Int. Journal for Housing Science, Vol.36, No.4 pp.199-210, 2012
Published in the United States

USE OF ARTIFICIAL INTELLIGENCE ALGORITHM IN HOUSING PROJECTS EFFICIENCY DECISIONS

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ABSTRACT

The world's growing population needs adequate and safe homes. In order to provide and increase the number and quality of housing projects, new alternative methods need to be investigated. In this paper, the use of artificial intelligence in decision making for housing projects will be presented. The artificial intelligence tool to be utilized will be artificial neural network algorithms. The complexity of issues related to planning and design of housing projects will be simplified into social, economic, engineering, environment and safety issues. In the artificial neural network algorithm, the parameters including population, environment, distance from hospitals, distance from schools, seismicity level of district of project, climate, topography, distance from highways, financial criteria are used as input parameters. The housing project efficiency is determined by the output parameter of the algorithm. Different housing project areas' data are used for training and testing the artificial intelligence model. Based on the results of the training phase, a forecasting study is presented for a specific area in Turkey. In order to reach the best results, various configurations and architectures are trained. The success rate of the model is measured by r2, a statistical indicator applied to the analysis. The best configurations, architectures, and error graphs are presented. Advantages of this innovative artificial intelligence approach are that; in the future, it can be utilized as a forecasting tool of efficiency of housing projects.

Key words: Artificial Intelligence, Neural Network, Housing Project, Earthquake.

0146-6518/04/199-210, 2012

Introduction

In recent years, due to the increased migration of the population, especially in big cities and big cities, came to the fore even more environmental problems. After this intensive industrialization in the emerging residential and public housing projects because of these environmental problems have become the focus of attention. Determining the location of housing projects or project out of the project come to the fore many questions such as whether it is appropriate. Prior to the start of the project in order to resolve such questions to include parameters that affect the project was a need to develop predictive approaches. The purpose of this study is to decide efficiency of based on artificial neural networks algorithm and it was applied to models by using the parameters affecting project and the area. Factors affecting the realization of housing project, according to these factors, the results of the evaluation and forecast of areas with the region or regions of the model in the light of the information can be obtained. As a case study, the Van region which is affected by a new natural disaster (earthquake) had been selected and after an earthquake to do things like the location of housing projects aimed to shed light on the stage of the decision. In addition the study aimed to reveal a different way of algorithm to decide the efficiency of the housing projects induced seismicity affects.

Project Area

A field of study is Turkey and Project area chosen as Van, due to located in Earthquake Zone and, in the near future the construction of housing projects will take speed because of the earthquake in 2011 with loss of life and property. The information of Districts of Van was evaluated within the scope of this study. The map of districts of the Van and location of the forecast study area is given in Figure 1.

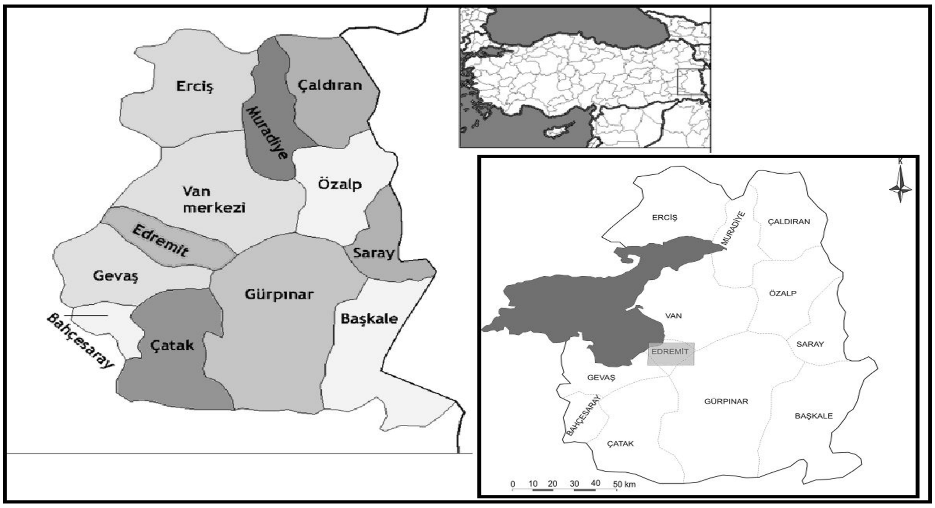

Figure 1: The districts of the Van and the location of the forecast study area Edremit at Van.[1]

Erdemkent housing project region map is given Figure 2 to shed light on the future studies of other provinces and regions a housing project area can be seen in Figure 3 which is chosen as a forecasting study in Edremit region. Edremit district located in Van Lake western coast and 18nd km of Van - Gevaş highway, district where the city is connected to has the characteristics of a junction both national and international perspective. Intercity bus service is able to establish large cities in the country, with all segments of the internal connection.

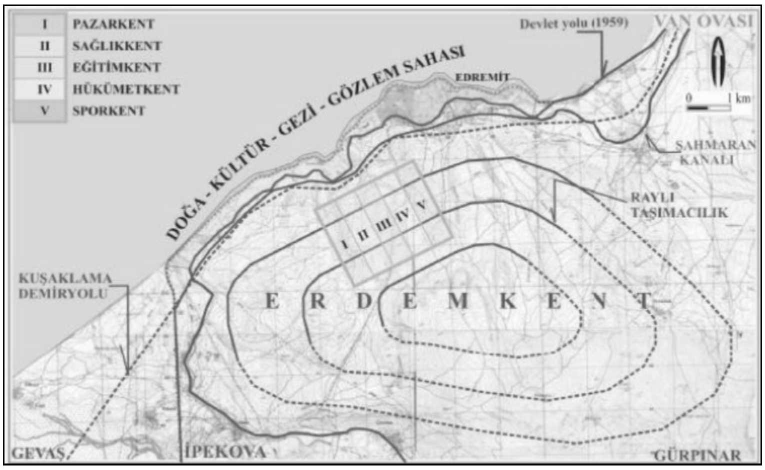

Figure 2: Erdemkent housing project region map. [1]

Figure 3: Erdemkent Public Housing Area [1].

<u>Properties of the project used for models</u>

Firstly, effective parameters detected and to make a decision of efficiency of a housing project and residential process determined as efficient or inefficient depending on this parameters. In this context, data are created over the 12 parameters which are most effective and necessary to use. In the scope of work Population, Environment level, Security level, number of Hospitals, number of Schools, Seismicity level of district of project, Climate, Topography difficulty, Highways, Risk of flooding of the lake, Distance from Fault and Financial chosen as input. Output parameters are taken into account the efficiency of the Housing project. Information about determination of the parameters is presented below.

Population

Taking into consideration of effect of population density in the project area, demographics distribution of Van is shown in Table 2.

Highways

Another parameter of the project is highways which is an important part of daily life as a transportation and traffic problem in big cities of Turkey. In this subject districts' daily traffic values are taken into account and Van 11. Region highways values are given Table 2.

Climate

As is known, region climate has an important role about both construction and usage of housing projects. For this reason, the main features that influenced by climate has been demonstrated and the prominent ones considered to make an overall effectiveness values between 0-4 has been identified. Data are evaluated with the light of Average Temperature, Average Wind Speed, Average Humidity and Average Annual Total Rainfall taken from Turkish State Meteorological Service website listed in Table 2 which also mention in method part.

Seismicity

Especially in recent years life and property losses resulting from earthquakes, has attracted attention once about the effects of the earthquake in our country. The province of Van and its surroundings location worthy of study about earthquake and ground interaction with past earthquakes and growing structure. In earthquakes that caused loss of life and property is one of the most important factor if ground characteristic. Therefore, determination of soil properties with drilling, laboratory testing and seismic refraction methods in the consideration of many past earthquakes, calculation of earthquake periods by instrumental and historical earthquakes analyzing, possible behavior of the existing structures in an earthquake and the consequences of high-magnitude earthquake in a residential are of the city examined in many studies. From Eastern Anatolia Region mechanism solutions for occurrence of earthquakes it is seen that strike-slip component of reverse faulting is dominated. This phenomenon supports the jammed region of Eastern Anatolia Region and Edremit (Van) surroundings [2]. When Edremit earthquakes in the historical period and its immediate surroundings (1900before) are examined, region with the latitude and longitude (37.23-39.23) K; (42.17-44.17) D is selected to determine the historical earthquakes. The largest magnitude earthquake which is effective in Van, Bitlis and

Muş occurs in May 30, 1881according to determined values and the maximum intensity of this earthquake is IX. Even if this region demonstrated in 2 zones in maps of earthquake, it is seen that throughout history region faced by devastating earthquakes. In this context, seismic risk is determined and data processed based on housing project districts in strict accordance with earthquake zones map (Figure 5). Based on the earthquake zone maps prepared by Ministry of Public Works and Settlement (ministry of environment and city planning) General Directorate of Disaster Affairs (disaster and emergency management presidency) of Turkey in 1996, Van and Edremit district located in zone 2, but this map is known to reflect the actual seismicity [2]. Existing Turkey Earthquake Zones Map lowland areas feel and suffered the earthquake mostly out of 1. Lowlands is floor where the thickness of the soil is more than 20 meters and ground water level is lower than 20meters. As we know, in these types of soil, seismic wave speed is very low while the energy is inexhaustible, and so earthquake felt in a long time. Also, the presence of water within the ground floor has a low elastic module and leads to the risk of liquefaction [2]. For this reason has not only due to seismic risk maps and also the fault offset are also taken in to account as a separate parameter.

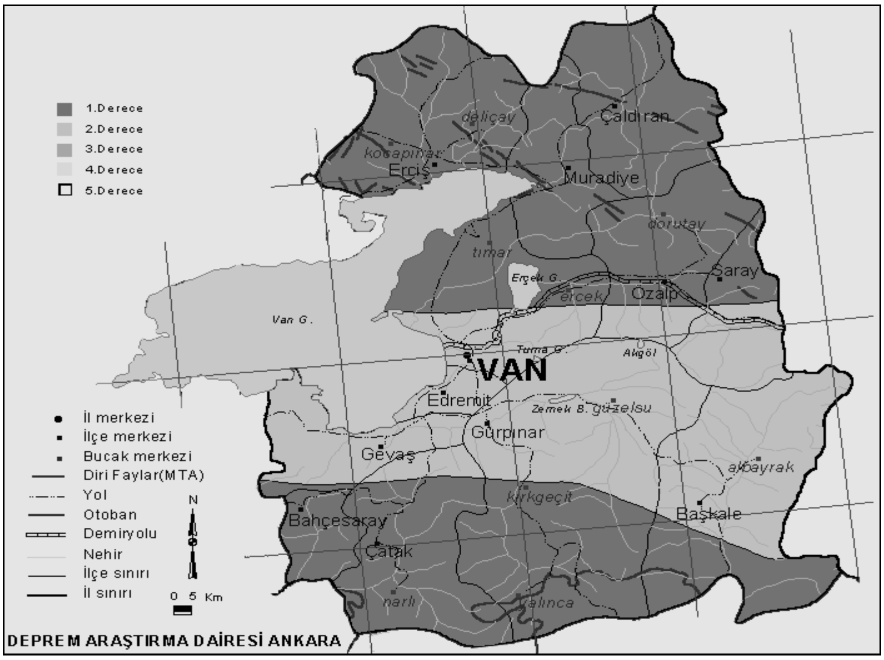

Figure 4: Map of Van Province Earthquake Zones [3].

Natural Disasters

Briefly, disaster is a natural, technological and human origin event which effect communities by stopping or undercutting a normal life and human activities with physical, economic, social and environmental losses on people and human settlements. Turkey, has always been a country the dangers of various natural disasters due to the formation of tectonic, geologic structure, topography and meteorological characteristics. When considering the country's physical and high social harm, natural events that occur largely cause in a large extent the loss of life, lead to injuries and property losses and as the result a disaster occur. In Turkey especially Earthquakes, landslides, flooding, erosion, rock falls and avalanches, drought are major natural disasters. In the natural disasters earthquakes, avalanches, floods and inundations can be considered as adverse events which affect settlements. Although this effect is generated even with different shape and affects eventually it cause loss of life and property to people living in residential areas. According to findings in Turkey a devastating earthquake occurs in every 9 months, annually 25 significant flooding has occurred. Due to climate of the region long-term torrential rains develop rarely in spring and autumn periods. During these periods, flooding of lowland areas are observed due to the region is generally devoid of vegetation. One other problem is meteorological rising connected to changes in the Lake Van. Changes have been present in a complete parallel in the levels of rainfall. The lake level realized as sometimes elevated, sometimes unchanged or very slightly descent during periods of 3-5 years. For example, elevated between the years 1955-1959, between the years of 1960-1966 descended, rise again from 1967 until 1974, fell again in 1975 until 1986.Since 1987, the lake level beginning to rise again, even though around 1990-1991 has shown a slight downward trend in the rise lasted until 1995. İskele, Eminpasa, Kale, Eski Camii districts in the province of Van many housing and facilities have become uninhabitable and unusable due to the rise of the lake water level. Some of the infrastructure facilities are under water, domestic waste water treatment facilities and the airport has become threatened by the waters of the lake. In this regard the region of Van Lake on the basis of the rise of towns and districts were evaluated against the potential areas affected by flooding and the generated data are taken into account [1]. In general terms of assessing, Van Lowland zone form the great majority and advantages and disadvantages of the Erdemkent taken as a forecast study shown in Table 1.

Table 1: Advantages and disadvantages of the Erdemkent area and Van Lowland [1].

The criteria		Van Lowland	Erdemkent
Area		100 000	120 000
Type of usage		Agricultural Area	Clayey soil
Ownership		private land	public land
The legal status		constitutional offense	
Seismicity		1. degree	
The cost (in terms of construction technique, at least)		20% more expensive	20% cheaper
The cost of apartment (except for the cost of land) Billion TL		27,7	25,4
State of development		in the agricultural area	rock floor
Transportation	Railway		the adjacent
	inner city	highway	light rail
	state road		the adjacent
Electricity, Water, waste costs, million TL / Flat / Year		A	A/10

Evaluation method

A few of the above-described two models have been developed in light of the effective parameters, 1.model and taken directly to the real numbers of the study data is shown in Table 2.

Table 2: Parameters for Model 1.

Parameters	Population	Financial	Hospital	Highway	Schools	Topography	Climate
REGIONS	**person**	**employment**	**number per region**	**number of vehicles transiting per day**	**Number per region**	**the difficulty of land**	**Temperature, wind, humidity, rainfall**
City	356.494	19825	7	54542	30	1	2
Bahçesaray	16.795	166	1	1820	10	0	4
Başkale	55.563	370	1	2161	1	0	4
Çaldıran	56.485	930	1	3710	3	0	1
Çatak	23.816	474	1	1839	12	0	3
Edremit	18.005	600	2	3805	6	1	3
Erciş	147.421	3819	1	10027	12	1	2
Gevaş	29.557	795	1	4795	6	1	4
Gürpınar	37.226	264	0	726	3	0	1
Muradiye	54.692	659	1	5461	7	1	0
Özalp	59.892	613	1	3790	13	0	0
Saray	21.578	234	0	1465	5	0	0
Erdemkent REGION	10.000	1000	2	1500	1	1	1

Parameters	Security	Environment	Dist. Fault	Risk of flooding of lake	Seismicity	Efficiency
REGIONS	**The crime rate per capita a year**	**Arable area**	**km.**	**#**	**#**	**#**
City	2577	10246	45	1	1	1
Bahçesaray	121	1790	20	0	1	0
Başkale	402	7449	20	0	2	1
Çaldıran	408	2486	5	0	1	0
Çatak	172	3296	15	0	1	0,5
Edremit	130	3180	65	1	2	1
Erciş	1066	8853	5	1	1	0,5
Gevaş	214	1313	40	1	2	0,5
Gürpınar	269	8789	50	0	2	1
Muradiye	395	5573	5	1	1	0,5
Özalp	433	2022	15	0	1	0,5
Saray	156	2524	10	0	1	0
Erdemkent REGION	100	1000	60	0	2	

To reach the best results, different configurations and architectures are trained. The best learning configurations and architecture for model 1 is defined. 2nd Model and the parameters of the real numbers 0, 0.5, 1 as stated as efficient, the Middle-efficient, in efficient definitions are given in Table 3. In the scope of models, min and max information of input and output parameters are calculated, neuron and weights information of used back propagation architecture are defined and the criteria used in the back propagation training are finally defined.

Table 3: Parameters for model 2.

PARAMETERS	Population	Financial	Hospital	Highway	Schools	Topography	Climate
REGIONS	**person**	**employment**	**number per region**	**number of vehicle transit per day**	**number per region**	**the difficulty of land**	**temperature, wind, humidity, rainfall**
Efficient factor	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Middle-efficient Factor	**0,5**	**0,5**	**0,5**	**0,5**	**0,5**	----	**0,5**
Inefficient Factor	**0**	**0**	**0**	**0**	**0**	**0**	**0**
City	1,0	1,0	1,0	0,0	1,0	1,0	0,5
Bahçesaray	0,0	0,0	0,5	1,0	0,5	0,0	0,0
Başkale	0,5	0,0	0,5	1,0	0,0	0,0	0,0
Çaldıran	0,5	0,5	0,5	0,5	0,0	0,0	1,0
Çatak	0,0	0,0	0,5	1,0	0,5	0,0	0,5
Edremit	0,0	0,5	0,5	0,5	0,0	1,0	0,5
Erciş	1,0	1,0	0,5	0,0	0,5	1,0	0,5
Gevaş	0,0	0,5	0,5	0,5	0,0	1,0	0,0
Gürpınar	0,0	0,0	0,0	1,0	0,0	0,0	1,0
Muradiye	0,5	0,5	0,5	0,5	0,0	1,0	1,0
Özalp	0,5	0,5	0,5	0,5	0,5	0,0	1,0
Saray	0,0	0,0	0,0	1,0	0,0	0,0	1,0
ERDEMKENT REGION	0,5	0,5	0,5	0,5	0,5	1,0	0,5

PARAMETERS	Security	Environment	Dist. Fault	Risk of flooding of lake	Seismicity	Efficiency
REGIONS	**crime rate per capita a year**	**arable area**	**km.**	**#**	**#**	**#**
Efficient factor	**1**	**1**	**1**	**1**	**1**	**1**
Middle-efficient Factor	**0,5**	**0,5**	**0,5**	----	----	**0,5**
Inefficient Factor	**0**	**0**	**0**	**0**	**0**	**0**
City	0,0	1,0	1,0	0,0	0,0	1,0
Bahçesaray	1,0	0,0	0,5	1,0	0,0	0,0
Başkale	0,5	1,0	0,5	1,0	1,0	1,0
Çaldıran	0,5	0,0	0,0	1,0	0,0	0,0
Çatak	1,0	0,5	0,5	1,0	0,0	0,5
Edremit	1,0	0,5	1,0	0,0	1,0	1,0
Erciş	0,0	1,0	0,0	0,0	0,0	0,5
Gevaş	1,0	0,0	1,0	0,0	1,0	0,5
Gürpınar	1,0	1,0	1,0	1,0	1,0	1,0
Muradiye	0,5	0,5	0,0	0,0	0,0	0,5
Özalp	0,5	0,0	0,5	1,0	0,0	0,5
Saray	1,0	0,0	0,0	1,0	0,0	0,0
ERDEMKENT REGION	1,0	0,0	1,0	0,0	1,0	

Results

To reach the best results, different configurations are trained and Architectures. Error – epochs elapsed, success rate r^2 and relative contribution factors from 1. model, as a result of these two developed model shown in Figure 6 and 7, and Table 4.

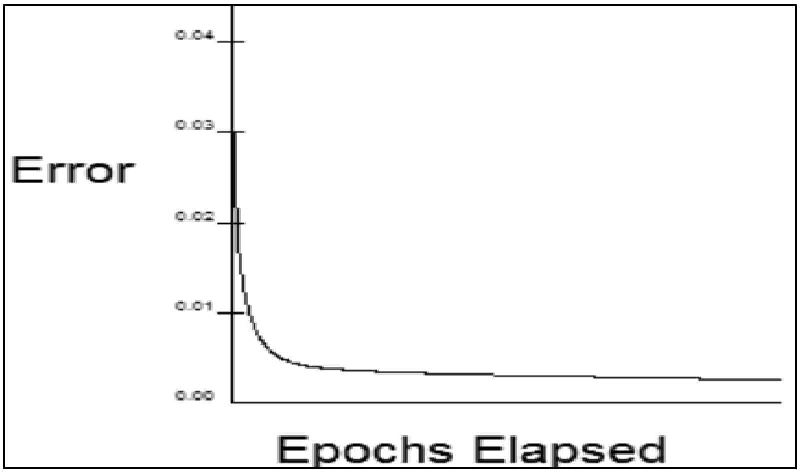

Figure 6: Model 1 error and epochs elapsed graph.

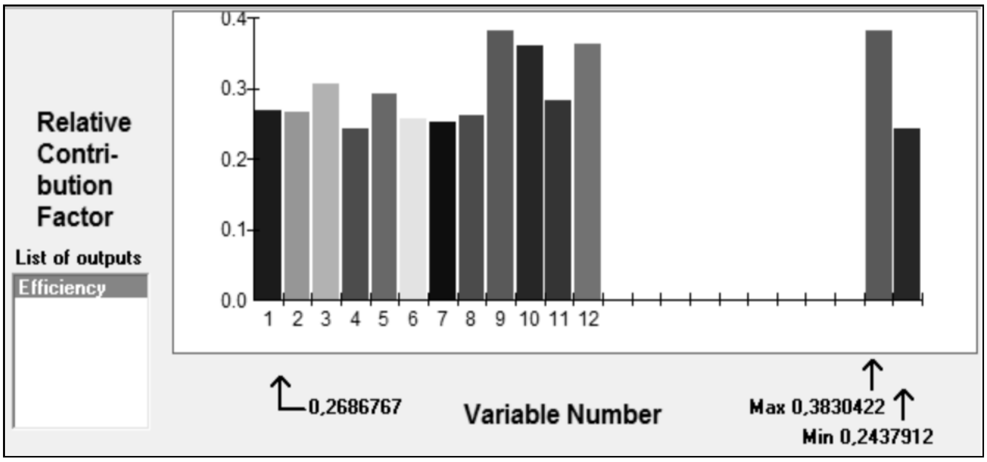

Figure 7: Model 1 relative contribution factors graph.

Table 4: Success rate of model 1.

Patters processed	13
R squared	0,7761
R squared	0,8170
Mean squared error	0,033
Mean absolute error	0,155
Min absolute error	0,012
Max absolute error	0,312
Correlation coefficient, r	0,9039

According to the results of model 1, effective parameters table in light of the data regions is in Table 5.

Table 5: Effective parameters distribution from model 1.

Environment	0,38304
Seismicity	0,36412
Dıst. Fault	0,36055
Hospital	0,30594
Schools	0,29205
Risk of flooding of lake	0,28246
Population	0,26868
Fınancıal	0,26763
Security	0,26133
Topography	0,25802
Climate	0,25159
Hıghway	0,24379

As a forecasting study, for doing a Project at Erdemkent region it will be % 68,78 (0,6878407) efficient project. Error – epochs elapsed, success rate r^2 and relative contribution factors from model 2 shown in Figure 8 and 9, and Table 6.

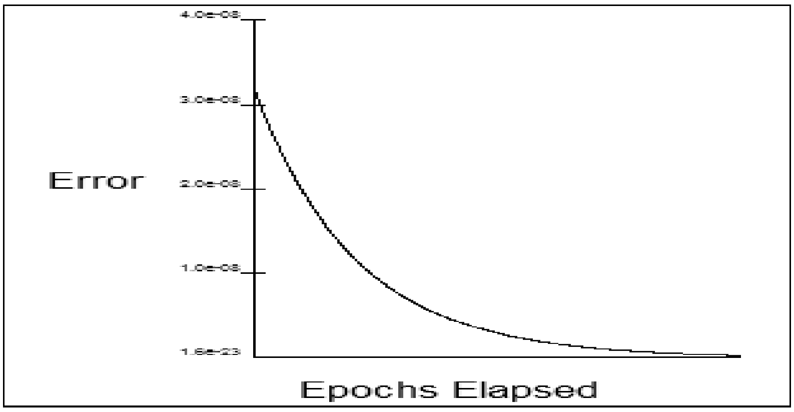

Figure 8: Model 2 error and epochs elapsed graph.

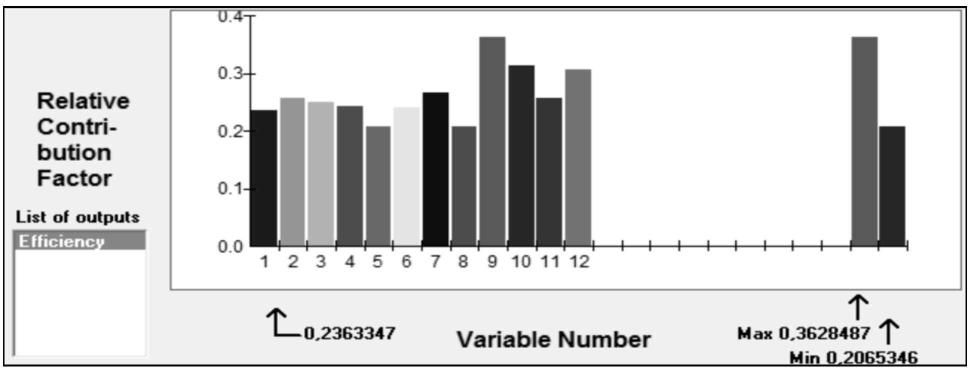

Figure 9: Model 2 relative contribution factors graph.

Table 6: Success rate of model 2.

Patters processed	13
R squared	0,6082
R squared	0,6665
Mean squared error	0,060
Mean absolute error	0,120
Min absolute error	0
Max absolute error	0,787
Correlation coefficient, r	0,8164

As from the results of model 2, the effective parameters are given in Table 7 by regions.

Table 7: Effective parameters distribution from model 2.

Environment	0,3629
Distance from fault	0,3146
Seismicity	0,3075
Climate	0,2656
Risk of flooding of lake	0,2577
Financial	0,2575
Hospital	0,2498
Highway	0,2442
Topography	0,2406
Population	0,2363
Schools	0,2076
Security	0,2065

As a forecasting study, according to model 2 for doing a Project at Erdemkent region it will be % 78,67 (0,786716282) efficient project.

Conclusion

In conclusion, this study shows that in Housing Projects Efficiency Decisions processes can be successfully performed utilizing AI tools, and that Environment, Seismicity and distance from fault are important in the analysis. For evaluation of Housing Projects the results show that the back propagation and GRNN are a suitable and alternative approach. Model 1 has the best success rate %81,7 and model 2 has the best contribution factors result (% 78,67) for doing a Project at Erdemkent region. There are 12 input parameters in this study, and using these 12 parameters, environment, distance from fault and seismicity can be solved by the way of Neural Network. Therefore AI tools, namely NN's used for solving and forecasting engineering problems are appropriate in Housing Projects Efficiency Decisions processes investigation and analysis. For future works, while deciding if the housing project will be efficient according to these factors or etc., we recommended using an AI tool model to see a short and easy pre decision result.

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