

How University Acts in the Development of “Smart Cities”

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Abstract. “Smart city” is a new model of territorial development, taking into account the growing importance of information, innovation and human capital. One of the main elements of the “smart city” is a developed system of higher education. The aim of this work was to study the impact of higher education on “smart” and innovative cities. The objectives of this work were to obtain quantitative characteristics of the impact of the University on the smart city. Approach to solving this problem was to build indicators based on indicators that characterize the quality of life, and ratings to compare cities on their basis. The hypothesis of the study is that the higher education system has a positive impact on the development of smart and innovative cities. A theoretically justified method of constructing an indicator of a certain direction of socio-economic development is a component analysis of indicators characterizing this direction. As a result, the rankings of Russian and foreign cities based on the characteristics of quality of life, which prove that education is a key indicator of the development of “smart” and innovative cities.

Keywords: “smart city”, University, territorial development, innovation.

1 Introduction

The growing role of the knowledge economy in strengthening the competitiveness of cities and improving the quality of life of the population is based on the development of innovation. The problem is that innovation processes, although global in nature, can take place outside the borders of a particular region. Therefore, the potential of cities and regions largely depends on the level of development of the regional innovation system.

2 Methods

Analyzing regional innovation systems Asheim and Isaksen focus on the role of innovation space consisting of business, universities, research centers and institutional conditions that ensure their interaction [1]. The authors also emphasize that regional development largely depends on external interactions, access to global channels of reproduction of advanced achievements of world science, their dissemination and implementation in innovative products and services.

Islankina E.A. and Fiyaksel E.A. emphasize that the regional innovation system includes the subsystems of production and consumption of knowledge which are in interaction under the influence of supply and demand for the results of intellectual activity, the prevailing institutional conditions and practices of state regulation. At the same time, the regional innovation system is open to interaction with the external environment through global research networks, in which knowledge is disseminated and trained, as well as global production networks, through which investments are attracted to the region, and local companies enter the markets [2].

In the field of research of the regional innovation system, a model of a “smart city” has been formed and received wide worldwide distribution. The idea of a “smart city” implies the presence of a localized infrastructure facility that combines the interaction of such structures as the state, business and science. The city uses innovative technologies, provides high quality of life of people on the basis of development of technologies and improvement of ecology of environment. The concept of “smart city” involves the formation of an institutional environment conducive to the creation and dissemination of innovations in all spheres of life.

An important role for a smart city is the interaction and connection of the efforts of government, business and science. A special role for the development of innovative economy, achieving economic growth and accelerating scientific and technological progress in the interaction of the three structures (government, business and science) has already been noted in his works by Henry Itzkowitz [3]. He calls this interaction a triple helix, noting that universities have a leading role in building such cooperation. Itzkowitz believes that cities with several universities can become generators of innovation-smart cities. Thus, the aim of this work is to quantify the impact of higher education on the development of smart cities.

3 Analysis of international experience in “smart city” development

At the moment, there are about 143 smart city projects in the world [4] – implemented and still in the project stage. Most of these cities are now present in North America and Western Europe, but many projects have been created in Eastern Europe, Latin America, the middle East and even in Russia.

The aim of this work was to obtain quantitative characteristics of the impact of the University on the smart city. To achieve this goal, Spearman's comparative analysis, ranking and rank correlation coefficient were used. International experience is the most pronounced and amenable to analysis. The most striking examples of smart cities can be called only 20 in the world, they are worthy of the status of "smart city".

The World Council on City Data (WCCD) on its website provides a fairly wide range of innovative standardized indicators of cities [5]. For each innovative city, information is provided for several years (2014-2017), the list of indicators follows the ISO standard 37120:2014 "Regime of Sustainable development of the Russian community. The indicators of the city services and quality of life" [6]. 11 cities were selected for the study, among which 4 are considered "smart" cities (Melbourne, London, Toronto and Amsterdam), and the remaining 7 are developing smart cities (Boston, Dubai, Buenos Aires, Makati, Guadalajara, Amman, Mecca). Data for 11 cities for 2014 and 2015 were selected for the analysis. The collected data make it possible to make a ranked rating of a sample of cities for the whole set of indicators, for this purpose calculations for all blocks of collected indicators are carried out. Ranks are defined for each indicator in the work. These ranks are averaged over a set of indicators. Using the values of the averaged ranks, the rating of the sample of cities is constructed (table 1).

Table 1. List of smart and developing cities in the world

City	Country
Melbourne	Australia
London	Great Britain
Amsterdam	Netherlands
Boston	USA
Toronto	Canada
Buenos Aires	Argentina
Dubai	UAE
Guadalajara	Mexico
Amman	Jordan
Makati	Philippines
Mecca	Saudi Arabia

Source: Authors.

A natural approach to solving this problem is to build indicators based on indicators that characterize the quality of life, and ratings for comparing cities on their basis. A theoretically substantiated method of constructing an indicator of a certain direction of socio-economic development is a component analysis of indicators characterizing this direction. The most complete methodology of its application and the results of testing in assessing the quality of life are presented in [7]. Further indicators are based on 106 indicators of quality of life standard ISO 37120: 2014. All these indicators are relative and comparable for cities of different scales and different countries. Therefore, a simplified heuristic approach is used to construct the indicator for the entire set of indicators. At the first stage on the basis of the economic theory indicators for which the desirable direction of their change is known are revealed. For example, an increase in the proportion of the urban population provided with wastewater services or a decrease in the mortality rate of children under 5 years per 1,000 live births indicate an improvement in the quality of life. For each of these indicators, the ranks of the cities selected for comparison are determined. The indicator is plotted as the sum of ranks for all indicators. If for some indicator, for example, "number of firefighters per 100 000 inhabitants", the desired direction of its change is not known a priori, the correlation coefficients of the indicator with the already built indicator are calculated to identify it. After that, the ranks of cities are determined by this indicator and included in the indicator. On the basis of the constructed indicator the rating of cities on set of indicators is constructed.

In order to build ratings that take into account Russian cities, it is necessary to select from a total of 106 indicators such as those presented in the statistical reports of the Russian Federation. At the first stage of solving this problem, out of 106 indicators were selected those that are most correlated with the indicator. Indicators with correlation coefficients above 0.7 list further.

Spearman rank correlation coefficient:

20.1 Share of urban population provided with wastewater disposal services – 0,9146

12.1 Life expectancy – 0,9035

16.4 Proportion of municipal solid waste disposed of in organized landfills – 0,8875

6.7 Tertiary education rate per 100,000 inhabitants – 0,8712

18.1 High-capacity public transport system mileage per 100,000 inhabitants – 0,8444

13.2 Area of outdoor public recreation areas per capita – 0,8425

8.2 Suspended particle concentration (PM10) – 0,8293

- 12.4 Under-5 mortality rate per 1,000 live births – 0,8276
- 6.5 Percentage of male school-age population enrolled in educational institutions – 0,8161
- 4.7 GDP per capita – 0,8147
- 21.3 Proportion of urban population with access to quality facilities – 0,8127
- 12.3 Number of doctors per 100,000 inhabitants – 0,7961
- 6.6 Percentage of school-age population enrolled in educational institutions – 0,7878
- 14.3 Crimes against property per 100,000 – 0,7797
- 15.2 Number of homeless persons per 100,000 inhabitants – 0,7728
- 12.2 Number of hospital beds per 100,000 inhabitants – 0,7696
- 16.3 Proportion of municipal solid waste that is recycled – 0,7623
- 15.1 Percentage of urban population living in slums – 0,7523
- 7.2 Percentage of urban population with authorized electricity connections – 0,7477
- 5.6 Number of business entities per 100 000 people – 0,7454
- 21.1 Proportion of urban population connected to drinking water supply – 0,7394
- 10.1 Number of firefighters per 100,000 inhabitants – 0,7203

Further, five of these indicators were selected to build a combined rating of foreign and Russian cities. The main selection criterion was the availability of data on these indicators for all the cities under consideration for 2014 and 2015.

- 5.6. number of business entities per 100 000 people;
- 12.1 life expectancy;
- 12.2 number of hospital beds per 100,000 population;
- 12.3 number of doctors per 100,000 inhabitants;
- 6.7 tertiary education rate per 100,000 inhabitants

To check the informativeness of the selected indicators, ratings of foreign cities were built on four indicators (5.6, 12.1, 12.2, 12.3) according to 2014 (see column 3 of table 2) and 2015 (column 5 of table 2). The rank correlation coefficient of the 2014 ratings for 106 indicators (column 2 of table 2) and 4 indicators (column 3 of table 2) is 0.9273. The rank correlation coefficient of the 2015 ratings for 106 indicators (column 4) and 4 indicators (column 5) is 0.9364. For the period under consideration, the selected indicators are sufficiently informative to be used for building ratings.

Table 2. Ranks of foreign "smart" cities by indicators of ISO 37120:2014

№	Rating 2014 (106 indicators)	Rating 2014 (4 indicators)	Rating 2015 (106 indicators)	Rating 2015 (4 indicators)
(1)	(2)	(3)	(4)	(5)
1	Melbourne	Melbourne	Melbourne	Melbourne
2	London	Boston	Amsterdam	Boston
3	Amsterdam	London	London	London
4	Boston	Amsterdam	Boston	Amsterdam
5	Toronto	Buenos Aires	Toronto	Buenos Aires
6	Buenos Aires	Toronto	Dubai	Toronto
7	Dubai	Dubai	Buenos Aires	Dubai
8	Guadalajara	Makati	Amman	Makati
9	Amman	Amman	Mecca	Amman
10	Makati	Guadalajara	Guadalajara	Guadalajara
11	Mecca	Mecca	Makati	Mecca

Source: Authors.

0.9273 - Spearman rank correlation coefficient rankings 2014

0.9364 - Spearman rank correlation coefficient rankings 2015

Then there was built the combined ratings for the selected Russian and foreign cities on 4 indicators: column 2 of table 3 for 2014. and column 4 of table 3 for 2015. In is normal that the relative position of foreign cities in the ratings for 4 indicators in tables 2 and 3 coincides. In the 2014 ranking of four indicators, all four Russian cities occupy adjacent positions in the middle part, taking into account indicator 6.7 "share of higher education per 100 000 inhabitants". In the 2015 ranking, Moscow and St. Petersburg maintain their positions on four indicators. Kazan and Tomsk slightly worsen them. In the rankings for 5 of the indicators of higher education regarding the state of Russia's cities is improving for 2014 and 2015 In the last row of table 4 shows the sum of ranks of four Russian cities in each of the ratings. Indicator 6.7 improves the position of Russian cities in the ratings of 2014 by an average of 0.5 points, in the ratings of 2015-by 0.25 points.

Table 3. Ranks of foreign and Russian "smart" cities by 4 selected indicators without taking into account the characteristics of education.

№	Rating 2014 (4 indicators)	Rating 2014 (5 indicators)	Rating 2015 (4 indicators)	Rating 2015 (5 indicators)
(1)	(2)	(3)	(4)	(5)
1	Melbourne	Melbourne	Melbourne	Melbourne
2	Amsterdam	Boston	Amsterdam	Boston
3	Boston	Moscow	Boston	Amsterdam
4	London	Saint-Petersburg	London	Moscow
5	Moscow	Amsterdam	Moscow	London
6	Saint-Petersburg	London	Saint-Petersburg	Saint-Petersburg
7	Kazan	Kazan	BuenosAires	Toronto
8	Tomsk	Toronto	Kazan	Kazan
9	BuenosAires	BuenosAires	Toronto	BuenosAires
10	Toronto	Tomsk	Tomsk	Tomsk
11	Dubais	Dubai	Dubais	Dubai
12	Makati	Makati	Makati	Makati
13	Amman	Guadalajara	Amman	Guadalajara
14	Guadalajara	Amman	Guadalajara	Amman
15	Mecca	Mecca	Mecca	Mecca
The sum of the ranks of cities of the Russian Federation	26	24	29	28

Source: Authors.

Improvement in 2014 on $(26-24)/4 = 0.5$

Improvement in 2015 on $(29-28)/4 = 0.25$

4 Conclusion

1. The results of the constructed ranks, led to the conclusion that education is a key indicator of the development of not only smart cities but also innovative cities.
2. Spearman's rank correlation coefficient showed that in order to compile the rating according to the ISO standard 37120:2014, it is possible to use not the whole set of 106 indicators, but a number of indicators that were obtained with maximum values.
3. In the considered sample there is a positive relative effect of the higher education index influence on the rating of the city development level.
4. The positive influence of the University on the development of Russian "smart" cities is traced.

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