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**MUHAMMADAMIN KABULOVICH TOHIROVNING TAVALLUDINING
80 YILLIGIGA BAG'ISHLANGAN
“SAMARALI QURILISH MATERIALLARI, KONSTRUKSIYALARI VA
TEXNOLOGIYALARI”
MAVZUSIDAGI XALQARO ILMIY-AMALIY KONFERENSIYASI
ILMIY ISHLARI TO'PLAMI**

Toshkent davlat transport universiteti Rossiya Arxitektura va qurilish fanlari akademiyasining akademigi, O'zbekiston Respublikasida xizmat ko'rsatgan yoshlar murabbiysi, texnika fanlari doktori, professor **Muhammadamin Kabulovich Tohirovning tavalludining 80 yilligiga bag'ishlangan “Samarali qurilish materiallari, konstruksiyalari va texnologiyalari”** mavzusidagi xalqaro ilmiy-amaliy konferensiya ilmiy ishlari to'plami chop etildi.

Muhammadamin Kabulovich kompozitsion qurilish materiallarining polistrukturaviy nazariyasini rivojlantirishga ulkan hissa qo'shgan olimdir. 1995-yilda Muhammadamin Kabulovich Rossiya Arxitektura va qurilish fanlari akademiyasining (RAASN) xorijiy a'zosi etib saylangan, bu esa ularning qurilish materialshunosligi sohasiga qo'shgan ilmiy hissasining xalqaro miqyosdagi e'tirofi bo'ldi. Ular o'z ilmiy faoliyati davomida 6 ta monografiya, 200 dan ortiq ilmiy maqola va 25 ta ixtiroga mualliflik guvohnomasi yaratganlar.

Ushbu konferensiyaning asosiy maqsadi – qurilish materialshunosligi, bino va inshootlarni loyihalash hamda qurilish sohasidagi zamonaviy ilmiy tadqiqotlar natijalarini muhokama qilish, shuningdek, muhandislik ta'limini takomillashtirish yo'llarini aniqlashdir.

Konferensiyada O'zbekiston Respublikasi hamda xorijiy mamlakatlarning oliy o'quv yurtlari va ilmiy-tadqiqot institutlari olimlari, shuningdek, muhim ilmiy tadqiqot natijalariga ega bo'lgan ishlab chiqarish vakillari o'z ilmiy ishlari bilan ishtirok etdilar.

“Samarali qurilish materiallari, konstruksiyalari va texnologiyalari” mavzusidagi xalqaro ilmiy-amaliy konferensiyaning asosiy yo'nalishlari quyidagilardan iborat:

1. **Resurs va quvvatni tejaydigan qurilish materiallari va texnologiyalari** – zamonaviy ekologik va iqtisodiy talablarni qondirishga qaratilgan innovatsion yechimlar.
2. **Bino va inshootlarning qurilish konstruksiyalari, zamonaviy hisoblash va loyihalash usullari - muhandislik** va texnologik yechimlarni takomillashtirish yo'nalishlari.
3. **Arxitektura va shaharsozlik** – estetik va funksional jihatlarni uyg'unlashtirgan zamonaviy loyihalar yaratish.
4. **Zamonaviy muhandislik ta'limi tizimini takomillashtirish** – kelajak mutaxassislarini yuqori malakali darajada tayyorlash uchun ta'lim jarayonini modernizatsiya qilish.

Mazkur konferensiya ilmiy hamjamiyatning turli vakillarini bir joyga jamlab, qurilish materialshunosligi sohasidagi zamonaviy muammolar va istiqbollarni muhokama qilish uchun qulay platforma vazifasini bajardi.

Smart city: problems and solutions

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Abstract: This article analyzes the concept of a smart city, the importance of the concept of "smart city" for humans, society and nature, and its role in modern urbanization. It also covers the main problems encountered in creating smart cities, including urban planning, infrastructure, technological integration, information security and environmental sustainability. The author offers solutions to these problems based on modern advanced urban planning methods, innovative technologies, digital management systems and ecological approaches. The article also discusses the future of smart cities, their impact on society and development prospects.

Keywords: smart city, urbanization, urban planning, digital technologies, innovation, infrastructure, information security, environmental sustainability, smart transportation, digital governance, IoT (Internet of Things), energy efficiency, environmental protection, smart systems, green technologies

1. Introduction

The 21st century is a time of technological progress and digital revolution, which directly affects the field of urban planning. The increase in population, the acceleration of urbanization, and the need for efficient use of resources have created the need for more effective management of cities. In such conditions, the field of urban planning and urban development. The concept of "smart city" has been promoted as a new and modern concept and has become a relevant issue for Uzbekistan, along with developing countries. The Resolution of the President of the Republic of Uzbekistan No. PQ-4881 dated October 30, 2020 "On measures to implement the Digital Uzbekistan – 2030" strategy, and the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 48 dated January 18, 2019 "On approval of the Concept for the introduction of "Smart City" technologies in the Republic of Uzbekistan" are the basis for the development and implementation of the "Smart City" concept in Uzbekistan [1], [2]. The "Smart City" concept aims to improve the quality of life by managing urban infrastructure based on modern information and communication technologies. Smart cities are primarily aimed at optimizing urban infrastructure and ensuring efficient use of resources using information technologies, IoT (Internet of Things), big data, and artificial intelligence. However, technical, financial, and social challenges along the way. It is difficult to achieve effective results without it. This article analyzes the main problems in the development of smart cities and proposes possible solutions to them.

2. Research methodology

In preparing this article, an attempt was made to work on the basis of a scientific-analytical approach. First of all, existing international experiences, scientific articles, reports and practical projects on the concept of "Smart City" were studied. The following methods were used in the process of data analysis:

- Analytical method - the main components of smart cities (transport, energy, security, ecology,

management systems) were studied separately, their interdependence and functional role were identified;

- Comparative method - the experience of smart cities in developed countries was compared with the current situation in Uzbek cities, and significant differences and similarities were identified;
- A systematic approach – by viewing the smart city concept as a complex, interconnected system, each problem and its solution were assessed in a comprehensive manner;
- Document analysis – official resolutions of the Government of the Republic of Uzbekistan, strategic programs, and regulatory documents on urban planning were analyzed;
- Expert opinion analysis - an in-depth analysis of the problems and proposed solutions was conducted based on interviews and open data from industry specialists and experts.

This methodological approach made it possible to systematically consider the problems raised in the article and justify their practical solutions.

"SMART " CITY " CONCEPT INTO PRACTICE IN THE OVERSEAS PROBLEMS

Although the implementation of the "smart city" concept is an important tool in solving the problems of modern urbanization, there are a number of obstacles and problems in this process. They are manifested at the urban planning, technological, economic, social and institutional levels.

Problems in urbanism

The successful implementation of the "smart city" concept requires modern and advanced urban planning approaches. However, urban planning problems existing in current practice slow down or complicate this process. The main aspects of these problems are presented below.

1. Outdated infrastructure. Many cities have outdated buildings, electricity, natural gas, water and sewage systems, making it difficult to integrate them with smart technologies. In such conditions, it is necessary to upgrade the existing infrastructure before introducing new digital solutions, which takes time and considerable cost.

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2. Weak planning and lack of coherence. In many cases, urban development plans are developed separately by different organizations, which leads to the lack of a unified strategic approach. As a result, smart city systems do not work together due to a lack of coordination between different sectors.

3. Unplanned and uncontrolled development of land areas. Unplanned and uncontrolled construction, the expansion of informal settlements, the mixing of residential and industrial areas make it difficult to effectively organize smart urban architecture. In such conditions, the implementation of technical and technological solutions becomes uneven and ineffective.

4. Limited public transport and road infrastructure. Smart cities rely on efficient public transport systems. However, in many cities, underdeveloped transport infrastructure, narrow and unsuitable road networks, traffic congestion and environmental problems make it difficult to fully implement smart transport systems.

5. Lack of data in urban planning. Real-time data collection and analysis are essential for managing smart cities. Unfortunately, in many cases, data on urban infrastructure is not digitized, decentralized, or available at all. This slows down the decision-making process and can lead to misdirection.

6. Financial constraints. Smart cities and the implementation of technical and technological solutions require significant investments, and sustainable financial resources are needed to modernize infrastructure, develop and maintain digital platforms. However, budget constraints and low investment flows are preventing the full implementation of many projects and initiatives.

7. Staffing and skills shortages. Highly skilled designers, engineers, IT specialists, and data analysts are needed to manage and effectively use digital systems. At present, the lack of sufficient specialists in these fields is preventing the full use of existing systems.

8. Legal and institutional challenges. The lack of clear legal frameworks, standards, and regulations for smart cities complicates the process. In addition, weak cooperation and information exchange systems between different government agencies disrupt the coherence of projects. Issues of digital security and personal data protection are also not fully resolved.

9. Social and cultural barriers. Low digital literacy, distrust of technology, and cautious attitude towards innovation make it difficult for smart city projects to be accepted by the general public. In addition, the lack of access to digital technologies for some groups creates the problem of a "digital divide" [3] – [8].

Lack of technological infrastructure and resources

At the heart of the "Smart City" concept is a modern technological infrastructure. This infrastructure creates the possibility of digital control, monitoring and automated management in all areas of city activity (transport, energy, healthcare, security, utilities, etc.). However, in many developing countries, in particular in Uzbekistan, the resources and infrastructure in this area are not yet sufficiently developed. This situation is reflected in the following problems:

1. Lack of sensors and IoT devices. The environmental sensors, IoT (Internet of Things) devices, and data collection systems needed for "smart cities" are not available or are available in limited quantities in many urban areas. This

makes it difficult to analyze data in real time and respond quickly to problems.

2. Weak network and internet infrastructure. The lack of stable and high-speed internet, 5G or Wi-Fi hotspots slows down the functioning of digital solutions. This problem is especially acute in remote areas, exacerbating digital inequality.

3. Insufficient data centers and cloud technologies. Data centers (data centers) that store and process large amounts of data, which are a key component of "smart city" systems, are either non-existent or have low capacity in many regions. Also, the level of use of cloud technologies is not yet developed.

4. Power outages and maintenance. Unstable or intermittent power supplies, as well as lack of systematic maintenance, also negatively affect the continuous operation of technological solutions.

5. Lack of local technological producers. Many modern technological tools are imported from foreign countries, which increases costs and reduces the level of technological independence. The absence or underdevelopment of local production cannot cover the domestic demand for resources [3] – [8].

To address these challenges, it is necessary to gradually develop technological infrastructure, establish public-private partnerships, support local technology startups, and develop a digital transformation strategy.

Social and economic inequalities

While smart cities often aim to improve urban life by integrating advanced technologies, this process can exacerbate social and economic inequalities. In most cases, smart city technologies are only accessible to financially self-sufficient citizens, making it difficult to provide technology to low-income groups. In addition, smart cities are often developed only in certain regions, which can create even greater disparities among local populations. Middle- and low-income groups are excluded from using these technologies, and as a result, they are unable to improve their lives.

The concept of smart cities aims to improve the quality of life of the population, expand access to services, and optimize urban governance. However, existing socio-economic inequalities are emerging as a significant obstacle to this process. In order for the introduction of smart technologies to be equally beneficial for all segments of society, existing differences must be taken into account. The main aspects of these inequalities are presented below.

1. Digital divide. Not all segments of society have equal access to digital technologies. Low-income families, the elderly, and those living in remote areas lack access to the internet, mobile devices, and digital services. This creates limitations for them in accessing smart city services.

2. Low levels of education and digital literacy. Some segments of the population, especially groups with low technological literacy or low digital literacy (e.g. rural residents, the elderly), cannot use modern applications, digital payment systems, and online services. This situation hinders the effective functioning of technologies.

3. Unequal access to economic resources. Services offered within smart cities (smart payment systems, automatic control of natural gas, electricity and water, smart homes, etc.) sometimes require additional costs. As a result of the inability of low-income groups to use such services, a situation of "underdevelopment even in the city" arises.



4. The gap between the city center and the suburbs. Many smart city projects are initially implemented in the central areas, while the suburbs are neglected. This further exacerbates the differences in infrastructure, quality of services, and living conditions between regions.

5. Lack of flexibility for people with disabilities and vulnerable groups. Smart city solutions should create equal opportunities for all citizens. However, the needs of people with disabilities, lonely elderly people, or socially vulnerable groups are often not taken into account. This contradicts the principle of inclusiveness [3] – [8].

To overcome these problems, it is important to develop a digital inclusion policy, establish digital literacy programs, and form a support system for socially vulnerable groups through subsidies or preferential services.

Personal information security and confidentiality

Smart cities involve the extensive use of information technology, which requires the collection of large amounts of data. This data usually relates to population movements, energy consumption, security monitoring, and other daily activities. This naturally raises issues of personal data security and privacy.

Data breaches, unauthorized access, and misuse of data can increase security challenges in cities. Legal and information security issues related to personal data, in particular, necessitate the need to protect citizens' privacy.

"Smart" "city" concept population daily life to the activity related big in size data collection, storage and analysis to do in mind This, in turn, makes the issue of ensuring the security and confidentiality of personal data one of the most pressing problems. Deficiencies in this area not only lead to a violation of citizens' rights, but also to a decrease in general trust.

1. Weakness of digital security systems. In many regions, modern technological solutions for information security are insufficient. Devices (cameras, sensors, mobile applications, etc.) connected to smart city infrastructure may be vulnerable to cyberattacks or data leaks.

2. Uncertainty of the legal framework. In many countries, including Uzbekistan, the legislative framework for the protection of personal data is not yet fully developed or is poorly implemented in practice. The lack of clear standards, accountability systems, and control mechanisms for organizations handling confidential data poses a threat in this area.

3. Possibility of unauthorized use of data. The data collected in smart city systems (location, travel routes, purchases, health status, etc.) can be perceived as an invasion of citizens' privacy if misused. This reduces citizens' trust in technology.

4. Lack of transparency in data transfer. In many cases, the population is unaware of what data is being collected about them, where it is stored, and for what purpose it is being used. This leads to violations of privacy principles.

5. Shortage of cybersecurity professionals. The lack of highly qualified IT professionals and information security engineers needed to ensure the security of personal data creates significant gaps in the protection of existing infrastructure [3] – [8].

To address this problem, it is necessary to improve legislation on the protection of personal data at the state level, set strict ethical and technical standards for

organizations handling data, and strengthen cybersecurity infrastructure.

Ecological and environmental problems

Smart cities are known for their goal of saving energy, reducing waste, and ensuring environmental sustainability. However, the environmental impacts of resource use must be studied in the process of implementing urban planning standards and technologies. The materials, technologies, and methods used in the construction of new smart cities often create a high demand for natural resources. Also, in some cases, harmful substances can be released into the environment during the production and implementation of smart technologies. The coordination of technology and natural resources remains a major challenge in ensuring the environmental sustainability of cities.

The concept of a "smart city" plays an important role in solving ecological and environmental problems.

1. The relevance of environmental problems. Today, urbanization processes, increased transport, industrial emissions and increased energy consumption have a negative impact on the ecological environment. Air pollution, waste problems, depletion of water resources, and reduction of green areas are among the main environmental problems.

2. Smart city and ecological approach. "Smart city" technologies serve to optimize urban infrastructure and reduce environmental problems. The following areas are important in ensuring ecological sustainability:

a) Smart energy systems

- Use of renewable energy sources such as solar and wind.
- Reducing electricity consumption by improving energy efficiency.

b) Air quality monitoring

- Real-time air quality monitoring using IoT (Internet of Things) sensors.
- Forecasting systems for monitoring and preventing air pollution.

c) Smart waste management

- Automatic waste separation and recycling systems.
- Improving the efficiency of waste collection logistics through digital control.

d) Green infrastructure

- Expanding green spaces, parks, and ecological transportation routes.
- Natural ventilation and air purification through vertical gardens, green roofs and walls.

e) Water resources management

- Monitoring and optimizing water consumption by the population.
- Implementation of water treatment plants and rainwater harvesting systems.

3. Environmental awareness and digital citizenship

- A smart city depends not only on technology, but also on the ecological culture of the population. It is important to inform citizens about environmental problems through digital applications and encourage them to actively participate in solving them [3] – [8].

3.5 LEGAL AND ADMINISTRATIVE BARRIERS



The construction and development of smart cities largely depends on governments and city management systems. In many countries, laws and regulatory frameworks aimed at creating smart cities have not yet been formed. However, existing legislation and standards often do not correspond to modern technologies.

This situation can create obstacles in urban planning processes and slow down the implementation of smart cities. In addition, the adaptation of management systems to new technologies can create uncertainties and difficulties in their implementation.

1. Inadequate legislation. In many countries, including Uzbekistan, clear and adapted laws on the implementation of "smart city" technologies have not yet been fully developed. This leads to the following problems:

- Delay in legal response to technological innovations – for example, the legal status of drones, smart cameras, or IoT devices is not clearly defined.
- Gaps in personal data protection – data about citizens collected through smart systems can be misused.

2. Lack of coordination of management systems. For smart cities to function effectively, close cooperation between state and local governments is necessary. However, the following obstacles are often encountered:

- Lack of cross-sectoral coordination – for example, sectors such as transport, energy, and environment operate independently of each other.
- Low digital literacy – some managers and employees lack the skills to work with modern technologies.

3. Financing and investment problems

- Legislative uncertainties pose risks for investors, making them hesitant to invest in "smart city" projects.
- Underdeveloped public-private partnership (PPP) mechanisms make it difficult to implement large infrastructure projects.

4. Standardization and technical regulations

- Due to the lack of uniform standards, different systems are not compatible with each other, which complicates integration.
- For example, cameras or sensors installed by different companies may not work with each other.

5. Citizen participation and rights

- Citizens are often left out of decision-making processes.
- This can cause social discontent and reduce the sustainability of projects [3] – [8].

3.6 ADAPTABILITY AND PREPAREDNESS FOR FUTURE CHANGES

While urban planning approaches for smart cities are often robust and clearly planned, they need to be flexible to future technological changes. Rapidly changing technological and social conditions require smart cities to be constantly updated and adapted.

Decisions made in projects and construction processes must be flexible enough to respond to future needs, otherwise the promising development of smart cities will be impossible.

1. What is flexibility?

- Resilience is the ability of a city's infrastructure, management, and technological systems to

respond quickly to various social, economic, and environmental changes.

- A smart city is not just a collection of modern technologies, but also a continuous development and an adaptive approach to changing conditions.

2. Key areas of readiness for future changes:

a) Technological flexibility

- Modular systems : Smart city systems should be modular, meaning they should be able to easily add new technologies or replace old ones.
- Unified platforms : Digital systems in different sectors (transport, energy, security) must be integrated.

b) Informed decisions

- IoT, AI (artificial intelligence), and Big Data are used to collect and analyze real-time information, which helps to make quick and informed decisions in any situation.

c) Climate change preparedness

- Environmental solutions (e.g., green buildings, rainwater harvesting systems) will be developed to address changes in air temperature, rainfall, and water scarcity.
- Strategies to conserve energy, expand green transportation, and reduce waste are used as countermeasures.

d) Social adaptability

- Appropriate services and infrastructure for different social groups (elderly, disabled, young people).
- Developing the city taking into account the opinions of citizens (through interactive platforms, public surveys).

e) Stability against external shocks

- Adaptive strategies will be developed to respond to situations such as pandemics, natural disasters, and economic crises (e.g., remote work systems, ambulance drones).

3. Strategic planning and innovation promotion

- Smart cities develop flexible strategies based on 10-20-year plans.

New solutions are constantly being implemented in collaboration with startups, research centers, and technology parks [3] – [8].

3. Discussion

The concept of "smart city" is a strategic direction for the development of modern cities. Within this concept, various sectors - transport, energy, healthcare, environment, security and management systems - work in an integrated manner. Importantly, such cities, while being based on technology, will be aimed at making people's lives easier, saving resources and ensuring environmental sustainability.

One of the main challenges in implementing this concept is the incompatibility of existing infrastructure with innovations, especially in developing countries. Outdated communications, problems with uninterrupted power supply, and insufficient Internet infrastructure hinder the full implementation of "smart" technologies. Another important aspect is the lagging behind of legislation. While smart technologies are developing rapidly, the legal issues related to them have not yet been fully regulated. This poses risks in



areas such as data security, privacy, and intellectual property.

In addition, environmental and social aspects also play an important role. If cities are not environmentally sustainable, technological progress can negatively affect the health of the population. Waste management, air and water quality control, preservation of green areas - all these should be key priorities in the smart cities strategy. Social equality and the level of digital literacy of citizens should also not be ignored. Every citizen should have access to modern technologies and participate in decision-making.

At the same time, solutions exist and are being implemented gradually. Through the Internet of Things (IoT), artificial intelligence (AI), big data (Big Data) and digital management systems, it is possible to increase efficiency in all areas of city life. Through single digital platforms, public services are provided quickly, transparently and conveniently. Technological solutions are being implemented on the basis of public-private partnerships, and citizens can actively participate in city governance through mobile applications and an online portal.

It is clear from the discussion that the concept of a "smart city" requires a comprehensive approach, systemic reforms, and modern thinking. Technologies are a tool, and the main goal is to create a comfortable, safe, and environmentally friendly living environment that fully realizes human potential [9], [10].

4. Conclusion

In the 21st century, cities are becoming not only economic, but also social, ecological and cultural centers. The growing number of urban residents, pressure on infrastructure and resources, environmental problems and security needs make the introduction of the "smart city" concept a necessity of the time. This concept aims to make life easier, optimize management and ensure environmental sustainability by introducing digital technologies in various areas.

While the development of smart cities holds promise for the future, they face several significant challenges in addressing urban design challenges. A comprehensive approach and collaboration are needed to address issues in technology, social inequalities, privacy, ecology, and governance. If these challenges are addressed, smart cities can significantly improve people's lives and enhance the quality of life in cities.

In today's rapidly changing world, the concept of "Smart City" is becoming an important factor in ensuring not only technological progress, but also sustainable development, a comfortable living environment and effective governance. The problems arising in the implementation of this concept - gaps in legislation, lack of coordination in governance, environmental risks, outdated infrastructure and difficulties in financing - require a comprehensive, integrated approach.

At the same time, each of these challenges can be effectively addressed through modern technologies, digital governance, environmental solutions, civic engagement, and adaptive strategies. The key is not to build a city, but to manage it in a sustainable and future-proof manner.

In addition, being prepared for future changes is also an integral aspect of a "smart city." Urban systems must be flexible and resilient to climate change, natural disasters, economic crises, and health-related risks. This requires

strategic planning, identifying digital threats, and testing and implementing innovative technologies in real life.

In conclusion, a "smart city" is not just a set of modern technologies, but a complex system that relies on human potential, innovation, sustainable development, environmental awareness and civic participation. By properly shaping this system, not only technological, but also social and environmental progress can be achieved. Properly planning the cities of the future today is one of the most important steps towards creating a sustainable and prosperous environment for future generations.

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