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IMPLEMENTATION OF THE SMART SYSTEM OF MANAGEMENT OF THE DEVELOPMENT OF TERRITORIAL COMMUNITIES: EXPERIENCE AND PERSPECTIVES

Abstract. The concept of SMART management in territorial communities has developed throughout the world as a response to urbanization, digitalization and environmental problems. This article examines the international applications of the SMART city initiative and examines its legacy for the territorial communities of Ukraine. Analyzing the successful strategies of countries such as Estonia, Singapore and Germany, the article identified practical ideas for promoting SMART management in communities. It was stated that in order to effectively implement the principles of SMART management, Ukraine must adopt a rich approach, which includes the improvement of digital infrastructure, the development of support policies, communities, prioritizing the development of human capital and promoting resilience in the community and regional planning. In addition, it is appreciated that centralized platforms will be implemented to optimize the main power services, such as health care, education and administrative functions, creating interaction between the power and the community. more accessible and replacing bureaucratic inefficiency. Having created a centralized system, Ukraine can also accept further analysis of data, allowing the authorities of the state government and municipal self-government to effectively respond to the needs of the community. In addition to promoting the standards of green living and stimulating the use of new energy,

suitable development of infrastructure and changing the ecological footprint of municipal territories.

It is also important to actively engage citizens in the formation of public services through confidential data platforms and intelligence forums. In this case, communication channels will be established with the communities and organize community consultations to align SMART projects with the real needs of the community.

The study reinforces the importance of technology, human capital, and management reforms needed to adapt advanced lighting technology to the Ukrainian context.

Keywords: Management, smart management, territorial community

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ВПРОВАДЖЕННЯ СИСТЕМИ SMART УПРАВЛІННЯ РОЗВИТКОМ ТЕРИТОРІАЛЬНИХ ГРОМАД: ДОСВІД ТА ПЕРСПЕКТИВИ

Анотація. Концепція SMART-управління в територіальних громадах розвинулася у всьому світі як відповідь на урбанізацію, цифровізацію та екологічні проблеми. У цій статті розглядаються міжнародні приклади ініціатив SMART city та розглядаються їхні наслідки для територіальних громад України. Аналізуючи успішні стратегії таких країн, як Естонія, Сінгапур та Німеччина, у статті визначено практичні ідеї для впровадження SMART-менеджменту в громадах. Констатовано, що з метою ефективного запровадження принципів SMART управління, Україна повинна використати застосувати багатогранний підхід, який включає зміцнення цифрової інфраструктури, розробку політики підтримки, сприяння залученню громади, визначення пріоритетів розвитку людського капіталу та впровадження стійкості в міське та регіональне планування. Окрім того зауважено, що слід запровадити централізовані платформи для оптимізації основних державних послуг, таких як охорона здоров'я, освіта та адміністративні функції, зробивши взаємодію між державою та громадою більш доступною та зменшивши бюрократичну неефективність. Створивши централізовану систему, Україна

також може сприяти швидшому аналізу даних, дозволяючи органам державної влади та місцевого самоврядування швидко та ефективно реагувати на потреби громади. Окрім того запровадження стандартів зеленого будівництва та стимулювання використання відновлюваної енергії сприятиме розвитку сталої інфраструктури та зменшить екологічний слід міських територій.

Також вважаємо за доцільне активно залучати громадян у формуванні громадських послуг через платформи відкритих даних і форуми спільнот. При цьому слід побудувати канали зворотного зв'язку з громадянами та організувати громадські консультації для узгодження проектів SMART із реальними потребами громади.

Проведене дослідження підкреслює важливість технологій, людського капіталу та реформ управління, необхідних для адаптації передового світового досвіду до українського контексту.

Ключові слова: Управління, смарт-управління, територіальна громада

Problem setting. In recent years, the accelerating pace of urbanization, coupled with rising environmental and societal challenges, has driven many countries to adopt SMART management practices within their territorial communities. As urban populations grow, the need for efficient governance, sustainable resource management, and enhanced public services becomes ever more pressing (Fig. 1). SMART management represents a forward-thinking approach that integrates digital tools, intelligent solutions, and technological innovations to address these needs effectively. Through information and communication technologies (ICT), SMART management aims to create connected systems that dynamically adjust to community needs, enabling cities and communities to function more effectively and sustainably [1, 2].

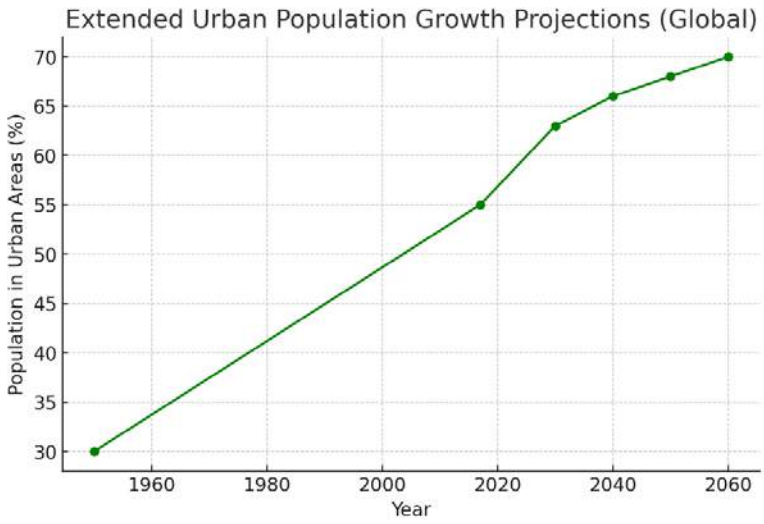

Fig. 1: Projected global urban population growth from 1950 to 2060, highlighting increasing urbanization and the need for sustainable SMART management.

The illustration below serves as an abstract representation of the paper's central aim: implementing SMART management to build more connected, sustainable, and resilient urban communities in Ukraine (Fig. 2). Through symbolic elements such as an interconnected cityscape, digital icons, and green spaces, the image captures the essence of integrating technology, governance, and environmental consciousness. The digital and urban elements emphasize the role of ICT in creating adaptive, efficient systems, while the green spaces highlight the commitment to sustainable growth. Together, these components visually convey the paper’s focus on enhancing quality of life through a balanced approach that combines connectivity, digitalization, and ecological responsibility.

Fig.2: Abstract illustration depicting the aim of implementing SMART management in Ukraine’s territorial communities, emphasizing connectivity, digitalization, and sustainability for improved quality of life (with the use of AI).

Countries worldwide, such as Estonia, Singapore, Germany, and South Korea, have pioneered various SMART management models tailored to their unique contexts. These models provide valuable case studies that highlight the benefits of ICT-driven governance, environmental stewardship, and citizen engagement. Estonia, for instance, has achieved considerable success in establishing an e-governance framework that simplifies administrative processes and enhances transparency, while Singapore's "Smart Nation" initiative focuses on citizen-centric digital services, particularly in healthcare and urban mobility [3, 4]. Germany’s Smart City Charter illustrates how the integration of ICT with urban planning can support sustainable development and foster community engagement, while South Korea’s Songdo district exemplifies how IoT and real-time data management can optimize resource use and improve urban functionality [5, 6].

Ukraine's territorial communities, currently at a pivotal development stage, could benefit significantly from adopting and adapting these international SMART practices. As Ukraine seeks to modernize its cities and promote sustainable growth, integrating digital solutions into governance, infrastructure, and public services could help address current challenges and position the country for future resilience. By exploring successful global strategies and focusing on implementing SMART management principles, Ukraine can create a foundation for more efficient, inclusive, and sustainable urban and community development [7, 8]. This paper will analyze international SMART management examples to identify actionable insights and strategic recommendations relevant to the Ukrainian context.

Research goal

The purpose of the article is to study the international experience of using SMART-management in the management of territorial communities and to develop practical ideas and strategic recommendations that can be adapted to Ukrainian realities.

Literature Review

The concept of SMART management in territorial communities has emerged as a critical response to urban challenges such as population expansion, environmental demands, and the increasing need for efficient public services [1, 2]. SMART management leverages information and communication technologies (ICT) to create interconnected systems that enhance sustainability, governance, and quality of life by dynamically responding to citizens' needs [3]. This approach spans domains such as governance, transportation, energy, and citizen engagement, fostering urban development that is people-centered and environmentally conscious, as Kuznetsova (2023) emphasizes [4]. This focus aligns technological advancements with goals of social inclusivity and sustainability, which are crucial for future urban resilience [5].

International case studies provide valuable insights into the applicability of SMART management in Ukraine. Estonia's e-governance system, which integrates digital identity, online public services, and e-residency, highlights how digital infrastructure can streamline administrative processes, increase transparency, and build public trust [6]. Singapore's Smart Nation initiative, which emphasizes citizen-centric solutions like digital healthcare and data-driven governance, exemplifies effective public engagement and efficient service delivery; this model offers a relevant framework for enhancing participatory decision-making in Ukraine's urban planning [7]. Germany's Smart City Charter combines ICT with urban planning to prioritize sustainability and community involvement, while South Korea's Songdo International Business District showcases the advantages of a purpose-built, sensor-integrated environment that efficiently manages urban resources such as traffic, energy, and waste [8, 9, 10]. Together, these examples underscore the importance of supportive policy frameworks, technological investment, and citizen engagement in building SMART urban systems.

Despite its potential, SMART management presents implementation challenges, particularly around digital accessibility, data privacy, and financial sustainability [11]. For instance, the digital divide restricts access to SMART services in less affluent regions, while data privacy concerns necessitate strong protection policies, as illustrated in Germany's approach [12]. The significant financial investments required for SMART projects also present hurdles, suggesting Ukraine could look to Songdo's model of public-private partnerships for a sustainable funding framework [2]. Ukraine's path forward could include adopting Estonia's policy frameworks, Germany's citizen engagement methods, and Singapore's focus on digital literacy to ensure SMART solutions are accessible and foster public trust [1]. With these adaptations, Ukraine's territorial communities can create effective, contextually relevant SMART management frameworks that contribute to sustainable urban development.

Key research findings

Examining global SMART management initiatives reveals several core principles and approaches that can be adapted to Ukraine's territorial communities. By analyzing the experiences of countries like Estonia, Singapore, Germany, and South Korea, we can identify strategic areas for Ukraine to focus on in its pursuit of efficient, sustainable, and citizen-centered SMART management. One fundamental component of successful SMART management is a robust governance structure that promotes transparency, accountability, and efficiency. Estonia's digital governance framework is an exemplary model, showcasing how ICT can streamline government services and improve public trust [1]. Estonia's e-identity system, which allows citizens to access various services online, has significantly reduced bureaucratic inefficiencies and strengthened public trust in government processes. This is especially relevant for Ukraine, where improving administrative efficiency and reducing corruption are key goals [2]. Implementing a similar e-identity system and centralized digital platform could simplify citizen interactions with the government, enhance transparency, and reduce operational costs within local governance structures.

Singapore's Smart Nation initiative also provides valuable insights into the role of supportive policies in fostering innovation and citizen-centered governance. By creating a regulatory environment that encourages public-private partnerships and ensures digital solutions are accessible to all, Singapore has laid the groundwork for sustainable and inclusive SMART development [3]. For Ukraine, a supportive policy framework that promotes collaboration with technology companies, research institutions, and non-profits could drive effective SMART initiatives, especially in regions requiring more infrastructure and technological advancement. Developing such partnerships would also allow Ukraine to address financial constraints, as public-private collaborations have proven effective in sharing the cost burden of implementing SMART systems, as seen in Singapore and South Korea [4].

Another crucial aspect of SMART management is technology integration, particularly through IoT, big data, and AI, which allow cities to create responsive and adaptive ecosystems. South Korea's Songdo International Business District is a standout example of a purpose-built SMART city where extensive IoT networks enable real-time data collection, supporting efficient resource management and service delivery [5]. Songdo's infrastructure highlights the benefits of designing cities with SMART technologies in mind from the beginning, particularly for managing traffic, waste, and energy use. For Ukraine, investing in similar IoT infrastructure and data analytics could address urban challenges such as traffic congestion and energy inefficiencies. By integrating sensor networks into urban planning, Ukrainian cities could offer more responsive services that adapt to citizens' needs [6].

Germany's approach to SMART management underscores the importance of environmental sustainability, with cities like Freiburg and Munich prioritizing green technology to minimize their environmental impact [7]. These cities employ ICT solutions that enhance energy efficiency, promote sustainable transport, and support eco-friendly practices, offering a model for Ukraine's communities to adopt. Implementing similar environmentally focused practices—such as smart energy grids, real-time environmental monitoring, and sustainable building policies—could help Ukraine address environmental challenges while promoting sustainable resource use (Fig. 3). These initiatives would not only reduce pollution but also contribute to Ukraine's resilience against climate-related challenges, enhancing the overall quality of life for residents [8].

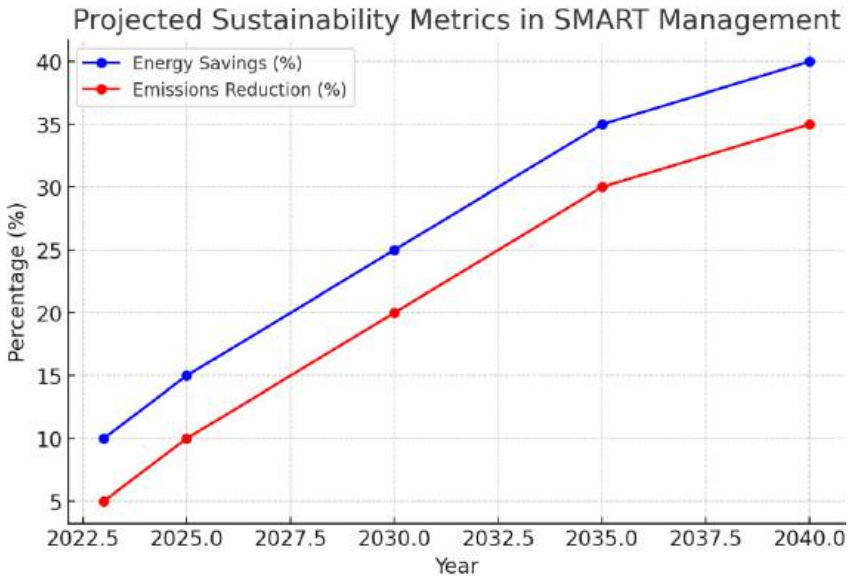

Fig. 3: Projections of energy savings and emissions reductions in Ukraine from 2023 to 2040, illustrating environmental benefits from SMART management initiatives.

In addition to technological and environmental priorities, a strong emphasis on human capital development is crucial for successful SMART management. Germany's initiatives around educating citizens in digital skills and ICT competencies build a workforce capable of supporting and sustaining SMART projects [9]. For Ukraine, investing in human capital through digital literacy programs and vocational training could equip citizens with the necessary skills to actively participate in a digital economy and ensure a knowledgeable workforce is available to maintain SMART systems. Similarly, Singapore's citizen-centric approach involves empowering residents with digital skills so they can fully engage with SMART services, ensuring that technology is accessible to all. This model could inspire Ukraine to implement digital literacy programs, particularly targeting older adults and underserved communities, to create a more informed and inclusive society [10].

Community engagement also plays a vital role in successful SMART city initiatives. Germany's projects often involve public consultations, open data policies, and community forums, which encourage citizens to actively participate in planning and decision-making processes. This participatory framework fosters public trust and ensures that SMART initiatives meet community needs. In Ukraine, a similar approach could strengthen public support for SMART initiatives. By implementing open data policies and creating platforms for citizen feedback, Ukrainian cities could ensure that SMART projects are aligned with the specific needs of their residents and foster a culture of transparency [11]. Singapore's Smart Nation initiative also underscores the value of citizen feedback, integrating it into service improvements to ensure that government services evolve in response to public needs. Promoting collaborative relationships between citizens and local authorities in Ukraine could enhance governance responsiveness and increase citizen satisfaction [1].

To ensure a sustainable model of SMART management, Ukraine must address challenges related to financing, infrastructure, and data privacy. Implementing SMART city initiatives requires significant financial investment, which can be a barrier for municipalities with limited budgets. Learning from South Korea's approach to funding through public-private partnerships, Ukraine could distribute the financial load by inviting private sector stakeholders to co-invest in urban infrastructure projects. Such collaborations have been successful in South Korea, enabling cities like Songdo to develop sophisticated SMART systems without excessive reliance on public funds [2]. Additionally, Ukraine should consider policies to safeguard data privacy, drawing on Germany's example, which emphasizes robust data protection frameworks. These frameworks are essential for maintaining citizen trust in systems that rely heavily on data collection and real-time analytics.

The international experiences of Estonia, Singapore, Germany, and South Korea offer Ukraine a valuable set of strategies and principles for implementing

SMART management within its communities. Establishing a strong e-governance framework, investing in IoT and data infrastructure, prioritizing environmental sustainability, and fostering human capital are all essential steps for Ukraine to create efficient, inclusive, and responsive communities. Embracing a balanced approach that includes governance reforms, technological investments, and citizen engagement can help Ukraine build resilient, SMART communities poised for sustainable growth and improved public services. By learning from these models and adapting them to local needs, Ukraine's territorial communities can address pressing urban challenges, support sustainable development, and improve the quality of life for all citizens.

1. **Urbanization Projections**: An extended line chart showing global urban population growth projections up to 2060, indicating a gradual increase in urbanization.

2. **Digital Literacy Growth**: A line chart with extended projections of digital literacy rates in Ukraine, demonstrating a steady rise through 2035 due to ongoing educational initiatives.

3. **Sustainability Metrics**: A chart showing projected improvements in energy savings and emissions reductions through 2040, illustrating the environmental impact of sustainability initiatives in SMART management.

Implementation Recommendations for Ukraine. To effectively adopt SMART management principles, Ukraine must take a multi-faceted approach that includes strengthening digital infrastructure, developing supportive policies, fostering community engagement, prioritizing human capital development, and building sustainability into urban and regional planning. Strengthening digital infrastructure is essential, as a resilient and comprehensive ICT backbone is critical for supporting various SMART initiatives. Estonia's e-governance model demonstrates the transformative potential of high-speed connectivity, centralized digital platforms, and data centers. Ukraine could implement similar centralized platforms to streamline essential public services, such as healthcare, education, and administrative functions, making interactions more accessible and reducing bureaucratic inefficiencies [1]. By creating a centralized system, Ukraine can also facilitate faster data analysis, enabling local governments to respond quickly and efficiently to community needs.

Policy development is another essential aspect of SMART management. Drawing from Germany's Smart City Charter, Ukraine could implement policies that set standards for energy efficiency, sustainable transportation, and community-oriented design. Establishing such policies ensures that sustainability becomes a core focus in urban planning, especially in sectors like public transportation and waste management [2]. The introduction of green building standards and renewable energy incentives would encourage sustainable infrastructure and reduce the environmental footprint of urban areas. Additionally, Singapore's regulatory approach, which

supports public-private partnerships and incentivizes innovation, could serve as a model for Ukraine to attract private investment and expand technological development across the country. This approach would not only promote collaboration but also address funding constraints by engaging the private sector in co-funding infrastructure projects [3].

Community engagement is crucial for SMART city success, as demonstrated in Singapore's Smart Nation initiative, where citizens are actively involved in shaping public services through open data platforms and community forums. Ukraine could adopt a similar model by introducing citizen feedback channels and organizing public consultations to align SMART projects with actual community needs [4]. Public awareness campaigns and online resources can educate citizens on how SMART initiatives impact their daily lives, fostering a sense of involvement and inclusivity. In Germany, this approach has proven effective in building public trust and ensuring transparency in urban governance. Adopting open data policies would further strengthen this relationship, encouraging active participation and making the decision-making process more transparent for Ukrainian citizens [5].

Human capital development is essential to sustaining SMART management systems. By prioritizing digital literacy and technical training, Ukraine can create a workforce equipped to manage and expand SMART infrastructure (Fig. 4). Germany's focus on educating citizens in digital skills and Singapore's inclusive digital literacy programs offer valuable examples. Integrating digital skills training into schools, vocational programs, and adult education centers would create a digitally literate workforce capable of supporting and innovating within SMART systems [6]. Special initiatives targeting older adults and rural communities would also be beneficial, ensuring that SMART solutions are accessible to all demographics and bridging the digital divide.

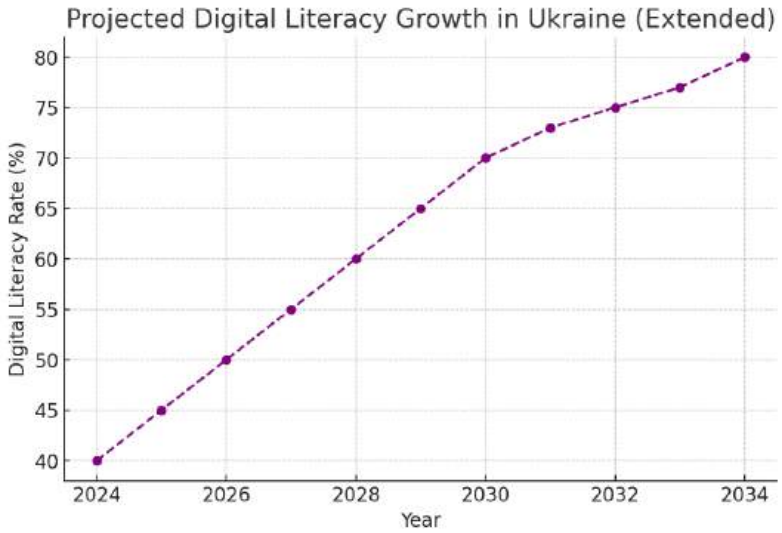

Fig. 4: Projected growth in digital literacy rates in Ukraine from 2024 to 2035, showing improvements from digital education initiatives.

Securing financial support is a key challenge for SMART initiatives, as these projects often require significant investment. Ukraine could benefit from adopting a public-private partnership model similar to South Korea's Songdo International Business District, where costs are shared with private companies to alleviate the financial burden on municipalities [7]. Such partnerships would enable Ukraine to attract foreign and domestic investment, tapping into technology companies' expertise and resources while providing regulatory support and public spaces in return. By implementing tax incentives or subsidies for private partners, Ukraine could further encourage investment in SMART infrastructure, thus advancing its technological capabilities without overburdening local budgets.

Data privacy and security are crucial considerations, as large-scale data collection is a cornerstone of SMART management. Protecting citizens' data is vital for maintaining public trust, as shown by Germany's robust data protection policies aligned with the EU's GDPR. Ukraine should adopt similar privacy policies, outlining clear guidelines for data collection, storage, and usage [8]. Additionally, establishing regular cybersecurity audits and protocols will safeguard sensitive information, reinforcing the integrity of digital systems. Transparency around data usage is essential, allowing citizens to understand how their information is utilized within SMART initiatives and ensuring that trust is maintained.

For SMART initiatives to be equitable, Ukraine must prioritize regional integration and equal access. Singapore's efforts to provide digital infrastructure across both urban and rural areas demonstrate the importance of minimizing the digital divide to ensure balanced territorial development. By expanding high-speed internet access and digital literacy programs to smaller towns and rural regions, Ukraine can prevent disparities in access to SMART services and improve the quality of life across the country [9]. Regional integration would allow all citizens to benefit from advancements in urban planning, reducing inequalities between metropolitan and non-metropolitan areas.

Establishing a National SMART City Task Force could provide strategic oversight, coordinating efforts across multiple government agencies and regions. This task force, drawing representatives from various sectors, would be responsible for setting SMART management goals, monitoring implementation progress, and providing guidance to local authorities [10]. Regular assessments of project outcomes would enable the task force to adjust strategies and align initiatives with national priorities, ensuring that Ukraine's SMART development remains cohesive and responsive to evolving needs.

Fostering a culture of innovation is also critical for long-term sustainability in SMART management. By encouraging local businesses and startups to participate in SMART initiatives, Ukraine can generate solutions tailored to its specific needs and challenges. Creating innovation hubs or SMART city incubators in partnership

with universities and research institutions could support this objective, providing a space for testing new technologies in areas like energy efficiency, transportation, and data analytics [11]. Incentivizing local innovation through grants, competitions, or subsidies would motivate developers to address issues uniquely relevant to Ukraine, such as energy optimization or regional transportation improvements.

In summary, Ukraine's path toward SMART management requires a holistic strategy that incorporates infrastructure development, policy support, community involvement, workforce training, and financial planning. By learning from the successful practices of countries like Estonia, Singapore, Germany, and South Korea, Ukraine can create resilient, efficient, and inclusive SMART communities. Each of these elements contributes to a balanced national framework that, when implemented, will drive sustainable growth and enhance the quality of life across Ukraine's territorial communities, setting a foundation for future innovation and improvement [12].

Conclusion

The implementation of SMART management practices across Ukraine's territorial communities holds great potential for addressing the country's pressing urban and regional challenges. By leveraging international best practices from nations such as Estonia, Singapore, Germany, and South Korea, Ukraine can build a framework that modernizes governance, optimizes resource use, promotes sustainability, and enhances public services. Each of these countries has demonstrated unique approaches to SMART management, offering valuable lessons that Ukraine can adapt to fit its specific context.

The recommendations outlined—ranging from strengthening digital infrastructure to fostering human capital development and community engagement—highlight the importance of a comprehensive, multi-pronged strategy. Strengthening digital infrastructure, inspired by Estonia's e-governance system, is critical for ensuring efficient and transparent service delivery. By creating centralized platforms that support essential services, Ukraine can improve accessibility and efficiency, making government processes more responsive to citizen needs. Furthermore, prioritizing sustainability, as seen in Germany's approach, underscores the role of SMART management in reducing environmental impact. By integrating energy-efficient systems, green building standards, and renewable energy incentives, Ukraine can reduce its ecological footprint while enhancing urban resilience to climate change.

Community engagement, as illustrated by Singapore and Germany, will be essential for fostering public support and ensuring that SMART initiatives are inclusive and tailored to local needs. Encouraging open communication through public consultations, feedback platforms, and transparency initiatives will help Ukrainian communities feel more connected to SMART projects, increasing public trust and ownership. This participatory approach will ensure that SMART solutions

are not only technologically advanced but also deeply relevant to the lives of the people they are intended to serve. Through citizen feedback and collaboration, Ukraine can create cities that are not only "smart" in functionality but also inclusive and equitable, meeting the needs of diverse demographics and regions.

Moreover, financial sustainability remains a significant factor in the successful implementation of SMART initiatives. South Korea's use of public-private partnerships for funding underscores the importance of collaboration between the public sector and private enterprises in supporting and maintaining SMART infrastructure. By attracting private investment, Ukraine can alleviate the financial burden on municipalities, making SMART projects more feasible and resilient. Such partnerships would allow Ukraine to leverage industry expertise and innovation, ensuring that projects remain on the cutting edge of technological advancement. Establishing a national task force dedicated to overseeing and coordinating SMART initiatives could further streamline efforts and ensure that projects align with Ukraine's long-term strategic goals.

Human capital development, exemplified by Singapore and Germany, is equally essential to building and sustaining SMART cities. Investing in digital literacy and technical education will ensure that Ukrainian citizens can fully engage with SMART systems and that local talent is prepared to support ongoing digital transformation. By prioritizing education and training, Ukraine can build a skilled workforce that is capable of managing, expanding, and innovating within SMART infrastructures, creating a robust foundation for future growth and adaptation.

In summary, Ukraine's journey toward SMART management is an opportunity to create resilient, inclusive, and technologically advanced communities that can adapt to future challenges. By implementing a balanced strategy that combines governance reforms, technological investment, sustainable practices, and community-centered policies, Ukraine can establish a model of SMART management that enhances the quality of life for its citizens while fostering sustainable economic growth. As Ukraine integrates these practices, it will set a new standard for innovation and responsiveness in urban and regional management, demonstrating how SMART solutions can drive a nation's development in an increasingly digital and interconnected world.

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