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Formation and Improvement of Public Administration Methods for Smart City Governance in Ukraine's Agglomeration Centres: Challenges, Tools, and Methodological Approaches

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ABSTRACT

The article substantiates theoretical and methodological approaches to the formation and improvement of public administration methods for Smart City governance in Ukraine's agglomeration centres under conditions of digital transformation and wartime challenges. It is determined that Smart City should be considered not as a set of technological solutions, but as an integrated public administration system based on strategic planning, project management, data governance, and stakeholder communication. The study identifies key conceptual, institutional, financial, technological, and security challenges in implementing Smart City in large urban agglomerations. Special attention is paid to the transformation of Smart City into a resilience tool under war conditions, ensuring continuity of critical services, infrastructure stability, and adaptive governance. An instrumental model for improving public administration methods through Smart City tools is proposed, integrating strategic, operational, analytical, and communication blocks into a unified governance framework. Based on international methodologies and Ukrainian realities, a scientific and methodological approach to ranking Smart City readiness in Ukraine is developed using an integrated Smart Governance Index. The Lviv Agglomeration Association is analysed as a practical case demonstrating effective intermunicipal cooperation and the transition from Smart City to Smart Agglomeration governance. The results confirm that Smart City effectiveness depends on the integration of digital tools into public administration methods and the formation of institutionalised governance models. The proposed model can serve as a basis for improving Smart City governance in Ukraine's agglomeration centres and enhancing their resilience and sustainable development.

KEYWORDS

Smart City; public administration; agglomeration; digital governance; resilience; Smart Governance Index; Lviv agglomeration.

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Формування та удосконалення методів публічного адміністрування Smart City в агломераційних центрах України: проблеми, інструменти та методологічні підходи

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АНОТАЦІЯ

У статті обґрунтовано необхідність переходу від технологічного розуміння Smart City до управлінсько-інституційного підходу, за якого цифрові інструменти розглядаються як засоби операціоналізації методів публічного адміністрування в агломераційних центрах України. Визначено, що ключові бар'єри смартизації в агломераціях мають багатовимірний характер і поєднують концептуальну невизначеність, інституційну фрагментацію, дефіцит координації та даних, ризики цифрової нерівності й алгоритмічної непрозорості, а також виклики кібербезпеки та стійкості критичної інфраструктури. Доведено, що воєнний контекст трансформує пріоритети Smart City у напрямі життєстійкості (resilience) та безперервності публічних послуг, посилюючи потребу в комплексній моделі адміністрування на рівні агломерації. Запропоновано інструментальну модель удосконалення методів публічного адміністрування в Smart City (поєднання стратегування, програмно-проєктного управління, data governance та комунікаційних механізмів), а також модель комплексного адміністрування Smart City в агломераційному центрі зі стратегічним, операційним, аналітичним і комунікаційним блоками. Практичну релевантність агломераційного підходу проілюстровано на прикладі Асоціації органів місцевого самоврядування «Львівська агломерація» як платформи горизонтальної координації, реалізації міжмуніципальних проєктів і міжнародної інтеграції. Додатково сформовано методологічний підхід до оцінювання готовності та ранжування Smart City в Україні через інтегральний індекс із нормалізацією показників, вагуванням і включенням домену життєстійкості, що дозволяє адаптувати міжнародні вимірювальні підходи до умов війни та післявоєнного відновлення.

КЛЮЧОВІ СЛОВА

публічне адміністрування; Smart City; агломераційні центри; міжмуніципальне співробітництво; е-урядування; data governance; життєстійкість; оцінювання та ранжування.

1. Introduction

The digital transformation of public administration is one of the key features of the development of modern urbanized systems and an important factor in improving the efficiency of cities and agglomeration centers. In this context, the concept of Smart City is gaining importance not only as a technological direction for the modernization of the urban environment, but as a management paradigm focused on the integration of digital technologies, data and institutional mechanisms into the management decision-making process. This approach involves considering Smart City not as a set of separate digital solutions, but as a tool for updating public administration methods aimed at increasing efficiency, openness and adaptability of management.

In the international dimension, Smart City is considered as one of the means of achieving the Sustainable Development Goals and improving the quality of urban governance, in particular in the context of the implementation of the UN Sustainable Development Goals [20]. At the same time, digital solutions are evaluated not only in terms of technological innovation, but primarily by their contribution to social cohesion, environmental sustainability and the effectiveness of public administration [19].

This issue is of particular relevance for agglomeration centers, the development of which is accompanied by a high concentration of population, significant infrastructure loads, a complex multi-level management system and the need for coordination between territorial communities. Under such conditions, the effectiveness of Smart City depends not only on the availability of digital solutions, but also on the ability of public authorities to ensure strategic coordination of actions, intermunicipal interaction, openness of data and an appropriate level of institutional capacity [3].

An important component of Smart City development is ensuring transparency of public administration, expanding e-governance practices and using open data as a tool to improve the quality of management processes [9]. At the same time, modern challenges in the development of public administration actualize the need to modernize the mechanisms of interaction between public authorities, business and civil society, which is a necessary prerequisite for the effective functioning of Smart City, especially within agglomeration systems [18].

In this context, intersectoral partnership is of particular importance, which ensures the pooling of resources, competencies and institutional capabilities of different participants in the development of urban space. At the same time, SMART infrastructure should be considered as an integrated system of technical, organizational and information components that ensure the manageability of urban processes and sustainable development, and not as a set of isolated IT solutions [16]. No less important is the organizational component, in particular the effective management of human resources, which determines the ability of the public administration system to introduce innovative approaches and support sustainable development [14].

In the context of digitalization, military challenges and post-war recovery, the formation of new methods of public administration of Smart City, based on the integration of digital technologies, data management and intermunicipal coordination, is of particular importance. This necessitates a transition from the fragmented implementation of digital tools to the formation of a holistic management approach capable of ensuring the effective functioning of urban systems in the agglomeration centers of Ukraine [7].

2. Literature Review

In modern scientific discourse, the concept of Smart City is considered a comprehensive model of urban development management that combines digital technologies, institutional mechanisms and public administration tools. One of the fundamental studies in this area is the work H. Chourabi et al. [1], which proposes an integrative model of Smart City development factors, which includes technological, organizational, institutional and social components of the functioning of urban systems. This approach emphasizes that the effectiveness of a smart city is determined not only by technological solutions, but also by the ability of authorities to integrate digital tools into management decision-making processes.

In international studies, considerable attention is paid to the institutional dimension of the digital transformation of the public sector. In particular, analytical materials of the Organization for Economic Co-operation and Development emphasize the need to transition to a data-driven public sector, in which

management decisions are based on the systematic use of data, interagency interoperability of information systems, and the development of data governance mechanisms [12]. This approach contributes to increasing the efficiency of public administration, transparency of government activities and the quality of public services.

The problems of Smart City development are also closely related to the global Sustainable Development Goals. The United Nations policy document "Transforming our world: the 2030 Agenda for Sustainable Development" emphasizes the importance of using innovative technologies and digital solutions to ensure the sustainable development of cities, increase their environmental sustainability and social inclusion [20]. Further development of this idea is presented in UN-Habitat reports, where Smart City is considered as a tool for improving the efficiency of urban governance and ensuring climate and social sustainability of urbanized areas [19].

In the domestic scientific literature, the issues of Smart City development are studied in the context of modernization of the public administration system, digitalization of state institutions and the formation of new models of interaction between government, business and civil society. In particular, H. Komarnytska [9] considers Smart City as a component of the open data and e-governance system, emphasizing its role in ensuring the transparency of management processes and the development of electronic services for citizens.

A separate area of research concerns the modernization of mechanisms of interaction between public authorities, business and civil society in the process of digital transformation. Reshota's works emphasize that the effectiveness of public administration in the face of modern challenges largely depends on the development of cross-sectoral partnerships and institutional mechanisms of cooperation between various subjects of public relations [18].

An important contribution to the study of institutional and technological aspects of Smart City development is made in the works of N. Podolchak et al. In particular, the works on SMART reconstruction substantiate the role of digital technologies as a tool for modernizing the public administration system and accelerating the post-war restoration of territories [15]. The researchers also emphasize the importance of innovation infrastructure and public administration mechanisms in the formation of prerequisites for the development of Industry 4.0 and the digital economy [13].

In the context of the study of institutional mechanisms for the development of smart infrastructure of cities, the works of Protsiuk are of great importance, in which the conceptual foundations of the interpretation of SMART infrastructure as an integrated system of technical, organizational and information components of the urban environment are substantiated [16]. The researcher also emphasizes the importance of cross-sectoral partnerships in the development of smart infrastructure and the formation of effective models of urban systems management [17].

A separate area of scientific research concerns the managerial aspects of the formation of Smart City systems in the context of state-building and strategic processes of territorial development. In the works of B. Karpinsky et al. The conceptual foundations of smart-urbanism, which provide for the integration of strategic management, digital tools and institutional mechanisms for the development of urban agglomerations, are considered [8]. Further research by these authors is devoted to the formation of a system of smart infrastructure and strategic architectonics of urban agglomeration management [6; 7].

At the same time, in modern conditions, the study of the role of digital tools in ensuring the adaptability of the public administration system to crises and emergencies is of particular importance. In this context, O. Herasymenko et al. [4] substantiate the importance of digital technologies as a tool for adapting public administration to crisis challenges, in particular in wartime.

Thus, the analysis of scientific sources indicates the formation of a comprehensive interdisciplinary approach to the study of Smart City, which combines technological, managerial, institutional and social aspects of the development of urbanized areas. At the same time, the scientific literature does not pay enough attention to the problem of integrating digital tools into the system of public administration methods at the level of urban agglomerations, which necessitates further research in this direction.

3. Problem Statement

The analysis of scientific sources shows that most of the Smart City studies focus on the technological aspects of digitalization of urban systems or individual e-governance tools. At the same

time, the issue of integrating digital tools into the system of public administration methods remains insufficiently studied, especially at the level of urban agglomerations, where management is characterized by multi-level and requires coordination between territorial communities.

In the context of digital transformation and modern security challenges, there is a growing need to form new management approaches that can ensure a combination of strategic planning, data management, software and project mechanisms, and interaction with stakeholders in the Smart City development system.

The article is aimed at the theoretical and methodological substantiation of the directions of formation and improvement of methods of public administration of Smart City in agglomeration centers of Ukraine.

To achieve this goal, the following research tasks are defined:

– to analyze modern approaches to the interpretation of the Smart City concept in the public administration system;

– identify key institutional and managerial challenges for the implementation of Smart City in agglomeration centers;

– to substantiate an instrumental model for improving public administration methods based on digital tools;

– to investigate the role of intermunicipal cooperation in the formation of the SMART governance system at the level of agglomerations.

4. Methods and Materials

The methodological basis of the study is an interdisciplinary approach that combines the provisions of the theory of public administration, urban studies, digital governance and the concept of Smart City. This approach allows us to consider the development of Smart City as a component of the transformation of the public administration system in the context of digitalization and the growing role of data in management decision-making.

The information base of the study consists of scientific works of domestic and foreign scientists in the field of public administration and digital transformation, international analytical documents, as well as materials on the functioning of agglomeration centers of Ukraine, in particular, the Lviv agglomeration.

In the process of research, a complex of general scientific and special methods was used. The method of theoretical generalization is used to systematize scientific approaches to determining the essence and role of Smart City in the public administration system. The method of system analysis made it possible to consider Smart City as a complex management system that integrates strategic, organizational and information-analytical components of territorial development management. The comparative method is used to analyze the institutional and digital parameters of the development of agglomeration centers, in particular Lviv and Krakow agglomerations. The modeling method is used to develop a conceptual model for improving the methods of public administration of Smart City. The graphical method is used to visualize the results of the study.

The application of these methods ensured the comprehensive nature of the study and made it possible to substantiate the directions for improving the methods of public administration of Smart City in the agglomeration centers of Ukraine.

5. Results and Discussion

The modern discourse of Smart City in public administration is increasingly shifting from the technological interpretation of the “smart city” to the managerial and institutional paradigm, within which digital solutions perform the function of operationalization of public administration methods, ensuring the achievability of strategic goals, the evidence of managerial decisions and the accountability of the authorities [1; 11]. For agglomeration centers, this is of fundamental importance, since agglomeration as a form of spatial organization of development exacerbates the problem of fragmentation of powers, resources and data between the core and peripheral communities, and therefore requires supramunicipal coordination, common data management standards and coordinated project management tools.

In Ukrainian conditions, the agglomeration dimension of Smart City is strengthened by two circumstances. Firstly, the intensity of recovery processes and the competition of budget priorities (security, critical infrastructure, social protection) objectively shift the emphasis from "smart comfort services" to "smart life support services". Secondly, the war actualizes the dimension of resilience as an integral characteristic of managerial capacity: the ability to ensure continuity of services, crisis communication, redundancy of critical systems, cyber defense, and manageability of resource flows. In view of this, it is advisable to expand the Smart City toolkit through digital solutions for crisis response and adaptation of management to emergencies, which is confirmed by the results of research on digital tools for anti-crisis adaptation of public administration [4]. Accordingly, "smart" in war conditions serves not so much to provide comfort as to ensure the controllability and continuity of critical functions of the urban system [19]. In this sense, Smart City is considered as a management infrastructure that supports the continuity of the management cycle – from planning and allocation of resources to monitoring results and feedback from citizens [9; 18].

To systematize the internal characteristics and external conditions of Smart City functioning in the agglomerations of Ukraine, it is advisable to use a SWOT analysis, which allows not only to describe the problems, but also to show their structural interconnectedness with the development potential and risks of the environment.

Table 1. SWOT analysis of the functioning of Smart City in the agglomerations of Ukraine

Category	Contents
Strengths	Developed IT and digital services sector in large cities; active involvement of international technical assistance; the presence of examples of leadership (Kyiv, Lviv, Dnipro); experience in e-governance and open data; adaptability of municipal management in crisis conditions
Weaknesses	Lack of a regulatory definition of Smart City; institutional dispersion; shortage of personnel; lack of strategic Smart City documents; incompatibility of information systems between communities
Opportunities	European integration vector; using reconstruction as a trigger for modernization; creation of agglomeration management structures; institutionalization of Smart City at the level of law; development of public-private partnership
Threats	Military risks; energy instability; cyberattacks; reduction of the development budget; Increasing digital inequality between communities

Source: Developed by the author.

The explanatory and analytical value of Table 1 is to identify the "core" of constraints of a managerial nature: the insufficiency of the institutional architecture of digital transformation (coordination structures, distribution of roles, data management centers), limited human capacity (analytics, data governance, project management), incompatibility of information systems and lack of tools for coordinated financing of digital and infrastructure components. At the same time, even with the presence of strengths (community activity, open data, partnerships, projectivity), the key threat is the increasing development asymmetry between the core and the periphery of agglomerations, which manifests itself in different digital capacities and uneven access to services and data. This approach is consistent with the logic of the formation of a data-driven public sector, where management decisions are based on standardized data, interagency interoperability, and mature data management procedures [12]. In this context, data governance is not a technical module, but an institutional mechanism for ensuring data quality, transparency and accountability of governance. The concept of SMART reconstruction emphasizes that innovations and digital technologies should be integrated into the public administration system as tools to accelerate recovery, increase transparency and efficiency of decisions [15]. At the same time, the development of innovation infrastructure and mechanisms of public administration in the logic of Industry 4.0 forms the prerequisites for technological and institutional strengthening of agglomeration centers [13].

The results of the theoretical and methodological analysis allow us to substantiate that the "weak link" of smartization in agglomeration centers is not the shortage of technologies as such, but the deficit of managerial mechanisms for their integration into the methods of public administration. Therefore, it is advisable to consider the improvement of methods as a process of institutionalization of digital tools in four interrelated dimensions: strategizing (goals, priorities, indicators), program and project management (project portfolio), data governance (data governance) and communication and participatory mechanisms (legitimacy, policy co-creation).

The visualization of these relationships is presented in Figure 1, which reflects an instrumental model for improving the methods of public administration of Smart City in agglomeration centers.

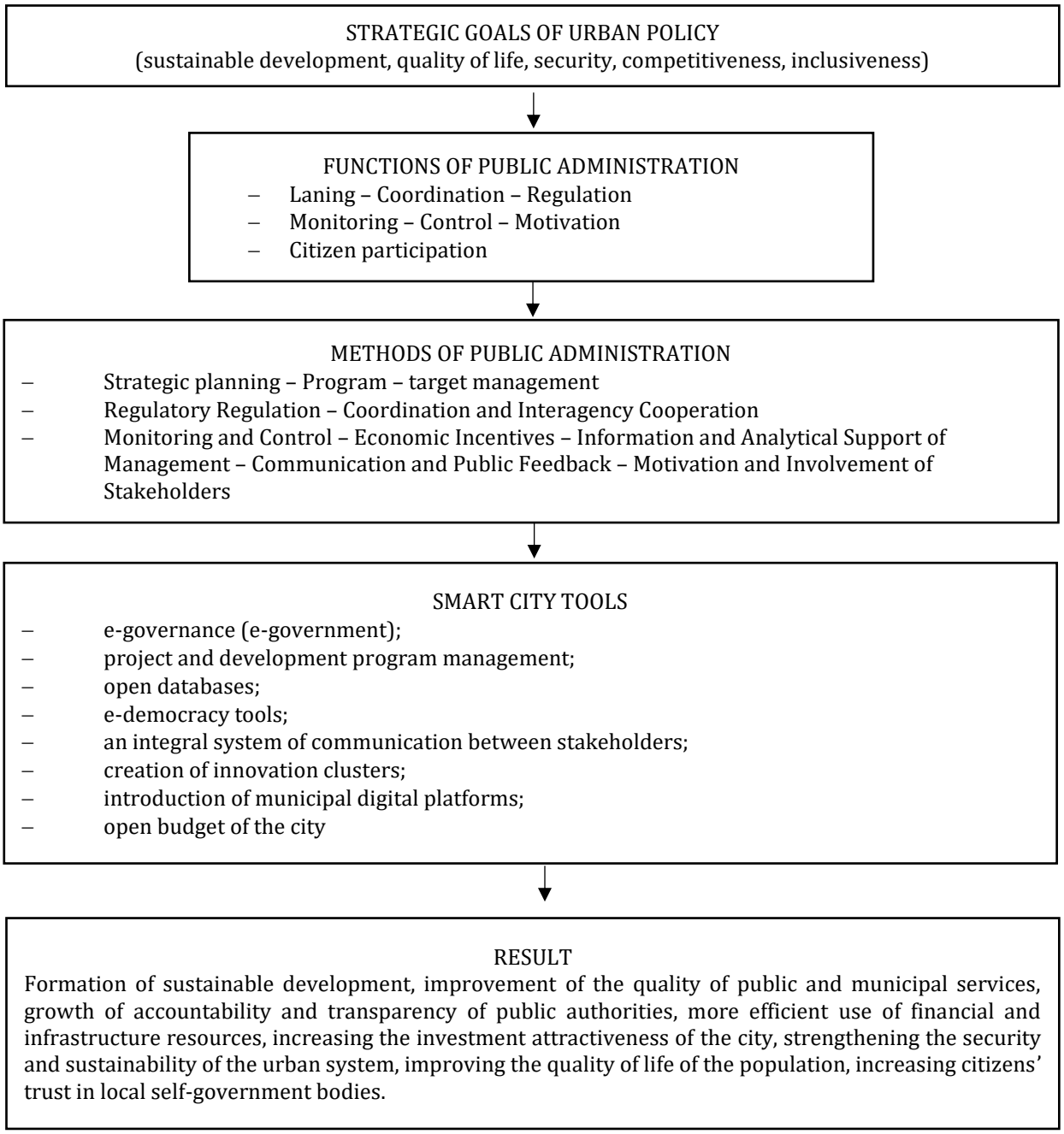

Figure 1. Instrumental model for improving public administration methods in Smart City

Source: Developed by the author.

The proposed model demonstrates the integration of strategic, project, analytical and communication dimensions of management into a single system that ensures the transformation of digital tools into effective management mechanisms. This makes it possible to conceptualize Smart City not as a set of technological solutions, but as an institutionally designed model of public administration focused on achieving measurable results in the development of agglomeration systems. The analytical interpretation of Figure 1 is that Smart City tools do not replace public administration methods, but enhance their functionality: administrative and legal methods become "digital by default", economic methods become more accurate and transparent thanks to data and digital calculations, social and communicative methods are more targeted through digital channels of participation and feedback, and information and analytical methods are system-forming for data-driven governance [1; 11]. As a result, the Smart City effect is manifested not in the number of platforms, but in the ability of the authorities to link strategy, resources, data, and projects into a single system of accountable governance.

Further results of the study are to conceptualize a comprehensive model of Smart City administration in agglomeration centers, which takes into account multi-level management, heterogeneity of stakeholders and the supramunicipal nature of key policies (mobility, waste, ecology, energy, spatial development). Within this logic, a Smart City in an agglomeration should be considered as a management system consisting of strategic, operational, analytical, and communication blocks, the interaction of which provides a link between political priorities, project implementation, data, and the legitimacy of decisions.

In this context, an important empirical marker is government and partnership approaches to measuring the digital capacity of territories. In particular, the Ministry of Digital Transformation of Ukraine, together with partners, developed an approach to index assessment of the digital transformation of regions. The practice of indexing is used as a tool for comparability and management diagnostics, which can potentially be adapted to the agglomeration level (with decomposition into a core/periphery). It is the index approach in Smart City governance that allows you to move from declarative to measurable, which is critical for recovery management and trust in policy outcomes.

Figure 2 shows a structural model of integrated Smart City administration in an agglomeration center, which illustrates the logic of combining strategic management, software and project implementation, data management, and communication with stakeholders into a single integrated system. The proposed scheme reflects the cyclical nature of the management process and demonstrates that Smart City does not function as a set of separate digital solutions, but as a holistic management architecture.

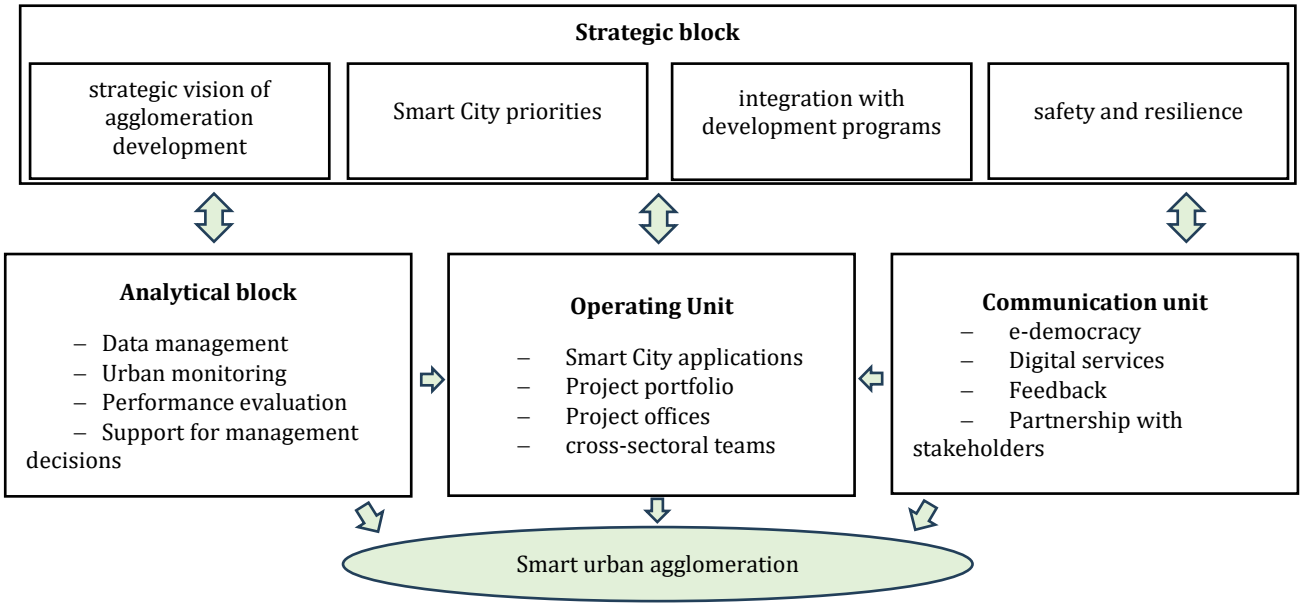

Figure 2. Model of integrated administration of the Smart City system in the agglomeration center

Source: Developed by the author.

First, the key resource of integrated administration is not only technology and funding, but institutional architecture: the presence of coordinating roles (responsible for digital transformation and data), interoperability rules, project portfolio management procedures, and accountability mechanisms. Secondly, for the agglomeration level, supramunicipal coordination becomes decisive, without which digital solutions reproduce the fragmentation of management: different communities accumulate incompatible data and services, which does not allow scaling solutions and obtaining a synergistic effect. That is why the institutions of intermunicipal interaction should be considered as an element of the "managerial framework" of the Smart City agglomeration.

The practical relevance of this thesis is demonstrated by the activities of the Association of Local Self-Government Bodies "Lviv Agglomeration", which unites the Lviv City Territorial Community as the core and 12 neighboring communities, providing a framework of horizontal coordination for integrated socio-economic, spatial and environmental development. It is important that the institutional evolution of the Association (expansion of the composition in 2025 due to the accession of Pidberiztsi, Obroshyn and Murovanska communities) strengthens its representativeness and resource base, and the project portfolio (MSW management 2025–2035 with the preparation of an intermunicipal agreement; logistics

hub concept; environmental initiatives; mobility and accessibility) demonstrates the actual implementation of the operational block of the integrated Smart City model at the supramunicipal level. In addition, international integration results (membership in OASC, participation in Metrex and Metropolis, international recognition through the Seoul Smart City Prize 2025) create conditions for implementation of interoperability standards and ethical data management as a necessary component of smart governance.

Thus, the case of the Lviv agglomeration confirms that the Smart City in the agglomeration center requires institutionalization of coordination mechanisms, otherwise, digital transformation remains a set of local services without a supramunicipal effect. In the war and post-war context, this acquires additional importance, since it is the agglomeration level that creates the prerequisites for coordinated management of critical infrastructure, transport accessibility, and recovery based on data corresponds to approaches to modernizing the interaction between government, business and civil society [15] and the development of cross-sectoral partnerships in the field of smart infrastructure [17].

A separate result of the study is to substantiate the methodological framework for assessing the readiness of Smart City for agglomeration centers of Ukraine, which should combine two dimensions: (1) digital capacity (availability of services, data, digital transformation institutions, personnel and processes), (2) resilience (stability of critical services, redundancy, cyber protection, crisis management and communication). The practice of the index approach, which was used at the regional level as part of digital transformation, is useful as a basis for the development of an agglomeration index, but it requires adaptation to the "core-periphery" logic and taking into account war risks.

In this sense, it is advisable to move from "assessing the availability of digital solutions" to "assessing the managerial capacity to use digital solutions as methods of public administration", i.e. evaluating not only the tools, but also the institutional procedures for their application. This allows us to consider the Smart City as a management system, and not as a technological set, consistent with the approaches to Smart City in open data and e-governance [9] and with an emphasis on the value principles of strategic adaptation of public administration in agglomeration centers [3].

Consideration of the Smart City as an integral management system objectively necessitates the transition from the local level of digitalization of an individual community to the agglomeration level of coordination, since the key functional subsystems of the smart city – mobility, waste management, environmental monitoring, engineering and social infrastructure – by their nature go beyond the boundaries of one administrative-territorial unit. In this context, the institutional dimension of Smart City is fundamentally important, which determines the ability of public authorities to ensure the consistency of management methods, data integration and synchronization of strategic priorities at the level of the entire agglomeration system.

A comparative analysis of European agglomeration centers confirms the decisive role of inter-municipal coordination as a basic factor in the effectiveness of Smart City. In particular, in the Krakowski Metropolitan Metropolitan Municipality (Krakowski Obszar Metropolitalny), the institutional formalization of cooperation between the core and adjacent communes made it possible to create an integrated system for managing mobility, digital services and spatial development, functioning on the basis of common data standards and joint strategic documents. provided the ability to scale digital solutions to the entire agglomeration, avoid duplication of functions and increase the efficiency of resource use, which, according to European Smart Governance approaches, is considered as a key criterion for the institutional maturity of Smart City [9; 11].

At the same time, in the case of agglomeration centers of Ukraine, including Lviv, the process of forming a similar institutional architecture is at the stage of formation, which necessitates the creation of organizational platforms capable of ensuring the systematic integration of public administration methods within the agglomeration. That is why the next logical stage of the analysis is to consider the practical implementation of this approach on the example of the Association of Local Self-Government Bodies "Lviv Agglomeration", which acts as an institutional basis for the formation of the municipal level of smart governance.

An important empirical result of the study is the substantiation that in Smart City agglomeration centers, governance acquires applied capacity only if there is an institutional framework for intermunicipal coordination capable of converting strategic goals and digital tools into common policies, agreed data standards and implemented supramunicipal projects. In this context, the example of the Association of Local Self-Government Bodies "Lviv Agglomeration", which functions as one of the most dynamic platforms of intermunicipal cooperation in Ukraine. The Association unites the Lviv City

Territorial Community as the core and 12 adjacent urban, township and rural communities (Zhovkva, Horodotska, Pustomytivska, Bibrska, Velykolyubinska, Davydivska, Zhovtanetska, Kulykivska, Novoyarychivska, Pidberiztsivska, Obroshynska, and Murovanska), forming a managerial space for integrated socio-economic, spatial and environmental development of territories.

In terms of content, the mission of the Association is to ensure the joint development of member communities by establishing horizontal ties, coordinating management decisions and initiating projects, the scale of which goes beyond the boundaries of one administrative unit. In terms of public administration, this means the formation of a supramunicipal level of policy coordination, which is critically important for areas with a naturally agglomeration logic: mobility, waste management, spatial planning, environmental systems, logistics, and critical infrastructure. The institutional development of the Association in 2025 testifies to the strengthening of its capacity: the expansion of the composition through the accession of Pidberiztsi, Obroshyn and Murovanska communities increased the representativeness and resource base, as well as increased the potential for scaling up joint management tools and services.

A separate analytical emphasis within the Smart City theme is the EBA project profile as a mechanism for "operationalization" of smart governance. This platform acts as a tool for attracting external funding and implementing grant initiatives, which corresponds to the logic of program and project management as a key component of the modern model of public administration. In particular, in 2024, the project "Strengthening Effective Democratic Governance in the Lviv Agglomeration" was implemented with the support of the Council of Europe, the results of which were the holding of the First International Forum of Agglomerations, the organization of intermunicipal children's camps, as well as the development and printing of a local history atlas of the Lviv agglomeration. Together, these actions reflect not only the communication dimension but also the formation of a common identity of the agglomeration, which in smart governance correlates with the growth of social capital and the legitimacy of supra-municipal management decisions.

In the future, the Association's activities will demonstrate a focus on structural problems relevant to Smart City as a management model. The project "Together for Better Services: Intermunicipal Cooperation in the Lviv Agglomeration" is aimed at supporting the implementation of intermunicipal cooperation in the field of solid waste management, in particular, the development of the Strategic Solid Waste Management Plan of the Lviv Agglomeration for 2025-2035 and the conclusion of an intermunicipal cooperation agreement. This example is methodologically significant, as it combines strategizing, standardization of procedures, coordination of roles and implementation mechanisms – that is, those components that ensure the transition from "local services" to "integrated agglomeration policies" in Smart City.

The project "Logistics Hub. Lviv agglomeration as an important logistics hub in the network of national and international connections" (donor: Ukraine–Moldova American Enterprise Fund) concerns the Lviv and Zymnovodivska communities and provides for the development of a logistics hub concept based on a comprehensive study of needs, opportunities and potential benefits for the region. The identified problems (lack of a centralized hub, low level of intermodal transportation, congestion of road infrastructure, insufficient digitalization of logistics processes, limited investment opportunities due to lack of strategy) are typical challenges of agglomeration development, in which Smart City tools have an applied role not as "IT solutions", but as management mechanisms for coordinating flows, data and investment decisions.

In the ecological dimension, the SpongeWorks project is aimed at restoring peatland ecosystems on the territory of a landscape reserve with an area of 2500 hectares of local importance within the Lviv community, and also covers the Novoyarychiv, Kulykiv and Murovanska communities. The significance of this example lies in demonstrating the agglomeration logic of ecosystem management, where the boundaries of natural systems do not coincide with administrative boundaries, and therefore require supra-municipal planning and monitoring mechanisms, including data, indicators and communication. The Smooty and Embracer projects focused on overcoming transport isolation, creating a sustainable, green and accessible mobility system, and solving the problems of connectivity and transport accessibility are not enough wealthy areas, reinforce the thesis that mobility is an "agglomeration service", and its digitalization makes sense only in the context of intermunicipal integration of routes, services, tariff/preferential mechanisms and data.

Additional proof of the platform's institutional maturity is the international recognition and integration of the Lviv agglomeration: winning the Seoul Smart City Prize 2025 in the Human-CentriCity

category for a project focused on human recovery and inclusion; obtaining membership in the OASC as the first such case in Ukraine; organization of the International Forum of Agglomerations of Ukraine; membership in the Metrex and Metropolis networks. In the scientific interpretation, these elements are not only reputational, but managerial significant, as they demonstrate readiness to implement international standards of smart governance, cross-sectoral interaction and transition from "urban" Smart City to "agglomeration" smart governance.

Thus, the case of the Lviv Agglomeration Association allows us to empirically confirm the conclusion that the key condition for an effective Smart City in the agglomeration centers of Ukraine is the presence of an institutionally entrenched coordination platform capable of combining strategizing, project portfolio, data management, and communication with stakeholders. It is such a platform that creates prerequisites for the consistency of public administration methods within the agglomeration and provides a synergistic effect that is unattainable in the case of fragmented digitalization of individual communities.

A comparative analysis of Lviv and Krakow agglomerations, which have similar demographic characteristics but are at different stages of institutional and digital development, is presented in Table 2.

Table 2. Comparative characteristics of institutional and digital parameters of Smart City in Lviv and Krakow agglomerations

Indicators	Lviv agglomeration	Krakow agglomeration
Population of the agglomeration	about 1.1 million people	about 1.3 million people
Institutional form of coordination	Association of Local Self-Government Bodies "Lviv Agglomeration"	Krakowski Obszar Metropolitalny
Year of establishment of the institutional structure	2021	2014
Having a shared Smart City/digital strategy	partially formed	Fully integrated Smart City Kraków strategy
City Operations Center	in the process of formation	functioning
Integrated agglomeration transport system	partially integrated	fully integrated
A single digital platform for city services	limited functionality	complex platform
Open Data Layer	medium	high
Smart City Index (IESE Cities in Motion Index)	not in the ranking	included in the rating
Level of intermunicipal integration	medium	high

Source: Developed by the author based on [2; 5; 10; 11].

The analysis of the indicators given in the table allows us to state that the level of development of Smart City directly depends not only on the implementation of individual digital solutions, but primarily on the formation of an integral public administration system, which ensures their integration into the processes of strategic planning, infrastructure management and interaction with the community. At the same time, the key factor of efficiency is the availability of institutional coordination mechanisms at the level of the agglomeration, which allow synchronizing digital solutions, data standards and development policies between the central city and adjacent territories.

A comparative analysis of Lviv and Krakow confirms that even with the comparable scale of the urbanized territory and the functional role of the agglomeration center, the institutionalization of Smart City as a component of the public administration system is crucial. In particular, in Krakow, digital tools are integrated into a single system for managing urban services and strategic monitoring, which ensures a higher level of consistency of management decisions, efficiency of resource use and adaptability of the city system to new challenges. At the same time, in the Lviv agglomeration, despite the presence of some successful digital solutions and platforms, the further development of Smart City largely depends on the deepening of intermunicipal coordination, the formation of a joint data management system and the institutional consolidation of the agglomeration level of public administration.

The results also confirm that the concept of Smart City in modern conditions is being transformed from a technological model for the modernization of urban infrastructure into a comprehensive management mechanism for ensuring the viability, efficiency and sustainable development of agglomeration systems. This is especially relevant in the context of digital transformation and military

challenges, when the ability of public authorities to ensure the continuity of critical services, the efficiency of decision-making and coordination between different levels of government is becoming a key factor in the functional stability of urban systems.

Thus, the results of the study allow us to substantiate that the formation and improvement of methods of public administration of Smart City in agglomeration centers of Ukraine should be carried out based on the integration of strategic management, digital tools, data governance and mechanisms of intermunicipal cooperation, which ensures the transition from fragmented implementation of digital solutions to the formation of an integral Smart Governance system as an institutional basis for the development of modern agglomerations.

6. Conclusions

As a result of the study, it is substantiated that the formation and improvement of methods of public administration of Smart City in agglomeration centers of Ukraine should be carried out based on a managerial and institutional approach, in which digital technologies, data and platforms act as tools for improving the effectiveness of public administration, and not a self-sufficient set of technological solutions.

It has been established that the key barriers to the development of Smart City in Ukrainian agglomerations are mainly managerial in nature and are associated with institutional fragmentation, lack of intermunicipal coordination, non-standardization of data and limited integration of information systems. It has been proven that in wartime, the concept of Smart City is transformed in the direction of resilience, and its effectiveness is determined by the ability to ensure the continuity of critical services, the adaptability of management decisions, crisis communication and cyber resilience.

Within the framework of the study, an instrumental model for improving public administration methods in Smart City, as well as a model for integrated Smart City administration in an agglomeration center, covering strategic, operational, analytical and communication blocks, was developed. On the example of the Lviv agglomeration, it has been confirmed that effective Smart City governance is possible in the presence of an institutionally fixed platform for intermunicipal coordination. Comparison with the Krakow agglomeration showed that the decisive factor in the effectiveness of Smart City is the institutionalization of metropolitan governance and the integration of digital tools into a single Smart Governance system.

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