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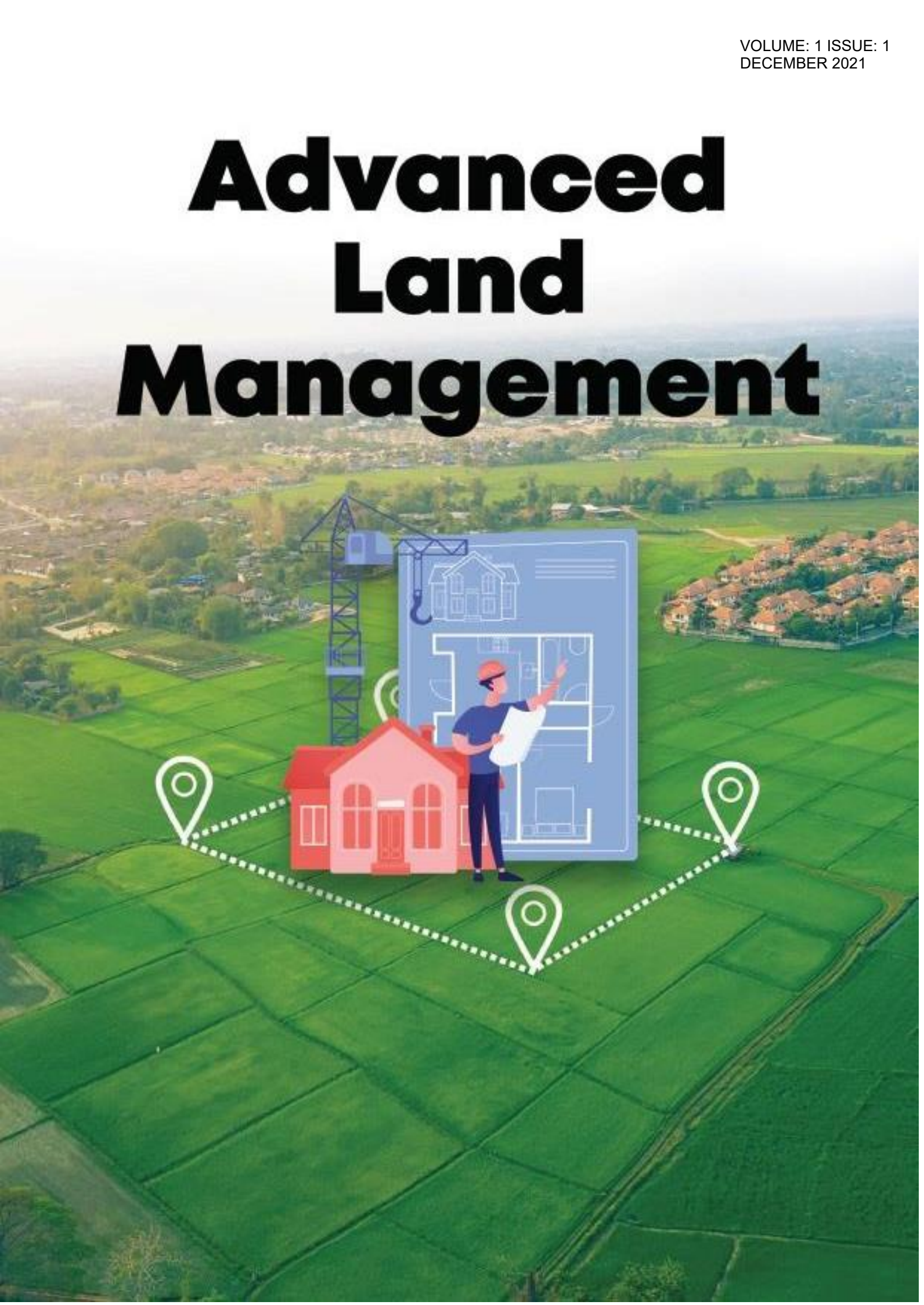

ADVANCED LAND MANAGEMENT

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Content analysis of real estate valuation courses taught in geomatics engineering departments in Turkey

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Abstract

In many applications in economic life, the values of immovable property are needed. Experts must also determine the value of these applications. Experts should also be selected from among people who are trained in the field of Geomatics Engineering, Civil Engineering, City/Regional Planning, Architecture related to the world of real estate. In this study, a detailed study was carried out about the real estate valuation courses taught in the Geomatics Engineering Departments of our universities. The features of these courses, such as Hours, content, mandatory or optional, were examined and content analyses were made. In this context, the importance of determining the content of the course in parallel with current developments in this field and its contribution to the training of appraisers was revealed. In particular, the importance of Geomatics Engineering education in the field of real estate valuation was emphasized.

1. Introduction

The value of real estate is needed in many applications related to the world of real estate. For example, taxation, nationalization, privatization, easements, property, banking, lending, insurance, such as private and public sector applications with the sale, donation, exchange, mortgage, contract to look to death, such as transfer, construction servitude, floor ownership, detached and permanent easement, usufruct right, right of fidelity, right of construction, it must be measured on the basis of such registration transactions immovable in the upper right. Experts must determine the value of these applications. Experts should also be selected from among people who are trained in the field of Geomatics Engineering, Civil Engineering, City/Regional Planning, Architecture related to the world of real estate. In this context, the real estate valuation course taught in the Departments of Geomatics Engineering is of great importance in addressing this need and educating new Real Estate Appraisers.

In general, real estate valuation can be defined as "estimation of the possible value of a real estate, real estate project or rights and benefits related to the real estate on the valuation day based on independent, impartial and objective criteria" [1-3]. An assessment of real estate can be defined as the expression of a real estate partially or completely in terms of quality and quantity [4]. Hire an expert valuation of immovable property; they are people employed full-time by real estate valuation companies who will assess a real estate, real estate project or rights and benefits associated with a real estate.

The functioning of the real estate valuation system in our country is at a low level compared to other countries developed in this area. In most European countries, street-based value maps have been created and value data for all real estate has been transferred to an information system. In our country, similar positional studies can only be carried out by Geomatics Engineers who have received adequate training in this field. For this reason, the importance of the trainings given in the Departments of Geomatics Engineering is increasing.

Basic concepts of valuation, legislation, analysis of data and methods of valuation with theoretical and practical applications constitute the basis of the education of undergraduate students in the field of real estate valuation [5]. The development of the country's economies is only increasing with the participation of real estate in the use of finance as liquidity, and therefore the need for Real Estate Appraisers is also increasing.

2. Method

One of the most important elements necessary to create a sustainable real estate valuation system is real estate appraisers. In the training of a real estate appraiser; current, knowing the needs of the sector, prepared in accordance with international development and standards, the contribution of real estate valuation training is great [6-7]. Today, the education needed in this field is mostly met by the real estate valuation course given in the Departments of Geomatics Engineering [7].

For the first time in Turkey, academic training in the field of valuation was started in 1978 at Yıldız Technical University under the name "Land Valuation". In 1988, the name of the course was changed to "Real Estate Valuation" [8]. Looking at the present day, it is seen that the real estate valuation course is given elective or compulsory in almost all cartographic engineering departments. Theoretical education comes to the fore. In addition, there are differences in the name, content, course time, mandatory or optional courses and semesters in which they are taught (Table 1 and Table 2).

Table 1 is examined; real estate valuation course is given under different names such as real estate valuation, real estate valuation, real estate valuation, GIS and real estate valuation. Although the course name is different, it is 80% similar in terms of content. As a resource, they often use similar resources.

Table 1. Universities where real estate valuation courses are given at undergraduate level

University Name	Course Name*	Course Time*
AKÜ	Application Of Real Estate Valuation	3
Aksaray	Real Estate Valuation with GIS	3
Artvin	Non-Carry Valuation	2
Avrasya	Real Estate Valuation	3
Bülent Ecevit	Real Estate Valuation	3
Cumhuriyet	Real Estate Valuation	3
Gaziosmanpaşa	Real Estate Valuation Applications	3
Gümüşhane	SPL real estate valuation principles	3
Hacettepe	SPL narrow scope Capital Market legislation	3
Harran	Real Estate Valuation Application of Real Estate Valuation	3
İTÜ	Real Estate Valuation	3
KTÜ	Real Estate Valuation	2
Kâtip Çelebi	Real Estate Valuation	2
Kocaeli	Application Of Real Estate Valuation	3
Konya Technical	Real Estate Valuation	3
Korkut Ata	Real Estate Valuation	2
NEÜ	Real Estate Valuation	3
Okan	Real Estate Valuation	3
Ondokuz Mayıs	Real Estate Valuation	3
Onsekiz Mart	Real Estate Valuation	2
Ömer Halisdemir	Real Estate Valuation	2
Mersin	Real estate development and valuation	-
YTÜ	Real Estate Valuation	2
Uşak	Real Estate Valuation	2

** References: Universities' own websites*

Credits, ECTS, compulsory/elective (C/E), theoretical, practical and in which semester they are taught are given in Table 2. Accordingly, it was observed that courses were generally 2 and 3 credits, mostly given theoretically, and that 3 or 4 ECTS were suitable for real estate valuation courses in most universities. On the other hand, given the fact that the course is compulsory/elective, it was determined that half of the universities usually gives this course as an elective course. Examining the semester column in the table, it is seen that the related course is generally taught in 6. or 7. semesters.

Table 2. Course Information

University*	Credit	Theory	Appll.	ECTS	C/E	Semester
Afyon Kocatepe	2	2	1	3	E	6
Aksaray	3	3	0	4	E	8
Artvin Çoruh	3	3	0	4	C	6
Çanakkale 18 Mart	2	2	0	4	C	7
Kayseri Erciyes	3	3	0	3	C	5
Gümüşhane	2	2	0	2	C	7
Şanlıurfa Harran	3	3	0	3	C	5
İzmir Kâtip Çelebi	6	3	0	6	E	6
Karadeniz Teknik	2	2	0	3	C	8
Konya Teknik	2	2	0	3	E	7
Necmettin Erbakan	2	2	0	5	E	5
Niğde Ömer Halisdemir	2	2	0	5	E	8
Samsun Ondokuz Mayıs	3	3	0	4 4	C	7
Osmaniye Korkut Ata	3 2	2	0	4 4	E	6 6
Sivas Cumhuriyet	2	2	0	5 3	E	7
Tokat Gaziosmanpaşa	3	3	0	4 4	E	4
Uşak	2	2	0	4	C	5
Yıldız Teknik	2	2	0	2	C	7
Avrasya	2	2	0	4	E	8
İstanbul Okan	3	3	0	5	C	4
Hacettepe	3	3	0	5	E	6
Zonguldak Bülent Ecevit	3	3	0	4	E	7
İstanbul Teknik	1.5	1	1	2	C	6
Mersin	-	-	-	-	-	-

** References: Universities' own websites*

The percentage values of the grades based on the homework, midterm exam and final exams of the exams conducted in the real estate valuation course are given in Table 3. Accordingly, visa and final exams are held throughout the universities, and the effect of these exams on the success rate is 40% of the visa, 60% of the final. In addition, it is seen that some universities practice in the form of a short exam (homework), except for the midterm exam. The effect of these assignments varies according to the examination regulations of universities.

Information about the content of The Real Estate Valuation course at some universities is summarized in Table 4.

83% similarity was found when examining the content of the course (Figure 1). It can be said that this is due to the fact that the courses are given mainly in theory or practice, and in some departments, there are applications for the content of the SPL valuation expertise exam.

The results of the analysis of real estate valuation courses for the course hours as credit, ECTS, theory and practice according to the sections are given in Figure 2. Accordingly, 12 universities give 2 credits, 9 universities give 3 credits, and 2 universities give with different credits. When we look at ECTS, 2 universities 2 ECTS, 6 universities 3, 9 universities 4 and 5 universities offer courses with different ECTS. When we look at the theoretical course time, 12 universities 2 Course hours, 10 universities 3 Course hours were sufficient, while 1 university considered a different course time appropriate. It has been explained earlier that the number of universities providing practical education is small. Only 2 universities offer practical training (Figure 2).

In the percentage in which semester this course was given, it is compared in Figure 3. 29% of universities give this course in 7 semesters, 24% in 6 semesters, 19% in 4 and 8 semesters, while 9% give this course in 4 semesters.

Courses on real estate valuation are elective in 52% of the Geomatics Engineering departments and compulsory in 48% (Figure 4).

Table 3. Effect of universities on homework, midterm exam, final grade percentile

University*	Homework	Midterm exam	Final
Afyon Kocatepe	%0	%40	%60
Aksaray	%20	%30	%50
Artvin Çoruh	%20	%30	%50
Çanakkale Onsekiz Mart	%0	%40	%60
Kayseri Erciyes	%0	%40	%60
Gümüşhane	%0	%40	%60
Şanlıurfa Harran	%10	%40	%50
İzmir Kâtip Çelebi	%0	%40	%60
Karadeniz Technical	%0	%40	%60
Konya Technical	%20	%40	%40
Necmettin Erbakan	%0	%40	%60
Niğde Ömer Halis Demir	%20	%30	%50
Samsun 19 Mayıs	%0	%40	%60
Osmaniye Korkut Ata	%0	%40	%60
Sivas Cumhuriyet	%0	%40	%60
Tokat Gaziosmanpaşa	%0	%40	%60
Uşak	%0	%40	%60
Yıldız Teknik	%30	%30	%40
Avrasya	%20	%20	%60
İstanbul Okan	%0	%40	%60
Hacettepe	%20	%30	%50
İstanbul Tecnhical	%0	%40	%60
Zonguldak Bülent Ecevit	%0	%40	%60
Mersin	-	-	-

** References: Universities' own websites*

Table 4. General characteristics of Real Estate Valuation courses given in some universities*

University	Course Objectives	Course Content	Learning Outcomes
YTÜ	Basic concepts of real estate valuation, legislation on Real Estate Valuation Analysis of valuation data valuation methods	Taxation, capital market, land regulations and real estate valuation applications for expropriation; valuation data; valuation methods; reporting techniques.	Students know the basic concepts related to real estate valuation. Students use methods related to real estate valuation. Students evaluate real estate for public and private sector requirements using appropriate data and methods.
BEÜ	Teaching students the methods of urban transformation, expropriation, zoning practices and assessment of land for credit purposes and in rural areas, ensuring that they have an idea on this issue, ensuring that they have an idea on the production of GIS-based valuation maps for valuation.	Concepts of value and immovable value. Assessment of urban and rural real estate. Parameters affecting evaluation and their relationships. Real estate legislation and assessment of real estate in terms of expropriation. Methods of evaluating real estate. Statistical analysis on a survey basis for the assessment of real estate. Generating valuation maps	Have knowledge about the concepts of Real Estate, Property and value, understand the importance of real estate valuation in Land Management, learn valuation methods, compare, learn valuation elements in expropriation legislation, learn expert functions and edit Real Estate Valuation Report, produce real estate value maps in 2 and 3 dimensions.
KTÜ	Providing students with an idea of land assessment methods using GIS for land valuation and producing valuation maps.	It will be able to learn the concepts of Real Estate, Property and value, understand the importance of real estate valuation in Land Management.	It will be able to learn methods of real estate valuation, elements of valuation in expropriation legislation. It will be able to learn the functions of an expert, organize an expert report, calculate the value of real estate. It will be able to calculate the real estate value according to the Nominal method, produce a 2-and 3-dimensional real estate value map.

** References: Universities' own websites*

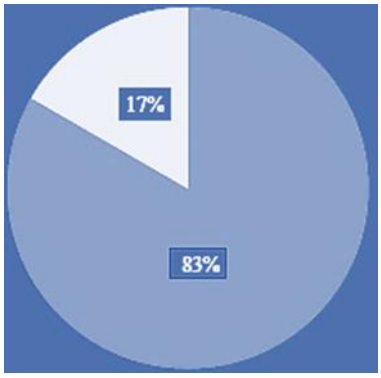

Figure 1. Similarity rate of course content

Figure 2. Course hours as credits, ECTS, theory and practice

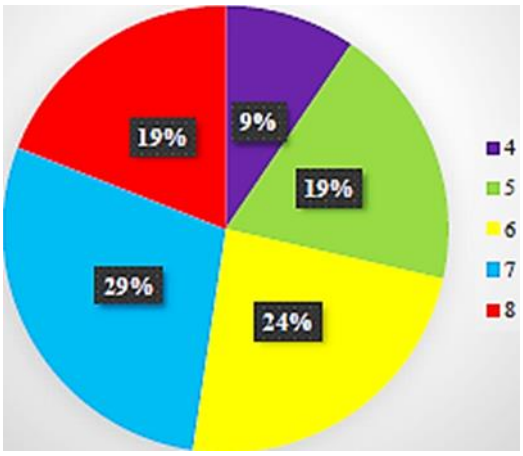

Figure 3. Information about the semester in which the courses are taught

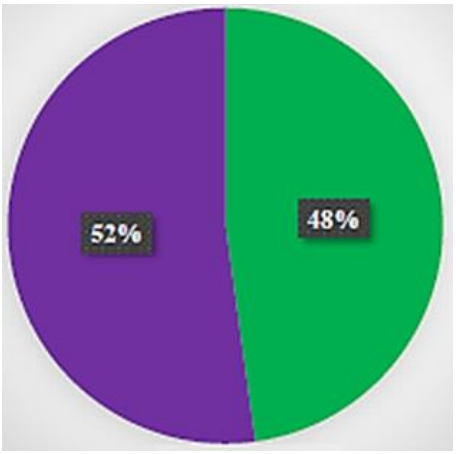

Figure 4. Compulsory or elective courses

3. Conclusion and Recommendations

- In this study, the course content of real estate valuation course in geomatics engineering departments was examined in ECTS, credit, semester, theoretical, practical, compulsory and elective aspects. The study found that the course content of universities was close to each other. It is seen that the real estate valuation course is given in general in the geomatics engineering departments.
- Many elements of this profession, which require professional experience and expertise, try to eliminate their shortcomings through trial and error, which damages the reputation of the profession. For this reason, education needs to be institutionalized. It is not enough for some of our universities to include undergraduate and graduate level valuations.
- Considering the importance of the valuation profession on behalf of our country in social and economic terms, CMB, BRSA, TDUB and other related institutions and organizations should conduct studies to open this department at universities or to provide courses on valuation in departments related to Real Estate.
- The research showed that universities mostly teach real estate valuation courses in 6 and 7 semesters. This indicates that universities believe that it would be more useful for undergraduate students to have basic professional literature in this field in advance before giving this course.
- Important in the profession is the work done in the field. A person can succeed in the exams by working on modules in the CMB licensing exams, even if they have not received training in valuation expertise. This should

not mean that the person has the ability to become an appraiser. SEC licensing exams should be questions about the problems that people experience in the field. In addition, an examination system should be introduced in which the experience periods of appraisers can be measured.

- SPK, real estate (real estate) not related to the world (nursing, Public Administration, international relations... etc.) 4-year university graduates should not open the doors of this profession, should prevent them from applying for exams.
- Today, the issue of real estate valuation has become even more important with the developing country's economy. Universities should take this into account in the education they will give at the undergraduate level.
- Given the lack of experts in the field of real estate valuation, it can be said that universities should update their course content and put practical education at the forefront, as well as the theoretical part. Because only theoretical courses are offered in all but 2 universities.
- In order to conduct practical training, existing lesson hours should be increased, real-life sample applications should be made, and current resources in this field should be included.

Acknowledgement

This article is an extended version of the same name presented at the 2nd Intercontinental Geoinformation Days (IGD) – 5-6 May 2021 – Mersin, Turkey event [9].

Conflicts of interest

The authors declare no conflicts of interest.

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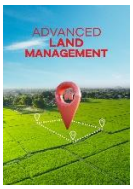

A study on smart urbanization research in Mersin Metropolitan Municipality

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Abstract

As a result of globalization, increasing urban populations bring with big problems. Due to population growth in cities, different problems are observed in many areas such as education, infrastructure, transportation, environment, health, energy and security and city municipalities are encouraged to use the latest technology in the world to overcome these problems. The concept of "smart cities", which was emerged in this context, directed municipalities to projects that facilitate city life easier. In this context, the aim of the study is to examine the smart city applications within the scope of Mersin Metropolitan Municipality projects. Firstly, the concept of smart city, national and international literature review on this subject and the applications related to smart city in Mersin were discussed. As a result, it is seen that the necessity and importance of smart city applications are increasing.

1. Introduction

Today, human beings live intertwined with technology [1]. As a result of globalization, technology is used in all areas of human life and provides great convenience to people. Advances in technology are rapidly changing urban life and causing transformations [2-3]. Today, cities face many problems as a result of increasing population, from infrastructure, transportation, traffic, air and water pollution, unplanned urbanization. In order to overcome these problems, the city administration seeks various quests and it is aimed to overcome these problems by creating different perspectives. Since the 1990s, city administrations have adopted human-oriented approaches and strategies in order to cope with the problems in cities both in the world and in Turkey [4-5]. The concept of 'smart city' that emerged in this context has become a popular approach to increase the quality of human life. Therefore, projects related to smart city applications have increased and become widespread [6].

In this context, the main purpose of this study is to evaluate the smart city applications of Mersin Metropolitan Municipality by examining the factors that are effective in the concept of smart city within the framework of technological development. This study aims to contribute to existing research in various ways. Firstly, it is to draw attention to the smart city policies and strategies of the city administrations by highlighting the smart city applications of the Mersin Metropolitan administration. Secondly, this paper is to compile the national and international literature on smart city applications.

This paper is organized as follows. In chapter two, the concept of smart city is explained conceptually and the relationship between these smart city elements and technological developments is examined. In the third chapter, the most up-to-date national and international scientific and academic studies on smart cities are presented. In the fourth chapter, information is given about the projects that Mersin Metropolitan Municipality has implemented and planned within the scope of smart city. Conclusions and policy recommendations are given in the fifth section.

2. The smart city concept: General elements and technologies

The city is a residential area that emerged with the necessity of people living together. In recent years, it has been one of the driving forces of the growth of cities with population densities. The city, as the place where knowledge is produced, is known as a key region for development. The concept of smart city, which stands out as a remarkable potential in solving urban problems in a rational way, is expressed as learning ability, technological development, new discoveries in information processing, information transfer and technology tools making city life easier. According to another definition, the smart city concept; It can also be defined as a smart combination of donations and activities of independent and conscious citizens in a future-oriented manner in their perceptions of economy, governance, people, mobility, environment and life. The concepts that come to the fore in the definitions of smart cities in the literature are as follows [7].

Resources are used more effectively and smartly,
- Priority is given to cost and energy saving practices,
- Having a high quality of life,
- Less environmental pollution,
- Low carbon emission,
- Public participation rate in decisions about the city

Smart cities are defined as smart environments with embedded information and communication technologies that create interactive spaces that enable virtual applications to be integrated into the physical world [8]. In addition, in recent years, the smart city and the ecological city union have begun to be mentioned together. In addition to these, smart cities; It is the concept of dealing with the biggest problems in our society such as transportation, pollution, sustainability, safety, health and business and overpopulation. Considered smart, these smart cities are built on an intelligent combination of citizens' assets and activities; They are cities with a positive outlook on the future economy, people, governance, mobility, environment and life [9].

In order to reach the smart city position, it is not enough for city governments to use only the latest technology, there are some basic elements for a city to be smart. In general, these elements in the literature; smart economy, effective mobility, smart environment, smart society, smart life and smart governance. Smart city elements are shown in more detail in Table 1 [10].

Table 1. Smart City Features and Qualities [11-12]

Smart Economy	Smart Management	Smart Environment
Innovative spirit	Participation in the decision-making process	The attractiveness of natural conditions
Entrepreneurship	Public and social services	Pollution
Smart Economy	Smart Management	Smart Environment
Economic image and brands	Transparent management	Environmental protection
Flexible job market	Political strategy and perspective	Sustainable resource management
Efficiency	Local availability	Cultural facilities
Transformation ability	National-international accessibility	Training facilities
Lifelong learning	Availability of IT infrastructure	Health conditions
Social and ethnic majority	Sustainable innovative and safe transport systems	Individual security
Flexibility		Building quality
Creativity		Tourist attraction
Clearance		Social structure
Participation in public life		

These elements and their features given in Table 1 are smart city components that are globally accepted. The formation of a smart city is also an indication that it does not consist solely of technology. The elements of the smart city in question are the components that should be implemented in the city administrations of both Turkey and all other countries.

Therefore, the projects carried out by the European Union (EU) on smart cities show the importance given to the concept of smart city at the international level. In addition, it supports projects related to smart cities of EU member states and candidate countries. Some of the smart project initiatives taking place in the EU are [11,13].

The Amsterdam Smart City Initiative project underlines the importance of fostering collaboration between the business sector and city dwellers and managers developing smart projects through energy conservation.
- Southampton City Council has switched to smart cards to highlight the importance of e-services.
- Edinburgh City Council has created a smart city vision as part of an action plan for state transformations.

• Malta's Smart City Strategy promotes business park projects, which it sees as leverage for economic development.
• IBM, Siemens and ORACLE always take their Smart Planet visions one step further.
• The Smart City INTERREG project was created by developing e-government services in the North Sea region in three dimensions between academia, industry and government stakeholders.
• As a result of the pilot study in four schools in the north of Portugal, a 12-13-year-old student was asked to describe the curriculum and simulation method. It is seen that 20% more success was achieved in the group in which the simulation method was used.
• Interpreting services are provided to tourists by placing 3 km long beacons (a location-based interaction technology using Bluetooth technology) in the city of Amsterdam. In this way, crowding in certain places in the city was prevented.
• Deloitte Amsterdam office generates more electricity than it consumes with 28,000 lighting panels placed on the roof of the building.
• In Oslo, which implemented smart street lighting for the first time in the world, savings of up to 70% were achieved in street lighting consumption.
Here are a few examples of smart city project applications made in various parts of the world related to smart city applications [13].
• With the automatic traffic control and tracking system, withholding tax in Los Angeles decreased by 35%, intersection delays by 20%, travel time by 13%, fuel consumption by 12.5% and air emissions by 10%.
• Tokyo spent $54 million on water pipes and electronic leak detectors, reducing water loss by 3.7%, earning US$172.4 million.
• Israel obtains 85% of its water needs from desalination plants. By 2020, this rate is estimated to be 100%.
• In Bukchon, a tourist area in Seoul, sensors are placed in garbage cans. In this way, garbage collection activities were carried out more regularly and the number of tourists increased.

2.1. Smart City Systems and Solutions of Municipalities

There are 30 metropolitan municipalities and 1,397 municipalities in total in Turkey. The population of metropolitan cities continues to increase over time. The problems that emerged with the increase in population made it necessary to change the understanding of municipality. Municipal administrations are required to carry out smart projects by taking advantage of the latest technological developments in order to eliminate or minimize the problems that occur [14]. In this context, the biggest problems in cities, the problems they cause and smart solutions are summarized in Table 2.

Table 2. City Problems and Suggested Smart Solutions [7]

Topics Urban Problems Smart Solution					
Transport	Energy	That	Health	Security	Urban Problems
Traffic jam	Increasing energy demand	Increasing water demand	Decrease in service quality	Increasing crime rates	Unplanned urbanization
Long time in traffic	Expensive, inefficient energy use	Loss of renewableness of resources	Difficulties in service delivery	Intelligent security systems	Elimination of the concept of time and space in services
Harmful gas emissions	Illegal use	Smart meters,	Home care	MOBESE, camera, smart sensors etc.	City information system
Adaptive traffic control	Smart meters,	Water quality monitoring	Environment		City guides
Smart link app	Smart grids	Leak detection	Environmental pollution		Waste management system
Parking guidance systems	Building energy management		Intelligent solid waste collection		Information kiosks
Smart bike			Decrease in service quality		Address and population information system

As can be seen in Table 2, smart solutions taken against the biggest problems in cities facilitate the service delivery of municipal administrations and raise the living standards of the society. In order to provide a better service to their citizens, municipal administrations seem to have agreed with the aforementioned companies for the implementation of smart systems in cities.

3. Results

In recent years, smart cities are an issue that has been given importance by the managers of big world cities (New York, London, Tokyo, Dubai etc.). Therefore, it is observed that there are studies on the aspects of smart city applications in studies conducted abroad.

Albino et al., [14] seeks to clarify the meaning of the word "smart" in the context of cities, with an approach based on an in-depth literature review of relevant studies as well as official documents of international studies. It also defines the main dimensions and elements that characterize a smart city. Different measures of urban smartness are reviewed to illustrate the need for a common definition of what constitutes a smart city, its definitions, and how it performs compared to traditional cities. In addition, performance measures and initiatives are described in several smart cities. Chourabi et al., [15], making a city "smart" emerges as a strategy to reduce the problems caused by the increase in the urban population and rapid urbanization. In response to the increasing use of the concept and closing the gap between smart cities in the literature, this article proposes a framework for understanding the concept of smart cities. Based on a search of a large and comprehensive body of literature from various disciplines, it has identified eight critical factors of smart city initiatives. These; management and organization, technology, governance, policy context, people and communities, the economy, built infrastructure and the natural environment. These factors form the basis of an integrative framework that can be used to examine how local governments envision smart city initiatives. The framework proposes directions and agendas for smart city research and sets out practical implications for policy makers.

Caragliu, et al., [12] aims to shed light on the often-difficult definition of the 'smart city' concept. A focused and operational description of this structure is presented and consistent evidence on the geography of smart cities in the EU27 is included in the study. Statistical and graphical analysis makes deep use of the latest version of Urban Audit data, tuned to analyze the factors that determine smart cities performance. As a result, it is concluded that a new strategic agenda for smart cities in Europe is established in order to achieve sustainable urban development and a better urban landscape. Schaffers et al., [16] explores internet cities, an open and user-oriented innovation environment to test and validate internet-enabled services for the future. Based on the current landscape analysis of smart city pilot programs, projects in the field of Future Internet experimental research and Living Labs can identify common resources for research and innovation that can be shared in open innovation environments. Effectively sharing these common resources with the aim of establishing urban and regional innovation ecosystems requires sustainable partnerships and cooperation strategies among key stakeholders.

4. Discussion

Many cities in Turkey are striving to become a smart city quickly. With the smart applications of Mersin Metropolitan Municipality, Mersin carries out big projects in line with being a smart city. Detailed information about the projects and projects carried out by Mersin Metropolitan Municipality within the scope of smart city is given below [17].

- **Smart Transportation Systems:** With the smart transportation web portal service, it is aimed to serve the citizens of Mersin through a single portal, and it has also been included in the phone application (Figure 1).

- **Smart Bicycle on Mersin Beach Project**: In addition to the city's infrastructure works, the importance of bicycle lanes and pedestrianization regulations in the transportation of the city is emphasized. The aim of this project, which was carried out within this framework, is to contribute to health, tourism and environmental policies as well as reducing traffic density. With this request, the people of Mersin will be able to use the bike with a credit card or KENTBIS card (Figure 2).

- **Metro Project:** This project, which has been started and continues, is the most important project in smart urbanization and is a vision project that will become a catalyst (Figure 3).

- **VR Mersin Project:** The VR Mersin project, which is one of the projects of the Metropolitan Municipality for the promotion of Mersin, that can be seen on the internet with the 360-degree virtual tour method, includes aerial, land, day and night shots at 272 points throughout the province. With the project, users can access Mersin's historical, natural and cultural values from anywhere in the world on the internet in a fast and reliable way. At the same time, users can watch 272 points on the Mersin border with a 360-degree virtual tour method, like a large open-air museum, while the system has four different language options. Mersin Promotional Film, prepared as part of the project, was selected as the best "TravelByDrone.com" video worldwide in September 2016 (Figure 4).

- **"Teksin Mersin" Smart City Mobile Application:** A vision project where many services that make life easier with the application downloaded to the phones of citizens living in Mersin are provided from a single platform (Figure 5).

Figure 1. Smart Urbanization in Mersin

Figure 2. Smart Urbanization in Mersin (Bicycle)

Figure 3. Smart Urbanization in Mersin (Metro)

Figure 4. Smart Urbanization in Mersin (VR Mersin)

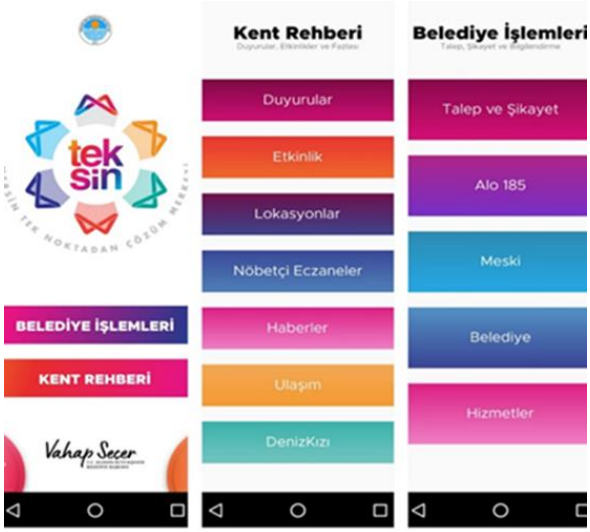

Figure 5. Smart Urbanization in Mersin (Teksin Mersin)

Figure 6. Smart Urbanization in Mersin (Call Center)

- **Mersin Metropolitan 24/7 Call Center:** With the call center system, which is accessible to Mersin Metropolitan Municipality citizens, all requests, suggestions and complaints of Mersin people can be conveyed to

the center 24/7. With the system, requests and problems are answered in a very short time, quality and fast service is provided. Another service of the Metropolitan Municipality is the Whatsapp notification line. Citizens can photograph and send the missing parts of the city to 0533 155 2 153 Whatsapp line. Citizens living in Mersin can now instantly report their requests, complaints and suggestions to the municipal authorities via their mobile phones (Figure 6).

- **Agricultural Forecasting and Early Warning System Project:** With this project aimed at farmers, farmers' products are protected against possible dangers. It is a project in practice with the effect of minimizing the effect of the producer on meteorological damages with the Agricultural Forecasting and Early Warning System, and all farmers are satisfied with this situation. With the project, agricultural risks are estimated and the damage to the producer is minimized with 12 stations established in 8 districts in Mersin. Information on meteorological pests coming from active stations is notified to the producers via SMS (Figure 7).

- **Smart Stations Project:** Mersin Metropolitan Municipality, which uses the developing technology effectively in its projects and services, has implemented the air-conditioned station project in Mersin, where the temperature is above 40 degrees in summer. Air-conditioned smart stations with features such as cameras, air conditioners, libraries, wireless internet, corporate television, uninterrupted energy and technological stops produce their own energy. The air-conditioned station, which produces its energy from the solar panels on it, has a system that provides coolness in the summer, protects the citizens from the outside environment and provides heat energy in the winter. In addition, it offers the opportunity to have a good time by reading a book while waiting for the bus at the bus stop that will stop at the bus stop. Stops of 16.8 m^2 will be recorded 24/7 with a security camera and citizens will be able to receive free Wi-Fi service. Citizens will be able to learn the bus times and the estimated arrival times of the buses with the corporate televisions at the station (Figure 8).

Figure 7. Smart Urbanization in Mersin (Agricultural)

Figure 8. Smart Urbanization in Mersin (Bus station)

- **Managed Wireless Internet:** It is a system that provides free internet service to citizens, thus enabling them to access the internet whenever they need it (Figure 9).
- **Geographic Information System:** A system model has been implemented that ensures that the geographic information systems needed by Mersin are fully met (Figure 10).
- **Mersin Metropolitan Municipality E-Government Project:** It is a major project where software services are provided to citizens in e-government, the state's gateway to the internet, which is Turkey's largest information network. With 7 services opened in a year, it is the second-best metropolitan municipality in inquiry in all fields (Figure 11).

1. E-Receipt Inquiry
2. Documentation Tracking
3. On Duty Pharmacy Inquiry
4. Inquiry Statement Information
5. Inquiry for Registry Information
6. Inquiry for Accrual Information
7. Collection Information Inquiry

- **Career Center Project:** The database that connects job seekers and employers in Mersin with a common database is a very secure and powerful Project (Figure 12).

Figure 9. Smart Urbanization in Mersin (Wireless)

Figure 10. Smart Urbanization in Mersin (GIS)

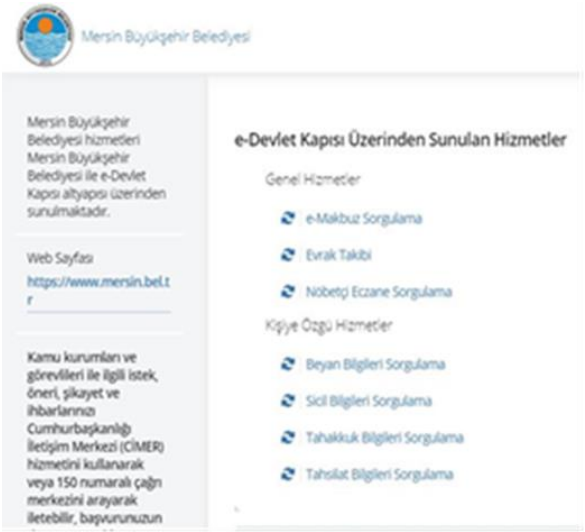

Figure 11. Smart Urbanization in Mersin (e-government)

Figure 12. Smart Urbanization in Mersin (Career Centre)

- **Disabled Individuals Database Project:** A database of disabled people living within the service boundaries of Mersin was created, their needs were identified and directed to relevant places. With the project, hospitals, schools, rehabilitation centers etc. It is possible to use facilities suitable for disabled people in accessing places. Metropolitan Municipality teams continue to work in the center and in the districts to visit the disabled people in the database and fill in the Disabled Information Form. There are 17,751 disabled individuals in the database (Figure 13).

- **Management Information System:** It is a document automation system with 8 modules. It is a system that enables documents to be prepared in electronic environment, signed and approved. Mersin Metropolitan Municipality is one of the first metropolitan municipalities to use the Management Information System fully (Figure 14).

1. Ebys Module
2. Aykome Module
3. Income Module
4. Analytical Accounting Module
5. Domestic Solid Waste Module
6. Officer Module
7. Movable Goods Module
8. Purchasing Module

Figure 13. Smart Urbanization in Mersin (Database)

Figure 14. Smart Urbanization in Mersin (Management Information System)

5. Conclusion

In 1980, with the industrial revolution, people's desire to live in cities started and this situation gained momentum after the development of technology and the concept of globalization in the 2000s. It is also estimated that the majority of the future population worldwide will live in cities. In order to overcome the problems that arise as a result of the increase in the population in the cities, it has become mandatory for the city administrations and municipalities to establish smart systems in the cities.

When the national and international literature is evaluated, it is seen that smart cities are generally considered as a solution to the problems that arise in cities. In other words, it is obvious that the concept of smart city is a planned city management by making use of technological developments. In other words, for a city to be called a smart city, it must have a structure that can produce smart solutions to problems, smart economy management, smart mobility, smart environment and most importantly, smart citizens use them.

It is seen that Mersin Metropolitan Municipality, which is considered as a case study within the scope of the study, has created quite a lot of projects within the framework of the smart city and put these projects into practice. It can be said that the smart projects produced and planned by the city of Mersin facilitate human life and put the city life in a systematic order. Although smart city applications in Turkey are very limited, it is seen that Mersin Metropolitan Municipality under the management of Vahap SEÇER has made a certain progress and succeeded with the projects it has done, as a result, the lives of people in urban life will be shaped by smart city applications. With smart city applications, solutions to problems and providing user-oriented municipal services are adopted and infrastructures will be created with information and communication technologies. The main suggestion made within the scope of the study is; It is predicted that metropolitan municipalities will give importance to smart city projects and will help cities to develop more quickly.

As a result, the lives of people in urban life will be shaped by smart city applications. With smart city applications, solutions to problems and providing user-oriented municipal services are adopted and infrastructures will be created with information and communication technologies. In this context, the smart city approach is one of the most important breakthroughs in the formation of knowledgeable and cultured cities.

Conflicts of interest

The authors declare no conflicts of interest.

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Investigation of the areas that will enable mixed use in the real estate development with risk analysis

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Abstract

Real estate development is a versatile business area that aims to create new added values to the country through land development and building construction by combining land, capital, and project thinking. The real estate is physically an integral part of the land and its buildings on the other hand, immovable development includes actions related to land development, building construction, marketing, operation and management. In order to be able to respond to economic demands in real estate development projects, financial analyzes must be carried out. Financial analysis allows us to see the risks on development projects through risk analysis as well as whether the development project is profitable or not. Identifying risks facilitates the risk management process and minimizes the financial risks of the company. In this study, mixed-use structures in the development of real estate, which are among the immovable development types determined in the common area determined within the boundaries of Mersin Province, Toroslar district and Yenişehir districts, were analyzed by the risk analysis method and it was observed that the determined sanatorium area and residential area could be profitable areas as an opportunity risk within the scope of immovable development.

1. Introduction

A real estate development project is a combination of location, project thinking and capital factors with the creation and profitable use of real estate objects; that have competitive capacity from an individual economy standpoint; create and ensure new employment opportunities; and are compatible with the social situation and the environment from the general economy standpoint. This definition describes the effects of the development project on both individual and general economy [1]. In conclusion, from the general economy perspective, the real estate development project must be able to meet public needs and from the individual economy perspective, it must have competitive ability and be consistently profitable. The research done in the framework of real estate development contain commercial decisions as well as economic, financial and legal subjects and analysis on the planning and preparation of the construction project [2-3].

The framework of real estate development contains two types of real estates: business-oriented real estate and residential real estate.

Because of the growing need for housing as a result of the increasing urban population, residential real estate development is more dominant in the market compared to the other forms of real estate. Global climate change,

potential water shortage, environmental pollution and the rapid consumption of natural resources brought the building of environmentally friendly structures onto the agenda. With the growing interest in building environmentally friendly structures, a new breed of building called green buildings came into being. Green buildings are advanced real estates that are built with the effects of buildings on environmental and human health in mind. Today, green buildings are the ones that come to mind when one thinks of sustainable, ecological and environmentally friendly building. Green buildings are defined as structures; that are built with a holistic approach that shapes the design of the building throughout its life-cycle, starting all the way from the choice of landscape; that are designed with a sense of social responsibility; in accordance with the climate and landscape conditions; that only consume as needed; that utilize renewable energy resources; that are built out of natural materials and are sensitive to the ecosystem and sustainable structures. With the growing number of green buildings, work started regarding standardization and certification systems. Certification systems aim to put forth universal and effective standards in order to define what a green building is, increase consumer awareness on the benefits of green buildings and create a transition in buildings. Benefits of green buildings can be listed as follows [4]:

- Decrease in CO_2 emissions that originate from buildings
- Minimizing the environmental destruction during the construction stage
- Decrease in operating expenses
- Utilization and improvement of renewable energy resources
- Recycling the waste material that result from excavation
- Accumulation and use of rain water through green roof method
- Utilization of natural light
- Energy conservation
- Reducing the cost of heating and cooling through insulation systems
- Increase in the value of the building
- Providing users, a healthier and more efficient environment
- Adding value to urban living spaces.

Business-oriented real estate describes industrial, private service and commercial structures which include manufacturing plants, storage spaces, workshops, industrial center spaces, distribution centers etc. Special service and commercial sector structures consist of building structures, restaurants, clinics, sanitariums, private education spaces, tourism structures, shopping malls, large hops, boutiques, public structures, cultural structures, charity organizations etc. Residential real estate consists of single and two-story houses, apartments etc. Users of these structures known as built real estate are industrial partners, service sector partners, commercial partners, non-profit organizations and residential users [2].

In a real estate development project, the type and method of the real estate in question is important. Types of real estate are landscape development, residential improvement, commercial spaces and mixed-use spaces. Methods of real estate development are divided into verbal and operational methods. Verbal methods include risk analysis, most effective and efficient use analysis and SWOT analysis. Operational methods include multiple decision support methods, analytic hierarchy process (AHP), build-up method, multiplication method etc.

In this study, the verbal real estate development method of risk analysis was employed. Risk, in the context of economics and finance, can be described as uncertainty or consequences of uncertainty. Risk is related to the inability to estimate the consequences in the planning environment and is described through the term probability.

Risk analysis is the assessment of the factors of a project's stability based on future events [5]. Risk analysis has two main components: Probability and Effect.

Risk analysis must be conducted in the investment decision stage before the application stage. In order to analyze the project risk, first, the risk needs to be identified and afterwards, measured. The amount of risk a project contains describes the variability of the project's potential returns [6].

Risk analysis methods include probability, scenario, sensitivity and simulation. Out of these methods, probability and simulation were used in this study for the sanitarium space and residential development spaces. These methods allow the project manager to assess the order and tendency of the risks and how to prevent them based on the income, time, cost and the ability to complete the project [7].

These risk analysis methods were used to assess the profitability and efficiency of the mixed-use sanitarium area and the residential area for the investor in every scenario.

2. Material and Method

2.1. Study area

This study area for this study was determined to be the 900 ha (Figure 1) space encompassing a portion of the Karaisalı, Fuat Morel, Portakal, Kocavilayet, Okan Merzeci, Çavak, 50. Yıl and Deniz neighborhoods that are situated within the limits of the Yenişehir and Toroslar districts of the Mersin province (Figure 2).

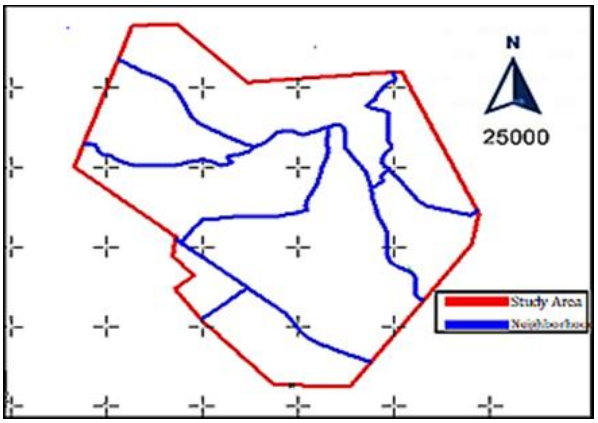

Figure 1. The study area (red line) and neighbourhood limits (blue lines)

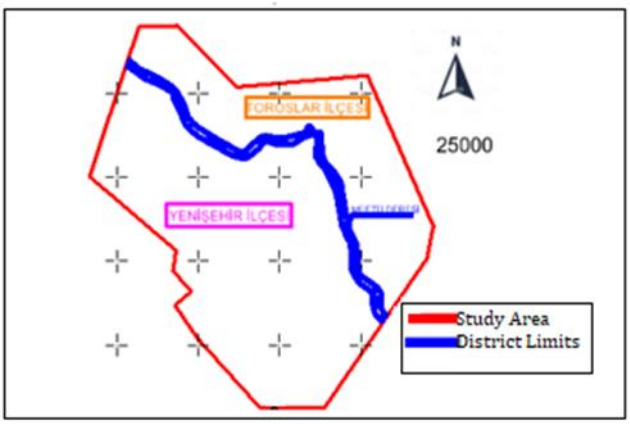

Figure 2. The study area (red line) and district limits (blue line-Müftü Stream)

The cadastre parcels where a Zoning Plan was implemented and those where it is not, consist of forest, agricultural and residential areas. There is also a stream bed that runs from the northwest to the southeast of the workspace (Müftü Stream). The stream continues on in the same direction and empties into the Mediterranean.

In the study, a sanitarium area and a residential area are planned to be built in these mixed-use building areas.

2.2. Data

In order to ensure reliability of the risk analysis for the effective and efficient use of the sanitarium area that will allow for mixed-use in the real estate development, the following data was acquired: The orthophoto map (Figure 3), the architectural map, the forest map (Figure 4), the General Directorate of State Hydraulic Works (DSI) flooding map of the Müftü River (Figure 5), cadastral state, development and DEM (Digital Elevation Model) maps (Figure 6), and archeological site data [8].

The study area consists of the land with 2-3% incline, situated on the south side of the sanitarium and residential areas that were determined based on the result on the DEM map.

According to the agricultural land use layer map, the areas determined as the sanitarium space and the residential area are situated on the IV and VII layers and there is no available the Zoning Plan for these areas. Also, according to the Soil Protection and Land Use Law No. 5403 [9], lands of IV and VI capability are classified as low-yield agricultural lands. Therefore, even in the event that there is a demand for the Zoning Plan, there is no obstacle in the way of this area being turned into a residential area.

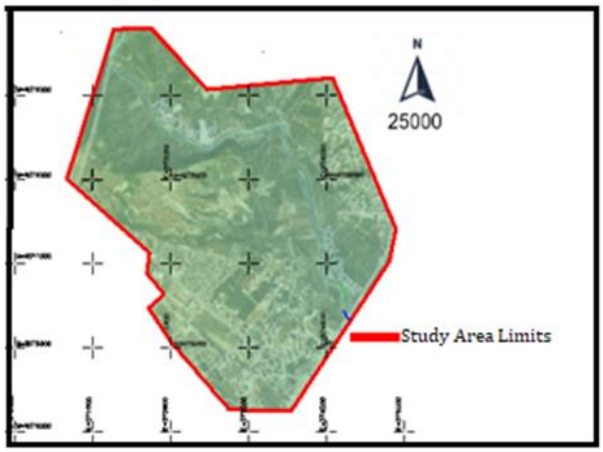

Figure 3. Orthophoto

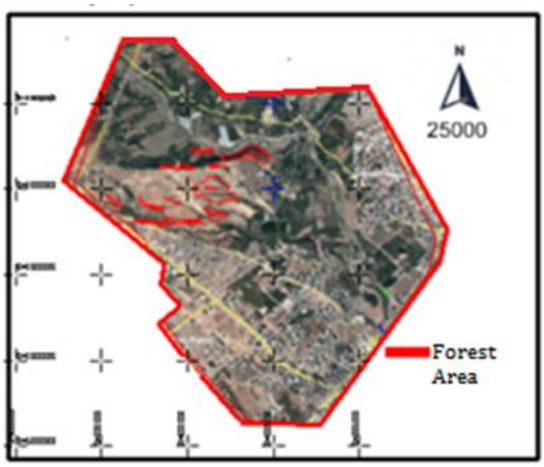

Figure 4. The forest area

As per the study conducted based on the data obtained from the General Directorate of Land Registry and Cadastre (TKGM) and the associated Municipalities, the area determined to be residential area situated north of Fuat Morel 2894 Street, is made up of cadastre parcels that are mostly considered private property (Figure 7 and Figure 8). The area determined to be the sanitarium area, situated on the southern limit of Çavak and North of Kocavilayet is outside the Zoning Plan and mostly made up of private property.

Arcgis 10.1 and Microstation GIS software's were utilized in the combined assessment of the data acquired. As per Protection of Cultural and Natural Properties Law No. 2863 [10], the study area was surveyed and determined to not contain any archeological sites that could be an obstacle towards real estate development.

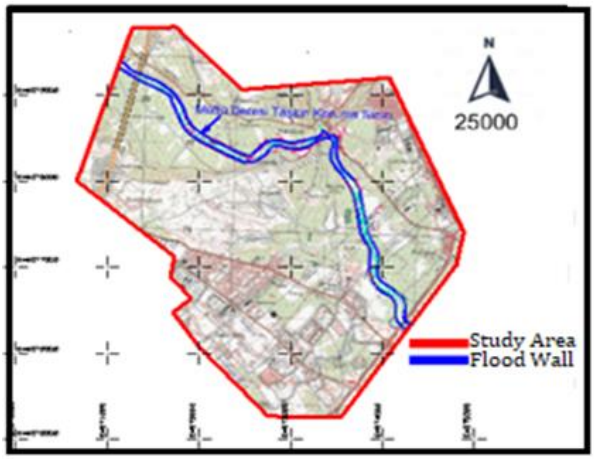

Figure 5. Flooding map of the Müftü River

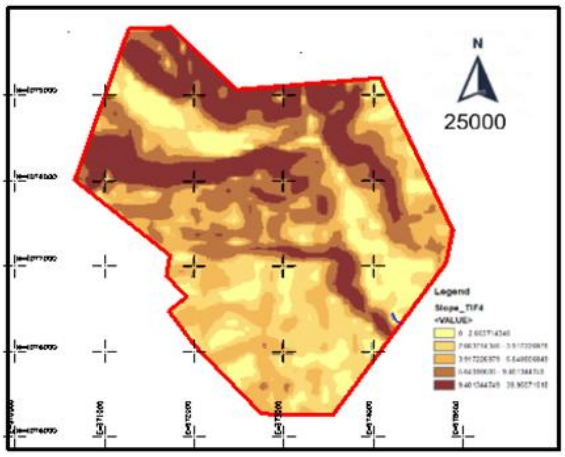

Figure 6. DEM

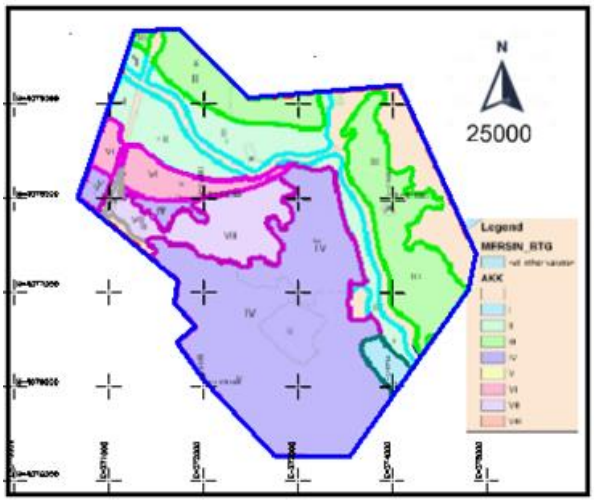

Figure 7. Agricultural estate land use capability (LUC) map

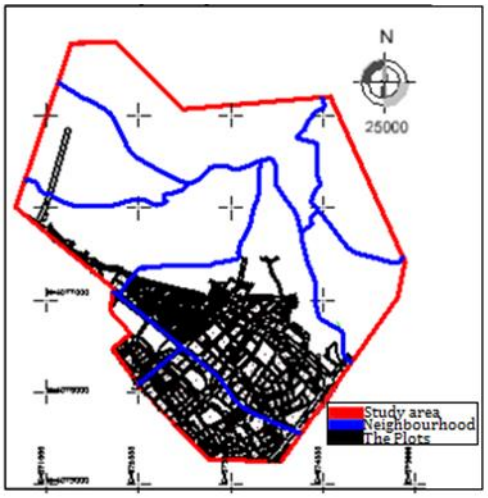

Figure 8. The Zoning Plan of Yenişehir District

2.3. Method

In this study, the verbal real estate development methods of qualitative and quantitative risk analysis were employed. Risk, in the context of economics and finance, can be described as uncertainty or consequences of uncertainty. Risk is related to the inability to estimate the consequences in the planning environment and is described through the term probability. Risk analysis is the assessment of the factors of a project's stability based on future events [5]. Risk analysis is important for determining the targeted returns on a certain investment and the variables that affect these returns. Risk analysis methods include probability, scenario, sensitivity and simulation. These methods contribute to evaluating subjects, the order and tendency of the risks and how to prevent them. Risks can be opportunities as well as threats. In this study, methods of scenario, sensitivity probability and the Monte Carlo Simulation were employed.

2.3.1. Monte Carlo Simulation

The primary purpose of risk analysis in a project is to run through every single possibility. There are many statistical and theoretical methods to achieve this goal. Some examples are the determining of a risk tolerance based on the project specifications, risk adjusted discount rates (RADR), description of subjective probabilities, formation of stochastic decision trees, sensitivity analysis and the probability analysis method of Monte Carlo Simulation [11].

The "Monte Carlo Simulation" is a term coined by S. Ulam and Nicholas Metropolis based on games of chance that are popular in Monte Carlo. Simulation is a technique in which random numbers and probabilities are used to solve problems [3,12]. Computer models are used to imitate real-life probabilities which assists in forming

predictions. These models are formed using spreadsheets and must contain a certain number of input and output parameters and equations that make use of these parameters. This type of model is usually a deterministic model and gives the same result in repeated calculations. Monte Carlo Simulation allows repeated re-evaluations of a deterministic model by using a series of random numbers as input. Using random inputs in this way allows one to turn an originally deterministic model into a stochastic model. Monte Carlo Simulation is also classified as a sampling method. The resulting data can then be represented as probability distribution and transformed into error lines, reliability estimations, tolerance zones and reliability intervals [3].

Three different Monte Carlo Simulation equations were applied on the mixed-use real estate development areas in the study area (Figure 9).

From the input data, the residential area sale value per square meter data was obtained from the on-the-spot current (at the time this article is being written) real estate sales data.

And the data for the calculation of the expenses was based on the Ministry of Environment and Urbanization Approximate Building Costs per Unit for the year of 2020.

Model Calculations (3 different simulation tests):

180 m^2 (3+1) house sale price=550,000,00 ₺
90 m^2 (2+1) house sale price=250,000,00 ₺
220 m^2 (4+1) house sale price=750,000,00 ₺
Residents are planned to be 2 blocks of 10-story apartments.
Approximate building costs per unit m^2= 2000,00 ₺
3+1 total 40 single section
2+1 total 80 single section
4+1 total 20 single section
Test1= 40*500000-(40*180*2000) =5600000 ₺
Test2= 80*250000-(80*90*2000) = 5600000 ₺
Test3=20*750000-(20*220*2000) =6200000 ₺

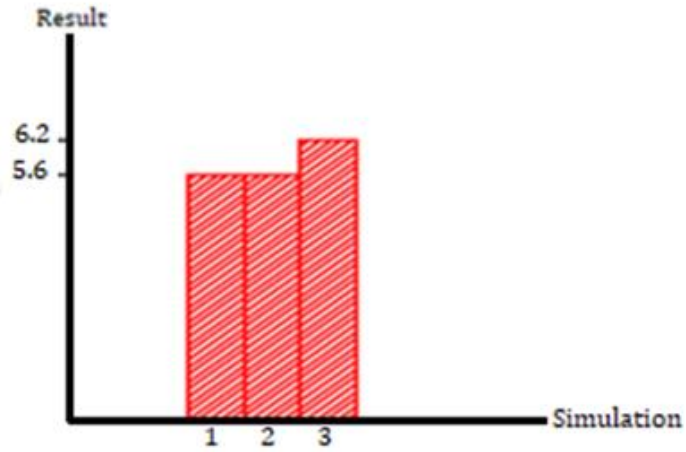

Figure 9. Monte Carlo Simulation results

3. Results

Following the analysis of the risks in question and the assessment of the environmental, economic and sector-specific factors and based on the Risk Rate Comparison (Table 1), it was observed that the residential area is compatible with the real estate market conditions.

A land use map of the study area was created (Figure 10). House Sales According to the Annual Data obtained from [13].

Variation Interval; 5 Years
Variable Parameter; Sales Amount
Constant Variable; House Price (Figure 11)

Table 1. Residential development area risk factors

	Environmental Risks		Economic Risks		Industry-Specific Risks	
	Kind of risks	100%	Kind of risks	100%	Kind of risks	100%
Residential Area	Destruction of the object	0	Macroeconomic changes	10	Sector movements	15
	Legal changes	10	Unemployment	10	Presentation and request behaviors	10
	Ecological demands	15	Income and purchasing power	20	Empty space risks	20
	Political risks	30	Interest rate change	30	Decline in rental prices	10
					Technological innovations	15

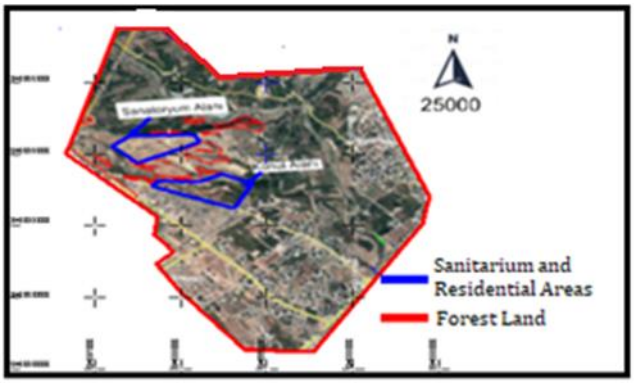

Figure 10. Image of the Mixed-Use sanitarium and residential areas

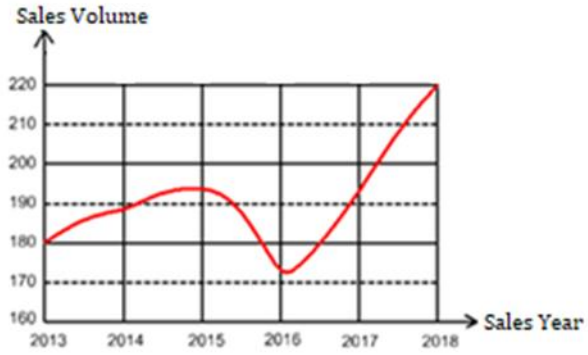

Figure 11. Residential development area sensitivity analysis variation figure

The results of the risk analysis conducted in this study with the subject Investigation of the Areas that will enable Mixed Use in the Real Estate:

The sanitarium space subject to real estate development shall satisfy public needs and be able to be used regularly and thus, it is considered that the sanitarium space shall contribute to the public economy.

Following an analysis regarding environmental and economic risks, it was observed that the area determined to be residential area is a profitable investment that contains a very small amount of financial threats and dangers (Figure 11).

Based on the results of the scenario analysis conducted on the sanitarium space, it was determined that the sanitarium space is an investment with no alternatives and was thus determined to be the best-case scenario for the area.

Based on the data obtained from the sensitivity analysis (price, sales amount etc.) conducted on the residential area has been determined that the residential area is a profitable investment (Figure 11).

Based on the sensitivity analysis data, it was observed that the variation intervals between the price and sales amount components of the analysis may be long (the probability of price and sales amount variation is very low) which represents an opportunity risk regarding real estate development (Figure 11).

4. Conclusion

In this study, sanitarium and residential areas were examined within the scope of real estate development in the area determined within the borders of Mersin province Toroslar district and Yenişehir district.

As a result of the researches and analyzes made, it is thought that the sanitarium area will contribute to the public economy by responding to the needs and by its usability. It was evaluated in terms of environmental and economic risks. According to the results of the Monte Carlo Simulation analysis on the residential area and the three different simulation equations showed that the residential area has the potential to be a profitable investment.

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Author contributions

Semih Dede: Conceptualization, Methodology, Software **Begüm Koruyucu Yurdagel:** Data curation, Writing-Original draft preparation, Software, Validation. **Fatih Tükenmez:** Visualization, Investigation, Writing-Reviewing and Editing. **Şeyma Ekizoğlu:** Writing-Reviewing and Editing.

Conflicts of interest

The authors declare no conflicts of interest.

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Comparison of modern methods using the python programming language in mass housing valuation

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Abstract

Multiple methods are used in the mass housing valuation. With the developing technology, modern methods have gained speed. In this study, a systematic study was conducted with machine learning to estimate the final price of housing property. The studied dataset contains 73 samples and 18 arguments. In this study with the Python programming language, NumPy, Pandas, Scikit–learn, Matplotlib and Seaborn, which are the basic libraries of Python, were used. Multiple linear regression (MLR) and decision tree regression method were used to perform the study. The adjusted determination coefficient (r^2) was used to measure the performance of the estimation accuracy of applications. As a result of applications, the multiple linear regression model showed better results than the decision tree model.

1. Introduction

Immovable property; the name given to the real estate, such as land, buildings, apartments, business places [1]. Valuation; market conditions by analyzing the change of the business is process of finding it in value of the property's real estates in the face of economic developments [2]. The real estate business valuation; it can be defined as the estimation of the probable value of an immovable property, real estate rights and benefits attached to the project or based on a valuation day, independent, impartial and objective criteria [3].

Real estate valuation appreciation or evaluation only if a property is not limited to, at the same time, the price or value of the property using historical data about the variables that affect the price of various predicts. A specific prediction of action includes the removal of useful information from raw data. Then comparisons are made with current sales prices. Estimates often using traditional assessment methods is cumbersome, however, artificial neural networks, machine learning, algorithms such as computers and the emergence of explore the correlations between the variables that affect the price of real estate, and multi-dimensional variables facilitated the creation of patterns in [4-5].

Real estate valuation methods; traditional, statistical, spatial analysis, modern, hybrid, separate valuation method as it is possible. Traditional methods in institutions often are the preferred method. Other methods can be divided into modern methods. For maps of real estate valuation Esri software (ArcGIS, ArcMap, ArcPAD, ArcCatalog, Bottom 4 image Mapper), immovable bulk value for processing GLASS (computer assisted Mass Appraisal), MATLAB fuzzy logic, decision tree analysis for Precision Tree, and program SPSS for neuro solutions neural networks, etc. software is used.

1.1. Importance of Real Estate Valuation

The city planning and economic development, reconstruction plans real estate appropriate valuation methods are possible. New residential areas to the selection of the conditions for consolidating fragmented parcels and their organization in real estate valuation in urban areas is of great importance [6].

City Planning, Public Investments (investment evaluations (pre and post), the selection of a residential area, parcel, regulations, and making transparent and reliable for the valuation of real estate in the real estate market is very important. In order to achieve the best results in the evaluation of the scientific method to select the most suitable one for the purpose of valuation are required [7].

1.2. Literature Review

Many modern methods for valuation of immovable properties are used in literature studies and in particular those who made the decision tree method with the application examined.

Random forest regression method had been used with 2695 samplings in the Russian city of St. Petersburg. A prediction value is close 95% accuracy to the actual value of the immovable property [4].

Installation work of 125 PV power plants in Turkey for the purpose of multiple linear regression by using the method for different locations have estimated the PV power. 96% accuracy obtained in the study [8].

In Mamak district of Ankara, the independent variables consisting of 96 by the method of regression and decision tree CDR dataset is studied. The decision tree method yielded higher than predictive value [9].

Singapore's private residential property market had been investigated from 1995 until 2017 and made an application for a dataset with more than 300,000 real estate transaction. The tree-based method, they have concluded that the assumptions of multiple regression analysis showed better performance than the traditional [10].

It was carried out a study by using the Random Forest community algorithm in Pendik. prediction performance of random forest regression method with the engine thematic compatible datasets in Turkish National Geographic Information System (TUCBS) was evaluated. The result obtained 85% with an accuracy rate [11].

The subject of valuation of immovable properties that are outside the heating value of solid fuels with higher sample argument CDR and 21st 185 examined by regression method and decision tree was seen in %76% 75% gave better results indicated that the performance of the decision tree method by a small margin has been [12].

The aim of this study using machine learning thanks to artificial intelligence, Python programming language, multiple linear regression and decision tree regression analysis to compare. Criteria were made to estimate the market value of the middle-ranked houses in Mersin Yenişehir district by classifying them.

2. Material and Method

The material of this study consists of 73 samplings in Mersin, Yenişehir, Çiftlikköy District. The samplings prepared with sale price and features of housing properties constitute a dataset.

2.1. The study area

Yenişehir, is a district of Mersin province in the south and the Mediterranean, the North Freeway, in the East, the Mufti's Creek, the area within the boundaries of the area in the west of Mezitli municipality 3681 hectares. According to the 2019 census, the population of the province 266,117 person.

In north of the study area, Mersin University Çiftlikköy Campus established on an area of 400 hectares is located. Approximately 20 thousand students on campus and educated in medicine, dentistry such as to be open to the public health organizations has a positive impact on housing prices. The study area is in Figure 1.

2.2. Data

The value of immovable housing type is collected. Because it is very close to campus 1+1, 2+1, 3+1 and 4+1 illustrates the diversity of rooms. The criteria that affect the value of housing: area (gross-m^2), area (net-m^2), housing type, number of rooms, number of bathrooms, number of floors, floor, facades, parking, security, swimming pool, type of heating, balcony, the age of the building, road frontage-shaped housing characteristics have been taken as independent variables. As housing prices have benefited from the dependent variable.

In preparing the data input as a float, integer data, and the normalization of the observed data in Table 1 are reviewed.

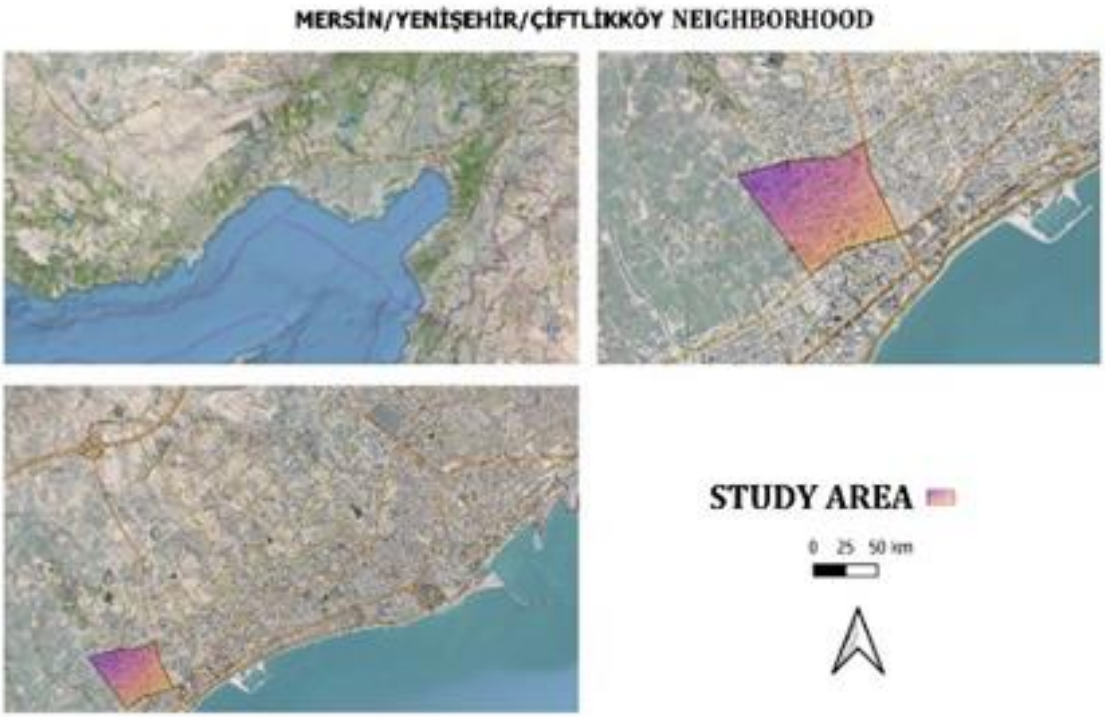


Figure 1. Study area

Table 1. The numeric equivalents of the data

Criteria	Description	Value
Type of housing	Apartment	1
	Site	0
Parking	There	1
	No	0
Security	There	1
	No	0
Pool	There	1
	No	0
Fronts	North	1
	South	2
	West	3
	East	4
Heating Type	Air conditioning	1
	Centre	2
	Private (Combi)	3

2.3. Method

2.3.1. Valuation Methods

Regression analysis between them cause-and-effect relationship in order to make predictions or extrapolations about the relationship between two or more variables called the regression model, statistical analysis is a technique that is characterized by a mathematical model [13].

2.3.1.1. Multiple linear regression (MDR)

The best relationship between a dependent variable and several independent variables of a dataset CDR can be used to predict under applied regression and machine learning is one of the models. The MDR model which minimizes the sum of squares of differences of observed and predicted values based on the method of Least Squares [8].

The MDR model, the dependent variable used in the calculation of the equality can be expressed as Equation 1.

$$Housing\ Price = x_0 + x_1y_1 + x_2y_2 + x_ny_n + \varepsilon \quad (1)$$

n: Number of samples,
$x_1, x_2, \ldots . x_n$: Weight values,
$y_1, y_2, \ldots y_n$: Independent variable, and
ε: Error term.

MDR analysis on the basis of the logic of the method of Least Squares operate. The connection between the one or more variable is used to detect [14].

2.3.1.2. *Decision Tree Regression*

A decision tree classifier or a regression analysis that is used to obtain tree-type data structure. Subsets is handled by dividing the dataset to be used every time. Consists of decision nodes and leaves. Decision nodes each time depending on the property, it is divided into two or more sub. The end nodes of the tree the leaf node represents the decision was taken [14].

This method is known as the space segment for a set of Predictor uses a decision tree splitting rule. The decision tree, the simplest interpretation is one of the methods which is easy to machine learning [10].

More specifically, the decision tree consisting of nodes and branches algorithmic structures. Each node is judged whether it is higher or lower than a value of a variable [15].

2.3.2. Performance

2.3.2.1. Adjusted determination coefficient ($\overline{R^2}$)

Coefficient of determination, in addition to measuring the success of the regression equation, the equation that reflects the power prediction of a statistic [16-17].

The function can be expressed with Equation 2.

$$\overline{R^2} = 1 - (1 - R^2)\,\frac{(n-1)}{(n-p-1)} \quad (2)$$

$\mathbf{0 < R^2 < 1}$

n: record number,

p: the number of independent variables

3. Results

MDR methods and random forest in Python the program was carried out. Python libraries that are used in the program; NumPy, Pandas, Scikit–learn Seaborn Matplotlib and consists of. Dataset are converted to the shape and ready for analysis more useful. The output from the python script is as shown in Table 2.

Table 2. Pandas MDR command output

	Gross Area	Certain Area	Type of Housing	Number of Rooms	Number of Bathrooms	Number of Floors	Current Floor
0	70	55	1	1+1	1	13	9
1	65	50	1	1+1	1	11	6
2	80	60	1	1+1	1	13	13
3	70	60	1	1+1	1	10	8
4	65	55	0	1+1	1	9	2

3.1. Multiple Linear Regression Model

The first libraries to be used in the application are included in the program. Pandas and missing data were achieved with the library entry for the control of dataset have been found.

As the data in Table 1, the correlation relationship between the independent variables and the remaining made the normalization process Thanks to the library Seaborn heat map (heatmap) was investigated by creating.

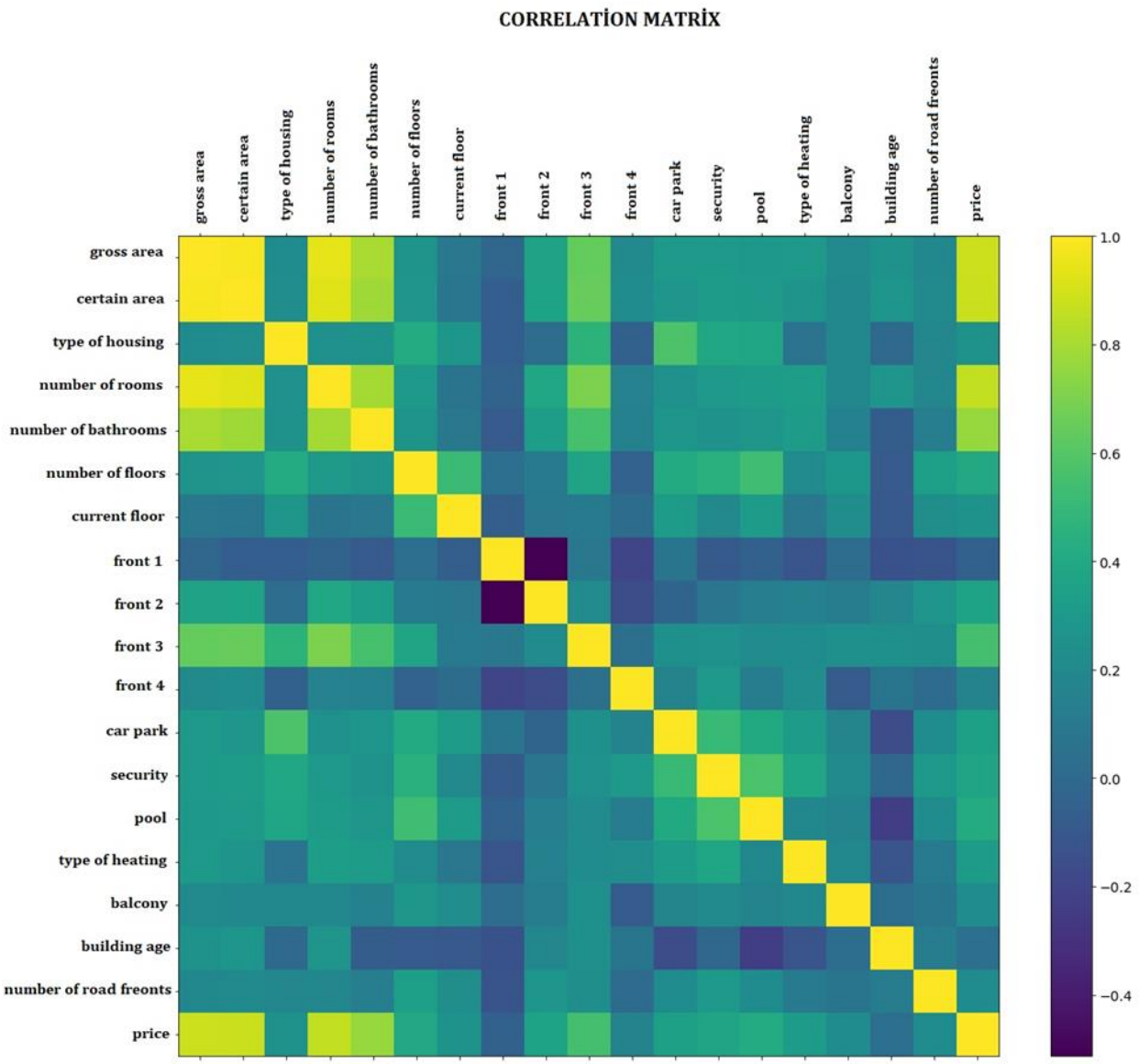
As for the correlation, probability theory and statistics, random variables, direction and strength of the linear relationship between two or more shows. Multiple correlation of a variable with two or more variable; its relationship with other variables fixed partial correlation techniques with any of these variables is calculated. The

correlation coefficient "r" and is indicated by -1 and +1 values between takes. $r = -1$ There was a linear relationship negative. $r = +1$ there is a positive linear relationship full. $r = 0$ there is a relationship between the two variables.

In this context, $r =$ the results are interpreted according to the following ranges for the relationship in the following way: 0.00 relationship-0.01 – 0.29 low level of the relationship, 0.30– 0.70 moderate relationship 0.71 – 0.99 a high level of iliski1.00 means perfect relationship.

The heat map as shown in Table 3, when the price of housing other variables held constant, the relationship between the level of were visualized.

Table 3. Correlation Relationship



Depending on the heat map, housing prices in Figure 2 of the most important variables that affect the output from the python script as a sequence of gross area, Net area and number of rooms. Other criteria like are shown in Figure 3.

Establish the MDR model r^2 Python script to calculate the score are written in the output. "Linear Regression" command by running the program has been called and were obtained from the model, and r^2 0,84 is. What this means is that the MDR of the model to 84% with an accuracy rate of reflect the criteria (Figure 3).

price	1.000000
groos area	0.885178
certain area	0.878313
number of rooms	0.858418
number of bathrooms	0.768317
front 3	0.551491
pool	0.419002
number of floors	0.401067
security	0.369414
front 2	0.363327
car park	0.344376
type of heating	0.322266
type of housing	0.256720
current floor	0.255915
number of road fronts	0.223549
balcony	0.220578
front 4	0.163782
front 1	0.045840
building age	0.037744

Figure 2. Factors That Affect Price

```
r2_score(y_test, model.predict(X_test))
```

```
0.8373184761402785
```

Figure 3. Account Accuracy

3.2. Decision *Tree Regression*

As in the first application dataset been summoned and is put into operation. In the model, the target variable, 'price' for density-separated from the rest of the dataset looking at the distribution and price. The output from the python script is in the attachment (Figure 4).

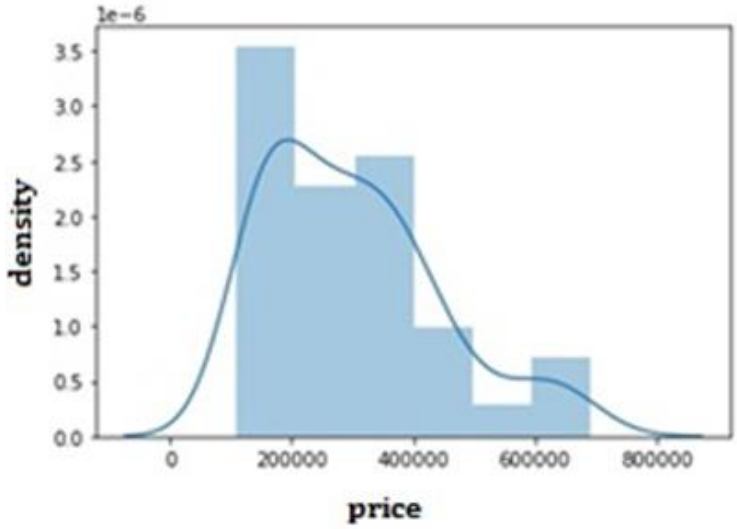


Figure 4. Density - Distribution Price

Ready to build the application model has become. Dataset the training and test sub-sets of data, allocation, create a decision tree model with the training data and the model 'fit' don't be performed. The output from the python script is in the attachment (Figure 5).

Based on the similarity between the actual value predicted with the accuracy of the calculation was made in the process (Figure 6).

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
d_tree1 = DecisionTreeRegressor(max_depth = 3, random_state=42)
d_tree1.fit(X_train, y_train)
```

Figure 5. Model building

```
predictions = d_tree1.predict(X_test)
errors = abs(predictions - y_test)
print('Mean Absolute Error:', round(np.mean(errors), 2), 'unit.')
mape = 100 * (errors / y_test)
dogruluk = 100 - np.mean(mape)
print('dogruluk:', round(accuracy, 3), '%.')
```

```
Mean Absolute Error: 64636.36 unit.
dogruluk: 75.668 %.
```

Figure 6. Model building

76% regression decision tree with an accuracy on the order gave no results. While establishing the ranking of the importance attribute to a classification model, made visualization was performed (Figure 7).

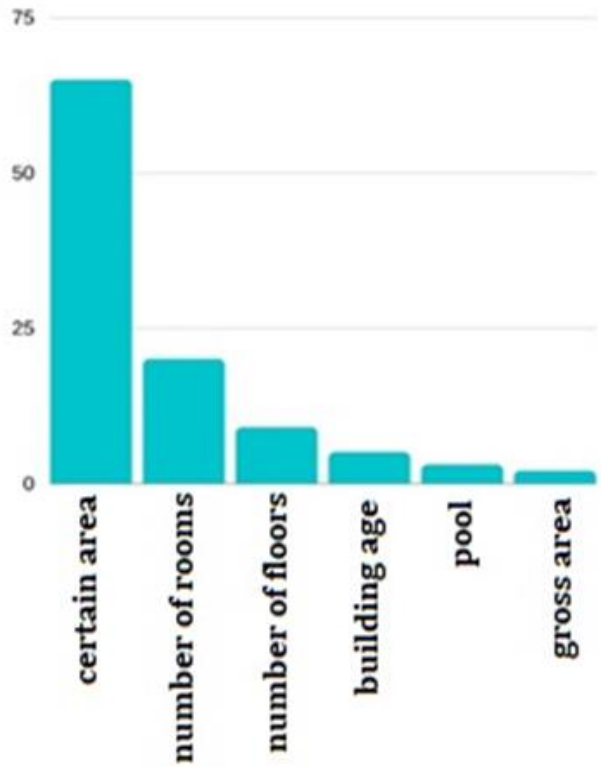


Figure 7. Attribute Importance Ranking

Visualization can be understood as the three most important variables that affect the price of the net this time house area, number of rooms and the number of layers as it seems.

4. Conclusion

As a result, the two methods applied to very accurate results were obtained. The variables that affect the estimate of the two applications was different. Multiple linear regression model accuracy is 84%, and the accuracy of Decision Tree regression model to be 76% was calculated.

Mass Real Estate Appraisal, which is the largest share of measuring the economic value of real property in the country has become one of the indicators of development. Gross domestic profitability of the real estate market in important economic dimensions. Various public and private institutions in the areas of unbiased, objective and scientific approach should be performed.

On the other hand, created a revolution in the industry business technology scientific machine learning. Many real estate site, Real Estate began using machine learning to predict the values of each of the technology. The need for a fast and economic evaluation of real estate and the greater availability of current information that can be accessed over the internet, big data and machine learning techniques to perform led to the implementation of real estate valuation.

They will buy or sell their property without the help of people's assessors. However, the economic crisis, pandemic, natural disaster or extraordinary situations such as the possibility of the presence of continuous development and immovable properties and their features because of the changes in the environment and realtors Valuation Professionals will always be needed.

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Author contributions

Gültekin Büyük: Investigation, Methodology, Software, Application, Validation, **Fatma Bünyan Ünel:** Conceptualization, Reviewed and Edited.

Conflicts of interest

The authors declare no conflicts of interest.

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Analysis of drinking water infrastructure systems with GIS

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Abstract

The aim of this study is to make heat maps in order to determine the pipeline fault areas with the geographical information system by using the location and detail information of the drinking water pipeline faults repaired by the Mersin Water and Sewerage Administration. The study area is covering Akdeniz, Mezitli, Toroslar and Yenişehir, where are the four central districts of Mersin. The coordinates of pipeline fault points were collected by GNSS. The points were analyzed with heatmap. Preventing future pipeline faults on these areas is very important. The study is going to help to prepare the advanced investment plans of the institution that invests in drinking water, and to ensure that the public institution uses these investments correctly and appropriately.

1. Introduction

80 countries with 40% of the world's population are already suffering from water shortages. The rapid increase in the population, on the other hand, the fact that the known water resources are stable, the water resources are not filled enough because the rain and snow are less. Water resources are also decreasing and the need for water is increasing day by day. 98% of this water is in the oceans and inland seas, but because it is salty, it is not suitable for use as drinking water, irrigation and industrial use. Only 2.5% of the world's water is fresh water. 87% of this is found in glaciers, soil, atmosphere, groundwater and is unusable [1-3].

Drinking water and sanitation services, which are considered as a public service throughout the world, are evolving in a direction that includes private sector participation, especially with the 1990s. The public aspect of water services ignoring the profit motive and the private sector starting to provide water services, water will become a commodity that can only be consumed by those who can pay the price. There are a number of efforts against this trend. The most recent of these efforts is the recognition of water as a human right by the United Nations Committee on Economic, Social and Cultural Rights in its General Comment No. 15 in 2002. This right, which has been expressed at international conferences in previous years, aims to guarantee that every person has access to a certain amount of water. However, the right to water, which is not included in an international treaty to be binding in terms of international law, is developing as a fragile concept of international law. This study examines the content and scope of the right to water, as well as the obstacles to the realization of this right [4].

"Turkey's Water Potential The average annual precipitation in our country is 643 mm, which corresponds to an average of 501 billion m³ of water. 274 billion m³ of precipitation returns to the atmosphere through evaporation from tea, rivers, lakes and seas and plants. 158 billion m³ of the water falling to the soil with precipitation is carried to the sea or lakes by many large and small rivers. The remaining 69 billion m³ constitutes 108 groundwater. 28 billion m³ of the underground water formed is re-joined into the surface waters in the form of spring water (springs). In

addition, an average of 7 billion m³ of water annually comes to our country from neighbouring countries with rivers such as Meriç and Asi. The gross water potential of our country (158+28+7=193) consists of 158 billion m³ of surface waters formed by precipitation and 28 billion m³ of water that reaches the surface again as spring water from underground waters, and 7 billion m³ of waters coming from neighbouring countries by rivers. When the 41 billion m³ (69-28=41) water that goes underground and joins the groundwater is added, the renewable gross water potential of our country reaches 234 billion m³ (193+41)" [5].

Infrastructure information systems, which are one of the components of Urban Information Systems, and their usage areas increases day-by-day. The usage of infrastructure information systems in a small-scale settlement is included. Atabey district of Isparta province was chosen as the study area. For this purpose, maps (Plans, data) of the drinking water network system, which is one of the infrastructure network systems of Atabey district, were obtained and these were digitized through the ArcView 9.0 Geographical Information System program [6].

In literature, there are many studies on the topics such as water management, water resources, drinking water, etc. In addition, traceability and sustainability of the system, pressure management, hydraulic behaviour of drinking water lines, and leak-leak detection is analysed with hydraulic modelling [7]. Hydraulic Modelling was performed with drinking water network using online monitoring (SCADA) in Antalya [8]. It was improved a decision support system, which optimizes the maintenance of water distribution network problem by differential evolution algorithm [9]. The use of Technical Performance Indexes was explored with the pressure-driven simulation model [10]. A multiobjective model was applied for water quality and trading-off pumping cost for operation of water distribution systems [11].

Research subject; the aim is to locate the existing the pipeline faults in the field with GNSS devices and to establish the relationship between the pipeline faults and which streets and to determine the infrastructure needs of the dense regions with GIS applications.

Mersin Water and Sewerage Administration reported the drinking water malfunctions occurring in the field in 2017 and 2020 by the repair teams formed within its body, and each the pipeline fault was taken from the field by GNSS measuring devices by the mapping unit within the institution.

A total of 1800 the pipeline fault points were taken from the streets and avenues for four districts of Mersin, and all of them were stored in Netcad.

2. Material and Method

2.1. The Study Area: Mersin Central Districts

Mersin province consists of 13 districts and the highest population is found in Akdeniz, Mezitli, Toroslar, and Yenişehir districts. The drinking water need of the population living in these districts is provided from the Berdan Dam located in Tarsus. Drinking water coming from the Berdan dam to Mersin with the pumping stations reaches the warehouses with the existing infrastructure systems and then to the households with the help of network lines. Mersin Water and Sewerage Administration (MESKI) is responsible for maintaining this system and providing the necessary drinking water and sewerage services. While doing this, it is necessary to eliminate the pipeline faults that occur in the existing network line and make an investment.

As the study area, Akdeniz, Toroslar, Yenişehir and Mezitli central districts of Mersin province with the highest population were selected. It is showed the pipeline fault points of drinking water in the study area (Figure 1).

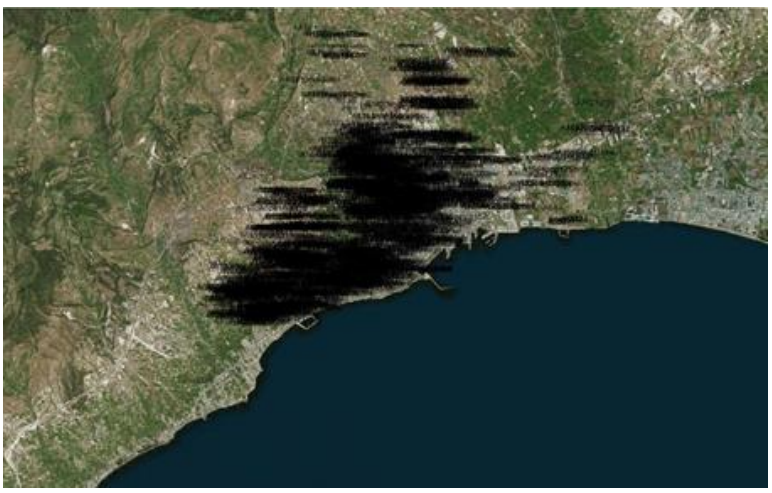

Figure 1. The points in the study area

These 1800 pipeline fault points selected in total correspond to the roads with a sensitivity of less than 1 meter horizontally and generally located in the city and specified in the zoning plans. All of the pipeline faults were physically collected from the field by GNSS device. The images of some pipeline fault were presented (Figure 2).

Figure 2. General situation of the pipeline faults

2.2. Mersin Central District Analysis with Heatmap Method

The points are stored on the Netcad program and it was chosen for the related database setup structure. The database was chosen as Microsoft Access database. The most important data to ensure relevant analysis is to determine the areas surrounding the points. These areas are district borders, neighborhood borders, roads and the pipeline fault points should know each other.

Heatmaps are a popular graphical way to summarize data, observe relationships among several statistical variables (the columns in a heatmap), and organize the observations from numerous participants (the rows in a heatmap) – all in one single graph. Heatmaps and related graphs can be defined the 19th century [12-13]. The underlying idea for heatmaps is that the data are split into different intervals that are assigned to a color.

3. Application

3.1. Editing the Database

First of all, the database was established with the Netcad Program, and then the database was transferred to ArcGIS in order to make the necessary examinations, and heat maps were produced.

Objects to the database were created by transferring CAD data to tables. Coordinate system of CAD data is determined as WGS84 (EPSG:4326) so that it can be easily understood in programs such as ArcGIS or QGIS and necessary coordinate transformations are made. The data of the Existing Roads has been downloaded from the Open-Source Map (OSM) [14] as SHP file for whole Turkey. Objects to the database were created by transferring CAD data to tables. Coordinate system of CAD data was determined as WGS84 (EPSG:4326) so that it can be easily understood in programs such as ArcGIS or QGIS, and necessary coordinate transformations were made. District boundaries and district boundaries of districts were selected as CAD data from 1/1000 application development plans, and then necessary coordinate transformations were made. Objects to the database were created by transferring CAD data to tables (Figure 3).

3.2. Editing Geographical Data

The roads converted to CAD were first cut according to the District Boundaries, then again using the same district borders, the table's named roads were filled in the database by using the "get information from the area inside" command in the OVERLAY operation under the Tools Menu of NetCAD.

Since all points of Mersin Water and Sewerage Administration for the years 2017 - 2020 are purchased in the NetCAD environment, you can enter the table in the Pipeline Fault Points database, where the main analysis will be made in the District Neighborhood and Roads, under the Tools Menu of NetCAD, in the process named OVERLAY, with the help of the "get information from the area inside" command. Then, the District - Neighborhood table was filled with the help of the database manager and the relationship 1-N relationship. The relation with the roads is provided with the BUMPER Command under the Tools Menu of Netcad.

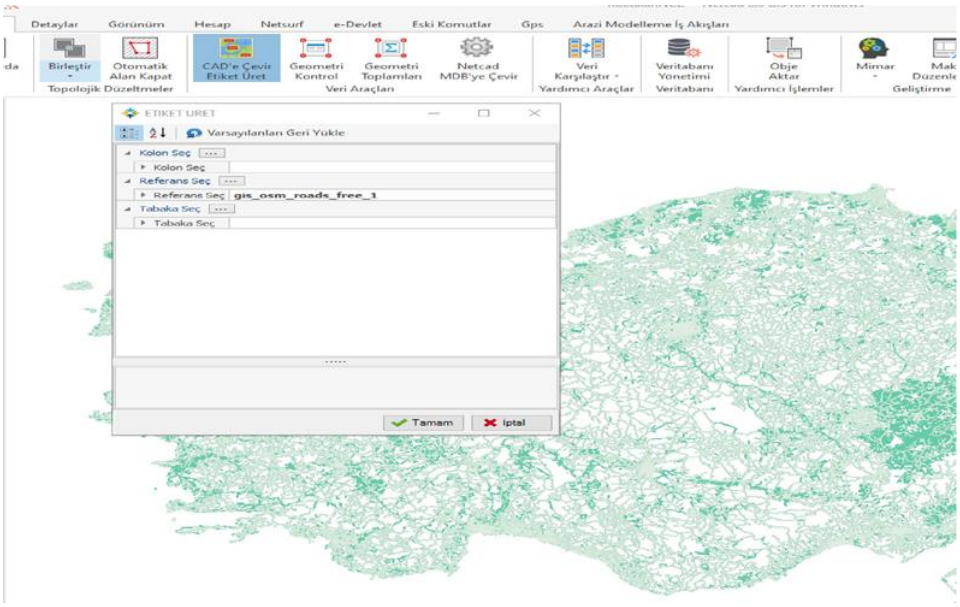

Figure 3. Transfer of Turkey OSM Roadmap

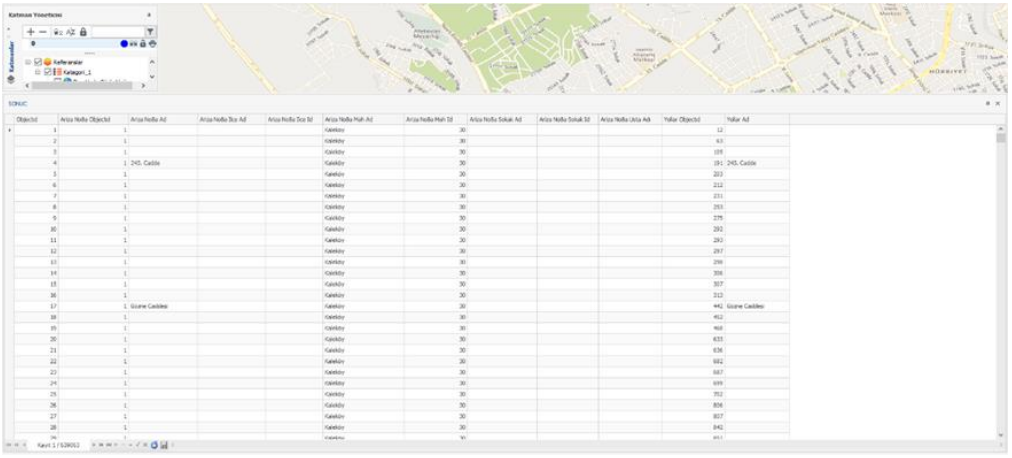

Figure 4. The points attributes in database

In following, the titles of the points attributes in database were gives. These were regulated together with their data in Figure 4.

- Number
- Date
- ULAKBEL No (MESKI the Pipeline Fault Code)
- Depth
- Pipe Diameter
- Pipe Type
- Repairman Name
- Location

3.3. Heatmap Analysis

Although Netcad includes database and GIS parts, NETIGMA module is needed for certain analyses. Analyses such as heat map (HEATMAP) are made. In Netcad Tables, simple queries such as filtering the pipeline fault points on Akbelen Blv or fetch the pipeline faults in Yenişehir District are made only with the current filter method. In order to make use of the Heat Map to understand in which regions the pipeline faults are concentrated, the pipeline fault points were converted to SHP files with the help of Netcad and a heat map was created with the help of ArcGIS.

The SHP file is opened with ArcMap and added as data to the Layers section. In order to make the map understandable, the Basemap will be added to determine the regions. A heatmap will also be created with the help of spatial analyst tool – density – point density (Figure 5).

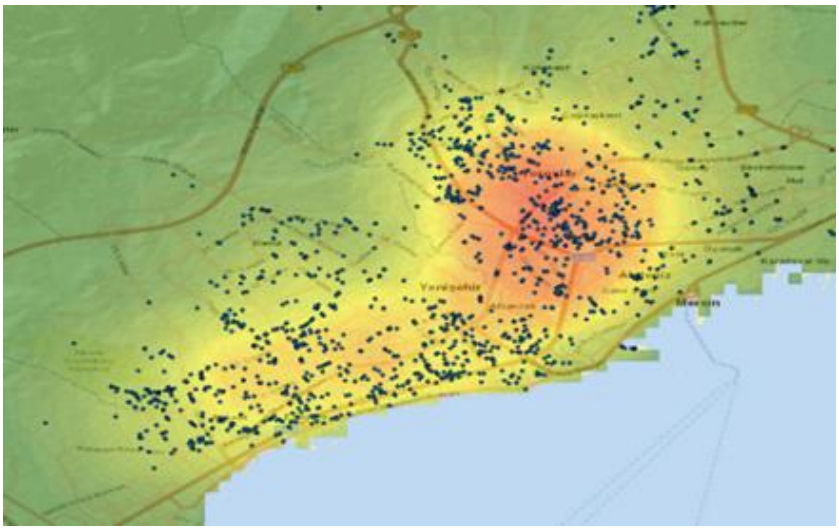

Figure 5. The pipeline faults heat map in Mersin

As can be seen in the heat map, it is seen that most of the pipeline faults are concentrated in Akdeniz and Toroslar districts, which are the former settlements of Mersin.

4. Conclusion

According to the results of the heat map, millions of m^3 of water is wasted in these periods when water shortages are at the door. Infrastructures, especially Osmaniye and Çavuşlu Districts of Toroslar District It turns out that drinking water renewal processes should be carried out in the İhsaniye and Nusratiye neighbourhoods of the Akdeniz District. During the collection phase of water breakdown points;

- Continuity of protection and operation by the public
- Effective use of drinking water facilities focused on citizen service
- Ensuring that repair tenders are made to the most troubled areas of the city.

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Author contributions

Hasan Galip Yeşil: Investigation, Methodology, Editing, Application**, Fatma Bünyan Ünel:** Conceptualization, Reviewed and Edited.

Conflicts of interest

The authors declare no conflicts of interest.

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