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A Case Study in Urban Transformation: Parameters of Urban and Social Infrastructure

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Kentsel Dönüşümde Bir Senaryo: Kentsel ve Sosyal Altyapı Parametreleri

ÖZ:

Kentsel dönüşüm uygulamaları için kurgulanmış olan bir matematiksel model çerçevesinde yeni yapılacak ya da yapılması planlanan kentsel dönüşüm çalışmalarında izlenmesi gereken yol ve yöntemlere ilişkin hesap ve değerlendirmelere katkı sunmaya çalışan bu makale; deprem kaynaklı bir riskli yapı çalışması yerine, ulusal ve uluslararası standartlar ve öneriler ışığında, alan temelli bir planlama çalışmasına yardımcı olmaya, planlamanın, mimari düşüncenin, mühendislik parametrelerinin ve çevresel etkilerin bir araya getirilmesiyle bir yapı oluşturarak bir Tasarı Kentsel Dönüşüm Modeli (TKDM)'nin Kentsel ve Sosyal Altyapı Parametrelerini düzenleyici bir öneri getirmeye çalışmaktadır.

Anahtar Kelimeler: Kent, matematik model, kentsel dönüşüm, sosyal altyapı.

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ABSTRACT:

Within the framework of a mathematical model designed for urban transformation applications in this article, it is tried to contribute to the accounts and evaluations related to the methods to be followed in the new urban transformation studies. This paper aims to create a structure by combining planning, architectural thinking, engineering parameters and environmental impacts in a field-based planning study in the light of national and international standards and recommendations, rather than an earthquake-based structure study. The model that emerged as a result of this study was called as Draft Urban Transformation Model (DUTM) and a suggestion is made a regulatory proposal for Urban and Social Infrastructure Parameters.

Keywords: City, mathematical model, urban transformation, social infrastructure.

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INTRODUCTION:

The consequent loss and degradation of urban and peri-urban green space and social infrastructure could adversely affect ecosystems as well as human health and well-being [1]. Urban transformation is working as a public policy to solve the urban problems caused by capitalist processes in the city (de-industrialization, increasing unemployment, the formation of collapse zones). Sustainable development has a global dimension. However, the existence of mutual interaction between local and global processes is also increasingly recognized [2]. In urban transformation, improving the living conditions without changing the demographic structure of a project area should form the basis of the transformational spirit [3]. In this context, the structural and regional data of a place to be transformed should be examined in detail and the road map should be drawn accordingly. The analysis of the present situation in an area subject to transformation, the current situation analysis, the demographic and socio-economic structure of the region, geological and geotechnical analysis, earthquake risk, physical structure analysis (structure functions, floor quantities, building types, structure quality, density), property situation, upper scale planning and investment decisions, 1/5000 scale master plan, 1/1000 scale implementation zoning plan, transportation, technical infrastructure, expectations of the households, surveys which will take a picture of the current situation, the study sheets should be in the feasibility and research reports where the problems of the region will be detected in the future.

The model is the whole of the conceptual structures in mind and the external representations of these structures to interpret and understand complex systems and structures [4]. Today, mathematical modeling is used not only in mathematics, but also in mathematical modeling in technology, architecture, economics, engineering, medicine and many other fields. [5] According to the mathematical modeling process, modeling does not take place in a number of isolated and linear related steps but by mutual and cyclic interaction of these steps. [6]

In order to obtain a draft model, in addition to the parameters obtained in the current situation, new parameters and digital inputs which are determined according to the need of the field are processed in the database. In the calculations made in the draft model study, in line with the recommendations developed with reference to national and international planning standards, it is within the boundary values accepted by numerical criteria integrated into the mathematical model. It is analyzed whether the said result provides the Draft Urban Transformation Model (DUTM). The values accepted for each data are not final, but indicate a range of values that can be revised according to the needs of each region. If the selected numerical inputs are within the limit values that are integrated into the draft model, the analysis is completed with the acquisition of DUTM. Otherwise; In the event that one or more limit values are not provided, the numerical inputs are reduced and multiplied by the analysis until such criteria are met, i.e. the design (appropriate) model is obtained.

1. Urban and Social Infrastructure Parameters

Urban and social infrastructure data, as shown in Figure 1, are started to be dealt with by creating the current status database of the selected region for transformation. In the second stage, within the framework of the urban transformation approach, an account and analysis method are set up within the national, international and proposal boundary value criteria with the data bank of the region in question.

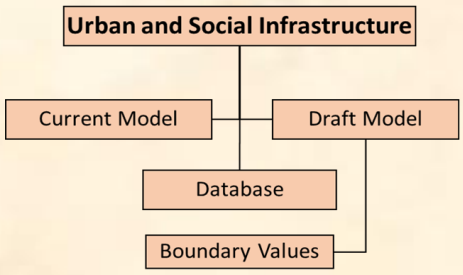

Figure 1. Urban and social infrastructure diagram [7]

The group data of the urban and social infrastructure parameters that are subject to the model described as "A" are examined under the current and draft model headings. The aggregate data index for this group is as in Table 1 and 2.

Table 1. Whole index of current data on urban and social infrastructure - A [7]

N.	A1 (Current)
1	Current population (person)
2	Project area (m²)
3	Current density (person / ha)
4	Current residential (zoned + land) (m²)
5	Current residential (zoned + land) percentage (%)
6	Current commercial (zoned + land) area (m²)
7	Current commercial (zoned + land) area percentage (%)
8	Current residential + commercial (zoned + unrecorded) area (m²)
9	Current residential + commercial (zoned + land) area percentage (%)
10	Current total (zoned + land) area (m²)
11	Current total (zoned + land) percentage (%)
12	Current road area (m²)
13	Current road area percentage (%)
14	Current green area (m²)
15	Current green area coefficient (m² / person)
16	Current educational facility area (m²)
17	Current educational facility area coefficient (m² / person)
18	Current health facility area (m²)
19	Current health facility area coefficient (m² / person)
20	Current social-cultural facility area (m²)
21	Current social-cultural facility area coefficient (m² / person)
22	Current religious facility area (m²)
23	Current religious facility area coefficient (m² / person)
24	Current technical infrastructure area (m²)
25	Current technical infrastructure area coefficient (m² / person)
26	Current total infrastructure area (m²)
27	Current total infrastructure area coefficient (m² / person)
28	Current total infrastructure area percentage (%)
29	Total area (m²)
30	Total area percentage (%)

Table 2. Whole index of draft data on urban and social infrastructure - A [7]

N.	A2 (Draft)
1	Project area (m²)
2	Draft density (person / ha)
3	Draft population (person)
4	Draft residential development area percentage (%)
5	Draft residential development area (m²)
6	Draft commercial development area percentage (%)
7	Draft commercial development area (m²)
8	Draft residential + commercial development area percentage (%)
9	Draft residential + commercial development area (m²)
10	Draft total development area percentage (%)
11	Draft total development area (m²)
12	Draft road area percentage (%)
13	Draft road area (m²)
14	Draft green area coefficient (m² / person)
15	Draft green area (m²)
16	Draft educational facility area coefficient (m² / person)
17	Draft educational facility area (m²)
18	Draft health facility area coefficient (m² / person)
19	Draft health facility area (m²)
20	Draft social-cultural facility area coefficient (m² / person)
21	Draft social-cultural facility area (m²)

22	Draft religious facility area coefficient (m² / person)
23	Draft religious facility area (m²)
24	Draft technical infrastructure area coefficient (m² / person)
25	Draft technical infrastructure area (m²)
26	Draft total infrastructure area coefficient (m² / person)
27	Draft total infrastructure area (m²)
28	Draft total infrastructure area percentage (%)
29	Draft development area / infrastructure area rate
30	Total area percentage (%)
31	Total area (m²)

In the urban and social infrastructure database of the current model, the data obtained in accordance with the feasibility studies of the region to be transformed are in the input column of the variable input data, and the data that these variable input data are mathematically correlated with each other in the dependent input column. The calculation and analysis results are shown in the output column (Table 3). As a parameter can be used as both input and output data, a continuous data transfer between these parameters occurs.

According to this;

- 30 current types,
- 12 variable inputs (obtained from feasibility studies),
- 3 dependent inputs (determined by the relationship between variable inputs),
- 15 output data (as a result of equation factors in the parameters section) are obtained.

Table 3. Urban and social infrastructure data of the current model - A1 [7]

N.	Type	Variable input	Dependent input	Output
1	Current population (person)	x	-	-
2	Project area (m²)	x	-	-
3	Current density (person / ha)	-	-	x
4	Current residential (zoned + land) (m²)	x	-	-
5	Current residential (zoned + land) percentage (%)	-	-	x
6	Current commercial (zoned + land) area (m²)	x	-	-
7	Current commercial (zoned + land) area percentage (%)	-	-	x
8	Current residential + commercial (zoned + unrecorded) area (m²)	x	-	-
9	Current residential + commercial (zoned + land) area percentage (%)	-	-	x
10	Current total (zoned + land) area (m²)	-	x	-
11	Current total (zoned + land) percentage (%)	-	-	x
12	Current road area (m²)	x	-	-
13	Current road area percentage (%)	-	-	x
14	Current green area (m²)	x	-	-
15	Current green area coefficient (m² / person)	-	-	x
16	Current educational facility area (m²)	x	-	-
17	Current educational facility area coefficient (m² / person)	-	-	x
18	Current health facility area (m²)	x	-	-
19	Current health facility area coefficient (m² / person)	-	-	x
20	Current social-cultural facility area (m²)	x	-	-
21	Current social-cultural facility area coefficient (m² / person)	-	-	x
22	Current religious facility area (m²)	x	-	-
23	Current religious facility area coefficient (m² / person)	-	-	x
24	Current technical infrastructure area (m²)	x	-	-
25	Current technical infrastructure area coefficient (m² / person)	-	-	x
26	Current total infrastructure area (m²)	-	x	-
27	Current total infrastructure area coefficient (m² / person)	-	-	x
28	Current total infrastructure area percentage (%)	-	-	x
29	Total area (m²)	-	x	-
30	Total area percentage (%)	-	-	x

As a result of the analysis of the current model according to the mathematical model operation diagram, assuming that the urban transformation study is necessary, project model analysis is started for the project area in question.

In the data section of the urban and social infrastructure database belonging to the model, the data determined in the variable input column (V) according to the need of the region to be transformed, the data determined for some parameters (educational, health facility, etc.) that are required for the condition in the C. column , in the legend column (L), this variable input (V) data with each other the mathematical correlation data is in percentage (%) and dependent input (DI) column and the results of the calculation and analysis are shown in the output (O) column. However, the proposed values are developed in national and international criteria where the adequacy of the outputs are questioned and the proposed values are in the limit (L) value column and the conditional (C) and appropriateness (A) columns that examine the situation within the limit value standards are also included (Table 4).

Table 4. Urban and social infrastructure data on the draft model- A2 [7]

N.	Type	V	L	DI	O	C	L	A
1	Project area (m²)	-	-	x	-	-	-	-
2	Draft density (person / ha)	x	-	-	-	-	-	-
3	Draft population (person)	-	-	-	x	x	x	x
4	Draft residential development area percentage (%)	x	-	-	-	-	-	-
5	Draft residential development area (m²)	-	x	-	x	x	x	x
6	Draft commercial development area percentage (%)	x	-	-	-	-	-	-
7	Draft commercial development area (m²)	-	x	-	x	x	x	x
8	Draft residential + commercial development area percentage (%)	x		-				
9	Draft residential + commercial development area (m²)	-	x	-	x	x	x	x
10	Draft total development area percentage (%)	-	-	x	-	-	-	-
11	Draft total development area (m²)	-	-	-	x	x	x	x
12	Draft road area percentage (%)	x	-	-	-	-	-	-
13	Draft road area (m²)	-	-	-	x	x	x	x
14	Draft green area coefficient (m² / person)	x	-	-	-	-	-	-
15	Draft green area (m²)	-	-	-	x	x	x	x
16	Draft educational facility area coefficient (m² / person)	x	-	-	-	-	-	-
17	Draft educational facility area (m²)	-	x	-	x	x	x	x
18	Draft health facility area coefficient (m² / person)	x	-	-	-	-	-	-
19	Draft health facility area (m²)	-	x	-	x	x	x	x
20	Draft social-cultural facility area coefficient (m² / person)	x	-	-	-	-	-	-
21	Draft social-cultural facility area (m²)	-	-	-	x	x	x	x
22	Draft religious facility area coefficient (m² / person)	x	-	-	-	-	-	-
23	Draft religious facility area (m²)	-	x	-	x	x	x	x
24	Draft technical infrastructure area coefficient (m² / person)	x	-	-	-	-	-	-
25	Draft technical infrastructure area (m²)	-	x	-	x	x	x	x
26	Draft total infrastructure area coefficient (m² / person)	-	-	x	-	-	-	-
27	Draft total infrastructure area (m²)	-	-	-	x	x	x	x
28	Draft total infrastructure area percentage (%)	-	-	x	-	-	-	-
29	Draft development area / infrastructure area rate	-	-	-	x	x	x	x
30	Total area percentage (%)	-	-	-	x	x	x	x
31	Total area (m²)	-	-	-	x	x	x	x

Here;

• 31 current types,

• 11 variable inputs (assigned by the designer),

• 7 legend (5 variables, 2 dependent),

• 10 percentage (%) data (obtained from the proportional comparisons in the database),

• 4 dependent inputs (retrieved from data banks that interact with the relationship between the variable inputs),

• 16 output,

• 16 conditions are used, 8 of which are less than or equal and 8 are greater than or equal (≥) and the relationship between output and boundary value is determined.

• 16 limit values,

• 16 Appropriateness criteria: positive (√) and negative (x) status of the condition relationship between output and limit values are reflected in the database, and in negative cases (x), it is obtained by trying to convert the condition into positive (√) with the help of variable inputs.

According to this; there are international (I) and national (N) value references of the input data of 16 types in the A2 - urban and social infrastructure database (draft density, draft green area, etc.) and the suggestions (S) given by DUTM in the final analysis are given (Table 5). The proposal of DUTM is accepted as the limit value in the model analysis.

Table 5. Limit value references for input data - A2 [7]

N.	Type	I	N	S
1	Draft density (person / ha)	√	√	√
2	Draft residential development area percentage (%)	√	√	√
3	Draft commercial development area percentage (%)	√	-	√
4	Draft residential + commercial development area percentage (%)	-	-	√
5	Draft total development area percentage (%)	-	-	√
6	Draft road area percentage (%)	√	√	√
7	Draft green area coefficient (m² / person)	√	√	√
8	Draft educational facility area coefficient (m² / person)	√	√	√
9	Draft health facility area coefficient (m² / person)	√	√	√
10	Draft social-cultural facility area coefficient (m² / person)	√	√	√
11	Draft religious facility area coefficient (m² / person)	√	√	√
12	Draft technical infrastructure area coefficient (m² / person)	-	√	√
13	Draft total infrastructure area coefficient (m² / person)	√	√	√
14	Draft total infrastructure area percentage (%)	√	√	√
15	Total area (m²)	-	-	√
16	Total area percentage (%)	-	-	√

In addition to the 16-input data shown in Table 4, the output data, which is the result of the equations of each data, were restricted in the same context to the limit value condition in accordance with the international (I) and national (N) standards and it was tried to make suggestions (S) (Table 6).

Table 6. Limit value references for output data - A2 [7]

N	Type	I	N	S
1	Draft population (person)	√	√	√
2	Draft residential development area (m²)	√	√	√
3	Draft commercial development area (m²)	√	-	√
4	Draft residential + commercial development area (m²)	-	-	√
5	Draft total development area (m²)	-	-	√
6	Draft road area (m²)	√	√	√
7	Draft green area (m²)	√	√	√
8	Draft educational facility area (m²)	√	√	√
9	Draft health facility area (m²)	√	√	√
10	Draft social-cultural facility area (m²)	√	√	√
11	Draft religious facility area (m²)	√	√	√
12	Draft technical infrastructure area (m²)	-	√	√
13	Draft total infrastructure area (m²)	√	√	√
14	Draft development area / infrastructure area rate	-	-	√
15	Total area percentage (%)	-	-	√
16	Total area (m²)	-	-	√

Since the types in Table 4 and Table 5 interact with each other in the model, each input data determined by the limit values provides a direct or indirect participation with whether the output yields the boundary value requirement.

CONCLUSION:

This paper aims to help the region-based planning work in the light of national and international criteria and recommendations, rather than a risky structure study with an earthquake. The Draft Urban Transformation Model (DUTM) has tried to bring the urban and social infrastructure data (current and draft), which is considered as the upper model of model A, with the suggestion that planning, architectural thought, engineering parameters and environmental effects form a structure together.

In this scenario; the analysis is carried out on 177 parameters, including 61 types, 23 variable inputs, 3 dependent inputs, 31 outputs, 7 legend, 4 percentage data, 16 conditions, 16 limit values and 16 appropriateness criteria.

As a result; the draft urban transformation model (DUTM) has created a model of accountability in a project area in which all the elements of transformation are brought together and in constant interaction with each other. The model provides a pre-transformation prediction for metropolitans, where the density ratio, like Istanbul in particular, is the maximum, and provides a method to minimize the problems by suggesting the most appropriate solution after conversion.

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