Socio-Economic Significance of Intelligent Cities

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Received: 20.05.2026 Accepted: 29.05.2026 Published: 30.06.2026
https://doi.org/10.54414/WRNI6598

Abstract

This article examines the socio-economic significance of the Smart City concept in the context of global urbanization and digital transformation. Based on an analysis of international experience and data from leading analytical agencies, the key economic and social effects of implementing smart technologies in the urban environment are systematized. Issues related to improving the quality of life of the population, the development of digital infrastructure, and electronic public governance are considered. Special attention is given to the role of management as a system-forming factor in the implementation of Smart City projects. The author proposes a system of key performance indicators (KPIs) for smart city management across six domains, verified in accordance with ISO 37120 standards and international best practices.

Keywords: intelligent city, Smart City, digital transformation, socio-economic effects, e-government, urban governance, KPIs, management

1.Introduction

Over the past two decades, the Smart City concept has evolved from a futuristic idea into one of the central directions of public policy and urban studies. The rapid growth of the global urban population — according to UN projections, by 2050 approximately 68% of the world's population will live in urban areas (DESA, 2020, p. 67) — is placing unprecedented pressure on infrastructure, transport systems, resource bases, and governance institutions.

Traditional approaches to urban governance are proving insufficient to address these challenges. In this context, smart cities are emerging as a strategic response to the problems of urbanization: the integration of digital technologies, big data, the Internet of Things (IoT), artificial intelligence, and platform-based solutions into the urban environment is intended to fundamentally enhance the efficiency of resource management and improve the quality of life of citizens.

However, at the same time, an essential part of scientific research is devoted to the technological aspects of Smart Cities, neglecting any consideration of their socio-economic impacts and management tools. The purpose of this paper is to address this problem by systematizing the existing information about the economic and social impact of smart cities and by defining the role of management in the implementation of smart city projects using the example of Azerbaijan. The Concept of the Smart City: Evolution and Contemporary Understanding. The definition of the term "smart city" has never been universal. Scholars have frequently questioned whether the "smart city" label aligns with actual urban needs or remains a marketing construct that overlooks social and cultural complexities (Hollands, 2008). The notion was introduced into academic literature in the late 1990s in works devoted to the issue of information technologies in the urban environment.

The definition of Caragliu, Del Bo, and Nijkamp presents the classical interpretation of the phenomenon: smart city is defined as an environment, where investment in human and social capital as

well as traditional (transportation) and modern (ICT) communication infrastructure ensures sustainable economic development and high quality of life, while preserving natural resources effectively (Caragliu et al., 2011, p. 70).

In the process of development, the following generations can be identified: technological determinism that prevailed in the first generation of the concept (2000s). A good example is the city of Songdo in South Korea, constructed from scratch as an ideal smart city, but criticized for disregarding the organic nature of the urban environment.

The second wave (2010s) changed the emphasis from development for the sake of development to generating value for the citizens – open data, platforms, and ecosystem, City OS of Barcelona. The third and current generation (2020s) puts man at its heart: digital citizens' rights, data sovereignty, artificial intelligence ethics, and inclusiveness.

The most important lesson from this evolution is that technology is just a tool, not an ultimate goal. The question "Which technologies are to be deployed?" becomes secondary to the question "Which issues of the urbanites need to be addressed?" This is the very approach that makes the best contemporary Smart City strategies work.

2. Economic Dimension of Smart Cities

The economic potential of smart cities is considered highly significant. According to estimates by the McKinsey Global Institute, Smart City technologies are capable of generating an additional economic impact equivalent to 1–3% of a city's gross regional product annually. This estimate is supported by an analysis of specific implementation areas. Let us consider the main economic effects by key domains.

Table 1. *Economic effects of Smart City technologies*

Direction	Economic effect	Source
Intelligent Transport Systems (ITS)	Reduced congestion losses by 15–25%; fuel savings of up to 12%	McKinsey, 2018
Predictive maintenance of housing and communal services (HCS)	Reduce maintenance costs by 10-25%; reduce downtime by 35-45%	Deloitte, 2020
Smart Grid (intelligent power grids)	Reduce network losses by 10–15%; save up to 50% on lighting	IEA, 2022
Digital government services	Reducing administrative costs by 15–30%; de-shadowing the economy	ВЭФ, 2021
Waste management	Reducing operating costs for waste collection and disposal by 30–40%	Waste360, 2019

(Source: compiled by the author based on data from McKinsey GI, Deloitte, IEA, and WEF.)

The integration of digital technologies into urban governance is a critical driver for achieving sustainable development, as strategic deployment of these solutions helps align local infrastructure with broader global economic goals (World Economic Forum, 2020). The return on investment (ROI) analysis

for individual areas deserves special attention. Smart lighting (approximately 200%), telemedicine (175%), and predictive utility services (165%) demonstrate the highest ROI over a five-year period. A medium-term return on investment horizon is typical for intelligent transport systems (5–9 years), while Smart Grid infrastructure and digital service platforms are focused on long-term effects (8–12 years) with maximum synergy potential (McKinsey, 2018, p. 152).

Most importantly, making use of the economic opportunities of smart cities will require not just having appropriate technologies, but the appropriateness of organizational mechanisms that implement those technologies. The absence of such mechanisms results in failures in achieving the expected outcomes of the projects implemented, as proven by the research on Smart City failures.

Social Implications of Smart Solutions. The social aspect of smart cities is as important as the economic one. It includes four major fields: healthcare, public safety, mobility, and the environment. In healthcare, intelligent monitoring and telemedicine systems can reduce ambulance response times by 25–35%, reduce mortality from acute cardiovascular events by 15–20% (according to The Lancet, 2021), and decrease the number of planned hospitalizations by 15–20% through remote patient management. (Dorsey & Topol, 2016, p. 159).

These results have been achieved, in particular, through smart healthcare programs in Copenhagen and Amsterdam. In the area of public safety, the use of video analytics and predictive policing systems has reduced street crime by 10-15%, traffic accidents by 20-30%, and emergency response times to less than 7 minutes in several UK cities and Singapore.

Transport mobility is one of the most tangible impacts of smart technologies for city residents. According to INRIX (2022), losses from traffic congestion in the world's 50 largest cities exceed $200 billion per year. Intelligent transport systems (ITS) can reduce traffic jams by 20–30% and lower fuel consumption by up to 12%. First of all, it is necessary to mention that with the help of intelligent optimization of traffic lights, Barcelona has managed to reduce the time spent on moving by 21%.

Smart technologies show great achievements in the field of ecology. The European Environment Agency (EEA, 2022) says that PM2.5 concentration in cities where there is a highly developed environmental monitoring system has dropped by 8-12%. Copenhagen has managed to decrease CO_2 emissions by 42% compared to 2005. Barcelona saves €37 million per year on lighting due to the use of adaptive control systems (European Environment Agency, 2022, p.148).

On the other hand, it is necessary to emphasize a crucial problem in most Smart Cities – the fact that the benefits of using digital technologies are unequally distributed. Those citizens who have low digital skills, the elderly, and low-income people may get into a "second-order digital divide". The necessity of inclusive design and digital literacy programs should be mentioned in order to guarantee social justice.

3. The Role of Management in Smart City Development

The analysis of international experience shows quite clearly that the quality of management becomes much more important in terms of the success or failure of the Smart City project compared to the choice of technology used. This hypothesis is proven by several examples of failures.

Firstly, the project Sidewalk Toronto of Google was suspended in 2020, not because of any problems with technology, but because of the failure of dialogue with the civil society regarding the use of data and digital rights. Secondly, the Smart Cities Mission project in India faced certain systemic challenges in the coordination of federal, regional, and municipal governments. Thirdly, PlanIT Valley in Portugal remained only at the conceptual level, among other things, because of the overestimation of technology's development and lack of attention to the naturalness of urban communities.

The identified failure patterns allow us to formulate key management requirements for the implementation of Smart City projects. First, a "needs-driven approach" is essential: the strategy must be

based on the actual needs of city residents, rather than on the desire to implement advanced technologies for the sake of implementation.

Secondly, interdepartmental coordination is crucial: a smart city permeates all city systems, so fragmented departmental governance (the "silo problem") leads to incompatible decisions and duplicated costs. Thirdly, an institutional coordination mechanism is necessary—the creation of a Smart City project office with cross-departmental authority and direct reporting to the head of administration.

This article proposes a proprietary system of smart city management KPIs, structured across six domains (Table 2), developed on the basis of ISO 37120 and ISO 37122 standards, as well as methodological documents of the World Economic Forum. The development of a balanced framework for assessing urban intelligence is essential, as foundational studies have highlighted the multidimensional nature of smart city ranking and performance criteria (Giffinger et al., 2007).

Table 2. *Author's system of KPIs for smart city management*

Domain	Key Performance Indicators
Digital services	Share of online services ≥ 95%; NPS index > 70; average service provision time < 1 business day
Transport	Increase in average speed by 15%; decrease in the number of accidents by 25%; share of passengers in public transport > 50%.
Energy and housing and communal services	Reduction of specific energy consumption by 20%; network losses < 7%; reduction of accidents by 30%
Safety	15% reduction in crime; emergency response time < 7 minutes
Environment	PM2.5 concentration < 15 μg/m³; CO_2 emissions reduction by 20% by 2030
Civic participation	Coverage of participation platforms by ≥ 20% of residents; implementation of at least 30% of civic initiatives

(Source: developed by the author based on ISO 37120, ISO 37122, WEF (2021).)

4. Conclusion

The analysis allows us to formulate the following conclusions.

1. The smart city has evolved from technological determinism to a human-centered paradigm. The modern concept of Smart City views technology as a tool for solving specific urban problems, rather than as an end in itself.
2. The economic potential of smart cities amounts to 1–3% of GRP annually and is realized through the reduction of transaction costs, optimization of resource consumption, and increased productivity of urban systems.
3. Social advantages include health care, safety, transportation, and environmental concerns; however, such advantages are not equally shared. An inclusionary strategy is important for the social sustainability of the Smart City initiative.

4. Management is a systemic element that influences more the success or failure of the smart city initiative than the technological selection process itself. Establishment of the project office with the cross-departmental mandate is an important organizational step.
5. The proposed proprietary KPI system in six areas (digital services, transportation, energy, security, ecology, and participation) provides the means to measure the effectiveness of the implementation of the Smart City strategies.

Suggestions that would be applicable for government organizations can be outlined as follows: using the "needs-driven approach" as the foundation for city strategy methodology; establishing project offices for digital transformation with inter-departmental authority; developing a KPI framework for the suggested six domains; and using open standards and APIs for platform selection. Furthermore, the institutionalization of smart city projects should be guided by internationally recognized standardization frameworks, such as ISO 37120, to ensure the comparability and sustainability of urban performance metrics across different regions (ISO, 2018).

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