STRATEGIC VISION FOR THE DEVELOPMENT OF SMART CITY SYSTEMS IN BULGARIA

Assoc. Prof. Mihail Chiprianov, PhD
"D. A. Tsenov" Academy of Economics - Svishtov

Summary: *Dynamic climate and technological changes are placing new demands on urban spaces. In Bulgaria, there is a strong contrast in digital readiness between large and small municipalities. This study aims to define a long-term strategic vision for the transition to smart city systems in our country, tailored to national and local specificities. Through the application of Gap analysis, critical gaps in technological integration, cybersecurity, human resource capacity and the regulatory framework in the country have been identified. As a result of the analysis, a conceptual model has been developed, built around four main pillars (technological, environmental, civic and governance), and a Roadmap for phased institutional development and full systemic integration of the Bulgarian smart city has been proposed.*

Keywords: *Smart cities, Intelligent cities, Strategic roadmap, Sustainable urban development, Strategic planning*

JEL: **O18**, **R11, Q01**

1. Introduction

The modern world is in a period of profound changes, driven by the increasing interconnectedness of economies, climate change and the rapid penetration of electronic technologies into all spheres of life. These three processes exert strong pressure on urban spaces. They concentrate the majority of the population and economic activity. The development of smart and sustainable cities is a process that requires adaptation to the specific context. International experience provides valuable lessons, but also clearly shows that universal solutions do not exist. Every successful model is the result of precise consideration of local economic, social, institutional and infrastructural features. (Nam & Pardo, 2011) (Services, 2010) (Dameri, 2013, 11 (5))

In this context, the formulation of a visionary target state for a smart city, tailored to national specifics, becomes an important strategic guideline. For Bulgaria, which is in a transitional stage of its digital transformation, this represents a unique opportunity for qualitative change.

There is a strong disproportionality and division between individual settlements in the country in terms of their readiness to implement smart solutions. This contrast is most clearly seen when comparing several large urban centers (Sofia, Plovdiv, Burgas) and smaller municipalities in the country. While large cities have more serious resources and are implementing partial solutions in transport and administration, smaller settlements lag behind due to lack of capacity and funds.

Based on a thorough Gap analysis, significant gaps in technological integration, infrastructure interoperability, management capacity and the regulatory framework in our country are identified. Achieving the future target state requires the preparation and implementation of strategic solutions that are a systematic response to the root causes of the identified gaps (Grozeva, 2012).

The main goal of this article is to define a long-term vision as a strategic document for the transition to a smart city system in Bulgaria, tailored to national and local specificities.

To achieve this goal, the following tasks have been set:

1. To justify the need for a nationally specific vision for smart cities based on international experience.
2. To outline the gaps in the Bulgarian urban environment through the conclusions from the analysis of the differences.
3. To describe the main dimensions of the visionary target state for the Bulgarian smart city.
4. To propose conceptual guidelines for creating a strategic roadmap to achieve this vision.

2. Literature review and theoretical framework

In recent years, the concept of a “smart city” has changed a lot. It has gone through three main steps. This change shows that people are more important than machines and technology themselves.

- Smart City 1.0 (Technology-Driven). In this first stage, big tech companies led the process. They offered ready-made solutions without asking people what they needed. Technology was put first, and the city was like a testing ground.
- Smart City 2.0 (Led by Municipalities). In the second stage, local governments and municipalities took over. Mayors began to decide how to use technology. The goal was now to improve public transport, cleaning and energy saving. However, the decisions still came only from the government.

- Smart City 3.0 (Created with Citizens). This is the modern stage. Here, people are the most important. Citizens are not just consumers. They are active participants and change the city together with the authorities. Through websites, discussions and meetings, people themselves say what the problems are and come up with solutions. (Nam & Pardo, 2011) (Peltan, 2015) (Shin, и др., 2024, 33 (2)) (Meijer & Bolívar, 2016, 82(2)) (Tappert, Mehan, Tuominen, & Varga, 2024, 9 (1))

Examples from around the world show that the most successful smart cities are those that take into account their people, place, and culture:

- Singapore. The government manages everything centrally. It collects a lot of data and emphasizes security and speed. (Du, Sun, & Huang, 2024)
- Amsterdam. The community works together. People do their own projects for ecology and clean energy.
- Barcelona. The city protects people's rights and their personal data. Free software is used, and citizens vote directly on important decisions. (Calzada, 2020, 33 (1)) (Gascó-Hernandez, 2018, 61(4)) (Ang-Tan & Ang, 2021, 42 (4))

The experience of these cities proves that there is no one-size-fits-all solution. You can't just copy the model of one smart city and move it to another place. This doesn't work for several reasons:

1. Different cultures and habits. The Singapore model requires complete trust in the state. This is difficult to implement in Europe, where laws strictly protect people's privacy.
2. Different financial capabilities. Large and wealthy cities have a lot of money for new technologies, but smaller municipalities do not have the same budget.
3. Different laws and rules. Each city has different laws and different opportunities for the administration to introduce new things.

Any new technology must be adapted to help the specific place and its culture. A smart city is not a ready-made product that can be bought from a store. It is a long process of change, in which the most important thing is the citizens themselves and their common work (Веселинова, 2009).

3. Methodology and results of the Gap Analysis

To understand what is hindering the development of a smart city, a so-called Gap Analysis is used. This method compares **the desired future state** (where we want to be) with

the current real state (where we are now). In this way, the gaps (gaps) that need to be filled are identified. Below are the main gaps, divided into three important areas (Веселинова, 2025).

Connecting technologies and exchanging data

This field studies how computer systems in the city work and whether they can talk to each other.

- Current status (Where we are now). Municipal systems operate in "piecemeal" (in so-called information silos). For example, the public transport system is not connected to the street light system, and air quality data is collected in a completely different place. There are no common data standards.
- Desired state (Where we want to be). All systems should be connected in a common network. Data should be exchanged automatically and in real time to make quick decisions.
- What is the gap (The Gap). The lack of common rules and uniform technical standards stops the exchange of information. When systems are closed to themselves, the city cannot react quickly to problems such as traffic jams or accidents.

Network status and information protection

This addresses the physical facilities (cables, devices) and data security in the city.

- Current status (Where we are now). Much of the city's equipment (pipes, cables, panels) is old. There are not enough sensors to monitor processes. At the same time, there are no uniform rules for protection against hacker attacks (cybersecurity).
- Desired state (Where we want to be). A modern city network with smart devices that are easy to maintain. Citizen data and city management must be fully protected from digital threats (Веселинова, 2025).
- What is the gap (The Gap). Outdated equipment cannot keep up with new software programs. The lack of a unified cybersecurity plan creates a serious risk of disrupting important city services in the event of an attack.

Employee skills and laws

This area encompasses the people who run the city and the rules by which the municipality operates.

- Current status (Where we are now). Municipal administrations lack sufficient IT specialists (IT experts). Salaries in the private sector are higher and municipalities have difficulty attracting young staff. In addition, current laws are cumbersome and do not allow for easy cooperation between the municipality and private business (Public-Private Partnerships - PPP).
- Desired state (Where we want to be). The municipality should have trained employees who understand digital innovations. Laws should be flexible so that businesses can easily invest money and expertise in city projects.
- What is the gap (The Gap). There is a serious deficit of knowledge and skills in the administration. Old laws stop the introduction of new ideas and prevent businesses from helping to finance the smart city.

Table 1

Summary data from the Gap analysis

Research area	Current status	Desired state	Main gap (Void)
Technology and data	Fragmented systems that don't talk to each other.	Common platform and real-time data.	Lack of common connectivity standards.
Infrastructure and security	Outdated equipment and weak protection against hackers.	A modern network with secure data protection.	Lack of money for new equipment and lack of a security plan.
People and laws	Few IT experts and cumbersome partnership laws.	Trained employees and fast laws for dealing with businesses.	Lack of capacity and outdated funding rules.

Source: own interpretation

The analysis shows that building a smart city is not just about buying new computers. The biggest gaps are related to the lack of common operating rules, the need for training people, and the urgent need for changes in laws to allow the city to develop properly (Веселинова, 2018).

4. Visionary goal state

Based on the analysis of the differences, the model of the future smart city system is defined (Figure 1). This system is not just a collection of new machines and computers, but a living environment in which technology serves people. The model is based on four main pillars

that work together and transform the city into a better organized, clean and comfortable place to live.

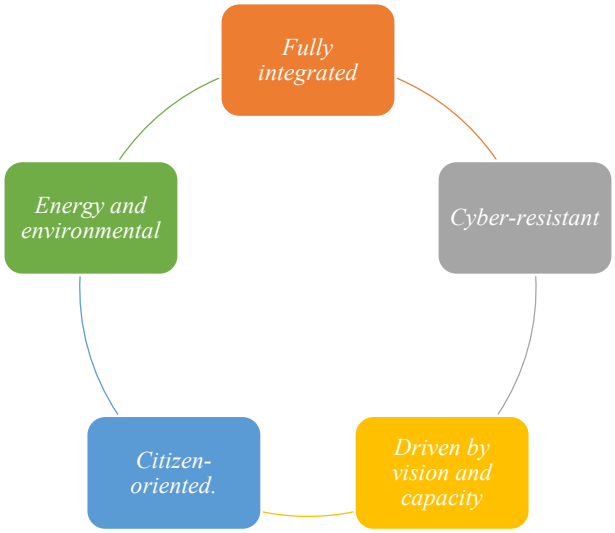

Fig. 1. Model of a future smart city system.

(Source: own interpretation)

The future desired state of the smart city in Bulgaria encompasses five important dimensions. They work together and create a holistic urban environment.

It all starts with the full connection of city systems. In this model, transport, energy, security and cleaning no longer work separately. They are united in a common network. All services exchange information in real time through a common national platform. This allows the municipality to see problems immediately and react quickly (Грозева, 2024).

To ensure that this common computer network is secure, the next important step is protection from digital threats and hacker attacks. All city equipment must be fully protected. The municipality strictly protects people's personal data. In this way, great trust is built in new technologies. Citizens are calm because the system is secure and transparent.

This protected foundation allows for real care for nature and energy saving. The city uses smart networks that distribute electricity and water according to needs. These networks are connected to stations that constantly measure air cleanliness. If pollution occurs, the system immediately signals. Thus, the municipality takes quick measures and keeps the environment clean (Грозева, 2019).

All these technologies have one ultimate goal - caring for people and equal access to services. Digital systems are being built to help every person in every neighborhood. Residents are no longer just bystanders. They become active participants in governance. People use easy-to-use platforms through which they can give ideas, make suggestions, and change their city.
For this to happen, a change in management is also needed, expressed through modern administration with a long-term vision. Municipal employees are developing new skills for working with data. Mayors no longer make decisions based on feelings, but on accurate numbers. At the same time, clear rules are being created for working with private business. Companies are investing their own funds in city projects, which saves money from the municipal budget.

5. Strategic decisions and Roadmap for Bulgarian cities

Managing the transition to a smart city requires building a comprehensive decision-making framework that goes beyond traditional management approaches. This framework is based on the principle of systems analysis and situational management, where each technological implementation is viewed not as an isolated event, but as an element of a larger urban system.

The decision-making process is structured around five sequential phases that ensure scientificity and practical applicability:

1. Urban diagnostics. Identifying specific deficits and challenges (e.g. air pollution, transport delays, energy waste) by collecting quantitative and qualitative data.
2. Capacity and resource assessment. Analysis of available financial resources, technological maturity of existing infrastructure, and levels of human capital training in the municipality.
3. Identification of technological alternatives. Research of possible software and hardware solutions, with priority given to open standards that guarantee future compatibility.
4. Assessment of local suitability. An assessment of how well the chosen solution meets the cultural, social and legal characteristics of the specific locality in order to avoid mechanical and unsuccessful copying of foreign models.
5. Multi-criteria decision making (MCDM). Mathematical and expert-based selection of the most effective project that balances economic profitability, environmental benefit, and social acceptability.

This conceptual framework ensures that investments are directed to projects with the highest added value for the community.

The roadmap is a time- and logically structured action plan. It divides strategic tasks into three time horizons, ensuring a smooth transition from administrative reforms to full technological integration.

Short-term horizon (Time frame: 1 year) - Institutional preparation and capacity building

The focus during the first phase is on removing the regulatory and personnel barriers identified during the gap analysis.

- Regulatory and normative changes. Preparation and adoption of local regulations and standards for data management. Optimization of administrative rules in order to facilitate procedures for long-term cooperation between municipal structures and the private sector. Creation of legal certainty for investments in urban innovations.
- Increasing digital competence. Organizing specialized training programs for municipal administration employees. The courses cover basic and advanced skills in working with geographic information systems (GIS), database management and urban planning software platforms. The goal is to create a core of trained specialists within the municipalities themselves.

Medium-term horizon (Time frame: 2 - 4 years) - Design and sectoral integration

The second phase moves towards actual implementation of the technologies in key sectors of urban life, building the first elements of the common network.

- Building pilot platforms. Developing and testing the core of the Unified National Platform in selected municipalities (pilot cities). This platform begins to unify data streams from different sources and provides their primary processing.
- Integration of critical sectors.
    - Transport and mobility. Implementation of adaptive traffic management systems through smart traffic lights and motion sensors. Digitalization of urban transport with real-time tracking and smart passenger charging.
    - Energy. Integration of smart meters in the municipal education and healthcare infrastructure. Introduction of automated energy consumption management systems and first steps towards the inclusion of local renewable energy sources in the city grid.

Long-term horizon (Time frame: 5+ years) - Full system integration

The final phase achieves full maturity of the smart city, where technology, governance, and citizens function in continuous interaction.

- Full system connectivity. All city subsystems (transport, energy, security, waste management, environmental monitoring) are fully integrated through the Unified National Platform. Data is automatically exchanged and analyzed in real time, allowing for automated operational decision-making in crisis situations or daily city processes.
- Mass civic participation. Digital platforms for co-creation and e-democracy are becoming a major tool for urban planning. Citizens actively participate in the allocation of local budgets, propose and vote on projects for the development of the urban environment, and exercise constant civic control over the activities of the administration. The city functions as a shared, self-organizing, and sustainable system.

6. Conclusion

This study offers a comprehensive view of the process of building smart cities in Bulgaria. The main contribution of the work lies in the detailed tracing of the evolution of the smart city concept and its shift from purely technological solutions to models that place citizens and their real needs at the center of the process. By applying the gap analysis method, the main challenges facing Bulgarian municipalities were clearly defined, related to the lack of technical standards, outdated infrastructure, administrative staff and cumbersome laws. The developed conceptual framework and the proposed roadmap provide practical steps and a clear action plan that can help local authorities transform cities into cleaner, safer and more comfortable places to live.

Of course, this study has its limitations. The analysis is based primarily on current theoretical models and general data for the country, without examining in detail the specific financial and geographical differences between individual Bulgarian municipalities. Future scientific research should focus on studying specific examples from practice in smaller settlements. The development of accurate mathematical models for assessing the economic efficiency of implementing smart technologies in the context of limited municipal budgets is also of interest for subsequent analyses.

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