

# SITE MANAGEMENT WITH FUZZY LOGIC APPROACH

Mehmet Nuri ÖDÜK



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## **PREFACE**

I present this book to my mother and father who have passed away to the hereafter.

**Mehmet Nuri ÖDÜK**



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## INTRODUCTION

Recently, immigration to cities has increased. With the effect of this, the way of life of people and the way of settling in cities have also changed. Cities have left these structures from single-storey detached houses to multi-storey structures over time. Developing technology and related global factors greatly affect human activities. In addition to science and engineering, sectors where consumer behavior is important such as agricultural economy, health sector and white goods are also affected by competition conditions. At the same time, the lifestyle change that came with urbanization, the transformation of family structures into nuclear families, and the coexistence of people from different cultures have caused some problems among people. The problems that arise, the legal regulations on the subject, many laws, decrees, etc. legislation has been made.

On the one hand, the sites and apartments where people will live are designed in accordance with the needs, on the other hand, it has become inevitable to manage these residential areas in a way that meets the common needs. Initially, this issue, which was tried to be carried out on a voluntary basis, has become quite wide in terms of its scope, administrators have not taken their legal responsibilities, etc. For these reasons, it has become a business line where people trained in this field can work professionally. At this point, it is necessary not to consider the management of apartments and estates with their purely legal dimension. Because the apartment and site management has to manage the organization, which includes officials who will perform different tasks, smoothly and effectively. Apartment and site management must keep the expenses and incomes that arise while performing the required activities in a transparent and accountable manner.

In this book, it has been tried to create site management with fuzzy logic approach by making use of computer technologies.

With this study, it allows the processing of numerical and non-numerical criteria affecting values for the solution of site management problems. With the designed model, it will be used in large areas as it provides management with criteria compatible with it.

For this, a study was carried out on the problems with the expert site management in order to determine the factors affecting the output value.

The human brain is the ability to reason according to other living things (Büyükkaracıġan, 2021a).

Fuzzy Logic method is used in every field of science. It has recently been used in the real estate industry.

The scope of fuzzy logic application areas is wide. These apps affect our lives. This Fuzzy Logic method provides an advantage by finding the estimated value of the real estates. It prevents the price increase in the markets and provides to find the real value of the real estate.

Site management is very important today. It has become very important nowadays. So far, advanced computer techniques have not been used in this area.

There are legal gaps in site management in our country and this issue has not been put into a certain system. The goal of this study is to serve the site management well using advanced computer techniques.

Today, the search for a new approach to site management continues. Starting from the computer field, a new one is added to professional applications.

Fuzzy logic techniques, which are the latest work of computer technologies in this wide range, are coming to a conclusion. The way each of these methods works is different. It is to make the computer think like a human brain (Büyükkaracıġan, 2015).

Machine systems, medicine, economics, etc. with the fuzzy logic method. Application examples are frequently encountered in many fields, especially in fields. Its concepts can be expressed mathematically (Sen, 2004).

In the first part of this book, literature research has been done. The works of all scientists in the world are explained. In the second part, artificial neural networks and fuzzy logic terms are given. Detailed books about this are my own at İksad Publishing. In the third

chapter, the basic concepts of site management are explained in general. In the fourth chapter, the site management applications of fuzzy logic and artificial neural networks are explained. Finally, references are given.

## 1. LITERATURE RESEARCH

Tanaka, Uejima, and Asai (1982) suggested in their study that the input and output values are not fuzzy in fuzzy logic.

Diamond (1988) introduced the fuzzy least squares method, similar to the least squares method. He produced a formula equivalent to the normal equation.

Moskowitz and Kim (1993) demonstrated sensitivity to the fuzzy value of the membership function of the diffusion.

Chang and Lee (1996) developed the generalized fuzzy weighted least squares method, which is based on the weighting to be made according to the membership degrees in case of outliers in the sample and interacts with the decision maker.

Wang and Tsaur (2000) found the modified fuzzy least squares method for solving problems with non-fuzzy independent variables and fuzzy dependent variables defined by Tanaka (1982).

Yang and Lin (2002) developed two new estimation methods for fuzzy variables based on fuzzy least squares method. Researchers also emphasized that it is necessary to use cluster analysis to identify heterogeneous datasets and outliers.

Lee and Chen (2003) reconsidered the generalized fuzzy linear regression model and showed that the nonlinear programming model can be used to determine fuzzy parameters.

Altunkaynak, Özer and Çakmakçı (2005) in their study; They aimed to estimate the amount of water demand in the future by considering the 3-period water consumption amount as the independent variable. The mean square error values were calculated for different model structures and the most effective model was selected. In this context, the fuzzy regression analysis model was applied to monthly water consumption fluctuations in Istanbul. As a result of the analyzes made; It was observed that the fuzzy model preserved the statistics. It was also concluded that this model helps to make predictions with a relative error value of less than 10%.

İşbilen Yücel (2005) used the fuzzy method in her application for the estimation of the informal economy. He emphasized that classical analysis methods can provide precise and clear results for the analysis needs of numerical sciences.

Yurtçu and İçağa (2007), in their study examining the fuzzy regression approach; An application has been made with numerical data in order to be an example in the comparison of classical regression and fuzzy regression. In the last part of his studies, information about the development of fuzzy linear regression analysis method is given and a summary of literature research on fuzzy regression analysis applications in the field of hydrology is presented.

Yanartaş (2009) used fuzzy linear regression analysis methods in his study, which deals with fuzzy linear regression analysis methods; analyzed under two main headings as methods based on linear programming and fuzzy least squares method. In the study, tests were carried out using different methods and it was determined that the most effective and preferred method for data with 48 definite inputs and fuzzy outputs was the least square mean method. It was stated that the most preferred method for samples with fuzzy input and fuzzy output was the IDFLS method.

İçen (2010) started by introducing the historical development of fuzzy logic and fuzzy sets; explained the differences between classical and fuzzy set operations, discussed fuzzy linear regression analysis methods and examined fuzzy hypothesis tests. In the application part of the study; The unemployment rate in Turkey was discussed and this rate was estimated with the help of fuzzy linear regression analysis methods, the method of blurring the coefficients and the linear programming method.

Gök (2010) created models using fuzzy linear regression analysis and logistic regression analysis methods, which are two alternative methods to the classical regression analysis method, and made an example application with these models. In practice; The author, who tried both methods for estimating the sector shares of banks, determined that the logistic regression analysis method produced more successful results.

Pan et al. (2011) used pavement conditions with five membership functions and made estimates using fuzzy regression analysis method to explain the uncertainty of classical methods. Researchers constructing estimated fuzzy regression equations on a case study using pavement inspection data; They sought to provide a model that could assist road authorities in determining desired repair actions regarding anticipated pavement conditions.

In their study where they emphasized the importance of fuzzy regression analysis.

Armutlu and Yazıcı (2012) conducted a fuzzy regression analysis with the data of 45 automobile brands, after giving the theoretical information of these analyses, and compared the results they obtained with the EKK method, which is a linear regression analysis method. They stated that it gave better results than the EKK method.

Nowaková and Pokorný (2013), in their study where they discuss interval and fuzzy regression technologies; stated that the linear fuzzy regression model is a more suitable method. Using genetic algorithm coefficients to describe fuzzy regression, the authors also show the probability domain of the uncertain model by presenting a numerical example.

Kaya (2014) in his study; He explained the fuzzy regression model developed by fuzzy logic and fuzzy logic. In the first part of his work; Using the consumption amount and GDP data, the author constructs a consumption function and analyzes it with a fuzzy regression model. Compared the results. In the author's work; observed that fuzzy regression analysis gave better results than classical regression analysis.

Chan and Engelke (2015) proposed a fuzzy regression method that explains the blurring that may occur when blurring due to human judgment is not taken into consideration in the methods for subjective image quality assessment (IQA). Addressing the uncertainty that is often neglected in the development of quality prediction models that relate subjective IQA and objective IQA in evaluation, the authors concluded that; They concluded that fuzzy regression models achieve more effective data fit and better generalization capacity when estimating subjective IQA at different image types and levels.

Yabuuchi (2017) examined the uncertainty possibilities in fuzzy regression models; Assuming that the uncertainty is included in a probability degree, a fuzzy regression model was created to remove the skewness in the data distribution. In this way, the author; It aimed to eliminate the uncertainty of a number and the distortion of models by using numerical examples created with random numbers. At the end of the author's work; He concluded that maximizing the degree of probability and adjusting the uncertainty of a grade allows constructing a fuzzy regression model that accurately describes a system without being affected by outliers.

Feyza Yıldız Yurtal (2019), "Innovation features that are effective in the adoption of information systems used in building and collective structure management: Apsiyon software program example" master's thesis.

Chen and Nien (2020) proposed fuzzy models with fuzzy inputs using fuzzy method. Further valuation methods are as follows.

- 1- Artificial Neural Networks (Artificial Neurula Network-ANNs);
- 2- Fuzzy Logic (Fuzzy Logic);
- 3- Spatial Analysis;
- 4- Self-Decreasing Integrated Mean Motion Method (ARIMA)

Pagourtzi et al. (2003) proposed approaches to human subjects in social sciences.

## 2. ARTIFICIAL NETWORKS AND FUZZY CONTROL

Artificial neural networks learn from the data collected in our brain and create new data. It is computer software that is imitated.

Neural networks take the computation and information processing job from the ability to learn and generalize. Artificial neural networks solve complex problems.

Artificial neural networks are especially used in system control (Ergezer et al., 2003).

Artificial neural networks are made up of nerve cells. Every connection has a value (Ödük & Büyükkaracıgan, 2013).

In this section, these technologies will be examined; Expert Systems: Technology that develops computer programs that can solve a problem in the same way that the experts of that problem solve it. Experts use their knowledge and experience when solving problems. An expert system has four basic elements. These;

- Foundation of knowledge
- Knowledge base
- Inference mechanism
- User interface

Machine Learning: It is computers learning.

Genetic Algorithms: It is a technology used to solve complex optimization problems. In order to solve a problem, first random initial solutions are determined. Then, these solutions can be matched with each other to produce high-performance solutions. The basic elements of a genetic algorithm are chromosome and gene, solution, crossover, mutation, fitness function and reproduction (Öztemel, 2003).

Prediction: This principle predicts the outputs from the input value.

Data Filtering: Finds the best among the obtained data. Classification: The system is faster by classifying the input values.

influences the conclusion.

Data Interpretation: Analyzes pre-trained network inputs,

Thanks to these inputs, new interpretations can be made about the subject. Data Association: Associates the learned information with the subjects and completes the missing information as a result.

ANNs have started to enter every area of our lives with the developing technology day by day. It is used in the fields of automotive, electronics, energy, space sciences, banking, finance and military, especially in the field of health (Büyükkaracıgan, 2022b).

To implement a linguistic control strategy based on human knowledge, Fuzzy Theory is used. While designing control systems, respectively; fuzzy control rules that make up the target, knowledge base are determined and blurring and clarification are done. Fuzzy Theory was proposed in 1965. Shortly after this date, Fuzzy Control developed very quickly.

There are many studies in literature such as, greenhouse automation (Ödük and Allahverdi, 2009), Calculation of concrete strengths (Büyükkaracıgan et al., 2011), Computing and Construction Fields (Akyol et al., 2009), lift system control of high-rise (Akyol et al., 2011), Modeling the rainfall-flow relationship (Büyükkaracıgan, 2021b).

Fuzzy logic is mostly used in control areas. Fuzzy logic is knowledge and rule based systems. The mathematical model controls the system. Most systems derive mathematical models. Fuzzy ravioli consists of 0 and 1 (Erkan 1999).

## **2.1. Fuzzy Logic Applications**

It uses in various artificial intelligence systems and technologies. This includes vehicle intelligence, consumer electronics, pharmaceuticals, software, chemicals and aerospace (Büyükkaracıgan, 2022a) .

It is used for gear selection in cars and is based on factors such as engine load, road conditions and driving style.

It is used in dishwashers to determine the required washing strategy and power depending on factors such as the number of dishes and the level of food residues on the dishes.

It is used in copiers to adjust the drum voltage according to factors such as humidity, picture density and temperature.

In aviation it is used to manage altitude control for satellites and spacecraft based on environmental factors.

In medicine, it is used for computer-assisted diagnostics based on factors such as symptoms and medical history.

It is used in chemical distillation to control pH and temperature variables.

It is used in natural language processing to determine semantic relationships between concepts represented by words and other linguistic variables.

It is used in environmental control systems such as air conditioners and heaters. It determines the output based on factors such as current temperature and target temperature.

It can be used in a business rules engine to facilitate decision making based on predetermined criteria.

## **2.2 Advantages and Disadvantages of Fuzzy Logic**

Fuzzy logic is often used in artificial intelligence and can be applied to trading software as well. Although it has a wide range of applications, it also has important limitations. Because it mimics the human decision-making process, it is most useful for modeling complex problems with ambiguous or distorted inputs. Because of its similarities with natural language, fuzzy logic algorithms are easier to code than standard logic programming. It even requires fewer instructions, thus saving on memory storage requirements. These advantages come with disadvantages due to the imprecise nature of fuzzy logic. Because systems are designed for erroneous data and input, they must be tested and verified to avoid erroneous results.

Fuzzy Logic Advantages;

Fuzzy logic is more likely to reflect real world problems than classical logic.

Fuzzy logic algorithms have lower hardware requirements than classical boolean (algebraic) logic.

Fuzzy algorithms can produce accurate results with imprecise or inaccurate data.

Disadvantages of Fuzzy Logic;

Fuzzy algorithms require extensive validation and validation.

Fuzzy control systems depend on human expertise and knowledge.

### **3. SITE MANAGEMENT**

The site management is generally concerned with the realization of maintenance, repair and modification works in order to improve the common areas within the site. Site management is a form of organizational business. The most important purpose of the enterprises, which is determined during the establishment phase, is to continue their existence (Karasioğlu and Kınalı, 2022).

#### **3.1. Historical Development of Mass Housing Structure in Turkey**

One of the benefits of the transition to settled life was the need for shelter. People, snow, rain, temperature, etc. In order to be protected from environmental conditions, they have created shelters such as caves and tree hollows. It can be clearly observed how factors such as natural structure, foreign relations, invasion or migration throughout history have affected the form and meaning of the dwelling; Since the earliest times, political and economic power and ideologies have also caused changes in housing ( Tümer & Dostoğlu, 2008, p. 1).

The reflection of the changes in the housing sector to the definition of housing is explained with the following definitions.

Developed, industrialized countries are largely urbanized countries with a reduced rural population. Therefore, it is not faced with a rural migration and the unemployment pressure it will cause. However, the problem continues for countries where a significant part of the population is in rural area (Altınışik, 2008).

Housing meets the basic needs of people (Yalçın, 2016, p. 10).

Housing is a more or less closed, physically large, safe shelter where people are protected from bad weather conditions, enemies and dangers, and meet their basic needs such as rest, nutrition and clothing (Kurt, 2015, p. 5).

In its historical development, housing has emerged as a dynamic collection of relations, depending on the natural conditions, the traditions and customs of the society, the characteristics of the political structure, the production relations and form, the population structure,

its increase and characteristics, the urbanization model and many other reasons (IMO, 2011, p. p. 181).

When all these totals are evaluated, if it is necessary to summarize the change and development in the definition of housing; Housing;

- 1- The building blocks of society are social,
- 2- In terms of creating a spatial integrity in meeting the shelter needs of people, physical,
- 3- In terms of individuals and families uniting to form society and social activities, social,
- 4- Administrative, in terms of laying the ground work for urbanization policies,
- 5- As they form a certain class structure and are affected by the characteristics of the political structure, political,
- 6- Economic value in terms of production, consumption and being an investment tool,
- 7- Having legal grounds for their structuring and management is legal,
- 8- It is a technological structure in terms of being affected by technological developments and changes.

In a social order, it is important to consider it as a "basic need" that there are vital areas where individuals are separated from the society and exhibit their private life needs in their own way, the concept of family, which is the smallest unit of the society, and the areas where the individual and society are established basic relations within the family. The importance of this basic need can be understood by the fact that it is included in many international declarations. This importance, which is not limited to international declarations, is stated in article 21 of the Constitution of the Republic of Turkey in our country: "No one's home can be touched. Unless there is a judge's decision duly given for one or more of the reasons such as national security, public order, prevention of crime, protection of general health and morals or protection of the rights and freedoms of others; unless there is a written order of the authority authorized by law in cases where delay is inconvenient due to these reasons; No one's residence can be entered, searched, or property confiscated." protected with.

The two important turning points of the urbanization process in Turkey were the proclamation of the Republic and the 2nd World War. The housing development process in our country has been discussed at certain intervals in the studies examined.

### **3.1.1. Before 1950**

It is the period in which the population of the country, where urbanization has not yet been experienced intensively, is mostly in rural areas and villages. From the proclamation of the Republic to the Second World War (1939), there was a lack of budget to be allocated for housing. The war-torn country has focused on the use of existing housing rather than new housing. However, the fact that the rate of urbanization is higher in Ankara, the capital city, compared to other cities, has led to the formation of movements related to housing construction here. As Ankara's growth and housing problems increase, it has become a necessity to deal with them in an organized manner. The Directorate of Reconstruction was established in 1928, Emlak ve Eytam Bank was established in 1926 to provide loans for new housing constructions, a special law was enacted authorizing the Ministry of Finance to have civil servants' residences built, and İmar Bank was established (Cantürk, 2016, p. 1).

The obligation to prepare zoning plans by the municipalities was determined in these years. Although the state tried to solve the planning and housing problem with various laws until the 1930s, the state could not be an active actor in housing production due to the problems in organization and lack of sufficient capital (Koca, 2015, p. 21).

The country's urban population, which had a very slow increase until 1950 (with its own internal dynamics), entered a very rapid growth process after this date as a result of the dissolution caused by the structural transformations in the rural areas, causing intense migration to the cities (Işık, 2005, p. 58). ).

### **3.1.2. Development between 1950-1980**

Industrialization, which is effective all over the world, has also shown its effect in our country. With the mechanization, people who could not find jobs in agricultural areas turned to cities. Intensive migration from rural areas to cities has led to the formation of distorted

structures in cities. This situation has also increased the need for housing with the increasing urban population. In order to meet the need, the understanding of cooperatives was born in this period. Housing cooperatives started to produce housing with the support of the Turkish Real Estate Credit Bank and the Ministry of Housing and Housing (Kurt, 2015, p. 17).

Both the officialization of the increasing squatting, the spread of apartments with the laws enacted to reduce the demand for slums, the efforts made by the state to make new urban residents in the lower income group homeowners, caused the need for some laws to be enacted between these years. The Building Construction Incentive Law No. 6188 in 1953, the Property Ownership Law of 1965, and the Slum Law No. 7755 in 1966 entered into force in this period and tried to prevent the distortion that occurred in the urbanization process. At this point, the importance of independent servitudes and independent areas has increased with the Condominium Law. In the pre-KMK period, the important thing is the whole of the structure.

In addition, the state; In the article 49 of the 1961 Constitution, “The state takes measures to meet the housing needs of poor or low-income families in accordance with their health conditions.” By including the phrase, it extended a hand to low-income citizens.

In particular, the start of structuring in multiple blocks was with the Cooperatives Law, which entered into force in 1969.

Especially after the Condominium Ownership Law, the shift of housing production from the state to the private sector producer and the fact that it can be sold in units caused the housing to be seen as a profitable commodity (Koca, 2015, p. 25).

### **3.1.3. Development Between 1980-1995**

The 1980s were a period in which political developments in Turkey and the world led to fundamental changes in economic policies, along with the formation of different lifestyles (Cantürk, 2016, p. 4).

With the regulations made in this period, small investors were removed from the housing market and taken into the hands of the state. It is the period in which mass housing increases rapidly. However, the

demand for mass housing has been the reason for the increase in the irregularity in the city centers due to the illegal rise in the slum areas in the city, the rise without calculation without infrastructure works. This situation brought with it the necessity of intervention. The Mass Housing Law, which entered into force in 1981, aimed both to ensure the formation of regular cities and to have low-income citizens own houses. In the 1982 constitution, it was stated that the state would take measures to meet the housing needs, that the enterprises related to mass housing would be supported by the state, and that it would make plans considering the city and environmental conditions in this framework. One of the most important breakthroughs of this period was the establishment of the Mass Housing Administration (TOKİ) in 1984. The function of the Housing Development Administration; It has been determined to ensure that the rapidly increasing housing demand is met in a planned manner by encouraging the housing production sector in Turkey (Yalçın, 2016, p. 42).

However, in 1990, it was organized as two separate administrations, namely the Housing Development Administration and the Public Partnership Administration, with the Decree Laws numbered 412 and 414. The inclusion of the Mass Housing Fund within the scope of the General Budget in 1993 prevented the mass housing administration from meeting the need for adequate housing production in the country.

#### **3.1.4. Development since 1995**

The Marmara earthquake in 1999 brought the issue of the durability of the housing structure to the agenda. The result of this natural disaster has found a response in the housing sector as "Urban Transformation". Slums or illegal buildings that have turned into apartments, which cause unplanned structuring in the inner city, and consolidation works with Urban Transformation have meant a step of innovation in planned urbanization as an implicit reason. Collective structures formed out of the cities have returned to the city again thanks to this. During this period, legal studies were carried out for the expansion of Urban Transformation; Law No. 5366 on the Renewal, Protection and Use of Worn Historical and Cultural Immovable Assets, Law No. 5393 on Municipalities, Law No. 6306 on Transformation of Areas Under Disaster Risk were created for this purpose. Within the

scope of Urban Transformation, the state has authorized Toki to set a model for other players in the housing sector.

In this period, the housing works carried out by TOKİ have ceased to be aimed only at low-income citizens. Housing works with social facilities for all social segments have started. In 2007, new additions were made to the Condominium Ownership Law, which was insufficient in solving the problems related to the management of the increasing number of socially equipped housing projects, and the concept of "Collective Building" was passed into law.

### **3.2. Mass Housing Administration (TOKİ)**

The Mass Housing Administration continues its work today in order to meet the increasing housing needs and to meet the housing needs of low and middle income citizens. In order to meet the increasing housing need in a planned manner, TOKİ's duties are determined as follows.

The duties of the Mass Housing Administration are defined in the Law No. 2985. If we evaluate it in a general framework, within the framework of relevant laws and regulations;

- 1- Developing housing projects in the country or abroad with its own hands or through its affiliates.
- 2- To carry out the social and infrastructure works required for housing projects.
- 3- Establishing a company or accompanying established companies for the development of the housing sector.
- 4- To support the industry developing around the housing sector and other structures working in this field.
- 5- To carry out urban transformation practices, to ensure the restructuring of houses in disaster areas, to transform slum areas,
- 6-. It can be listed as making plans for the necessary architectural order and giving credits for these processes.

TOKİ; After the stagnation period that continued until 1993; Until 2002, it provided financing support to 29,950 housing units. On its own land, it has completed the construction of 43,145 houses and has benefited from the opportunities provided by the Mass Housing

Fund in these transactions. In 2011, they achieved their target of 500,000 residences. By 2023, they have set their total target as 1,200,000 houses, by gaining 700,000 more houses.

The Mass Housing Administration (TOKİ), which was established in 1984 for the provision of mass structures by the state, is also the leading actor for urban transformation activities today. Together with the 10th Development Plan, TOKİ also plays an important role in urban transformations in order to standardize living spaces for different income levels, to eliminate social differences and to ensure the quality and spatial integrity of structures that are at risk in disasters.

### **3.3. Real Estate Investment Trust (REIT)**

According to Article 4 of the Communiqué on Principles Regarding Real Estate Investment Partners; Real estate investment trust, within the framework of the activities established to issue its shares for the purpose of operating the portfolio consisting of real estates, real estate projects, rights based on real estate, capital market instruments and other assets and rights to be determined by the Board, within the framework of the activities outlined in Article 48 of the Law, within the procedures and principles determined by this communiqué. It is a capital market institution that can engage in other activities permitted in this Communiqué, provided that the By managing the portfolios they have created, they aim to obtain rental income or income from trading related to these portfolios. However, they cannot make short-term trades.

They cannot undertake the construction-related operations themselves, and it is forbidden to have machinery and equipment related to these operations.

Besides these restrictions; They also have the privilege of being exempt from corporate tax.

REITs need to be established as joint stock companies, and structures that are already joint stock companies can turn into REITs.

The fields of activity of REITs are regulated in the Capital Markets Law No. 6362 and they can operate within this framework.

The functioning of REITs; The fields of activity of REITs that raise funds by offering their shares to the public and invest the funds they collect in real estate; buying real estate that provides rent, investing in asset-backed securities, financing mass construction projects and constructions (Şarkaya, 2007, p. 176).

### **3.4. Cooperatives**

Special importance has been attached to cooperatives with their structuring function aimed at making the inadequacy of the capital structures of the broad masses of the people self-sufficient through associations and creating a national community base that can stand upright (Günay, 2009, p. 34).

Cooperatives aim to solve the economic and social problems that the individual cannot solve alone (Everest & Yercan, 2012, p. 1032).

In other words; Cooperatives are the collaboration method of individually insufficient labor and capital to create power for larger investments by combining them.

Cooperatives; It is a platform that can develop democracy as a form of culture and understanding, when it is understood as democratic institutions managed and supervised by their equal partners participating in market preferences and decision-making processes, with equal voting rights (one vote for each partner) and managing the cooperative together with the participation of the partners (T.R. Ministry of Customs and Trade, 2017, p. 3).

Although there is an understanding of cooperatives operating in many areas, Housing cooperatives are discussed in accordance with the scope of this study. These structures were formed by the gathering of entrepreneurs with small capital and operated in the form of housing production on a local basis (Kurt, 2015, p. 30).

Although the foundation for housing cooperatives dates back to the founding periods of the Republic, it gained momentum with the Cooperatives Law published in 1969. Although the increase in credit support in the 80s increased the speed of the housing cooperative structuring, it did not have enough power today due to the

establishment of the Mass Housing Administration and the greater support given.

### **3.5. Mass Housing (Building) Concept**

The fact that the housing sector is effective on inflation, financial markets, balance of payments and the state budget increases the economic importance of the sector (Kurt, 2015, p. 22).

The concept of housing, which has changed due to many social, political, natural and technological reasons since the foundation of the Republic, has left its place to mass housing structures. In addition, in terms of finance and accounting, businesses should primarily stop showing environmental factors as expenses in traditional accounting records and keep separate records for environmental factors (Kınalı, 2021).

According to the definition made by the Turkish Language Institution, it is “the whole of the structures created with the loan aids and contributions provided by the state to the citizens in a certain pre-planned settlement area” (Turkish Language Institution, 2019).

Collective Structure; It refers to the housing, infrastructure, common places, commercial, cultural and social facilities and their service places built or to be built according to a specific settlement plan on one or more main immovables, and the public area that is not subject to condominium ownership (Antalya, 1998, p. 106).

In the Property Ownership Law (art. 66), Collective Structure;” It refers to more than one structure, which is built or to be built according to a certain approved settlement plan, on one or more zoning parcels, and is interconnected in terms of infrastructure facilities, common areas, social facilities and services, and their management.” defined as.

In order for a building to be considered a collective structure, it must meet the following conditions;

- 1- There must be more than one building on one or more zoning parcels.

- 2- These buildings should be connected with each other in terms of infrastructure facilities, common areas, social facilities and services.
- 3-. They must be affiliated to the same management for the infrastructure facilities, common areas and social facilities they are connected to.

The exception to this condition is stated in article 66 of the Condominium Ownership Law as follows: “However, this condition is not sought for the places between these parcels and allocated to the public, such as roads, squares, green areas, parks, car parks, according to the zoning plan.”

The areas reserved for the public among the buildings built on more than one parcel do not spoil the collective structure of the relevant building. However, if there is a special structuring, land or building belonging to a different person among the relevant zoning parcels, it is not possible to talk about a collective building.

According to Altıntaş (Cezaoğlu, 2010, p. 21), the reasons for mass housing are social, economic and planning. Social reasons; It is to ensure integration by gathering social structures consisting of individuals and families within the framework of neighborhood relations. In terms of economy, multi-dwelling buildings built on a single plot of land can be considered as the reason for the decrease in land costs and providing ease of payment by taking advantage of certain credit opportunities within the framework of mass housing. In planning, the fact that there are various social areas suitable for urban planning and for the benefit of the individuals living in them can be counted as one of the reasons for the formation of mass housing.

### **3.6. The Place of Building and Collective Structure Management in the Turkish Legal System**

In the section on housing development, many incentive and regulatory laws for the housing sector are mentioned. Migration after the war brought with it housing shortage, illegal construction, slums and unplanned growing cities (Yıldırım, 2012, p. 1).

The reasons such as increasing population, urbanization, urban transformation and changing human needs, which form the basis of all

these changes, brought along the necessity of forming a planning. In order to manage this planning in a certain order, laws are enacted and zoning plan studies are carried out for the public benefit.

What is wanted to be mentioned under this topic is to evaluate the legal framework of the regulations brought by the maintenance and repair, operating cost sharing and collective living after the settlement in collective buildings rather than housing construction. The first step of the legal regulation that emerged with the formation of collective Competition conditions brought about by globalization and technological developments also affect e structures in Turkey has been tried to be resolved within the Turkish Civil Code.

Issues related to the management of the main real estate and condominium are discussed in the Civil Code under the Title of the Fourth Book - Property Law; The content of the Right to Property, Scope of the Property Right, and Joint Ownership have been evaluated under the headings. Provisions on neighborhood relations are discussed under the title of Second Separation-Restrictions of Immovable Ownership.

However, the inadequacy of the relevant laws and the "condominium ownership", which needs a unique list of rules, was tried to be resolved with the entry into force of the Condominium Ownership Law, which was accepted in 1965, in 1966.

However, the Property Ownership Law was able to solve the problems of apartments with few independent areas. This inadequacy has caused the law to remain unanswered in terms of maintenance, repair and operating expenses of the areas allocated to the common use of more than one building built on the same parcel, as well as the sharing of all these. In order to be able to carry out these transactions, to create the right expense sharing, and to legalize more than one building built on a parcel, we have added the additional article 3 under the title of "Special provisions to be applied in more than one building" to the Condominium Law No. 2814 of 13.04.1983. and thus the application of more than one building on a parcel also gained a legal basis (Şengül, 2010, p. 8).

The amendments made with Law No. 2814 were repealed in 2007 with the enactment of Law No. 57113.

New articles on Collective Buildings took their current form with Law No. 5711. Thus, collective structures could find a place for themselves with the comprehensive amendment made to the relevant law in 2007.

The basic framework of both collective building management and building management is the Condominium Law No. 634. The rights and obligations of the flat owners, the duties of the manager, the obligation to account, the form and conditions of the ordinary and extraordinary meetings, voting procedures and quorums, prohibited works, definitions of common places and places, the scope of the works to be done, Principles regarding the management of collective buildings. is formed within the framework of the law. However, it still does not have sufficient imperative provisions for the solution of questions or problems that it cannot answer in the field of collective structure. Disputes are tried to be resolved with many sub-branches such as Code of Obligations, Tax Code, Penal Laws, regulations regarding Technical Maintenance and Operation, Supreme Court decisions, precedent cases.

### **3.7. Building and Mass Building Management**

Despite the frequent changes in the world, companies want to maintain their position and continue their existence by keeping up with these changes. Today, while institutions need more time and work to achieve their main goals, they can delegate all their business activities to specialist organizations in order to increase the efficiency of their facilities (Baskin, 2015).

At this point, the issue of facility management comes into play.

Facility management; It is a multidisciplinary profession that considers the integration between people, spaces, processes and technological components in order to ensure the functionality of built structures and facilities (Demirtaş, 2015).

It is a multi-disciplinary profession to ensure its functionality, comfort, safety and efficiency (www.ifma.org, 1998-2019).

Facility Management sector; management, inspection, security, technical, maintenance, cleaning, waste, garden, landscaping, finance,

law, informatics, pest control, fitness, customer relations, software, training, consultancy, etc. services such as elevator, escalator, exterior cleaning units, heating boiler, cooling group, ventilation plant, air conditioner, fan-coil unit, heat station, calorimeter, counter, water cooling tower, cctv, camera, access control system, turnstile, barrier, valve, pump, booster, expansion tank, heat exchanger, lighting, transformer, ag/og cells, generator, fire panel, fire pump, detector, pool, spa, decoration, work clothes, kitchen equipment etc. It is a very comprehensive sector that covers different products (Alathl, 2019).

The concept of facility management, which has a place in many areas from the production and service sector, besides the disciplines in the definition, the companies in this field save the structures they support by providing consultancy in many areas. The concept of Facility Management began to be heard in Turkey towards the end of the 90s. In the mid-2000s, it started to become widespread with the emergence of new application areas and the entry of foreign companies into the sector. (Baskin, 2015).

Facility Management areas can be listed as factories, shopping malls, hospitals, collective buildings, hotels, institutions and organizations, production centers, residences, sites and buildings. The Facility Management area, which will be evaluated in this study, is limited to the management of buildings / collective structures.

In addition to feeling more secure in the area they live in, people's desire to spend their time outside of work productively due to the worsening of urbanization and working conditions causes them to seek living spaces where they can meet all these needs. Over time, this quest with coexistence, migrations and urbanization movements has found its way in multi-storey residences and social facilities. Individual lives in single-storey residences have turned into “communal living” areas rising towards the sky, where more people can live on less land. With these changes, besides the urge to shelter and feel safe, living spaces; It has also become a symbol of gaining respectability and social acceptance. These areas, on the other hand, are called closed housing settlements, in the study of Tümer and Dostoğlu; According to the definition made by the International Facility Management Association (IFMA), which is open to the public, surrounded by walls, railings or barriers; Facility management (FM) is defined as settlements that do not have a built environment, are protected by security demands, have a

controlled entrance, and are managed by their own private management by integrating people, places, processes and technology (Tumer & Dostoglu, 2008, p. 54).

In the changing world conditions; Housing and collective structures, which are of great importance for people in terms of social, security, economic and accommodation, are set to certain standards, ensuring that the people living in them continue their lives at a certain level of welfare and security, "management in buildings and collective structures". " puts its activity on the agenda.

Site management; The Property Ownership Law No. 634 and the "Management Plan" indexed to this law, the "Manager/Management Boards" appointed or elected within the framework of other laws and regulations referred to by this law, "Auditors/Supervisory Boards", "Home Owners General Boards", Councils of Representatives, etc. in a legal-financial-administrative-social dimension in the subjects and areas defined through the governing body, in the personnel-material-education-procedure quadratic; four basic services consisting of security, cleaning, technical and administrative works; It is the process of performing administrative and field services, open to the intervention of the judge, within the framework of legislation with a balanced budget approach, based on a vision that increases residents satisfaction and real estate value (Aydın & Dönmez, 2011, p. 5).

As can be seen in the definition, building/collective structure management is a form of administration that combines many disciplines such as law, technique, finance, accounting, human resources, technology and purchasing.

The housing structure, which has changed over the years, and the technical equipment added to these houses have created the need for management. Technical developments such as the existence of boiler rooms in the period of single-block apartments, the transformation of these boiler rooms into fuel oil with time and changing technology, and their transformation into natural gas, again affected by technological changes, necessitated intervention by people with technical knowledge other than those working as a central heating boiler. Such reasons have also ceased to be issues that neighbors can put in order among themselves. The increase in the number of flats and the rupture of neighborly relations made it difficult to coordinate these processes

technically and administratively. Technical changes such as the existence of elevator, generator, hydrophore, VRV systems, heating and cooling systems in buildings and the difficulty of managerial activities necessitated the continuation of all these process managements in a certain hierarchy or with the help of a professional hand from outside.

The management of housing projects, which have the budget and functions of an enterprise, are aimed at meeting the desire of the residents of the estate, even if they do not seek profit, to socialize their spare time, to live with their neighbors in an environment of security and peace, and to try to keep the budget and functions in a balance of minimum cost and maximum quality / satisfaction. At the same time, they have objectives such as protecting the material values-brand value of housing projects, meeting the essential needs such as maintenance and repair, determining the operating expenses correctly and realizing all these on the basis of law. To be able to monitor all these processes through a single channel and to be managed in an integrated manner requires different areas of expertise. The combination of the required fields of expertise increases the importance of the need for building/collective building administrators and management firms.

At the emergence of each facility; There are processes of formation until the building loses its quality, such as designing, projecting, constructing and starting the session. Since collective buildings are also a facility, their life cycles are the same. Within this cycle process, management support should start from the construction stages of constructions and continue until the process of architectural projects, budgeting, supply chain management, sales and rental, residence and construction (termination of condominium or construction servitude). Unfortunately, the need for management in our country is felt only after the "session" has started. Of course, the most active slice in this process is the period from the start of the residence to the end of the property. However, the creation of estimated management scenarios during the construction phase will increase the satisfaction in the session process, and the management activity will be facilitated with predictive processes.

One of the reasons affecting the sales of flats today is the amount of dues. People do not want to pay high dues. In order to avoid such situations, estimated management scenarios should be created by

obtaining management consultancy at the beginning of the building construction and even at the architectural drawing stage. In addition, the activities regulating neighborhood relations within the building, the election procedure and task framework of the administrations, the technical specifications that will ensure the longevity of the building, the measures to protect the brand value of the building should be determined at this stage and included in the Management plan. This can only be achieved by obtaining management consultancy at the design stage.

For the management of a building that has reached the stage of life, in Article 27 of the Property Ownership Law, “The main real estate is managed by the Board of Flat Owners and the management style is decided by this board, without prejudice to the mandatory provisions of the laws.” has a provision. As it can be understood from this provision, the main thing in the management is the floor owners board and the decisions made by this board. Decisions made by the Board are implemented as long as they are not contrary to the laws of the Republic of Turkey and unless otherwise stated in the management plan. Some meetings are required for the decisions to be made by the Board. These meetings are called Ordinary General Assembly Meeting and Extraordinary General Assembly Meeting. Ordinary General Assembly Meetings are periodic meetings held in January every year, if there is no specified time in the management plan. The separation of meeting times for collective buildings and buildings other than mass buildings is Article 29 of the Property Ownership Law: “The condominium owners' board convenes at the times indicated in the management plan, not less than once a year, within the first month of each calendar year if such a time is not indicated. In collective structures, on the other hand, the boards convene at the times indicated in the management plans, not less than once every two years, or within the first month of the second calendar year if such a time is not indicated. Was determined as “.

Extraordinary General Assembly Meetings, on the other hand, are held at the request of the manager or auditor or 1/3 of the floor owners board in cases where an important situation needs to be evaluated and resolved at times other than the Ordinary General Assembly Meeting.

In order for the meetings held and the decisions taken at this meeting to be valid, they must meet some form requirements of the

Condominium Ownership Law. If it is necessary to summarize these form conditions on the table;

**Table 1.** Form Conditions for Ordinary and Extraordinary General Assembly Meetings

	<b>ORDINARY GENERAL ASSEMBLY</b>	<b>EXTRAORDINARY GENERAL ASSEMBLY</b>
Meeting Call	15 days before meeting date	15 days before meeting date
Agenda	No obligation to specify	The agenda for the decisions intended to be taken at the meeting is clearly stated. Decisions out of the agenda can be taken upon the request of 3/1 of the participants.
Meeting Opening	It is collected with more than half of the floor owners in terms of number and land share. If a majority cannot be achieved in the first meeting, the second meeting is held.	It is collected with more than half of the floor owners in terms of number and land share. If a majority cannot be achieved in the first meeting, the second meeting is held.
Number of days between meetings	Not less than 7 days, not more than 15 days.	It cannot be less than 7 days and more than 15 days.

As stated in the table, a call letter must be sent 15 days before the meeting date for both meetings. Here, the Ordinary and Extraordinary Meeting distinction; It is obligatory to specify the topics to be discussed as an agenda item in the call letter sent for the Extraordinary General Assembly. In order for both meetings to be held and decisions to be taken, article 30 of the Condominium Ownership Law: "The floor owners' board convenes with more than half of the floor owners in terms of number and land share and decides by majority of the votes." condition must be met. If this condition is not met in the first meeting, a

second meeting is required. The time period between the two meetings is less than seven days; should not exceed fifteen days. In addition, the place and time of the second meeting to be held in case the quorum is not achieved must be stated beforehand in the invitation letter sent.

Another factor to be considered during this meeting is the decision quorum. As stated in the law, some decisions can be made by majority vote, some decisions by unanimous vote, and some decisions can be made with the vote rates determined in the law.

### **3.7.1. Decision Quorums**

#### **3.7.1.1. Decisions Requiring Majority of Number and Land Share**

##### **a) Appointment of manager and auditor**

Pursuant to Articles 34 and 41 of the Condominium Ownership Law, the majority of the number and land share of the flat owners is required in order to select the manager and auditor in the management of the main real estate.

##### **b) Innovation and additions**

Property Ownership Law; It points out that decisions to be taken regarding useful innovations should be made mostly in terms of number and land share. In the areas allocated for common use, the flat owners cannot make changes individually. The benefit to be obtained from a common area and the innovations to be made in order to increase this benefit can be decided by the number and the number of land shares.

#### **3.7.1.2. Decisions requiring a Four-Fifths (4/5) Majority**

The management plan prepared for a building is a contract that binds all flat owners. Changing a document of such importance can only be possible with a decision to be taken by a majority. The rate of the relevant majority is again specified as a four-fifths majority in the Condominium Ownership Law.

### **3.7.1.3. Decisions to be taken by unanimous vote**

While some innovations and additions can be decided by majority vote, unanimity is required for some innovations and additions. If the change / improvement to be made here affects all floor owners, the logic of unanimity is sought will not be wrong. Regarding this issue, it is clearly stated in the law that a unanimous decision must be taken in the transition from the central system to the individual heating system for buildings with a total construction area of more than two thousand square meters. Moving from the central system to the individual system, starting from the provision, is a decision that will affect all floor owners.

The Property Ownership Law has evaluated some transactions under the title of prohibited works. The important point here is that the consent of all flat owners is sought in structures that will operate commercially or that may cause discomfort in terms of health and noise in buildings where the title deed has been registered. In the prohibited business section, such businesses; entertainment and meeting places such as cinemas, theatres, coffee houses, casinos, pavilions, bars, clubs, dance halls and similar places; , is indicated as.

Independent areas to be added to the main structure later are also among the decisions to be taken unanimously. Since the independent sections to be added to the main structure later will affect the land shares of all floor owners positively or negatively, a unanimous vote is required. Not only for the independent section to be built later, but also for the land shares to be determined after the construction of this independent section is completed, must be unanimously approved.

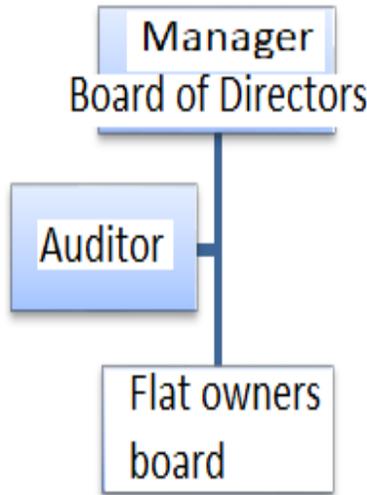
Assignment Dispositions and important works: Article 45: Assignment dispositions such as registration of the main real estate with a right or division of the land and transfer of the ownership of the divided part to someone else, or important management works such as renting the outer walls, roof or roof of the main building for advertising purposes only upon the unanimous decision of all floor owners. can be done.

In order for the decisions taken during the meetings to be considered legally valid, the decision quorums should be taken into consideration.

### **3.7.2. Manager-Auditor Selection and Duties**

By law, it is obligatory to establish management in structures with more than 8 independent areas. The manager can be chosen as a single person or as a board, or can be chosen from outside or among the floor owners. The manager elected in the meetings held has all the responsibilities and rights as a proxy against the floor owners board, and a majority in terms of number and land share is required for the manager to be elected. In addition to the duties of the manager, he also has some legal responsibilities. The Property Ownership Law has addressed this issue under the title of Accountability. First of all, the management plan was pointed out for the accountability of the manager, and in cases where there is no provision in the management plan, it was stated that the manager should be accountable for the activities and income and expense accounts of the floor owners board at the general assembly meetings held in January every year. Except for these specified periods, the manager can always be asked to show the accounts related to income and expenses, upon request of half of the floor owners. Accountability of the manager is done through the auditor. Auditor selection should be made mostly in terms of number and land share, as in the selection of managers. The distinction here is that the supervisory or supervisory board can only be selected from among the flat owners. The auditor or members of the supervisory board, the manager or the board of directors, at the times specified in the management plan; If such a time is not specified, it has the authority to audit every three months or in case of a justifiable reason. The Audit or Board of Auditors writes down the findings obtained as a result of the audits as an “Audit Report” and signs it. This report is communicated to all floor owners and informed.

After the Manager / Board of Directors and Auditor Supervisory Board made in the building managements, the hierarchy of the relevant building is formed as in Figure 3.1.



**Figure 3.1.** Hierarchical structure of building management

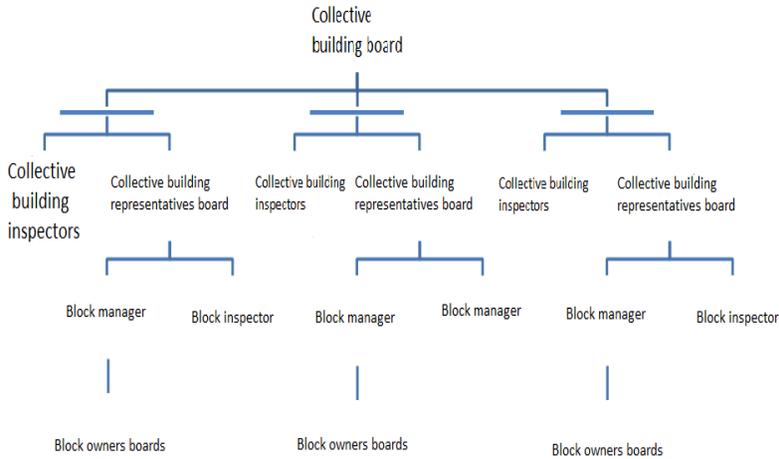
In Collective Buildings, the formation of the management body proceeds more hierarchically than the building management selection. In order for the management bodies to be formed in Collective Buildings;

1- The Block Floor Owners Board selects the block manager. Selections are made for the areas where the block structures are located and for the solution of the problems that occur within the block. KMK art. 71 : “The block manager and supervisor, the floor owners in the block; For the common places and facilities of non-block buildings, the manager and the auditor are elected by the majority of the flat owners in these buildings in terms of number and land share.

2- Collective Building Representatives Board, on the other hand, elects managers for common areas and facilities within the scope of collective building. KMK art. 71: “For all common structures, places and facilities within the scope of the collective structure, the manager and the auditor are appointed by the absolute majority of the managers and representatives participating in the collective structure representatives' board, of the number of independent sections they manage and represent.”

“Block supervisor” for auditing selected Block Managements; An auditor/supervisory board body is also established for the auditing of

the Collective Building Representatives Board. The hierarchical formation of collective structures is as follows;



**Figure 3.2.** Mass Building Management Hierarchical structure

The mandate of the management; “In condominium, the activity area of the joint management is the main real estate and especially the common places within this real estate (Antalya, 1998, p. 109).

Common areas are the general areas of use, which are allocated for the common use of all people in the building, and are outside the independent section. As stated in Article 4 of the Condominium Law Common Places; The subject of common places can be specified in the contract. The places and things written below are in any case considered common places in accordance with this Law.

- 1- Foundations and main walls, beams, columns and curtain walls forming the carrier system and other elements that are part of the carrier system, common walls separating independent sections, ceilings and floors, courtyards, general entrance doors, vestibules, stairs, elevators, landings, corridors and public toilets and sinks, concierge flats or rooms, general laundry and laundry drying areas, general coal storage and communal garages, sockets and closed parts outside the independent section for the protection of electricity, water and gas hours, heating rooms, wells and cisterns, general water tanks, bunkers,(1)

- 2- Sewerage facilities and garbage ducts, heating, water, gas and electricity facilities, common networks and antennas for telephone, radio and television, hot and cold air facilities outside of each floor owner's own section,
- 3-Roofs, chimneys, general roof terraces, rain gutters, fire safety ladders.
- 4- Apart from the ones listed above, other places and things that are essential for joint use, protection or benefit are also included in the subject of (Common place).

The common areas are registered in the title deeds of the independent section owners in proportion to their land shares, and when the independent area is transferred, it is automatically transferred to the new owner. In addition to the common areas specified in the Condominium Ownership Law in a general framework, the nature of the collective buildings and their technical equipment, social areas and equipment should also be taken into account, and the "things" that are subject to common use within the building should be considered as common areas. Because another important sub-title of management and operation services is technical operation and maintenance/repair activities. Keeping the equipment used efficiently, following the warranty terms and durations, arranging personnel trainings related to usage, performing legally compulsory tests and inspections, periodic controls and inspections related to the performance of technical equipment, detecting deficiencies and planning new investments, maintenance/ Coordination of repair works, preparation of emergency plans for quick and effective solution of unexpected technical problems are included in this title (Demirtaş, 2015, p. 3).

The scope of management activity in building and collective structure management is to ensure the maintenance, repair and operation of the main real estate and common areas. In this context, when it is considered that each structure has its own culture, unique technical equipment and responsibilities, the managerial duties and responsibilities specified in the "Management plan" gain great importance. As a matter of fact, the Condominium Ownership Law primarily points to the job description in the management plan. The Management Plan is a list of rules that are in the nature of the constitution of the buildings. It includes management rules specific to

the relevant structure, meeting times, managerial duties, and even technical specifications in some complex structures.

The importance of the Management Plan is mentioned in the Property Ownership Law; Payables of the Flat Owners Art. 18 “The floor owners are mutually obliged to comply with the provisions of the Management Plan” and Art. 28 “The management plan regulates the management style, the purpose and form of use, the fee to be received by the managers and auditors, and other matters pertaining to the management. The management plan is in the form of a contract that binds all the flat owners.” gains from the items.

To evaluate in the general framework, if necessary, the duties of the Manager;

- 1- Observing the general maintenance and repair processes,
- 2- Implementation of the decisions taken by the floor owners board,
- 3- To ensure that the building is used in accordance with its purpose,
- 4- To make the necessary expenses and to collect the advances and dues for these expenses,
- 5- Having the obligatory books opened by the notary public and taking the necessary records (Decision book, Income Expense book, etc.)
- 6- To ensure and organize the Ordinary and Extraordinary General Assembly meetings in accordance with the law,
- 7- Determining the amount of dues by making the business project,
- 8- It can be listed as managing the notification processes of mandatory documents (operation budget, General assembly call letters, Audit Report, etc.).

In this process, there are different moments of expertise that need to be managed and laws, regulations and legislation specific to these areas of expertise. Therefore, from a manager, the Elevator Regulation, the Elevator Maintenance and Operation Regulation, the Regulation on the Protection of Buildings from Fire, the Parking Lot, the Regulation on the Distribution of Heating and Hot Water Costs in Central Heating and Sanitary Hot Water Systems, Shelter Regulation, Energy

Efficiency Law; Legally, having knowledge and knowledge of the Civil Code, Code of Obligations, Condominium Law, Labor Law, Occupational Health and Safety Laws, as well as being a financier who can manage large budgets correctly and effectively, and having the competence to perform accounting transactions in accordance with the relevant tax laws and accounting principles. Complicates its activities. Building and collective structure management, Law, Human Resources, Accounting, Technical, Customer Relations, technology, etc. Considering that it consists of different disciplines, there is no harm in evaluating it under these headings.

### **3.8. Evaluation of Buildings and Collective Administrations in Different Disciplines**

#### **3.8.1. Law**

As mentioned in the section The Place of Building and Collective Management in the Turkish Legal System, the general framework of the management activity is the Condominium Law No. 634. At the points where the KMK is insufficient, the necessary regulations are referred to other laws, regulations, legislation, case law, Supreme Court decisions, precedent cases, etc. is resolved with. From this point of view, knowing only the Property Ownership Law will be insufficient while monitoring management consultancy and management activities. Turkish Civil Code No. 4721, Code of Obligations No. 6098, Identity Reporting Law No. 1774, Occupational Health and Safety Law No. 6331, Labor Law No. 4857, Tax Procedure Law No. 213, Social Insurance and General Health Insurance Law No. 5510, Private Security Law No. 5188 The Law on Energy Efficiency No. 5627 is closely related to many laws, such as the Law on Energy Efficiency. Moreover; Elevator Operation, Maintenance and Periodic Control Regulation, Regulation on the Protection of Buildings from Fire, Shelter Regulation, Housing Doormen Regulation, Parking Lot Regulation, Regulation on the Distribution of Heating and Hot Water Expenses in Central Heating and Sanitary Hot Water Systems, etc. Should have knowledge about many regulations and perform the necessary procedures or ensure that they are carried out.

In addition, with the authority given by the Condominium Law, the manager can initiate legal action against the flat owners who do not

pay. Legal support is needed in order to make collections in line with the calculated budget. For this reason, many building and collective structure management or management companies are involved in management activities by consulting law offices and lawyers.

### **3.8.2. Human Resources**

In site and building managements, personnel are required to be employed in various job descriptions and areas in order to ensure that the activities can continue without interruption and to ensure the satisfaction of the residents with an uninterrupted service understanding. While the needs of the residents can be met with the concierge, guard, and heater in apartments or buildings with a small number of independent areas, the need for employment in different departments arises with the growth of the buildings and the presence of social facilities in them, the increase in the number of residents and the diversification of technical equipment. Accounting, preliminary accounting, technical personnel, security personnel, consultant personnel / receptionist, cleaner, public relations personnel, site manager etc. Employment of people with different job descriptions is on the agenda.

While determining the personnel need, relying only on service continuity or the equipment owned may cause unnecessary personnel employment. This situation may also cause dissatisfaction of the residents as it will have an increasing effect on the dues.

When analyzing the personnel needs, first of all, the talents, areas of expertise, skills and trainings (certificates) of the employees/people, and whether there are any personnel who have come to retirement age should be well evaluated. If it is a structure that has never been employed before, it is necessary to create management scenarios for the future.

It is also a task that should be in contact with the legal department and the accounting department in matters that have legal provisions such as determining the salary scales of the employed personnel, calculating the compensations such as overtime, seniority, notice etc. is the area.

Determining which personnel will be employed in which project can be predicted by the management plans as well as the project's need, location, security situation, risk analysis, number of blocks, equipment owned and maintenance requirements of these equipment, social facility areas, project size and the segment it addresses, etc. Criteria also appear as determining factors in personnel employment. Necessary environmental analyzes can be determined within the framework of the analysis of the people who own/will be the owner of the building, the examination of the architectural projects of the building and the mandatory provisions specified in the Labor Law. At the same time, it may be necessary to evaluate part-time employment, subcontracted employment, fixed-term work, supply and maintenance companies in technical matters. When classified in general, the personnel to work in the management; Administrative Staff (Site manager, preliminary accounting/accounting, public relations staff, secretariat etc.) can be considered as Field Staff (Security staff, Cleaning staff, Gardener, Technical staff).

### **3.8.3. Accounting and Financial Advisory Transactions**

Building and collective building managers or boards of directors have an obligation to be accountable, and they are obliged to be audited by the auditors or supervisory boards elected by the flat owners. It is of great importance that all income and expense transactions of the relevant structure are recorded correctly, that the statements regarding the Social Security Institution are accurately and timely reported in the managements where personnel are employed, and that the tax accruals that must be reported in accordance with the Tax Procedure Law are made correctly and on time. The fact that the management is working by proxy always faces the danger of imposing the penalty on all flat owners for mistakes arising from legal accounting and consultancy transactions. Budgets that are not calculated correctly can put all owners in debt, and even a budget that is made correctly can be endangered with unplanned expenditures. In addition, the follow-up of the collections to be made from the flat owners and the communication with the legal department for the uncollectible receivables are also of great importance.

### **3.8.4. Public Relations**

It would not be wrong to consider the Flat Owners as the partners of the building they are in. It is the first group to be affected as a benefit from the activities carried out by the administrations or as a loss from penal sanctions for an action not taken. For this reason, sharing information about management activities, carrying out the activities or necessary warnings on time, evaluating the complaints and suggestions from the flat owners or residents living in the building will be activities that will increase the trust and satisfaction of the managements or management companies. Thus, the relevant board of directors or management firm will be able to continue their activities for longer periods.

### **3.8.5. Technical**

Although technical operations are the visible face of management activities, they are among the areas that have the most impact on the satisfaction level of the residents. Problems such as encountering a cold house due to the boiler not working, reaching the apartment on foot due to the elevator not working, unlit lamps or water tanks that are not activated in case of water cuts can be enough for the residents of the site to evaluate their management negatively.

Apart from the subject of satisfaction, timely maintenance of the technical equipment of the building, following the warranty periods and warranty scopes, solving the malfunctions, etc. Activities prolong the life of the equipment, preventing greater costs, and prolonging the life of the equipment.

When evaluated within the framework of all these disciplines, the formation of large data piles in the management of buildings and collective structures is inevitable. Managers / Management firms often have to make all these data stacks meaningful in order to protect their individual reliability, not to be the target of criminal sanctions, and to carry out management activities without any damage to the structure. It is inevitable that legal deadlines are not missed, business plans are made correctly and on time, they are a legal-based management requirement and an activity that needs to be accounted for, and while

doing all these, they need technological support in order to establish an effective communication with the residents.

## 4. APPLICATIONS

Changes over the years and developments in human history have also brought about changes in social structures. The process that started as agricultural society, industrial society with the industrial revolution; Afterwards, it continues its life cycle as today's information society. Bengshir; He defined the information society as a society that values information, knows how to use it, and can produce information (Bensghir, 1996, p. 11).

With this social change, information, the speed of access to information, and the developments in technology have become indispensable in today's world. The information obtained by collecting, classifying and systematically combining the meaningless and scattered data has begun to mean power. In the 21st century, companies that foresee that they will gain a competitive advantage with the management of information apart from human and money management, have seen information as a key to perform their basic functions and have started to make large investments on information. The source of economic development has turned from physical capital to workforce that processes and produces information; science and technology have gained more importance (Akolaş, 2004, p. 36).

In the development of the Information System; Advances in computer software and hardware technology, increasing interest in the efforts of making the decision-making function effective, the desire for complete, accurate and reliable information, the pressure of fierce competition and the researches done in leading universities played an important role (Bensghir, 1996, p. 85).

Changes in science and technology, on the other hand, have affected the way companies do business, and have provided differentiation in issues such as time, cost and efficiency. Information technologies appear as the leading player in all processes from the evaluation of internal and external data obtained as a meaningful whole, from contributing to the strategic goals of the companies to the management of their daily work. Not only in business life; It has become an indispensable part of social and individual activities. Information systems, which have a great role in our business and social life, can be defined as the field that includes computer hardware and

software technologies used to store, transmit and process data. However, when we look at today, information technologies appear as an advanced field that includes networks, communication networks, internet, intranet, trained manpower and procedures, as well as being the systems where computers and software are configured.

In recent years, developments in technology have increased the data and information has been reached more quickly. (Yüksel, 2005, p. 249).

#### **4.1. Information Technologies**

According to Behan and Holms (1999), collecting and storing information consists of tools ( Peyman, Mohsen, & Hassan, 2011, p. 99).

Another definition; data (data), information (information) and processed information (knowledge), numbers, text, letters, sounds, pictures, images, etc. It is the whole of technologies that cover a very wide area from computer to mobile phone, which enables the acquisition, storage, processing, storage, recall when necessary, transmission and access to this accumulation obtained from other points (Özata & Güleş, 2005, p. 34).

Thanks to these technologies, the data collected inside and outside the company is not only accumulated, but also can be recalled and evaluated in decisions about the past and the future, it helps the senior management staff to see the whole picture by combining interdepartmental sharing and data pool.

The meeting of information technologies with software and human factor creates information systems.

#### **4.2. Information Systems**

Information systems are related to the collection, organization, processing and storage of information (Aydın İ. , 2012, p.181).

Information systems that provide decision-making support, supervision, coordination and control, together with; It also helps

managers and employees solve problems, explain complex issues, and create new products. At the basic level, in the planning stage of the enterprises to determine the target, they can draw the right target path by collecting, organizing and processing internal and external information.

### **4.3. Managerial Information Systems**

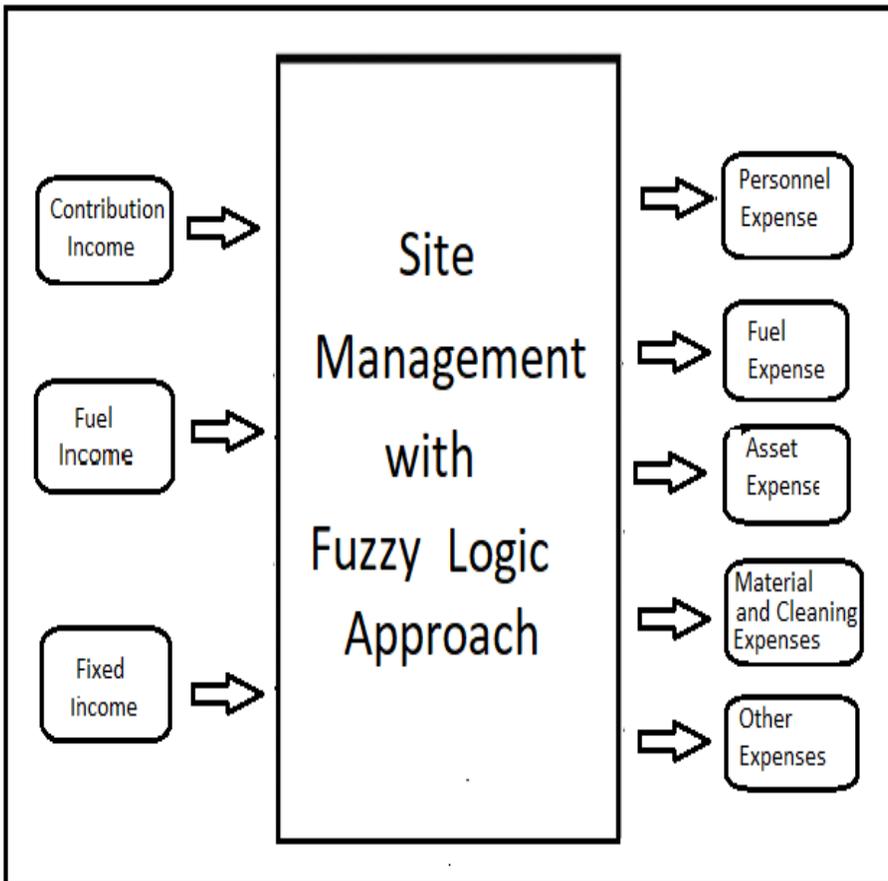
Management; It is the sum of the processes of making decisions that will enable the efficient use of people, resources, equipment, raw materials, capital and time in order to achieve certain goals and enforcing these decisions. Each hierarchical step has a separate task area, especially in achieving the purpose served in the organization. The operational, tactical and routine decisions that each level will take within the basic hierarchy consisting of upper, middle and lower levels provide the greatest contribution to the achievement of the goals of the managers. In this process, it is inevitable to reach the right information on time and at less cost. Reaching the right information in a timely manner can be achieved with the support of information systems. At this stage, administrative information systems emerge. Managerial Information systems; They are information systems that provide operational, tactical and strategic information support to lower, middle and senior management in organizational decision making and managerial problem solving processes, which aim to ensure inter-level communication in an organization (Güleş, Bülbül, & Çağhyan, 2003, p. 64).

Businesses using these systems can more easily perceive the opportunities and threats in their environment, save time by speeding up their routine work and focus more on their self-efficacy. With the rapid flow of information between levels, they have an advantage in making the right decisions, and they can progress faster in reaching the goal with coordination and control. Management information systems; computing, senior management, office automation and expert systems.

### **4.4. Creating a Site Management Model with Fuzzy Logic Approach**

Five values are used for input values. These linguistic values are: Very low, low, medium, high and very high.

Entries are Contribution expense, Fuel expense and Fixture expense. Outputs are Personnel expense, Fuel expense, Fixture expense, Material and Cleaning expense and Other expenses. Therefore, the system has a complex structure and the number of rules created in the fuzzy rule base is 150. While determining these rules, help from an expert was taken. An interface made with the program Delphi 7.0 is used. Random values can be entered in the program, as well as desired values can be entered. The program gives a warning when the numbers exceeding the minimum and maximum values of the input parameters are entered. The graphics of the input and output parameters can be seen in the program. Rules fired with given input values appear in the main menu. The current values entered into the input parameters are in the blur part of the input values. Input and output values are shown in the figure below.



**Figure 4.1.** Site Management with Fuzzy Logic Approach

MATLAB program was used to create a model with fuzzy logic approach with site management. Fuzzy logic tool menu and adaptive editors were used with graphical user interface (Jang and Gulley 2001).

The Mamdani method with the Fuzzy Inference System and the Sugeno methods with the Adaptive Network Based Fuzzy Inference System were used. In 10 applications, Mamdani and Sugeno structures were compared with each other with different criteria. The effect of the number of criteria on the site management and, as a result, the usability of Mamdani was tested with Sugeno.

#### 4.5. Creating a Model with Mamdani Structure

The fuzzy logic toolbox of the MATLAB program is used to determine value with the Mamdani structure. Figure 4.2 shows the structure of the fuzzy system editor working using the graphical user interface.

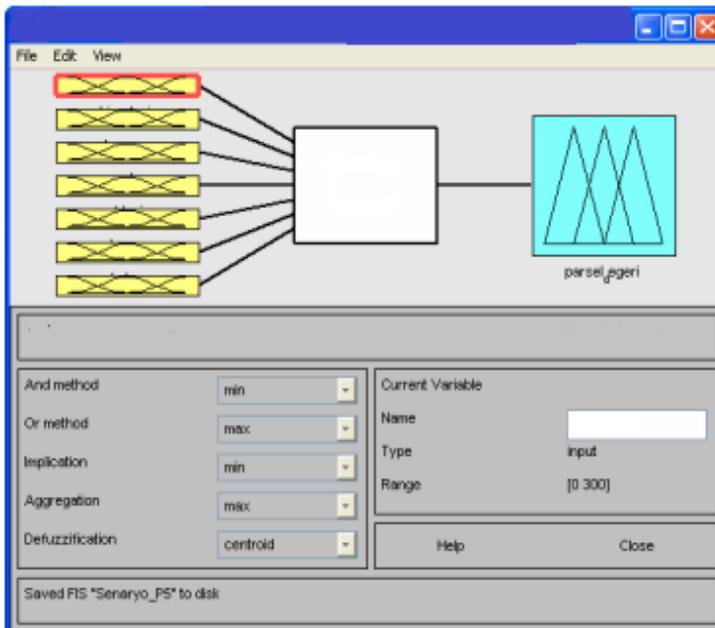


**Figure 4.2.** Fuzzy Inference System structure in graphical user interface

In Figure 4.2, the functions of the Fuzzy Inference System structure are given below.

- 1- Fuzzy system, input and output variables are defined.
- 2- Membership Function, variable-related membership functions are defined.
- 3- The rule editor defines the behavior of the system.
- 4- The rule and surface viewer examines the Fuzzy Inference System. The rule viewer is a MATLAB-based representation of the fuzzy inference diagram representation. The rule watcher used as a control, for example, we can see which rules are active or how the shapes of the individual membership function affect the results. Screenshots and explanations of the operations performed are summarized.

**a-Fuzzy Inference System Editor:** When creating a model in the Mamdani structure for value determination, first of all, the variables must be defined. In Figure 4.3. the model in the Mamdani structure created in the Fuzzy Inference System editor for value determination is seen.



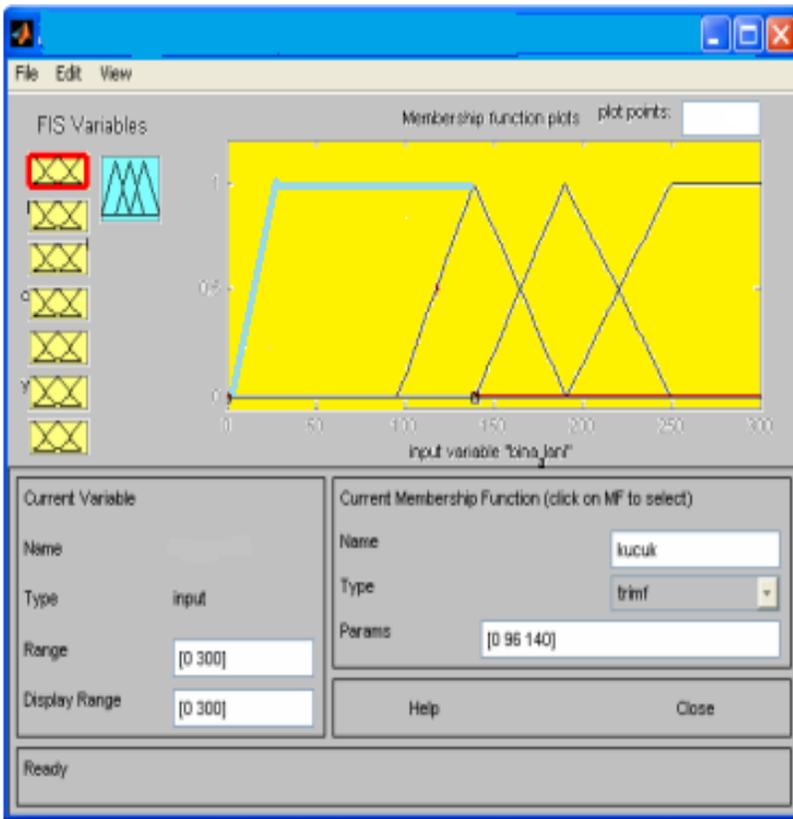
**Rule Viewer**

**Surface Viewer**

**Figure 4.3.** Fuzzy Inference System editor

**b- Membership Function Editor:** The criteria to be used in the determination of expenses have been blurred by separating each criteria into memberships with the help of the Fuzzy Inference System editor. While assigning the criteria to membership, the results of the studies were taken into account.

The section where these memberships are assigned in the Fuzzy Inference System structure Figure 4.4. It is shown in.



**Rule Viewer**

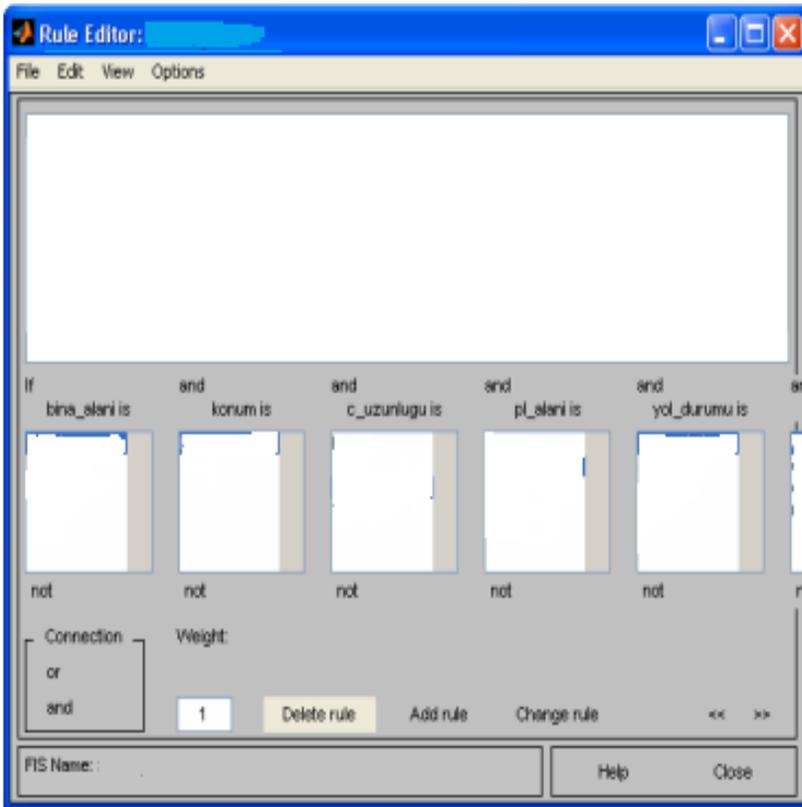
**Surface Viewer**

**Figure 4.4.** Memberships created according to the Mamdani method in the Fuzzy Inference System structure

**c- Rule Editor:** Rules have been created according to the assigned memberships. These rules were created with expert opinion and supported by the data collected. They are the person or persons who are expert site manager, know the market conditions and have knowledge about the criteria. The expert in this study is the person who

did the study. The site, which was created according to expert opinion, was tested by entering each data one by one. During this test, there was no rule triggering in some data, and in these cases, a new rule was written.

The numbers in the rule codes represent the membership numbers for each criterion. Figure 4.5 shows the rule base in the Mamdani structure.



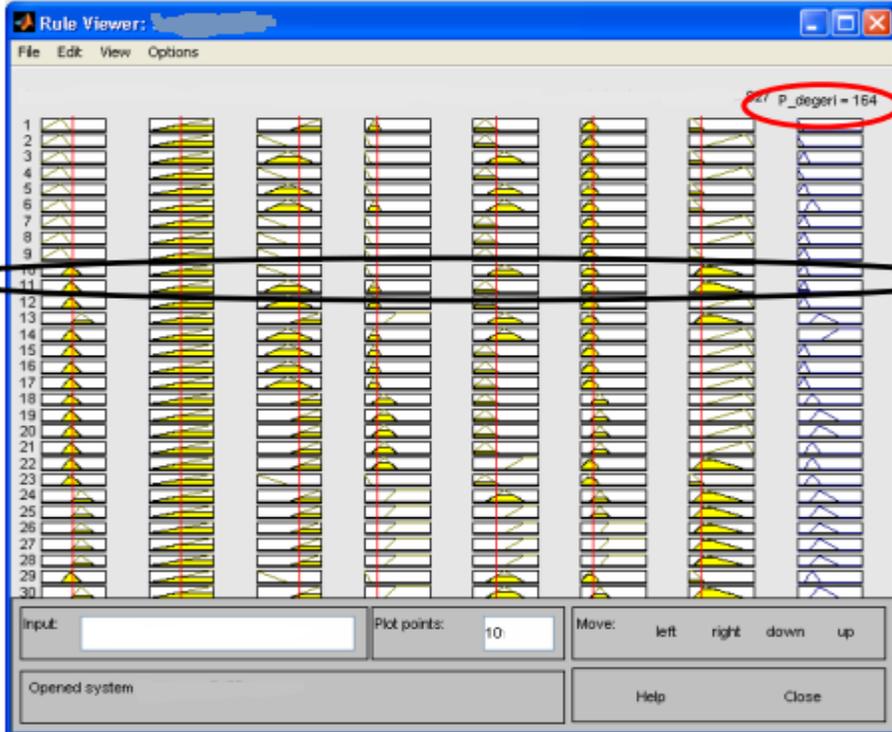
Rule Viewer

Surface Viewer

**Figure 4.5.** Rule base created in Mamdani structure

**d-Rule Follower:** It is the section where the memberships are assigned and the rule base is created and tested by entering the data. It is shown in Figure 4.6. that the output value is obtained with the data entered according to the rule base created in Figure 4.5. Looking at Figure 4.6., rule 11 triggered the membership of the output function because of the rule written, since there is membership for all values

entered in the input section. There can be one or more rules triggered like this. According to the suitable clarification method, the value is determined as marked in Figure 4.6.



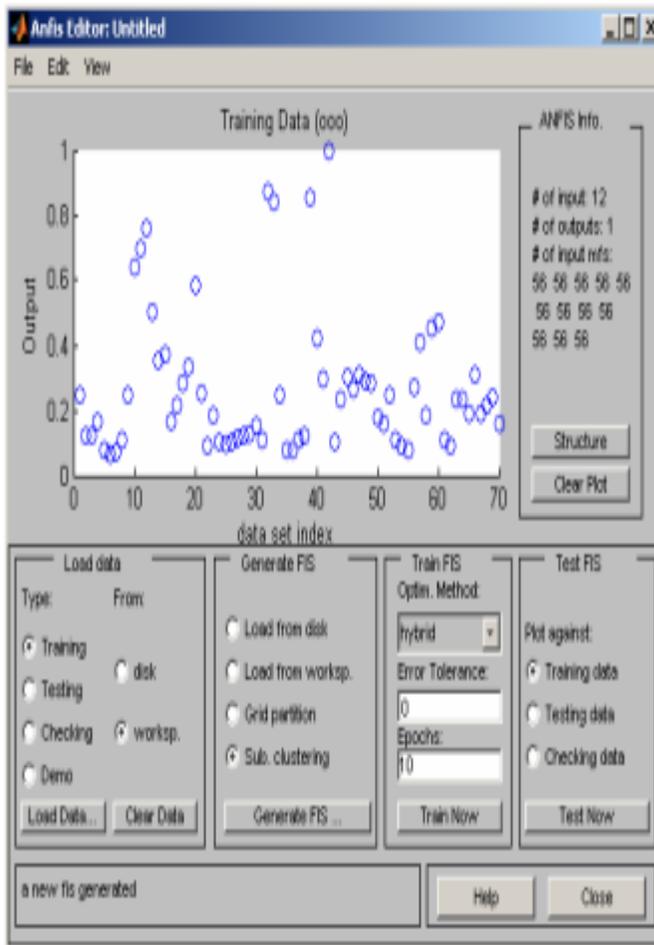
**Figure 4.6.** The part where the values are determined according to the rule base created in the Mamdani structure

Using the model created in the Mamdani structure, the usability of the model was tested with different criteria numbers.

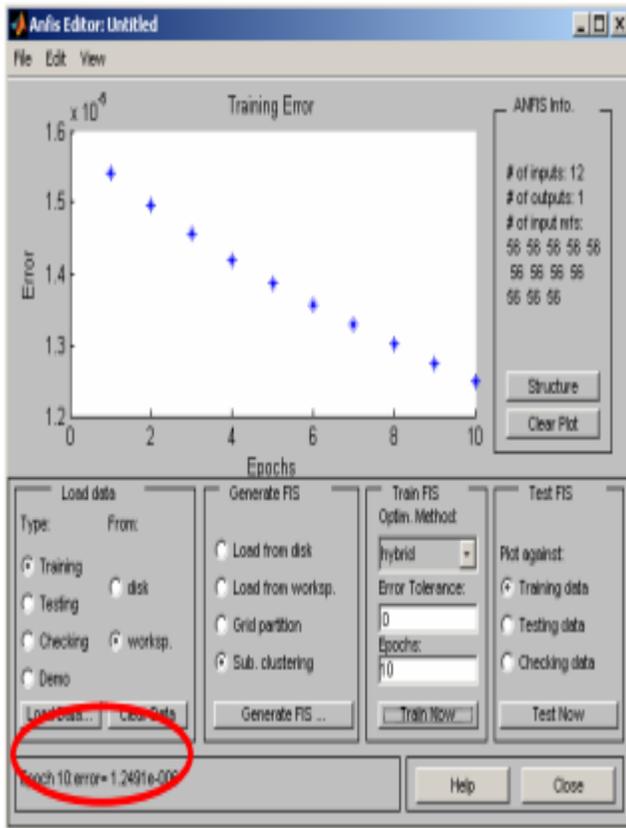
#### 4.6. Modeling with the Sugeno Structure

With the Sugeno method, the most appropriate membership and the number of memberships were determined and a fuzzy structure was created in the unstructured and built area. Due to the fuzzy nature of Sugeno, it is necessary to create a structure with the data. For this reason, as it is understood from the literature studies, the data should be trained with approximately 2/3 and tested with the remaining 1/3 (Brondino and Silva 1999, Lokshina et al. 2003).

In Sugeno, the data is normalized for ease of operation and speed. Normalization method in practice; divided by the largest. Figure 4.7. shows the Adaptive Network Based Fuzzy Inference System editor where the data is trained and tested. Since the Sugeno structure is a structure formed by data, the function is created according to the outputs corresponding to the input data by iterating with the training data. The test data is used for the verification of this structure. Figure 4.8. shows the error of the training data in 10 iterations. It was decided that the number of iterations was sufficient as a result of the trials. The training and test error is obtained by multiplying the difference of the output value with the output value in the structure resulting from iteration.



**Figure 4.7.** Fuzzy Inference System Based on Adaptive Mesh Editor



**Figure 4.8.** Training of data in Sugeno structure and training error in Adaptive Network Based Fuzzy Inference System Editor.

Figure 4.9 shows the part where the test data is loaded into the Fuzzy Inference System Based on Adaptive Network Structure, while Figure 4.10 shows how close the test data are to the Sugeno data and the test error graphically. It is possible to see the structure formed according to the Sugeno method in Figure 4.11.

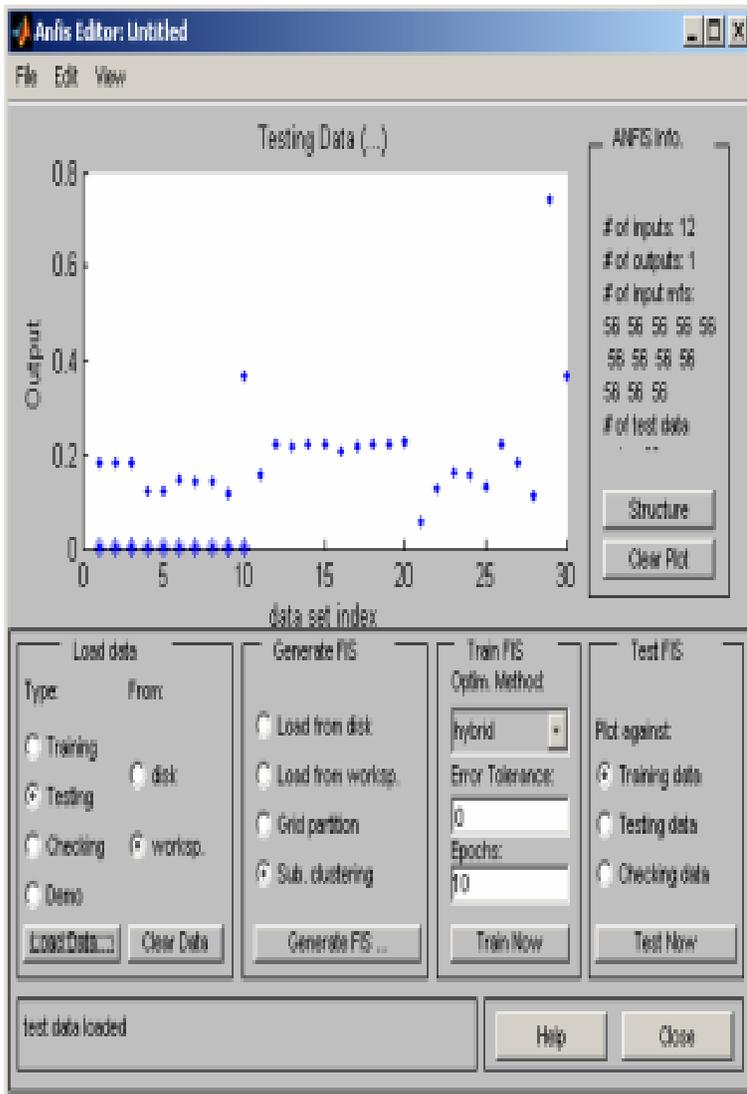
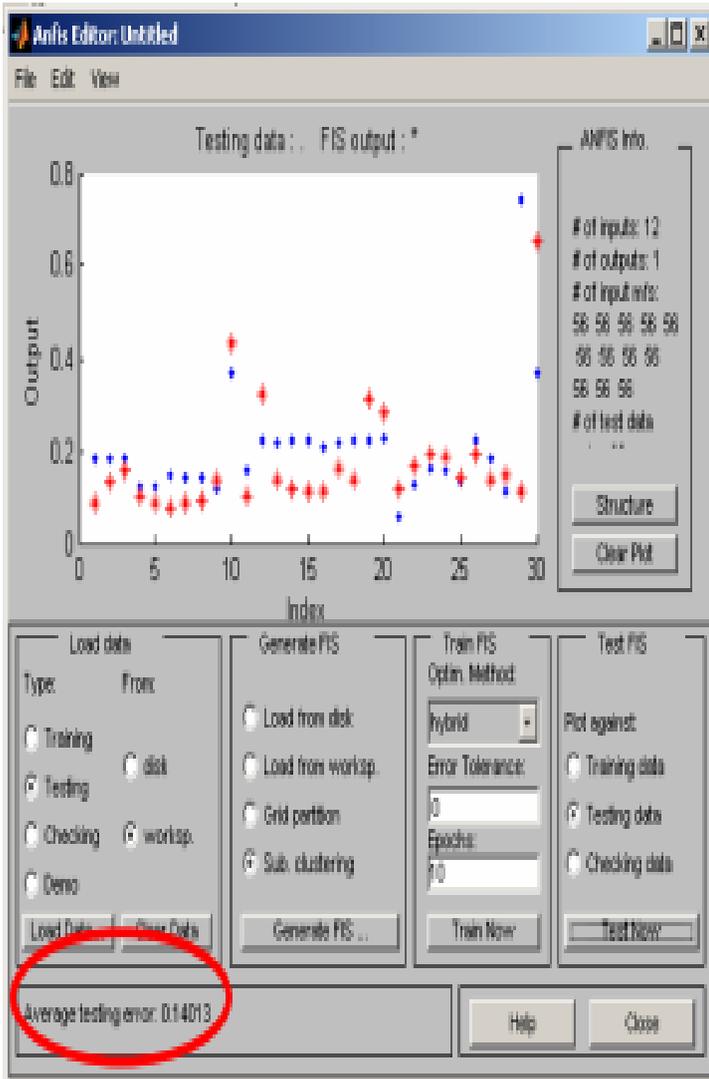
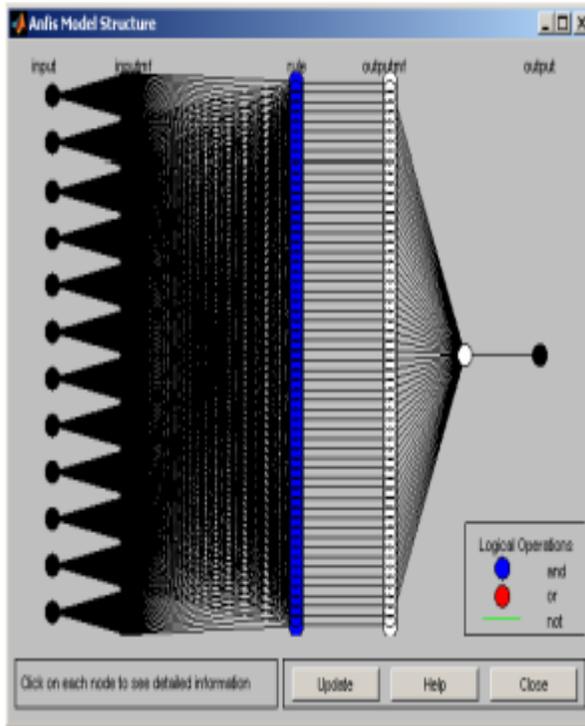


Figure 4.9. Distribution of test data in the Sugeno structure



**Figure 4.10.** Distribution of corresponding values of test data in Sugeno and test error



**Figure 4.11.** Structure formed in Sugeno

Training algorithms are organized in fuzzy logic. These are artificial neural networks algorithm.

In this study, the matlab program was used for control purposes. Both time and money were saved. This application was made for the first time, especially using computer technologies. With this application, a different study was carried out with a fuzzy logic approach in site management.

In this study, the opinions of experts were taken. Both site administrators and computer users were used.

## 5. CONCLUSION

For people, shelters are areas where they can be protected from environmental factors, ensure their biological continuity, and where they can coexist and establish relationships as families and individuals, which are the building blocks of society. The change of these basic areas over the years is the change with factors such as urbanization, disasters, urban transformation activities, changes in human needs, industrialization and migration. These areas are tried to be eliminated with the initiative of the state and e-private companies. With the increasing population, mass housing has begun to form in order to meet this need.

Meeting the operational needs of the common infrastructure and social facilities such as maintenance and repair, the creation and management of budgets were assigned to the "management" established in collective structures or outsourced as a service. The developments in time, the increasing number of residents, the formation of large budgets, the increasing diversity of equipment in social areas, and the fact that there is a legal structure brought along different areas of expertise that made management activities difficult. In order to overcome this difficulty in the management of buildings and collective structures, information technologies and systems, which are indispensable in today's technology age and whose benefits are researched in every field, are utilized.

It is known that the technologies used in this field save time, especially.

Building and collective structure emerge as both organizational and technological innovations that change the business processes of management. It is possible to find many software on the market for the building and mass management sector. In this study, the site management aspect is discussed with the Fuzzy logic approach.

Fuzzy logic approach is not used in this area. Our aim is an innovation for the sector due to its contribution to the formation of certain standards with the fuzzy logic approach.

## REFERENCES

- Alatlı, L. (2019). Facility management /tesis yönetimi nedir? FMEXPO İSTANBUL: <http://fmexpoistanbul.com/facility-management-tesis-yonetimi-nedir/>
- Akyol, Y., Büyükkaracıgan, N. and Ödük, M. (2009). Fuzzy logic method in computing and construction fields. International Conference on Computer, Electrical, and Systems Science, and Engineering, Amsterdam
- Akyol, Y., Büyükkaracıgan, N. And Ödük, M. (2011). The Importance of fuzzy logic approach in lift system control of high-rise buildings. The International Congressfor global Science and Technology (ICGST), Dubai, U.A.E.
- Altınışık, İ. (2008). Türkiye’de ekonomik risk kaynakları ve krizler. Journal of Selçuk University Social Sciences Vocational School Volume 10, Issue 1-2, 633 – 641.
- Altunkaynak, A., Özer, M. and Çakmakcı, M. (2005). Water consumption prediction of İstanbul city by using fuzzy logic approach. Water Resources Management, Vol: 19, pp. 641 – 654, DOI: 10.1007/s11269-005-7371-1
- Armutlu, H. ve Yazıcı, M. (2012). Fuzzy robust regresyon’un diğer regresyon teknikleriyle karşılaştırılması ve bir uygulama. Öneri, Cilt:10, Sayı: 38, ss.33 – 51.
- Aydın, S., & Dönmez, N. (2011). İleri site uygulamaları. İstanbul: Esop Otelcilik Bina Yönetim Hizmetleri.
- Baskın, A. (2015). Entegre Bina ve Tesis Yönetimi. 05 13, 2017 tarihinde Proje Yönetim Okulu: <http://abprojeyonetimi.com/entegre-bina-ve-tesis-yonetimi/>
- Bay, Ö.F., Atacak, İ. (2006). Desing of a single phase neuro-fuzzy controlled uninterruptible power supply, Fifteenth Turkish Symposium on Artificial Intelligence Neural Network TAINN, Muğla.
- Brondino N. C. M., Silva A. N. R. (1999). Combining artificial neural networks and gis for land valuation purposes. Computers in Urban Planning and Management, Venice, Italy 9.
- Büyükkaracıgan, N., Ödük, M.N., Akyol, Y. and Uzun, H. (2011). Farklı çimento karışımları ile üretilen beton dayanımlarının bulanık mantık yöntemi ile araştırılması. Sosyal ve Teknik Araştırmalar Dergisi, Vol. 1, No.1.
- Büyükkaracıgan, N. (2015). Applications of artificial neural networks in civil engineering. ICCSEIE 2015: 17 th International Conference on Civil, Structural, Environmental and Infrastructure Enginnering, 19-20. May. Dubai, UAE.

- Büyükkaracıġan, N. (2021a). Modeling the rainfall – flow relationship with artificial neural networks. 13th International Conference of Strategic Research on Scientific Studies and Education, 26-28 May, Ankara.
- Büyükkaracıġan, N. (2021b). Modern method sapproach in realestate valuation. İksad Publishing House, Ankara.
- Büyükkaracıġan N. (2022a). Modeling of construction project risk management with fuzzy logic method, ICHEAS 1st International Conference on Applied Sciences, pp. 64-68, Ankara.
- Büyükkaracıġan N. (2022b). Use of fuzzy logic method in flood risk management, ICHEAS 1st International Conference on Applied Sciences,, 68-76.
- Chan, K. And Engelke, U. (2015). Fuzzy regression for perceptual image quality assessment. Engineering Applications of Artificial Intelligence, Vol: 43.
- Cantürk, E. (2016). Cumhuriyet'ten günümüze Türkiye'de konut sorunu ve konut politikalarının gelişimi. Altüst, 1.
- Cezaoġlu, S. (2010, Eylül). Toplu konut alanlarında planlama ve kentsel tasarım ilkeleri; toki kayseri uygulamaları üzerinden bir inceleme. Yayınlanmamış yüksek lisans tezi. Gazi Üniversitesi Fen Bilimleri Enstitüsü Şehir ve Bölge Planlama Bölümü, Ankara.
- Chang, P. and Lee, E. S. (1996). A Generalized fuzzy weighted least-squares regression. Fuzzy Sets and Systems. Vol. 82, Issue 3, p. 289-298.
- Chen, L. And Nien, S. (2020). A new approach to formulate fuzzy regression models. Applied Soft Computing, Vol 86.
- Demirtaş, Ö. (2015). Bina ve tesis yönetim sektörü. Türkiye İş Bankası İktisadi Araştırmalar Bölümü, İstanbul. (access date: 20.10.2022) [https://ekonomi.isbank.com.tr/UserFiles/pdf/ar\\_10\\_2015.pdf](https://ekonomi.isbank.com.tr/UserFiles/pdf/ar_10_2015.pdf)
- Diamond, P. (1988). Fuzzy least squares. Information Sciences, Vol. 46/3, pp. 141-157.
- Ergezer, H., Dikmen, M., & Özdemir, E. (2003). Yapay sinir aġları ve tanıma sistemleri. PIVOLKA, 2(6), 14-17.
- Erkan, K., 1999. Bulanık mantık ile doğru akım motorunun incelenmesi, Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, İstanbul.
- Everest, B., & Yercan, M. (2012). Yoksullukla mücadelede kooperatiflerin önemi; tarım kredi kooperatifleri örneġi. 10. Ulusal Tarım Ekonomisi Kongresi, pp. 1032, Konya.
- Feyza Yıldız Yurtal (2019). Bina ve toplu yapı yönetiminde kullanılan bilişim sistemlerinin, benimsenmesinde etkili olan yenilik özellikleri: Apsiyon yazılım program örneġi, Yüksek Lisans Tezi.
- Gök, A. C. (2010). İşletmelerin tahminleme sürecinde bulanık doğrusal regresyon analizi ve lojistik regresyon analizinin uygulanması. Dokuz

- Eylül Üniversitesi, Sosyal Bilimler Enstitüsü, Yayınlanmamış Yüksek Lisans Tezi.
- Güleş, H. K., Bülbül, H., & Çağlıyan, V. (2003). Bilişim teknolojileri kullanımının işletme performansına etkisi: Küçük ve Orta Ölçekli Sanayi
- Günay, M. (2009). Konut yapı kooperatifleri misyonu gereği yarı özerk kamu kurumu statüsüne kavuşturulmalıdır. İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi, 34.
- İçen, D. (2010). Bulanık doğrusal regresyon analizi. Hacettepe Üniversitesi, Fen Bilimleri Enstitüsü, Yayınlanmamış Yüksek Lisans Tezi.
- İMO. (2011). Türkiye'de konut sorunu ve konut ihtiyacı raporu. Ankara: İnşaat mühendisleri odası-genel merkez.
- İşbilen Yücel, L. (2005). Bulanık regresyon: Türkiye'de 1980-2004 döneminde kayıt dışı ekonominin bulanık yöntemlerle tahminine ilişkin bir uygulama. İstanbul Üniversitesi, Sosyal Bilimler Enstitüsü, Yayınlanmamış Yüksek Lisans Tezi.
- İşık, Ş. (2005). Türkiye'de kentleşme ve kentleşme modelleri. Ege Coğrafya Dergisi, 58.
- Jang, J. S. R. and Sun, C. T., 1995. Neuro-fuzzy modelin gand control, Proc. Of the IEEE Special Issue on Fuzzy Logic in Engineering Applications, 83 (3): 378-406.
- Jang, J. S., Gulley, N., 2001 "Matlab Fuzzy Logic Toolbox", The Math Work Inc., Version 2.
- Karasioğlu, F. and Kınalı, F. (2022). Detecting financial failure with the assistance of financial statements: an implementation in borsa İstanbul, Eurasian Journal of Researches in Social and Economics (EJRSE), 197-221.
- Kaya, T. (2014). Bulanık regresyon ve ekonometrik bir uygulama. çukurova üniversitesi, Sosyal Bilimler Enstitüsü, Yayınlanmamış Yüksek Lisans Tezi.
- Kınalı, F. (2021). Çevresel yönetim muhasebesi, sosyal, beşeri ve idari bilimler alanında uluslararası araştırmalar, VI, pp: 417-431, Eğitim Kitabevi, Konya.
- Koca, D. (2015, Mayıs). Türkiye'de çağdaş konut üretiminin yeniden okunması. Dergi Park: <http://dergipark.gov.tr/download/article-file/208054>
- Kurt, N. (2015, Mart). İktisadi açıdan türkiye'de toplu yapı yönetim kavramı. Karabük Üniversitesi sosyal Bilimler Enstitüsü İktisat Anabilim Dalı Yüksek Lisans Tezi
- Lee, H. T. and Chen, S. H. (2003). Using Cpk index with fuzzy numbers to evaluate service quality. International Transactions in Operational Research, Vol: 9, Issue: 6, pp. 719 – 730.

- Lokshina I. V., Hammerslag M. D., Insinga R. C., (2003). Applications of artificial intelligence methods for real estate valuation and decision support. Hawaii International Conference on Business, Honolulu, Hawaii, USA.
- Moskowitz, H. and Kim, K. (1993). On assessing the h value in fuzzy linear regression. *Fuzzy Sets and Systems*, Vol: 58, Issue: 3, pp. 303 – 327.
- Nowaková, J. And Pokorný M. (2013). Fuzzy linear regression analysis. *mathematics*, Computer Science. 12th IFAC Conference on Programmable Devices and Embedded Systems The International Federation of Automatic Control September 25-27, Velke Karlovice, Czech Republic.
- Ödük, M.N., Allahverdi, N., 2009. A Study on green house automation with fuzzy control method, *World Academy of Science Engineering and Technology (WASET)*, Vol. P 7, September 2009, pp. 599 – 603, Amsterdam, The Netherlands.
- Ödük, M. And Büyükkaracıgan, N. (2013). Application of artificial neural network modeling to monthly flows of gediz stream. *International Conference on Electrical, Computer, Electronics and Communication Engineering*, Amsterdam.
- Özata, M., &Güleş, H. K. (2005). *Health information systems*. Ankara: Nobel Publishing House.
- Öztemel, E. (2003). *Yapay sinir ağları*. İstanbul: Papatya, pp.15-18.
- Pagourtzi E., Assimakopoulos V. (2003). Development of real estate evaluation system with the use of g.i.s. technology. The 10th European Real Estate Society Conference in Helsinki ERES, Finland.
- Pan, N., Ko, C., Yang, M. And Hsu, K. (2011). Pavement performance prediction through fuzzy regression. *Expert Systems with Applications*, 38 (8), 10010 – 10017.
- Peyman, Y., Mohsen, A. S., & Hassan, G. (2011). The Analysis of the relations hip between organization al structure and information technology (it): and the barriers to its establishment at the university of ısfahan from the faculty member's view points. *Higher Education Studies*, 98-104.
- Şarkaya, C. (2007). Gayrimenkul yatırım ortakları üzerine bir inceleme ve türkiye'ye ilişkin sektör analizi. *Sosyal Bilimler Dergisi*, 176.
- Şengül, M. (2010). Türk medeni hukukunda toplu yapılar ve toplu yapı yönetimi. Doktora Tezi. İstanbul: Marmara Üniversitesi Sosyal Bilimler Enstitüsü Hukuk Anabilim Dalı.
- Tümer, Ö. H., & Dostoğlu, N. (2008). Bursa'da dışa kapalı konut yerleşmelerinin oluşum süreci ve sınıflandırılması. *Uludağ Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi*.

- Türk Dil Kurumu (2019). Türk Dil Kurumu: [http://www.tdk.gov.tr/index.php?option=com\\_gts&arama=gts&guid=TDK.GTS.5c9a81ae173c04.77390744](http://www.tdk.gov.tr/index.php?option=com_gts&arama=gts&guid=TDK.GTS.5c9a81ae173c04.77390744).
- T.C Gümrük ve Ticaret Bakanlığı. (2017). Türkiye kooperatifçilik raporu-2016. Ankara: T.C Gümrük ve Ticaret Bakanlığı.
- Yalçın, A. (2016). Toplu konut sektörünün istihdama etkisi. 10: York University.
- Yanartaş, S. S. (2009). Bulanık regresyonda kullanılan yöntemler. Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Yayınlanmamış Yüksek Lisans Tezi.
- Yang, M. and Lin, T. (2002). Fuzzy least-squares linear regression analysis for fuzzy input-output data. Fuzzy Sets and Systems, Vol. 126, Issue 3, pp. 389 - 399.
- Yıldırım, H. (2012). Toki'nin sosyal konut ve lüks konut projelerinin değerlendirilmesi; Ankara örneği. Ankara Üniversitesi Fen Bilimleri Enstitüsü-Taşınmaz Geliştirme ABD.
- Yurtçu, Ş. ve İçağa, Y. (2007). Bulanık doğrusal regresyona genel bir bakış. Yapı Teknolojileri Elektronik Dergisi, vol: 2, pp. 37 - 43.
- Wang, H. And Tsaur, R. (2000). Resolution of fuzzy regression model. European Journal of Operational Research, vol. 126, Issue 3, pp. 637 - 650.
- www.ifma.org. (2019). What is facility management?: International facility management association. International Facility Management Association: <https://www.ifma.org/about/what-is-facility-management>







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