



MANAGEMENT OF THE QUALITY OF LIFE 5.0 IN THE SMART CITY BASED ON SUSTAINABLE INNOVATIONS

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ABSTRACT

A smart city is an urban area where technologies and data collection enable the improvement of quality of life, sustainable development, and the effectiveness of urban operations.

Smart city unites humans, processes, and data, connected with the help of information and communication technologies, to solve the issues of viability and sustainable development of the city. Implementation of technological progress in the infrastructure of the smart city leads to the creation of a place, which is always connected to the network due to real-time information (Alvarez-Risco et al., 2023).

Digital technologies offer powerful tools for solving multi-faceted challenges faced by cities, paving the way towards smarter, more effective, and more sustainable city ecosystems. By implementing smart systems of healthcare, public safety initiatives, and environmental monitoring, smart cities improve the quality of life of their residents. Smart cities use data and digital technologies to improve the quality of life. More complete data in real-time allows observing events in the course of their development, understanding the models of demand, and offering quicker and cheaper solutions.

Sustainable development is the basis of the smart city development. Since urban areas face such challenges as climate change, pollution, and depletion of resources, sustainable development is of the utmost importance. Smart cities focus on the reduction of the carbon footprint, growth of energy efficiency, and the use of renewable resources. The key to future sustainable urban development is technology.

The transformation of cities to smarter and more sustainable environments is the modern reality, which changes city life. Improved mobility, energy-efficient infrastructure, smart management, intellectual urban planning, and top-priority support of citizens' well-being pave the way to sustainable urban future.



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1. INTRODUCTION

A smart city is an urban area that uses different types of digital sensors of the Internet of Things to gather data. These data are used for the effective management of assets, resources, and services, which, in turn, help improve operations around the city.

The smart city concept emerged as a new trend for solving complex issues connected with urban development. The focus of the smart city is on the transition from approaches oriented towards infrastructure support to the improvement of citizens' quality of life and sustainable development (Chang and Smith, 2023).

The smart city allows for better usage of the existing resources, optimising processes that take place in the urban environment and adapting to changing needs and challenges. Due to smart technologies, the city has become more effective, environmentally clean, and comfortable for residents. Smart cities use technologies to make everyday life more affordable, satisfy individual needs, and raise the well-being of their residents.

To ensure the effective development of smart cities, it is important to understand factors that determine the quality and well-being of their residents. Smart cities contribute to an increase in the quality of life of their residents due to the use of innovative technologies and data, fostering the creation of a more effective, cleaner, and healthier urban environment (Pangsy-Kania and Kania, 2024).

Quality 5.0 is a concept that is constantly development. It expands the principles of Quality 4.0, focusing on the management of human-centred quality, sustainable development, and ethical production. Quality 5.0 envisages a balance between technological progress, human values, and sustainable practices.

The concept of a smart city appeared as a solution for dealing with the problems of an increase in urban population and the transformation of cities into economically effective and socially stable environments. This concept includes different aspects of urban development, which could be treated as the decisive factors of urban regions' competitiveness in the involvement of business and workforce and improvement of the quality of life (Džunić et al., 2022).

Environmental sustainability is one of the key aspects of the smart city. Technologies can improve sustainable development through management of the quality of air and water, mitigation of the consequences of climate change, preservation of natural resources, and integration of renewable energy. This may include also precise accounting and analytics for energy consumption optimisation and smart grids, which control flows of electric energy and forecast demand.

The goal of this paper was to study the management of Quality of Life 5.0 by the example of smart cities that employ sustainable innovations and demonstrate how these innovations contribute to the improvement of the quality of life in smart cities.

2. LITERATURE REVIEW

The smart city concept is an innovative approach to solving modern challenges of urban development, ensuring the sustainable development of territories. It is based on the use of digital technologies, the Internet of Things, big data, and artificial intelligence to raise the effectiveness of the management of resources, environmental safety, and the quality of the population's life. The smart city project is based on the improvement of residents' quality of life through the optimisation of everyday things. These include the creation of transport systems based on electronic and digital technologies, provision of administrative services electronically, comprehensive modernisation of the city's digital equipment, development of ecology, the use of environmentally clean sources of energy, acceleration of all processes of urban infrastructure, improvement of the quality of life in the city, etc.

The issues of smart cities, Quality 5.0, and sustainable innovations – in isolation and their interconnection – were studied and analysed by many scholars.

Becker et al. (2023) conceptualised and demonstrated the application of City 5.0, in particular, the paradigm of design of a city fit for life, which transformations aimed at eliminating the limitations for residents through the use of digitalization for the provision of public benefits and services. The scholar proposed City 5.0 as a new paradigm of design, aimed at residents and future cities, within which cities are seen as markets that connect providers of services with residents as consumers.

Džunić et al. (2022) compared cities from different European regions based on residents' perception of different aspects of urban life – infrastructure, conditions of life, environment, finance, and governance – as the indicators of the quality of life. This paper assessed regional differences in residents' satisfaction with different categories of urban development, which are the basis for assessing the quality of life in European cities. Wang and Zhou (2023) studied how investments in smart cities influence the subjective quality of life in China and used a general ordered logistics model to consider the impact of investments in smart cities. The subjective quality of life was measured with the help of three indicators: satisfaction with life, frequency of happy emotions, and frequency of depressive emotions.

Chotpittayanon et al. (2024) dwelt on the success factors for sustainable development of the smart city in Thailand and concluded that sustainable success of smart city development in Thailand depends on several factors,

including effective management of technologies and innovations, potential of leaders, readiness for the smart city, and availability of smart city infrastructure. These factors require cooperation between the government, social sector, private sector, educational sector, and community to foster the sustainable and effective development of smart cities around Thailand.

Amangeldiev et al. (2025) embarked on the improvement of the Quality 5.0 concept in local governance and the development of scientific and practical recommendations to enhance the quality management of this regulatory practice in smart cities. Having studied the leading international experience of implementing sustainable innovations in information management systems to ensure Quality 5.0 in local governance across the top 30 smart cities in the world in 2024, the authors found the essence of Quality 5.0 in local governance and developed a range of scientific and practical recommendations to improve the management of Quality 5.0 within smart cities.

Arkin et al. (2020) dwelt on the active development of information and communication technologies in the world and in the context of smart cities. According to the authors, the promising trends, which determine the development of the telecommunication sector, include transformation of the operational model under the influence of digitalization, mass implementation of business analytics methods based on big data analysis and artificial intelligence, creation of business ecosystems with business partners, and telecommunication business entering adjacent markets connected with technological solutions, financial services, and IT.

Carro-Suárez and Sarmiento-Paredes (2023) revealed the effect of digital technologies, used in smart cities, on the social, environmental, economic, and institutional dimensions of sustainable development; Ramli et al. (2024) established smart technologies that potentially influence consumer behaviour in energy consumption and provided valuable insights on the role of smart technologies in the effect on energy consumption by households within the sustainable development of smart cities; Berniak-Woźny et al. (2025) emphasised the critical role of start-up incubators in promotion of sustainable development programmes and smart cities through support of innovations and cooperation to solve city problems; and Ferreira (2021) pointed to the connection between the smart city and residents' quality of life.

The smart city concept is an important tool for ensuring the sustainable development of territories, which allows cities to deal with the challenges of urbanization more effectively; these challenges include pollution, ineffective use of resources, transport problems, and reduction in the quality of life. The application of digital technologies, the Internet of Things, big data, and

artificial intelligence contributes to the optimisation of city processes management and an increase in environmental sustainability and social unity.

3. RESULTS

Sustainable development of cities, which is ensured through the balance of the development of the economic, social, and environmental components based on new digital tools and information and communication technologies, transforms into smart development in the conditions of a digital economy. Modern cities, which implement the programmes of sustainable development, make a transition to the smart city concept, because, in the conditions of digitalization of economy and society, intellectualization of its development and management becomes the objective pattern.

Smart city is a fundamental component of development; it is based on the Internet of Things, with digital technologies being implemented in all spheres of smart cities. Due to the quick rate of global urbanization and the expected growth of the urban population by 2050, there is a growing need for intellectual and sustainable solutions, which reduce the negative influence on the environment and improve the quality of life of residents. One of the largest advantages of a smart city is its ability to receive information from a wide range of sources. A city, equipped with mobile devices, sensors, car networks, and IoT devices, can create a network of intellectual infrastructure that can assess the effectiveness of systems and processes of the city.

Smart city has the following aspects: infrastructure – the use of modern infrastructural solutions, connected to the IoT (roads, buildings, energy systems, and water supply); transport – optimisation of transportations, in particular, electric cars, innovative systems of public transportation, and smart systems of traffic management; energy – use of energy-saving technologies, energy distribution, renewable energy sources and monitoring of energy efficiency; - water supply and waste disposal – the systems of water supply management and water consumption reduction, and improvement of waste disposal; - communications – broadband Internet, wireless networks, and access to information for residents; information management – collection, analysis, and use of information to improve city management; social integration – ensuring access to the technologies of all population groups and development of social initiatives; security – CCTV, smart systems for security and monitoring; city management – the use of data analytics to make decisions on planning of city development, resources management, crisis management, etc.

Smart cities and the IoT have a substantial effect on the development of cities, enhance the quality of the population's life, help raise effectiveness and safety, improve infrastructure, and contribute to innovations and

economic growth. Dissemination of these technologies in cities is the key to the creation of a more sustainable, technological, and comfortable urban environment.

The development of the IoT leads to an increase in the number of connected devices, which are used in everyday city operations. This improves the quality of life and contributes to the reduction of the carbon footprint. However, further development of waste management with the help of the IoT requires larger support from the government and private sectors. This involves regulation, incentives, innovations, and cooperation for the creation of IoT applications in the formation of a sustainable future.

Smart cities use data in real-time and complex algorithms to optimise transport flows, reduce energy consumption due to smart networks, implement effective systems of waste management, and provide public services more efficiently. These innovations raise the comfort of urban life and stimulate a decrease in energy consumption and waste.

The Internet of Things in the concept of the smart city transforms city objects, cities, and infrastructure into a connected network, ensuring new opportunities for management and optimisation of the urban environment. This technology became one of the key elements of future cities, offering innovative solutions for the improvement

of the quality of life and effective use of resources. One of the main aspects of the IoT in a smart city is the collection and analysis of a large volume of data from different sources.

Smart cities that function in the conditions of Quality 5.0 management differ from smart cities of the age of Quality 4.0 management because their creation is connected with the achievement of the Sustainable Development Goals in the sphere of the quality of life. Various categories of interested parties are involved in the formation and development of such cities' infrastructure. They include the business sector, healthcare sector, science and education, social support, and security sector (Adel & Noor Alani, 2024). An important role in the formation of modern smart cities belongs to ecology, which influences the health of the current and future generations. Accordingly, another participant in the creation of smart cities is environmental organisations. Local authorities also have a significant role in the creation and development of smart cities.

Achieving high-quality life parameters in smart cities, as part of the Quality 5.0 management concept, is closely tied to the implementation of sustainable innovations across various sectors. Let us consider these innovations in the context of their application during the creation of the leading smart cities (Table 1).

Table 1. Sustainable innovations contributing to the Quality of Life 5.0 in smart cities

City	Smart City Rank	Level of technologies and infrastructure	Sustainable innovations
Lausanne (Switzerland)	10 th position (2025). 7 th position (2024)	AA	Sustainable innovations centre Drone Valley unifies start-ups and R&D organisations. It develops drones for environmental protection, green energy, transportation of small cargos for medical organisations, and monitoring of construction objects and communal facilities. These sectors contribute to ecological protection and the growth of the quality of life due to the reduction in the level of climate change. The Drone Valley cluster has been functioning since 2004.
Zurich (Switzerland)	1 st position (2025). 1 st position (2024)	AAA	The Drone Valley cluster has been integrated with innovative business structures in Zurich. An example of a sustainable innovative solution created by cluster employees from Lausanne and Zurich: - Drone Voliro T, which has a 360° angle of view. It is used by public utility organisations of Zurich, Lausanne, and other smart cities in Switzerland. This drone allows for the replacement of human labour in high-altitude work. Personnel previously working at these areas have been retrained as drone operators.
Geneva (Switzerland)	3 rd position (2025). 4 th position (2024)	AAA	2016-2017 saw the start of the G'innove project, financed and supported by various government and municipal organisations and services. The project is aimed at stimulating and supporting social innovations that contribute to the quality of life in the city. This project also allows ensuring the growth of social activity (city entrepreneurs can present sustainable innovations that contribute to the development of technologies and support self-employment). The priority is given to projects using technologies that contribute to the management of Quality of Life 5.0 and the quality of life of people with limited mobility.
Singapore	9 th position (2025). 5 th position (2024)	AAA	Sustainable innovations for the improvement of access to the smart healthcare system: - Affordable means for monitoring the state of health. Singaporeans can purchase affordable portable devices integrated with digital health records. The doctor and the patient receive timely information about health changes. These

			devices have an affordable price due to a public-private partnership. They are developed by specialised companies that cooperate with the R&D sector; - Medical diagnostics for citizens of Singapore with the use of AI, which ensures high precision; - Digital platforms of telemedicine ensure organisation of remote medical consultations, which helps in case of busy schedules or low physical mobility.
Canberra (Australia)	8 th position (2025 год). 3 rd position (2024)	AAA – infrastructure. A - technologies	Sustainable innovations in smart medicine: - Digital platform HotDoc for quick appointments. Machine learning and big data analysis are used. This platform is peculiar for the high speed of information processing and formation of alternative offers; - Free (including anonymous) online medical consultations.
Copenhagen (Denmark)	7 th position (2025). 6 th position (2024)	AAA – infrastructure. AA – technologies	To support the quality of life of all groups of the city population (including people with limited mobility), the following sustainable innovations are used, which contribute to Quality 5.0 management: - Digital platforms of telemedicine, based on the Internet of Things, provide access to healthcare services; - Digital educational platforms support the programmes of lifelong learning; - Emergency response systems provide support for the population in extreme situations (using the Internet of Things, big data analysis, and computer vision); - Digital platforms in the sphere of culture and art (theatres and museums). These platforms use computer vision and provide access to the city's cultural life.
London (United Kingdom)	6 th position (2025). 8 th position (2024)	AAA	City systems of data management are used to react to social and environmental challenges. They are based on the Internet of Things (monitoring of city areas with the help of digital sensors), big data analysis, machine learning, and neural modelling. Digital infrastructure contributes to social activity and satisfaction of residents' demands for information and communication (5G was started in 2019).
Abu Dhabi (UAE)	5 th position (2025). 10 th position (2024)	A	Innovative solutions to raise the quality of life contribute to the decrease in the number of cars, the optimal height of buildings, the use of solar energy, and the reduction of waste. They are applied in Masdar City on the territory of Abu Dhabi. Leading technologies and innovations in architecture and energy are used to create a smart city. The key sustainable innovation is aimed at protecting the population and city objects from destructive desert winds.
Dubai (UAE)	4 th position (2025). 12 th position (2024)	A	Systems of medical appointment management and systems of health records management. Digital infrastructure includes smart technological solutions in construction, aimed at residents' comfort in the conditions of a desert climate.
Oslo (Norway)	2 nd position (2025). 2 nd position (2024)	AAA	Systems of the management of buildings' energy efficiency, using the Internet of Things. These systems allow saving of energy. The systems of management of city vehicles work based on big data analysis and machine learning, and contribute to the ecologization of the transport system and the reduction of traffic jams.

AAA – highest indicator;

AA – medium indicator;

A – low indicator.

Source: Compiled by the authors based on (ACT Government, 2025; Blackwell, 2022; Business Norway, 2025; IEREK, 2025; Digitaldubai.ae, 2025; The IMD World Competitiveness Center, 2025; Jeannerat & Lavanchy, 2024; Petrea & Ursache, 2023; Swisstech, 2021; U.ae, 2025; World Economic Forum, 2023)

Green technologies are already integrated into the infrastructure of certain modern smart cities: renewable energy sources, such as solar panels, wind turbines, and hydroelectric power stations; energy-efficient buildings (systems of heating, ventilation, and air conditioning; improved systems of lighting management and improved insulation); waste management (complex programmes of disposal and innovative technologies of turning waste into energy); smart grids (real-time data and enhanced algorithms for optimisation of energy distribution,

reduction of energy losses during energy transportation, and an increase in reliability of energy supply); green transport; urban agriculture, etc.

Smart transport systems are designed to solve the problems of transport collapse: traffic jams, lack of parking space, ineffective public transportation, etc. Solutions here include adaptive traffic lights, smart parking, public transport monitoring, information systems for drivers, etc. These solutions help reduce

traffic jams, and polluting emissions, raise traffic safety, and improve public transportation.

The goal of smart transport lies in making city traffic more effective, convenient, and sustainable. The main features of smart transport include tracking (GPS and sensors for tracking the location of transport vehicles in real time); traffic and navigation; electric mobility; joint use of transport; unmanned transport; security; effective management of public transport; reduction of emissions; parking management.

Smart Grids allow better and more effective management of demand and offer, integration of renewable energy sources, application of smart meters, and implementation of street lighting. This leads to a reduction in energy consumption, an increase in electric supply reliability, a decrease in CO₂ emissions, and a faster transition to renewable energy sources.

4. DISCUSSION

A smart city is a city that uses the potential of technologies and innovations and other resources for more effective stimulation of sustainable development and eventual improvement of its residents' quality of life. The main goal of the smart city is to optimise the city's functions and stimulate economic growth, with simultaneous enhancement of the quality of life of the residents through the use of intellectual technologies and data analysis.

Innovations in smart cities aim to raise the quality of life. This is possible due to the application of leading technologies, which make cities more effective and sustainable. Apart from this, this facilitates the community's involvement and improvement of the infrastructure. Sustainable development in smart cities contributes to the preservation of natural resources, improves the quality of air and water, reduces polluting emissions, and fosters the sustainable development of mobility. Smart cities make digital technologies and data work for better decisions, thus enhancing the quality of life. The creation of a city, which is suitable for life, requires diverse technologies and processes depending on the scale of a region, urban infrastructure, and characteristics of the community for the population's well-being.

Technologies of data collection, in particular real-time data, are of the key importance for smart city initiatives and the advantages they offer. Data-based analytics helps local authorities to improve city planning and develop city services, from waste management to public transport, which also contributes to the quality of life and, in particular, Quality 5.0.

The foundation of the smart city concept is energy efficiency and sustainable infrastructure. Integration of renewable energy sources, development of smart grids,

and implementation of the leading systems of energy management are of utmost importance here. Though the goal is the quick reduction of energy consumption, decrease in carbon emissions, and cost savings, the factual results differ. Automatization of city infrastructure based on predictive maintenance and the Internet of Things is a promising direction for smart city development. Using leading technologies to analyse and forecast the state's critically important local objects allows raising the effectiveness of resource management, minimising emergencies, and improving the quality of life of residents. Here the "Mobility as a Service" concept is a promising direction for developing urban transport, which combines autonomous transport vehicles, mobile robots, and digital platforms to ensure sustainable mobility.

5. CONCLUSION

Smart city is the leading direction of urban development. Smart cities use digital technologies to raise the quality of life, optimise resource management, and contribute to sustainable development.

Quality 5.0 emphasizes the importance of integrating quality into all aspects of society's functioning, with technological progress leading to the improvement of the quality of life, sustainable development, and social responsibility. This integration involves the introduction of complex models of quality management, which react to quick technological and environmental changes.

The spheres of smart cities' functioning, in which ICT, the IoT, and other smart technologies play an increasingly important role, include transport, energy, and infrastructure.

Smart city is a fundamental trend in urban development, which is based on the application of technologies to support sustainable growth. Economic development, social unity, and environmental protection are directly connected with the smart dimension of cities, which involves the utilisation of technologies in almost all city functions.

The Internet of Things, big data, mobile apps, and Industry 5.0 can make cities more effective. Smart cities can manage technologies to improve their residents' lives by fostering the enhancement of the environment, saving costs, optimising public services, raising transparency in management, attracting talented employees, improving communication with residents, etc. Technologies that are implemented today make smart cities more comfortable, effective, and eco-friendly. Intellectual transport systems reduce transport jams, smart grids save energy, smart CCTV systems raise security, e-government makes communication with the authorities simpler, and big data analytics allows for better management decisions.

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