Profession of Land Surveyors in the Age of the Technological Revolution

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SUMMARY

Since the earliest times the profession of surveyors has been considered as the ability to perform terrain measurements and to map the measurement results; if necessary - also to restore locations of measured features. The importance of surveying and related cartography was and it is still crucial for development of each country. For many years, the rapid technological development has been also significantly affecting all areas of geodesy, from underground geodesy to the cadastre. Initially, these were modern and accurate methods of distance measurements and digital processing of observation data, then GPS technology, laser scanning and the use of drones for photogrammetric measurements and databases located in clouds. The paper attempts to present the further technological development related to surveying and to indicate surveyors' places in the future.

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1. Introduction

Federation Internationale des Geometres (FIG, French), the International Federation of Surveyors, or Internationale Vereinigung der Vermessungsingenieure (German) – surprisingly, none of these names includes the word 'geodesy' in the Polish translations (Międzynarodowa Federacja Inżynierów Mierniczych, Międzynarodowa Federacja Mierniczych, Międzynarodowe Stowarzyszenie Organizacji Inżynierów Mierniczych, respectively). Likewise, the FIG Commission 2 - Professional Education makes no reference to the term 'geodesy'. The authors of this article represent Poland, and Poland is represented in FIG by the Association of Polish Surveyors (Stowarzyszenie Geodetów Polskich, SGP in Polish). This is the first time the word 'geodesy' comes up in the Polish name of this association. Internationally, **geodesy** is the science of measuring Earth as a planet, its geometric shape, size, movement, and orientation in space among other celestial bodies, whereas **surveying** is the measuring activities to determine the positions, size, shape, and legal status of real estates. Poland regained independence after the end of the First World War, after years of partitions, when it was divided among the Austro-Hungarian Empire, where the Austrian cadaster was operated, the Kingdom of Prussia with a Prussian cadaster, and Russia, in which there was no cadaster at that time, but its tasks were fulfilled by land measurements. Following re-establishment of Poland's independence, the authorities of the reborn Polish state established a new structure, referred to as a 'cadaster', in the Polish territories across all three former partitions. The cadaster-related profession was assigned to the Association of Polish Surveyors (Stowarzyszenie Mierniczych Polskich). Then came the Second World War, the German occupation, and the post-war era. By then, the name **geodesy** (surveying) and the related Association of Polish Surveyors (geodesists) (Stowarzyszenie Geodetów Polskich, SGP) were established. There are simply too many terms and expressions to be reviewed and discussed in this short paper, especially that various terminology concepts continue to exist in this profession, and that professional education is delivered at several dozen secondary and higher education establishments, both public and private. To round off this question, please refer to a proverb by a famous Polish poet and satirist, the late Wojciech Młynarski: "Let's do our own thing" (*Róbmy swoje* in Polish), which means, setting all that is lost in transaction apart, that we will not delve into methodological and linguistic deliberations, and instead, we will address the technological revolution of the profession of a surveyor that we currently witness in Poland.

2. The present of surveyors and geodesy

In the geodetic world of today, collecting data appears to be as easy as never before. The increasingly advanced surveying techniques and the continually smaller surveying errors have led to a situation where surveying essentially means correct operation of the geodetic equipment, or even a correct activation of the equipment, while the measurements are taken without any active involvement of an operator. However, there is also one more important aspect – in the surveying of the borders of real estate properties or registered parcels of land, what matters is not only what to survey, but also where to survey, for example, to identify the turn point of the borders of a registered parcel of land. This is the knowledge that cannot be substituted by any surveying equipment – here, the experience of a surveyor is what matters most, and will most likely continue to be of key importance. In many countries across the world, including Poland, geodetic surveys can only be performed by licensed professionals who are confirmed to have the proper experience and knowledge. In Poland, there are 7 types of surveying licenses, including license no. 2 – one referring to border surveys.

A surveyor in the 21st century has virtually an unlimited access to spatial data via the Internet. It would seem that public authorities are currently competing with one another in preparing their own geoportals. New local, regional, and national geoportals are emerging. Some of them are updated online and on an ongoing basis by uploading new spatial objects to the database. Some of the geoportals are developed in a public procurement procedure, but are not updated in real time, whenever a new object appears in a database kept by, for example, a starosta [head of country administration] who is involved in the keeping of the National Land Surveying and Cartographic Database (Państwowy Zasób Geodezyjny i Kartograficzny); instead, the updates are performed by a geoportal operator. The National GEOPORTAL (GEOPORTAL Krajowy) established and maintained by the Surveyor General of Poland is growing increasingly popular.

Fig 1. Example of the National Geoportal

The National GEOPORTAL, set up via WMS (Web Map Service) in Poland, features data included in other public portals. The up-to-datedness of the spatial data published on the GEOPORTAL crucially depends on the up-to-datedness of public registers and databases that constitute the core of the National GEOPORTAL via WMS, and whether these services are provided by specific public geoportals. Apart from spatial data related to land surveying, such as the land and building register, the infrastructural network register, the database of topographical objects (BDOT500 and BDOT10k), address points, geodetic matrices, the State Border Register, the State Register of Geographical Names, the digital terrain model, the digital surface model, and the orthophotomap, the National GEOPORTAL also provides the numbers of land and mortgage registers (if the starosta who keeps a land and buildings register makes these umbers available), 3D models of buildings, planning concepts, a prices and values register for real estates, enclosed areas, data from other public registers, as well as the results of Parliamentary elections, monitoring and forecasts of soil conditions, and many more. Moreover, its capacity to run multiple spatial analyses is continually extended, including creating terrain profiles or calculations of the volume of oil masses.

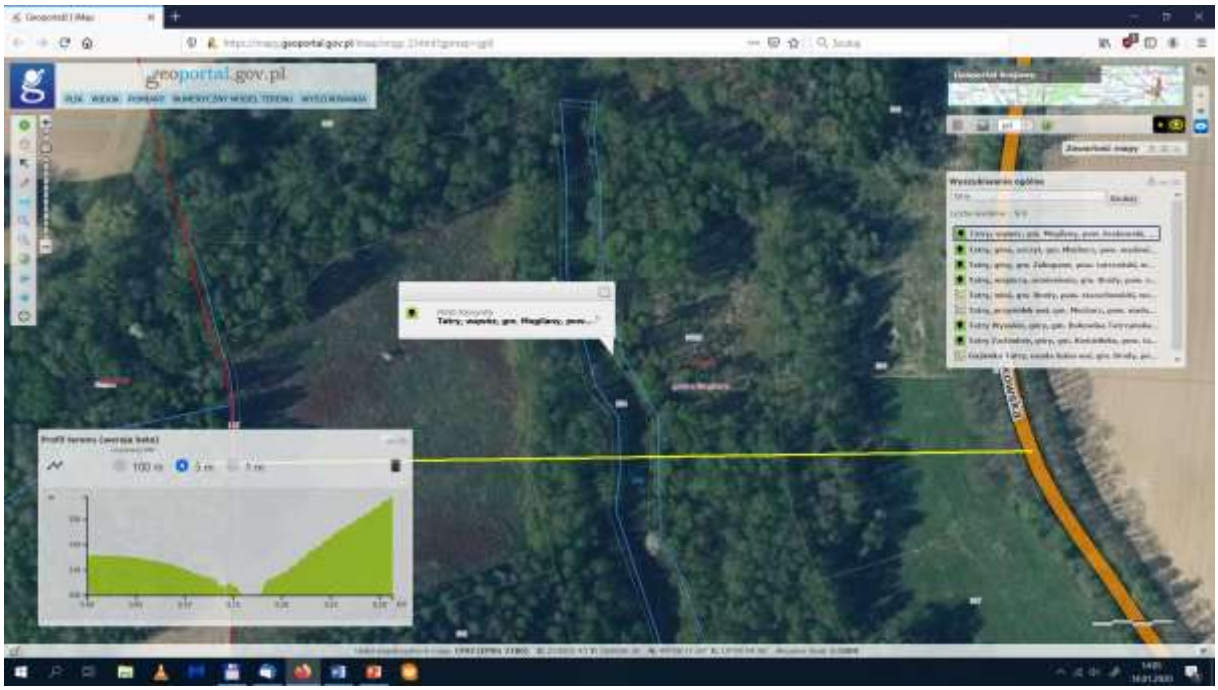

Fig.2 – Example of a terrain profile in the National Geoportal

GEOPORTAL is currently the fourth most popular governmental website in Poland, and the number of hits in 2019 almost reached an impressive 4 million.

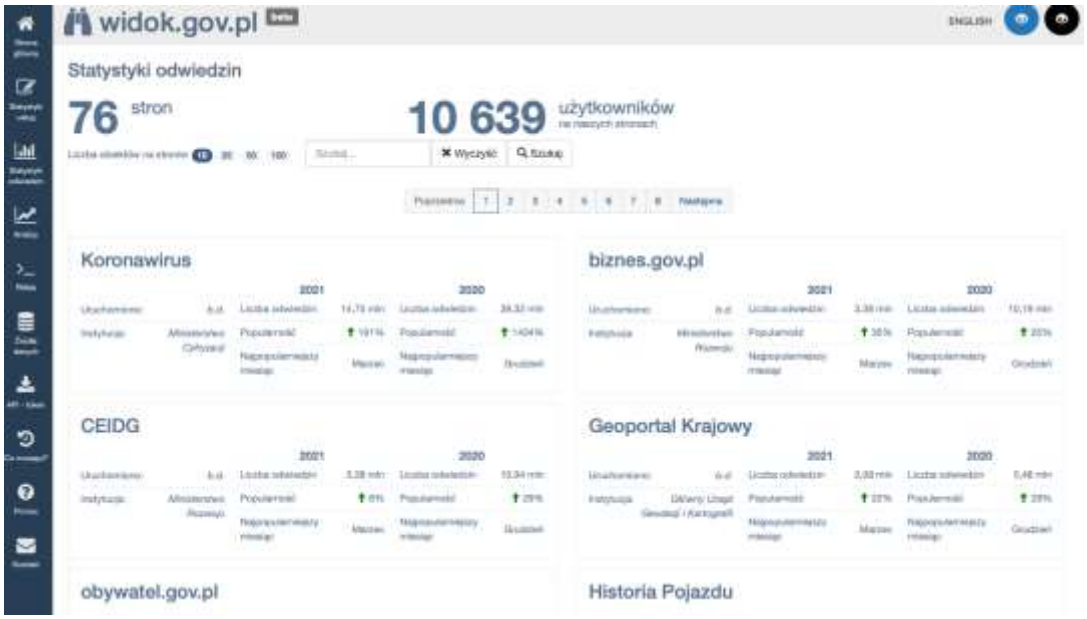

Fig. 3 The most popular governmental websites in Poland

The amount of data available on public web portals is enormous. One of the most, if not the most, difficult issues is the processing of large amounts of data, as well as data redundancy, which should be avoided. All web portals are available to the public, including surveyors, as stipulated in the Informatization of the Act on the Operation of Entities Performing Public Duties adopted in 2005. For many sectors of the economy (builders, surveyors, architects, designers, etc.), geodetic portals are generally available, but licenses must be procured and data must be acquired in order to be able to use the data for commercial purposes, at the rates indicated in the Geodetic and Cartographic Act.

All spatial data portals are available for all citizens. This is governed by the provisions of the Spatial Information Infrastructure Act, stating that public authorities running public registers that contain spatial databases should ensure that every citizen can take advantage of the following services:

- **Discovery Service,** making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata;
- **View Service,** that makes it possible, as a minimum, to display, navigate, zoom in and out, pan or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
- **Download Service,** that enables copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;
- **Transformation Service,** that enables spatial data sets to be transformed with a view to achieving interoperability;
- **Invoke** Spatial Data Service.

These services are to be generally available via **means of electronic data transmission**.

It leads to a situation in which landowners can check the borders of any relevant real property, buildings, utilized area, and contours of soil quality class via public portals. However, it is often the case that the data do not comply with accuracy / quality requirements. Some borders can originate from the vectorization of cadastral maps, whose purpose is to establish spatial databases or to help transfer funds of direct agricultural support. They do not originate from source materials on which the register is based; it can also be the case that source materials are missing, e.g. from a former Austrian cadaster (the technology used back then was based on plane table surveys). When cooperating with a land surveyor, a land owner expects that the borders found on the GEOPORTAL are reflected in real life. While performing his work, however, a surveyor is bound by the source documents, which he tries to explain to the real property owner. This is one of the reasons for conflicts not only at the interface between a surveyor and a landowner, but also between land owners.

Advanced surveying and calculation technologies in geodesy and cartography increasingly often eliminate surveyors from the investment process. Many operations at the construction site are performed by professional construction workers trained in the operation of surveing equipment. A surveyor only performs the activities which are legally assigned to be performed by surveyors. Many operations, which seemingly belong to the geodetic repertoire, are increasingly often eliminated or performed not only by professionals from other market sectors, but also by robotics. Smart programmed machines increasingly perform the work which used to be handled by surveyors (such as a bulldozer on the construction site of a road, which not only performs its traditional tasks, but is also equipped with devices which lay out road, calculate the soil mass, and maintain the designed road level and downslope). Robotics is now a very attractive field of study at universities.

At the same time, due to unlimited access to higher education, both private and public, there are too many surveyors on the market. There are around 20 thousand licensed surveyors in Poland. This situation translates into low prices of geodesic services owing to limited number of contracts and too many providers.

General accessibility of increasingly accurate surveying methods is another factor which prompts a future redefinition of the profession of a surveyor. An accuracy range of several dozen centimeters can be obtained with a plain smartphone with which measurements can be performed using GPS, Glonass, Galileo or BeiDou satellites, the increasingly frequent capability to perform measurements within two frequency bands, after downloading a stream of corrections and after installation of appropriate applications. GPS measurements can be performed with Xiami Mi8 smartphone of 2018, within L1 and L5, and Galileo E1 / E5 frequencies. The use of miniature devices connected to a smartphone, such as R1 Trimble or PPM 10 XX, increases the accuracy range to up to a few centimeters.

Fig. 4 Trimble R1 surveying instrument.

Also, measurement data obtained can be post-processed in order to produce even higher accuracy.

It is also worth mentioning that the increasingly advanced distance meters used in the construction sector, in combination with the appropriate applications, may further contribute to the elimination of surveyors from the survey process. The increasing accessibility of increasingly accurate measurements becomes a matter of fact.

3. Summary

The profession of a surveyor, and especially a cadaster surveyor, requires extensive technical and legal expertise. However, due to the technological progress, the expectations towards surveyors have been changing.

Increasingly, surveyors are no longer seen as professionals who are able not only to perform measurements of spatial objects, but also to obtain, analyze, and process archival data, or data originating from various sources. Owing to the general availability of geoportals which feature enormous amounts of spatial data, and a broad access to increasingly accurate measurement data, surveyors are more and more often expected to interpret the available spatial data.

Surveying activities are increasingly often performed by individuals who are not educated surveyors, while surveyors are only engaged when a problem emerges and needs to be clarified, or whenever their involvement is legally required.

It can be expected that, in the near future, surveyors will be marginalized and eliminated from assignments in some market sectors, such as construction, measurements of soil masses, or agricultural surveying. It is no longer required to master complex technologies in order to perform an accurate measurement, as measurements are taken automatically by contractors. Legal regulations can delay this process, but it cannot be entirely eliminated.

The role of a surveyor dealing with a real estate cadaster appears to be slightly different. Here, archival data needs to be analyzed in the context of legal provisions or technologies which are a thing of the past, and therefore automatization or artificial intelligence can be of no use in some cases.

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