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Quality of life and modern cities: A methodological framework for the analysis and evaluation of sustainability levels of neighborhoods

Abstract

Choosing the best neighborhood is considered a dynamic process, in which many variables are taken into consideration, which affect the quality of life in a specific area. For example, families with kids tend to choose a neighborhood which consists the school unit that they send their kids to. Considering this, the purpose of this research is the creation of a methodological approach for the analysis and evaluation of sustainability, which is applied in thirty-two (32) neighborhoods in the Attica region, while considering the factors of sustainable development and how they influence quality of life. In order to evaluate these neighborhoods, the variables that compose them have been separated in the categories of transportation, infrastructure and land use. For each of these categories, three different performance indicators were created, which in turn resulted in the creation of a total performance indicator for each neighborhood. Spatial patterns concerning each indicator were identified and the indicators were, then, correlated with the corresponding property values of each neighborhood, resulting in the creation of the "Value for Money" indicator. This approach is considered the first to include such variables and most importantly using schools as the focal points of each neighborhood. Finally, useful conclusions were drawn concerning the plenitude of the analyzed variables in each neighborhood, which was related with sustainable development, and how these variables concerning the categories mentioned above were distributed in their respective neighborhoods.

Keywords: Performance assessment, Quality of life, Sustainability, Neighborhoods, G.I.S.

1. Introduction

The term "sustainable development" was introduced by the Brundtland Commission in 1987 and sustainability was described as the process of "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Our Common Future). In order to achieve sustainability, significant social, economic and environmental factors must be taken into consideration, as they are directly related with quality of life, especially through the processes of Smart Growth (Heaton-Kennedy, Dannenberg 2012) and New Urbanism (Leccese, McCormick 2000; Steiner 2012). Achieving satisfactory, if not the best, conditions of quality of life is a pressing issue for the residents of urban cities and it is directly linked with the process of urban planning, which in most cases determines future development. While most cities have been developed through the transport approach of urban planning, sustainable development has gained ground in the recent years and it is widely considered that most urban cities are failing in terms of sustainability. Consequently, the design and planning of sustainable communities is of the utmost importance and it requires the efficient combination of social, economic and

environmental factors. Still, in many cases sustainability is not the primary focus of urban development, as many efforts are based on economic gain, primarily through the transport approach of urban planning.

However, another approach of urban planning is one that focuses on offering the best opportunities for the overall happiness of residents. While efficiently designing sustainable economic, environmental and social systems in a community, this approach focuses on improving life conditions and happiness of its residents (Leyden et al. 2011; Zidansek 2009). Considering sustainable development and quality of life, sustainable cities are also "happy" cities, as a positive correlation has emerged between the two factors (Cloutier et al. 2014). As a result, an approach that focuses on improving overall happiness of residents tends to create better conditions for sustainable development and vice versa.

Achieving sustainability is possible through its main components, by achieving economic, social, environmental and technical sustainability. Mostly through the contributions of Howard (1898), Perry (1929), Mumford (1937; 1954) and Fisher (1984), concerning neighborhood theory, creating specific criteria for neighborhood sustainable development has been made possible (Choguill 1993; 2008).

In this article, sustainability levels are evaluated, while taking into consideration researches about neighborhood quality and well-being (Dahmann 1981, Diener 1984, Ventegodt et al. 2003), with the help of specific neighborhood features. The methodological framework developed consists of the analysis and evaluation of different aspects of sustainable development, such as infrastructure, land use and transport – mobility features. Specifically, features that promote alternative means of transport (such as walking, biking etc.) are of great importance, while mixture of different land uses is also taken into consideration. This article does not only examine neighborhood satisfaction through its residents, but through its development on those specific categories and overall, which represents if it offers the same opportunities and conditions for achieving overall life satisfaction for everyone, especially elders, people with disabilities, children and other sensitive age groups. In addition, this article is based on a correlation between sustainable development and quality of life (Cloutier et al. 2014), as high sustainability levels tend to result in better quality of life conditions.

All sustainability factors have a significant role in achieving neighborhood, community and housing satisfaction (Sirgy, Cornwell 2000; 2001; 2002), and the most important one is the common meeting place for residents of the neighborhood. As a result, in this article, the desired focal point for a neighborhood is considered a school unit, as it is a place where people and mostly children and their parents should feel safe.

2. Methodological framework

For the creation of the methodological framework, certain variables of urban neighborhoods were analyzed and separated in the categories of infrastructure, land use and mobility.

2.1. Data

For the variables and sub-variables of the above categories, data were collected for each neighborhood. The variables of infrastructure were those concerning the existence of pedestrian

crossings, public transport, infrastructures for people with disabilities and the absence of obstacles for ease of pedestrian traffic. The variables of land use concerned housing, public or open spaces, commercial uses and services. One of the mobility variables was pedestrian infrastructure, which contained the sub-variables of sidewalk width, sidewalk status (good, moderate or bad) and the existence of bike lanes, and the other one was the road network, which contained the sub-variables of road width, the existence of median strips and lighting adequacy.

In order to create performance indicators for each category and a total performance indicator, it is important to objectify as best as possible, how these variables influence everyday life, which results to the analysis of the significance of each variable and sub-variable. In order to determine that, a questionnaire survey was conducted where people were asked to prioritize all ten variables and determine the importance of sub-variables.

2.2. Performance indicators

Knowing the significance of each variable and sub-variable of every category is the first step, in order to calculate the performance indicators. The process of the methodological framework and the mathematical equations created for the calculation of the performance indicators are presented on Table 2.1.

Table 2.1. Methodological process for the calculation of Neighborhood Performance Indicators (NPIs)

NPI calculation process	**Infrastructure**	**Land use**	**Transport**	
Densities - Averages	***(Densities)*** $d_{var} = \frac{\sum_i^n var}{A}$		***(Averages)*** $avg_{var} = \frac{\sum_i^n var}{n}$	***(Densities)*** $d_{var} = \frac{\sum_i^n var}{A}$
Normalization (0 – 1 scale)	$score_{var} = 1 - \frac{(d_{var} - max)}{(min - max)}$ (***positive influence***) $score_{var} = 1 - \left\{1 - \frac{(d_{var} - max)}{(min - max)}\right\}$ ***(negative influence)***		$score_{var,sub} = 1 - \frac{(d_{var} - max)}{(min - max)}$	
Weight correlation	$score'_{var} = w_{var} \cdot score_{var}$		$w'_{sub} = w_{sub} \cdot w_{var}$ $score'_{sub} = score_{sub} \cdot w'_{sub}$	
Category score	$NPI_{category} = \sum_i^n score'_{var}$		$NPI_{category} = \sum_i^n score'_{var,sub}$	
Individual neighborhood performance indicators	$NPI_{category(\%)} = 1 - \frac{(NPI_{category} - max_{\Sigma var})}{(min_{\Sigma var} - max_{\Sigma var})}$			
Overall *NPI*	$NPI = \sum_i^n score_{category}$, $NPI_{(\%)} = 1 - \frac{(NPI - max_{\Sigma cat})}{(min_{\Sigma cat} - max_{\Sigma cat})}$			

As shown above on Table 2.1, all NPIs are normalized on a 0 to 1 range. It is obvious that the 0 value represents the worst neighborhood, in which case the specific neighborhood's scores for every variable are 0 and in turn each category's scores are 0 as well, which results in a value of 0 for individual and total NPIs. On the contrary, the 1 value represents the perfect neighborhood, considering the variables recorded in the process of this research, because of the normalization after which the variables with the highest densities or averages will be valued as 1. Variables and sub-variables with the highest values will represent the best cases and as a result their summary will be the highest valued score for their respective categories, consequently defining the "perfect" neighborhood, because of the highest valued total NPI.

Moreover, the correlation between neighborhood performance and its economic factors is achieved by creating a new indicator, representing the "value for money" aspect of a neighborhood, where objective values of areas of the examined neighborhoods have been correlated with their respective total NPIs (Form. 1).

$$NPI_{VFM} = \frac{NPI_{\%}}{\frac{value}{1000}} = \frac{NPI_{\%}}{value} \cdot 1000 \quad (Form. 1)$$

3. Results

Based on the research conducted with the use of questionnaires on what people really need in "school neighborhoods", results for each variable and sub-variable are as follows.

3.1. Sample data

Results of this survey are shown on Figure 4.1 and Table 4.1, where variable hierarchy is on a 0 – 1 scale.

Figure 3.1. Variable significance

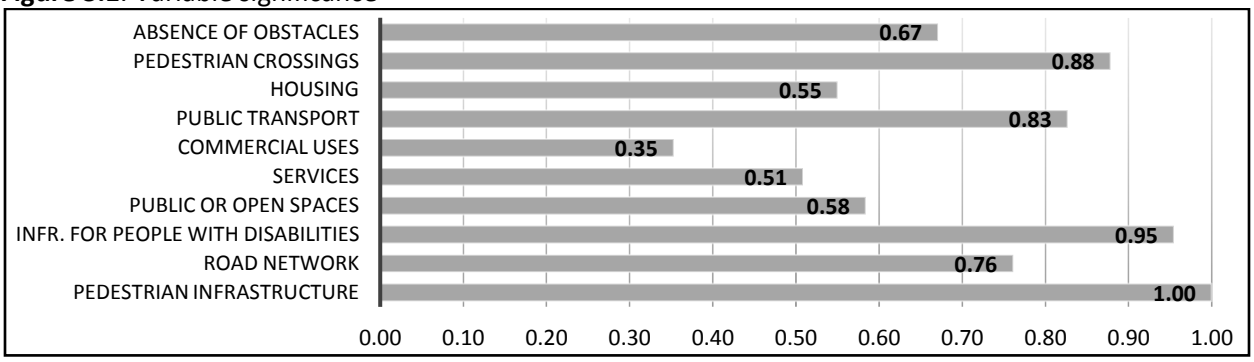


Table 3.1. Sub-variable significance

Variables	Sub-variable	Significance
Road network	Lighting adequacy	0,688
	Road width	0,761
	Median strip existence	0,721
Pedestrian infrastructure	Sidewalk status	1
	Sidewalk width	0,876
	Existence of bike lane	0,871

Results shown on Figure 3.1 and Table 3.1 represent the significance of every variable and sub-variable, as occurred by total responses. Sub-variable significance shows the percentage of the sample which said that a specific sub-variable is important, multiplied by the sub-variable's variable significance. For example, 90.5 percent of the total sample said that lighting adequacy is important in a neighborhood, but this is a sub-variable of the road network variable, which has a significance score of 76 percent, thus resulting in a sub-variable significance of 68.8 percent for lighting adequacy. Variable importance is calculated by the total answers of respondents, in the process of hierarchizing all ten variables, by using each score and its corresponding answers. In

the end, results were normalized using the highest scoring variable significance, which of course is valued 1 (or 100 percent significant).

3.2. Neighborhood Performance Indicators

Based on the above methodological framework, results of Neighborhood Performance Indicators (NPIs) are as follows (Table 3.2).

Table 3.2 Results of Neighborhood Performance Indicators

Neighborhood schools	***$NPI_{land\ use}$ (%)***	***$NPI_{infrastructure}$ (%)***	***$NPI_{transport}$ (%)***	***NPI (%)***	***NPI_{VFM} (%)***
106th Athens Primary School	27,87	40,39	37,33	36,48	24,32
11th Halandri Primary School	9,64	31,65	33,16	28,08	14,04
13th – 16th Zografou Nursery Schools	17,53	18,88	34,97	26,34	17,56
142th Athens Primary School	24,19	28,19	48,12	36,98	24,65
16th Athens Secondary School	31,07	25,09	32,70	29,91	16,62
1st – 19th Zografou Primary Schools	12,39	17,65	32,77	23,88	15,92
1st & 2nd Zografou Secondary Schools	17,67	23,65	26,81	24,00	16,00
1st – 3rd Holargos Secondary Schools	7,18	23,78	32,40	24,68	11,22
1st Agios Dimitrios High School	21,17	34,03	43,23	35,94	27,65
1st Ilion Primary School	29,23	32,08	75,69	52,46	52,46
1st Neo Psichiko Primary School	8,61	17,29	17,71	15,80	6,58
1st Halandri Primary School	15,19	19,83	25,26	21,53	13,89
1st - 5th - 7th Athens Primary Schools	33,88	54,27	52,62	49,51	39,61
2nd Halandri Secondary School	3,61	32,70	25,58	23,62	11,81
2nd Athens Primary School	41,80	73,71	58,20	60,05	38,74
2nd Metamorfosi Primary School	10,09	33,33	29,46	26,94	24,49
3rd Agioi Anargiroi High School	8,42	40,86	35,14	31,79	30,28
3rd Vrilissia Primary School	11,26	31,40	43,91	39,58	18,60
49th Athens Secondary School	17,07	32,64	29,23	27,97	20,72
4th Halandri High School	5,20	35,12	36,22	29,82	16,57
4th Argiroupoli Secondary School	14,15	48,49	60,18	47,41	36,47
4th Zografou High School	43,84	42,28	42,44	42,66	28,44
56th Athens Secondary School	14,73	31,84	62,35	43,15	28,77
57th Athens Secondary School	18,96	27,74	37,19	30,56	20,38
5th Zografou Primary School	32,25	48,64	25,01	34,10	22,73
5th Athens High School	37,47	45,51	40,82	41,69	18,13
6th Athens Vocational High School	48,03	19,57	60,80	44,91	29,94
6th Nursery – 5th Secondary Nea Ionia Schools	43,89	45,09	30,53	37,87	30,29
77th Athens Primary School	16,18	45,82	30,98	32,92	23,52
7th Athens High School	26,56	37,77	54,62	43,68	21,30
8th Agios Dimitrios Primary School	47,51	17,86	40,99	34,74	30,21
Special Primary School of Pedagogical Section of University of Athens	14,54	37,23	40,19	34,23	8,56

In general, school neighborhoods that show high valued infrastructure or land use NPIs are the ones located at central points of the study area. More specifically, neighborhoods located at the center of a municipality tend to rank higher in the categories of land use and infrastructure and as the distance from the center of the study area or a municipality grows, land use and

infrastructure NPIs tend to rank lower, in comparison with neighborhoods located at shorter distances from city or municipality centers. However, there are a few cases where more distant neighborhoods rank as well as high (with an overall NPI of more than 40 percent) as neighborhoods located near the center of the city of Athens, which is something that is mostly attributed to the municipality in which it belongs, because of the attention given to preserving and developing better conditions for neighborhoods' residents. Such neighborhoods that do not show a decrease of their NPIs, while distance from the city center increases, are located in municipalities such as Agios Dimitrios, Argiroupoli, Nea Ionia and Ilion.

In addition, neighborhoods that are located in municipalities with seemingly better socio-economic factors (where objective housing values tend to increase), like Neo Psichiko, Halandri and Holargos, tend to rank lower in all NPI categories, in comparison with other neighborhoods of the study area. As for the "value for money" *NPI*, the neighborhood showing equal NPI_{VFM} and overall NPI values is that of the 1st Ilion Primary School, while small differences between values also appear in the neighborhoods of the 1st - 5th - 7th Athens Primary Schools and the 2nd Athens Primary School, therefore these neighborhoods are the ones offering the best quality for price relationship.

Consequently, investing more money while trying to choose a neighborhood does not necessarily mean that the specific neighborhood will also be better than another, which might be less expensive, as this will be extensively justified through the correlation between objective housing values and overall NPIs in the next chapter.

3.3. Neighborhood performance indicators correlations

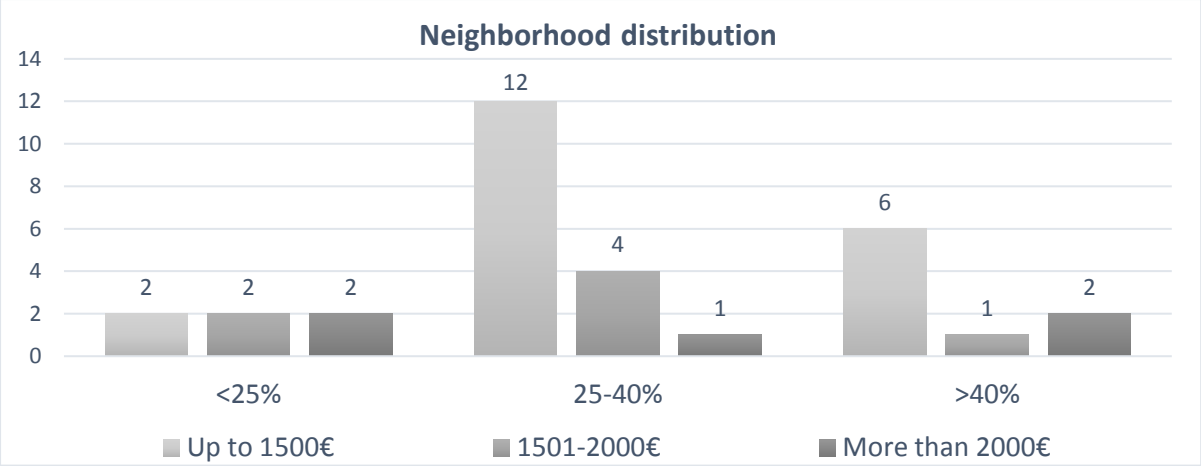
Results of correlation of NPIs between other NPIs and objective housing values (OHV), with the use of Pearson correlation coefficient are as follows (Table 4.3).

Table 3.3. Correlation results of NPIs and objective housing values using Pearson correlation coefficient

Correlation	*Transport NPI*	*Infrastructure NPI*	*Land use NPI*	*OHV*
Transport *NPI*	-	0,279300023	0,375991907	-0,194103971
Infrastructure *NPI*	0,279300023	-	0,294605995	-0,059093202
Land use *NPI*	0,375991907	0,294605995	-	-0,236376605
Overall *NPI*	0,860782854	0,673404674	0,626375074	-0,211710601

As shown on the above table, correlations between NPIs are all positive, which means that the development of a category implies the development of another, to a certain extent that is represented by their correlation result. Through the correlation of NPIs with objective housing values, conclusions can be drawn on the matter of how economic factors affect neighborhood performance. Results above show negative correlations between all categories and overall NPI with objective housing values, which practically means that choosing a better neighborhood does not necessarily mean an increase in housing value. Results of how neighborhoods are distributed, concerning objective housing values and their overall NPIs, are shown on Figure 3.2.

Figure 3.2. Neighborhood distribution between objective housing values and overall NPIs



The above figure shows that there are many cases of neighborhoods where low objective housing values are recorded, while their overall NPIs are not low. These results justify even more the negative values of the correlation results between objective housing values and *NPIs* as it is quantitatively shown that higher values of NPIs do not imply increases in objective housing values.

Taking all of the above results into consideration, choosing a neighborhood in a municipality of figuratively better socio-economic conditions should not always be considered as the best option, especially when others offer more, in terms of plenitude, for less money invested, concerning affordable housing.

4. Discussion and Conclusion

Results of neighborhood research in this article are not as expected, as different issues emerge while evaluating neighborhood sustainability and quality of life performance. Since the first decades of the 20th century, car usage in the urban environment has been constantly increasing, thus altering the form of urban cities (Newman et al. 1996). Urban development focused mainly on an approach which created better conditions for the ease of transportation by motorized vehicles, thus downgrading alternate means of transport, which subsequently makes sustainable development more difficult.

Naturally, neighborhood performance assessment is a dynamic process which is based mainly on how the area of a neighborhood is perceived, if it is developed in urban or rural environments, if it is located centrally or on distant areas of a city center and, of course, the type of focal point around which they are developed. School units are considered focal points of neighborhoods, where safety of their residents is of the utmost importance, as they serve as meeting points for children and their parents or grandparents and as a result, are considered places where all age groups meet. With that in mind, results of the neighborhood performance assessment could have been different, as variables in this case are evaluated on a stricter approach, due to safety conditions that must be met, regarding schools and residents of sensitive age groups. However, the feeling of safety is one of the main components of quality of life and plenitude of amenities that meet human everyday needs is the other.

Also, results show that neighborhoods with better socio-economic conditions do not always perform better than other neighborhoods of seemingly worse conditions and in some cases, they

do not even perform as well as them. Comparing the neighborhoods of the 1st Ilion Primary School, which is located in a municipality of low or middle-class residents, and the 1st Neo Psichiko Primary School, which is a neighborhood located in a municipality of higher class residents, the 2nd shows a 2.4 higher objective housing value, although its overall performance is 3.3 times worse than the one of the 1st Ilion Primary School.

In the city of Athens, neighborhoods that are developed around a school unit do not show as high overall performance indicators as expected. With an average neighborhood performance indicator of 34.6 percent and only nine out of thirty-two neighborhoods above 40 percent, it is quite obvious that neighborhoods consisting of schools are highly or moderately underdeveloped. In addition, the 40 percent limit does not exclusively mean that a neighborhood with a higher overall NPI is "good", but that it has a better chance of getting better, from a sustainability and quality of life aspect, in the near future. Naturally, neighborhoods above 50 percent (only two, barely a 6.3 percent of total examined neighborhoods) are considered as good choices, as they are not only good at the time of the research, but they also have greater chances of being developed into highly sustainable neighborhoods that offer the best quality of life conditions. As a result, efforts must be made, in order to halt the underdevelopment of school neighborhoods, while creating better conditions for their sustainable development.

In general, neighborhood development in Athens necessitates specific goals, which will meet resident's needs. In order to improve quality of life through the process of sustainable development in urban neighborhoods, the following suggestions are made:

- Defining neighborhood size with clear boundaries, while maintaining high densities of neighborhood features;
- Limiting car usage, thus assuring residents' safety, especially for children and elders and promoting walkability and alternate means of transport (e.g. by creating bike lanes);
- Improving land use mixture, especially with the existence of shops, parks and open spaces, which creates new job opportunities and promotes social interactions;
- Improving street and pedestrian network conditions, while mainly focusing on improving infrastructure conditions for people with disabilities
- Creating new and improving already existing housing opportunities, especially for families with children
- Orienting sustainable urban development, while considering different needs and wants of every neighborhood's residents.

In conclusion, findings of the present study reveal the importance of sustainable urban development in neighborhoods centered around schools, where safety, infrastructure, land use and mobility factors are of higher importance than other neighborhoods. The developed approach, its results and useful conclusions drawn in this article will be useful in future studies of neighborhood sustainability and quality of life, while final suggestions are of great importance for any future attempt of sustainable development in neighborhoods with schools.

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