Foreign experience of the development of territories with uneven landscape

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Abstract. The article presents the results of a study of foreign practices of "smart" city concept implementation in territories with uneven landscape. Territories located in the foothills with a significant height difference from 0 to 600 meters above sea level are considered as territories with an uneven landscape. The study addresses the problem of assessing the management readiness level of cities to determine relevant experience for its implementation in the Russian Federation. The authors of the study developed seven criteria for assessing the readiness of cities to implement the "smart" city concept, using the elaborated method of the management readiness level determination. The study was conducted on the basis of an expert assessment of criteria and subsequent ranking of cities according to their integral indicators. The authors conclude that due to the similarity of the geographical and demographic characteristics of Bilbao and Cuenca with the regions of the North Caucasus, as well as the high management readiness level of these cities, their experience is applicable to the Russian Federation.

Keywords: smart city, strategic planning, municipal administration, spacial development, territories with uneven landscape

1 Introduction

Spatial development is a comprehensive approach to the challenges of urban growth, investment attraction and innovative technological solutions of implementation in order to improve the citizens quality-of-life (Dou et al., 2020).

The first task of the executive and representative bodies of local government in the development of territories and implementation of the "smart" city concept is to adapt management mechanisms to the changing environment and the ability to accumulate and evaluate information about the region (Kamolov, 2019).

The second task after achieving a sufficient level of adaptation of the management system mechanisms to the specific conditions of the region is the development and adoption of a formalized strategy for socio-economic development of the region or city (Baltac, 2019). The development of the strategy must be accompanied by the definition of resources for further change, which includes determining the budget, infrastructure and staff involved in the implementation of the prescribed activities (Knyazeva, 2020). The setting of the main goals and objectives of the territory development, supported by a rational assessment of the readiness of management systems, as well as the elaboration of a formalized socio-economic development strategy indicates the achievement of a certain level of managerial readiness of the local administration (Kamolov, 2021).

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At the moment, the scientific discourse does not define of the term "management readiness level". However, the term "technology readiness level" is widely used in the scientific literature, its definition includes elements of management and organizational readiness.

The the concept of "technology readiness levels" was first introduced by the National Aeronautics and Space Administration (NASA), which defined it as a system of indicators to assess the readiness to implement a particular technology and provide a consistent comparison of the readiness of different types of technologies (Mankins, 1995). The assessment model involves basic research of new technologies and concepts, as well as the technologies development with specific application objectives.

Russian scientists also have been made attempts to apply this methodological approach to assess a broader range of technology readiness and technological projects aspects. For example, TPRL (Technology Project Readiness Level) is used to assess technology project readiness levels and it covers six main areas (Petrov et al., 2016):

1. Technology Readiness Level;
2. Manufacturing Readiness Level;
3. Engineering Readiness Level;
4. Organizational Readiness Level;
5. Business Readiness Level;
6. Commercialization Readiness Level.

Organizational readiness allows to determine the readiness level of the management system in decision-making process, through the formulation of tasks, assessment of resources, discussion and preparation of measures together with all stakeholders. Scientific expertise is defined as an integral part of the development of strategies to implement innovative solutions. In this regard, one of the most important criteria is the availability of documentation that records the plan and results of the work performed.

It seems necessary to consider how urban development strategies are implemented in a very specific territory, but important for the Russian Federation – they are territories with uneven landscape. Territories with uneven landscape are defined as territories generally located in the foothills with a significant height difference in the range from 0 to 600 meters above sea level, requiring the use of special urban solutions in the complex projects of spatial development (Gerrard, 2014).

The main criteria for selecting cities for the study were demographic and geographic characteristics. The study considered cities with a population of 50,000 to 100,000 people, as well as larger cities with a population of 100,000 to 350,000 people.

In terms of geographical characteristics, cities were selected on the basis of the following criteria:

1. Mountain areas or foothills
2. Cities located between the 40th and 50th parallel of north

Thus, the following cities were studied (Table 1):

Table 1. Cities under study. Source: compiled by authors.

City	Area	Population	HDI
Vladikavkaz (Russia)	291 km²	300,000	0,807
Bilbao (Spain)	40,6 km²	350,000	0.934
Cuenca (Spain)	911 km²	53,000	0.869
Podgorica (Montenegro)	108 km²	174,000	0.838
L'Aquila (Italy)	466 km²	69,000	0.889
Pistoia (Italy)	236 km²	90,000	0.907

Structural analysis of cities was made by examining and comparing the area, population, and the Human Development Index (HDI), elaborated and compiled by the United Nations to measure the social and economic development of countries and regions. Bilbao has the smallest area in the sample of cities (40,6 km²), being the most densely populated city (350,000 people). Cuenca is the largest city (911 km²), with a population of 53,000. The HDI of the selected cities is, on average, high.

2. Materials and Methods

The main purpose of the study is to develop a methodological approach to determine management readiness levels of cities located in areas with uneven landscape, in respect of the "smart" city concept implementation, and to identify relevant practices for application in the Russian Federation. **The object** of the study is the development strategies of cities located in areas with uneven landscape. **The subject** of the research is a set of organizational and economic measures that ensure managerial readiness of the region to implement the concept of "smart" city.

The empirical basis of the study is strategies for socio-economic development of cities, as well as statistical data on the population of the selected cities.

The research methodology is based on the method of expert assessment, the method of analogy, based on the analysis of definitions of management and organizational readiness, the comparative method, as well as the method of ranking cities according to the integral indicator. The integral indicator is calculated as **the sum of the products** of the scores assigned to each of the seven criteria identified in the course of the research, and their corresponding weighting coefficients, reflecting the degree of importance of the criterion in the overall assessment of the city management readiness to implement the concept of "smart" city.

3. Results

In order to determine the region's readiness to implement the "smart" city concept, it is necessary to analyze the existing strategic planning documents (Popov & Semyachkov, 2020). A strategic planning document is a long-term roadmap that includes a set of specific goals, objectives and activities (DiNapoli, 2002). Thus, it can be argued that a strategic planning document reflects a rational decision-making process that requires clearly defined timeframes, financial resources and key performance indicators (Cities Alliance, 2011).

In this study, the assessment of key performance indicators (KPIs) was based on the handbook " Collection Methodology for Key Performance Indicators for Smart Sustainable Cities", prepared by the United for Smart Sustainable Cities (U4SSC) working group with the support of the International Telecommunication Union (ITU). The document identifies 91 KPI in three areas: economy, environment, society and culture (UNECE, 2017). Methodological recommendations for the definition of key performance indicators include the rationale for the choice of indicators, the interpretation of indicators, and it also reflects the methodology for calculating quantitative sub-indicators in the three areas (Vukovic et al., 2021).

In the course of the study, the strategies of socio-economic development were analyzed for each city included in the sample. The analysis of definitions of management readiness made it possible to identify criteria in the performance of management systems. Each strategy was evaluated on the basis of these criteria:

1. Strategic planning document (criterion K1);
2. Clear planning horizon (criterion K2);
3. Responsible agency (criterion K3);
4. Scientific support (criterion K4);
5. List of activities in the strategy (criterion K5);
6. Data on the allocated budget (criterion K6);
7. Compliance of the KPIs with the U4SSC methodology (criterion K7).

The assessment was done by assigning a score to each criterion ranging from 0 to 10. Where 0 means no criterion that can get a score, 10 reflects the highest score the city can get. The assessment of the criterion "Strategic planning document" reflects the volume of the document, the depth of elaboration of the tasks and the detalization of the statements. The criterion "Clear planning horizon" was evaluated on the basis of the long-term character of the strategic planning document and the possibility of implementing activities within a limited time frame. "Responsible agency" was considered in terms of the involvement of a specialized agency of the executive branch in the process of strategy formulation and activities implementation. The presence of a scientific component and the participation of expert groups in the development of the document was reflected in the "Scientific support". The highest score for the "List of activities in the strategy" was given to cities whose strategies reflected the programming phase. The presence of detailed budget parameters for all activities was evaluated as part of the "Data on the allocated budget" criterion. The assessment of the criterion " Compliance of the KPIs with the U4SSC methodology " was based on the compliance of key performance indicators with U4SSC methodology, taking into account the recommendations for the selection of indicators, interpretation of indicators and calculation of sub-indicators. The results of this work are given in Table 2.

Table 2. Criteria scoring. Source: Compiled by the authors based on strategic planning documents of the cities of Bilbao [2], Cuenca [4], Vladikavkaz [13], L'Aquila [11], Pistoia [15] and Podgorica [16].

	Bilbao	Cuenca	Vladikavkaz	L'Aquila	Pistoia	Podgorica
Criteria	Score					
Strategic planning document	10	10	5	9	6	7
Clear planning horizon	10	10	10	10	10	10
Responsible agency	9	10	5	7	8	7
Scientific support	8	7	0	7	6	6
List of activities in the strategy	10	10	6	8	0	8
Data on the allocated budget	10	10	0	9	0	10
Compliance of the KPIs with the U4SSC methodology	10	10	3	0	0	0

According to the weighting coefficient formula, we assign weights to each of the established criteria (Table 3). To determine the weighting coefficient, we used the formula for calculating the weighting coefficient (1), where **k** is the weighting coefficient of the criterion, **S** is the score obtained for each criterion.

$$k = \frac{\frac{1}{(|S_{1\ldots n}|+1)}}{\frac{1}{(|S_1|+1)}+\frac{1}{(|S_2|+1)}+\ldots+\frac{1}{(|S_n|+1)}} \quad (1)$$

Table 3. Weighting coefficient of the criteria. Source: compiled by the authors.

	Bilbao	**Cuenca**	**Vladikavkaz**	**L'Aquila**	**Pistoia**	**Podgorica**
Criteria	Weighting coefficient of the criteria					
Strategic planning document	0,136	0,135	0,059	0,06	0,04	0,074
Clear planning horizon	0,136	0,135	0,032	0,054	0,025	0,053
Responsible agency	0,152	0,135	0,059	0,075	0,03	0,074
Scientific support	0,168	0,188	0,355	0,075	0,04	0,084
List of activities in the strategy	0,136	0,135	0,051	0,067	0,28	0,065
Data on the allocated budget	0,136	0,135	0,355	0,06	0,28	0,053
Compliance of the KPIs with the U4SSC methodology	0,136	0,135	0,089	0,605	0,28	0,59

In accordance with the method of expert assessment, we determine the integral indicator of the readiness level for each criterion for each city (Table 4).

Table 4. Integral indicator of the readiness level. Source: compiled by the authors

	Bilbao	**Cuenca**	**Vladikavkaz**	**L'Aquila**	**Pistoia**	**Podgorica**
Criteria	Total score					
Strategic planning document	1,36	1,35	0,295	0,54	0,24	0,518
Clear planning horizon	1,36	1,35	0,32	0,54	0,25	0,53
Responsible agency	1,368	1,35	0,295	0,525	0,24	0,518
Scientific support	1,344	1,316	0	0,525	0,24	0,504
List of activities in the strategy	1,36	1,35	0,306	0,536	0	0,52
Data on the allocated budget	1,36	1,35	0	0,54	0	0,53
Compliance of the KPIs with the U4SSC methodology	1,36	1,35	0,267	0	0	0
Integral indicator	9,49	9,42	1,48	3,206	0,97	3,12

As a result of the assessment of cities, three levels of management readiness of cities to implement the concept of "smart" city were identified.

"Level 1" reflects the readiness of the cities according to the first four evaluation criteria, namely the presence of a strategic planning document, the responsible agency, scientific support and a list of activities in the strategy. The cities that did not reflect the data on the programming stage and budget parameters were included in this group. Such cities are Pistoia and Vladikavkaz. The range of integral indicators is from 0.97 to 1.48.

"Level 2" includes "Level 1" + data on allocated budget and a clear planning horizon. The second group includes L'Aquila and Podgorica, due to the lack of fixed performance and efficiency indicators. The range of integral indicators is from 3.12 to 3.206.

The cities that meet all seven criteria are in "Level 3". The third group includes the Spanish cities of Bilbao and Cuenca. The range of integral indicators is from 9.42 to 9.49.

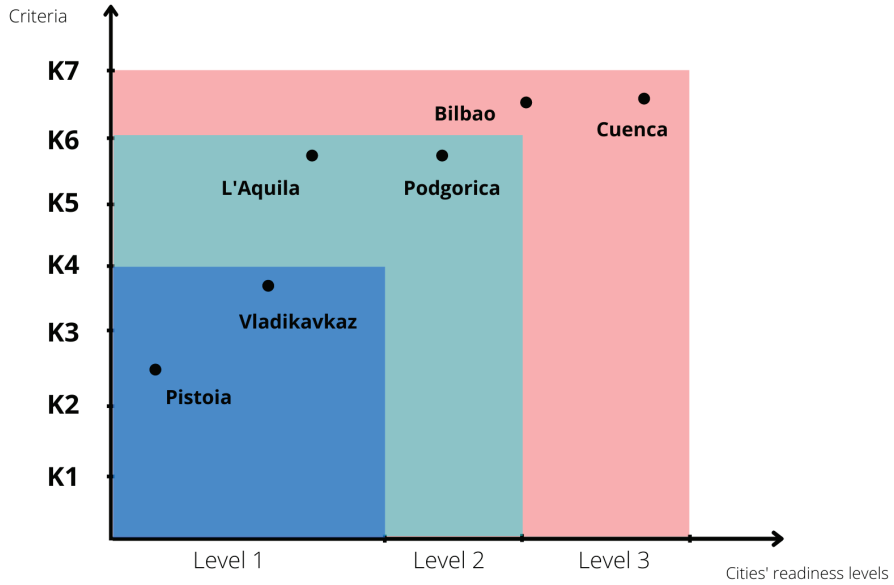

Figure 1. Cities' readiness levels. Source: compiled by the authors.
The symbols of the indicators correspond to the list of developed criteria.

4. Discussion

Currently, the term "management readiness" is considered as part of the system to evaluate the level of technology readiness. We have found that modern authors do not analyze the readiness of management systems in the implementation of the concept of "smart" city, which raises the need to identify the main criteria to assess the degree of involvement of cities in the development and digitalization of urban space.

As a result, the cities assessment, Vladikavkaz and Pistoya showed the lowest level of managerial readiness to implement the concept of "smart" city. During the study of Vladikavkaz's strategy, it was not possible to obtain data on two out of seven indicators: "Scientific support" and "Data on the allocated budget", due to their absence (Ministry of Economic Development of the Republic of North Ossetia-Alania, 2019). The three criteria for evaluating the city of Pistoia, i.e, "List of activities in the strategy", "Data on the allocated budget" and "Compliance with the KPIs methodology U4SSC" were assigned 0 points (Pistoia Council, 2020).

The study shows that the Spanish cities - Bilbao and Cuenca showed the highest degree of management readiness to implement the concept of "smart" city. Bilbao received the highest score of five out of seven criteria (Bilbao Council, 2019). The city of Cuenca had the highest score of six out of seven indicators (Cuenca Council, 2017).

5. Conclusion

By determining the management readiness levels and analyzing cities according to the developed criteria, we could recommend the experience of the cities of Bilbao and Cuenca as the most relevant practices for application in the Russian Federation, due to the similarity of geographical and demographic characteristics. The practical significance of this research lies in the possibility of using its results by the executive and representative authorities at the stages of goal-setting, planning and programming strategies for the development of the concept of "smart" city. The results of the study can be useful for Russian cities with similar geographical and demographic characteristics: Kislovodsk, Essentuki, Pyatigorsk, Cherkessk and Nalchik.

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