ESJ Humanities Peer-reviewed

The Importance of Surveyors and GPS Technology in Systematic Land Registration in Georgia: A Study of the Challenges and Opportunities

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Doi:10.19044/esj.2024.v20n20p32

Submitted: 30 May 2024
Accepted: 01 July 2024
Published: 31 July 2024

Cite As:
Merebashvili T. 2024). *The Importance of Surveyors and GPS Technology in Systematic Land Registration in Georgia: A Study of the Challenges and Opportunities*. European Scientific Journal, ESJ, 20 (20), 32. https://doi.org/10.19044/esj.2024.v20n20p32

Abstract

The purpose of this work is to explore the historical and contemporary importance of land registration, focusing on the crucial role played by Georgia's surveyors. The paper concentrates on the combination of GIS-based state systems with GPS PlateTalk map registrations to resolve conflicting cadastral information as well as for accurate ownership record keeping. The Georgian absence of a unified legal and administrative framework significantly complicates land boundary delineation leading to disputes among surveyors. To standardize surveying practices and improve accuracy, an all-encompassing legal framework must be put in place.

The study adopts historical, comparative legal, and hermeneutic research methods using examples from Germany and Holland that demonstrate how such advanced technologies as drones, LiDAR, and blockchain can enhance the precision, speed, and security of survey practice. Furthermore, professional education investment must be increased in both teachers and attorneys who are also informed about Geoinformation Systems (GIS), thus enabling them to perform their functions properly when it comes to law matters concerning land registers.

Conclusions urge policy-makers to invest in modern technological gadgets as well as engage in legislative reforms that would make their cadastral systems stronger. That would result in the creation of robust cadastral

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

systems by investing in modern technology as well as carrying out legal reforms that would modernize their existing cadastral systems.

Keywords: Cadastral survey drawing, Land cadastre, Overlapping property boundaries, Mapping

Introduction

The importance of systematic recording of titles in land cannot be undervalued, especially in a country like Georgia where economic growth, legal clarity, and social stability depend on correct property records. After independence, Georgia went through the process of extensive land privatization that has been largely facilitated by surveyors from the Institute. The introduction of systematic registration of real estate rights has led to greater demand for accurate cadastral information thus pointing out the critical role played by surveyors in its provision.

However, Georgia's current legislative framework is fragmented and insufficient to comprehensively define surveyors' rights and duties.

An example of these technologies transforming land registration systems all over the world and how they have been reported recently is illustrated by many studies as well as articles. Notably, incorporating advanced geospatial technologies in Germany and Holland has improved spatial data accuracy significantly, thus increasing the trustworthiness of cadastral records by reducing legal disputes.

Williamson (2022) gives a general glance at how land administration systems are linked to sustainable development in different countries. It underlines how accurate land information is important for economic advancement, social orderliness, and environmental conservation. The authors also emphasize on GIS and GPS-related technologies that come into play in current land management activities while noting that a strong legal framework is required to ensure that they operate accordingly.

This research is very important for Georgia, the establishment of property boundaries and land ownership in a legal and precise manner is crucial for economic development, social stability as well as legal clarity. The lack of detail in the regulation of geospatial rights and obligations hampers the accuracy of land registration while increasing the likelihood of conflicts in addition to ineffectiveness. By looking at how modern GIS technologies can be incorporated with GPS technology in day-to-day surveying work. A land surveyor has always played a critical role in the establishment of property boundaries and the proper recording of land ownership interests. In Georgia, as part of the privatization of the land state program, a comprehensive system of surveying and land registration was required to be established to serve as the foundation for legal land ownership and to resolve land disputes. Thus, the

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Surveyor's Institute is expected to play a crucial role in the privatization process, as it will ensure the accuracy and legality of land records. However, their rights and obligations are not determined properly in the Georgian legislation. This creates inconsistencies in the everyday practice of surveyors and may cause legal disputes.

Modern surveying practice utilizes Geographic Information Systems (GIS) and GPS technologies (Merebashvili, 2023). These systems enable surveyors to collect, analyze, and display spatial data with a high degree of accuracy, which is necessary to ensure the accuracy of the cadastral records. GIS enables the integration of different data sets that provide a holistic perspective of land parcels, property boundaries, and other geographical objects. GPS technology complements the GIS by offering accurate coordinates of land parcels, which are necessary to determine their boundaries and resolve disputes. Overall, proper use of GPS and GIS technologies together with the Surveyor's Institute helps to ensure the accuracy and efficiency of the land registration system.

This article discusses the way the Surveyors' Institute and GPS technologies tackle legal issues of the systematic land cadastre establishment in Georgia. The article outlines the existing legal framework and current state of law regulating the activities of surveyors. It attempts to evaluate, whether there is a need for the systemic regulatory framework of the profession. The article considers the functions of the Surveyor's Institute and the usage of GPS technologies as examples, highlighting the factors, that have a significant impact on the legal and practical effect of the land registry.

A primary legal challenge to surveying in Georgia is a lack of coherent, integrated regulatory policy. Rights and duties of surveyors, rights and duties of land owners, buyers, and institutions, are defined in various laws, orders, and normative acts, often fragmented and sometimes contradictory. For example, while the Order of the Minister of Economy and Sustainable Development of Georgia #1-1/410 from the 3rd of August, 2016, regulates certain aspects related to land measurements in the course of public auctions, this order does not provide a comprehensive legal basis for surveying activities. The piecemeal approach leaves lots of room for dispute over land boundaries, ownership, and usage rights. The absence of unified procedures and uniform qualifications for the surveyor further aggravates these issues. In many developed countries, to become a surveyor, one has to go through very tedious training and certification procedures. These procedures make sure that the surveyor is qualified and will follow the standardized procedures. In Georgia, the lack of such criteria leads to the fact that the quality of the surveyor's work is very variable, and therefore, the reliability of the cadastre data. This situation dictates the need to institute legislation that defines the qualifications, rights, and responsibilities of surveyors, and ensures

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

consistency and accuracy in land registration processes use of GPS/GIS as technology will offer a pathway to address some of these challenges. Precise and comprehensive data will enhance the accuracy of the cadastre record and reduce the potential for dispute. For example, GPS will pinpoint property boundaries precisely, while GIS will integrate multiple data layers to provide a comprehensive view of land use and ownership. However, its effective application demands a regulatory framework supportive of their implementation and guaranteeing that surveyors are adequately trained for use conclusion, even as the Surveyor's Institute is very important to the land registration process in Georgia, its great potential cannot yet be realized due to the lack of a comprehensive legal framework. Developing standardized regulations and utilizing state-of-the-art technologies would increase the accuracy and reliability of the cadastral records in Georgia, thus providing for legal ownership and reducing the number of disputes. This paper highlights said issues and attempts to provide solutions for the effectiveness of surveying activities in Georgia.

Role of geography and GIS in a legal context

Maps have been used since ancient times to determine the territories of states (Black J., 1997), therefore, cartographic data were the main tool of land distribution and jurisdiction over them. A map primarily serves to determine the physical location of a country or individual objects (Harley JB., 1987). Thus, it is also a determinant of law-making and politics. A map is more than just a geographical tool, it is a tool for gaining influence (Soja EW., 2009). Montesquieu developed new theories that linked the issues of climate and farmland with law (Montesquieu SL, 1994). His work reveals the connections between law and geography from early times to the emergence of modern laws.

Geoinformation systems have led to the creation of maps of practical use by law enforcement agencies for crime analysis and investigation purposes (Rogers R., 1994). Over time, GISs have become an important ally for law enforcement agencies, these systems are versatile and run on both mobile devices and personal computers (Heywood I., 2006).

Mapping and GIS are applied to law enforcement and in many other fields, such as town planning, environmental management, and transportation. City planners use GIS technology to analyze demographic trends, assess land-use patterns, and optimize infrastructure development. Environmental agencies apply GIS to monitor and manage natural resources, trace animal habitats, and regulate the impact of human activities on ecosystems.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Historical context of surveying activity

Surveying is as old as the practice of managing and organizing land and resources. It has roots way into antiquity, taking its origins from ancient Egypt. The need to restore the boundaries of agricultural plots destroyed annually by the flooding of the Nile River led to the development of early surveying methods. Precise measurements conducted by ancient Egyptian surveyors helped to restitute those lands but contributed to the monumental undertakings of constructing the Great Pyramid of Giza (9). Evidence of surveying can also be seen in Roman history, where surveyors were important in defining geographical units of the vast Roman Empire. As early as 300 AD, Roman surveyors were to establish precise boundaries and maintain tax registers for the lands under Roman dominion (Hopkins K). Their work set the basis for administrative systems that were based on precise land data, which underlined the role of surveyors in the governance and administration of resources. The value of surveying can also be found in the Bible, where land boundaries and landmarks are mentioned. In Deuteronomy 19:14 and 27:17, Proverbs 22:28, and Job 24:2, the importance of defining property boundaries is stressed, showing the persistence of surveying principles in ancient society (Bible, 2nd Law). The techniques of surveying evolved further with the passing of centuries, making great strides during the European Enlightenment (12). The 18th century saw the development of triangulation as a revolutionary method of surveying. Based on accurate angle measurements, it created an interlocking network of reference points for purposes of mapping and communication. The method introduced new changes in the field of surveying and paved the way for later innovations in geospatial technology.

Surveyors had to make use of many tools and instruments, such as measuring wheels, guide chains and compasses to estimate geographical data and demarcate the borders between nations. The painstaking efforts of the early surveyors not only facilitated exploration and settlement but also helped in laying the way to establish legal frameworks governing the ownership and administration of lands. Nowadays, technological innovations have revolutionized surveying into an era of unprecedented precision and efficiency. GPS and GNSS technologies have provided access for surveyors to accurately measure the coordinates of geographic objects and collect space-based data with a level of accuracy. Today, any serious surveyor would have access to GNSS rovers and total stations (Hallmann F., 1994), among other critical tools for conducting surveys accurately and quickly across any landform and weather condition. Digital mapping technologies have expanded the capabilities of surveyors, and geographic information systems have empowered them to analyze and visualize their spatial data in ways that were previously unimaginable. Surveying plays an essential role in shaping our world and assisting decision-making processes in many ways at the local,

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regional, and global levels of planning urban communities and infrastructure, managing the environment, and disaster management. Land Surveying Institute is an ancient profession in the world that has undergone continuous evolution towards advancement for the rising needs and complexities of human societies. From the greatest ancient civilizations to the digital age, surveyors have been the silent but essential molders of the world we live in, giving us valuable data and information that help in our understanding of the Earth and its resources. The position of the surveyor remains critical in this continually evolving technological world to move us through our planet with certainty and sensitivity.

Surveyor as a land surveyor at the time of registration

In the process of registration of rights to real estate, the most important thing is the survey of the land, taking into account the interests of the buyer and the seller. for example, From the 20th century to the present day, the functional meaning of the surveyor's activity in the USA has not changed: determining the boundaries of the land - land survey, which determines the geographical boundaries of the property object. This process is necessary to avoid future neighborhood disputes due to overlapping borders. Through advanced technology and methodology, a land surveyor/surveyor provides geoinformatics data processing based on legal data. In the context of limited commercial rights, such as easements and right of way, the surveyor specifies the geographic location of the easement and accurately reflects it in the documentation (Wilson R.C., 2006). During zoning, land surveyors assess whether a property complies with municipal zoning ordinances, providing critical information to the buyer, including the seller. Land surveyors play an important role in the process of creating a topographic map, which is an essential component of construction permit documentation (15). Moreover, land surveyors have an important function in the resolution of land disputes, expert results, and providing evidence, for example, in connection with the demarcation of the country's borders, they create property and general land maps with high accuracy, which is a necessary basis in the process of real estate registration and obtaining ownership rights (16). The land surveyors are responsible for bringing the document establishing the ownership right into harmony with the actual circumstances (Pylaeva A.V., 2020). A land information system can be created with cadastral programs and digital maps, which are collected in geoinformation systems (GIS) (Tanawijaya H., Velisia M., 2022). Surveying activity is of such great importance, both in legal and other sciences, that in many developed countries the profession of surveyor requires legal education (Ronald L., Williams SR/WA). The government of Georgia carries out systematic registration of rights to land plots free of charge (20). The process of registration of ownership rights and changes in registered

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

data on plots of land located in different geographical areas or within the scope of a project of special state and public importance is ongoing on a proactive basis (21, Article 2). Along with the establishment of the National Agency of Public Registry, the legal importance of systematic registrations has increased, especially in such geographical units where there is an overlapping situation in the registered data, which becomes the basis of legal disputes between the owners, and in this process the land surveyor and advanced GPS technologies play a decisive role. It is the Surveyor's Institute that provides the field digitization of agricultural land as an object, the preparation of documents necessary for the registration of ownership rights, and the specification of geographical boundaries (Navratil G., Frank U.A., 2004). Systematic registration is also a legal mechanism for obtaining ownership rights for legitimate owners (21, Article 4). Within the framework of systematic registration, a social context is provided for citizens, which implies a subsidy of the registration fee. Surveyor and GPS technologies have an advanced role in the process of effective implementation of systematic registration, protection, and realization of the rights of the true owner and owner (25, Article 2).

Integration of modern technologies

Among the advanced GPS technologies, famous are LiDAR and advanced software, which have revolutionized geodesy and play a major role in construction law for example, in completing architectural documentation (Li Y., Liu X., Han X., 2016).

Moreover, blockchain for land registration is transparent, secure for information, and publicly available, which provides the ground for the record of the ownership transaction over a plot of land. Blockchain has the power to offer a very high standard of protection of records of land ownership and to avoid fraud, as well as provide correct and updated data on information related to the landowner, and land geo-information data. The implementation of such technologies in the state institutions of Georgia deserves its support, and in the future, it will greatly increase the quality of land registrations and the protection of the rights of owners.

Educational and professional development

One way of conquering the problems facing surveying activities is for the state to develop a policy on specialized education and professional development of surveyors. The universities and other institutions of learning will provide special curricula and syllabi, meaning special educational programs that have content on new technologies and methods of measurement. Surveyors are best served by such specialized professional development programs that help them update their skills. The partnership between

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educational institutions, government institutions, and professional bodies may provide the policy development needed for the development of the surveying profession (Zheng Z., 2018).

One of the effective ways to respond to such challenges in surveying activities is to come up with a state policy on specialized education and professional development for surveyors. It is through a set of established guidelines and incentives that various governments may wish to encourage universities and other learning institutions to design specialized curricula and syllabi that meet dynamic changes in the surveying profession. These programs would ensure measurement is undertaken with the latest technologies and methodologies, thus equipping surveyors with the latest tools and techniques in the profession.

Measuring challenges in Georgian legal reality

There is no separate legal order for surveying activities in Georgia. The surveyor's rights and duties are not sufficiently regulated at the normative level but are scattered in various articles in orders or separate normative acts, for example, order #1-1/410 of the Minister of Economy and Sustainable Development of Georgia dated August 3, 2016, where it is determined that the surveyor is signed in writing with the interested person The person acting based on the contract, who is responsible for the preparation of the cadastral survey drawing. Of course, the above will not be enough to establish the legal order of rights and duties of the surveyor's institute. Foreign countries dedicate separate normative material and legal frameworks to the order of this institution and define the rights and duties of surveyors. For example, in Germany, there is a special law about land surveying and land cadastre production, the normative content defines that a national land survey must be carried out, which means whether, for example, the registration object requested by a private owner corresponds to the state interests, land cadastre production is also carried out in the context of conducting property surveys Determining the time and boundaries of buying and selling is mandatory, and the processes are produced in geoinformation systems (26, 2004). The legislation of Georgia does not require the surveyor to be involved in the process of the agreement of the parties or to verify such an agreement, however, in the Netherlands, like France, the surveyor has the right after the field survey when the object is measured and then the geometric relationship is adjusted in office conditions through geoinformation systems (GIS), the decision of the parties will be verified and recorded by the surveyor even (Wakker J, 2003).

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GPS and GIS in cadastral boundary survey and map updating

It is easy to follow how geography evolves with law, how changes in legislation affect geography, and how geography reflects the imprints left by legal norms. The law establishes territorial boundaries (sovereignty) (28, Article 1), maintains or protects boundaries and physical location (29, Article 12), and affects spatial planning. Geodesy as a science with the help of GIS is used at the state level in the following main directions: 1. Land registration; Determination of cartographic data for cadastral systematization. An accurate map is used to determine the boundaries of a plot of land; 2. Environmental protection: Cartography creates maps, which are important for the practical implementation of environmental protection norms.

Disputes related to real estate, especially land, are a common challenge for the law, not only in Georgia but all over the world (30). The use of geoinformation systems promotes the publicity of such issues as 1. determination of land ownership, transfer of land ownership rights, information on limited commercial rights, and security information; 2. Value of land and property; 3. Land market support and analysis; 4. Data on planning and management of utility services (Ventura SJ, 1995).

In Holland To effectively process information about the rights of the owners and the plot, the cadastral and land registry agencies are separate institutions (Wakker J, 2003), that is, they divide the registration process into cartographic and administrative activities, which ultimately serve one purpose. The administrative database contains the essential legal and administrative information of any land plot, and the cadastre ensures the alignment of geo-information systems and cadastral survey drawings of the plot with administrative data (32). there is no separate legal framework for the cadastre. Since the introduction of the land register and cadastre in Holland in 1832, all changes to the cadastral map have been preserved in the geoinformation system of the land plot (Gurung P, 2021). Map updating is related, for example, to the agreement of the parties on the location of new boundaries, when the surveyor measures new boundaries establishes the coordinates of new boundaries brings them into correspondence with topographic objects, and determines objects located on the ground (Hagemans E., 2022). At the beginning of the 19th century, one of the tools used by surveyors was a chainsaw, and today the latter has been replaced by GPS devices, which are managed by RTK-kinematic servers, which means real-time coordinate digitization. The RTK method works to ensure the accuracy of the GPS. The location of objects is determined by coordinates (35), according to already registered digital cadastral data The surveyor can determine the actual (coordinates) with a GPS device (Safrei I., 2018). GPS technologies are integrated into any digital device, but surveying involves positioning through at least two satellite GPS receivers, one for measuring the baseline and the

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other for measuring the actual distance and location of the position (Meng F., 2020).

Resolving land use conflicts is a complex process, during disputes it is necessary to analyze spatial data, which is carried out through GIS, however, to ensure the accuracy and reliability of GIS data, GPS technology is necessary, which is an advanced tool for collecting, verifying and updating spatial data. The legislation of Georgia does not provide a clear record that only licensed persons can carry out surveying activities because, in the archive records of the National Agency of Public Registry, there are several registration documents and cadastral surveying drawings, which are stored by an unlicensed person, improperly (mobile phone or so-called handheld GPS) is made with a measuring tool.

Conclusion

The relationship between geoinformation systems (GIS) and law is a complex and multifaceted process, especially in Georgia, where active work on integrating these fields is still in the early stages. This paper underscored a deep relationship between GIS and legal sciences, laying particular stress on the critical role that GIS plays in legal research and practice. The inter- and multidisciplinary nature of GIS enhances its utility in the legal domain, making it an indispensable tool for accurate land registration and property rights management. Systematic registration of rights to immovable objects is a vital process for securing property rights, which in turn ensures the social function of the land. Looking from historical and contemporary perspectives, this paper highlights the enduring relevance of the surveyor's profession. From ancient times to the present day, surveyors have been indispensable in defining property boundaries, ensuring the accuracy of land records, and facilitating legal ownership. Nevertheless, the current legislative framework in Georgia does not provide a comprehensive definition of surveyors' rights and duties, which creates considerable challenges for the profession. A lack of a unified regulatory framework for surveying activities in Georgia has resulted in inconsistencies in practice and potential legal disputes. Surveyors operate mainly as subjects of private law, but the scattered nature of existing regulations results in fragmented and sometimes contradictory guidelines. This lack of clarity hampers the reliability of cadastral data, which is crucial for accurate land registration and dispute resolution. To resolve these issues, it is indispensable to develop a comprehensive legal framework that clearly defines the roles, responsibilities, and standards of surveying activities.

Modern technologies, primarily those in GPS and the Real-Time Kinematic systems, are very important for enhancing land survey accuracy and efficiency. GPS location data, used in determining land boundaries, are crucial for collecting relevant cadastral information. RTK improves the

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

process by adding the accuracy of the positions, as it delivers real-time GPS data corrections. Such technologies, if implemented massively in surveying activities, would guarantee that the cadastral data is reliable and thus reduce the probability of land disputes and enhance stability in land ownership records. In addition, the use of GIS in legal research and practice will unveil a need for a multidisciplinary approach to land registration and property rights management. GIS integrates diverse forms of spatial data into a single, comprehensive view of land use, property boundaries, and other features. This holistic view is gold for legal professionals, as it puts them in a position to analyze intricate land issues. Therefore, modern lawyers with proficiency in GIS and other related technologies have a firmer grasp of legal and national issues related to land ownership and registration. Another method of promoting the development of the surveying profession in Georgia would involve educational initiatives and continuous professional development. Universities and academic institutions should offer special courses that include modern technologies and methodologies in surveying. Continuous professional development programs will enable surveyors to keep pace with the changes within the profession to give accurate and reliable services. Moreover, universities, government agencies, and professional bodies need to collaborate to support surveyors in their professional growth and ensure a high level of performance.

In conclusion, the Surveyor's Institute plays an important role in the land registration process in Georgia. The strong potential that can, however, be realized when a harmonized legal framework is established; standardization of regulations and modernized use of technology, for example, the use of GPS and GIS, shall lead to Georgia attaining its goals of improving the accuracy of cadastral records. This will prop legal ownership, reduce disputes, and translate to the country's economic development and social stability. A robust legal framework, accompanied by investment in education and technology, will be put to find solutions for the problems which the surveying profession is going through and ensure effectiveness in land registration processes in Georgia. The need for a fully harmonized legal framework for the surveying activity is therefore great. It would provide for not only the rights and duties of the surveyors but also licensing rules and standard procedures. That will make a more predictable and stable environment for land registration for the benefit of the property owners, legal practitioners, and society as a whole. In effect, Georgia can create a transparent and efficient system of management of land ownership and registration by solving these problems and hence social and economic welfare.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Conflict of Interest: The author reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The author did not obtain any funding for this research.

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