

## QUALITY OF LIFE MEASUREMENT: THE APPLICATION OF ANALYTIC HIERARCHY PROCESS METHOD

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### ABSTRACT

The objective of this study is to provide a quality of life measurement method for policymakers. To this aim Analytic Hierarchy Process (AHP) method employed since AHP is one of the efficient and widely used tool among Multiple Criteria Decision Making methods to develop new policies through the ranking the alternatives. The developed model was applied to Istanbul since it is the densely populated city in Turkey. In the proposed model five indicators were selected to represent health, education, safety and security, economic equity and income. The data were normalized considering the indicators' negative or positive contribution to the quality of life concept. The nine years between 2009 and 2017 are considered as alternatives. Equal weights were assigned to the criteria. The results indicate that between 2009 and 2016 the quality of life performance of Istanbul was consistent. Even though 2016 was rated as the least performed year, the quality of life performance score got the highest score in 2017.

**Keywords:** Quality of Life, Analytic Hierarchy Process, Multiple Criteria Decision Making, Sustainability, Policy Tool.

### INTRODUCTION

Gross Domestic Product (GDP) is a widely used indicator to measure the economic activity but has the limits of measuring the quality of life in societies. Quality of life is a multi-dimensional concept which requires employing different criteria. GDP alone does not provide an accurate assessment to evaluate the inequality problem and discuss quality of life. GDP is not designed to measure of well-being or quality of life since it is based on how much produced and consumed in markets (Costanza et al., 2016). The increase in national income is accepted as an important goal by the authorities. However, there are criticisms by UNDP. UNDP (1996) identifies five types of growth;

- Jobless growth: The growth is not expanded as the opportunities for employment and creating new jobs
- Ruthless growth: The majority of income created by the economic growth is taken by the rich
- Voiceless growth: Economic growth has not been supported by an extension of democracy or empowerment
- Rootless growth: Loosing the cultural identity
- Futureless growth: Ignoring the sustainability and over-exploitation of the resources owned by future generations

The limitations of GDP are been widely discussed in the literature (UNDP, 1996; Stiglitz, Sen and Fitoussi, 2010; Costanza et al., 2016). To overcome this limitation, various indexes were developed by using different indicator sets such as the Human Development

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Index (UNDP, 2018), the Better Life Index (OECD, 2018), and the Quality of Life Index (Numbeo, 2018). Aforesaid indexes are periodically calculated to compare the countries and have attracted international attention.

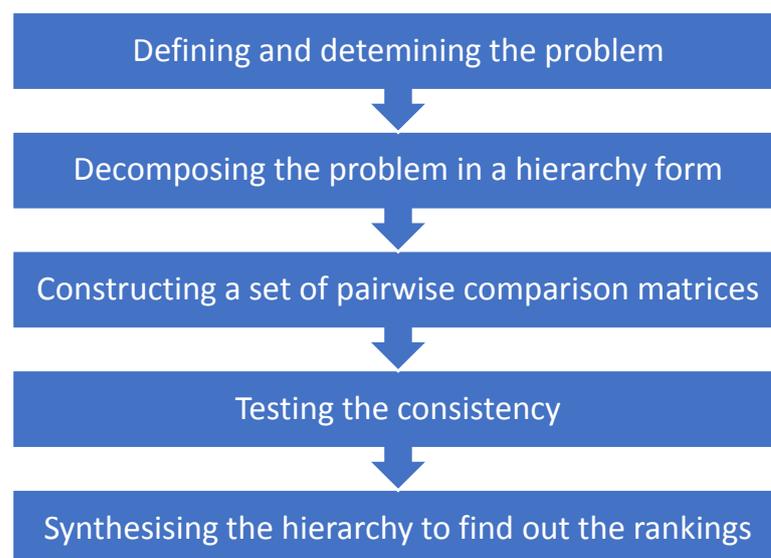
There are studies focused on quality of life measurement for urban scale. Lambiri, Biagi and Royuela (2007) have made a comprehensive literature review in this field. Biagi, Ladu and Meleddu (2018) investigated the dwellers' perception of quality of life in cities with the Capability Approach of Sen. Costanza et al. (2007) have been employed both objective and subjective criteria for the measurement. Besides, there are also studies using AHP method to measure urban quality of life (Saaty, 1986; Feneri, Vagiona and Karanikolas, 2015). Since the complexity of the concept and a common definition does not exist in the literature, specifically in economics literature (Biagi et al, 2018), the studies for alternative methods to measure the quality of life in the literature are expected to increase.

The goal of this study is to provide an alternative model to measure the quality of life in urban areas. The Analytic Hierarchy Process method is employed since it provides a tool for decision makers and an easy to apply method. The performance of İstanbul, densely populated city of Turkey, has been chosen to apply the model. Total population of İstanbul announced by Turkish Statistical Institution is above 15 million and population density is 2892 people per km<sup>2</sup>. On the other hand, İstanbul is the major economic, commercial and financial center of Turkey. Therefore, measuring the quality of life of the city becomes urgent. With the application of the model the quality of life changes over time could be monitored. Thus, the future policies could be developed more effectively.

## 1. METHODOLOGY

### 1.1. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is an effective multi-criteria decision making method to find out the optimal choice among the selected alternatives, developed by Saaty (1980). It is a widely used method to simplify the complex problems by decomposing them into a simple hierarchy. The steps of the method defined by Saaty (1985) are presented in Figure 1.



**Figure 1:** Flowchart of the AHP application steps

AHP is based on the ability of individuals' pairwise comparisons through their knowledge, experience, ideas and instincts (Saaty, 2008). Dividing complexity into smaller elements within a hierarchical system makes the comparisons more effective. In each level of the hierarchy, the elements are compared pairwise with respect to their importance. To do such comparisons Saaty (2000) created 1–9 scale (Table 1). Although alternative scales have been developed in the literature the 1-9 scale is widely accepted (Ramanathan, 2001).

**Table 1: 1-9 Comparison Scale**

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	

Source: Saaty (2000).

The score of  $a_{ij}$  in the pairwise comparison matrix symbolizes the relative importance of the element on the row (i) over the element on column (j). The general form of pairwise comparison matrixes are given in Equation (1).

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ \vdots & \vdots & 1 & \vdots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{bmatrix} \quad (1)$$

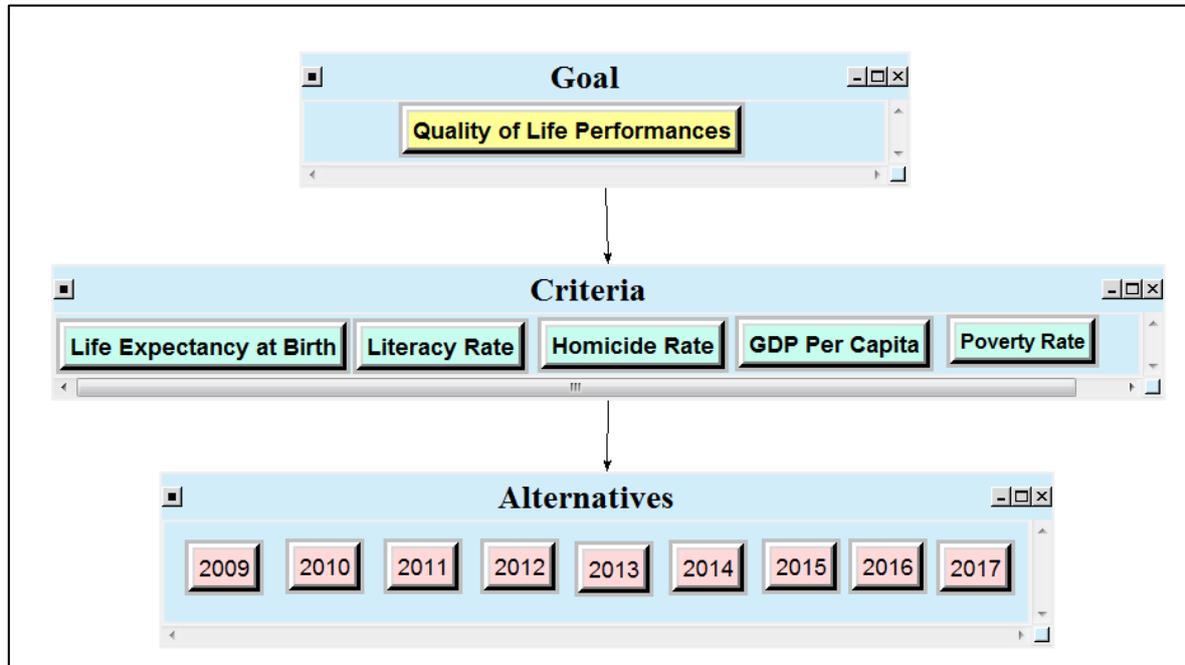
Such that  $[a_{ij}] > 0$

After all pairwise comparisons are completed than the problem turns into general process of calculating the largest eigenvalue corresponding to eigenvector to calculate the Consistency Index. By dividing the Consistency Index to the Random Consistency Index the final value must be less than 0.10 (Saaty, 2000). Random Consistency Index for different matrix orders provided by Saaty (1980).

## 1.2. Quality of Life Measurement Model

In order to assess quality of life a hierarchy tree is developed (Figure 2). The goal exists at the first level of the hierarchy. In the proposed model five criteria as the second level of the hierarchy were selected to represent health, education, safety and security, economic equity and income. The definitions of the criteria are presented in Table 2. Equal weights were assigned to the criteria. All data were acquired from Turkish Statistical Institution. The

data were normalized considering the indicators' negative or positive contribution to the quality of life concept. The nine years between 2009 and 2017 are considered as alternatives. Alternatives are the third and the last level of the hierarchy. SuperDecisions software v.2.8.0 is employed for the analysis.



**Figure 2:** Hierarchy Tree of the Model

**Table 2:** Quality of Life Indicator List

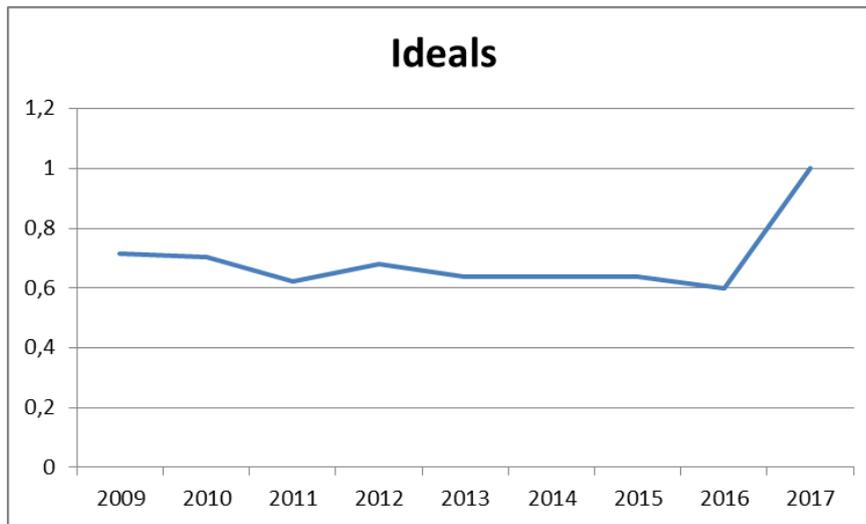
Indicator	Unit	Definition
Life expectancy at birth	%	Percentage of total infant deaths
Literacy rate	%	Percentage of literate persons of the total population
Homicide rate	%	Percentage of homicides in all types of crimes
GDP per capita	Thousand TL	Gross Domestic Product of economic activity, current prices
Poverty rate	%	Poverty rate by equalized household disposable income

## 2. RESULTS

According to the results obtained from the analysis, alternatives are ranked from the highest score to the lowest score. The quality of life measurements for İstanbul are presented in Table 3 and visualized in Figure 3. The "normal" column in the table presents the quality of life measurement results of alternatives. The "idealized values" column was derived from the normals column. These values were obtained by dividing the value of each alternative in the normals column by the highest value in the normals column. Therefore, in the idealized column of values, the best alternative with the highest score has a value of "1". The "raws" result column was obtained directly from the supermatrix. In the hierarchical models, the column of raws and the column of normals are the same.

According to the overall synthesized priorities for the alternatives in Table 3, the highest performed year when equal weights assigned to the criteria is 2017 (0.160417). On the contrary the least performed year is 2016 (0.095969). The results indicate that between 2009 and 2016 the quality of life performance of İstanbul was consistent. Even though 2016 was

rated as the least performed year, the quality of life performance score got the highest score in 2017.



**Figure 3:** Quality of Life Performances of İstanbul

**Table 3:** Quality of Life Rankings of the Alternatives

	Ranking	Ideals	Normals	Raw
<b>2009</b>	2	0.71464	0.114640	0.057320
<b>2010</b>	3	0.705065	0.113104	0.056552
<b>2011</b>	8	0.622522	0.099863	0.049932
<b>2012</b>	4	0.681367	0.109303	0.054651
<b>2013</b>	5	0.639267	0.102549	0.051275
<b>2014</b>	6	0.636736	0.102143	0.051072
<b>2015</b>	7	0.635907	0.102010	0.051005
<b>2016</b>	9	0.598245	0.095969	0.047984
<b>2017</b>	1	1.000000	0.160417	0.080209

### 3. CONCLUSIONS

Quality of life has a critical importance for urban sustainability. The steps to be taken to improve the quality of life will support sustainable development as a whole. Therefore studies are gaining increasing interest from various academic disciplines. It is also a challenge for urban managers and public authorities. The comparison of previous performances of the urban areas promotes the understanding of the strengths and weaknesses. Not only managing the current states of the urban areas but also predicting the future strategies and policies needs to be supported by the measurement methods. A standard method and indicator set for measuring quality of life cannot be offered but however measurement gives information about

change and direction of development. This study provides a new model to measure quality of life.

As a result of this paper various policies proposed below;

(1) Steps to improve indicators will contribute to the quality of life in urban areas. For this purpose, both central and local governments should promote the health, education, security and economic environment.

(2) The model employed in this paper can provide a measurement tool to support decision makers.

(3) Periodically calculated measurements can help to determine progress or performance losses.

(4) Urban residents should capitalize to governmental sustainability and quality of life projects and municipalities' decisions.

(5) The model employed in this work can be extended to diverse studies and projects due to its flexible nature. The model could be applied with different weights.

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