ITU A|Z
VOL:8 NO:2, 17-34 2011-2

Quantitative data evaluation model in the process of planning: Case of Istanbul metropolitan area

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Received: April 2011 *Final Acceptance: August 2011*

Abstract:
In the matter of sustainability, several methods have been used in setting natural, social, economic, cultural and structural growth potentials and tendencies. Quantitative evaluation and estimation methods, which were developed after 1960's especially for evaluating the synthesis phase of planning process or presenting possible tendencies with different acceptances, have accelerated after 1980's with the development in computer technology. This has facilitated evaluation of data in several ways and simulation in a short time. In the article, a method will be explained to develop future scenario of metropolitan cities by using natural, socio- economic and physical data. With the principle of conservation of natural structure of Istanbul, increasing quality of life and evaluation of space in a competitive way, it is planned to obtain different results by using different data.

Even if Istanbul is an important service center for both Turkey and other countries of the region, it holds an important manufacturing function. While the competing force of the city is supported by economic structure, the force of urban development over natural resources undermines this competing force. Factors affecting the competing force of Istanbul are determined by literature studies, and are evaluated by using spatial data. Spatial data are used by defining factors affecting sustainability Sieve analysis is used as an evaluation method in an ArcGIS environment. By evaluating the indicators of competing force in Istanbul, the future position of the competing force of the city is presented spatially. Aforementioned steps are tested in the method by life quality point of view and the results are compared

Istanbul, the biggest city of Turkey, has been growing both economically, demographically and spatially. It threatens both natural areas around the city and the future of the city by the pressure over water reservoir areas. In defining Istanbul's spatial development tendencies and forming future scenarios, sustainability of the natural areas should be taken into consideration.

Keywords: *Sieve analysis and evaluation, competing approach, sustainability of natural structure approach, life quality approach, data evaluation model*

1. Land use models and using process of quantitative methods in planning

In planning, during either future land use or transportation centered land use estimation, several views on land use, functional relations or organizations have suggested in different periods. Planning and the replanning of settlements depend on certain principles: new searches began with Soria Y. Mata's idea especially in the last quarter of 19th century, followed by French architect Tony Garnier in 1917, Milyutin in 1929, L.Hilberseimer in 1941 and J. Jose Sert in 1948. The origin of the searches beginning with S. Mata in 1882 was the accessibility and the relation between working and housing depend on the importance of the production (Giritlioğlu C., 1985).Beside the linear city form in this period, researchers such as P. Wolf in 1919, A. Edwards in 1930, S.E. Sanders and A.J. Rabuck in 1946 have proposed several views and models on radial and radio concentric city forms. After these years, most of the approaches in planning of the settlements had an entirety in itself and the city forms were developed based on the economical and technological conditions of the period.

In spite of the disuse of computer in the developed models of r land use estimation in the middle of 20th century, studies with dense use of mathematical concepts have attracted attention. Models developed by economists were mostly thought according to size that could form a sample or scale developed by human factor or calculators. Especially after 1980's the decrease in the time of operation depended on the transformation of computer to personal computers, common use of it and technological developments have increased the studies on models. With common use of computer in whole scientific branches, data communication especially among city and region planners and other branches (geography, geodesy and cartography, environment, geology) have increased. As a result, data belong to all the scientific branches have unified and healthier land use estimations have been done. At the end of the 1980's the development of computer programs in geography (GIS) let the input-output possibilities for data, inquiry and evaluation according to the aim (Peuquet, Marble 1990; Archer v.d. 1961).

The method explained in the article

Models defining effect area

- "Detroit Urban Simulation Model" Metropolitan Area Transportation Model (1955-1956) (Kain, 1975)
- "Chicago Transportation Study" (1960's). In the model with the active using of computer, increase in the speed of transportation in metropolitan area were aimed
- A prototype model depend on linear programming in the development estimation of residential areas was developed by Herbert-Stevensa in 1960's
- "Boston Regional Transportation Study" (in the middle of 1960's)
- The beginning of attraction type models developed for land use estimation depend on Ira S. Lowry's "Lowry Model" in 1961. Lowry İ.S.,1964
- Crecine, "Metropolitan Model Depend On Time" (1964)
- Goldner, "Planned Land Use Model" (1968)
- Batty, "Nottingham-Derbyshire Model" (1971)
- Batty, "Reading Model" (1973) (Batty, 1976)
- Dökmeci, Çağdaş, Tokcan, "Multi-Purpose Land Use Model" (1988) (Dökmeci, 2005)

Cellular Automata (CA) based land use simulation models

- Tobler, with his study in 1979, was the first person who propose a cellular approach to geographical modeling
- Takeyama's studies in 1996 followed Coucleis's studies in 1985,

1988, 1989, 1996

- Batty and Xie developed CA for both land use samples and connected transportation web producing urban models (Kain, 1987)
- Portugali and Benenson searched general organization principles of the city with CA models in 1995 and 1997 studies (Portugali, Benenson, 1995)
- In 1996 Cecchini developed a model which depend on cellular neighborhood relations and physical data (also with density) in defining urban form and used this model in simulating the growth of an urbanized area (Cecchini, Besussi, 1996)
- In White and Engelen's (1993, 1994, 1997), White's (1997) and Engelen's (1997) studies, CA based urban transformation and urban simulation models which combine theoretical concept with experimental realities were developed. (White, Engelen, 1993, 1994)
- Yüzer (2001), CA based LUCAM Model which allows urban transformation and development simulation. (Yüzer M.A, 2001)

2. Quantitative data evaluation model

In defining urban spatial tendencies and forming future scenarios, the effectiveness of important factors such as sustainability of natural structure, socio-economic relation systems, transportation systems, different sector structures, sectoral projections, etc. play role. . While these scenarios are constituted, different layers within the existing socio-economic order may exhibit differences in the trends and expectations. According to these evaluations what are the most effective router elements in the creation of the scenarios may be a matter open to debate. Because of not taking into account or ignoring the needs and expectations of the social mass or trends of investors, a scenario taking only the sustainability of natural structure will affect the well-balanced development of the city negatively. Besides a scenario responding only the user and investor trends and ignoring the sustainability of natural structure will also affect the urban development negatively. The method which was developed in the article is aimed that urban planners can see the trends according to the results of acceptations of scenarios and mathematical approaches of possible developments and changes especially while they are developing scenarios in a synthesis phase. The defined model in the article which is able to produce with different assumptions and different results to urban planners and other actors are defined in the context of fiction and steps of the model.

The basic structure of the model, which was developed for the determination of future scenarios and evaluation of data in planning process, was conceptualized in four stages.

Stage 1: The basic plot of the scenario is determined
Basic fiction;
Scenario based on enhancing the quality of life
Scenario based on sustainability of natural structure
Scenario based on directing competitive investment
Stage 2: The data are classified depending on the scenario which the basic plot is defined
Stage 3: Impact values of the data, coefficients of importance are described depend on the assumptions
Stage 4: Every cell representing space is associated with all the data and the change, transformation or development potentials of the cells are calculated.

Quantitative Data Evaluation Model is tested throughout Istanbul metropolitan area and according to the results of testing, future tendencies are defined. In the article all the steps of the model will be explained on the basis of the study for Istanbul.

Stage 1: The basic plot of the scenario is determined

Basic fiction;

Scenario based on enhancing the quality of life

In this scenario the aim of the model is to define the value of every spatial cell occurred in terms of life quality as a tool to help users spatial land use preference according to the data defined in the model and coefficient applied to this data.

Scenario based on sustainability of natural structure

In this scenario the aim of the model is to get a synthesis that every spatial cell evaluated on the basis of sustainability of natural structure conditions according to the data defined in the model and coefficient applied to this data. The model takes into account all the natural components in this approach and depending on the basis of the sustainability it offers a number of settlement choices to the users.

Scenario based on directing competitive investment

In this scenario the aim of the model is to define every spatial cell which offers advantages to the investors based on competitiveness on the selection of the facility according to the data defined in the model and coefficient applied to this data. In this approach the model takes into account all the advantageous conditions occurred throughout metropol for all the investments and offers a synthesis schema which facilitate investors to access settlement choices directing land use.

Stage 2: The data are classified depending on the scenario which the basic plot is defined

In this level of the model, first of all 1/50 000 scale base maps were prepared throughout Istanbul Metropolitan Area. On this map built environment data such as land use, residential areas, industrial areas and commercial areas, natural structure data such as water reservoir boundaries, forest areas, agricultural area and transportation data such as transportation axes, railway, ports and airports were classified.

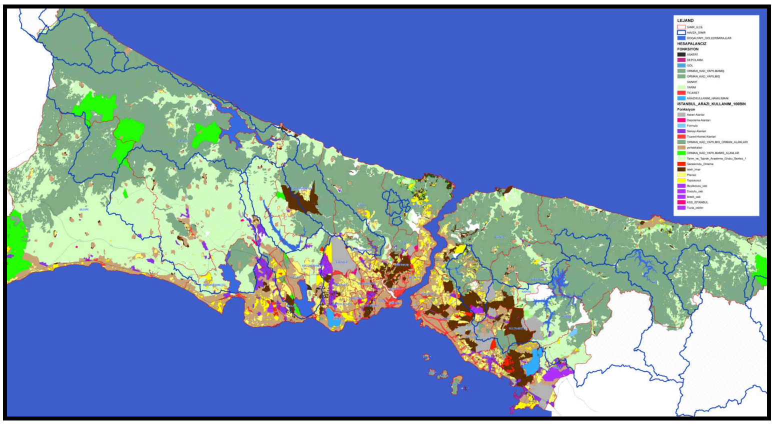


Figure 1. *Sketch of classified land use (IBB, 2007)*

After preparing the base sketch to be used, Istanbul Metropolitan Area is divided into 25 ha squares. "**OBJECT ID**" is given to each of the grid and taken to ArcGIS.

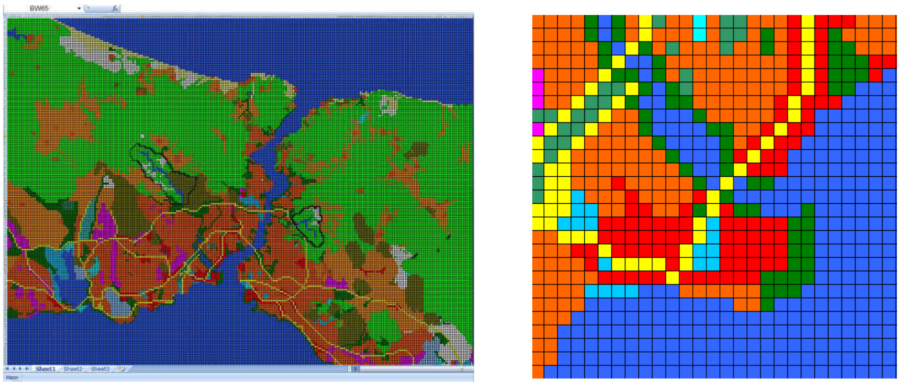
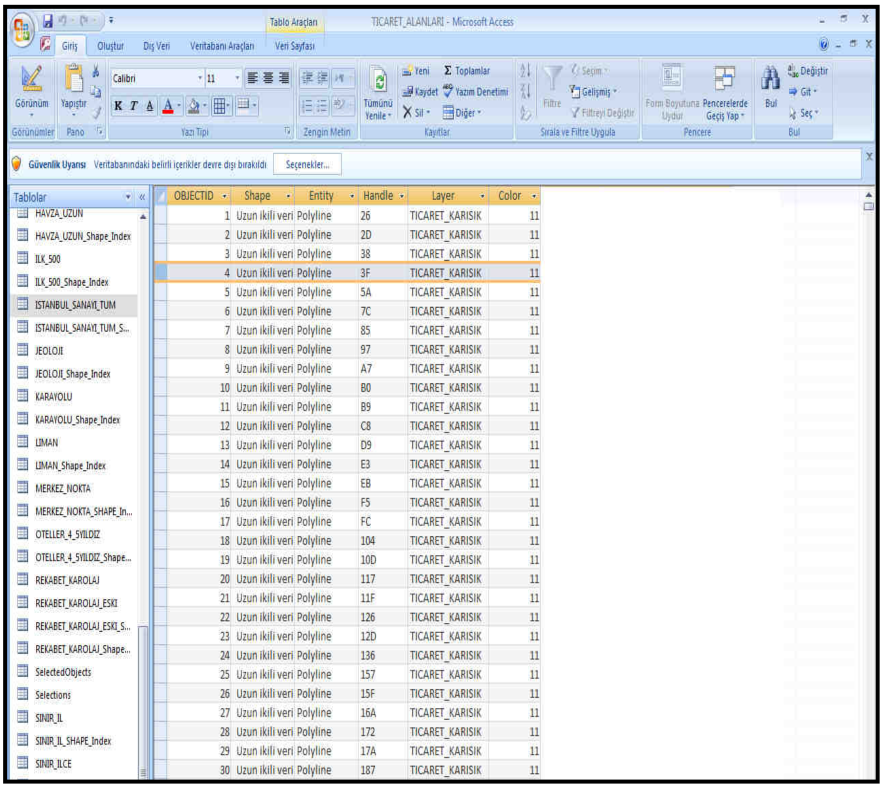


Figure 2. *Definition of classified land use in each 25 ha cell*

By getting outputs from 25 ha cells settled on 1/50 000 scale base sketch and OBJECT ID's belonging to these cells, land use data belong to every cell are entered into table of data in the Excel environment (Figure 3).

During the data entry, to facilitate the process for each land use and to make definitions in cells, more perceivable abbreviations are pursued.

After completing all data entry, table prepared in Excel Environment is transferred into the MS Access environment and is associated with sketch prepared in the ArcGIS environment. Thus, cells are created in the detail of 25 ha of land use.



OBJECTID	Shape	Entity	Handle	Layer	Color
1	Uzun ikili veri	Polyline	26	TICARET_KARISIK	11
2	Uzun ikili veri	Polyline	2D	TICARET_KARISIK	11
3	Uzun ikili veri	Polyline	38	TICARET_KARISIK	11
4	Uzun ikili veri	Polyline	3F	TICARET_KARISIK	11
5	Uzun ikili veri	Polyline	5A	TICARET_KARISIK	11
6	Uzun ikili veri	Polyline	7C	TICARET_KARISIK	11
7	Uzun ikili veri	Polyline	85	TICARET_KARISIK	11
8	Uzun ikili veri	Polyline	97	TICARET_KARISIK	11
9	Uzun ikili veri	Polyline	A7	TICARET_KARISIK	11
10	Uzun ikili veri	Polyline	B0	TICARET_KARISIK	11
11	Uzun ikili veri	Polyline	B9	TICARET_KARISIK	11
12	Uzun ikili veri	Polyline	C8	TICARET_KARISIK	11
13	Uzun ikili veri	Polyline	D9	TICARET_KARISIK	11
14	Uzun ikili veri	Polyline	E3	TICARET_KARISIK	11
15	Uzun ikili veri	Polyline	EB	TICARET_KARISIK	11
16	Uzun ikili veri	Polyline	F5	TICARET_KARISIK	11
17	Uzun ikili veri	Polyline	FC	TICARET_KARISIK	11
18	Uzun ikili veri	Polyline	104	TICARET_KARISIK	11
19	Uzun ikili veri	Polyline	10D	TICARET_KARISIK	11
20	Uzun ikili veri	Polyline	117	TICARET_KARISIK	11
21	Uzun ikili veri	Polyline	11F	TICARET_KARISIK	11
22	Uzun ikili veri	Polyline	126	TICARET_KARISIK	11
23	Uzun ikili veri	Polyline	12D	TICARET_KARISIK	11
24	Uzun ikili veri	Polyline	136	TICARET_KARISIK	11
25	Uzun ikili veri	Polyline	157	TICARET_KARISIK	11
26	Uzun ikili veri	Polyline	15F	TICARET_KARISIK	11
27	Uzun ikili veri	Polyline	16A	TICARET_KARISIK	11
28	Uzun ikili veri	Polyline	172	TICARET_KARISIK	11
29	Uzun ikili veri	Polyline	17A	TICARET_KARISIK	11
30	Uzun ikili veri	Polyline	187	TICARET_KARISIK	11

Figure 3. *Land use data received in the excel environment*

Table 1. *Abbreviations used in the description of cell*

Residential Area Data		**Transportation**	
Low Density Residential Area	KD	E-5 Highway	UE
Medium Density Residential Area	KO	Tem Highway	UT
High Density Residential Area	KY	Railway	UD
Economic Activity Areas Data		Airport	UH
Industry+Warehouse	ESD	Port	UL
Organized Industrial Areas	EO	Bus Station	UDO
Commerce	ET	**Facilities**	
Residential+Commerce	EKT	Military Area	DOA
Natural Structure Data		Green Area	DOY
1stdegree Agricultural Land	DT1	Sport Facility	DOSP
2nd Degree Agricultural Land	DT2	Technical Infrastructure	DOTAY
3rd Degree Agricultural Land	DT3	Education	DOE
4th Degree Agricultural Land	DT4	Administrative Facility	DOI
Lake And Dam	DGB	Cemetery	DOM
Water Basin	DH	Health Facility	DOS
Forest Area	DO	**Other**	
Sea	DDE	Inside Istanbul	ISD
		Outside Istanbul	IS

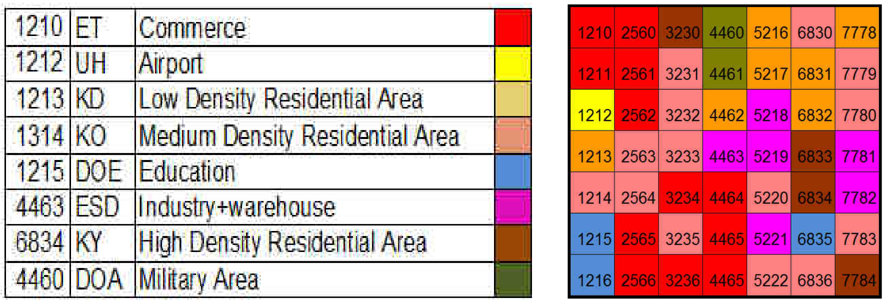


Figure 4. *Cells shown in the ArcGIS environment*

Stage 3 and Stage 4

Model Formulation

A_{ykd}= (p1 x c1+p2 x c2+..+pn x cn) / ∑v
A_{ykd} : quality of life synthesis value of cell A
P1= data value number 1 applied to cell A
C1= impact factor applied to data value number 1
∑h : Total number of data *   * Total number of data, is used in the calculation of "arithmetic mean" .Taking "arithmetic mean" in the model is because of difference in the number of data existing in each cell.

In this method, each cell gets a value based on previously defined sub-set of data. While this value is determined, the raw data are taken into consideration in their own language and undergoes transformation between 0-100 to provide a unity of language with other data.

Table 2. *Cells shown in the ArcGIS environment*

Katsayılar

İLÇELER	Öğrenci/ Öğretmen		4	Öğrenci/ Derslik		5	Okullaşma Oranı (%)		5	Yüksek okullaşma oranı 2000		3	GSYİH1995-96 (Alıcı fiyatlarıyla)		4	top ecz sayısı		4
Adalar	9	100	400	12	100	500	23	1	5	0,13	70	210	1522087	30	120	12	1	4
Avcılar	26	30	120	37	1	5	72	50	250	0,07	30	90	50993868	100	400	83	30	120
Bağcılar	24	70	280	26	50	250	45	30	150	0,07	30	90	43238834	50	200	252	100	400
Bahçelievler	17	70	280	22	70	350	88	70	350	0,21	100	300	59791702	70	280	79	30	120
Bakırköy	18	70	280	32	30	150	166	100	500	0,02	1	3	144055814	100	400	150	50	200
Küçükçekmece	19	70	280	21	70	350	62	50	250	0,04	1	3	49997468	50	200	157	70	280
Maltepe	15	100	400	24	70	350	90	70	350	0,10	30	90	21990188	30	120	166	70	280
Pendik	28	30	120	20	100	500	56	30	150	0,12	70	210	28843281	30	120	93	30	120
Sarıyer	8	100	400	17	100	500	74	50	250	0,05	1	3	20853347	30	120	83	30	120
Silivri	14	100	0	17	100	0	-	-	0	0,04	1	3	12302203	1	4	-	-	0
Sultanbeyli	32	1	4	21	70	350	39	1	5	-	-	0	24164807	30	120	30	1	4
Şile	17	70	0	15	100	0	-	-	0	-	-	0	6907798	70	280	-	-	0
Şişli	14	100	400	24	70	350	144	100	500	0,11	70	210	153304196	100	400	261	100	400
Tuzla	13	100	400	24	70	350	94	70	350	0,04	1	3	12826773	1	4	38	1	4
Ümraniye	16	70	280	28	50	250	83	70	350	0,02	1	3	37052480	50	200	138	50	200
Üsküdar	16	70	280	21	70	350	114	100	500	0,06	30	90	51529428	50	200	229	100	400
Zeytinburnu	29	30	120	45	1	5	66	50	250	0,06	30	90	81292689	70	280	116	50	200
Değerler	0-15	100		20 altı	100		40 altı	1		0-5	1		12 826 773	1		0-50	1	
	16-25	70		20-30	70		40-60	30		6-10	30		33 223 987	30		51-100	30	
	26-35	30		31-40	50		61-80	50		11-15	70		54 900 883	50		101-150	50	
	35 üstü	1		41-50	30		81-100	70		15 üstü	100		81 292 689	70		151-200	70	
				50 üstü	1		100 üstü	100					153 304 196	100		200 üstü	100	

İLÇELER	ana arterler		2	üniversite bitirenlerin toplam nüf içindeki oranı		4	pop/building		4	nüfus artışı (binde)		1	işsizlik oranı		1	suç sayıları		1
Adalar	27	30	960	0,13	50	200	3	100	400	-8,9	100	100	0,048	100	100	6	100	100
Avcılar	11	1	32	0,07	30	120	17	30	120	61,4	20	20	0,060	50	50	31	50	50
Bağcılar	22	30	960	0,02	1	4	15	50	200	84,7	20	20	0,056	50	50	34	50	50
Bahçelievler	24	30	960	0,07	30	120	24	1	4	47,3	40	40	0,055	70	70	16	70	70
Bakırköy	39	50	1600	0,21	100	400	21	1	4	-37,0	60	60	0,046	100	100	26	70	70
Küçükçekmece	29	30	960	0,04	1	4	13	50	200	52,1	40	40	0,056	50	50	38	50	50
Maltepe	29	30	960	0,10	30	120	14	50	200	33,5	60	60	0,058	50	50	13	70	70
Pendik	19	1	32	0,04	1	4	9	70	280	66,2	20	20	0,059	50	50	27	70	70
Sarıyer	35	50	1600	0,10	30	120	7	70	280	34,4	60	60	0,054	70	70	40	30	30
Silivri	-	-	0	0,08	30	120	5	100	400	33,2	60	60	0,050	70	70	11	70	70
Sultanbeyli	-	-	0	-	-	0	-	-	0	75,6	20	20	0,000	100	100	17	70	70
Şile	-	-	0	-	-	0	-	-	0	24,6	60	60	0,00003	100	100	0	100	100
Şişli	35	50	1600	0,12	50	200	12	50	200	7,8	80	80	0,052	70	70	35	50	50
Tuzla	16	1	32	0,05	1	4	7	70	280	24,6	60	60	0,057	50	50	28	70	70
Ümraniye	20	30	960	0,04	1	4	10	70	280	89,1	20	20	0,057	50	50	10	100	100
Üsküdar	40	50	1600	0,11	50	200	12	50	200	22,4	60	60	0,052	70	70	24	70	70
Zeytinburnu	33	50	1600	0,04	1	4	15	50	200	40,2	40	40	0,056	50	50	48	30	30
Değerler	20 altı	1		0-5	1		0-5	100		0'ın altı	100		5,0 altı	100		50 altı	100	
	20-30	30		6-10	30		6-10	70		0-20	80		5,0-5,5	70		51-80	70	
	31-40	50		11-15	50		11-15	50		21-40	60		5,6-6,0	50		81-110	50	
	41-50	70		15-20	70		16-20	30		41-60	40		6,1-6,5	30		111-140	30	
	50 üstü	100		20 üstü	100		21 üstü	1		61-80	20		6,6 üstü	1		140 üstü	1	
										81 üstü	1							

These values are multiplied by Impact Coefficients which are previously defined for the “Synthesis of the Quality Of Life”. All values resulting from the multiplication of the cell are collected and the arithmetic averages are taken by dividing by the number of data. Thus, the “Quality Of Life Synthesis Value” (QLSV) for cell is obtained.

Object ID	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7	Data 8	Data 9	Data 10	Data 11	Data 12	Data 13
Values	30	70	30	50	1	100	1	50	70	20	1	50	30
Effect Coefficient	4	4	5	5	3	4	4	2	4	4	1	1	3
Effect Coefficient Value	120	280	150	250	3	400	4	100	280	80	1	50	90
Total Value of Cell	1808												
Quality of Life Synthesis Value = Total Value/13 = 1808/13 = 139,0769													

	Analysis of Quality Of Life Studies	Coefficient
1	Activity Rate	4
2	Student/Teacher	4
3	Student/Classroom	5
4	School Enrollment Rate (%)	5
5	High School Enrollment Rate 2000	3
6	Gross Domestic Product 1995-96 (with receiver prices)	4
7	Total Pharmacy Number	4
8	Main Artery	2
9	Rate of University Graduates in the Total Population	4
10	Population/Building	4
11	Population Growth (per thousand)	1
12	Unemployment Rate	1
13	Crime Number (according to 100.000 pop)	3

Table 3. *Sample of calculation table for a cell*

1. Highway Transportation	Scoring
0-3 km	100
3-6 km	80
6-10 km	60
10-15 km	40
15-20 km	20
> 20 km	1

6. First 500 Industries	Scoring
0-1 km	100
1-3 km	90
3-7 km	80
7-15 km	40
15-30 km	20
30 km+	1

2A. Port	Scoring
0-5 km	100
5-10 km	80
10-20 km	70
20-40 km	60
40-80 km	50
> 80 km	1

7. Risky Areas	Scoring
Areas Require Detailed Geological Investigation	100
Measured Settlement Areas	70
Risky to Settle Areas	1
Inconvenient to Settle Areas	1

2B. Airport	Scoring
0-5 km	100
5-10 km	80
10-20 km	70
20-40 km	60
40-80 km	50
> 80 km	1

8. Gross National Product(districts)TL	Scoring
< 13.000.000	1
13.000.000-35.000.000	30
36.000.000-55.000.000	50
56.000.000-82.000.000	70
> 82.000.000	100

3. Railway	Scoring
0-3 km	100
3-6 km	80
6-10 km	70
10-15 km	60
15-20 km	50
> 20 km	1

9. 4-5 Star Hotels	Scoring
0-1 km	100
1-3 km	90
3-7 km	80
7-15 km	40
15-30 km	20
> 30 km	1

4. Land Values	Scoring
<65 TL/m2	100
65-150 TL/m2	80
150-300 TL/m2	60
300-450 TL/m2	40
450-700 TL/m2	20
>700 TL/m2	1

10. Natural Structure(water basins,forests)	Scoring
0-5 km	1
5-7 km	30
7-10 km	50
10-15 km	70
>15 km	100

5. Industrial Areas	Scoring
0-3 km	100
3-6 km	80
6-10 km	60
10-15 km	40
15-20 km	20
> 20 km	1

11. Commercial Areas	Scoring
0-3 km	100
3-6 km	70
6-10 km	30
> 20 km	1

12. Foreign Capital	Scoring
> %10	100
%3 - %10	70
%2 - %3	50
%1 - %2	30
<%1	1

3. Scenarios based on enhancing quality of life, sustainability of natural structure and directing competitive investment throughout İstanbul metropolitan area

The scenarios based on Enhancing Quality of Life, Sustainability of Natural Structure, and Directing Competitive Investment throughout Istanbul Metropolitan Area is produced. In the development of these scenarios, data sets vary depending on the purpose of each scenario. In all three scenarios, under the scenario effects vary based on the commonly used data on cells.

3.1. Enhancing the quality of life scenario

In this scenario, 12 different sets of data are evaluated. Effects of the data on the scenario differentiate depending on the coefficients.

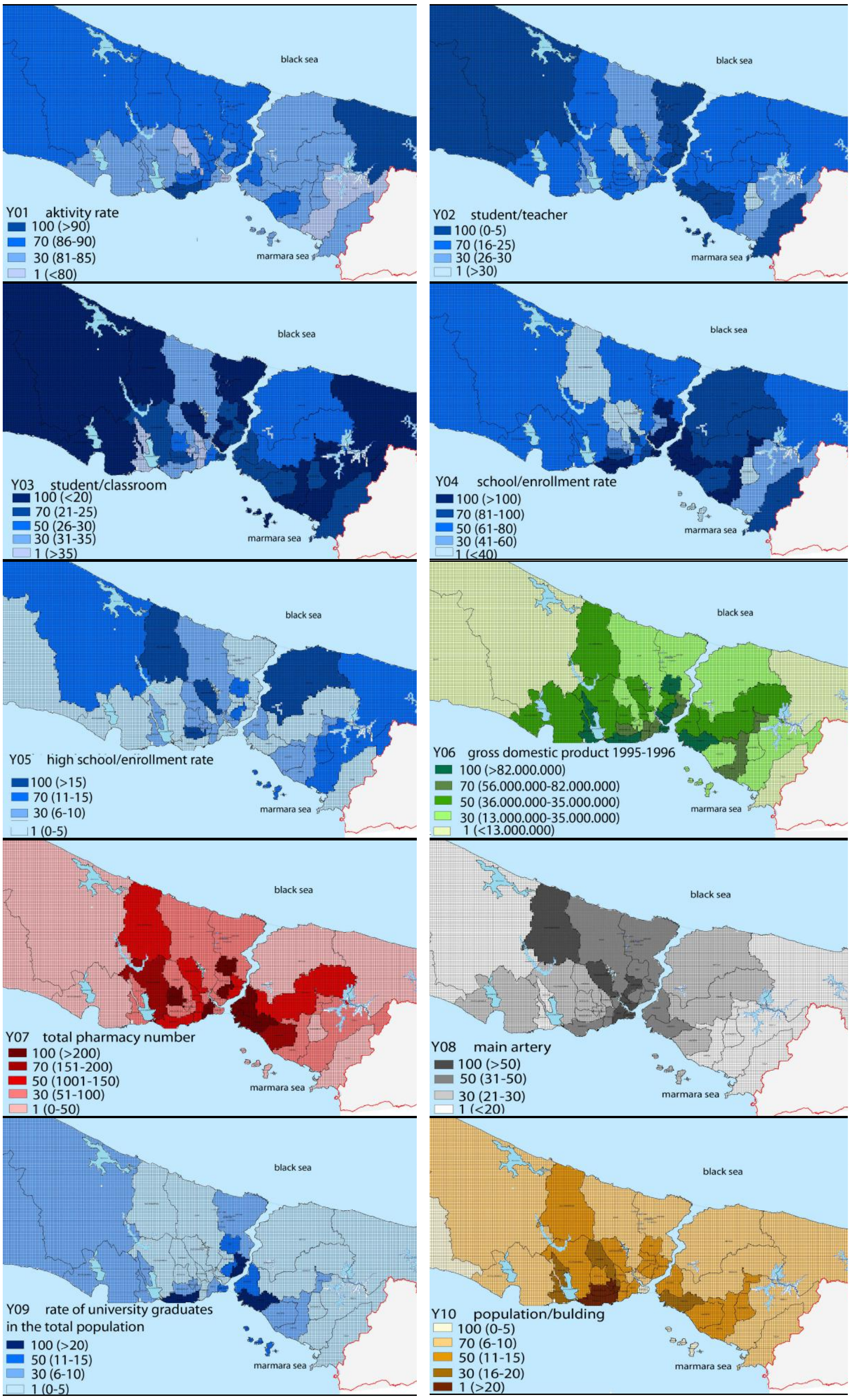


Figure 5. *Data set of enhancing the quality of life scenario*

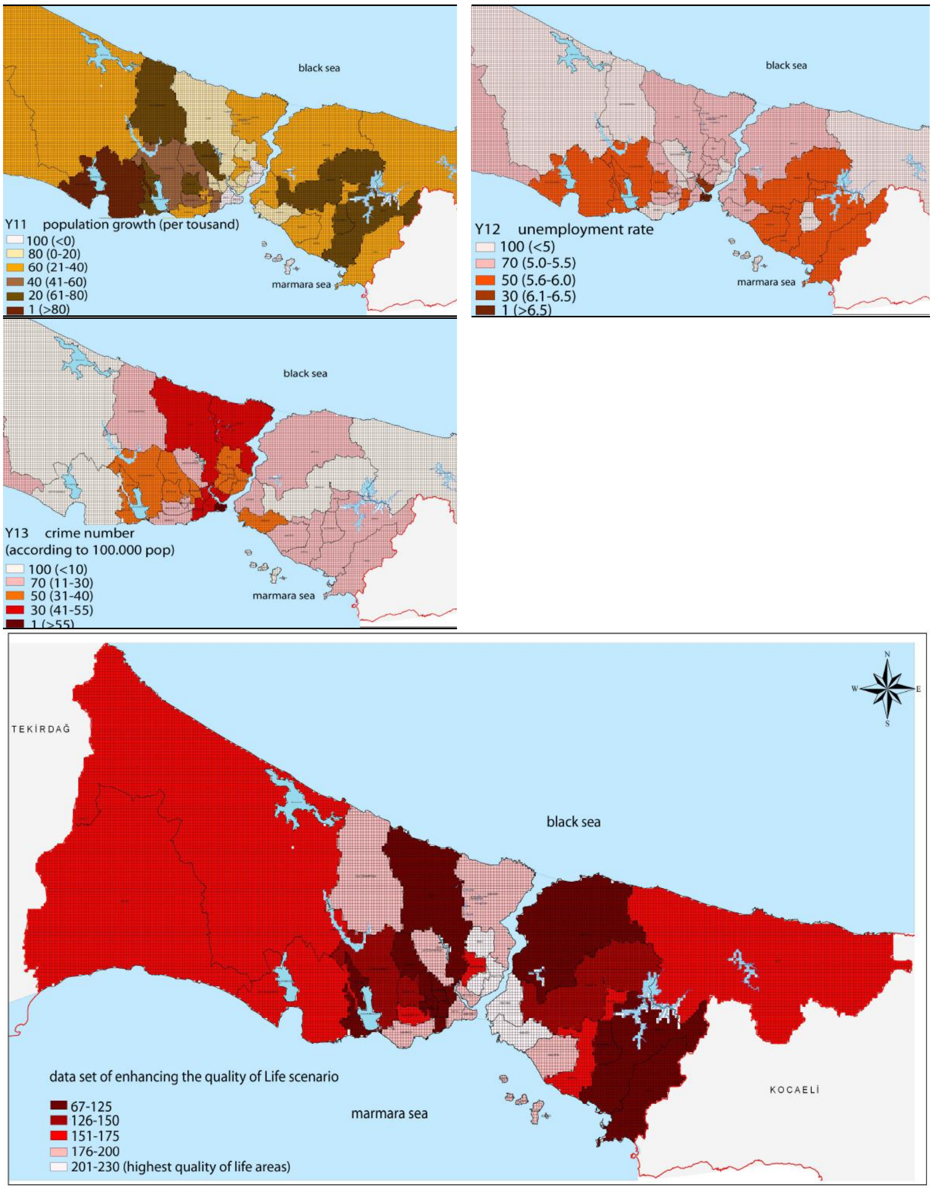


Figure 5. *Continued*

Evaluation of the Scenario Based on Enhancing the Quality of Life

- In Istanbul districts having the highest quality of life are Şişli and Beşiktaş on the west side, Üsküdar and Kadıköy on the east side.
- While districts with the high quality of life show similar characteristics along the coastline of the west side, it decreases towards deeper inland.
- Districts having the lowest quality of life are Zeytinburnu and Bayrampaşa.
- In the spatial sense, areas so close to so many different features indicates areas of urban decay and deterioration and is required to take measures in this regard.

3.2. Sustainability of natural structure scenario

In this scenario, 5 different sets of data (Forest Areas, Water Basins, Streams, Agricultural Areas and the Risky Areas) are evaluated. Effects of the data on the scenario differentiate depending on the coefficients.

NATURAL STRUCTURE ANALYSIS SCORING SYSTEM	
D1. Forests	**Scoring**
Inside Forest Area	1
Outside Forest Area	100
D2. Water Basins	**Scoring**
0-5 km	1
5-7 km	25
7-10 km	50
10-15 km	75
>15 km	100
D3. Creeks	**Scoring**
0-500 m	1
>500 m	100
D4. Agricultural Areas	**Scoring**
4th Degree and Over Agricultural Areas	100
1st, 2nd, 3rd Degree Agricultural Areas	1
D5. Riskli Alanlar	**Scoring**
Areas Require Detailed Geological Investigation	100
Measured Settlement Areas	70
Risky to Settle Areas	1
Inconvenient to Settle Areas	1

NATURAL STRUCTURE ANALYSIS STUDY COEFFICIENT		
		Coefficient
1	Forests	1
2	Water Basins	1
3	Creeks	1
4	Agricultural Areas	1
5	Risky Areas	1

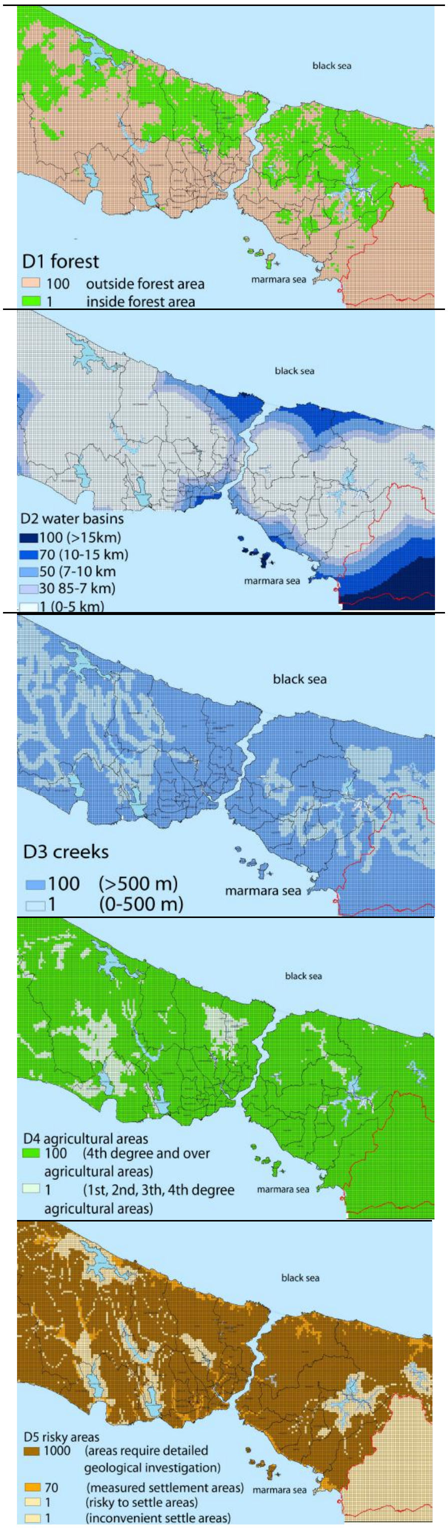


Figure 6. *Data set of sustainability of natural structure scenario*

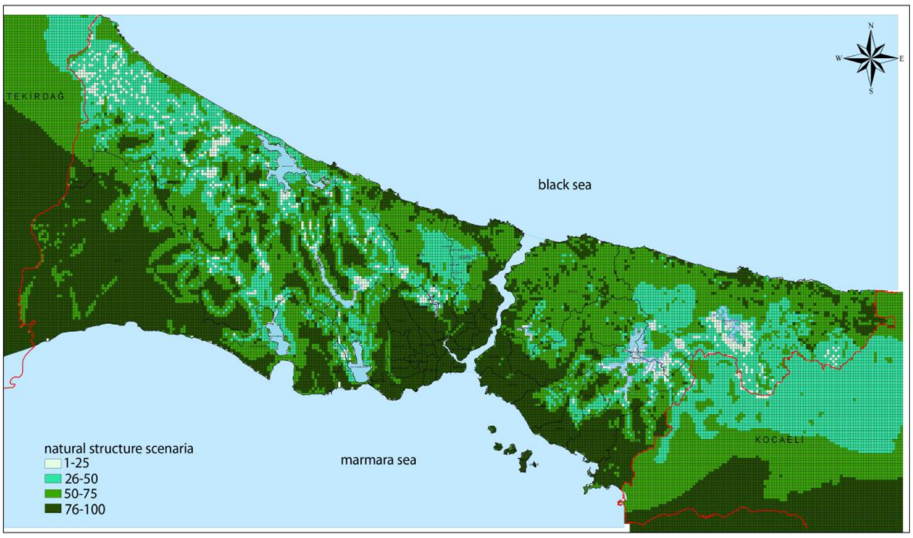


Figure 6. *Continued*

Evaluation of the Scenario Based on Sustainability of Natural Structure

- According to the spatial development scenario created by the properties of natural structure, it is seen that in the northern parts of the city, development potential is limited. Areas suitable for settlement are determined as a part of Umraniye and areas of the southern coast of the east side.

- The majority of Sultanbeyli and Ümraniye districts and Maltepe, Kartal, Pendik and Tuzla district’s northern parts and partly south of TEM Highway are identified as areas of high natural value

- The most risky areas on the east side are Sarıyer, Küçükçekmece, Avcılar and Büyükçekmece districts and a part of Şişli district. Since these areas also contain the city's major water reservoirs, protection of the effects of urban growth is important for the sustainable development of the city.

- As the development is limited through the north of the city, in the development of east-west direction natural areas are a threshold which has to be taken into account.

3.3. Directing competitive investment scenario

In this scenario, 12 different sets of data (Highway Transport, Ports, Airports, Railways, Land Values, Industrial Areas, Top 500 Industry and High Risk Areas, GNP values, 4-5 star hotels, Natural Structure, Commercial Institutions and foreign capital institutions) are evaluated. Effects of the data on the scenario differentiate depending on the coefficients.

COMPETITIVE INVESTMENT SCORING SYSTEM

1. Highway Transportation	Scoring
0-3 km	100
3-6 km	80
6-10 km	60
10-15 km	40
15-20 km	20
> 20 km	1

2A. Port	Scoring
0-5 km	100
5-10 km	80
10-20 km	70
20-40 km	60
40-80 km	50
> 80 km	1

2B. Airport	Scoring
0-5 km	100
5-10 km	80
10-20 km	70
20-40 km	60
40-80 km	50
> 80 km	1

3. Railway	Scoring
0-3 km	100
3-6 km	80
6-10 km	70
10-15 km	60
15-20 km	50
> 20 km	1

4. Land Values	Scoring
<65 TL/m2	100
65-150 TL/m2	80
150-300 TL/m2	60
300-450 TL/m2	40
450-700 TL/m2	20
>700 TL/m2	1

5. Industrial Areas	Scoring
0-3 km	100
3-6 km	80
6-10 km	60
10-15 km	40
15-20 km	20
> 20 km	1

6. First 500 Industries	Scoring
0-1 km	100
1-3 km	90
3-7 km	80
7-15 km	40
15-30 km	20
30 km+	1

7. Risky Areas	Scoring
Areas Require Detailed Geological Investigation	100
Measured Settlement Areas	70
Risky to Settle Areas	1
Inconvenient to Settle Areas	1

8. Gross National Product(districts)TL	Scoring
< 13.000.000	1
13.000.000-35.000.000	30
36.000.000-55.000.000	50
56.000.000-82.000.000	70
> 82.000.000	100

9. 4-5 Star Hotels	Scoring
0-1 km	100
1-3 km	90
3-7 km	80
7-15 km	40
15-30 km	20
> 30 km	1

10. Natural Structure(water basins,forests)	Scoring
0-5 km	1
5-7 km	30
7-10 km	50
10-15 km	70
>15 km	100

11. Commercial Areas	Scoring
0-3 km	100
3-6 km	70
6-10 km	30
> 20 km	1

12. Foreign Capital	Scoring
> %10	100
%3 - %10	70
%2 - %3	50
%1 - %2	30
<%1	1

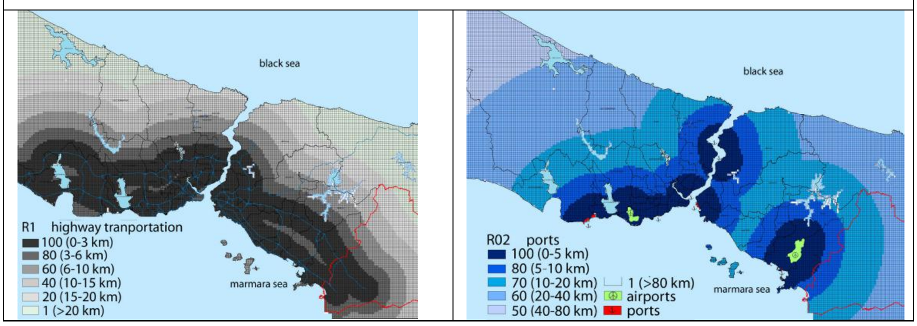


Figure 7. *Data set of directing competitive investment scenario*

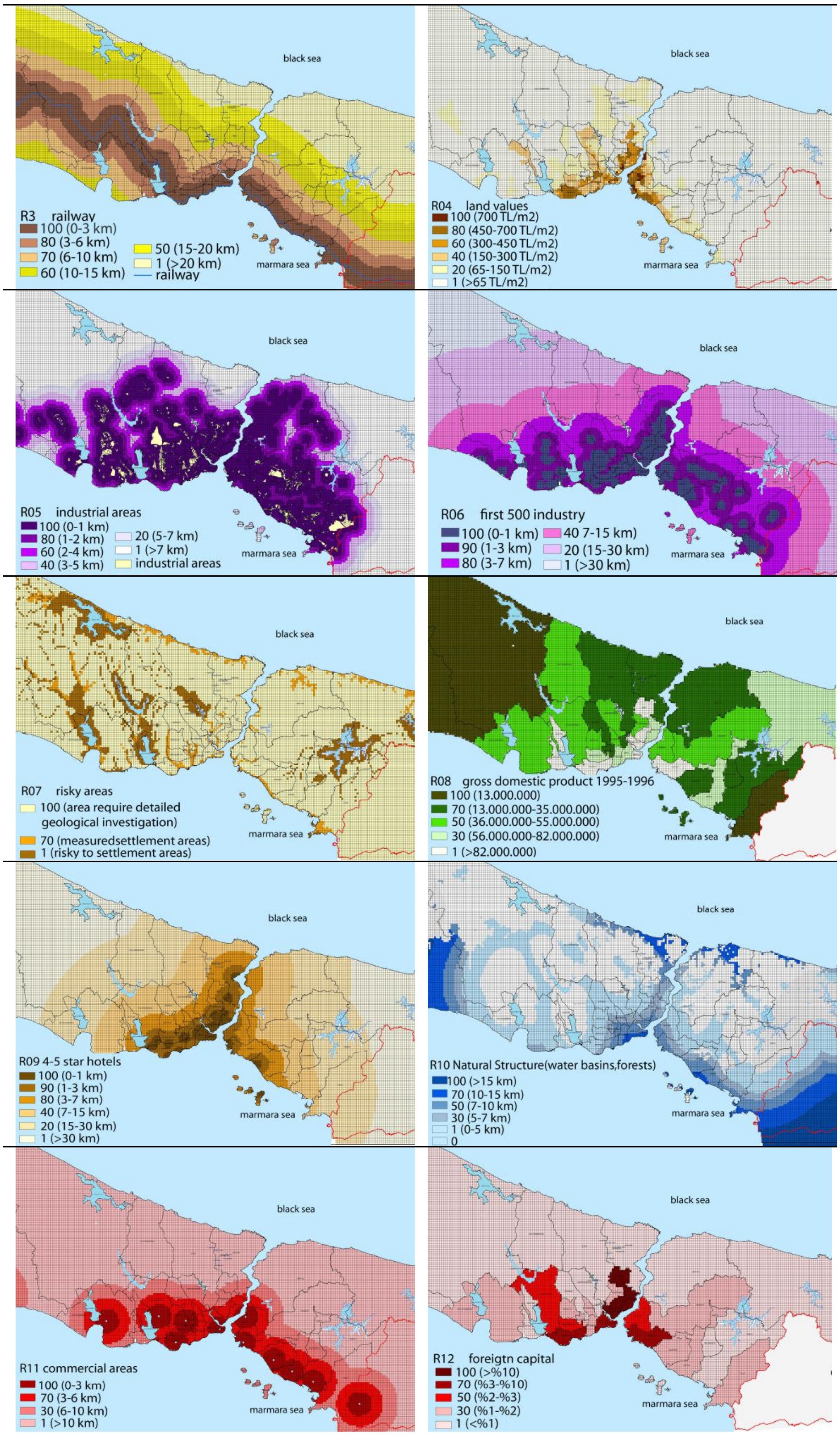


Figure 7. *Continued*

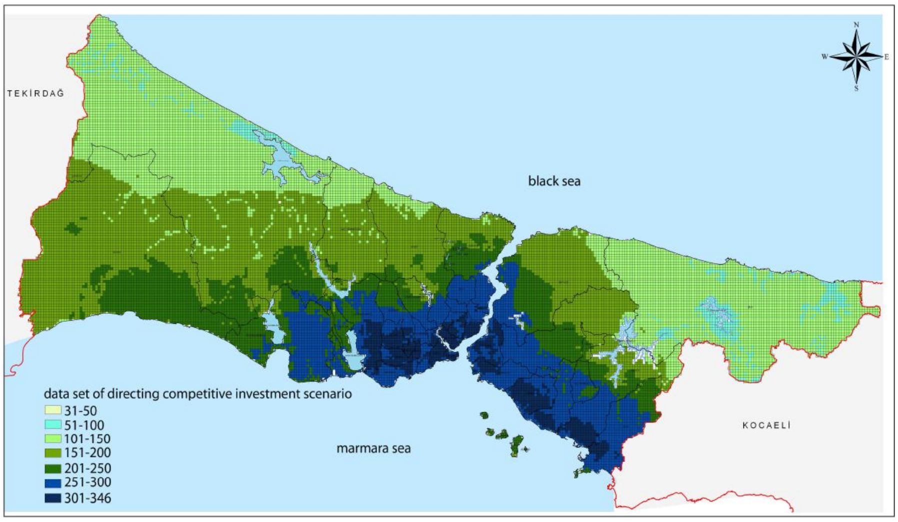


Figure 7. *Continued*

Evaluation of the Scenario Based on Directing Competitive Investment

- According to the results of the competitive analysis, the most competitive areas in the west side of Istanbul are determined as Besiktas, Beyoglu, Eminonu, Bakirkoy and a part of Sisli districts.

- The most competitive areas in the east side of Istanbul are determined as Kadıkoy and a part of Üsküdar districts. These existing central areas of Istanbul are at the same time the high quality of life areas.

- Areas in the surroundings of centers are remarkable with the development of their potentials. Northern parts of Kadıköy and Üsküdar districts, coastal areas of Maltepe and Kartal districts and central areas of Pendik district are areas of relatively high competitiveness.

- In the west side of Istanbul a part of Sisli Güngören, Zeytinburnu, Bayrampaşa and Bağcılar districts have increased their competitiveness with location and transportation facilities. Similarly, the central part of the Golden Horn area and central areas of Küçükçekmece district are striking areas.

- These areas with the proximity to the center and the ease of investment because of not yet fully developed are an advantage in developing projects improving the competitiveness or urban regeneration projects in unplanned-obsolete areas.

4. General scenario development

Under the model depending on the goal, 3 different scenarios are developed. In these scenario decision-makers, have a say in the development of the cities, can use these results in the stage of synthesis as a tool determine the trend. Trends in urban settlement may vary based on three different approaches. In this case, both improving the quality of life and developing a competitiveness scenario based on the sustainability of the natural structure are promising. Once the goal is identified, the model is run for the second time. To obtain a general scenario from these 3 scenarios, 2 different methods are used. These methods are elaborated below.

Method 1

In this method, each scenario (natural structure, competitiveness, quality of life) was accepted and used as the raw data in the overall scenario. By giving specific coefficients to each of these scenarios, calculations are made for each cell. By taking the arithmetic average of cells, development potential of the cells is displayed.

Table 4. *General approach to scenario development method 1*

<table>
<tr><td>Object ID</td><td>Natural Structure Synthesis Value (DYD)</td><td>Synthesis Value Based on Competitiveness RD</td><td>Synthesis Valu Life Quality YKI</td><td>Total Cell Potential Value Result From Scenario HPD=Total Cell Value/3</td></tr>
<tr><td>20252</td><td>27</td><td>54</td><td>20</td><td rowspan="4">THD=108+162+60=330
HPD=330/3=110</td></tr>
<tr><td>Scenario Coefficient</td><td>4</td><td>3</td><td>3</td></tr>
<tr><td>Total Value</td><td>TDD(Natural)
TDD=4x27=108</td><td>TDR(Competition)
TDR=3x54=162</td><td>TDY(life)
TDY=3x20=60</td></tr>
<tr><td>Total Cell Value (THD)</td><td colspan="3">THD=108+162+60 THD=330</td></tr>
</table>

Method 2

In this method, to determine the growth potential of the cells, first, scores are given in his own master class to all sub-data, and then by multiplying influence coefficients defined for each upper limit, the total value is found. By taking the arithmetic mean of this value by the number of data, the Cell Potential Value is obtained. Finally, the Cell Potential Values are classified within itself (protected area from 10-50, residential area from 51-100, industrial area from 101-150, service area from 151-200 etc.). Depending on this classification, for the cells' overall themes the base scenario is created.

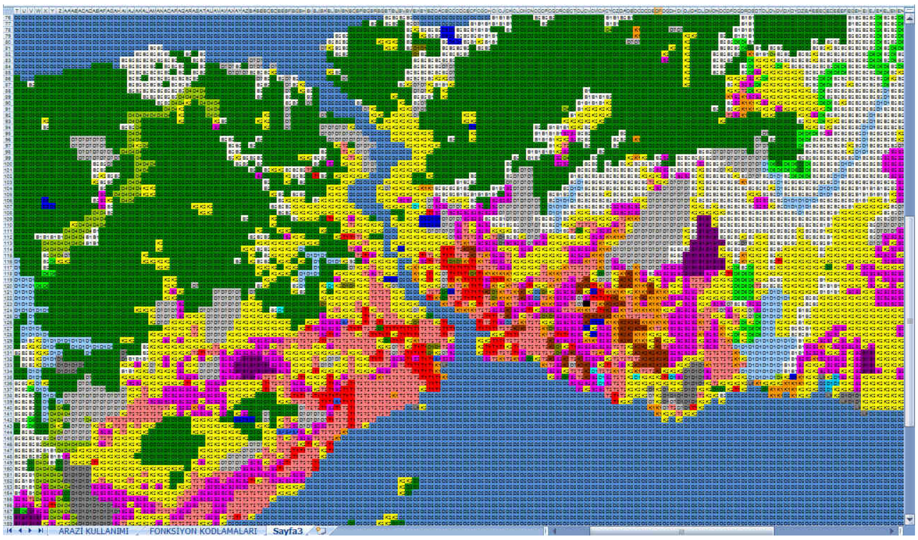


Figure 8. *General Synthesis Schema of Istanbul Metropolitan City*

5. Conclusion

In addition to traditional planning approaches in the planning of settlements, modeling techniques are effective in decision-making. Especially in the synthesis phase of planning, revealing possible changes, and transformation and development trends signals potential risks cities have to face in the future. Computer technology and programming can easily be done on personal computers today. Especially, which minimize the calculation time, directed researchers to try to develop new modeling approaches? This and similar models, especially in metropolitan planning processes help in creating world city identity of Istanbul, and producing estimations of spatial data. Besides, the quantitative data predictions can be considered as an important tool in accurate development planning. Such models also permit to the compare system of relationships between different functional areas (residential areas, commercial areas, industrial areas, transportation, communication, etc.).

With modeling and simulation techniques developed in the world especially in recent times, countries are experimenting simulations for seeing the possible development of settlements, and social and physical conditions in their own countries. With this and other similar numerical models, which will be used in different geographic countries in globalizing world, managing or directing settlement order in continents, and movements in population and capital will also be possible. Particularly, environmentally sensitive planning and sustainable development (conservation of natural and cultural heritage) concepts are imperative all around the world. In obtaining the possible future development schemes of cities, revealing transformations in natural, physical and social environment and determining the positive and negative effects of developments observed in settlements on natural and cultural heritage, utilization of modeling and simulation techniques will be considered as one of the planning standards in the near future in developed countries. In this context, the use of numerical techniques in urban planning and education institutions can be considered as a tool that will contribute to the process of accreditation and compliance with developed countries

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In the model, data named “examination and investigation of development process of industrial sector in Istanbul Metropolitan Area together with spatial dimension, defining the future development potentials and tendencies of this sector” and prepared in the leadership of Prof. Dr. Cengiz Giritlioğlu, Prof. Dr. Mehmet Ocakçı, Ass.of Prof. Mehmet Ali Yüzer, Ass.of Prof. Ferhan Gezici, Dr. Hatice Ayataç, Dr. Gülden Demet Oruç, Dr. Elif Alkay for Istanbul Municipality Company BIMTAS between 2005-2007 were used. Burcu Müderrisoğlu, Sacide Akkuş, Ayça Yazıcı, M. Sıdık Sönmez, Sedat Nacar, Sedef Soykam, Okay Açıl, Özgür Karaca, Yasemin Aslan, Başak Kırtıl helped to prepare the data for the GIS program.

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Planlama sürecinde sayısal veri değerlendirme modeli;
İstanbul metropoliten alan örneği

Metropoliten kentlerde sürdürülebilirlik bağlamında doğal, sosyal, ekonomik, kültürel ve yapısal büyüme potansiyellerinin ve eğilimlerinin saptanmasında farklı yöntemler kullanılmaktadır. Özellikle planlama sürecinin sentez aşamasında değerlendirme yapabilmek veya olası eğilimleri farklı kabullerle ortaya koyabilmek üzere 1960'lı yıllardan sonra geliştirilen kantitatif değerlendirme ve tahmin yöntemleri 1980'li yıllardan sonra bilgisayar teknolojisinin gelişmesiyle birlikte hız kazanmış ve verilerin kısa zamanda çok yönlü değerlendirilmesine ve simülasyonlarına olanak tanımıştır.
Bu makalede Metropoliten kentlerde doğal, sosyo-ekonomik ve fiziki veriler kullanılarak geleceğe yönelik senaryo geliştirilmesine katkı sağlayabilecek değerlendirme ve öngörülerin elde edilmesinde kullanılabilecek bir yöntem açıklanmaktadır. İstanbul bütününde doğal yapının korunması prensibi, yaşam kalitesinin yükseltilmesi prensibi ve rekabetçi bakış açısıyla olası mekan kurgusunun değerlendirilmesi prensibi ile farklı veriler kullanılarak farklı sonuçların elde edilmesi planlanmıştır.

İstanbul Türkiye ve bölge ülkeleri için önemli bir hizmet merkezi olmakla birlikte, mevcut yapısı içinde üretim fonksiyonları da önemini korumaktadır. Kentin sahip olduğu rekabet gücü ekonomik yapı tarafından desteklenirken, kentin gelişmesinin doğal kaynaklar üzerinde yarattığı baskı rekabet gücünü olumsuz etkilemektedir. İstanbul'un rekabet gücünü analiz edebilmek için literatür çalışmalarına bağlı olarak rekabet gücüne etki eden faktörler belirlenmiş ve bunlar mekânsal veriler kullanılarak değerlendirilmiştir. Değerlendirme yöntemi olarak elek analizi kullanılmış ve Arc-GIS programından yararlanılmıştır. İstanbul'da rekabet gücünü belirleyen göstergeler değerlendirilerek gelecekte kentin rekabet gücü açısından durumu mekânsal olarak ortaya konulmuştur.

İstanbul Türkiye'nin en büyük kenti olarak hem ekonomik anlamda hem de nüfus ve alanca hızla büyümektedir. Bu durum kentin yakın çevresindeki doğal alanları olduğu kadar özellikle su havzaları üzerinde oluşan baskı nedeniyle kentin geleceğini de tehdit eder boyuttadır. İstanbul'un mekânsal gelişim eğilimlerinin belirlenmesi ve geleceğe yönelik senaryolarının oluşturulmasında doğal alanların sürdürülebilirliğinin ön planda tutulması gerekmektedir. Bu kapsamda sürdürülebilirliğe etki eden faktörler belirlenerek mekânsal veriler kullanılmış, olası etkiler elek analizi tabanlı yaklaşım benimsenerek Arc-GIS programında değerlendirilmiştir. Yukarıda tanımlanan adımlar yaşam kalitesi bakış açısıyla yöntemde sınanmış ve sonuçlar karşılaştırılmıştır.

Bu makalede "Veri Değerlendirme Modelinin" amacı, kapsamı ve İstanbul Metropoliten Kenti için yapılan örneklemenin sonuçları ayrıntılı olarak açıklanmıştır.