serving the mentioned purpose. The discussed frames are described as the national system of spatial references (Official Journal of Laws, No. 70, item 821); they include the following problems:

- Definition of the parameters of a solid, approximating the shape of the Earth and the implementation of these parameters in relation to the space of Poland;
- Definition of the principles of the description of vertical shaping of the Earth's surface and altitudinal location of the related objects;
- Definition and implementation of cartographic grids for all-geographic and medium and small-scale specified developments;
- Definition and implementation of the flat coordinates' systems for large-scale elaborations.

Practically, the discussed system is reflected in the set of the points of horizontal and altitudinal geodetic structure, defined in the specified projection of the Earth ellipsoid, adopted for a given country. Since the 19th century, the so-called geodetic reference system with its beginning situated at the geometric centre of the

Fig.1. Central point of the coordinates' system "Borowa Góra" in 1936 (Source: http://www.igik.edu.pl/pl/bg-rys)

selected rotary ellipsoid and local orientation in relation to the territory surface has been utilized for measuring purposes.

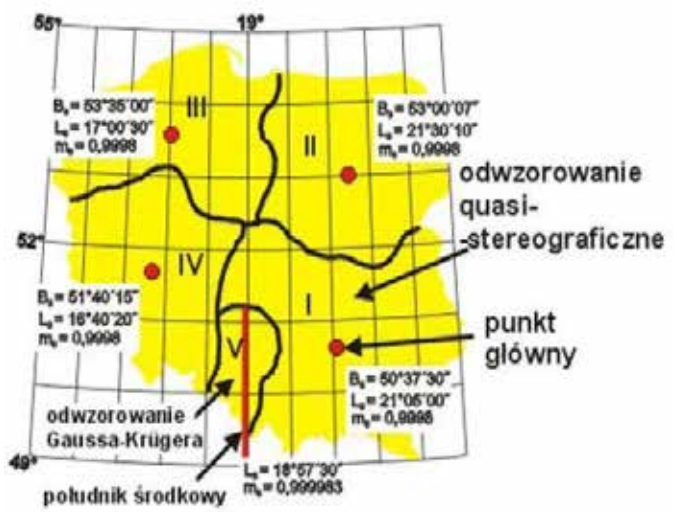
The period of the origins of the Second Republic of Poland was characterized by a considerable differentiation of definition and implementation of the reference ellipsoid models and coordinates' systems. After many years of the application of the models used by the invaders, the first Polish system "Borowa Góra" was defined with the aim to unify the existing models. It entered into force as late as in 1936. The Bessel ellipsoid with the driving point in the vicinity of Warsaw, with astronomic coordinates: Φ=52o28'32'', =21o02'12" and astronomic azimuth of direction Borowa Góra-Modlin: A=261o53'16'' was adopted a reference area [16]. The system "Borowa Góra" was utilized in creation of horizontal geodetic structures. For the structures used in civil purposes, the Gauss-Krüger projection in 5 two-degree belts was applied. Before the World War II, many local systems for the cities or industrial districts were additionally founded. Since the mentioned period, all maps, being issued during the peace as well as during the war time, contained a printing of the coordinates' grid in the "Borowa Góra" system [2].

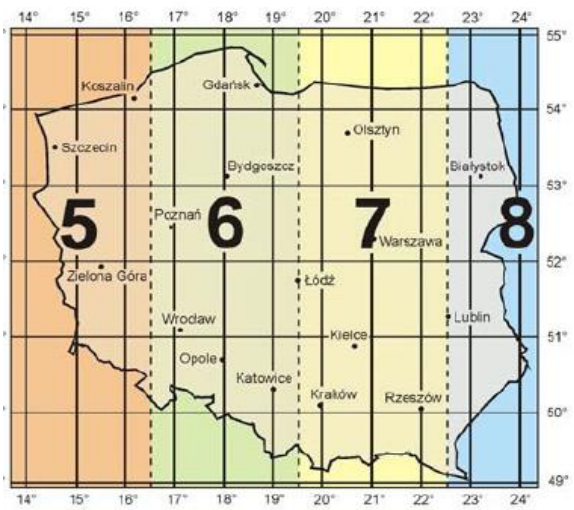
The post-war territorial changes of the country have caused the necessity of developing the map, covering a new territory of Poland. In the new situation, it was indispensable to use all Polish as well as German available geodetic-cartographic elaborations. They were adapted to the "Borowa Góra" system via transformation, with the simultaneous change of the quasi-stereographic project on Gauss-Krüger [3]. Since 1947, 3-degree mapping belts and scale factor for central meridian mo = 0.999935.

After the World War II, to unify the reference systems under the "Warsaw Pact", the system "Pułkowo 1942 was introduced in 1952 in Poland. It contained Krassowski ellipsoid and a driving point at the vicinity of the former Leningrad (presently: Sankt Petersburg). Based upon the mentioned system, three systems of flat coordinates were introduced: "1942" system (military and topographic civil maps), "1965" system (master map and derivates) and "GUGiK-80". The mentioned systems were applied until the end of the 20th century. In 6-degree projection up to 1959, the maps in scale 1:250000 and then, in the scale of 1:100000 were developed for the whole country; for the large-scale maps, the azimuth mapping "1965", with the division of the country into 4 separate mapping zones, with own system of coordinates and scale of 0.9998 in the centre of each of the mentioned systems was applied (Fig.2a). Due to a separate definition of four systems of the coordinates (and the fifth one in roller mapping), a considerable error resulted at the site of their contact what, in effect, made the transformation of coordinates to the uniform reference system very difficult.

Finally, three-degree Gauss-Krüger (roller transverse) projection of ellipsoid GRS80, with the consideration of scale factor 0.999923 in axial meridian and on the edges of mapping belts was adopted as the basis for flat coordinate systems. The x coordinates are counted from equator and y coordinates - from axial meridian, for which value of 500 000.00 m preceded by the number of belt is adopted; it is equal to value of axial meridian, being divided by 3.

Fig. 2. Post-war systems of coordinates, adopted for the needs of terrestrial measurements and large scale maps: a) "1965", b) "2000" (Source: https: //geoforum.pl/gis/odwzorowania)





For the needs of elaborating the large scale topographic maps, the same projection of ellipsoid GRS80 was adopted but in one belt covering the territory of the whole country, with the axial meridian 19o and scale 0.9993. The x coordinates are decreased by 5 300 000.00 m and y coordinates are not preceded by the number of belt.

The current obligatory state systems of coordinates in Poland are defined similarly as in many other countries. WGS84 is the system adopted as uniform for the whole Globe, mainly due to its application in navigation, including satellite navigation and that one in the military maps of the NATO. It is a geocentric system, based on ellipsoid GRS80. It describes the location, using geographic geodetic latitude and longitude and in gradian recording DDoMM'SS" or decimal DD.ddddo with suffix S, N, W, depending on the direction of angle measurement.

The grids of geodetic structures are physical representation of the specified systems of the coordinates. At the end of the 20th century, Polish reference grid was integrated with the European ETRF (eng. European Terrestrial Reference System), implementing the European Reference System ETRS89, modified at the breakdown of the centuries to the form ETRS2000 [https://geoforum.ol/geodezja/systemy-uklady]. The systems of altitude were also subjected to evolution of their definition. Being inherited after the invaders, the systems of normal altitudes (relating to gravitation) were referred to three points of measurement of the sea level – mareographs (sea-level recorders) in Amsterdam (German annexation), Trieste (Austrian annexation) and Kronshtadt (Russian). Due to the fact of remaining of Poland in the Russian influence zone after the World War II, there was adopted the common system specified as Kornstadt60 (dating back to 1960, after necessary measurement and integration with the pre-war systems). The discussed system was subjected to updating and modifications, reaching finally a form, defined as Kronszadt60. Poland inherited, from the German invader, many documents, connected with the construction of railway and urban infrastructure, the ordinates of which were measured in Amsterdam system. Due to this fact, to preserve the continuity and uniformity of the data, the railway sector preserved the mentioned altitude system. Similarly, numerous maps of the cities in the Western Poland still have the ordinates recorded in the old Amsterdam system.

In 2007, the system of normal altitudes EVRS, referring to the reference level NAP in Amsterdam (nederl. Normaal Amserdams Peil) was introduced in Poland as being uniform in the whole European Union. It constitutes mathematical and physical basis for the implementation of altitude systems which are, in Poland, marked with symbols PL-KRON86-NH and PL-EVRF2007-NH. The date of December, 31, 2019 was indicated as the term of changing the binding system of normal altitudes into PL-EVRF2007-NH [https://www.gugik.gov.pl/].

2.2. The records of the state of property and space management

Practical aspect of geodesy in the economy is visible, first of all, in connection with the turnover of the land and implementation of investment assumptions and, in particular:

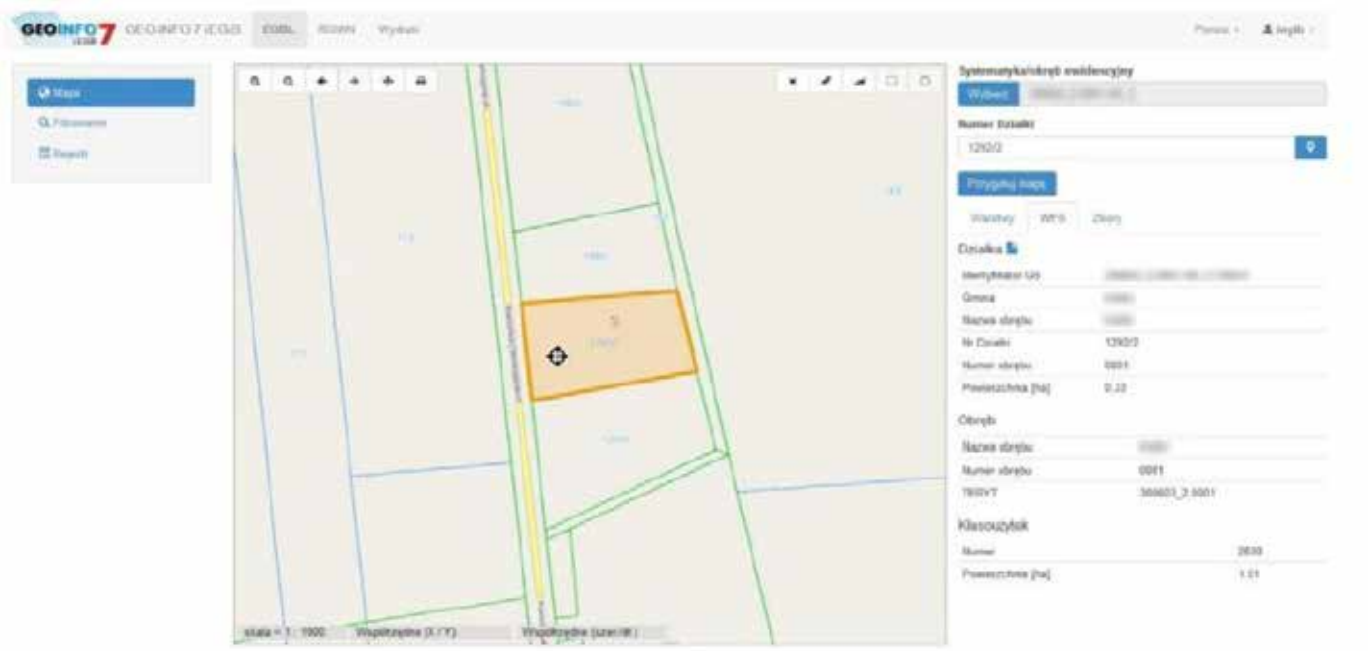
- The sale and purchase of land, and also the problems of property right succession;
- Individual investments oriented mainly to the improvement of life quality but also, intended for developmental purposes;
- Public investments, in particular – ensuring the appropriate conditions of transport, energy, gas and water supply and sewage disposal.

The basis for the implementation of the mentioned above goals provides the universal access to the existing spatial information resources, and individual one – to the resources being protected due to the personal data protection. The mentioned resources are collected for the needs of the inhabitants in the organizational units of the district authorities (in Polish: starostwo powiatowe), dedicated to geodesy. They include two categories of geodetic-cartographic data: registers of records of land, buildings and premises and a master map. The records of the land – EGiB – contain information on the land property, the methods of the territory utilization and on the buildings, with the eventual indication of the premises, possessing a separate owner. It is conducted in two blocs, being defined as a graphical part (cadastral map) and a descriptive part (collection of non-cartographic data). The master map collects the data, obtained on the grounds of the direct measurement and illustrating in detail the distribution of the objects permanently connected with the surface of the earth. Together with the development of computerization, the discussed resources are successively transformed from analogue form into numerical one, being accessible via ICT systems.

The recording of the land and buildings dates back to the Austrian and German cadastres which, gradually with the time, were subjected to evolution based upon the experience of other European countries. In Poland, the land cadastre was founded immediately after the first annexation on the territories, occupied by the Austrians and later on, in the first part of the 19th century – on the territories, occupied by the Germans [4]. On the territories of the Russian annexation in the years 1865 – 1900, the recording of the land in the area of Zamojski family estate (in Polish: Ordynacja) was locally established. It followed the geodetic principles of the Austrian cadastre. It is difficult to speak about any cadastre on the remaining territories of the former Russian annexation.

After the end of the World War I, Poland introduced the acts, based upon the rules of the former invaders in respect of the land tax and cadastre. The Act on the land classification for the needs of land tax (the so-called treasury act) was the basis for the organization of uniform land cadastre. Due to the outbreak of the Second World War, as early as in 1945, the Act on the state geodetic and cartographic service was published; in 1947, there was published the decree on the land and building cadastre which introduced the uniform land cadastre at the territory of the whole country, with the utilization of the so-far existing materials, including also cadastre documents coming from the former annexation. The final shape of the land cadastre in Poland was formulated in 1955 in the decree on the recording of land and buildings and in the executor regulations. The successive step towards the unification of the land cadastre occurred by means of the Act published in 1989: Geodetic and Cartographic Law (Official Journal of Laws, 1989, No. 30, item 163) and the published Regulation (1996) on the recording of land and buildings. In the successive issues, the mentioned regulation leads to computerization of the records and the improvement of functioning

Fig. 3. The example of map with the selected plot and record of the collected data in ICT system (Source: Podręcznik-użytkownika-aplikacji-GEO-INFO-o.EGiB_.pdf)



of the management systems. In February 28, 2019, as a result of numerous amendments of the Act – Geodetic and Cartographic Law and the executor regulations, the consolidated text with the newest version of the regulation of the records of the land and buildings was published (Official Journal of Laws 2019, item 393).

At present, at the end of 2019, the obligatory records of the land and buildings cover the data, describing as follows:

- The location, borders and area of the real estate and the occurring therein types of land and soil classes, and also, land and mortgage register designations, or the corresponding sets of documents;
- The location, destination, utility functions and general technical data of buildings;
- The location, function and utility area of the premises.

It contains also the subjective information on the owner or other natural or legal persons which manage the land or buildings or their parts and, also, on cadastral value of the property, or eventual enrolling of the said buildings to the register of historical relics. It also specifies whether or to what degree the distinguished area of land is covered with a natural environment protection.

The current records of land are run by the appropriate authorities in a form, being uniform for the whole country. It has a form of ICT system, ensuring the collection, updating, and making accessible the data covered with the tasks of EGiB (Records of Land and Buildings) system (Fig. 3).

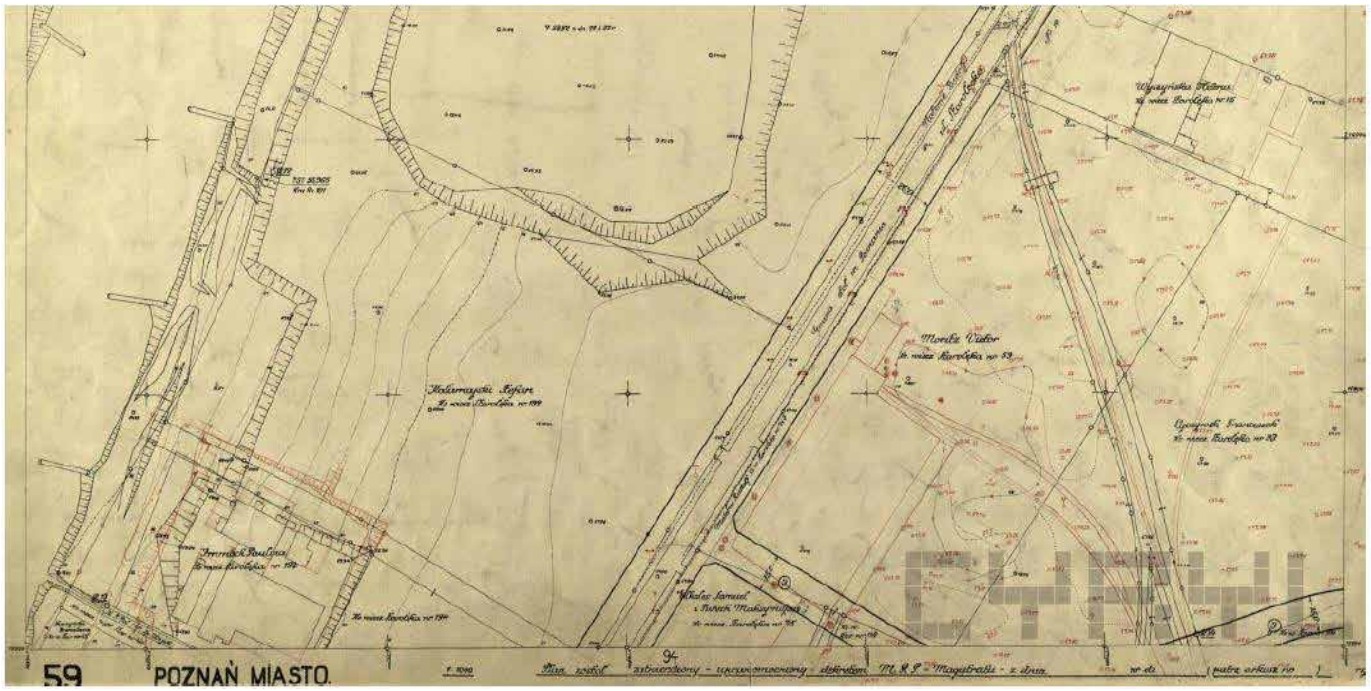
It is estimated that the records cover at least 30 million plots and the same number of buildings. Since a certain time, the attempts have been undertaken with the aim to transform the records into the cadastre of the real estate which would combine the information on the property and the records collected in the Real Estate Registers and tax records (the property tax).

The Integrated System of Information on Real Estates, ZSIN, is now being created on the national level. There will be created a central repository of the copies of district data collections of land and buildings' records. ZSIN will ensure the data exchange in a form of e-documents between EGiB and other public registers such as EKW (Land and Mortgage Registers), PRG (Register of Borders), TERYT, REGOn and KSEP. The task of ZSIN system will include also the mediation in sending notifications on the data changes, performed in the particular public registers, having the importance for other public registers (Source: https://gugik.gov.pl/projekty/zsin-faza-i/dane-egib,dost.1.07.2019) .

2.3. Master map

Before the World War II, the uniform large scale maps were not performed. Since the beginning of the 20th century, the cadastral maps were developed, mainly at the territory of Prussian (scales 1:4200 and 1:2100) and Austrian (scales 1:2880 and 1:1440) annexation. They contained the context similar to the present cadastral maps. More detailed maps were created unitarily in the cities. The examples include the scanned maps of the fragments of Poznań, dating back to the thirties of the 20th century, available at the website cyryl.poznan.pl. (Fig. 4). On the grounds of these maps, 50 copies were developed and successively updated and supplemented with the new data. The discussed plans – due to their destination – were performed with the unusual precision; the division into plots was marked and the names of their owners as well as the numbers of land and mortgage register, confirming the said property, the streets, parks, cemeteries, buildings of public service and many other objects were carefully drawn (cyryl.poznan.pl). In connection

Fig.4. The pre-war large-scale map of a fragment of Poznań, dating back to the years 1930-36 (Source: cyryl.poznan.pl/kolekcja/311/plany-dzielnic-poznania-1932-1950-archiwum-panstwowe-w-poznaniu)



with the planned big investments, similar maps were incidentally developed in Cracow (dawnemapykrakowa.pl) and in other cities.

The master map in a form similar to the contemporary one was kept in the 1970s based upon the regulations, contained in the technical instruction of GUGiK (The Head Office of Geodesy and Cartography) [5]. The map was performed in a paper version in four basic scales: 1:500, 1:1000, 1:2000 and 1:5000, being chosen according to the current and anticipated degree of the investment in a given territory (Instruction K1, 1979). In the intensively invested areas, with a big number of underground facilities, the scale 1:250 was employed. The selection of the size of the map sheet, based on the ISO A1 format, (practically 50 x 80 cm in a frame) resulted in the introduction of division into sections and of emblems, facilitating the location of the defined fragments of the territory (section).

Together with the development of reproduction techniques, the paper map was replaced by underlay made from transparent, matted film. To increase the readability and make the choice of the text of the map's copy easier, the details were divided into subject layers – situational (S), land records (E), territory infrastructure (U) and altitude (W). The primary map (P) on aluminium foil glued with the paper (the so-called boards) was the basis for the development of situational content. Additionally, the overlay of the structure was kept (O) and in certain district or urban Centres of Geodetic and Cartographic Documentation, there was a cover of the project arrangements (R). To avoid the repetition of the content, a part of a given object was outlined on one overlay and the remaining part was found on the other one. The register overlay contained only the labels of the plots or buildings; their contours were found on the situational lap. Similarly, the U overlay contained the pipelines together with the description and wells whereas the covers and manholes were outlines on S lap. For the reproduction purposes (cyanotype, later on, xerographic technique), depending on the need, the selected foils were overlapped.

The results of the elaboration of the direct field measurements were the main data source for creation of the master map. Due to this reason, the master map became a cartographic source elaboration, utilized later for performance of derivate maps. To preserve the map in the current status, the new text was charted on the existing section laps (foils), removing (by gilette) the objects which were subjected to demolition or transformation.

The map was performed in the continuous manner for the whole territory of the country, with the division into the areas, corresponding to the territorial competences of the geodetic and cartographic documentation centres – ODGiK (earlier "map storage places").

Together with the development of information technology, mainly of graphical software of personal computers, the map became to be developed in a numerical form, preserving the main principles of its creation; it was reflected in the successive version of Instruction K-1 and then, the regulations establishing the problems of the master map (Official Journal of Laws, 2015, item 2028). Finally, the map is created as a computer visualization of the content of few databases, corresponding – in respect of its content range – to the traditional overlaps of the map. The bases are kept by the district or urban ODGiK, mainly based on the direct field measurements, carried out by the surveyors within the frames of services for the society. Some contents of district bases are collected in the central resources. Due to computerization of geodetic and cartographic resources and of the units responsible for their keeping, making the cartographic data available and service of surveyors performing the updating of the resources are nowadays conducted in a form of computer

services (geo-portals); owing to this fact, the effectiveness of the service of the growing demand on geodetic-cartographic data has been improved. The quality of the performed elaboration has been also risen up.

3. The selected areas of the surveyors' activity

3.1. Geodetic and cartographic service

Since the beginnings of geodesy, its performers included royal or princely officials, later on, the state clerks, nominated to their post by the highest authorities of the state. During the period of annexation, the appropriate offices of Prussia, Austria and Russia carried out the mentioned activity. They published also the respective executor regulations and supervised their respecting by the performers of geodetic and cartographic work. In effect, after regaining the desired independence, the differentiated systems of measurements, measurement units and maps existed in different parts of the country; the performers of the measurement work had different titles which were obtained based upon different criteria. As late as in 1925, the resolved Act established a title of a sworn surveyor and determined the conditions to be met by a candidate to this title. The sworn surveyor's task was to implement the measurement work, reserved for the state service. He used also the official stamp. During the inter-war period, the unification of the measuring regulations had place; 5.5 million ha of land were integrated. However, one office, coordinating permanently the work of the surveyor did not exist. It should be noted that since 1919 until the 1930s, the self-governing environments of geodesists from different centres (mainly Lvov and Warsaw) undertook the initiatives that obliged the governing authorities to establish one such centre. In effect, the pre-war geodesy implemented its work in a certain degree of disorganization, what increased the costs and limited the range of the implemented work and later on, has brought the confusion, together with the unfavourable consequences until the contemporary times.

The first central office, coordinating the work of surveyors - the Head Office of the Country Measurements (GUPK) was established in 1945. GUPK undertook the tasks connected with the reconstruction of the country after the war destructions; it also commenced the creation of the uniform economic map of Poland. Gradually with the time, geodesy was found in three departments; principally, the matters of geodesy were taken by the Central Office of Geodesy and Cartography; however, the agricultural geodesy was subordinate to the Ministry of Agriculture, and the urban problems were located at the Ministry of Municipal Economy. The changes in the site of placing the geodesy and cartography in various governmental offices are continued. It refers also to the centre of geodesy management i.e. the Head Office of Geodesy and Cartography – GUGiK.

At present, Geodetic and Cartographic Service (Polish SGiK, Fig.5) consists of the organs of geodetic and cartographic supervision, i.e. the Chief Geodesist of the Country (GGK) and Voivodes, and of the geodetic and cartographic administration organs: marshals of the voivodeships and starosts (head of district). The Chief Geodesist of the Country is subjected to the minister specific of the administration, construction, planning or housing matters; GGK implements its tasks via GUGiK. The district or urban Centres of Geodetic and Cartographic Documentation Centres (PODGiK, MODGiK) play a function of direct performers of the services in respect of obtaining, processing and making the state geodetic and cartographic resources (PZGiK) available. They perform the following tasks of the head of the district:

- Keeping the district geodetic and cartographic resources, including the land and building register, soil science classification of agricultural land and geodetic records of the net of infrastructure of a given territory;
- Coordination of the position of the planned grids of the infrastructure of a given territory;
- Establishment of detailed structures;
- Running the common taxation of real estate and development and keeping the taxation maps and tables concerning a given property;
- Protection of geodetic, gravimetric and magnetic sings;
- Generation, running and making databases of land and building records available (cadastre of real property), geodetic records of the grid of a territory infrastructure, register of the prices and values of the real estates, detailed geodetic structures, topographic objects with the accuracy, ensuring the generation of standard cartographic elaborations in scale: 1:500 – 1:5000;
- Generation, running and making the standard cartographic elaborations available (i.e. master map and cadastre maps) on the ground of the data contained in the databases.

The units of geodetic administration in the structure of self-governing territorial organ, headed by the Voivodeship Geodesist in the Marshall Office, have a separate range of duties.

Fig.5. Structure of geodetic and cartographic service in Poland (own elaboration on the grounds of pl.wikipedia.org/wiki/Główny_Geodeta_Kraju)

3.2. Geodetic work for the society

Geodesists are employed in the field work in order to perform the maps for the design purposes and as-built object surveys as well as in all geodetic work connected with the formal legal operations on the land and service of the intended investments. Owing to such meticulous work, the national geodetic and cartographic resources

(PZGiK) are updated every day. The geodesists implement their work in accordance with the guidelines contained in the regulation on technical standards for performing the geodetic situational and altitudinal measurements (Official Journal of Laws 2011, No. 263, item 1572). Owing to this fact, the effects of the discussed work are immediately ready to supply the resources with the accurate and reliable data. When considering the problem from the historical viewpoint, since the period of regaining the independence until nationalization of geodetic work in the 1950s, similar activity was performed by the offices of the Sworn Surveyors (mainly in the respect of cadastre) and then, by the state and urban surveying enterprises. After introduction of the system changes in the 1990s, the mentioned tasks were undertaken mainly by the independent contractors and private geodetic companies.

Together with the development of measuring techniques, mainly GNSS (Global Navigation Satellite Systems), the methods of performing the measurements have been radically changed; it accelerated and improved the quality of geodetic and cartographic elaborations. The development occurred also in other measuring techniques, first of all, in photogrammetry and teledetection. The modern photogrammetry enables performance of spatial elaborations based upon the high-resolution digital photos made from the board of airplanes and drones, and also, from the ground stands, cars, trail or aquatic vehicles. Owing to the elaboration of the discussed image data, the models of a given territory's coverage as well as many of spatial objects, mainly of buildings, are created. They are supported by laser 3D developments as well as by large-scale satellite images. In effect, we obtain different teledetection elaborations, which become the subject of interest apart the official national resources. A wide spectrum of the said elaborations opens the door to many new initiatives which may positively affect the economic and social development of our Fatherland.

It seems that the attempts of Polish geodesy to exceed the borders of Poland, to appear in the world – what would become a source of export incomes – are still too weak. The effective attempt in this respect was undertaken in the years 1970 – 90 via the foreign trade company POLSERVICE and Geokart enterprise. The geodetic work was carried out in Iraq, Libya and Kuwait, and also, in Turkey, Tanzania and Greece and, to a smaller degree, in Czechoslovakia, German Democratic Republic and the Soviet Union (geoforum.pl/geodezja/historia). The mentioned work was continued in the 1990s by enterprises PPGK and WPG from Warsaw and OPGK from Cracow and Bydgoszcz and after bankruptcy of the state geodetic performance, by private companies. We should mention here Geoservex from Bydgoszcz, implementing its work in many countries, including India and Pakistan and the American continent.

Fig.6. Diagnostic measurements at the object in India (Source: http://www.geoservex-india.com)

3.3. Vocational education and science

The beginnings of the contemporary vocational geodetic education date back to the period of the First World War. As early as in the mentioned period, two-level structure of educating the surveyors was planned: higher education (engineering) and secondary (technical) education. Warsaw University of Technology (PW) was the first higher education school which introduced the Courses of Surveyors in 1916. Their task was to prepare professionally the performers of geodetic work for the needs of big tasks at the beginning of the Second Republic of Poland (the inter-war Poland). In November 1917, the Surveying School began its activity; later on 3-year national Surveying School (www.zs14.pl) was established. In 1919, the secondary Surveying Schools were opened in Lublin and Łomża; in 1922, similar school began their activity in Cracow, Kovel, Poznań and Vilnius. Earlier, in the school year 1917/1918, the surveying departments were created in building vocational schools (www.zsgd.poznan.pl).

Rich academic traditions in respect of teaching of the geodesy were developed since the pre-war period by the Lvov Polytechnic School, renamed into Technical University of Lvov in 1920. During the inter-war period, three faculties were joined into the Surveying Department [6] headed by the well-deserved professors – Lucjan Grabowski (1871-1941) or Kasper Weigl (1880-1941). In the autumn of 1921, the Faculty of Surveying was established at the Warsaw University of Technology; owing to the attempts of Professor Edward Warchałowski (1885-1953), it was later renamed into Geodetic Faculty in 1925. During the World War II, many meritorious professors and teachers died in the battles or due to the destructive activity of the invaders – Nazi Germany and communistic Russia. After the Second World War, the initiatives were undertaken with the aim to educate vocationally the geodesists; the secondary geodetic schools were established or reactivated. As early as in 1945, the Surveying Department was established at the National Building School in Jarosław (www.spg.rzeszów). The same situation occurred in some other cities. In Rzeszów, the post-secondary technical school, with direction: geodesy and cartography was brought to life. It was a precursor of Geodesy Technical School. In April 1945, the National Road Vocational Secondary School commenced its activity; it was included into the National Construction School in 1951. Finally, in 1960, the Geodetic-Road Secondary Vocational School (In Polish: Technikum) was established; at present, it is the Complex of Geodetic-Road Schools (www.zsgd.poznan.pl). The fates of vocational secondary technical schools in Bydgoszcz, Bialystok, Cracow, Łódź, Wroclaw and other cities were similar. Nowadays,

Fig.7. The main building of Warsaw University of Technology in 1975, the site of the Faculty of Geodesy and Cartography (Source: warszawa.fotopolska.eu/310159.foto.html)

the directions of geodetic education in numerous state and private upper-secondary schools and since the school year 2019/2020, in lyceums and secondary vocational school, have become more and more popular.

During the World War II, teaching at Warsaw University of Technology functioned on the principle of the underground education and in January 1946, it commenced a normal activity. It was the only one Faculty of geodesy after the war. In 1954, the Faculty was renamed into Faculty of Geodesy and Cartography (www.gik.edu.pl). At AGH University of Science and Technology, the independent Faculty of Mining Geodesy was established as late as in October 1951. In 1960, the geodetic studies were opened in Olsztyn. At the present moment, there are 20 units offering education in geodetic specialties; the traditional Geodetic Faculties at Warsaw University of Technology (Fig.7), AGH University of Science and Technology, University of Warmia and Mazury in Olsztyn and other later established directions of the studies at polytechnic schools (Gdańsk, Koszalin, Wrocław...etc) and Universities of Life Sciences (Cracow, Wrocław) enjoy an established reputation.

Polish geodesy has also its place in the international scientific environment. During the pre-war period, the professors involved in the organization of geodetic faculties at higher education schools, deriving mainly from Warsaw environment, were very active in the field of science. The first scientific papers and monographs were published as early as before 1920 by the future founder and the Dean of the Geodesy Faculty, and later on the Rector of Warsaw University of Technology – Prof. Edward Warchałowski. The geodesist and astronomer, Prof. Felicjan Kępiński (1885 – 1966) published numerous papers in the field of sky mechanics. The publication legacy of Prof. Kępiński in the inter-war period, amounts to more than 100 bibliographic items which brought him the recognition of the international astronomic environment. Despite of playing many important functions at the University of Technology and in the Chief Office of the Country Measurements, Professor Warchałowski participated actively in the domain of his profession and in the numerous international scientific conferences until the end of his life. The place of the mentioned Professors was later occupied by their successors and pupils. We should mention here the following names of the professors from Warsaw: Stefan Hausbrandt (1896-1971), Felicjan Piątkowski (1908-2004), Jan Różycki (1909-2005), Czesław Kamela (1910-1992), Tadeusz Lazzarini (1913-1986) or Zdzisław Adamczewski (1931-2018). The other national scientific centres may also be proud of their worthy representatives such as Michał Odlanicki-Poczobutt (1910-2004) from Cracow, Lubomir W. Baran (1935-2004) from Olsztyn or Roman Hlibowicki (1911 – 1999) from Wrocław. Many persons living abroad found also recognition in the field of science and higher education: in Canada - Prof. Teodor J. Błachut, a graduate of Lvov Polytechnic School, specialist in photogrammetry, the member of the National Council of Canada and Polish Academy of Sciences. Dr Jerzy M. Zarzycki, Engineer, graduate of Warsaw University of Technology followed his way. In Canada, the married pair of professors, Adam and Maria Chrzanowski, the post-war graduates of AGH University of science and technology enjoy a high appreciation; they are the recognized professors of the New Brunswick University. In respect of supporting the decision with the geo-information methods in the USA, Professors Jacek Malczewski and Piotr Jankowski, originating from Poznań, occupy a meaningful position. In Europe, Prof. Jerzy Gaździcki, the pioneer of geodetic information science in Poland and in the Netherlands has attained a significant position (Delft University). All the mentioned persons and places are the examples of abundant, recognized activity of Polish science.

At the present time, most of the scientific studies are implemented in Polish universities and scientific-research centres, mainly in IGiK, Cosmic Centre and recently, also in ASG system. Within the frames of the international organization of geodesists (FIG, Fédération Internationale des Géometres), specialists in photogrammetry (ISPRS, the International Society for Photogrammetry and Remote Sensing) and cartographers (ICA/ACI, International Cartographic Association), Polish authors have delivered many lectures and published the results of their studies during numerous conferences and symposia. It is not appropriate to mention any name as not to decrease the achievement of the remaining persons. The most of the discussed specialists were linked with the Association of Polish Surveyors and participated actively in its foundation, or represented the organization abroad. A group of successors follows their activity.

3.4. The Association activity

The support for the commercial activity for the particular sectors can be found in the professional organizations. In the case of geodesy, the Association of Polish Surveyors refers to the oldest roots of origin. Its beginnings reach to the first all-national Congress of the Surveyors in 1919, in consequence of which the seeds of the structure of the association movement were created in a form of the Circle of Engineers – Surveyors at the Association of Technicians in Warsaw. But first of all, the mentioned Congress was involved in the establishment of the organizational background of the Second Republic of Poland via drafting the memorial on establishment of the "Chief Surveying Office". Finally, in 1919, the self-governing organization of the surveyors participated actively in development of

the questionnaire on the organization of the state surveying system. The successive Congresses of the Surveyors' Delegates were held in Warsaw in 1921 (2nd Congress) and in 1923 (3rd Congress) and in the successive years. In effect, the new postulates were, inter alia, developed as regard organization of geodesy in Poland. The associations of the surveyors were founded not only in the Capital city of Warsaw but also in Poznań (Association of Cadastral Officials of the Western Territories of the Republic of Poland, since 1921), in Katowice (the Association of Mining Surveyor, since 1922) and in other cities, associating the higher and higher numbers of geodesists connected with the specificity of their specialization. In 1924, the first number of monthly "Surveyor Review" was published; for many years, it had been the only one periodical, dedicated totally to the geodesy problems. The "Geodetic Review" is now its continuation.

In 1926, Polish Unions of Surveyors made the accession to the International Federation of Surveyors (FIG). In Poland, the meetings of the Standing FIG Committee was organized three times: in 1932 in Warsaw, in 1959 in Cracow and in 1985 in Katowice. In May 1975, the meeting of the Commission 7 of FIG - "Cadastre and Agricultural Equipment" had place. The General Assembly of FIG was expected to be held in 1942; however, the World War II dramatically destroyed the plans. The War brought also about to the death of more than 1200 surveyors, many of them being involved in the association movement.

After the Second World War, the construction of a new society was commenced. As early as in 1945, the Union of the Surveyors of the Republic of Poland resumed its activity; after liquidation of the institution of the Sworn Surveyor, the mentioned above organization was transformed into the Scientific-Technical Association of Polish Surveyors, in abbreviation SGP. During its successive Congresses, SGP has updated its opinion in the matter of the national geodesy and, also, has initiated many activities connected with the profession of geodesist. In spite of the later removal of the definition "Scientific-Technical" from its name, the matters of science and development of geodesy and a new generation of geodesists remain still one of the main concerns and spheres of activity of the Association. Despite the formation of many competitive professional groups, the Association remains the main driving force of development and integration of geodesists; it is also the organizer of numerous scientific, organization and social meetings. The Celebration of the Jubilee of the 100th anniversary of SGP was a solemn form of summing up the mentioned above activity (Fig. 8). The ceremony was held in the historical building of Polish Federation of Engineering Associations NOT in Warsaw, on 25-26 January 2019.

4. Summing up and conclusions

A difficult history of our nation received a new, promising image after regaining the independence 100 years ago. The time of building the nationality and then, laborious undertaking of many challenges aimed at reaching a life standard similar to that one in other European countries is approaching slowly the desired target. There were the periods of ups and downs, sometimes very dramatic ones such as the Second World War, or the complicated situations such as dependence on Moscow and the imposed attempts to build the socialist economy and, finally, a difficult process of integration with the European Union with its sometimes unclear standards but with the enormous potential. The mentioned fates had a big impact on human life, obtaining and loosing of various forms of property, obtaining and loosing of the subjectivity by many social groups. Finally, it also affected the laborious gaining and sometimes, a

Fig. 8. Extraordinary Congress of SGP Delegates during the celebration of the Jubilee of the 100th anniversary of SGP, Warsaw, 25-26 January 2019

dramatic decline of the economic foundations. All these phenomena were accompanied by geodesy, being called "surveying" for a long time, and at present – geodesy and cartography.

We have undertaken the attempts to shape the profession of geodesist and the related structures, we have modified and updated the difficult problems of cadastre, we have outlined the geometric frames of the Globe surface description, we have founded and we are enthusiastically implementing the idea of the common, all-national large-scale economic map of Poland; we outline and perform a stocktaking of the new intended investments and we are involved everywhere where the issues of field measurements can help in the solution of the spatial problems. Introduction of the modern system of spatial references, integrated with the systems of the other European countries and implemented in a form of Active Geodetic Net (ASG), supporting the measurements with modern satellite techniques GNSS are the consequence of the discussed efforts. Cartography and spatial management, and first of all, cadastre, are based upon the carefully updated database systems owing to everyday involvement of many groups of geodesists. The national systems of photogrammetric and scanning (LiDAR) illustrations are created and the 3D developments of the building models are implemented. For the needs of the implementation of the mentioned tasks, the geodesists are equipped in better and better instruments and measuring and computational technologies.

For 100 years, the whole discussed process has been actively participated by the professional organizations of geodesists, which – under various names and recently as the Association of Polish Geodesists – have undertaken many initiatives; they included building of efficient organizational structures of the national geodesy as well as integration and professional organization of geodesists but first of all, the attempts to make geodesy and cartography useful for the society. Numerous vocational and associative relations with geodesists of other countries were initiated, many trainings, conferences and scientific symposia are organized, professional press is published and didactic publications are issued. The geodesists employed in higher education system implement and publish numerous scientific papers at the national as well as international level.

Is everything OK? No. The relations between the administration and practical performance are not satisfactory, the secondary education – after the period of liquidating the secondary vocational schools – is deprived of the teachers-specialists and has the deficits in equipment of laboratories; the greater technological deficits are however found in higher education schools. Science is underfinanced and at present, a discipline of geodesy and cartography has completely disappeared as an independent unit.

However, the period of 100 years of active participation of geodesy in the social life of Poland has strengthened the profession of geodesist as one of the main pillars of the social and national development. The Association of Polish Geodesists has been a meaningful binding element and a driving force of many undertaken initiatives.

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