

**CDSSES 2020****IV International Scientific Conference "Competitiveness and the development of socio-economic systems" dedicated to the memory of Alexander Tatarkin****SMART CITIES DEVELOPMENT INDICES**

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(a) Ural Institute of Management, RANEPa, 66, 8 Marta st., Ekaterinburg, Russia, [epopov@mail.ru](mailto:epopov@mail.ru)(b) Institute of Economics, the Ural Branch of Russian Academy of Sciences, 29, Moskovskaya st., Ekaterinburg, Russia, [k.semyachkov@mail.ru](mailto:k.semyachkov@mail.ru)**Abstract**

Modern cities are increasingly faced with growing socio-economic, environmental, energy challenges, and problems that require new approaches to their solution. In the context of the digitalization of the economy and the introduction of digital technologies in various areas of the urban economy, one of the promising areas for research is the development of methodological foundations for the digitalization of socio-economic systems and construction systems for the index assessment of smart cities. Thus, this study's relevance is reduced to the need to improve approaches to assessing the digitalization of the urban environment within the framework of the concept of a smart city. The purpose of this study is to systematize existing approaches to the index assessment of the digitalization of cities and create an index methodology for assessing the digitalization of the urban environment based on the author's model 7I. The main features of the methodology of this study are the implementation of several logically related stages. First, it is the identification and systematization of existing approaches to the index assessment of smart cities. Secondly, it analyzes the directions of the digitalization of cities and the indicators used for this. Thirdly, it adapts the generally accepted indicators for assessing smart cities for the 7I model. This study's results are in the development of a methodological approach to the index assessment of smart cities in the framework of the 7I model.

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## 1. Introduction

Currently, there is an increasing interest in the problems of territorial development based on the principles of sustainable development (Bifulco et al., 2016). Digital technologies, as a new factor in the development of territories, are changing the principles of forming urban space. There is a growing consensus that digital technologies improve the performance of the public sector by enabling citizens to access better services (Anttiroiko et al., 2013). In developed countries, this leads to a greater extent to the emergence of additional economic effects, while in developing countries, the impact of digital technologies has wider results in the fight against poverty, climate change or ensuring the inclusion of people in economic, social and political life (Cardullo & Kitchin, 2019).

Recently, the issue of introducing digital technologies into the urban environment has been actualized. The idea of making cities smarter to take advantage of the digital age is increasingly being discussed in the scientific community (Camboim et al., 2018; Kummitha & Crutzen, 2019). To date, digital technology projects are being implemented in cities across Europe, North America and Asia. However, smart cities have great potential for promoting sustainable development in developing countries as well. Today, international competitiveness is driven by the innovativeness of cities. To this end, cities are undergoing fundamental transformations. With the rapid development of digital technologies, cities are turning into megacities with significant digital potential (Caird & Hallett, 2019).

In modern literature, the term “smart city” means a safe, environmentally friendly and efficient urban territory with a developed infrastructure, the main purpose of which is to ensure sustainable economic growth and a high quality of life. In general, the smart city is described as a concept that involves the introduction and deployment of digital technology infrastructure to support social and urban growth through better economies, citizen engagement and better governance (Anthopoulos et al., 2016). A number of studies on smart cities have noted that initiatives should be implemented in the areas of economy, mobility, environment, human life and local governance. Despite a growing body of research on smart cities, the literature lacks a detailed analysis of the governance of smart city initiatives, as well as a description of the underlying drivers and challenges they face (Streitz, 2019). The complexity of the issues under study is due to the need to assess factors that often do not depend on the city itself.

## 2. Problem Statement

Modern science is actively developing a theoretical and methodological apparatus that describes the processes of functioning of smart cities. Attention to the development of smart cities is manifested in most countries of the world, which indicates a great interest in the formation of new conditions and principles for the development of modern cities (Ok & Yoo, 2017; Späth & Knieling, 2020). This focus on smart city research has spawned a significant number of approaches to looking at and analyzing smart cities. Among the main approaches to considering smart cities, we can distinguish a component approach, a staged approach, as well as more specialized approaches designed to assess the state of a particular area of a smart city (Popov & Semyachkov, 2020). The component approach boils down to considering the main subsystems or components of a smart city, usually 6 components of a smart city are distinguished: smart mobility, smart environment, smart living, smart economy, smart governance, smart people.

An approach that characterizes a certain sequence of development of a smart city, stages or levels of a smart city can be called a milestone. The main idea of this approach is that in order for a city to become smart, it needs to go through several stages, which include creating a certain infrastructure, collecting and analyzing data, using this data in decision-making systems with the aim of improving the quality of life of citizens, reducing emissions pollutants, improving the efficiency of using various resources and achieving other socio-economic effects. More specialized approaches to the study of smart city development focus on specific areas of the functioning of urban systems. A significant number of such studies are devoted to the use of digital technologies in urban environments (Chen, 2019; Zhuang et al., 2017). Among the main, most important advantages of digital intelligent solutions used in the development of urban areas, we can note (Ingwersen & Serrano-López, 2018; Shelton & Lodato, 2019):

- using the most efficient technologies;
- openness of the environment to the spread of smart technologies;
- cost reduction, savings on transaction costs;
- improving the quality of interaction with citizens, involving citizens in the processes of public life;
- availability of access to open data;
- increasing the speed and transparency of decisions made;

Currently, both supranational associations or organizations and national organizations, as well as technology companies and representatives of the scientific community, are engaged in the development of a methodological framework for assessing the development of smart cities (Engel et al., 2018). The International Organization for Standardization (ISO), the European Committee for Standardization (CEN), and the British Standards Institute (BSI) are striking examples of developers of international standards for digitalization of the urban environment. Other well-known approaches to assessing the development of smart cities include Smart City Maturity Model (SCMM), Smart City Reference (SCR), European smart cities ranking (ESCR), Smart City Index Master Indicators (SCIMI), The Ericsson Networked Society City (ENSC), City of opportunity (CoO), Global Power City Index (GPCI), Smart city Index (EasyPark model). The systematization of approaches to assessing the development of smart cities has shown that, in general, there are three main types of methods: assessing the levels of a smart city, assessing the components (development directions) of a smart city, and narrowly focused research (for example, transport or sustainable development). In general, the study of the features of approaches to assessing the development of smart cities makes it possible to form promising directions in the field of assessing smart cities.

### **3. Research Questions**

The main issue of this study is to analyze existing approaches to assessing the development of smart cities and to develop our own approach to assessing the development of smart cities based on the 7I model.

Among the main questions of this study are the following:

- What are the current approaches to assessing the development of smart cities, their features and disadvantages?

- How can existing approaches to assessing the development of smart cities be improved?

#### 4. Purpose of the Study

The purpose of this study is to develop methodological approaches to assessing the development of smart cities.

#### 5. Research Methods

As an object of research, this article considers the modern concept of digitalization of the urban environment in various manifestations of economic activity. The subject of this research is economic relations that are formed in various areas of economic application of digital technologies in modern cities. The analyzed data are scientific research reflected in periodicals, as well as the author's results in the framework of the study of digitalization processes in modern cities. The research method is a systematic logical analysis of various stages of digitalization and directions of development of modern cities.

#### 6. Findings

As the experience of digitalization of the urban environment and the development of modern cities show, this process is associated with the passage of a number of stages. From our point of view, there are 7 stages (priorities) of the smart city development (model 7I). On the other hand, as the experience of the development of smart cities shows, they are based on certain components (smart economy, smart governance, etc.). Thus, we propose an approach that takes into account both the stages of development of smart cities and the main components of such development (table 1). This matrix approach makes it possible to assess the evolution of a smart city and its main characteristics.

**Table 1.** Smart city development assessment matrix

<b>7I-Model levels</b>	<b>Smart economy</b>	<b>Smart living</b>	<b>Smart governance</b>	<b>Smart people</b>	<b>...</b>
Institutions	Institutions for Economy	Institutions for Smart living	Institutions for Governance	Institutions for People	...
Infrastructure	Infrastructure for Economy	Infrastructure for Smart living	Infrastructure for Governance	Infrastructure for People	...
Intranet	Intranet for Economy	Intranet for Smart living	Intranet for Governance	Intranet for People	...
Integration	Integration for Economy	Integration for Smart living	Integration for Governance	Integration for People	...
Interfaces	Interfaces for Economy	Interfaces for Smart living	Interfaces for Governance	Interfaces for People	...
Innovations	Innovations for Economy	Innovations for Smart living	Innovations for Governance	Innovations for People	...
Implementation	Implementation for Economy	Implementation for Smart living	Implementation for Governance	Implementation for People	...

In general, from our point of view, a matrix approach to assessing the development of smart cities based on assessing the stages of their formation, as well as studying the components of a smart city, is more consistent with the tasks of such studies and is more comprehensive and adequate in cases of analyzing the functioning of smart cities. An important point in assessing smart cities is the choice of specific indicators of their development. It should be noted that a specific list of indicators cannot be considered exhaustive and final. This is explained by the fact that, firstly, the technologies used in the development of smart cities are changing, which, accordingly, affects the indicators used to assess the development of smart cities, and secondly, the very priorities of assessing the development of certain cities often change. At present, it is not uncommon for a situation when, even within the framework of one methodological approach developed by a certain organization, in different years of research, a different set of indicators for assessing the development of smart cities is used, which indicates the variability of views on the processes taking place in modern cities.

## 7. Conclusion

As a result of the study, the purpose of which is to develop an approach to assessing the development of a smart city, the following results were obtained.

First, the study shows the importance of the development of modern cities, taking into account the opportunities provided by digital technologies, their implementation in various areas of urban space as a tool for solving the socio-economic and environmental challenges of our time.

Secondly, some approaches to assessing the development of smart cities are systematized, and their features are considered. It is shown that several types of approaches to assessing the development of smart cities can be distinguished, including assessing the components of a smart city, assessing the stages of development of a smart city, or a specialized narrowly focused assessment of any direction of development of a smart city.

Third, the author's approach to assessing the development of smart cities is proposed, based on highlighting the development levels of a smart city (model 7I) and a smart city component (smart economy, smart governance, smart living, smart people, smart mobility, smart environment).

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