



EFFECTS OF QUALITY OF LIFE ON THE PRICE OF REAL ESTATE IN VILNIUS CITY

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ABSTRACT. The urban development covers the consensus of a wide range of activities and is aimed at equivalent coordination of the impact of economic, social and environmental factors on planning. Due to different attitudes and interests planners and scientists find it rather complicated to come to a common and widely acceptable attitude towards urban development patterns through harmonization of forms and development principles. The paper includes the theoretical attitudes, related to future insights, into the urban development conceptions. Moreover, assessing the impact of the economic paradigms on urban visions, the paper analyses the influence of development concepts on the qualities of development forms as well as on the creation of future urban alternative visions, compatibility with the principles of sustainable development and proper quality of life. The price of real estate is addressed as one of the key social indicators and the ones that reflect the quality of life. The theoretical provisions, with the help of expert evaluation, are verified taking the districts of Vilnius as an example and considering qualities and forms, population, jobs, area, noise level and pollution of individual districts on the basis of different components. Conceptual modelling principles are applied to determine critical values of the indicators that characterize the sustainable development. Based on them, a system is created that helps to define features of individual urban districts, potential development alternatives and achievable allowed marginal values of the quality of life.

KEYWORDS: Sustainable development; Quality of life; Price of real estate; Urban development

1. INTRODUCTION

In 1972, the United Nations Conference on Human Settlements (Habitat) was the first one to address human living conditions and issues of settlements (including cities). Since then, the issues have not gone: they have remained

the same. Moreover, some new ones have occurred as a result of the urbanisation process development and the globalisation of economic and other activities. Today, with the increase in life expectancy, the decrease in birth rate, increase in divorce rate and the potential for

less pollution in our post-industrial society, the city has once more become man's natural habitat. Compact polycentric cities are the only sustainable form of development and should be designed to attract people (Turskis et al., 2006; Zagorskas and Burinskienė, 2005; Zagorskas and Holmberg, 2008; Zagorskas et al., 2007; Zavadskas et al., 2006, Zavadskas et al., 2010). If urban regeneration will be not implement in cities – buildings and public spaces, education, health, employment, social inclusion and economic growth – will be undermined.

Hence, to improve the quality of life in modern cities, a special attention is paid to the analysis and evaluation of social consequences of the urban development: what is the ideal city? How does it look like? What factors determine that it is a place where inhabitants feel good and safe, where it is convenient to work, live and spend their leisure time?

The modern city is the most desirable place to live. It is a place where buildings are in a healthy, safe and attractive environment to live and to work in; a place with good communications, where housing is built and maintained in a sustainable manner by applying new cooperation forms between end-users and the building process in a broad sense. The application of new technology will allow achieving the desirable quality of life in cities.

According to American architect Richard Rodgers, sustainable urban development is dependent on three factors; the quality of architecture, social well-being and environmental responsibility. The compact sustainable city is multi-cultural with a hierarchy of density, has a mix of uses and tenures, is well connected with a coherent public transport, walking and cycling infrastructure, is well designed both in terms of public spaces and building, and is environmentally responsive (Rogers, 1997). Measuring quality of life in cities typically involves the development of indicators which cover themes such as crime, healthcare, cost of living, etc. Formulating indicators gives rise to

difficult questions relating to what should be incorporated as significantly influencing „quality of life“. One reason for this is that there are large numbers of diverse definitions of quality of life (Fahy and Cinneide, 2008).

The development of technology is gradually changing human conscious, priorities and judgment on the quality of life. As a result, the shifting conception of housing reflects changes in the price of flats. Housing prices is one of the key indicators revealing the level of economic development of cities and areas as well as the quality of life (Burinskienė and Rudzkienė, 2004; 2005; 2007a,b).

2. EFFECTS OF THE LIVING ENVIRONMENT ON PRICES OF REAL ESTATE

In recent years, scholars have been increasingly focused on the real estate market consisting of a system of market mechanisms with its typical features and laws, and real estate market research. The real estate market is one of the most significant parts of any national economy, comprising about half of the total planet assets (Hu and Pennington-Cross, 2001).

The real estate market has a number of qualities, of which the most important are low liquidity and cyclical nature. Cycles of the real estate market are not fully coincident with general economic cycles. The decline of the real estate market starts and ends earlier than the general economic decline. Furthermore, prices of real estate tend to increase steadily in the long-term (Galiniene et al., 2006; Brown and Liu, 2001).

As it is already known, the key factors controlling the market are demand and supply, and their ratio determined by the dynamics of prices. In the real estate market, demand depends on income of the population, changes in the population, turnover of transport technologies and preferences of the population, dynam-

ics of relations among social groups, crediting conditions and opportunities. In short periods, supply may change faster than demand as the real estate demand is not very elastic in short periods. Supply is determined by a number of indicators: construction volume, ratio between the cost of objects and the selling price, changes in construction technologies, prices for land plots and infrastructure.

However, a system of indicators determining real estate demand and supply in one or another region or city is never complete as it is difficult to take into consideration such aspects as national and cultural factors, behavioural stereotypes of the population that decide priorities of market participants and effect the rate and price of the real estate demand and supply. In a small region, the real estate demand depends on a number of factors such as infrastructure, ecological state, variety of cultural and domestic objects. Nevertheless, the determinant factor is location, which reflects in differences of prices in different regions.

The image of the modern city is conditioned by the distribution of industrial companies, main roads, aesthetic picture. Also, some researchers suppose that consumers' marginal willingness to pay for environmental landscape attributes decreased during the 2008 recession compared to the 2000–2006 real estate boom (Cho et al., 2011). Real estate specialists note that the attractiveness of historical city centres as a residential place has been decreasing. Areas with unique architecture and high level of comfort in residential premises are becoming the most attractive (prestigious) ones. Low air pollution is considered to be one of the main factors for attractiveness. However, the key factor determining the quality of the living environment is still the location of the district. It is important to mention that the increase in the quality of the environment requires systemic, focused attempts to organise functionally- and socially-integrated urban and territorial structure as well as to form

solid and compact structural territorial units (Motieka, 2009).

Even though many authors have analysed the impact of high quality environment on the real estate value (Boyle and Kiel, 2001; Colwell et al., 2000), there are not many research on the aesthetic impact of the living environment on the price of real estate. What concerns the effects of the quality of the visual living environment on the price of real estate, attention should be paid to the effects of different visual factors, such as positive effect of the view to water (Benson et al., 1998), negative impact of electric power transmission lines (Hamilton and Schwann, 1995). While analysing real estate operations in the New Zealand, the scholar S. C. Bourassa established that attractive neighbouring houses increase the price by even 37% (Bourassa et al., 2004). Similarly, poorly-maintained houses reduce prices of neighbouring houses. Moon et al. (2010) analyses how to set an appropriate price of skyscrapes in consideration of its landmark value in different area.

For the purpose of the investigative part, Vilnius, the capital of Lithuania, was taken as an example. The city of Vilnius is the biggest city in Lithuania, covering the area of 401 km². At the beginning of year 2010, Vilnius had the population of 560 thousand. The selection was conditioned by the available large statistical database (qualitative indicators) used for the comprehensive plan of the city of Vilnius as well as a database of the representative survey of residents carried for the purpose of the said comprehensive plan. Furthermore, Vilnius is special as its Old Town, which started its formation as back as the Middle Ages, is one of the biggest in the Eastern Europe (its area is more than 120 ha) and influences the central part of the whole city. Political centre of the Grand Duchy of Lithuania from the 13th to the 18th century, Vilnius has had a profound influence on the cultural and architectural development of the Eastern Europe. Despite inva-

sions and partial destruction, it has preserved an impressive complex of Gothic, Renaissance, Baroque and classical buildings as well as its medieval layout and natural setting. These were the reasons why the historical centre of Vilnius was included in the UNESCO World Heritage List in 1994. Following the recovery of the economic situation, the Old Town is intensively being restored and renewed. Green areas around the Old Town have increased the value of the place even more, thus maintaining high prices of real estate.

Four states of the development of Vilnius planning may be identified: partial urban planning up to 1795, the annexation of Lithuania to the Russian Empire; centralised planning when the state was a part of the Tsarist Russia until 1918 when Lithuania restored its independence; brief period of 1918–1944 when the owner of the city changed five times in 30 years (the Republic of Lithuania, Poland, Soviet Union, Germany, Soviet Union again); centralised planning during the soviet period in 1944–1990 (Čiurlionienė, 2008). In the latter period, the construction of multi-apartment buildings and new districts (Naujamiestis, Žirmūnai, Lazdynai, Karoliniškės, Viršuliškės, Pašilaičiai, Fabijoniškės - 8% of recent Vilnius

area) started in Vilnius. During the implementation of the sovietisation policy, foreign workers were displaced to new factories built in Vilnius, the division of the soviet army was dislocated in Šiaurės Miestelis, the territory of Vilnius.

Now, the development of Vilnius is chaotic – elemental and poorly-managed territorial development in suburban areas, the city is dispersible with low density of the built-up areas and low population density in urbanised territories. The central part of Vilnius may be characterised by poor quality of the living environment, heavy traffic, high concentration of jobs, pollution, conflict between pedestrians and transport. It also has peripheral issues, such as undeveloped physical and functional structure, engineering and social infrastructure, insufficient public transport. Although the differences in the quality of life are becoming more obvious, trends of changes in prices of real estate remain similar. Nevertheless, the price for 1 sq. m. differs by 2.5 times. Such situation is illustrated by the chart below. The chart presents the dynamics of prices of real estate in the Old Town and Pilaitė (the last multi-storey district that is built in Vilnius) (Figure 1).

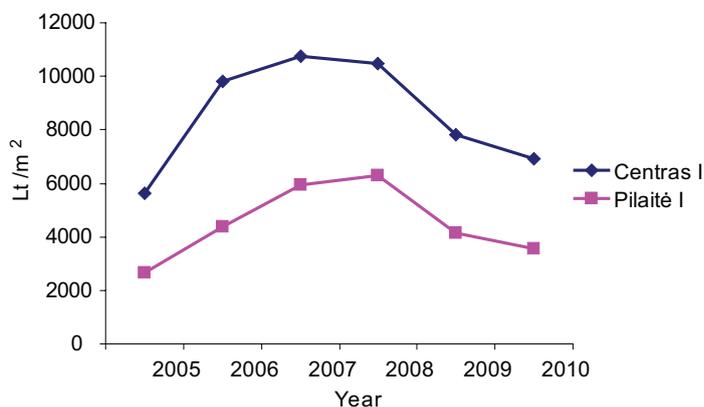


Figure 1. Changes in prices of real estate in the Old Town and Pilaitė (JSC “Ober-House” monitoring data)

3. RESEARCH ON PARTICULARITIES OF DIFFERENT DISTRICTS IN VILNIUS

Major criticisms levelled at quality of life projects are that the indicators typically reflect expert opinion about what constitutes quality of life and that citizens' perceptions of the communities and environments in which they live are ignored (Moller, 2001). The involvement of the public in environmental policy-making is proffered as a means of empowering citizens, enhancing institutional capacity and increasing social responsibility (Fahy and Cinneide, 2008; Staniūnas, 2008; Čiegis and Gineitienė, 2008). This research aims at learning why differences of the quality of life are becoming more evident in zones, residential areas and individual districts of Vilnius, even though they contradict to the principles of sustainable development and promote such negative processes as emigration, compulsory mobility, degradation of different parts of the city, social segregation. For this purpose, it has been decided to investigate the database of Vilnius residents' survey.

In January–February 2005, a representative survey of Vilnius residents was carried out in order to supplement the information base of the comprehensive plan of Vilnius 2005 with data that were not in official sources of statistics and to learn residents' opinion on their living area, job opportunities, reasons of potential migration, etc. (JSC „Rait“, 2005). In total 2,575 residents of Vilnius at the age of 16–74 evaluated the environment of 41 residential areas in Vilnius. The respondents used five-point scale to evaluate 22 statements describing the quality of a residential area: 1. Close to the city centre; 2. Extensive supply of trade services; 3. Close to a school; 4. Close to a kindergarten; 5. Extensive supply of entertainments; 6. Clean air; 7. Nice environment; 8. Safe; 9. Good communication with the city centre; 10. Good communication with

the workplace; 11. Well-attended environment; 12. No noise; 13. No drug-addicts; 14. Close to a hospital; 15. Close to a pharmacy; 16. Good facilities for sports; 17. Many cultural establishments; 18. No alcoholics in sight; 19. No homeless in sight; 20. Close to a workplace; 21. Beautiful architecture of buildings; 22. Well-attended parks.

Other scientists (Viteikienė and Zavadskas, 2007; Zavadskas et al., 2007a) have also analysed the system of these 22 indicators. The expert survey was used to identify indicator values, while the multi-purpose method of evaluation CORPAS (Complex Proportional Assessment) was applied to prioritise residential districts by their sustainability. Burinskienė and Rudzkienė have evaluated the impact of certain indicators on housing changes in different districts of the city, developed an empirical correlation-regressive model and identified general groups of districts of the city by using the cluster method (Burinskienė and Rudzkienė, 2006). Jakimavičius and Burinskienė propose and discuss accessibility and other indicators-based urban transport system analysis and GIS (geographic information systems) calculation method for indicating problematic transportation zones in Vilnius city (Jakimavičius and Burinskienė, 2009).

Other scholars have also thoroughly analysed Vilnius in respect of sustainable development. Thus, for instance, Kaklauskas et al. (2009) have compared Vilnius with cities of other developed countries, found their differences and proposed how to improve sustainability of Vilnius. Having analysed the statistical data on morbidity of Vilnius residents, the authors together with Turskis identified the impact of air pollution on human health, possibility to get certain diseases and the price of real estate (Zavadskas et al., 2007b). Raslanas et al. (2006) have analysed and compared prices of flats in Vilnius and in London using mathematical statistical methods. They established and compared the determining factors.

The authors of the article believe that the analysis of prices of real estate should take into account both the opinion of residents and socio-economic factors that allow achieving the desirable quality of life. Many researches are based either on residents' surveys or on data of statistical sources. However, the relation between these two types of data, i.e. how data of residents' surveys are related to and reflect statistical data provided by EUROSTAT and other official sources, is rarely examined. This research aims at combining the data received by the survey of Vilnius residents carried out by JSC "Rait" in 2005, and official statistical data on transport districts that are marked in the comprehensive plan of the city of Vilnius.

4. METHODOLOGIES OF THE MULTIVARIATE STATISTICAL ANALYSIS

To describe the social-economic processes and phenomena, a great volume of initial data and indicators are used that characterize the development of a process, therefore it is very important to select the most important ones of them and to consider a small amount of indicators or their groups. Frequently the initial data are transformed so that to ensure the minimal loss of information.

Most of these indicators take the form of time series. This causes some difficulty connected with the establishment of interrelation structure of these indicators. In addition, many social and human-initiated events deal with incomplete or limited by nature information and a complex structure of interdependencies. That is why the use of multivariate analysis methods for analysis of the social-economic process is not only justified but also indispensable.

Multivariate statistical methods from the majority of possible probabilistic-statistical models enable us to make a grounded choice of a model that suits best to the initial statistical data that characterize the real behaviour of the set of objects under consideration and can

estimate the present and future situation most exactly as well as to present substantiated and exact conclusions.

For the research multivariate analysis techniques were used to reveal the key information contained in residents' survey, and these analyses were applied in three stages. First, principal component analysis (PCA) was used to identify the variables that accounted for the maximum amount of variance within the data in terms of the smallest number of uncorrelated variables (components). Second, factor analysis was conducted on these remaining 9 variables in order to reduce them to a smaller number of underlying factors.

The aim of factor analysis is to explain the outcome of p variables in the data matrix X using fewer variables, the so-called factors. These factors are interpreted as latent (unobserved) common characteristics of the observed $x \in R^n$. In the factor analysis every observed $x = (x_1, \dots, x_n)^T$ can be written as:

$$x_j = \sum_{l=1}^k a_{jl}f_l + \varepsilon_j, \quad j = 1, \dots, n; \quad k \leq n, \quad (1)$$

where: f_l for $l = 1, \dots, k$ denotes the factors; ε_j is the residual of x_j on the factors. Given the assumption that the residuals are uncorrelated across the observed variables, the correlations among the observed variables are accounted for the factors.

And finally, the multi-dimensional regression analysis was performed to assess the mutual relationship of variables and forecast their changes. For this we will make use of a linear equation:

$$y_i = \beta_0 + \sum_{j=1}^k \beta_j x_{ij} + \varepsilon_i, \quad i = 1, \dots, n, \quad (2)$$

where: β are unknown parameters; ε_i is a random variable with the mean $\mu = 0$ and variance σ^2 .

The statistical methods above helped to verify two hypotheses based on urban models of Rogers (1997) with separated home, work and leisure areas. Respective features described each area:

Hypothesis I. Home, work and leisure environments that are typical for a certain residential district highly affect prices of flats in such district and their changes. 5 variables out of those analysed were related to the home environment: extensive supply of trade services; close to a school; close to a kindergarten; close to hospital; close to a pharmacy. The work environment of the district is measured by 2 variables in the residents' survey: good communication with the workplace and close to the workplace. These two variables have also impact on the price of flats in the district. The leisure area is evaluated by 4 variables, that is, extensive supply of entertainments; good facilities for sports; many cultural establishments; well-attended parks.

Hypothesis II. Other factors such as prestige of the district, nice environment, etc. have a great impact on the price of flats in a residential district and the pattern of their changes. The verification of hypothesis II included the comparison of official statistical data and general data of the residents' questionnaire survey. In the survey, the biggest group of qualities (11) consisted of general variables related to the

quality of the environment: close to the city centre; clean air, nice environment; safe, good communication with the city centre; well-attended environment; no noises; no drug-addicts; no alcoholics in sight; no homeless in sight; beautiful architecture of buildings. Theoretically, all these variables could affect the price of real estate in the residential districts analysed.

A great number of variables aggravate the data analysis and the determination of qualities and relations typical for a group. The number of data was reduced by the principal component analysis method that reduces the number of variables with minimal information losses by replacing the information present in many qualities with a smaller number of variables. When analysing the variables, the suitability of data (variables) to the analysis was checked by the Kaiser-Meyer-Olkin measure of sampling adequacy test (KMO) (Kaiser, 1960).

KMO of the variables of the "home" group is 0.76, meaning that the data are suitable for the analysis. The analysis of eigenvalues identified one distinct factor which explains 78% of the variance change (Total Variance Explained) (Figure 2).

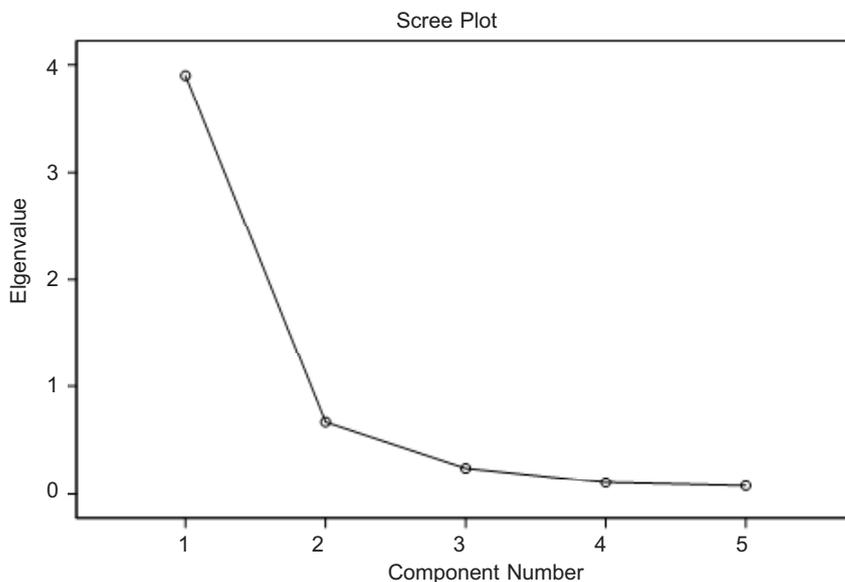


Figure 2. Screen plot of variables from the "home" group

After one significant factor was determined, its factor scores were calculated and replaced the initial variables:

$$F'_j = \sum_{i=1}^n b_{ij}z_i, \quad j = 1, \dots, m, \quad (3)$$

where: F'_j – factor value j ; z_i – standardised value of the variable i ; b_{ij} – coefficient values.

Similarly, variables of the “work” area were replaced by one variable which explained 93% of the total variance, while variables of the “leisure” area were replaced by one variable explaining 69% of the total variance.

Variables of the “environment” area were suitable for factor analysis (KMO = 0.748), however, here two factors were distinguished, explaining 69% of the total variance change. The rotation helped to determine the order of the variables (Table 1).

Table 1. Correlation of variables with the factors distinguished

	Rotated component matrix ^a	
	Component	
	1	2
Close to the city centre	–.311	.780
Clean air	.783	–.150
Safe	.882	–.178
Good connection with the city centre	–.375	.843
Well-attended environment	–.070	.673
No noise	.861	.003
No drug-addicts	.851	–.260
No alcoholics in sight	.694	.047
No homeless in sight	.689	–.482
Beautiful architecture of buildings	.404	.754

Extraction method: principal component analysis.

Rotation method: Varimax with Kaiser normalisation.

^a Rotation converged in 3 iterations.

As Table 1 shows, the first factor consists of 6 variables (clean air, safe, no noise, no drug-addicts,

no alcoholics in sight, no homeless in sight). This factor is related to health & safety.

The second factor consists of 4 variables (close to the city centre, good communication with the city centre, well-attended environment, beautiful architecture of buildings). This factor reflects the attractiveness of the city centre and aesthetics of the district.

5. CASE STUDY. REFLECTION OF VILNIUS RESIDENTS’ OPINION IN THE PRICE OF FLATS

5.1. Assessment of the relation between the residents’ opinion and changes in the price of real estate in Vilnius

Five factors distinguished from the research data (home, work, leisure, safety & health, centre & aesthetics) were analysed by relating them with average prices of flats in different transport districts of Vilnius in 2005–2010. The period of 2005–2010 was special as the economic crisis of that time determined the reduction of the “price bubble”. Although prices were going down in all Vilnius districts (Figure 3), the reduction differed in different districts.

In solving the question whether changes in the values of one variable tend to be associated with changes in the others, we can use different statistics. The best-known is Pearson’s sample coefficient of correlation

$$\rho = \frac{\sum XY - m\bar{X}\bar{Y}}{\sqrt{(\sum X^2 - m\bar{X}^2)(\sum Y^2 - m\bar{Y}^2)}}, \quad (4)$$

where: \bar{X} ; \bar{Y} are the means of the variable X and Y , respectively.

The sample coefficient of multiple determination is denoted by R^2 and represents the relationship between more than two variables. It equals the proportion of the total variation in the values of the dependent variable Y , which is explained by multiple regression of Y on X_1, X_2, \dots, X_n , and possibly additional independent variables X_{n+1}, X_{n+2}, \dots

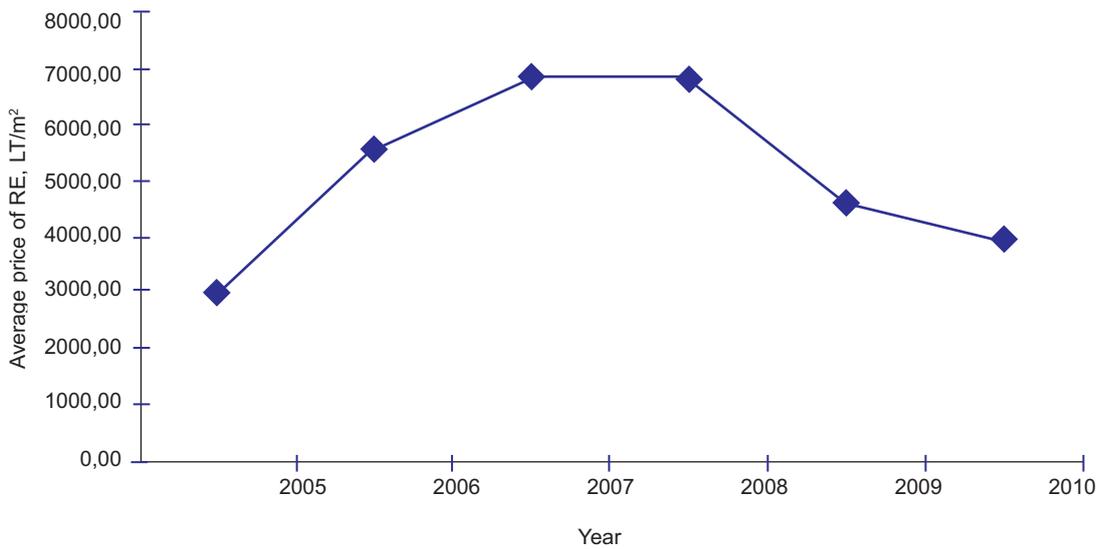


Figure 3. Average price of flats in Vilnius in 2005–2010 (JSC “Ober-House” monitoring data)

$$R^2 = \frac{\sum (\hat{Y} - \bar{Y})^2}{\sum (Y - \bar{Y})^2}, \tag{5}$$

where: \hat{Y} are estimated values of Y and \bar{Y} is the mean.

The coefficient of multiple correlation indicates a fraction of the total variation in Y accounted for the regression equation and is denoted as a square root of the multiple coefficient of determination $R = \sqrt{R^2}$.

A partial coefficient of determination is a measure of the strength of the relationship between the dependent variable and independent variable, when the linear effect of the rest of the variables is being eliminated. The general formula for this coefficient is presented as:

$$r_{i(jk \dots n) \bullet tu \dots w}^2 = \frac{R_{i \bullet jk \dots w}^2 - R_{i \bullet tu \dots w}^2}{1 - R_{i \bullet tu \dots w}^2}, \tag{6}$$

where: R^2 are coefficients of multiple determination.

The square root of the partial coefficient of determination $r_{i(jk \dots n) \bullet tu \dots w}$ is called a partial correlation coefficient.

The significance of the unique distribution of each indicator is examined by calculating the sample coefficient of partial correlation r . Since the sample under investigation is rather short the hypothesis $H_0: r = 0$ was tested. As a test statistic we use Fisher’s statistic $z(r) = \frac{1}{2} \ln \frac{1+r}{1-r}$.

The results of the examination of the impact of the factors distinguished on the price of real estate in Vilnius districts in 2005 determined that two factors – work and health & safety – have no impact on changes in prices in districts (at the 5% significance level).

Other factors proved to be significant.

The change in prices in 2005 can be forecasted using the following regression equation:

$$y_{2005} = 2646.15 - 589.1x_1 + 972.18x_2 + 632x_3, \tag{7}$$

where: y_{2005} – prices of flats in 2005 (LTL/m²); x_1 – factor of the home environment; x_2 – leisure factor; x_3 – factor of centre & aesthetics.

To verify the significance of the regression equation, the sample coefficient of multiple

determination R^2 is used. Having calculated the value of this criterion for all the data of years analysed, we obtain $R^2 = 0.71$. Hence, it may be stated that this model explained 71% of the changes in the price of district flats in 2005. The significance of the regression coefficients, i.e. the hypothesis $H_0: \beta = 0$ is verified by the criterion $t_j = \frac{b_j}{s[(X^T X)^{-1}]_{jj}^{1/2}}$ where

s – the standard error of residuals. When the hypothesis $H_0: \beta = 0$ is true, statistics t has Student's t -distribution with $n - k - 1$ degrees of freedom. For all coefficients $|t| > 2.6$ and $p < 0.02$, therefore, all coefficients are statistically significant at the 5% significance level.

The regression analysis method was also employed in forecasting price changes in 2006, 2007, 2008, 2009 and 2010 with the help of the factors above. The equations were as follows:

2006 ($R^2 = 0.38$)

$$y_{2006} = 5517.5 - 943.7x_1 + 1654.1x_3, \quad (8)$$

where: y_{2006} – prices of flats in 2006 (LTL/m²); x_1 – factor of the home environment; x_3 – factor of centre & aesthetics.

2007 ($R^2 = 0.48$)

$$y_{2007} = 6773.85 - 1040.2x_1 + 1836.5x_3, \quad (9)$$

where: y_{2007} – prices of flats in 2007 (LTL/m²); x_1 – factor of the home environment; x_3 – factor of centre & aesthetics.

2008 ($R^2 = 0.52$)

$$y_{2008} = 6711.0 - 857.2x_1 + 1712.7x_3, \quad (10)$$

where: y_{2008} – prices of flats in 2008 (LTL/m²); x_1 – factor of the home environment; x_3 – factor of centre & aesthetics.

2009 ($R^2 = 0.35$)

$$y_{2009} = 4431.4 + 895.4x_3, \quad (11)$$

where: y_{2009} – prices of flats in 2009 (LTL/m²); x_3 – factor of centre & aesthetics.

I quarter of 2010 ($R^2 = 0.38$)

$$y_{2010} = 3756.3 + 886.0x_3, \quad (12)$$

where: y_{2010} – prices of flats in the first quarter of 2010 (LTL/m²); x_3 – factor of centre & aesthetics.

5.2. Disclosure of factors “centre & aesthetics” and “home” by statistical data of the comprehensive plan of the city of Vilnius

The forecast of changes in the price of real estate using statistical data requires the relation between values of the “centre & aesthetics” factor and the data provided in the comprehensive plan of the city of Vilnius. The article analysis the following statistical data:

Population density in districts, 2004	population/ha
Density of workplaces in districts, 2005	qty/ha
Length of streets	km
Noise in the daytime	DbA
Area of built-up territories, 2005	%
Area of built-up territories, 2009	%
Area of green territories, 2005	%
Area of green territories, 2009	%
Distance to the centre	km

The analysis of the relation between the “centre & aesthetics” factor and the statistical data showed that most of the changes of this factor may be explained by two variables: distance to the centre d_c and the difference of the green area $\Delta_{2009-2005}$:

$$x_3 = 1.59 - 0.202d_c - 0.118 \Delta_{2009-2005}, \quad (13)$$

where: x_3 – factor of centre & aesthetics; d_c – distance to the centre; $\Delta_{2009-2005}$ – the difference of the green area in 2005 and 2009.

The equation (13) explains 66.5% of the changes in the factor of centre & aesthetics (determination coefficient is $R^2 = 0.665$, all equation coefficients are significant with the significance level of 0.001).

The relations of this equation are illustrated in the charts below (Figure 4).

Furthermore, the analysis revealed certain values of the “centre & aesthetics” factor (Table 2). Vilnius transport districts were grouped by these values (Figure 4).

Cluster 1 consists of four districts in the heart of Vilnius: Centre II, Old Town, Žvėrynas, Naujamiestis. It is the oldest part of Vilnius and the Old Town – one of the largest surviving medieval old towns in Northern Europe. In 1994 the Vilnius Old Town was included in the UNESCO World Heritage List (No. 541) in recognition of its universal value and originality. These districts are the oldest and prestigious neighborhoods in Vilnius. To the northwest lies Vingis Park. It remained mostly residential with very few industrial enterprises. Territory has a great number of government and educational institutions, finance and insurance companies, as well as health care institutions.

Cluster 2 consists of six Vilnius districts: Centre I, Antakalnis, Santariškės, Baltupiai, Šnipiškės, Žirmūnai II. Antakalnis is one of the oldest historical suburbs of Vilnius City. It is located in the eastern section of Vilnius, along the right bank of the Neris River. Šnipiškės is located on the north bank of the river Neris, it is the site of Vilnius’ new business district. Several skyscrapers and the new Europa Tower business center have been erected. Although until recently the area was just a small village north of Vilnius proper, it continues to be expanded with plans for modern commercial and apartment complexes. Santariškės and Baltupiai belongs to Verkiai – the northernmost elderate in Vilnius and situated beside Verkiai Regional Park.

Cluster 3 consists of eleven Vilnius districts (most of which are residential districts with multi-apartment houses of 40–30 years old). Šeškinė is a fairly new suburb located in the north of Vilnius, built in 1977 as a micro-district. It is a largely residential suburb. Karoliniškės is a microdistrict and elderate. The district was started to be built in year 1971. Fabijoniškės and Justiniškės are the newest districts of Vilnius municipality, built in the late 1980s to early 1990s. Almost all buildings are Soviet-built human habitats. The districts have good a recreation area with a little forest, park, and a lake.

Cluster 4 consists of two districts: Pilaitė I and Naujininkai; Naujininkai is one of the Vilnius’ neighbourhoods that is situated in the south-west of the city and lies between the Vilnius Airport and the railway station.

Cluster 5 consists of 4 peripheral Vilnius districts (Dvarčionys, N. Vilnia, etc.), except Žirmūnai I. Naujoji Vilnia is a neighborhood in eastern Vilnius, situated along the banks of the Vilnia River. The district has a population of about 32,800. 34% of the population are Poles. Žirmūnai is the most populous administrative division (elderate) in Vilnius. It is also a neighbourhood Vilnius, encompassing the city district of the same name, built in the 1960s. Žirmūnai was important to the industrial sector in the USSR; since that time, this function has been replaced or supplanted by newer businesses, including some of Lithuania’s leading companies.

Cluster 6 consists of two most “green” districts in Vilnius: Verkiai and A. Paneriai, that is, the remaining peripheral Vilnius districts. Verkiai, is an elderate in Vilnius and also the name of a settlement, historically situated north of Vilnius but today a part of Vilnius city municipality. Verkiai elderate is a northernmost elderate of Vilnius. It occupies 5,565 ha and has 30,000 inhabitants. It is rich in architectural monuments and historical sites.

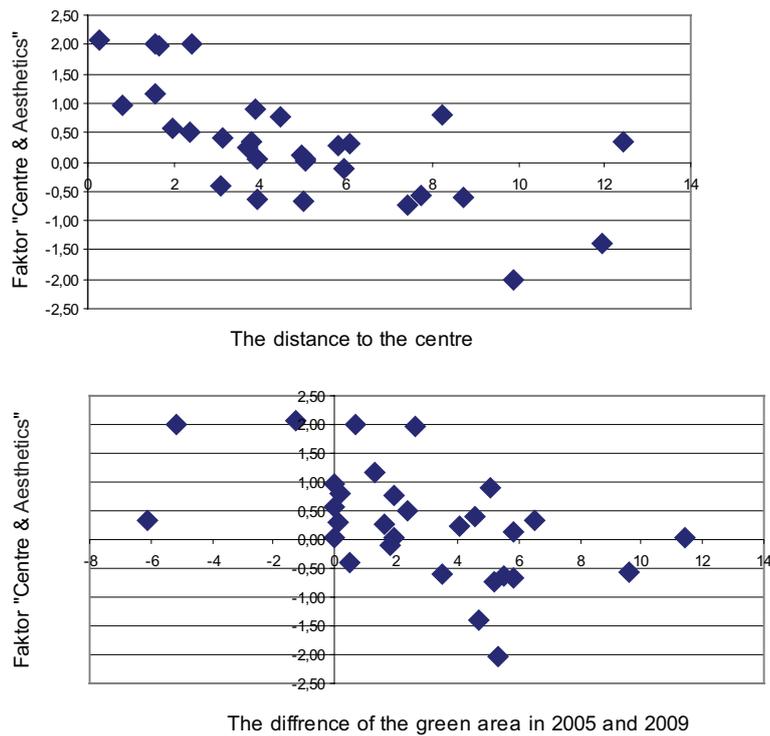


Figure 4. General shift in changes of the “centre & aesthetics” factor, the distance to the centre and green areas

Table 2. Values of the “centre & aesthetics” factor in Vilnius districts

Rating of the district	Name	“Centre & aesthetics” factor	Group	Rating of the district	Name	“Centre & aesthetics” factor	Group
1	Centre II	2.08	1	16	Viršuliškės	0.24	3
2	Old Town	1.99	1	17	Fabijoniškės	0.12	3
3	Žvėrynas	1.98	1	18	Vilkipėdė	0.12	3
4	Naujamiestis	1.16	1	19	Justiniškės	0.05	3
5	Centre I	0.97	2	20	Rasos	0.03	3
6	Antakalnis	0.89	2	21	Lazdynai	0.02	3
7	Santariškės	0.79	2	22	Pilaitė I	-0.1	4
8	Baltupiai	0.78	2	23	Naujininkai	-0.41	4
9	Šnipiškės	0.56	2	24	Užusienis	-0.58	5
10	Žirmūnai II	0.5	2	25	N. Vilnia	-0.6	5
11	Šeškinė	0.4	3	26	Žirmūnai I	-0.63	5
12	Karoliniškės	0.35	3	27	Ž. Paneriai	-0.68	5
13	Valakupiai	0.34	3	28	Dvarčionys	-0.72	5
14	Pilaitė II	0.3	3	29	Verkiai	-1.39	6
15	Pašilaičiai	0.28	3	30	A. Paneriai	-2.02	6

Variables connected by statistical relations may be also identified in the home environment factor which had a negative effect on prices in 2005–2008, i.e. prevented them from increasing. This factor is explained the best by the variable “population density in districts” from the data provided in the comprehensive plan of the city of Vilnius. The said variable is related to the factor by non-linear relations:

$$x_1 = -0.681 - 0,037f - 0.0002f^2, \tag{14}$$

where: x_1 – factor of the home environment; f – population density in districts.

The equation (14) explains 70% of the changes in the factor of home environment (determination coefficient is $R^2 = 0.70$, all equation coefficients are significant with the significance level of 0.05) (Figure 5).

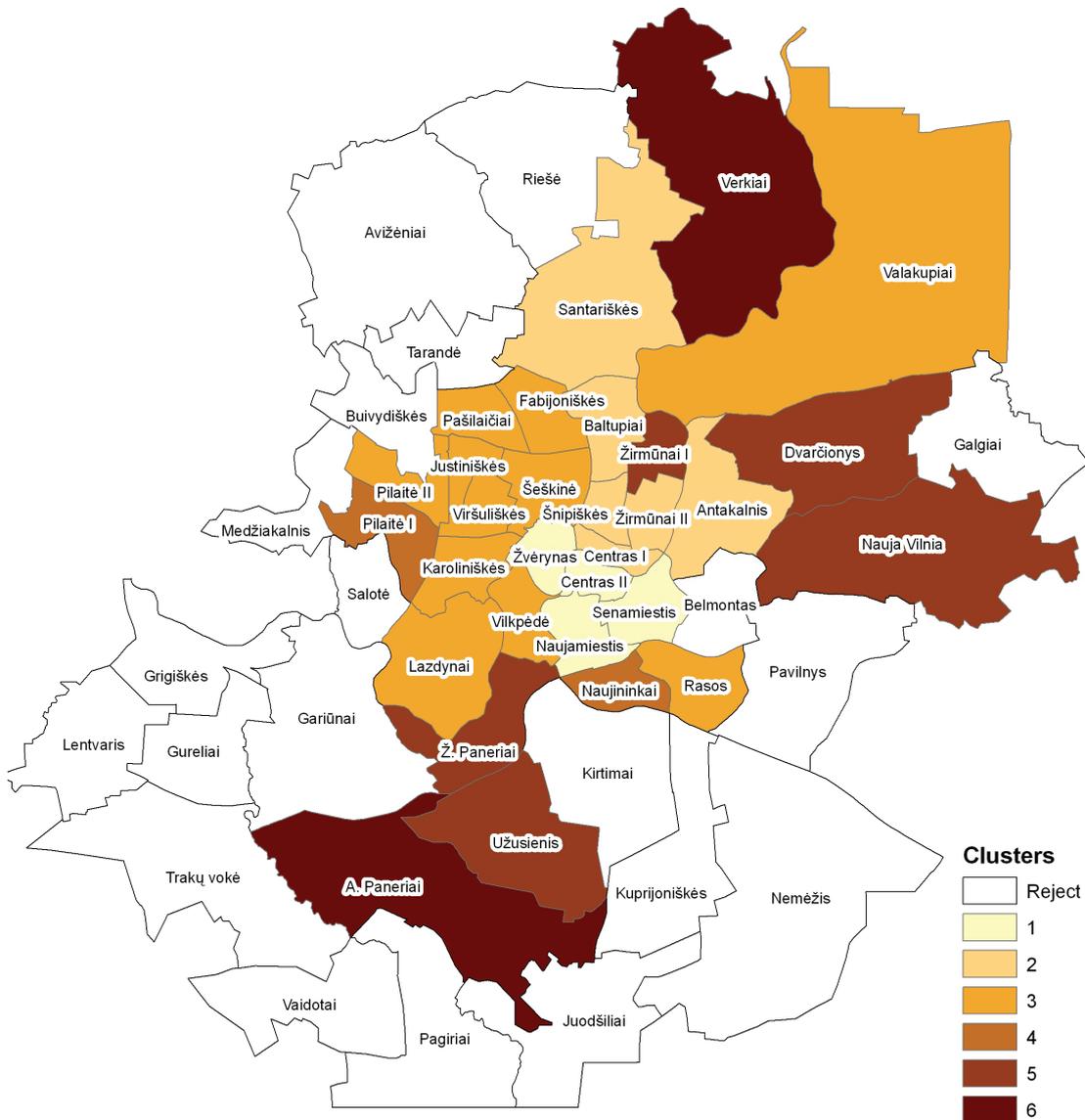


Figure 5. Vilnius districts grouped in six clusters

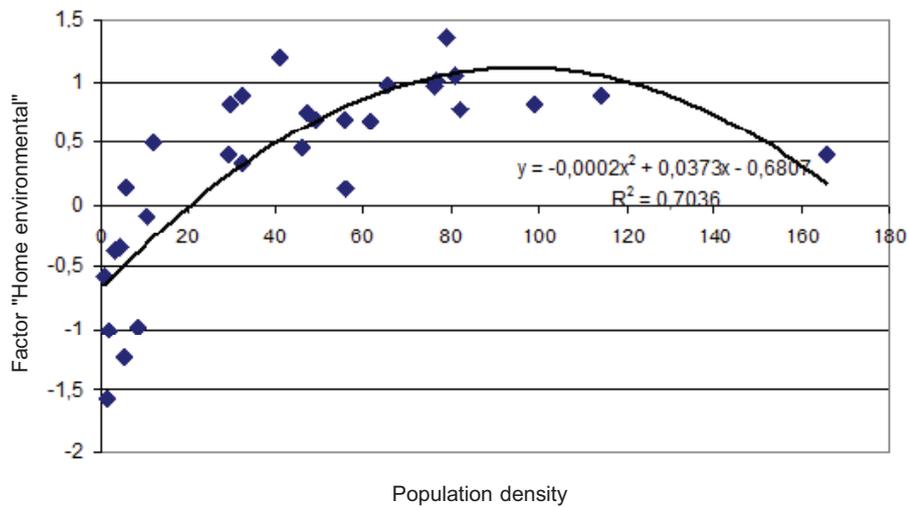


Figure 6. Relation between population density in districts and the factor of home environment

6. CONCLUSIONS

1. The assessment of Vilnius by the level of sustainability was carried out using the data of a representative survey of the capital residents, where residents used five-point scale to evaluate 22 statements describing the quality of life. These factors were grouped into three areas characterized by similar qualities. The home area was represented by 5 variables, the work area by 2 variables, the leisure area by 4 variables. The last group with 11 qualities consisted of general variables related to the quality of the environment.
2. The authors of the paper put forward 2 hypotheses to identify the factors determining the changes in the price of real estate in different Vilnius districts. The first hypothesis suggested that the price of real estate was conditioned by the home, work and leisure environments, while the second one said that the changes in the price of real state are highly affected by the prestige of the residential area.
3. Factor analysis was employed to cut the quantity of data. The analysis replaced the information present in many qualities by one variable. The analysis of eigenvalues distinguished one distinct factor in home, work and leisure groups. The biggest group, that is, the group of the quality of the environment, had two factors distinguished. The first one was related to health & safety, while the second one reflected the attractiveness of the city centre and aesthetics of the district. Hence, five factors were distinguished from the available data: home, work, leisure, safety & health, centre & aesthetics. These factors were further analysed by relating them to the average price of flats in Vilnius transport districts in 2005–2010.
4. It was established that in 2005–2010 two factors, namely work and health & safety, had no impact on changes in the price of flats in Vilnius transport districts. It was determined that, in different years, the price of flats was influenced by the following factors:

Year	Factor
2005	home, leisure, centre & aesthetics
2006	home, centre & aesthetics
2007	home, centre & aesthetics
2008	home, centre & aesthetics
2009	centre & aesthetics
2010 (1 qtr.)	centre & aesthetics

The conclusion was made that two variables had the greatest impact on the price of flats in Vilnius residential districts. The first variable was related to the “home” factor which had negative effect in 2005–2008. The second variable was the joint factor of “centre & aesthetics” with the positive effect which remained during the changes in the “price bubble” (2009–2010).

- It was determined that in terms of the principles of sustainable development the residents usually associated the quality of life with the concept of the quality of the closest living environment and the centre & aesthetics, i.e., the concept of prestige. According to the residents, the factor “centre & aesthetics” means prestigious and high quality living environment. Such environment is Vilnius districts that are the closest to the city centre and characterised by larger green areas. The factor “home” had the greatest negative effect on districts where the average population density was 40–120 per ha.

After the resultant factors were identified, the analysis was continued to prove or deny the hypotheses put forward. The analysis found out that according to the capital residents the price of real estate was mostly effected by the prestige of the Vilnius district – prices remained high next to the protected areas.

- The research determined the precise values of the factor “centre & aesthetics”, and Vilnius districts were grouped into

six clusters consisting of the following components:

- Cluster 1 consists of four districts in the heart of Vilnius: Centre II, Old Town, Žvėrynas, Naujamiestis;
- Cluster 2 consists of six Vilnius districts: Centre I, Antakalnis, Santariškės, Baltupiai, Šnipiškės, Žirmūnai II;
- Cluster 3 consists of eleven Vilnius districts (most of which are residential districts with multi-apartment houses of 40–30 years old);
- Cluster 4 consists of two districts: Pilaitė I and Naujininkai;
- Cluster 5 consists of five peripheral Vilnius districts (Dvarčionys, N. Vilnia, etc.);
- Cluster 6 consists of two districts: Verkiai and A. Paneriai, that is, the remaining peripheral Vilnius districts.

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SANTRAUKA

GYVENIMO KOKYBĖS POVEIKIS NEKILNOJAMOJO TURTO KAINOS VERTINIMUI VILNIUJE

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Subalansuota miestų plėtra apima įvairių veiklos sričių konsensuą, siekiant lygiavertiškai derinti ekonominių, socialinių, ekologinių veiksnių įtaką planavimui. Dėl skirtingų požiūrių ir interesų planuotojams bei mokslininkams nelengva rasti bendrą, visiems priimtina požiūrį į miestų plėtros šablonus, derinant formas ir plėtros principus. Straipsnyje analizuojama plėtros konceptų įtaka plėtros formų savybėms, ateities miesto alternatyvių vizijų kūrimui, atitikčiai darnios plėtros principams ir tinkamai gyvenimo kokybei. Kaip vienas pagrindinių socialinių ir gyvenimo kokybę atspindinčių rodiklių nagrinėjama nekilnojamojo turto kaina. Teorinės nuostatos, pasitelkiant ekspertinį vertinimą, tikrinamos Vilniaus miesto rajonų pavyzdžiu (Lietuvos Respublikos sostinė – 560 tūkst. gyv.), atsižvelgiant į atskirų 40 transportinių rajonų savybes ir formas, gyventojų, darbo vietų skaičių, teritorijos plotą, triukšmo lygį, užterštumą pagal skirtingus komponentus. Darnią plėtrą charakterizuojančių rodiklių kritinėms reikšmėms nustatyti taikomi conceptualaus modeliavimo principai. Jais remiantis sudaroma sistema, padedanti nustatyti atskirų miesto rajonų plėtros savybes, galimas vystymosi alternatyvas, pasiekiamas leistinas ribines gyvenimo kokybės reikšmes.