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QUALITATIVE INDICATORS FOR MEASURING THE PERFORMANCE DEVELOPMENT OF SELECTED CITIES

Kvalitativni indikatorji merjenja uspešnosti razvoja izbranih mest

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Abstract

Recognizing that cities are becoming generators of economic development and a source of growth for the national economy, researchers are increasingly identifying the stages of development and positioning of cities upon which the adequate preparation of strategic and development guidelines is dependent. The comparison of the level of their development efficiency calls for indicators measuring the performance of cities that are representative and comparable between countries. In the case of medium-sized cities, we consequently have to question the applicability of the methodology and indicators used mostly in cases of large, global cities by internationally recognized institutions. With the established set of qualitative indicators and assistance from a computer program for multiparameter decision-making processes (DEXi), this paper also seeks to compare the performance development of selected European cities.

Keywords: city, region, measurement systems, descriptive indicators, city-ranking, sustainable development, urbanization, quality of life

Izvleček

Ob spoznanju, da postajajo mesta generator gospodarskega napredka in vir rasti nacionalnega gospodarstva, se poraja potreba po prepoznavanju stopnje razvoja ter umeščanja mest, od katerih je odvisna priprava ustreznih strateških in razvojnih smernic. Primerjava mest po stopnji razvojne uspešnosti narekuje razvoj indikatorjev merjenja, reprezentativnih in primerljivih med posameznimi državami. Posledično se moramo v okviru proučevanja srednje velikih mest vprašati o uporabnosti metodologije in indikatorjev, ki jih na primerih velikih, globalnih mest največkrat uporabljajo mednarodno priznane institucije. Z oblikovanim naborom kvalitativnih kazalnikov ob uporabi računalniškega programa večkriterijskega odločanja (DEXi) želijo avtorji v prispevku primerjati uspešnost razvoja izbranih evropskih mest.

Ključne besede: mesto, regija, sistemi merjenja, deskriptivni indikatorji, razvrščanje mest, trajnostni razvoj, urbanizacija, kakovost bivanja

1 Introduction

Existing methodologies for comparing a city's performance and the quality of an urban city structure affect more or less a wider field of urban and regional disparities, wherein specific approaches cover only limited areas. Nijkamp (1986)

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focused exclusively on infrastructure impacts, whereas Callois and Aubert (2007) empirically analysed the impact of social capital on regional development. Singh et al. (2009, pp. 189–212), Slottje (1991), and Somarriba and Pena (2009) provided an overview of sustainable development indicators, but failed to interpret the quality of life indicators. In the field of competitiveness, Winter (2010) presented a synopsis of indicators measuring urban competitiveness on a European scale, while Parris and Kates (2003) indicated the multi-layered nature of sustainable development and consequently incompleteness of a measuring indicator's clear definition. Missing thematic indicators can also be found in the context of measuring regional disparities at the broader level of the European countries (Oliveira Soares et al., 2003; Tausch et al., 2007). Comparing cities by using indicators representing diverse aspects of urban life is only possible with the meaningful formation of a structured system; simply adding many indicators to obtain a single index might result in a criticism of uncertainty. Similar effects can also be achieved by using a larger set of non-aggregated indicators; therefore, the identification of an appropriately small number of relevant indicators is crucial. In the process of system formation, the inclusion of indicators with a higher impact on the general differences between selected cities in different countries is necessary, along with an additional assumption of environmental, human, and social capital as well as the integration of the demographic perspective.

This article presents the concept of measuring the urban development, based on different theoretical background and applied practices (Chapter 2), through which the most appropriate tailored concept (European Common Indicators [ECI]) is introduced as the baseline for the study, considering the specific criteria (city selection in Chapter 3), followed by a selection of the qualitative, descriptive performance development indicators (Chapter 4). Based on the structure and categorization of the gathered data (by survey, taken in five EU cities, introduced in Chapter 5), the applied DEXi method (Chapter 6) is introduced as one option in the multi-criteria decision-making process (city management). The method's case applicability is further discussed based on the results and their interpretation (Chapter 7).

2 Theoretical background and applied practice

In accordance with the Charter on European Sustainable Cities and Towns, Voula (1996) listed six key areas of sustainable development and urban transformation: the active city/town, beautiful town, green city/town, town with a better environment, cooperation for a better city, and the town catalogue. The strategy of urban sustainability consequently includes urban performance indicators, such as: 1) local involvement (citizens' participation), 2) employment, 3) city deficit, 4) economic growth, 5) urban mobility, 6) urban metabolism, resources, consumption, 7) environment and social expenditure, 8) urban safety, 9) public health, 10) social justice, and 11) global change.

Indicators of sustainable development highlight the complex and dynamic structure of the urban surroundings. After the adoption of Agenda 21 (1992), this type of indicator has been used by many institutions (e.g., United Nations–Urban Indicators Program, World Health Organization, 2009) as the analytical tools for studying the quality of life in the urban environment. The wider set also represents the SUD-LAB European Commission project's indicators with an extended database of European cities, where indicators are divided into the following categories: a) air quality, b) composed environment, c) cultural endowments, d) social disparities, e) transportation quality, f) urban administration, and g) waste management (Bănica, 2010, p. 340). Bănica (2010) defined the index of local development as an integrated indicator, including the importance of individual elements (weights)–namely, the category of infrastructure (4), followed by the economy (3), local community (2), and public administration (1):

$$I_{di} = [(I_i x\ 4) + (I_e x\ 3) + (I_{mc} x\ 2) + (I_{ap} x\ 1)] / 10, \quad (1)$$

meaning:

- I_{di} – local development index
- I_i – infrastructure index: utilities, transport and health infrastructure, natural resources
- I_e – local economy index: financial services and insurance, labour, and public budget
- I_{mc} – local community index (community spirit): safety of citizens, tourist attractions, cultural/sports facilities, and cultural/historical heritage
- I_{ap} – public administration index: services and support to small and medium-sized enterprises, urban planning, communication, and information dissemination

3 Selection of cities

The methodology for the comparison of medium-sized cities includes the selection of an appropriate sample, defined by location (criterion 1: European cities), inclusion in the databases (criterion 2: city's inclusion in the Urban Audit database), definition in terms of a smart city (criterion 3: city in the Smart Cities database), comparability in terms of the urban size (criterion 4: population size ranging from 100.000 to 200.000 inhabitants), and regional significance (criterion 5: capital of the region or an important regional centre). The cities that fulfilled these criteria and, thus, were included in our research are Maribor (Slovenia), Pleven (Bulgaria), Linz (Austria), Erfurt (Germany), Trieste (Italy), and Brugge (Belgium).

4 Selection of indicators

The selection of qualitative indicators results from a conceptual understanding of urban sustainability indicators, based on the ECI first established during 1999–2003 under the guidance of the Ambiente Italia research institute. Among more than 1.000 indicators, reflecting trends in urban development in accordance with the principles of

the social inclusion, local governance and democracy, local/global city integration, local economy, environment, cultural heritage, and quality of the institutional environment, and in the context of ECI 10 key indicators, the following pointers of sustainable development of European cities were selected (Ambiente Italia, 2003; Riga City Council, 2005):

area 1: citizens' satisfaction with the local community–indicator 1: average satisfaction with the local community

area 2: local contribution to global climate changes–indicator 2: CO_2 emissions per capita

area 3: local mobility and transportation–indicator 3: percentage of trips by private motorized transport

area 4: availability of local public open areas and services–indicator 4: percentage of people, living within 300 metres of a public open area > 5000 m^2

area 5: quality of the local ambient air–indicator 5: emissions of particulate matter (PM_{10})

area 6: children's journeys' to and from school–indicator 6: percentage of children going to school by car

area 7: sustainable management through the local authorities and local enterprises–indicator 7: percentage of environmental certificates with reference to the total of enterprises

area 8: pollution (noise)–indicator 8: percentage of the population exposed at night to noise levels >55 dB

area 9: sustainable land use–indicator 9: percentage of protected areas

area 10: products promoting sustainability–indicator 10: percentage of population favouring sustainable products

The quoted methodology that we found to be suitable for the study's baseline was developed according to a bottom-up approach, involving local authorities as the main actors in the process and improving synergies with the existing set of indicators. This showed, on the one hand, the extent to which the ethos (fundamental values peculiar to a specific person, people, culture, or movement) was actually based upon understanding of the real needs of municipalities and, on the other, the possibilities of achieving policy objectives for actions that shall bridge more than one level of governance. The indicators' initiative was focused on monitoring urban sustainability at the local level, with the aim of helping a local authority interested in beginning to monitor the progress in terms of the quality of its urban environment. Towns and cities can adapt the proposed set of 10 indicators to suit local circumstances. Respondents' distribution (from 14 EU countries) covered all classes of urban dimension (cities or aggregations of cities): 13 large (population > 350.000), 18 medium-sized (100.000 < population < 350.000) and 11 small (population < 100.000) cities.

For countries and their cities (especially on a European scale, in transition countries and, consequently, Slovenian cities) with a smaller population settlement, measurement concepts, as presented in the introduction (Chapter 1), can be partially or wholly inadequate. The selection of meaningful indicators, tailored to a specific city sample (e.g., medium-sized, European), situation, and decision-making problem (city management), depends on the defined focused areas of city development. Thus, the selection of appropriate indicators to allow for the narrow, specific measurement of future development's effectiveness from this perspective proves to be relevant.

The ECI concept was used in the study due to its successful implementation and effective city policy development's purpose. Based on its principles (the measurement method, definitions, and scale values will be presented in Chapter 6), and by introducing the five specific areas, qualitative performance indicators of urban development were selected for this study (Table 1).

5 Data structure and categorization

In the cities Maribor, Pleven, Linz, Erfurt, Trieste, and Brugge, a survey[1] based on a questionnaire implementing the computer-assisted web-interviewing (CAWI) method (using the application from KWIK Surveys [SOZ 2011]) was conducted. The size of a representative sample was calculated using the standard deviation of the observed variable for statistical population, as determined from previous studies and the predicted confidence interval base (Bastič, 2006). The standard deviation's (σ) value for the studied variable in the statistical population is 3,607, error probability is 0,5, and value of the variable t at $t_{0,05}$ is 1,96. The calculation of the sample size n (n = 199,92 ≅ 200) was determined as $\sqrt{}_n$ = 1,96*3,607/0,5. Sampling was conducted according to the principle of non-random quota sampling and judgement sampling, as well as partly to random using a social network.

In n = 200, we obtained 184 correctly completed questionnaires, representing the sampling fraction:

$$p = (184/200 = 0{,}92);\ \text{SE (standard error of estimate)} = \\ = (\sqrt{0{,}92\ (1\text{-}0{,}92)\ /200})*100 = 1{,}9 \quad (2)$$

Considering the error probability, the z–value (standard score z at the selected error probability) was calculated:

$$\alpha = 1\text{-}0{,}95 = 0{,}05;\ \alpha/2 = 0{,}025;\ z_{\alpha/2} = z_{0{,}975} = 1{,}96 \quad (3)$$

At the standard error of the estimated SE (without correction factor) of 1,9 percent, the lower confidence limit was determined:

$$8\% - 1{,}96*1{,}9\% = 2{,}4 \quad (4)$$

[1] By planning the survey, the recommendations of the sample survey approach were followed (see Tominc, 2006, p. 10).

Table 1: *City Performance Indicators: Qualitative and descriptive*

Indicator	Scale value			
Perception of local community				
The overall level of satisfaction with the local community	very satisfied	moderately satisfied	unsatisfied	
Public transport	easy accessible	difficult to access	inaccessible	
Social and health services	appropriate	acceptable	unacceptable	
Quality of the institutional environment	high	solid	unsatisfactory	
Education (number of educational facilities in your city)	1	1–5	more than 5	
Accommodation options and accessibility	high	medium	Low	
Employment opportunities	frequent	occasional	Rare	
Local mobility				
Systematic displacements (home–school and home–work)	private transport	public transport	non-motorized	
Number of daily trips (per capita), unsystematic	1–5	to 10	more than 10	
Access to basic services (bakeries, public transport, health facilities)	in the range of 300 m	in the range of 2 km	more than 2 km	
Accessibility to educational institutions (schoolchildren, students)	by foot, bicycle	public transport	private transport	
Enterprises				
Enterprises (sectoral)	mainly service sector	balanced industrial and service sector	mainly industrial sector	
Enterprises R&D	1–5	6–9	≥ 10	
SMEs and large enterprises	mainly SMEs	balanced SMEs and large enterprises	mainly large enterprises	
Environment				
Noise exposure	55–64 dB	65–74 dB	≥75 dB	
Environmental protection (opinion)	good	average	satisfactory	
Preference for eco-products	my preference	high costs	occasionally available, diverse habits	I don't trust them
QOL				
Subjective perception of poverty (local environment)	high	moderate	low	
Subjective perception of safety (local environment)	completely safe environment	stable environment	lower safety	

Source: KWIK Surveys Questionnaire (2011)

The questionnaire included 20 closed questions, to which respondents (aged 20 to more than 60 years, wherein this range did not predefine the target group) replied with a choice from anticipated, mutually exclusive answers. If a single-case dichotomous question (of two completely opposite directions type; e.g., male, female) had been used, a selection of multiple answers would have been possible. The Likert scale used allowed respondents to express their level of agreement/disagreement to various viewpoints. A semantic differential was not included.

For the perception of poverty indicator, 66,7 per cent of respondents from the survey sample ($n = 200$) indicated alternative b) moderate. If the results are generalized to the population, in accordance to the sample size, we will be able to predict with 95 per cent probability that between 60,1 and 73,3 per cent of the population believes in the existence of a moderate perception of poverty. The aim of the survey is not to project the results to the entire population in particular cities, but to create a database for setting up a DEXi decision model (a case study of the qualitative database's processing possibilities using artificial intelligence decision-making methods). In qualitative research, it is necessary to consider the limitations of subjectivity and perception; the results yield the respondents' answers (subjective, reflecting their self-image, which is not inevitably consistent with objective indicators), and attention must be drawn also to the social desirability of responses (overvalued shares).

6 Multi-attribute decision-making using the DEXi program

Using the established system of descriptive city performance development indicators, the authors seek to enable qualitative decision-making in a systematic way by using a multi-attribute model in complex situations with a large number of factors and variables. According to Grünig and Kühn (2005, p. 7), problem solving can be done in several ways: intuitively, routinely (by adopting formerly employed procedures), or randomly based on the selection and systematic rational thinking, supported by relevant information. The general approach of the decision analysis originates from the axioms of game theory by John von Neumann and

Oskar Morgenstern (1953). Its main steps represent structuring the problem, estimating the likelihood of possible outcomes, determining their utility, and evaluating alternatives as well as selecting strategies (Belton & Stewart, 2002; Čančer, 2007; Čančer & Mulej, 2005).

In this study, we decided to use the Decision Expert (DEXi) multi-attribute decision method, developed at the Jožef Stefan Institute (based on the methodology of DECKMAK [DECision MAKing]), which includes a result analysis of the evaluated variants (Bohanec & Rajkovič, 1990; Bohanec & Rajkovič, 1995; Špendl, Rajkovič & Bohanec, 1996). DEXi uses discrete and qualitative criteria whose values are described in general words, such as good, excellent, and unacceptable–unlike the analytic hierarchy process's (AHP) numerical method, which uses weights to determine the importance of the criteria (e.g., the Saaty Rating Scale, 1990). Like AHP, the DEXi method is based on the decomposition of the decision problem to the hierarchical structure of criteria, where instead of words, intervals of numerical values can be used. The difference is noticeable also at the lower-level criteria aggregation functions in the final assessment, where the program uses decision rules of the "if–then" type instead of weights. DEXi allows for the evaluation of variants in the case of their incomplete and inaccurate information (Bohanec, 2011).

In the first phase of the study, we identified the criteria, hierarchically reordered in a tree of attributes for building the decision model. Following this purpose, for each attribute (basic and aggregate), description and scale values were determined. Basic criteria represent the perception of the local community, local mobility, enterprises, environment, and quality of life (QOL).

Area 1

Satisfaction with the local community

An important component of a sustainable society characterizes the general welfare of its members or living conditions, which include safe and affordable housing, the availability of basic services (schools, health, etc.), interesting and satisfying work, and opportunities to participate in local planning and decision making. This indicator has no validated goals, only a general recognition that the welfare of citizens and their satisfaction with the local community are important elements of sustainability (European Commission, 2002).

Public transport (accessibility)

The indicator public transport (accessibility), adopted from the models of sustainable urban development, is related to accessibility, the availability of transport/transportation, social connectivity, access to motor vehicles, and travel perceptions. Integrated accessibility is defined as the spatial distribution of potential destinations as well as the quality and characteristics of the involved activities (Handy & Niemeier, 1997; Zahavi et al., 1981). According to Wegener et al. (2000), accessibility is defined as a construct of two functions: one representing the activities and opportunities, and the other representing effort, time, distance, or the costs of achieving them:

$$A_{\mathrm{i}} = \sum_{j} g(W_j).f(c_{ij}) , \qquad (5)$$

where A_{i} represents the accessibility of area i, W_{j} activity W on area j, and c_{ij} the cost of reaching area j from area i. Functions $g(W_{\mathrm{j}})$ and $f(c_{\mathrm{ij}})$ are defined as activity functions.

Among the indicators of area 1, the study also included social and health services, accommodation options and accessibility, and employment opportunities, based on the Eurobarometer (2009) survey "Perception survey on quality of life in European cities 2009", which indicated significant variations in the level of satisfaction with health services among EU cities. In Western European cities, an 80 per cent majority of residents indicated mo derate or very satisfied, while the level of satisfaction in many Southern and Eastern European cities was significantly lower (Eurobarometer, 2009). Considering the methodologies of the Eurobarometer survey and the Urban Audit Perception Survey (Urban Audit, 2004), two indicators–accommodation options and accessibility as well as employment opportunities–were selected for our study. The results of the stated surveys show a pessimistic view of the labour market, with the expected inverse relationship between the availability of jobs and the availability of accommodation options.

Area 2

The local mobility indicators include 1) systematic displacements (home–school and home–work); 2) the number of daily trips (per capita), unsystematic, 3) access to basic services (bakeries, schools, public transport, health facilities); and 4) accessibility to educational institutions. The set of indicators was derived from theoretical principles of ECI, where the indicators of local mobility and transport include the percentage of trips by private motorized transport. Systematic trips (per capita) represent daily displacements to work/school and back, whereas unsystematic trips are made for other reasons (e.g., shopping, recreation). The model of citizens' local mobility in the urban context is important in terms of quality of life (promoting alternative modes of transport; public transport, cycling). Access to basic services (bakeries, schools, public transport, health facilities) in a sustainable community is vital for the quality of life and performance of the local economy. The selection of this indicator is based on the headline indicator availability of public open areas and services (see ECI). Accessibility is defined as a percentage of people living within 300 metres of a public open area or other basic services and collective transport routes that–at least for part of a normal business day–operate on a minimum frequency (half-hourly service); public school (compulsory education); and bakery, greengrocery, and primary public health services. The European Environment Agency, Directorate-General for Regional Policy and ISTAT (*Istituto nazionale di statistica* [Italian National Bureau of Statistics]) apply

the concept "within 15 minutes by foot" for determining accessibility. The absence of stores selling fresh fruits and vegetables is an indicator of social exclusion and health risk (European Commission, 2002). Methodological principles of the indicator accessibility to educational institutions are also found in the context of ECI indicators, where the headline indicator of the area "children's journeys to and from school" represents the percentage of children going to school by car. The value of the attribute in the study refers to the modes of transport used for children's journeys to and from school (public and private transport), including also the possibility to "walk, bike" (European Commission, 2002). A sustainable society is namely one which, in terms of the traffic safety and crime, seems safe enough that parents feel comfortable allowing their children to walk or cycle along the streets as well as use public transport.

Area 3

Indicators of area 3 (enterprises) are represented by enterprises (sectoral), enterprises R&D, and SMEs and large enterprises. The selection of indicators is based on the study "The Economic Map of Urban Europe" (Laakso & Kostiainen, 2007), which in the context of the city's economic structure emphasizes the importance of the service and manufacturing sector. The results of the study highlight the specialization of the service sector (concentration of administrative functions), which in some capitals (e.g., Vienna) includes the dominant share of employment. In other capitals (e.g., Barcelona), a markedly closer balance between service and manufacturing sector was noted (Laakso & Kostiainen, 2007). Production in the European Union on average employs 25 per cent of the workforce, despite the fact that de-industrialization plays an important role in the economy of many European urban regions. Industrialized European cities are seldom cities in economic decline; on the contrary, some of them are among the most dynamic and economically robust cities in Europe (Laakso & Kostiainen, 2007, p. 14). Considering the importance of the service and manufacturing sector in the formation of decision rules for cities, the equilibrium principle (balanced service sector and industry) is preferred in our study. The SMEs and large enterprises indicator as well as the enterprises R&D indicator was selected based on the ECORYS (2012) research and the Eurostat Database (2013). The results of the research show that, despite the euro crisis and the strained economic situation, SMEs in the EU represent an important role in the union's economy. According to the 2012 data, 20,7 million SMEs contributed 67 per cent of the total employment and 58 per cent of the total gross value added (ECORYS, 2012). The Small Business Act (SBA) for Europe (updated in 2011) recognizes the importance of SMEs' role in the EU economy in striving to strengthen it in terms of reducing the administrative barriers, accessing new markets, ensuring free competition, promoting R&D, and supporting SMEs in the regional and environmental context of the Europe 2020 key objectives: smart, sustainable, and inclusive growth. Many SMEs are faced with "non -recruitment growth" (or "jobless growth"), but dynamic companies, despite the delicate economic environment, have demonstrated increased EU activity in high-tech and knowledge-based industries and services. According to the EU-27 area's Eurostat data, on average, micro enterprises and SMEs as well as large enterprises have made an almost balanced contribution to the added value. Considering these starting points regarding the role of SMEs and large companies and their added value, the decision rules (SMEs and large companies indicator) in our study are related to their balanced distribution in the urban environment of medium-sized cities. The importance of the high-technology sector and knowledge-based services leads to a preference for a higher number of R&D enterprises in selected urban areas.

Area 4

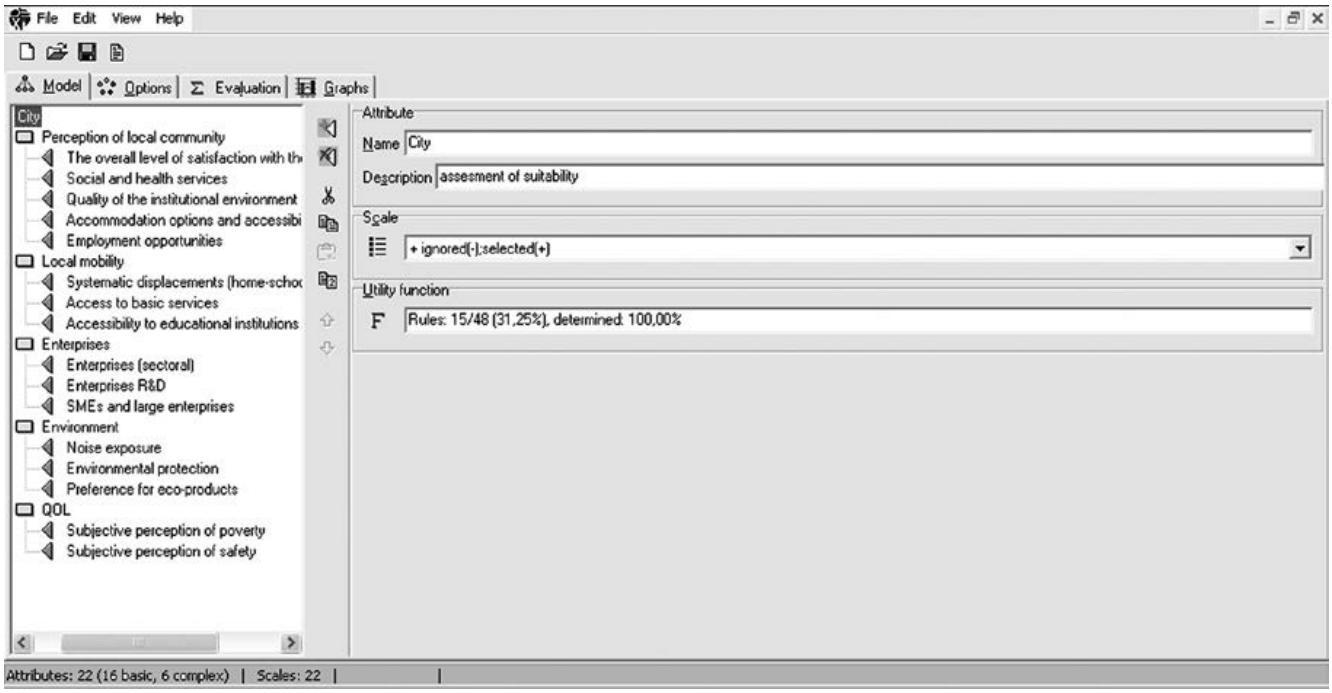
Area 4 relates to the environment and includes three indicators: 1) exposure to noise, 2) environmental protection (opinion), and 3) preference for eco-products. Selection results from the ECI set were used to cover the area of noise pollution (Ambiente Italia, 2003; European Commission, 2002), where the headline indicator represents the percentage of the population exposed to noise L_{night} (at night) > 55 dB(A).[2] On the quoted basis, the noise exposure indicator's scale values of 55–64 dB, 65–74 dB, and ≥ 75 dB (noise level), which do not relate to a specific time of day (e.g., by day, by night), were used in the study. A sustainable society should combine urban functions such as housing, work, and mobility without exposing residents to excessive noise. The selection of the environmental protection (opinion) indicator was based on the Urban Audit Perception Survey (Urban Audit, 2004), which in the context of the local perception of QOL measurement in 31 European cities uses an indicator of a clean city. Interestingly, between cities, where most of the population believes that the city is clean, the majority of the population also feels completely safe. The baseline of the indicator preference for eco-products represents the ECI (Ambiente Italia, 2003) in the field of sustainability-promoting products (namely, the headline indicator percentage of people buying sustainable products). The indicator includes eco-labelled products, organic products, energy-efficient products, Fairtrade Labelling Organizations (FLO) fair trade products, and eco-products (e.g., Blauer Engel/ Germany, the Nordic Swan/Scandinavian countries, and the EU-Ecolabel/European Union).

Area 5

Indicators of area 5, QOL, are represented by a) the subjective perception of poverty (the local environment) and b) the subjective perception of safety (the local environment). The subjective perception of poverty is based on a Eurostat Database (2011) indicator: population at risk of poverty or exclusion: NUTS2. The selection of the subjective perception of safety was based on the Urban Audit

[2] Abbreviation for DeciBels Adjusted, dB(A): the noise power calculated in dB.

Figure 1: *Model Page of the DEXi Model Window*



Source: DEXi processing of collected data

Figure 2: *Decision Rules for Attribute Environment*

Decision rules

	Noise exposure	Environmental protection	Preference for eco-products	Environment
	41%	36%	22%	
1	more than 75 dB	*	*	Ignored
2	<= 65-74 dB	satisfactorily	*	Ignored
3	<=65-74 dB	<=average	<=occasional available	Ignored
4	*	satisfactorily	<=high costs	Ignored
5	*	<=average	<=diverse habits	Ignored
6	*	*	<=I don't trust	Ignored
7	>=65-74 dB	>=average	>=high costs	***Selected***
8	>=65-74 dB	***Good***	>=diverse habits	***Selected***

Source: DEXi processing of collected data

Perception Survey (Urban Audit, 2004) about the local perception of QOL in European cities.

The decision model consists of 22 attributes (Figure 1): 16 basic and 6 aggregate. In the next phase of our study, an adequate value, which in DEXi consists of words or numerical intervals (Jereb, Bohanec & Rajkovič, 2003), is assigned to each attribute. The "if–then" method is used by DEXi in the table rows, which represent the utility function or decision rules. By setting the first (representing the worst options' combination) and the latest (best value) rules using Function Editor and by setting appropriate weights, the program automatically calculates other values which, if found to be unacceptable, can still be properly edited.

When interpreting the decision rules for the attribute environment (Figure 2), in the case of noise exposure, greater than 75 dB, regardless of the scale value[3] referring to the attributes environmental protection and preference for eco -products, the decision for the city selection is not taken. Decision rules are formed with reference to previously presented European Union environmental policy, wherein the headline indicator represents the percentage of the population exposed to night noise levels > 55 dB(A). Correspondingly, a still acceptable daily noise level of up to 75 dB was considered in the study.

[3] * represents any value.

Figure 3: *Options' Evaluation Results*

Option	Maribor	Pleven	Linz	Erfurt	Trieste	Brugge
City	ignored	ignored	***selected***	ignored	ignored	ignored
Perception of the local community	ignored	ignored	***selected***	solid	ignored	***selected***
The overall level of satisfaction with the local community	moderately satisfied	moderately satisfied	***very satisfied***	***very satisfied***	moderately satisfied	***very satisfied***
Social and health services	acceptable	acceptable	***appropriate***	***appropriate***	***appropriate***	***appropriate***
Quality of institutional environment	solid	solid	***high***	solid	solid	***high***
Accommodation options and accessibility	medium	medium	medium	medium	medium	medium
Employment opportunities	rare	***frequent***	***frequent***	occasional	occasional	***frequent***
Local mobility	***selected***	***selected***	***selected***	***selected***	ignored	***selected***
Systematic displacements (home–school and home–work)	***private transport***	public transport	***private transport***	***private transport***	***private transport***	public transport
Access to basic services	***in the range of 300 m***	***in the range of 300 m***	***in the range of 300 m***	in the range of 2 km	in the range of 2 km	***in the range of 300 m***
Accessibility to educational institutions	***by foot, bicycle***	***by foot, bicycle***	***by foot, bicycle***	***by foot, bicycle***	public transport	***by foot, bicycle***
Enterprises	ignored	***selected***	***selected***	***selected***	selected	ignored
Enterprises (sectoral)	mainly services	***balanced industrial and service sector***	***balanced industrial and service sector***	mainly services	***balanced industrial and service sector***	***balanced industrial and service sector***
Enterprises R&D	1–5	1–5	***more than 10***	***more than 10***	6–9	1–5
SMEs and large enterprises	mainly SMEs	***balanced SMEs and large enterprises***	***balanced SMEs and large enterprises***	mainly SMEs	***balanced SMEs and large enterprises***	mainly SMEs
Environment	ignored	***Selected***	***selected***	***selected***	***selected***	ignored
Noise exposure	65–74 dB	***55–64 dB***	65–74 dB	***55–64 dB***	65–74 dB	***55–64 dB***
Environmental protection	average	average	***good***	***Good***	average	average
Preference for eco-products	I don't trust them	high costs	***my preference***	diverse habits	high costs	diverse habits
QOL	ignored	ignored	ignored	ignored	ignored	ignored
Subjective perception of poverty	moderate	moderate	low	moderate	low	moderate
Subjective perception of safety	stable environment	stable environment	stable environment	stable environment	stable environment	stable environment

Source: DEXi processing of collected data

Figure 4: *Comparison of Options Maribor–Linz*

Comparison of options

Attribute	**Maribor**	**Linz**
City	ignored	***selected***
┌ **Perception of local community**	ignored	***selected***
├ The overall level of satisfaction with the local community	moderately satisfied	***very satisfied***
├ Social and health services	acceptable	***appropriate***
├ Quality of the institutional environment	solid	***high***
├ Accommodation options and accessibility	medium	
└ Employment opportunities	rare	***frequent***
├ **Local mobility**	***selected***	
├ Systematic displacements (home–school and home–work)	***private transport***	
├ Access to basic services	***in the range of 300 m***	
└ Accessibility to educational institutions	***by foot, bicycle***	
├ **Enterprises**	ignored	***selected***
├ Enterprises (sectoral)	mainly services	***balanced industrial and service sector***
├ Enterprises R&D	1–5	***≥10***
└ SMEs and large enterprises	mainly SMEs	***balanced SMEs and large enterprises***
├ **Environment**	ignored	***selected***
├ Noise exposure	65–74 dB	
├ Environmental protection	average	***good***
└ Preference for eco-products	I don't trust them	***my preference***
└ **QOL**	ignored	
├ Subjective perception of poverty	moderate	low
└ Subjective perception of safety	stable environment	

Source: DEXi processing of collected data

The selection was confirmed in the case of the attribute scale value of 65–74 (weight of 41 per cent), environmental protection with a scale value of good, and preference for eco-products with a scale value of diverse habits. After entering attribute values Figure 3) for all options (Maribor, Pleven, Linz, Erfurt, Trieste, Brugge), obtained by completed survey questionnaires (value selection is determined by the percentage majority), the study included an evaluation of alternatives. The option with the highest evaluation is generally considered the best, but an analysis based on mutual comparisons is essential to ensure that reasonable, proven solutions are identified (Jereb et al., 2003, p. 14).

7 Results and their interpretation

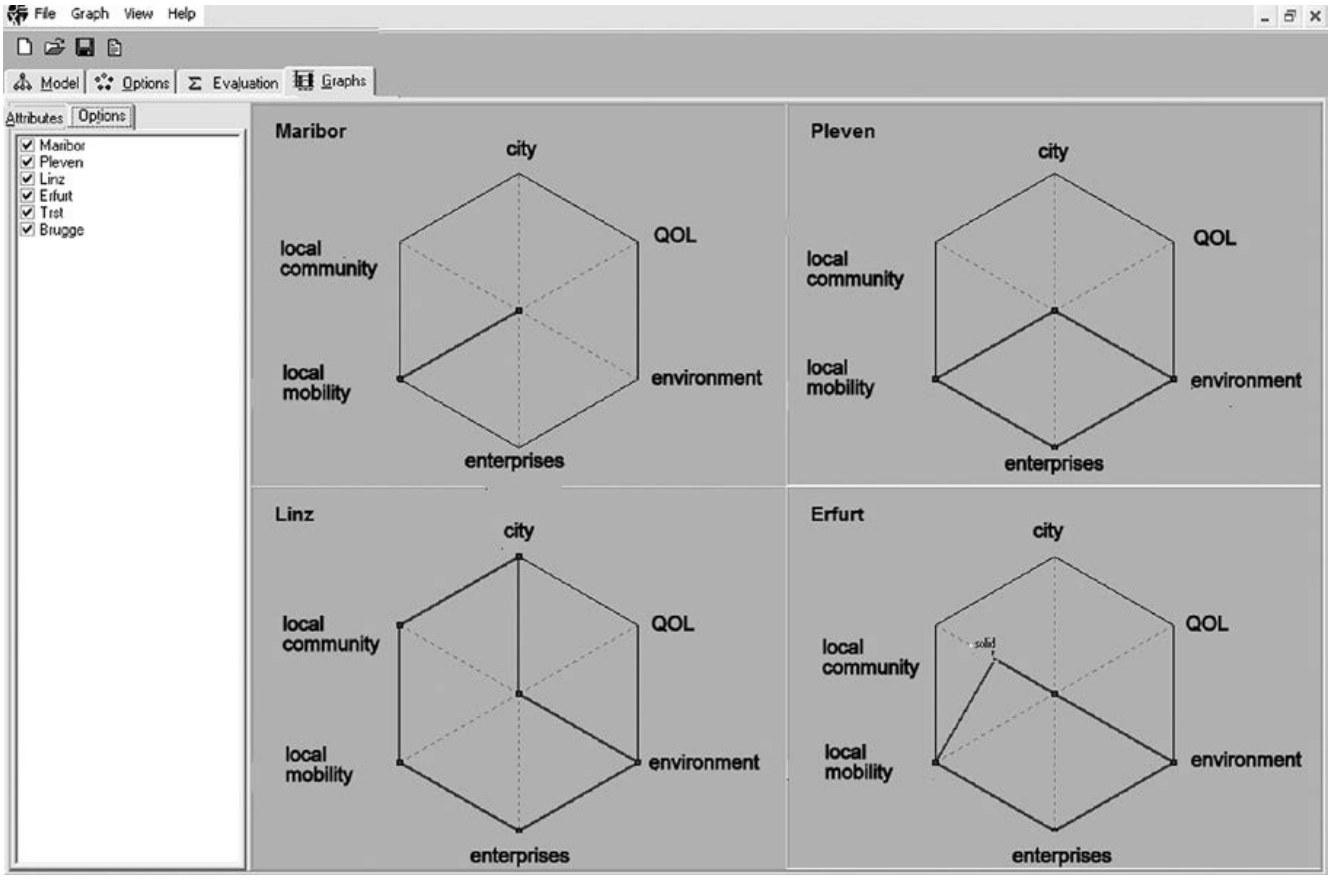
A comparison of the options (cities) Maribor (unselected) and Linz (selected) showed the parallel values of both cities–namely, values according to weights and decision rules for Maribor illustrate moderate satisfaction with the local community, the acceptability of health services, solid quality of the institutional environment, predominant services and SMEs, 65–74 dB of noise exposure, average environmental protection, distrust of eco-products, moderate subjective perception of poverty, and a stable environment (median values, positioned in neither the critical nor selection interval).

Determinant values for the city's non-selection include rare employment opportunities and the extremely small number (up to 5) of R&D enterprises (the importance of this weight amounts to 47 per cent), as non-selected also characterizes the common combination of aggregate criteria values. Values favourably affecting the choice include private transport within the systematic mobility (the latter is independent from the use of public transport), rapid access to basic services, and the availability of educational institutions (proximity to schools). For the city of Linz, all listed values express maximal selection influence (Figure 4).

Based on the size of the star plot radar chart (Figure 5) and the pursuance of the weights, the selection's decision criteria are met only by the city of Linz. The bottom option represents the city of Maribor with the best evaluation of the attribute local mobility. The evaluation results can be interpreted more clearly in a graphic form with a star diagram (Figure 5), taking into consideration the extent of the surface area (star) or criteria's importance.

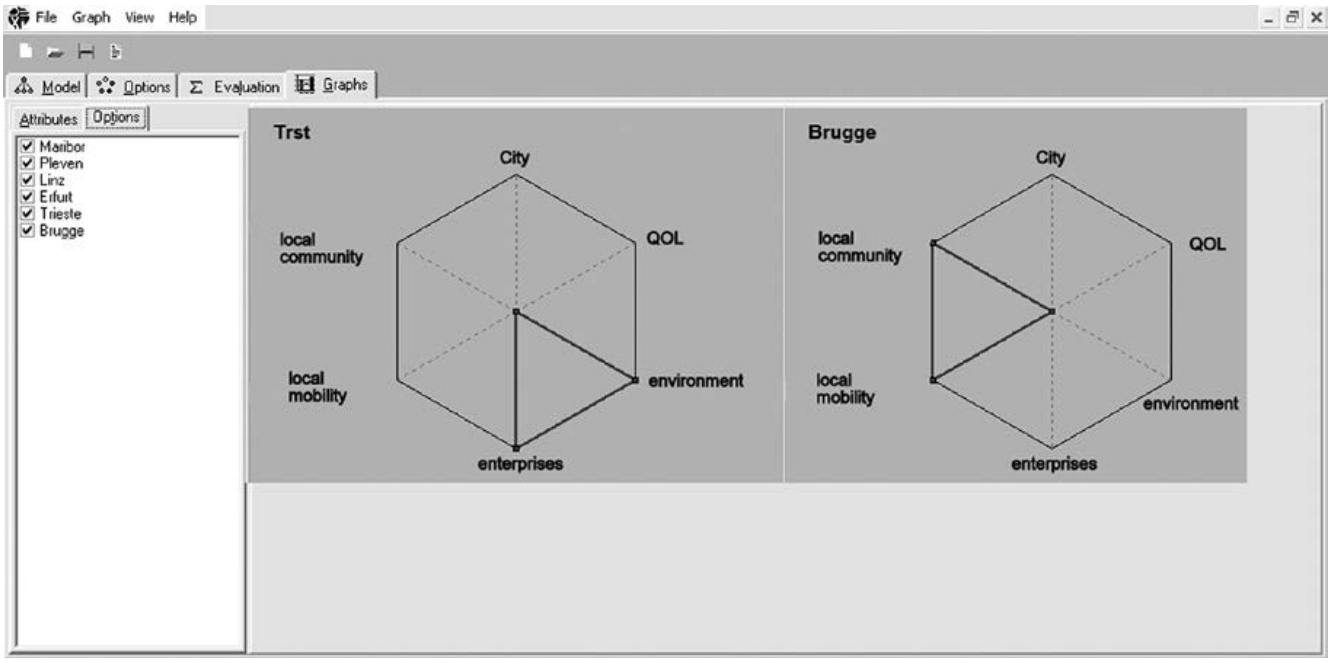
The city of Erfurt is better than Pleven in the area of local community perception (solid), while the plot areas of

Figure 5: *Radar Chart (star plot)—Comparison of options' (cities) attributes*



Source: DEXi processing of collected data

Figure 6: *Radar Chart (star plot)—Comparison of options' (cities) attributes*



Source: DEXi processing of collected data

Trieste and Brugge are identical (Figure 6), with the difference being that Trieste is better evaluated for enterprises and environment and Brugge for local community perception and local mobility. It is interesting to note the QOL in terms of the subjective perception of poverty and safety under the assumption of strict selection decision rules–namely, the option (city) is chosen only in the case of imperceptible poverty and stable environment or imperceptible poverty and completely safe environment (QOL expresses an important attribute of evaluation), whereby the decision rules of this attribute are not met by any city included in our study.

8 Conclusion

The purpose of our study is to compare the performance development of chosen European cities according to an established set of qualitative indicators with the assistance of a computer program for multiparameter decision-making processes by using ECI methodology in a sample of nationally and internationally (European) comparable cities whose selection followed certain criteria. The determination of appropriate measurement indicators, closely related to the evaluation of well-known methodological concepts (ECI indicators, urban status and sustainability indicators) and collected relevant databases (questionnaire, KWIK Survey) resulted in a useful tool: a list of selected descriptive indicators, reasonably divided into five areas and measurement categories, allowing for the selection of the most suitable option (city). By using a multi-attribute decision-making process and a supporting software tool DEXi for the qualitative data analysis, the decision model of the city selection consisted of 22 criteria, including 16 basic and 6 aggregate factors. The evaluation of options offered clarity in the multi-criteria decision-making process in accordance with the specified hierarchy and the importance of decision criteria (decision model, rules, and option evaluation). Achieving the best possible decision often requires a trade-off between perfect modelling and usability of the model.

Meanwhile, the multi-criteria decision-making program DEXi allowed for verbal assessment (scale values: ignored, selected) and offered a graphical user interface (the star diagrams to compare the options' attributes). It is also reasonable to draw attention to the trend of combining other methods–namely, in addition to the use of DEXi in the decision-making phase of method selection, programs such as DEXiTree and Vredana can be employed. The latter uses mixed qualitative and quantitative evaluation, giving options in addition to qualitative and numerical assessment (numerical interval), thereby allowing for differentiation even within a single qualitative value.

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