Economic-Mathematical Assessment of the City Brand Competitiveness Based on a Quantitative Indicators System

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Abstract The article substantiates the need for a quantitative indicators system of the city brand competitiveness, as well as offers the guideline of developing such a system, focusing on main areas of the city branding. Also, in this article the main development stages of economic-mathematical mechanism for assessing the city brand competitiveness have been formed, bearing in mind the priority of city brand competitiveness indicators, to meet the goal of increasing it in certain areas of city branding.

Keywords City brand, City brand competitiveness, City brand competitiveness indicators, Quantitative assessment of competitiveness

1. Introduction

It's worth nothing that currently the contribution of the brand to the competitiveness of places, ranging from territories, cities to countries is wildly acknowledged. Therefore, the key to successful increasing of the city competitiveness lies in effective promoting and boosting the city brand competitiveness. In the conditions of a dynamically developing world, emerging global and local economic crises, alongside with increasingly fierce competition of territories, the objective of identifying the city brand competitiveness, as a driver for the city promotion, is extremely crucial in such competitive environment. It is no longer enough to assess qualitatively the level of the city brand competitiveness for maintaining its competitive position. The vibrant development of cities dictates the necessity to manage the process of creating city brand competitive advantages, while possessing the complete systematic information about its competitiveness.

From our point of view, the foundation for improving the process of the city competitiveness assessment, primarily, lays in thorough monitoring of those factors, which exhaustively and sufficiently form the city brand competitiveness. Thus, a quantitative assessment of referred factors' influence reflects the objective picture of tailoring the city brand competitiveness.

Such systematic description of referred factors serves as a

tool to create an economic-mathematical mechanism of the city brand competitiveness assessment. The mechanism which offers a range of opportunities to specifically enhance the city brand competitiveness.

Such an approach will enable the authorities, in charge of promoting the city brand, to purposefully create its competitive advantages.

The relevance of this article consists in the necessity to create an essential quantitative indicator system of the city brand competitiveness, in a compartment with economic-mathematical mechanism for the city brand competitiveness quantitative assessing, deriving from it.

2. Theoretical Base

A study of relevant scientific sources on assessing the city brand competitiveness and the city brand as a driving force of the city competitiveness [1-6] revealed that the problem of assessing the city competitiveness and its brand attractiveness is quite complex. Most indicators in these studies are of a pronounced qualitative nature, and as a rule, there are no adequate statistics on some indirect quantitative indicators of the city brand attractiveness.

Some of the analyzed sources contain quantitative indicators of such assessment, but do not offer their system. The list of indicators is fragmented. It does not provide an opportunity to assess the brand competitiveness comprehensively, to take into account exhaustively the fundamentally different areas of building the city brand competitiveness, while having the necessary and sufficient set of indicators for each such area.

The analyzed papers focusing on the quantitative assessment of the competitiveness of the city/city brand [4,7-10] have demonstrated the following:

- subsequently, the comparison of the obtained data, containing the target values or objectively the best values of similar indicators of the city/city brand is not carried out [4,7]. This leads to both a high degree of subjectivity of the assessment results and complexity in the process of comparing the competitiveness of several cities/brands of cities;
- it has been noticed that the weightiness of competitiveness indicators in building the competitiveness of the city/city brand in general, may not be taken into account. The indicators are analyzed as equilibrium [4,8-10]. That is incorrect and doesn't reflect the reality. The contribution of various indicators to the building of the comprehensive city /city brand competitiveness may vary significantly, in accordance with the objectives and conditions of the assessment;
- there may be no system of competitiveness indicators in its right, or either the indicators are presented in the form of a sheer listing, without being combined into groups according to the areas for assessing the competitiveness of the city/city brand [4,8,10]. Thus, the principle of systematic competitiveness assessment has not been respected;
- the title of the indicator may be of a generalized, inaccurate nature without containing units of measurement [7,10]. This also contributes to a greater expert's subjectivity while assessing such an indicator;
- the assessment of the city brand competitiveness may be missing in each area of the city branding, in a form of a generalized competitiveness indicator of the city brand for the given area, with due regard for the weight of the latter's contribution to the building the total city brand competitiveness. Also, there is missing the assessment of the impact of individual city brand competitiveness indicators, in a view of such indicators weight in the building the city brand competitiveness in each branding area [4,8,10]. Under such an approach we come across definite complexities in assessing whether the indicators are higher, or there is the lag (the "weak point" of competitiveness) in the exact areas of building the city/city brand competitiveness. While also – it is difficult to assess the impact of changes in a particular indicator of the city brand competitiveness on the building city brand competitiveness in a certain branding area. Thereby, this significantly complicates the process of making managerial decisions on the city brand development and promotion.

The indicators system of the city brand competitiveness should be a list of fundamentally different characteristics (formation areas) of the city brand competitiveness. This system should describe and allow to evaluate such competitiveness completely and exhaustively.

The quantity of such indicators should not be excessive. The objectivity of the conducted assessment of the city-brand competitiveness should be ensured by due regard of a city-brand competitiveness components and the weightiness of such components.

The mechanism of quantitative assessment of the city brand competitiveness is designed to perform assessment of the city brand competitiveness in various branding areas, taking into account the contribution (weight) of each area in the process of building the total city brand competitiveness.

Furthermore, such a mechanism should enable to assess in quantitative terms, the way in which a change in a particular indicator of a city brand competitiveness affects its competitiveness in general and particularly in a certain branding area. Therefore, such a mechanism offers the possibility to those, responsible for managerial decisions on the city brand promotion, to identify «the bottleneck» of the city brand competitiveness and arrive at a decision on how to eliminate it in a prompt manner.

As a result, such a mechanism confers the possibility to clearly and purposefully identify and ensure the unique competitive position of the city brand.

3. Quantitative Indicators System of the City Brand Competitiveness

The main city branding areas have been taken as the basis for developing a quantitative indicators system of the city brand competitiveness assessment [4,11-17] from the standpoint of its attractiveness for various types of tourism and investors [18]:

- natural resources of the city;
- cultural and historical heritage;
- Trade & Entertainment capability;
- scientific capacity;
- medicine and recreation;
- sport;
- urban industrial, manufacturing and investment potential of the city;
- urban conditions.

Figure 1 proposes a block diagram of a quantitative indicators system for a city brand competitiveness assessment, taking into account the main areas of city branding.
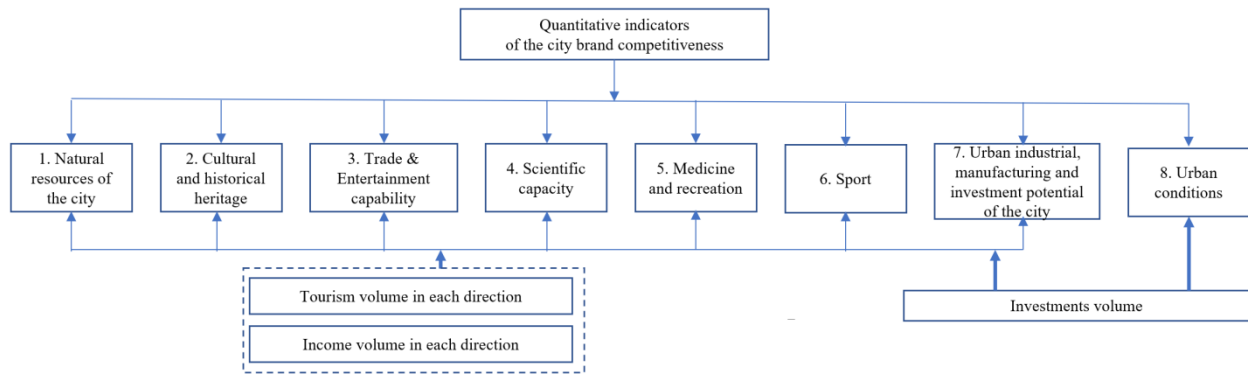
Figure 1. Block diagram of a quantitative indicators system of the city brand competitiveness assessment (*Source: developed by the author*)

Table 1. Quantitative indicators of the city brand competitiveness assessment in the main areas of its forming

№	Indicator	Assessing methodology /Indicator source	Unit of measure
1	Natural resources of the city		
1.1	Ecology (air purity, water purity)	Official data of Russia/USA: Air quality Index [19,20] Quality Class of Surface Water [21,22]	Index Class
1.2	Comfort of natural and climatic conditions	Methodology, Official information / Indicators [23-26]: 1. temperature conditions, 2. relative humidity, 3. precipitation, 4. wind speed, 5. cloudiness	1. t°C; 2. %; 3. mm, %; 4. m/c; 5. point, %.
1.3	Sanitary conditions and landscape aesthetic appearance	Methodology/ Balanced Scorecard for Assessing the Interaction between the City Improvement& Landscaping Infrastructure and other Urban Economy Development Infrastructures [27]	1. % (indicators of the level for citizens' provision with the landscape aesthetic qualities and facilities design of various infrastructures, such as: indicator of historical and cultural heritage of the city, indicator of citizens'education, indicator of city housing and transportation, etc.; indicator of all types of city amenities availability; indicator of green areas share within the city, other indicators; 2. ths.rub. (budget funds, funds from investors, funds from legal entities and citizens contributed to the city improvement and development of city's green areas)
1.4	Natural and recreational potential	Methodology [28,29] / Level of the nature and recreation potential	Level
1.5	Uniqueness and diversity of natural and climatic resources	Methods and methodologies [30,31]: 1. Landscape diversity [32,33], 2. Attractiveness [34,35] 3. Specially protected natural areas (PAs) of federal, regional and local significance, 4. Significance (availability of natural monuments of federal, regional and local significance) [36], 5. Touristic visitation intensity on natural complexes [37,38]	1. diversity index 2. point 3. point 4.point 5. tourism opportunity score of a location
2	Cultural and historical heritage		

№	Indicator	Assessing methodology /Indicator source	Unit of measure
2.1	The position of historical and cultural complexes in global and national culture (global /federal/regional/ local significance)	Official statistics [39] Methodology [40]	point
2.2	Popularity rating and availability for the tourists of protected historical and cultural sites	Methodology [41,42]	attractiveness of the feature for tourists
2.3	Popularity rating and availability for the tourists of oldest villages, territory of special protection	Methodology [41,42]	attractiveness of the feature for tourists
2.4	Popularity rating and availability for the tourists of cultural and historical activities and the scale of such events	Methodology [41,42]; Scale	attractiveness of the feature for tourists; ths.pers. unnually
2.5	The preservation level of the objects representing historical and cultural heritage – The current condition of such objects	Methodology [43]	Radar chart sets an algorithm for assessing the degradation of a historical and architectural object
2.6	Number and share of personnel employed in the creative sector	Ncr – the average annual number of personnel employed in the creative sector of the city; $\frac{Ncr}{N}$ – the personnel employed share in the creative sector in the total share of employed population in the city, where N – total annual average number of employed city population [44]	thousands %
3	Trade & Entertainment capability		
3.1	Sufficiency of shopping floor space per person	$\frac{S_T}{N} * 1000$ pers where S_T – retail space of modern formats; N – average annual city population [45]	m²/per
3.2	Availability and scale factor of amusement parks and other recreational facilities	$\frac{Sn_i}{St}$, where Sn_i – the total square footage of the i-th amusement park or other recreational venue; $i = \{1 \dots n\}$, where n – number of amusement parks and other recreational facilities; St – area of the city territory	coefficient
4	Scientific capacity		
4.1	Number of R&D staff	Methodology [46]	pers.
4.2	Number of researchers with a degree	Methodology [46]	pers.
4.3	Internal costs of R&D	Methodology [46]	mln.rub.
4.4	Number of students, studying for bachelor, specialist, master's degree programs per 10 000 inhabitants	Methodology [46]	pers.
4.5	Number of students working for a master's degree – PG students	Methodology [46]	pers.
4.6	Number of students working for a doctor's degree – PhD students	Methodology [46]	pers.
4.7	Number of patents granted for inventions and utility models	Methodology [46]	units
4.8	Range of innovation activity of the organisations	Methodology [46]	%
4.9	Amount of innovation	Methodology [46]	mln.rub.
4.10	Volume of public and private investments involved in science and education	Methodology [46]	mln.rub.
4.11	Ranking of city universities on global/national level	Official information about the international [47] and Russian [48] university rankings	Point
5	Medicine and recreation		

№	Indicator	Assessing methodology /Indicator source	Unit of measure
5.1	Range of medical and recreational services: - Number of personnel, involved for each service for the period; - Number of clients for each service for the period; - Turnover for each type of service for the period	data of local executive bodies in Healthcare sector; local statistics	Pers. Pers. Ths.rub.
5.2	Availability of in-patient beds	$\frac{m}{n} * 10000$, where m – number of hospital beds; n – average annual population	items per 10 ths. pers.
5.3	Popularity rating and availability for the tourists of sanatoriums and health resort and recreation complexes	Methodology [41, 42]	attractiveness of the feature for tourists
6	Sport		
6.1	Availability, variety, capacity of sports facilities	Vij – capacity of the i-th sports facility, which specialized in the j-th sport/sports area of the city	pers.
6.2	Availability and capacity of fan clubs/institutions	i – number of fans' clubs/institutes; Mi – number of participants of the i-th fans' club/institute	items; pers.
7	Urban Industrial, manufacturing and investment potential of the city		
7.1	Rate of entrepreneurial activity	Methodology [49, 50]	%
7.2	Investments' share in fixed assets per capita of GRP	Methodology [49, 50]	%
7.3	Availability and scale of the production clusters	Methodology [51]	Coefficient for each cluster
7.4	Gross regional urban product per capita (for the city)	Official statistics [68,69]	ths.rub.
7.5	The share and volume of annual urban output in reginal/national level	Official statistics [68,69]	% in GRP, % in GDP
7.6	Availability and the amount of high-tech industries	Vi – amount of the i-th high-tech industry [52]	mln.rub.
7.7	Share of profitable enterprises	Official statistics [68,69]	per cent of the total number of businesses
8	Urban conditions		
8.1	Security level	Number of crimes per capita	Items per 1000 pers.
8.2	Development of the transport infrastructure	Methodology [53]	Index
8.3	Population density	$\frac{Na}{St}$, where Na – average annual number of inhabitants in the city, St – city's total area [54]	pers./km^2
8.4	Employment density	$\frac{Np}{St}$, where Np – average annual employment of the city, St – city's total area [54]	pers./km^2
8.5	Human potential	Methodology [55]	indexes
8.6	Development of the tourist infrastructure	Methodology [56, 57] /index of the tourist infrastructure	index
8.7	Average wage per capita	Official statistics [68, 69]	ths. rub
8.8	Quality of Urban Living	Methodology [58, 59]	index
8.9	Housing affordability index	Methodology [60, 61]	index
8.10	Unemployment rate	$\frac{N_i}{Ne_i}$,	%

№	Indicator	Assessing methodology /Indicator source	Unit of measure
		where N_i – number of unemployed in the i-th age group; Ne_i – labour force participation rate in i-th age group [62]	
8.11	Comfort level of the urban environment	Methodology [63]	index

Source: developed by the author taking into account references, which are given in the Table 1

Note, depending on the goals of assessing and increasing the city brand competitiveness, the main branding areas can be supplemented or corrected by managerial decision making persons in this matter. Table 1 proposes quantitative indicators for the city brand competitiveness assessment, detailing it for each city branding area, and the assessment methods for such indicators.

The experience of Russian scientists and international experts was implemented in the process of evaluating various indicators, which were taken into account as quantitative indicators for the city brand competitiveness assessment in the relevant city branding areas.

In addition to the indicators (Table 1), it is necessary to take into account for each city branding area:

- tourism volume (official statistics [68,69], people);
- income volume (official reporting [68,69], thousand rubles);
- investments volume (official reporting [68,69], thousand rubles).

4. Economic-Mathematical Assessment Tool for City Brand Competitiveness

Elaborated by the author, economic-mathematical assessment tool for an industrial entity competitiveness, as well as methodological approaches to evaluating the competitive performance of the industry, serve as the basis for economic-mathematical assessment tool of the city brand competitiveness [64-66].

Furthermore, in accordance with the methodology of the above-mentioned tool development, the private indicators can provide assessments of the conceivable influence of the main areas of city branding on the overall city brand competitiveness. These private indicators represent the coefficients to evaluate the level of city brand competitiveness, reflecting the current state of the main areas of city branding. Such private indicators are the statistic basis for formation of the generalized indicators of city brand competitiveness and serve as a key platform to the efficiency of management decision-making on developing and promoting the city brand, which as a result, lead to boosting the city brand competitiveness.

When selecting the generalized indicators, it is crucial that their content has a certain rational value for studying the city brand competitiveness in various aspects. The generalized indicator captures the convergence within the set of private indicators (total or otherwise determined), taking into consideration the weighty contribution of such private indicators in a given generalized interaction. When selecting the generalized indicators, it is crucial that their private indicators have a certain rational value for studying the city brand competitiveness in various aspects. Furthermore, it is essential to estimate accurately the relevance of the private indicators as components of generalized indicators, from the perspective of building the city brand competitiveness, in the framework of the given generalized indicator.

Thus, we offer the tool to develop a generalized indicator of the city brand competitiveness for each above-mentioned area of city branding, subsequently consisting of the private indicators of the city brand competitiveness. Therefore, the generalized indicator of the specific area of city branding will be named after the area correspondently. Whilst quantitative indicators operate as the private indicators, providing the detailed assessment of the city brand competitiveness on each area of the city branding.

For that matter, the generalized indicators feature the cumulative effect of the private indicators impact and its weighty contribution on building the city brand competitiveness in the appointed area of city branding.

The integrated indicator of the city brand competitiveness, (recording weighty contribution of each generalized indicator involved in the city brand competitiveness) should be identified, when designing the generalized integral assessment of city brand competitiveness in all areas of city branding. It may be stated that the weighty contribution of each generalized indicator is selected according to the order of priority of the specific area of city branding in the process of building the city brand competitiveness.

Therefore, the integrated indicator brings sufficient evidence to draw conclusions regarding the city brand competitiveness, and in case of necessity, aims at improving the efficiency of regulatory decision-making on city branding competition policy, on the basis of the acquired information.

The following approach to identify the referred indicators can be recommended.

As each city brand can be characterized by a certain set of private indicators *S,* affecting its competitiveness, the pending task to be accomplished -is the task to select a brand-sample, while assessing the private indicators. Such a brand sample is intended to be used to compare both the city brand competitiveness indicators and those of a brand-sample, and subsequently, identify the quantitative value of the competitiveness coefficient.

It should be noted, that the issue of results comparability

is significant for making comparison between different city brands competitiveness, as well as for choosing a brand-sample.

To comply with this condition, the city branding areas and the private indicators for each city branding area (see Table 1) would have to coincide for the city brands under comparison.

For instance, in the capacity of the values of brand-sample's competitiveness indicators, can be taken similar indicators' target values of the analyzed city brand. Also, as indicators of a brand-sample, we may include competitiveness indicators of a competitor-city brand, with the best values.

The city brand competitiveness coefficient of the separate characteristic, described by the corresponding private indicator, can be calculated by the formula:

$$K_i = \frac{s_i}{s_{i0}}, \qquad (1)$$

where s_i – value of the i-th analyzed private indicator of the private indicators set $(s_i \in S)$;

s_{i0} – value of the i-th basic private indicator of the sample from its private indicators set $(s_{i0} \in S_0)$;

K_i – competitiveness coefficient for the i-th private indicator.

With regards to calculating the competitiveness coefficient on unemployment rate, we should keep in mind that the dependence would be reverse:

$$K_i = \frac{s_{i0}}{s_i}. \qquad (2)$$

Between formula (1) and formula (2) should select the one that, according to which the growth rate Ki corresponds to an increase competitiveness. Accordingly, in case that the unemployment rate of the assessed city brand is lower than the unemployment rate level of the of a city-competitor, that leads us to the conclusion, that the city brand under speculation is more competitive in the respect of this indicator.

Which should be reflected, conversely, in the formula (2) in form of an inverse of the parameters.

Hence, the following conclusions may be drawn on the subject of the city brand competitiveness coefficient K_i:

- provided that $0 \leq K_i < 1$, then the city brand competitiveness on the s_i-indicator is lower than that of the city-competitor in question;
- provided that $K_i > 1$, then the city brand competitiveness on the s_i-indicator is higher than that of the city-competitor in question;
- provided that $K_i = 1$, then the city brand competitiveness on the s_i-indicator is equal to the city-competitor competitiveness on the same indicator;
- provided that $K_i \approx 0$ on the s_i-indicator then the city brand appears to be non-competitive. Such occurrence would have been completely inadmissible in the process of building the city brand competitiveness, in the framework of the given areas of city branding.

For each s_i indicator under assessment, in the framework of the given areas of city branding competitiveness, coefficient should be strictly above zero: $K_i > 0$. To put it another way, while assessing the city brand competitiveness, the areas of the city branding are selected accordingly, with a view to promote the city brand. Otherwise, we should state that the city brand lacks a precondition for a successful promotion in the market and achieving competitive advantage, due to being non-competitive in at least one of selected areas of the city brand competitiveness assessment. Thereby, while building the city brand competitiveness, that results in creating a «bottleneck» which puts the city brand at risk of losing in the competition.

Generalized indicators for the city branding areas can be calculated by the following formula:

$$Q_j = \sum_{i=1}^{n_j} K_{j,i} \alpha_{j,i}, \qquad (3)$$

where $K_{j,i}$ – competitiveness coefficient for the i-th private indicator, that characterised j-th generalized indicator;

n_j – number of private indicators, that characterised j-th generalized indicator;

$\alpha_{j,i}$ – ratio reflecting the weight (weighting coefficient) of that private indicator $K_{j,i}$ in assessing the city brand competitiveness of using the generalized indicator Q_j;

j – city branding area. For this case $j=1…8$ (see Table 1).

The significance (weightiness) of private indicator, as a rule, is determined by economic laws and described by mathematical dependencies, as well as by an expert and takes values $0 \leq \alpha_i \leq 1$. Moreover, when calculating each of the generalized indicator for weighting coefficients of private indicators, included in this generalized indicator, the condition should be observed:

$$\sum_i \alpha_i = 1. \qquad (4)$$

Hence, we are keen to present, modified by the author, method of hierarchy analysis put forward as a mechanism, which allows to estimate the weighty contribution of the private and generalized indicators the city brand competitiveness.

When applying the method of hierarchy analysis [67], suggested for estimating the competitiveness weighting coefficient, a square matrix of paired comparison is made, where the factor a_i is indicated by w_i as the matrix element: $a_{ij}=w_i/w_j$.

In the proposed application of the method of paired comparison, the ratio of the values of the indicators is determined. It is obvious that $a_{ij}=1/a_{ji}$. Hence, the matrix of paired comparison is a positive definite, inverse symmetric matrix having rank equal to 1.

The proposed version of applying the method of paired comparison, determines the ratio of indicators values. Thus, it becomes obvious that $a_{ij}=1/a_{ji}$. Hence, matrix of paired comparison is a positively definite, conversely to symmetric matrix having rank equal to 1.

Also worth noting is that the pairwise comparisons of

elements are performed proceeding by the aggregate percentage of the listed criteria, within the indicator system provided that w_1, w_2, ..., w_n are not foreknown in advance. In contrast to the method of hierarchy analysis, the pairwise comparisons of elements are not carried out by the experts, given that it would have introduced some degree of subjectivity and uncertainty into the final result. Consequently, the weighty contribution of the indicator has derived from the aggregate share of these criteria within the system. That being the case, the solution to the problem lies in finding the vector $(w_1, w_2, ..., w_n)$. The elements of the paired comparison matrix are summarised by rows (for each value i the sum $a_i = a_{i1} + a_{i2} + ... + a_{in}$ is calculated). After this all a_i are rationed so that their sum is equal to 1. As a result, we manage to accrue the required vector w.

Thus, $w_i = a_i/(a_1 + a_2 + ... + a_n)$.

We also believe that, close attention should be paid to the private indicators of the city brand competitiveness, endowed with the highest weighting coefficients, while analyzing the city brand competitiveness and in the process of shaping the management decision-making on developing and promoting the city brand.

As ultimately such private indicators have proved to make the greatest contribution to building the city brand competitiveness withing the given area.

Based on formula (4) the level of the integrated city brand competitiveness can be calculated:

$$K_I = \frac{\sum_{i=1}^{N} Q_i \alpha_i}{\sum_{i=1}^{N} \alpha_i}, \qquad (5)$$

where Q_i – the i-th generalized indicator of the city brand competitiveness;

α_i – weighting coefficient of the i-th generalized indicator of the city brand competitiveness;

N – number of significant generalized indicators of the city brand competitiveness.

And the condition should be observed here too:

$$\sum_{i=1}^{N} \alpha_i = 1. \qquad (6)$$

Obviously, the purpose of the city is to achieve such values of generalized indicators of the city brand competitiveness, which satisfy the condition

$$K_I \to \max. \qquad (7)$$

The above mathematical dependences of the definition of the city brand competitiveness allow to take into account systematically the effect of all private and generalized indicators for achieving the purposes of improving the city brand competitiveness:

$$\begin{cases} K_i > 0, (i = 1, ..., N_1) \\ Q_i = \sum_{i=1}^{n(i)} K_i \alpha_i, (i = 1, ..., N_2) \end{cases}$$

$$K_I = \frac{\sum_{i=1}^{N_2} Q_i \alpha_i}{\sum_{i=1}^{N_2} \alpha_i} \to \max \qquad (8)$$

where K_i – city brand competitiveness coefficient for the i-th private indicator;

N_1 – number of private indicators of the city brand competitiveness;

Q_i – the i-th generalized indicator of the city brand competitiveness;

N_2 – number of generalized indicators of the city brand competitiveness;

α_i – weighting coefficient of the city brand competitiveness coefficient K_i;

$\sum_{i=1}^{n(i)} \alpha_i = 1$ for any generalized indicator Q_i;

$n(i)$ – number of private indicators of the city brand competitiveness in the i-th generalized indicator;

K_I – integrated indicator of the city brand competitiveness;

$\sum_{i=1}^{M} \alpha_i = 1$ for integrated indicator K_I.

5. Example of Using the Economic-Mathematical Assessment Tool for City Brand Competitiveness

By way of illustration, we cite an assessment of generalized indicators of the urban conditions' competitiveness on the example of Yekaterinburg city and Tyumen city, for the subsequent comparison and for drawing conclusions on the competitiveness of urban conditions for these two cities.

Table 2 presents both basic values and the values of indicators of urban conditions' competitiveness for Yekaterinburg city and Tyumen city (depending on the identification conditions of the relevant indicator of the table in Sverdlovsk and Tyumen regions, respectively). As a case study for calculation, the basic values here were provided within the maximum/minimum values for Russia, disregarding the comparability of the regions under consideration (formulas 1 and 2).

For a given evaluation example, the weighting coefficients of the indicators are assumed conditionally.

In this case, must be met the condition of equality of the sum of the weighting coefficients to one for a specific generalized indicator (formula 6):

$$\sum \alpha_i = 0,09 + 0,09 + 0,08 + 0,09 + 0,1 + 0,09 +$$
$$+0,09 + 0,1 + 0,1 + 0,08 + 0,09 = 1$$

Table 2.   Indicators of urban conditions' competitiveness for Yekaterinburg city and Tyumen city

№	Indicator	Unit of measure	Indicator weighting for the assessment, α_i	Yekaterinburg city (Sverdlovsk region), s_{1i}	Tyumen city (Tyumen region), s_{2i}	Basic indicator (of brand-sample), s_{i0}	The region of the basic indicator
1	Security level [70]	items per 1000 pers.	0,09	92,1	119	12,5	Chechen Republic
2	Development of the transport infrastructure [71]	index	0,09	3,17	3,34	7,24	Moscow region
3	Population density [72]	pers./km^2	0,08	22,19	9,6	4956,1	Moscow
4	Employment density [73,74]	pers./km^2	0,09	1902,3	688,8	2950,5	Moscow
5	Human potential [75]	indexes	0,1	0,864	0,866	0,931	Moscow
6	Development of the tourist infrastructure [76]	index	0,09	91,8	90,8	120,3	Krasnodar Territory
7	Average wage per capita [77]	ths. rub	0,09	48590	72 367	120120	Chukotka Autonomous Area
8	Quality of Urban Living [78,79]	index	0,1	58,13	77,39	79,5	Moscow
9	Housing affordability index [80]	index	0,1	7,7	6,4	2,3	Magadan region
10	Unemployment rate [81]	%	0,08	3,7	3,6	1,5	St. Petersburg
11	Comfort level of the urban environment [82]	index	0,09	203	233	293	Moscow

Generalized indicator on urban conditions for Yekaterinburg city (Sverdlovsk region) according to the formula (3) is:

$$Q_{cityconEk} = 0{,}09 \cdot \frac{12{,}5}{92{,}1} + 0{,}09 \cdot \frac{3{,}17}{7{,}24} + 0{,}08 \cdot \frac{22{,}19}{4956{,}1}$$

$$+0{,}09 \cdot \frac{1902{,}3}{2950{,}5} + 0{,}1 \cdot \frac{0{,}864}{0{,}931} + 0{,}09 \cdot \frac{91{,}8}{120{,}3}$$

$$+0{,}09 \cdot \frac{48590}{120120} + 0{,}1 \cdot \frac{58{,}13}{79{,}5} + 0{,}1 \cdot \frac{2{,}3}{7{,}7}$$

$$+0{,}08 \cdot \frac{1{,}5}{3{,}7} + 0{,}09 \cdot \frac{203}{293} = 0{,}5057$$

Generalized indicator on urban conditions Tyumen city (Tyumen region), according to the formula (3) is:

$$Q_{citycon\ T} = 0{,}09 \cdot \frac{12{,}5}{119{,}0} + 0{,}09 \cdot \frac{3{,}34}{7{,}24} + 0{,}08 \cdot \frac{9{,}6}{4956{,}1}$$

$$+0{,}09 \cdot \frac{688{,}8}{2950{,}5} + 0{,}1 \cdot \frac{0{,}866}{0{,}931} + 0{,}09 \cdot \frac{90{,}8}{120{,}3}$$

$$+0{,}09 \cdot \frac{72367}{120120} + 0{,}1 \cdot \frac{77{,}39}{79{,}5} + 0{,}1 \cdot \frac{2{,}3}{6{,}4}$$

$$+0{,}08 \cdot \frac{1{,}5}{3{,}6} + 0{,}09 \cdot \frac{233}{293} = 0{,}5255$$

The conducted assessment leads to the conclusions that Tyumen city has a higher level of competitiveness for urban conditions.

Within Tyumen city, more attractive conditions have been created for:

- development of the transport infrastructure,
- average wage per capita,
- quality of Urban Living,
- housing affordability,
- unemployment rate
- comfort level of the urban environment.

In the case of certain managerial decisions of the city authorities are taken, a change of a particular urban condition indicator for Yekaterinburg city will give a clear picture of the change in the generalized indicator of competitiveness for urban conditions. That could also be applied when comparing the level of competitiveness in a certain branding areas of Yekaterinburg city and Tyumen city.

Having executed the assessment of the generalized indicators, in this manner, for all areas necessary for the city brand competitiveness study, it is possible to calculate the integral indicator of the competitiveness of the city brand (formula 8).

6. Conclusions

Based on the research of various sources, we can confidently conclude that the quantitative indicators system of the city brand competitiveness, presented in the article, has no analogues. While assessing the city brand competitiveness, the analysis of all city branding areas is conducted, whereas each city branding area is followed by a detailed elaboration with quantitative indicators. Thus,

the incorporation of quantitative indicators provides a systematic assessment of the city brand competitiveness, giving attention to all aspects of building the city brand competitiveness. Such indicators, in a sufficient amount, is the detailed and exhaustive statistics base, ideally qualified to carry out such an assessment.

Elaborated by the author, economic-mathematical assessment tool provides the opportunity to explicate the level of the city brand competitiveness, using a quantitate and systematic approach to evaluating the city brand competitiveness, with due regard for all the factors affecting, in various areas of city branding.

Therefore, such analysis allows to identify strong and weak sides of the city brand competitiveness and serves as a key platform to the efficiency of management decision-making on regulation and promoting the city brand on the particular indicators or the branding area.

The objectivity of the city brand competitiveness assessment is firmly adhered through consideration the weighty contribution (weight) of each specific indicator of the city brand competitiveness in the shaping of a generalized indicator for each city branding area, as well as the weighty contribution (weight) of each generalized indicator including each branding area in the integrated – general – assessment of the city brand competitiveness.

Furthermore, comparing the values of individual indicators, with the selected basic values of a similar brand-sample indicators, provides a more objective assessment of competitiveness.

The objectivity of the assessment here is ensured by the fact that the target values of each indicator or the best values of similar indicators of a brand of a city-competitor can be taken as the base values.

Thus, the comparison of values will reveal the proximity or lag of indicator values from similar target values or advancements of a more successful brand. Moreover, it is possible to conduct the same competitiveness assessment and analysis in particular for a brand-competitor.

Thus, the unique competitive advantages of a brand-competitor identified in the structured and targeted manner through evaluation and analysis will allow to benefit from the experience of a competitor, while building the city brand under examination.

The presented economic-mathematical tool of the overall assessment of city brand competitiveness, including the specific and generalized indicators, offers insight with regards to the responsiveness of the overall city brand competitiveness to adjustments in certain specific or generalized indicators of the city brand competitiveness. And this, in turn, will provide assistance for the identification the specific city branding area, and highlight the detail, affecting the results of assessments of the city brand competitiveness level to a greater or lesser extent. This means that the conducted analysis will reveal what impact will have any possible adjustments to the current city branding areas on the overall city brand competitiveness. As a consequence, such approach gives you a more precise and objective final assessment of the city brand competitiveness.

The article shows that the mathematical functional description of interrelations between private and generalized indicators of the city brand competitiveness, will illustrate quantitatively the impact of bringing changes in one indicator of the branding area, in the way it affects the other and as a result the influence of such adjustments on the city brand competitiveness. Ultimately, such functional interrelations facilitate to detect the criticality of such adjustments for the city brand competitiveness.

As a final point, we would like to summarize that all the aforementioned will determine the policy for the well-timed management decision-making on achieving the required values of competitiveness indicators, by means of identifying and promptly eliminating the «bottleneck» of the city brand competitiveness, brining progress to streamline activities and thus, undoubtedly, resulting in boosting the city brand competitiveness.

Presented in this article economic-mathematical mechanism, elaborated for assessing a city brand competitiveness, may serve as efficient tool to those making managerial decisions on promoting the city brand by designing a unique strategy and tactics for increasing the city brand competitiveness, while retaining competitive advantages of a city, and also preventing the losses of position in rapidly changing conditions and in times of crisis.

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