

# Improvement of the Efficiency of Urban Management within the Concepts of Smart City and Sustainable Development (As Exemplified by Cities in Kazakhstan)

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*Abstract:* - The idea of urban development corresponds to the concept of a smart city and is based on resource savings or more favorable benefit-cost ratios in the long term using a systematic approach to solving a specific problem. In addition, it is necessary to address such challenges in the interests of all city residents with due regard to the possibilities and level of management efficiency. The study aims to identify opportunities for improving the efficiency of managing an urban resource potential within the concept of a smart city. The article considers various approaches to the concept of smart city. In particular, it presents the 4T concept of urban resources based on the relationship between the development of a smart city and its resource potential. Based on the analysis of five large cities in the Republic of Kazakhstan, reporting and strategic documents of local government authorities, a survey of their residents, and targeted interviews with local government employees, the authors of the article have studied their perception of innovations, expectations from their implementation, and manifestations of smart management in these local government bodies. This allowed the authors to evaluate the results obtained within the concept of a smart city and the 4T resource potential.

*Key-Words:* - Smart city; Smart city management; Smart management; Talents; Technologies; Tolerance; Trust

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## 1 Introduction

The concept of smart city is a new approach to city management. This involves the establishment of a novel urban operational framework, where municipal authorities delineate societal objectives and choose the means for their execution. For instance, they set benchmarks for quality and anticipated outcomes of rendered services, [1]. Their focus extends beyond the mere continuity of

services and innovations; they also prioritize economic effectiveness, [2]. Furthermore, they actively contemplate the adoption of emerging technologies, encompassing the introduction of eco-friendly and energy-efficient solutions aimed at bolstering energy security and sustainability, [3], [4].

Innovative technologies used in various spheres of human activity, primarily information and communications, can significantly increase the

functionality of urban space, [5]. They contribute to smart management in the public sphere but it is people (authorities, society, users, and decision-makers) who determine the implementation of these principles, [6], [7].

The concept of smart city management assumes that public authorities and city services and institutions effectively use the advantages of modern information and communications technologies (ICT) and modern technical and technological solutions that improve the quality of public services and save on the use of city resources, [8]. The savings can cover travel time, communications, energy, and costs associated with waste management or reduce costs associated with negative impacts caused by residents and actors, [9]. With the help of ICT, it is possible to obtain relevant information and ensure the collaboration of various decision-making centers.

In our opinion, smart cities have a huge development potential since they can solve various problems related to urbanization, [10], sustainable development of territories, [11], transport, [12], public safety, healthcare, [13], development of tourist attractions, [14], economic growth, and the digital divide. The corresponding scientific literature highlights the importance of integrating disruptive technologies and data-driven decision-making into planning and managing the urban space of the future. However, it is vital to ensure that smart city development remains inclusive and equitable and benefits all citizens.

### 1.1 Literature Overview

The concept of a smart city is not defined and interpreted in a unified manner, and different authors emphasize different aspects. The concept is a response to global demographic trends and urbanization processes, the formation of an innovative ecosystem, and the pursuit of sustainable development, [15]. As a result, cities get involved in creative social experimentation and solve modern problems through partnerships with creative actors, [16], [17].

For example, Capra defines a smart city as a territory with high learning, innovative, and creative potential, many research centers and higher education institutions, digital infrastructure, communications technologies, and sufficient management efficiency, [18]. Alternatively, another study emphasizes the capacity of cities to draw in and maintain a population of highly skilled professionals and entrepreneurs, [19]. And Hollands reveals approaches that emphasize: a) transport and telecommunications infrastructure; b) the use of

ICT; and c) the role of digital media, creative industries, and cultural initiatives, [20].

Thus, a smart city demonstrates sustainable economic growth (high economic efficiency) in the long term, offers a high quality of life, promotes investment in human and social capital, and uses the latest ICT or technological solutions that determine the quality of public services. This city is governed in accordance with the principle of joint management.

A smart city is an innovative concept for the modernization of cities. Its implementation is a difficult task for urban planners, [21], regionalists, local governments, and residents, [22], [23].

Kornilova proposes a systematic approach to urban development, [24]. The scholar describes three levels of smart city development:

– Smart City 1.0 refers to smart cities at a very early stage of creation. The use of modern technologies has been initiated by ICT companies. They implement various solutions, whether cities need them or not. A good example is the city of Songdo in South Korea, which is the largest private sector development in the world. It is becoming a business center comparable to Shanghai, Hong Kong, Kuala Lumpur, or Singapore, [25];

– Smart City 2.0 is a stage in the development of smart cities with a dominant role of public administration. The use of modern technologies is initiated by local authorities. The introduction of new solutions aims at improving living standards, for example, in Seoul or San Francisco, [26]. Today most cities implementing the smart city concept belong to Generation 2.0, [27];

– Smart City 3.0. Many modern cities are discovering the active position of their residents concerning further development. The role of local authorities is to create space and allow the use of the diverse potential of residents as co-producers of public services, [28].

The list of these stages is not exhaustive as the next phase Smart City 4.0 inspired by Economy 4.0 is under formation, [29].

In our opinion, the most interesting concept of a smart city is described by the 4T model of urban resources, [30], based on the relationship between urban innovation and the resource potential of a particular city. According to this concept, it is a synergistic interaction of four components: tolerance, trust, talents, and technologies. Florida proves that there is a combination of factors from a tolerant community, creative professions, and a high level of technological development that promotes the growth of cities, [30]. Cities that score high on these four indicators attract highly skilled and

creative employees, people from the sphere of culture and art, as well as investors. Such cities become smart cities.

The study aims to identify opportunities for improving the efficiency of managing an urban resource potential within the concept of a smart city.

## 2 Methods

In the course of the study, we selected a qualitative-quantitative approach.

This study assesses the effectiveness of managing the resource potential of a smart city since one of the main indicators of the “Digital Kazakhstan” state program is the development of smart cities in the five largest cities of the country: Astana, Karaganda, Shymkent, Alma-Ata, and Aktobe. The main actors are local government bodies (akimats). The main priorities in terms of smart city development are as follows: to improve the living standards of residents; to increase the share of public e-services; and to implement innovative projects that correspond to the concept of smart city.

The methodology includes research areas and individual research stages.

In the first stage, we analyzed literature in the field of smart cities and evaluated the 4T model of smart cities. The main sources for the analysis of urban development were program documents of Astana, Karaganda, Shymkent, Alma-Ata, and

Aktobe. When considering the relevant reporting and strategic documents of city Akimats, we characterized and evaluated these documents within the concept of smart city and the 4T model of resource potential.

In the second stage, we used the methods of survey and questionnaire to measure the perception of innovations by residents of Astana, Karaganda, Shymkent, Alma-Ata, and Aktobe. The perception of innovations and expectation from their implementation was assessed using a survey in social networks. The method was based on a non-probability type of sampling (accidental sampling). The questionnaire comprised closed-end questions with several options. In total, 589 residents of the cities filled out the questionnaires.

In the third stage, we conducted targeted interviews in five akimats (Astana, Karaganda, Shymkent, Alma-Ata, and Aktobe) with their employees responsible for the implementation of projects related to the development of the smart city concept. A total of 21 interviews were conducted.

From the statistical viewpoint, the results obtained were processed using PSS Statistics.

## 3 Results

Both the technical and social infrastructure of Kazakhstan and other developing post-Soviet countries lag behind that of developed economies.

Table 1. Manifestations of smart city management (opinion of residents)

No.	Questions	Answers, %			
		Definitely no	Likely not	Likely yes	Definitely yes
<b>Is it important for you...</b>					
1	To live in a prestigious city?	6%	26%	42%	25%
2	To have access to modern infrastructure?	2%	14%	52%	32%
3	To have access to new technologies?	4%	15%	51%	30%
4	To have an opportunity to purchase innovative products?	5%	27%	48%	20%
5	To have access to interesting jobs?	7%	23%	49%	22%
6	To have a potentially high salary?	9%	39%	42%	10%
7	To live in a city involved in science?	3%	12%	45%	40%
8	To have an opportunity for advanced training in the city?	2%	14%	50%	34%
9	To have access to recreational facilities in the city?	4%	9%	35%	52%
10	To have access to efficient public transport in the city?	2%	6%	44%	48%
11	To have access to bike paths?	3%	10%	43%	45%
12	To participate in city management?	5%	24%	50%	20%
13	To have easy electronic/telephone communication with the akimat?	2%	15%	52%	32%
<b>In your opinion...</b>					
14	Is there clean air in the city?	14%	37%	38%	11%
15	Are you satisfied with waste disposal?	13%	32%	42%	13%
16	Is the city administration friendly to residents?	2%	17%	54%	25%
17	Is there nepotism in the akimat?	8%	57%	25%	10%
18	Is there tolerance in the akimat?	4%	14%	60%	22%
19	Do you have confidence in the competence of the akimat?	5%	19%	54%	22%

Note: compiled by the authors

However, the projects that bring the cities of Kazakhstan closer to the concept of smart cities are being implemented by local self-government bodies. There is a process of renewing different aspects of cities. It depends on a particular city, its history, internal conditions, the resourcefulness of local authorities, and other parties involved.

Table 1 presents the results of our study on urban innovations and living conditions in terms of the perceptions and expectations of their residents.

In the municipalities under consideration, the highest expectations of residents are related to places of recreation and leisure (52%), efficient public transport (48%), bike paths (45%), scientific activity (40%), the possibility of professional development (34%), and access to electronic communications (32%). Research indicates that survey participants express a preference for access to cutting-edge infrastructure, educational opportunities, and recreational amenities, and these elements significantly influence how they perceive their hometown's innovativeness.

The examination of smart city projects through focused interviews highlighted that each of these projects encompasses social and technological housing innovations, as well as inventive measures to promote community engagement (as illustrated in Table 2). Nevertheless, there is a notable deficiency in the implementation of projects related to urban audits, the effective and innovative utilization of city data, including information about residents and users, and the integration of the Internet of Things and smart networks. These aspects are currently underutilized, with only a 71.4% level of

implementation, indicating room for improvement in these areas.

The first direction of the analysis of the development policy of the cities under consideration was to assess their strategic documents and find direct references to the concept of a smart city. We carefully studied the content of strategic documents. Then we selected records related to the research topic and fragments that define the desired future usually formulated in the form of vision, goals, directions, or development efforts.

In all cases, the documents considered indicated the concept of smart city since all the cities were included in the “Digital Kazakhstan” state program as separate projects: Smart Astana, Smart Karaganda, Smart Ontystuk, Smart Almaty, and Smart Aktobe.

The analysis of strategic documents revealed differences in the future of these cities: through vision, goals, directions, or development projects, for example, in terms of environmental protection or energy efficiency.

The second direction of the analysis of the development policy of the cities under consideration was to consider the policy of the akimats within the 4T concept of urban resources in two contexts: reporting documents that determine the current state of urban resources and strategic documents that determine the desired future of cities. This creates a synthetic picture that includes the current state and the elements that shape the planned future of the city (usually included in the vision, goals, directions, or implementation projects). The results of the analysis are presented in Table 3.

Table 2. Manifestations of smart management in akimats (opinion of akimat employees)

No.	Manifestations of smart management	Yes	No	Don't know
1	Social and technological housing innovations	100%	-	-
2	Smart districts	85.7%	14.3%	-
3	Innovative solutions to support social involvement	100%	-	-
4	Smart solutions for sustainable mobility in the functional city area	85.7%	14.3%	-
5	Smart grids for the communal economy management	71.4%	28.6%	-
6	Internet of Things	71.4%	14.3%	14.3%
7	Ecotechnologies and environmental solutions	85.7%	14.3%	-
8	Efficient and innovative use of data about the city, its inhabitants, and users	71.4%	28.6%	-
9	City audit	71.4%	28.6%	-

*Note: compiled by the authors*

Table 3. The analysis of urban resources within the 4T concept of development strategies of cities in Kazakhstan

City	Talents	Tolerance	Technologies	Trust
Alma-Ata	High level	Medium level	High level	Medium level
Astana	High level	Low level	High level	Medium level
Karaganda	Medium level	Low level	Medium level	Low level
Shymkent	Low level	Low level	Medium level	Low level
Aktobe	Low level	Low level	Medium level	Low level

*Note: compiled by the authors*

## 4 Discussion

Based on the results obtained, we can consider conclusions both from objective and subjective perspectives. According to the subjective approach, Alma-Ata is ranked first, followed by Astana and Karaganda, with Shymkent and Aktobe lagging. This assessment refers to strategic documents. Since they were not based on uniform guidelines, different assessments are also associated with the differentiation of the procedure for creating such documents. Consequently, differentiation also concerns the specification and volume of documents: for example, the Alma-Ata strategic document is extensive and significantly exceeds the strategic documents of Shymkent or Aktobe.

In this regard, it is also possible to define 4T resources in strategic documents which rank resources as follows: technologies, talents, trust, and tolerance. Indeed, the technological resource is the priority of all strategic documents. However, its references vary. In almost all cases, there is a direct mention of talents in strategic documents. On the contrary, the direct mention of trust and tolerance was found only in one case.

We concluded that the construction of smart cities in Kazakhstan should be guided by a model based on innovative technical-economic infrastructure and developed educational organizations. This can stimulate economic growth and create new jobs in the technology sector, [31]. Developing the necessary infrastructure, services, and applications to support smart cities can attract investment, spur innovation, and foster entrepreneurship, especially for Astana and Alma-Ata. Such a model has worked well in metropolitan areas that have a significant concentration of the population, are characterized by high GDP and GDP per capita, serve as the headquarters of large corporations, and are located in business centers and public institutions, [29].

To build a smart city, it is necessary to create sectors of an innovative economy that improve the living standards of residents with an effective control center, [1]. The fundamental concepts underlying the definition of a smart city can be illustrated through the activities of the akimat. In the realm of smart city management, emerging technologies play a crucial role, aiding city authorities in addressing contemporary challenges brought about by the expanding urban population and the rising demand for the digitization of public services, [32]. The akimat activities in the interests of residents should ensure a high level of comfort and satisfaction from the functions performed and the public services provided, which improves the

quality of life, convenience, ease, and trouble-free functioning. This approach should be applied not only to residents but also to other users of urban services.

Another practical factor is the development with the help of professional and qualified personnel, thinking out-of-the-box, striving for development, using the maximum knowledge of employees, and providing them with accessible working tools, [26]. In a broader sense, the akimat fully uses its human and economic resources and capabilities.

The akimat should not only be smart but also follow procedures in the field of intellectual actions and willingly use smart solutions in certain activities. The development of technologies together with the development of professional capacity will advance digital equality and inclusion, [33], so that all citizens can benefit from technology-driven transformation, [34]. This requires investment in digital infrastructure and efforts to bridge the digital divide by providing access to essential services and opportunities for all residents.

## 5 Conclusion

In the course of the study, we analyzed the synergistic interaction of four components in five cities of Kazakhstan: tolerance, trust, talents (human capital), and technologies. As a result, we revealed that none of these cities use this model and only apply some of its elements. Thus, it is necessary to build a new model based on an innovative technical-economic infrastructure and developed educational organizations. This will help to achieve sustainable development goals by optimizing resource consumption and reducing environmental impact. Then it will be possible to improve public safety by training specialists who can regulate the use of artificial intelligence and analyze big data for the development of smart cities. By gradually developing the above-mentioned individual components, we can achieve a synergistic interaction of the four components, i.e. implement the 4T model.

It is stated that efficient urban management can lead to cost savings, which can help control inflation by preventing excessive price increases in essential goods and services. Additionally, sustainable practices, proposed in the paper, are relevant to modern economics, considering the impact of resource scarcity and environmental factors on prices.

Moreover, the emphasis on technological innovation aligns with economic growth, influencing inflation rates through increased

productivity and altered production costs. Efficient public services, as discussed in the paper, can enhance consumer satisfaction and potentially influence consumer behavior, indirectly affecting inflation dynamics.

The study is limited by the sampling of respondents. Therefore, it is incorrect to apply the conclusions drawn on smart city management to all cities of Kazakhstan.

Future research in this field should prioritize cross-city comparative studies to examine variations in smart city strategies and their economic consequences, especially regarding inflation dynamics. Long-term assessments of the economic and environmental impacts of smart city initiatives are crucial, alongside investigations into the relationship between digital infrastructure development and inflation. Additionally, exploring the socioeconomic inclusion and environmental sustainability aspects of smart cities can provide valuable insights into their broader economic implications.

In our opinion, one of the most complex challenges in the development of smart cities in Kazakhstan is to improve the health and well-being of the population, as well as counterbalance environmental factors that affect health. We believe that it is also necessary to conduct research in the field of telemedicine and remote medical services, which can be facilitated with the help of reliable digital infrastructure, the development of legislation, and increasing the professionalism of employees.

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The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

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The authors have no conflicts of interest to declare that are relevant to the content of this article.

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