

## Kadastro 2034'e Doğru Kuzey Makedonya Kadastro

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### Makale Bilgileri

### ÖZ

#### Makale Geçmişi

Geliş: 16.11.2022

Kabul: 19.12.2022

Yayın: 31.12.2022

#### Anahtar Kelimeler:

Kadastro,  
Kadastro Sistemi,  
Kadastro 2014,  
Kadastro 2034,  
Kuzey Makedonya.

Bu çalışmanın temel amacı, Kuzey Makedonya Cumhuriyeti'nin mevcut kadastro sununun ve kadastro sisteminin tanımlanması ve bu tanım aracılığıyla, bu çalışmadaki temel kaygı, Kadastro 2034 çerçevesinde Kuzey Makedonya kadastro sununun sunulmasıdır. Kadastro 2034 kavramına giden yol, çerçeve çalışmaları, görev ve sorumlulukları ile birlikte Kadastro 2014 kavramı tarafından yönlendirilmekte ve formüle edilmektedir ve bu nedenle bunun bir incelemesi de yapılmıştır. Bir vaka çalışması olarak, Kuzey Makedonya'nın Pollog bölgesine kadar uzanan Tetovo şehrinin ilçesinin bir parçası olan Shemshovo'nun kadastro belediyesi seçilmiştir. Kuzey Makedonya'nın mevcut kadastro sununun günümüzde karşı karşıya olduğu zorlukların, sorunların ve engellerin belirlenmesi ve açıklığa kavuşturulması, Kuzey Makedonya kadastro sununun Kadastro 2034 çerçevesinde olması için yapılması gerekenlerin ve takip etmesi gereken kilit noktaların neler olduğu konusunda sonuçlara ulaşma yolumuzu kolaylaştırmaktadır. Bu aynı zamanda mevcut kadastro sununun geleceğin kadastro sununa giden yolunu da basitleştirir. Bu da bizi bu çalışmanın formülasyonunu bir bütün olarak çizmeye ve özetlemeye ve ardından aynı konu ve aynı kavramla ilgili gelecekte yapılacak diğer çalışma ve araştırmalara önerilerde bulunmaya yöneltmiştir.

## North Macedonian Cadastre Towards Cadastre 2034

### Article Info

### ABSTRACT

#### Article History

Received: 16.11.2022

Accepted: 19.12.2022

Published: 31.12.2022

#### Keywords:

Cadastre,  
Cadastral System,  
Cadastre 2014,  
Cadastre 2034,  
North Macedonia.

The main aim of this study is the definition of the actual cadastre and cadastral system of the Republic of North Macedonia, and through this definition, the main concern in this study is the presentation of the North Macedonian cadastre in the framework of the Cadastre 2034. The path towards the Cadastre 2034 concept is directed and formulated by the Cadastre 2014 concept, along with its framework tasks and responsibilities, and due to this, a review of this has also been carried out. As a case study, it was chosen to be the cadastral municipality of Shemshovo, which is part of the district of the city of Tetovo, extending to the region of Pollog, North Macedonia. The identification and clarification of the challenges, problems and obstacles that the current cadastre of North Macedonia face in our time, simplifies our way towards obtaining the results of what needs to be done and what are the key points that the North Macedonian cadastre must follow in order to be within the framework of the Cadastre 2034. This also simplifies the path of the actual cadastre towards the cadastre of the future. This lead us to draw and summarize the formulation of this study as a whole, and following later, to give recommendations for other studies and researches that will take place in the future, related to the same topic and the same concept.

**Atıf/Citation:** Jonuzi, E.; Durduran, SS.; Alkan, T. (2022). North Macedonian Cadastre Towards Cadastre 2034, *Necmettin Erbakan University Journal of Science and Engineering*, 4(2), 26-44.



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## INTRODUCTION

The creation and development of robust cadastral systems, as well as their maintenance, affect the development and progress of society. It also affects the development of individual professionals and professions in different fields. Simultaneously, it plays a decisive and very important role in the progress and maintenance of the development of economic, social, political, cultural, civic and national processes. Undoubtedly, because of technical development, technological development and digitization, many changes are observed in different sectors and fields. The same developments are inevitable in the cadastral sector and cadastral works. These results and leads in the tendency to reform, develop and improve cadastral systems and cadastre in general and in particular. The result of this is the creation of new automated and digital infrastructures that seem to be much more vital. The same developments are foreseen and planned by analyzing the general demands and needs. Subsequently, this enables the creation of a strategy, which provides facilities for access, information retrieval, use, and other diverse requests. Created strategies, depending on the purpose, can be short-term strategies and long-term strategies. The same helps the realization of stated goals and enables predictions, forecasts, and preliminary plans to reach the desired objectives, goals, and targets.

Cadastre 2014 incorporates data, information and recommendations on the long-term status of the future of the cadastral system frameworks within the globe, present reform projects, trends and patterns related to the cadastre, and what ought to be done to create this part more viable and more effective [1]. The cadastral frameworks of the future may only support to the extension of the field of ownership by being a framework or a system that ensures or assurance this ownership [2]. The focus of Cadastre 2034 is shaping the future cadastre or the vision of the future, by continuing and proceeding with the enhancement suit and method as advanced in Cadastre 2014, and as an outcome of these demands, six standards, principles, or six fundamental pillars for Cadastre 2034 have been decided and situated [3,4]. The main aim of Cadastre 2034 is to shape the cadastre of the future by continuing the reform process as developed in Cadastre 2014 [5], and Statements of Cadastre 2014, announced by FIG [6]. Focus is given to their applicability in current contexts [3]. To remain relevant cadastral science must continue to look to the future: potential challenges and opportunities need identification, analysis and response [3]. In arranging the Cadastre 2034 guidelines, each standard, principle, or pillar is determined or decided to be the outcome of the internal and external environment analysis. Such, it is vital to show lawfully substantial, quick, precise, and definitive cadastral data information, which enacts a key part in the assembly of financial, property, tax assessment, spatial arranging, and land-land arrangement in the utterance of social needs and requests [7]. Cadastres must continue to change to meet the challenges of poverty, environmental protection, good governance and economic stability [3]. Subsequently, harmonized cadastral data information from diverse sources ought to be shared among numerous users, clients, and applications [7].

This study is organized into six sections. Within these sections, the Introduction part is prepared to be presented as a first section; enabling a general background and the main objective of this study or this paper. The purpose or the main objective of this study is to provide a general framework regarding the cadastre, and its development in the Republic of North Macedonia, its reflection in modern future times, especially within the vision of the Cadastre 2034, as well as the goals and objectives of the Cadastre 2034, following the strategies and recommendations of the same, to be part of the positive developments in the future, perhaps necessarily inevitable. The study aims to identify, present and make a general introduction of the predictions of Cadastre 2034, in cadastral works, in general and in particular, and the development of cadastre as a sector, thus is offered as a novelty or an innovation, not only in our country, but also at the same time for other developed and developing countries. The remaining part is organized as follows; after the introduction part, we develop the Problem Context, which contains part of the Cadastre 2014, Cadastre 2034 and North Macedonian Cadastre. Following is the Setting the scene section, where we are going to represent motivation and basic principles, scope and goals, strategies and problems, materials and methods, research questions and research design. The case study is the fourth section. In this part is presented the case of the study, namely

the Pollog region, the cadastral municipality of Shemshovo, city of Tetovo, and attached is displayed the investigation and occasion scrutiny. This study region was chosen because in this region or territory there are measurements carried out since the first geodetic and engineering measurements which date back to the very early days in the Republic of North Macedonia. These measurements are very important and represent high quality at the same time. Forecasting the future – 2034, is the fifth section. What should be emphasized in this part, is a general presentation about cadastral challenges, problems and obstacles in North Macedonia. Making a concept about the road of the cadastre of North Macedonia towards the cadastre 2034, leads and prepares us of what we must do and what must be done to be within the framework and on the road of the Cadastre 2034 concept. Yet, as the six section or as a final part of this work at the same time is the conclusion section, where we are going to summarise our work and conclude it. Also, it is worth noting that within this section, we also are going to make some recommendations and suggestions for future studies and future works.

## **PROBLEM CONTEXT**

### **Cadastre 2014**

The viewpoint provided by Cadastre 2014 is still relevant for a contemporary and actual modern cadastre. However, in addition to this perspective, it is also important to take into account the social and technological trends that will impact land management over the next 20 years [8]. Within the framework of Cadastre 2014, it is intended to ensure the legal security of all land rights, restrictions and responsibilities as well as their legal recognition [9,10]. The ideas of combining cadastral maps and records, aside from these objectives, cadastral modeling, cadastral modeling using information technology, empowering the participation of open and private division within the cadastral considers and conducting the cadastral applications as cost-recovery were decided within the Cadastre 2014 and after these principles and standards were distributed in 1998, they were interpreted in numerous different languages and they were utilizing as models for nations [1,8,10-12]. Undoubtedly, as in all other countries, also in the Republic of North Macedonia, the Cadastre 2014 has had a very important and almost irreplaceable impact. Cadastre 2014, or more precisely its principles, also known as the Statements (Statement 1, which quotes: “Cadastre 2014 will show the complete legal situation of land, including public rights and restrictions!”; Statement 2, which quotes: “The separation between ‘maps’ and ‘registers’ will be abolished!”; Statement 3, which quotes: “The Cadastral mapping will be dead! Long live modelling!”; Statement 4, which quotes: “‘Paper and pencil – cadastre’ will have gone!”; Statement 5, which quotes: “Cadastre 2014 will be highly privatized! Public and private sector are working closely together!”; and Statement 6, which quotes: “Cadastre 2014 will be cost recovering!”) of the Cadastre 2014, have been a guide for the development of a cadastral system like the cadastral system of North Macedonia and the cadastre itself [13]. It is clear that in the Republic of North Macedonia, the Cadastre 2014 vision process has not been completed and has not been fully implemented. There is still work to be done and realized, but nevertheless, it can be concluded without a doubt that a great and important work has been done so far. The performance of the Republic of North Macedonia, in the framework of the Cadastre 2014, can be concluded to be relatively high and on the right track.

### **Cadastre 2034**

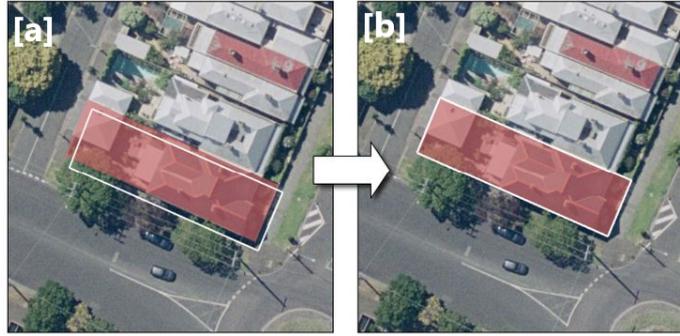
Indeed, according to Steudler, in numerous cases, such as the issues in measure accuracy, the land object or the data layers are managed and dealt within the field of Cadastre 2014, the request of land and land usage utilization is expanded, in confront of a few worldwide issues, such as the population increase, climate changes, food and nutrition and the notions or ideas emphasized with Cadastre 2014 are required to be respected more comprehensively form and way with "Cadastre 2034". According to the national strategy of cadastral reforms and innovations of Australia, and based to the concept and vision of Cadastre 2034, the cadastre of the future predicts that the actual cadastral system we recognize nowadays will not accomplish

community prospects in the forthcoming; we can yet see a gap rising among what we have in actuality and what will be needed and wanted in the future. Within the framework of Cadastre 2034 and its vision for the future, apart from the aim of providing all the basic conditions and services as in the current cadastre, it is also claimed and assumed to guide the policies, patterns and norms of the future [3,8,14-17].

### *Pillars of Cadastre 2034*

Based on the framework of the Cadastre 2034, we can clearly state that within this framework or this vision of the cadastre of the future, six fundamental pillars, or six main points are based on the concept and vision of the Cadastre 2034 itself, and they are as follows:

**1. Survey-accuracy based cadastre** – This predicts and presupposes that the boundaries of the land will be measured and determined with very high accuracy and precision. Also, attached, it is understood that the real boundaries will be in full compliance with the cadastral plans and their content. The reduction of errors is claimed to be in the maximum form (Figure 1).



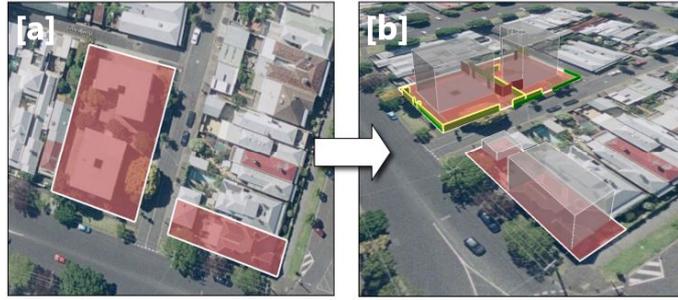
**Figure 1.** *Cadastrs will be survey accurate: virtual representations must match reality [3]; (a) actual cadastre, (b) cadastre of the future or Cadastre 2034.*

**2. Object-oriented based cadastre** – This envisages, presupposes, and implies the redefinition and reformulation of all legal rights, restrictions, and responsibilities (RRR) over land use. Object-Based Cadastre will permit people to readily and confidently identify the location and extent of all RRRs associated to land and real property. Land parcels are properly determined in the essential cadastre, but with the new vision will be required new ways of modelling and presentation of the information. Parcels will continue to be a significant people-land organization instrument; however, many new interests display vastly further spatial footprints [3] (Figure 2).



**Figure 2.** *Not all property interests fit comfortably in the parcel framework: object-oriented design is required [3]; (a) actual cadastre, (b) cadastre of the future or Cadastre 2034.*

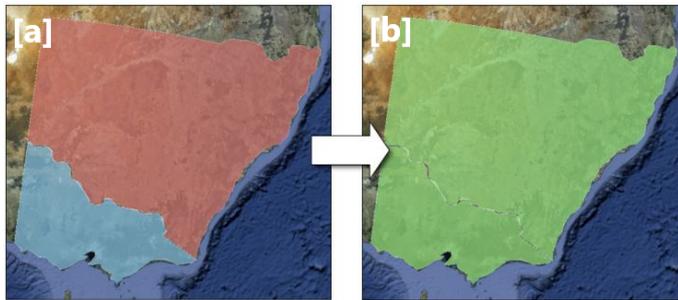
**3. 3D and 4D (+Time) based cadastre** – The inclusion of height in the cadastral frames will be indisputable and an essential part of the cadastral vision. In this form, new dimensions will be opened in relation to modeling, visualization, management, integration and analysis on the property. The novelty is assumed to be the time dimension, i.e. 4D or otherwise 3D + Time. Thanks to these advances, it is claimed to minimize and dramatically reduce almost all administrative misunderstandings regarding property interests [3] (Figure 3).



**Figure 3.** 2D approaches do not enable the complete legal situation on land to be easily understood: 3D and 4D cadastral systems will mitigate administrative friction and improve decision-making [3]; (a) actual cadastre, (b) cadastre of the future or Cadastre 2034.

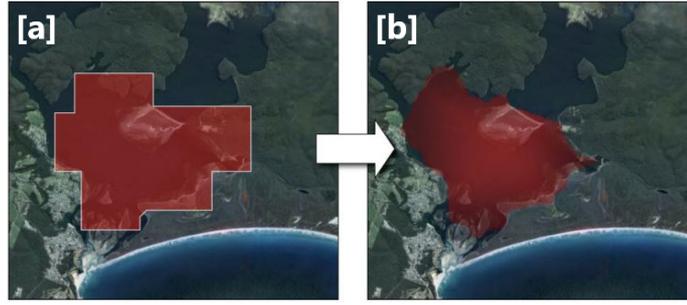
4. **Real-Time based cadastre** – The cadastral systems of the future will be up-to-date and will have full access in real time, which will enable access to information and retrieval of the desired information without any delay. In current cadastral systems, such processes and procedures are long and time-consuming. In future cadastral systems, the same processes and procedures will be able to be updated in real time, from the field. Shortly, robust checking processes and such developments will strongly enable the straightforwardness of the cadastre [3].

5. **Regional/Global based cadastre** – The cadastral systems of the future will have the opportunity, capacity and development to connect and interact in the sense of the regional cadastre and the global cadastre. Such an interaction between the regional cadastre and the global cadastre will enable the global management system on them, in terms of the land market and environmental management, where environmental issues and inconvenience are often spread over multiple jurisdictions [3,18] (Figure 4).



**Figure 4.** Cadastral systems will become interoperable allowing management of economic and environmental concerns at regional and international level [3]; (a) actual cadastre, (b) cadastre of the future or Cadastre 2034.

6. **Natural or Organic based Cadastre** – The cadastral systems of the future will be integrated in that form to enable better modeling of the natural-organic living environment. Moreover, legal controls protecting flora and fauna or the land interests of indigenous communities (such as those found in developing countries) are often vague and require new tools for representation and management [19] (Figure 5).



**Figure 5.** Future cadastres will better model the organic natural environment [3]; (a) actual cadastre, (b) cadastre of the future or Cadastre 2034.

### ***Enduring Principles of Cadastre 2034***

According to the national strategy of cadastral reforms and innovations of Australia, and based on the concept and vision of the cadastre of the future, there are fundamental principles that must be incorporated into future innovations to ensure that cadastral systems remain secure, accessible, transparent and efficient over time. These enduring principles will continue to be an integral part of the design of environments in which cadastral systems are managed. The enduring principles are:

- Certainty in the spatial extent of ownership.
- Uniquely defined land (and/or property) that is common to all registers – ownership, valuation, land use.
- Integrity and security of the parcel boundary system.
- A strong relationship between regulators and the industry.
- Appropriate regulatory standards.

### ***Purpose of Cadastre 2034***

According to the national strategy of cadastral reforms and innovations of Australia, and based to the concept and vision of the cadastre of the future, the purpose or the main objective of Cadastre 2034 is to provide a clear vision for what the community might anticipate and what the government must provide in the future. In order to provide a coordinated and uniform approach to preparing future policies, laws, standards, models, and research, Cadastre 2034 is meant to direct the growth of jurisdictional systems. Cadastre 2034 addresses these shifts and the difficulties they entail. It persists the trek and road to connect cadastral data and inquiry with wider social and legal interests on land and builds on the accomplishments of Cadastre 2014, which heralded the establishment of digital cadastres [10, 20].

### ***Objectives of Cadastre 2034***

According to the national strategy of cadastral reforms and innovations of Australia, and based to the concept and vision of the cadastre of the future, Cadastre 2034 takes into account user scenarios that will result in shifting requirements in the future and identifies areas where actual and present inquiry falls short of consumer anticipations today. The goal is to document the trends and present an idea of what our cadastral system will be needed for in the future by the community. The objectives of Cadastre 2034 are to:

- Constitute and determine an ordinary and normal vision for all jurisdictions, industries, and academia.
- Lay aside enduring principles to maintain the vital ingredients of the cadastral system over time.
- Extend and put the goals necessary to catch a consistent and coordinated treatment to the conversion or reduction of the cadastral infrastructure over the next 20 years.

- Identify the necessary essential outcomes that will guide the governance, policy development, standards, research programs and the design of future systems.
- Suggest operations and innovations that will direct the accomplishment of the vision.

### ***Vision of Cadastre 2034***

According to the national strategy of cadastral reforms and innovations of Australia, and based to the concept and vision of the cadastre of the future, Cadastre 2034 vision is: A cadastral system that ensures individuals quickly and safely determine the place, position, and scope of all rights, restrictions, and responsibilities associated with real property and land. The cadastral arrangement representing things to come is imagined as similar to an exceptionally powerful piece of the upcoming choice of emotionally supportive networks; directing the management, development, and investment of real estate and land.

### ***Mission of Cadastre 2034***

According to the national strategy of cadastral reforms and innovations of Australia, and based to the concept and vision of the cadastre of the future, Cadastre 2034 mission is: To encourage and encourage innovation, as well as ensure the management, coordination, and standards required to create a unified cadastral system that can be used to find long-term answers to meet new opportunities and requirements. One aspect of the journey is planning for the future. Taking ownership of the plan and leading outright all aspects, from strategic actions to clever innovations, to create a cadastral system that we can keep and proceed to be proud of in the future is the most important aspect. The defiance will be to lead the convergence of user expectations for integrated social, economic, and land-related systems, as well as increase opportunities, and the disruption caused by one technology's phasing out and the beginning of another.

### ***Goals of Cadastre 2034***

According to the national strategy of cadastral reforms and innovations of Australia, and based to the concept and vision of the cadastre of the future, the hankering targets presume how the future cadastral system will be designed, organized, accessed, operated, and make used; doing so in a way that takes into account not only how it affects the environment right now but also how we create, use, and preserve cadastral information resources for the future. Cadastre 2034 has five goals. They aim is to reach and overtake a cadastral system that:

- is essential and primary to land and property ownership, and to be guided in a sustainable manner
- is truly approachable and available, easily visualized, and perusal understood and exhausted
- is completely merged and joined with broader legal and social interests in land
- ensures a digital submission and reflection of the real world that is survey accurate, 3- dimensional and dynamic, and
- is a federated cadastral system based on ordinary and normal standards (Figure 6).

### **North Macedonian Cadastre**

Establishing the Cadastre is extremely important, same as developed countries as well as developing ones [22]. It presents perhaps a vital, crucial and irreplaceable need for which a genuine work strategy must be created, in planning, and creating the same.

### ***Legal aspect***

According to Agency for Real Estate Cadastre (AREC), as in other countries, as well as in the Republic of North Macedonia, there are numerous laws, legal regulations, acts, orders, directives and resembling other

legal circulars which have helped and played a decisive role in the creation of the cadastre and its formulation as a sector. The first geodetic works in the Republic of North Macedonia began in 1928 [23]; with the first law formulated at that time, by the government, namely the land cadastre law - 1928. The same period, namely the years 1928-1945, is known as the period where the initial cadastral survey was also carried out [23]. Following the first law, as a result, we have several laws created and formulated by the governments of the time, amendments to the laws that were made in certain periods, and that for the sole purpose of regulating the powers of this institution and completing them. The Geodetic Authority of the People's Republic of Macedonia, as named at that time, was established on 14 July 1947 [24]. In the ambition to formulate the legal aspect in a more complete and perfect form, 8 principles have also been created, on which the cadastral system of the Republic of North Macedonia is based. The same principles are laid out in the law on the real estate cadastre.

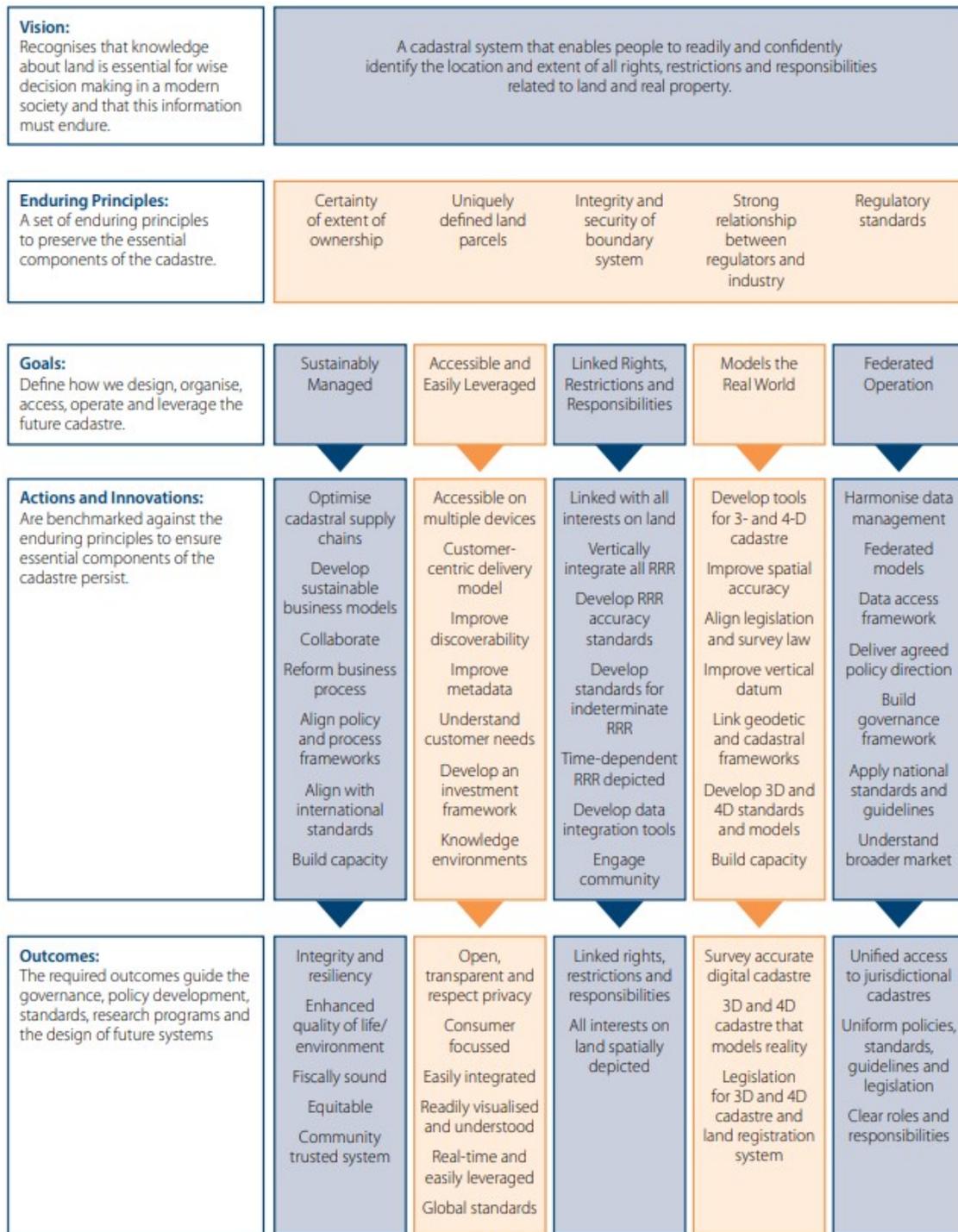
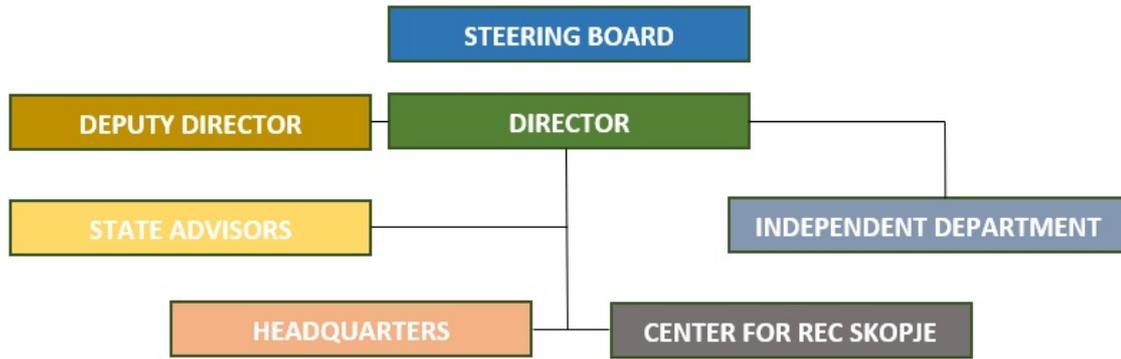


Figure 6. Framework of Cadastre 2034 [21].

**Institutional aspect**

According to AREC, Agency carries out all the cadastral works in the Republic of North Macedonia. This institution dates back to 1947 and its structure was determined in 1986 by the Law on Survey, Cadastre and Real Estate Rights Registration. AREC has a modern and strong organizational structure and execution. It is managed by a Steering Board, comprised of five members. The director is the leader appointed to lead the AREC, and he has his deputy (Figure 7).



**Figure 7.** The organizational structure of AREC (according to AREC).

### *Technical aspect*

From a time perspective and in the historical aspect, it can be said that since the first works or the first geodetic measurements carried out in the period 1928-1945, in the Republic of North Macedonia, until the present day, many works have been carried out, and many projects have been realized, which have helped the completion and formulation of the technical process of the cadastre in our country. However, we cannot conclude that all works, projects and plans anticipated in advance have been carried out in general and without omission. Some of them have not been fully realized and have not been completed based on the frameworks foreseen. Some of these continue to be in the process of development and work; however, it can undoubtedly be said that a very important basic and fundamental work has been done. Of course, both in the near future and in the distant future, many further works and developments are planned, which will help even more in the development and expansion of the same sector.

## SETTING THE SCENE

### Motivation

Based on preliminary research and analysis, based on observations, lack and demand, together we conclude that a study and a work of this type, is necessary and adequate for the Republic of North Macedonia as a state, more specifically for the Cadastre of the Republic of North Macedonia as a sector in particular. To be in the context of our work and for the same work to be more concise and complete, we have based it on some basic principles as well:

- *Striving for efficiency*
- *Prioritizing effectivity*
- *Encouraging Compatibility*
- *Emphasizing Satisfaction*

### Scope

The basic purpose of this study is:

*“The presentation of the Republic of North Macedonia, namely the Cadastre of the Republic of North Macedonia, in the vision, path and within the framework of the cadastre 2034”.*

To achieve and fulfill the goal, our study and our work is based on three goals, namely:

- **Goal 1:** *To identify, analyze, define and classify the concept of Cadastre 2034.*
- **Goal 2:** *To identify, analyze, define and classify the main challenges, problems, and obstacles that*

*occur on the path of North Macedonia toward Cadastre 2034*

- **Goal 3:** *To identify, analyze, define and classify the impact of Cadastre 2034 over the North Macedonian Cadastre to be in line with the cadastre of the future.*

### **Strategy**

The creation of the work strategy is the seed of work and the final fruit. We have drawn up and designed a work strategy about what will be done, how are we going to do it, and what will be achieved as a result by doing it. To reach the objectives of the research, following work strategies, we need to address and access the following problems:

- *Recognition, the description, summary and statement of study context*
- *Elaboration of the Cadastre 2014 and North Macedonian Cadastre*
- *The presentation of the Cadastre 2034 and the path of the North Macedonian cadastre towards it*
- *Identification of Challenges, Problems and Obstacles on the way to Cadastre 2034.*

### **MATERIALS AND METHODS**

**Material** – It is important to note that for this study or for this work there are original and official data, were provided by relevant institutions, such as AREC and its regional units.

**Methods** – As research methods that will be used to achieve the goal of the research we have listed the following:

- *Literature review,*
- *The collection of data; data analysis and data processing, and*
- *Creating a vision and idea for the cadastre of the future, with emphasis on the study over the Republic of North Macedonia*

### **Research questions**

We have listed the study questions that will help us reach our goals and requests in the best way possible:

- *What are the current challenges, problems and obstacles of the cadastre of North Macedonia in the present time?*
- *What is the road through which North Macedonia and its cadastre should go to be on the right track of the cadastre of the future*
- *What are the requirements and what must be done to be part of the Cadastre 2034 and to create and formulate the cadastre of the future?*

### **Research design**

Attached will be presented the design of our study, namely the research and work we have done in this article. We have prepared and presented the same in the visual form of the figure format (Figure 8).

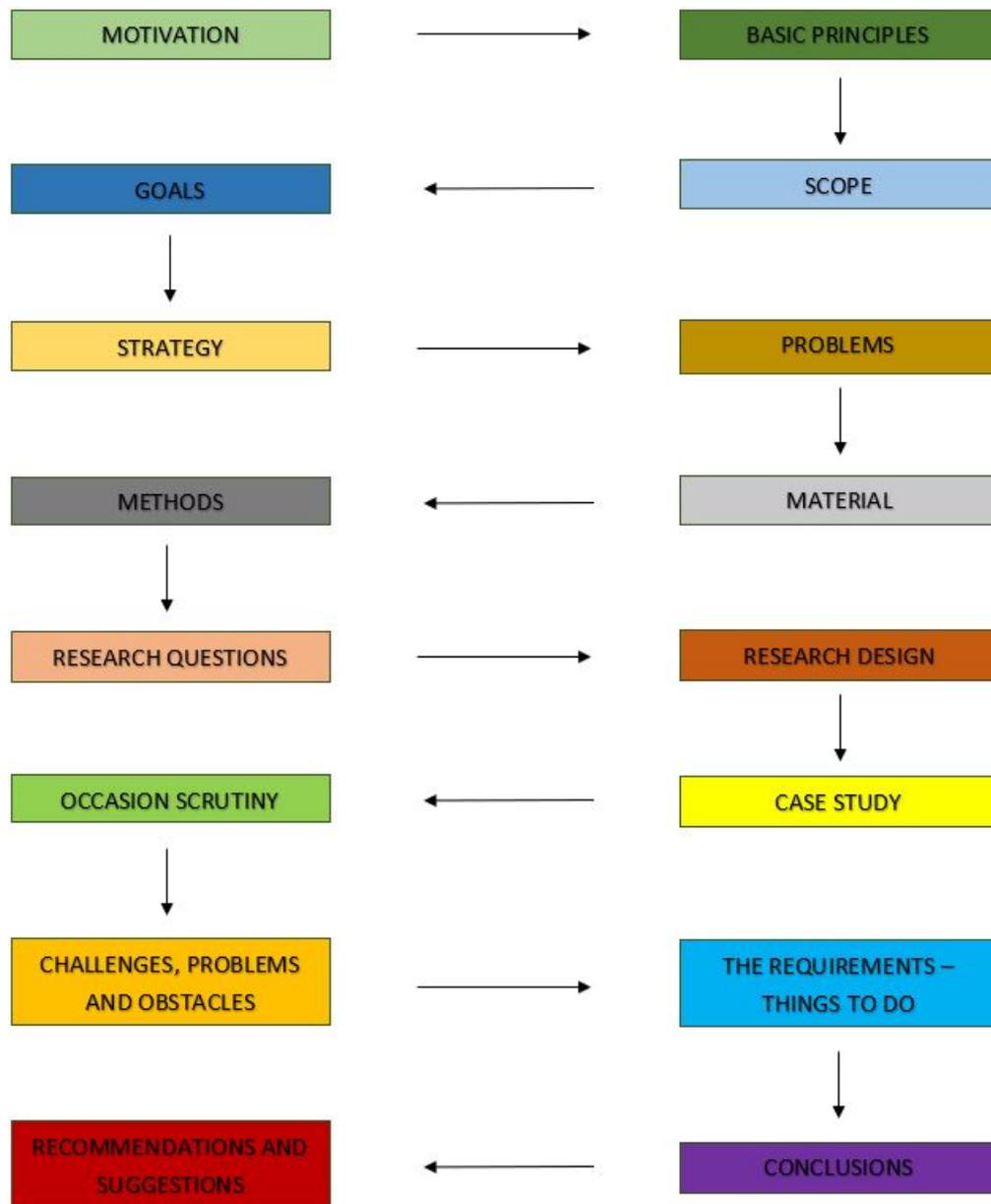


Figure 8. Research design.

### CASE STUDY

Our study takes place in the cadastral municipality of Shemshovo, which is a settlement in the north-western part of the country, more precisely in the city of Tetovo, the region of Pollog, in the Republic of North Macedonia. The Republic of North Macedonia lies on the Balkan peninsula, the continent of Europe (Figure 9).



**Figure 9.** Study Area: Polog region – Shemshovo, Tetovo, North Macedonia [25] (internet source: VectorStock)

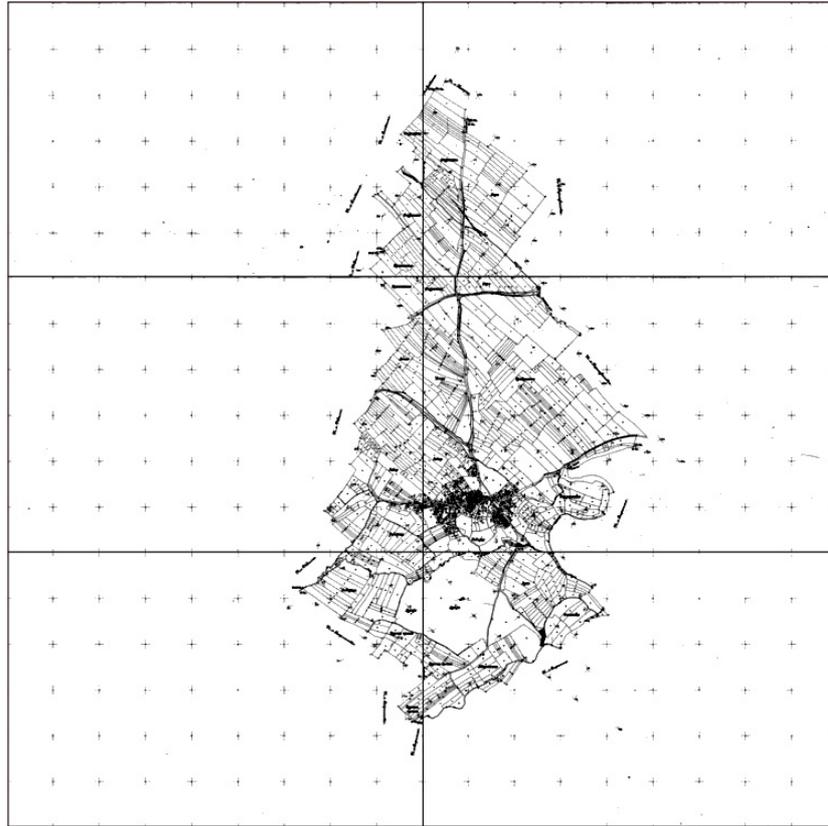
### Investigation and Occasion Scrutiny

The data of the raster cadastral plan and the vector cadastral plan, for the cadastral municipality of Shemshovo, which will be presented below, were provided by the local office of the AREC, located in the city of Tetovo (Figure 10-11).

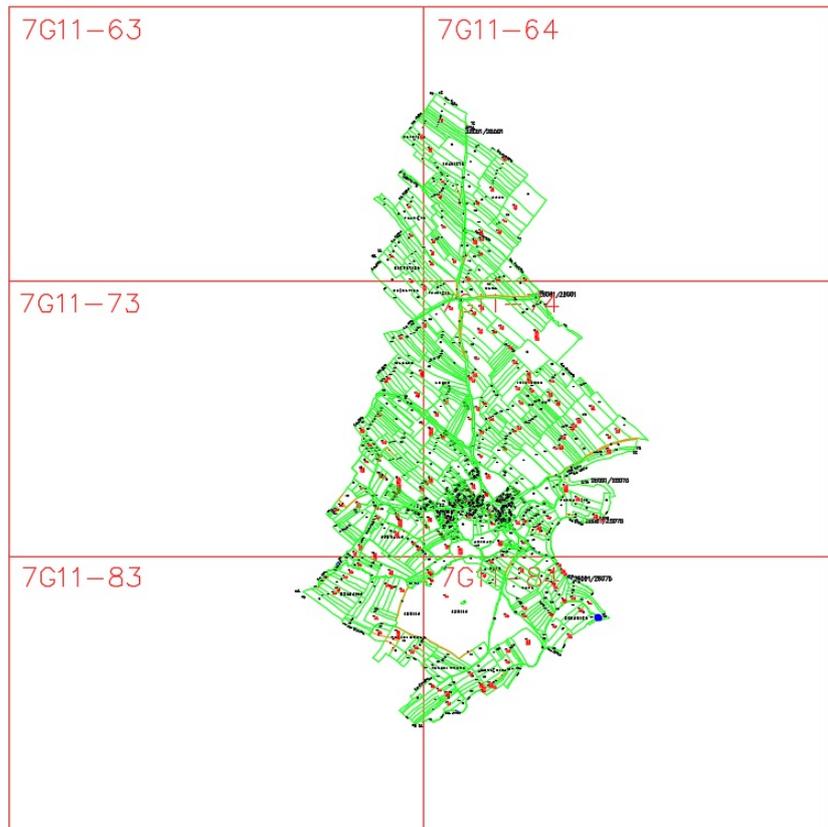
In the process of harmonization and digitization of land data, vectorized boundaries were taken as important and basic. This process was based on vectorized plans. This approach contributed to the mismatch between the boundaries on the cadastral plan and the real boundaries on the ground. This is a result of the fact that the limits are set and regulated respecting and based on tachometric measurements.

The procedure for dividing real estate, i.e., land (parcel), changes/modifies and adjusts its boundaries, creating new cadastral parcels, with a new unique number, as well as modifying the administrative data for the newly created parcels.

It is important to emphasize the fact that until now all borders in the region of Polog have been established and regulated by the original data, namely tachometric measurements. But what is worrying and the question that follows is how the division will continue to be done in the future; taking into account the vectorized limits or the original ones, i.e. from tachometric measurements.



**Figure 10.** Cadastral plan, raster – Pollog region, Shemshovo, Tetovo (original and official data source; powered and facilitated by the local office of AREC).



**Figure 11.** Cadastral plan, vector – Pollog region, Shemshovo, Tetovo (original and official data source; powered and facilitated by the local office of AREC).

## FORECASTING THE FUTURE

### Challenges, problems, and obstacles of North Macedonian Cadastre

As in any other country, also in North Macedonia, there are problems of different types, natures and characteristics. Problems of different types and natures can also be encountered within the cadastre of our country.

We have listed and classified the general problems experienced and identified in the Cadastre of North Macedonia as follows:

- The process of digitalization of cadastral plans. There are marked differences between the original data from the tachometry and the official data of the digitized plans for the boundaries of parcels. In this case, the official data of the digital plans do not appear or even cannot be seen as reliable for limits in relation to the data from tachometric measurements. These differences presented at the borders can raise and in general practice shows that they initiate new conflicts between the parties. Namely, such conflicts can be of the type between parties, between parties with private geodetic offices, and between private geodetic offices and the AREC.
- The Republic of North Macedonia has enabled its citizens several times to register buildings through the legalization process, regulated by law. However, the constructions in the form without permission continue almost as normal, and the state's control over it seems to be dysfunctional. This leads us to the fact that some buildings are not registered in cadastral maps.
- Attention to ground control points is almost zero, despite the fact they present an asset for the cadastre of North Macedonia. Ground control points such as triangulation points, or polygons which are the basis of their cadastral work have not been preserved and most of them have disappeared. The same tradition continues to be repeated even further. Care for them seems to be almost zero.
- The state does not have mechanisms to control the sale and purchase of the real estate. Manipulations with prices and values of real estate are large, and this problem occurs throughout the territory of the state. In this case, the real estate sale prices presented by the citizens do not really reflect real values. This action is recorded as loss and damage for the state because the tax value of the same property does not represent a real value either.
- There are cases when there is a lack of coordination between the real owner of the property, namely the registered owner of the property in the cadastre and the real owner of the property on the ground. This represents uncertainty and instability in general. Such cases are generally encountered in unwritten and uncontracted agreements between owners for the change of properties. As a result of such actions, later the same is faced with the problems of RRR on the same properties.
- Influenced by external factors and conditions, such as economic, political, and other crises (for example, the pandemic crisis or the impact of the war in Ukraine), directly affects the change in market conditions. In these cases, citizens or users show a decrease in interest and this leads to a decrease in requests from the same.
- The lack of creating an efficient and effective standard to regulate the systemization of employees and employment as a process within the AREC institution. This leads to unfavorable results for the institution as a whole and shows in any way, a lack of seriousness in relation to the competencies, responsibilities, and duties of an institution. Such a standard would enable the connection and advancement of new professionals, namely new staff within the institution, thus advancing the professionalism and seriousness of the institution as an organizational whole.

- A serious problem for the AREC institution is the lack of favorable working conditions and facilities. The lack of necessary and appropriate spaces probably makes normal, efficient, and productive work impossible. This problem is mostly encountered in regional units, in different cities within the territory of the North Macedonian state.

### The road of North Macedonian Cadastre towards Cadastre 2034

The path of the North Macedonian cadastre towards the future cadastre, specifically the Cadastre 2034, can be described more easily, based on the so-called basic pillars of the Cadastre 2034. We have chosen to present the same summary and presentation in the form of an introductory and descriptive table, which will be presented below (Table 1).

**Table 1.** *A Summary, Assessment and a General Presentation of the Cadastre of North Macedonia in the Shadow of the Cadastre 2034.*

PILLARS OF CADASTRE 2034	DESCRIPTION
<b>Survey-accuracy based cadastre</b>	<p><b>In the present time</b> – Accuracy used until now, in the current cadastre of our time, can be said and found to have been at a high level, specifically high accuracy ensured in centimetre accuracy.</p> <p><b>In the future</b> – The accuracy that is claimed to be used in the future, that is, in the cadastre of the future, is expected to be of very high accuracy, specifically below the centimetre accuracy.</p>
<b>Object-oriented based cadastre</b>	<p><b>In the present time</b> – The current cadastre can be summarized as a parcel-based cadastre, and the registration of all rights, restrictions and responsibilities (RRR) are based on the ideas and principles of this type.</p> <p><b>In the future</b> – The cadastre of the future is claimed to be a cadastre based on objects and therefore the registration of all rights, restrictions and responsibilities (RRR) will be based on the basis and principles of this type, so that all the needs for this can be met and fulfilled the viewpoint.</p>
<b>3D and 4D (+Time) based cadastre</b>	<p><b>In the present time</b> – In our time, in the current cadastre, the visual presentation is almost always done in 2D format. It can be concluded that the 3D format has been overlooked almost completely.</p> <p><b>In the future</b> – In the future, thus in the cadastre of the future, in addition to the height dimension, i.e. the 3D format, it is also intended to use the time dimension, i.e. the 4D format.</p>
<b>Real Time based cadastre</b>	<p><b>In the present time</b> – In the current cadastre, after measurements or field work are done, they must be processed and updated. This action costs time and allows errors and omissions of various forms to be carried or repeated.</p> <p><b>In the future</b> – The cadastre of the future claims that the data from field measurements will be updated, processed and enabled in real time. So at the same time, it is supposed to have immediate access to the cadastral data.</p>
<b>Regional and Global based cadastre</b>	<p><b>In the present time</b> – Current traditional cadastres are generally regional cadastres. They do not have global access and are not integrated into international networks.</p> <p><b>In the future</b> – The cadastre of the future claims that, in addition to the regional cadastre, it will also enable the creation of the global cadastre. This implies the integration of current traditional cadastres and cadastral systems in a network international and global level.</p>
<b>Natural or Organic based cadastre</b>	<p><b>In the present time</b> – In the framework of the current cadastre, there was no such concept. In this aspect, there has not been a paraphrase of this type. However, with the global changes in the environment, such a thing is foreseen for the cadastre of the future.</p> <p><b>In the future</b> – In the framework of the cadastre of the future, this type of cadastre gives direction and direction for a new field and a new concept. The same, it is claimed to serve and contribute specifically for flora, fauna and marine environments, namely for the modelling of flora, fauna and marine environments.</p>

### **What should be done to be within the framework of Cadastre 2034**

In order to be able to articulate and paraphrase the idea that the cadastre of North Macedonia is on the way to the cadastre of the future, in the shadow and under the framework of the 2034 cadastre, we have summarized some important points, concrete steps and important decisions that North Macedonia, that is, its cadastre should be taken in this direction. We have listed the same as below:

- There are marked differences between the original data from tachometric measurements and the official data for parcel boundaries. The official data from the vectorization process does not appear or even can be seen as reliable for final boundaries, as they do not correspond to real boundaries in the field. Finding a common path helps in the reflection and trust that citizens create on the cadastre and its seriousness in general
- Special care must be taken with the construction of facilities without permission and facilities that are not registered in the real estate cadastre. The same unlicensed and unregistered constructions directly affect the development, the process and the road to the cadastre of the future.
- Despite the fact that the measurement and determination of the boundaries of cadastral parcels are carried out with high accuracy, the same measurements are possible and offered and provided for users and citizens only in 2 dimensional (2D) format. Something like this prevents development and the road to the cadastre of the future. From the same measurements provided by the field, visualization in 3D format should be enabled and offered. In addition to the 3-dimensional (3D) format, the concept of Cadastre 2034 requires the development of the 4-dimensional (4D) format, namely the time parameter. In this direction, a lot of work must be done and a lot of commitment is needed to fulfill such a criterion.
- At the moment when the divisions, adjustments and changes of cadastral parcels are made, the same divisions, adjustments or changes must be uploaded and updated as quickly as possible, so that users and citizens have clearer and more regular access to updated information, changes and adjustments.

### **CONCLUSIONS**

In advance, it is worth noting that there are not many studies regarding the cadastre of the future, specifically for Cadastre 2034. The most detailed and detailed studies of this type can be counted those of countries like Australia and New Zealand. Based on this context, we have tried to paraphrase a concept for the Republic of North Macedonia.

The idea of this paper and the purpose of this study is to present the Macedonian cadastre in the shadow of the cadastre of the future, namely the Cadastre 2034. Consequently, in order to enhance in the field of cadastre, its current and basic structure is analyzed, to choose the ideal course of action for what we should do for the future. Therefore, this study presents and explains a general framework of the current situation of the North Macedonian Cadastre, achievements and tasks are done, challenges, problems, and obstacles with which faces and confronts. Attached, we predicted, evaluated, and created a vision for the cadastre of North Macedonia under the spectrum of the cadastre of the future and the framework of the Cadastre 2034.

Overall, the AREC, has so far carried out and developed works and projects of high importance, which has helped the development of the North Macedonian cadastre as a whole. It can be freely paraphrased that the North Macedonian cadastre has been within the framework of the 2014 cadastre and has been developed in its direction, following its main principles and vision. Amazing work has been done in that direction, but not all responsibilities are finally completed. In order to complete and finish the entire project, there is still work to be done in this direction.

The works that must be started and in a form or in another must be done, in the direction of the cadastre

of the future, also represent a special and great importance in the development of the cadastre of North Macedonia. These are jobs that involve great duties, obligations and responsibilities, in the framework of the cadastre development process towards the cadastre of the future and in terms of strategic and technological planning and design.

It should not be overlooked and should not be forgotten that the development of cadastre and cadastral systems also depends on external factors and indicators and different fields, which directly affect their development process. In this context, the development of cadastre and cadastral systems must be evaluated and formulated in coordination with economic, political, social and other developments. For this, processes such as globalization, urbanization, climate change, other environmental and technological developments along with information systems should also be in focus. Finally, as a result, we can freely and without doubt conclude that North Macedonia is on the right path of development and progress towards the future.

### **Recommendations and Suggestions for future studies and future work**

Based on our study and our aforementioned work, we are able to draw conclusions and create a concept and forecast for the cadastre of the Republic of North Macedonia under the shadow and vision of the cadastre of the future. Undoubtedly, this work will neither be the first nor the last of its kind. We hope that through this work we motivate and inspire others who want to work and do research and studies of this nature. In future studies, the data and information that are presented in our work can be taken as a basis for work and used for new and broader studies and perspectives, to create new innovative models in modern times. The point that we want to emphasize in this final part and what we want to give in the form of recommendation and suggestion is that:

- Based on our work and study in the future studies of the same type can be done, but in a context, location and point of view new.
- Reclassifying, re-evaluating and re-extending the view or model we have addressed in our research.
- Creating a concrete work or study, similar in terms of content and form, with a similar or different location, depends on the choices of the researchers, by using the well-known method of Strength, Weakness, Opportunities, Threats (SWOT) analysis.

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