IRSTI 39.21.0 https://doi.org/10.26577/JGEM20257722

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ANALYSIS OF THE POTENTIAL FOR DEVELOPING "SMALL SMART CITIES" IN KAZAKHSTAN: THE CASE OF THE SHU, AYAGOZ AND SHALKAR CITIES

This study investigates the potential for developing "small smart cities" in Kazakhstan, using Shu, Ayagoz, and Shalkar as case studies. The research addresses the need for balanced territorial development through digital transformation, emphasizing the importance of extending smart city concepts beyond major urban centers. Employing a mixed-methods approach, the study integrates the Smart City Readiness Index (SCRI), stakeholder insight analysis, and governance assessment to evaluate these cities' preparedness for smart transformation. The findings reveal substantial disparities in readiness across the three cities. Shu demonstrates the highest level of readiness (43%) across key dimensions, including digital infrastructure, economic potential, and stakeholder engagement. Ayagoz and Shalkar, though strategically located as transport hubs, lag due to weak institutional capacity, limited digital infrastructure, and insufficient stakeholder participation. All cities show notably low performance in environmental sustainability and public-private partnership development. Stakeholder analysis further highlights Shu's relative strength in intersectoral coordination, public engagement, and trust-building mechanisms. Meanwhile, Ayagoz and Shalkar face challenges in mobilizing local academia, international partners, and civil society. Governance assessments underline the need for improved local administrative capacity, consistent funding, legal clarity, and digital governance practices in smaller municipalities. The study concludes that while small cities like Shu have foundational advantages for implementing smart city initiatives, significant institutional, infrastructural, and participatory challenges remain in Ayagoz and Shalkar. The authors recommend targeted policy interventions, enhanced stakeholder collaboration, and pilot projects tailored to local contexts. The research contributes to the discourse on equitable digital urbanization and offers practical insights for policymakers aiming to foster inclusive and sustainable smart city development in secondary urban centers across Kazakhstan.

Key words: small smart cities, Kazakhstan, digital infrastructure, governance, stakeholder engagement, sustainable urban development.

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Қазақстандағы «шағын ақылды қалаларды» дамыту әлеуетін талдау: Шу, Аягөз және Шалқар қалаларының мысалында

Бұл зерттеу Қазақстандағы «шағын ақылды қалаларды» дамыту әлеуетін Шу, Аягөз және Шалқар қалаларының мысалында қарастырады. Зерттеудің мақсаты – цифрлық трансформация арқылы аумақтық теңгерімді дамуды қамтамасыз ету қажеттілігіне жауап беру және ақылды қала тұжырымдамасын ірі мегаполистерден тыс өңірлік шағын қалаларға енгізудің маңыздылығын айқындау. Зерттеу аясында аралас әдіснамалық тәсіл қолданылып, оған «Ақылды қалаға дайындық индексі» (SCRI), мүдделі тараптар талдауы және басқару жүйесіне қатысты бағалау әдістері енгізілді. Нәтижелер зерттелген үш қаланың дайындық деңгейінде айтарлықтай айырмашылықтар бар екенін көрсетті. Шу қаласы цифрлық инфрақұрылым, экономикалық әлеует және мүдделі тараптардың қатысуы сияқты негізгі өлшемдер бойынша ең жоғары дайындық деңгейін (43%) көрсетті. Аягөз бен Шалқар қалалары көліктік-логистикалық жағынан стратегиялық орналасуына қарамастан, институционалдық әлеуеттің әлсіздігі, цифрлық инфрақұрылымның жеткіліксіздігі және мүдделі тараптардың төмен белсенділігі себепті артта қалып отыр. Барлық қалаларда экологиялық тұрақтылық пен мемлекеттік-жекеменшік әріптестікті дамыту көрсеткіштері өте төмен. Мүдделі тараптармен жүргізілген бағалау Шу қаласының секторааралық үйлестіру,

тысу және сенім қалыптастыру тұрғысынан салыстырмалы артықшылықтарға ие екенін көрсетті. Ал Аягөз бен Шалқарда жергілікті академиялық орта, халықаралық серіктестер мен азаматтық қоғамды жұмылдыруда елеулі қиындықтар байқалады. Басқару мәселелері бойынша зерттеу нәтижелері шағын қалаларда әкімшілік ресурстарды нығайту, қаржыландыру тұрақтылығын қамтамасыз ету, заңнамалық базаны нақтылау және цифрлық басқару тетіктерін жетілдіру қажеттігін көрсетеді. Қорытындылай келе, Шу секілді қалаларда ақылды қала бастамаларын іске асыру үшін іргелі алғышарттар болса, Аягөз бен Шалқарда институционалдық, инфрақұрылымдық және қатысушылық сипаттағы елеулі кедергілер сақталып отыр. Авторлар нақты аймақтық жағдайларға бейімделген пилоттық жобаларды іске асыруды, саясатты мақсатты түрде үйлестіруді және мүдделі тараптармен өзара әрекеттестікті күшейтуді ұсынады. Бұл зерттеу Қазақстандағы теңгерімді цифрлық урбанизацияны ілгерілетуге және шағын қалалардағы тұрақты ақылды даму мәселесіне қатысты саясаткерлерге нақты ұсыныстар ұсынуға бағытталған.

Түйін сөздер: шағын ақылды қалалар, Қазақстан, цифрлық инфрақұрылым, басқару, мүдделі тараптар, тұрақты қалалық даму.

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Анализ потенциала развития «малых умных городов» в Казахстане: на примере городов Шу, Аягоз и Шалкар

Данное исследование посвящено оценке потенциала развития «малых умных городов» в Казахстане на примере городов Шу, Аягоз и Шалкар. Работа отвечает на необходимость обеспечения сбалансированного территориального развития посредством цифровой трансформации, подчёркивая важность распространения концепции умных городов за пределы крупных мегаполисов. Методологически исследование основано на смешанном подходе, включающем индекс готовности к созданию умного города (Smart City Readiness Index – SCRI), анализ вовлечённости заинтересованных сторон и оценку механизмов управления. Результаты показывают существенные различия в уровне готовности трёх городов. Город Шу продемонстрировал наивысшую степень готовности (43%) по ключевым направлениям: цифровая инфраструктура, экономический потенциал и участие заинтересованных сторон. В то время как Аягоз и Шалкар, несмотря на стратегическое транспортное положение, отстают из-за слабых институциональных возможностей, ограниченной цифровой инфраструктуры и недостаточного вовлечения местных акторов. Во всех трёх городах отмечается особенно низкий уровень развития экологической устойчивости и механизмов государственно-частного партнёрства. Анализ заинтересованных сторон выявил сравнительные преимущества Шу в межсекторном взаимодействии, общественном участии и механизмах формирования доверия. Напротив, Аягоз и Шалкар сталкиваются с трудностями в мобилизации академических институтов, международных партнёров и гражданского общества. Оценка управленческих аспектов подчеркивает необходимость укрепления административного потенциала на местном уровне, обеспечения устойчивого финансирования, совершенствования нормативно-правовой базы и цифрового управления в малых муниципалитетах. В заключение отмечается, что несмотря на наличие базовых условий в Шу, реализация умных городских инициатив в Аягозе и Шалкаре требует преодоления значительных институциональных, инфраструктурных и координационных барьеров. Авторы предлагают внедрение пилотных проектов с учётом местной специфики, развитие межсекторального сотрудничества и целенаправленные политические меры. Исследование вносит вклад в научный дискурс по вопросам справедливой цифровой урбанизации и предоставляет практические рекомендации для развития устойчивых умных городов в региональных центрах Казахстана.

Ключевые слова: малые умные города, Казахстан, цифровая инфраструктура, управление, заинтересованные стороны, устойчивое городское развитие.

Introduction

In recent years, the concept of Smart Cities has gained significant global attention as a forward-looking approach to urban development, aiming to enhance the quality of life for citizens through digital innovation, efficient governance, and sustainable infrastructure. While much of the focus has been on large metropolitan centers, the development of "small smart cities" has emerged as a critical pathway for balanced regional growth, especially in countries like Kazakhstan with vast territories and diverse urban profiles.

Recent studies have begun to explore the readiness and potential of various Kazakhstani cities to embark on smart city transformations. A 2024 cluster analysis identified Almaty and Astana as leading candidates for smart city development, with cities like Aktobe also showing distinctive features that could support such initiatives. However, the analysis also highlighted deep regional inequalities that could impede the successful implementation of smart city projects in other areas (Urdabayev et al., 2024).

In smaller cities, such as Shu, assessments have revealed challenges in urban system planning, with residents expressing dissatisfaction across multiple dimensions, including environmental, social, and economic aspects. Nonetheless, the city's strategic location as a transport hub and its cultural significance present opportunities for targeted smart city interventions that address local needs and leverage existing assets (Satterthwaite, 2021).

The national government's commitment to smart city development is further evidenced by the establishment of the Reference Standard of Smart Cities in 2019, aiming to standardize approaches across various urban centers (Abdrassilova & Aukhadiyeva). Moreover, initiatives like the Smart Astana project and the development of digital infrastructure in cities such as Aqkol demonstrate the feasibility of implementing smart solutions even in smaller urban settings (Ismagulov & Chukubayev, 2024).

The global discourse on smart cities emphasizes the importance of stakeholder engagement, especially in SMCs. Ruohomaa et al. (2019) argue that successful smart city development in smaller municipalities hinges on the active participation of local stakeholders, including citizens, businesses, and academic institutions. This collaborative approach ensures that smart city initiatives are contextually relevant and address the specific needs of the community.

Kazakhstan's national strategic vision emphasizes digital transformation, inclusive governance, and improved public services across all regions. However, the readiness and capacity of small cities to adopt Smart City principles remain underexplored. This study focuses on three representative small cities (Shu, Ayagoz, and Shalkar) to assess their potential for smart city development. These cities vary in geographic location, administrative structure, and socio-economic conditions, offering valuable insights into the challenges and opportunities facing smaller urban centers.

The objective of this research is to conduct a comparative analysis based on key dimensions such as digital infrastructure, institutional readiness, stakeholder engagement, and governance frameworks. By evaluating these dimensions through survey data and contextual analysis, the study aims to identify strengths, gaps, and strategic recommendations for fostering sustainable smart city initiatives at the small-city level in Kazakhstan.

Literature review

The concept of smart cities has gained significant traction globally, offering innovative solutions to urban challenges through the integration of information and communication technologies. In Kazakhstan, while major cities like Almaty and Astana have been at the forefront of adopting smart city initiatives, there is a growing interest in exploring the potential for developing small smart cities across the country.

Smart City Potential in Kazakhstan: A recent study by Nurbatsin et al. (2023) employed cluster analysis to evaluate the potential of Kazakhstani cities for smart city development. The analysis considered indicators such as human capital, infrastructure, education, information technology, and production. The findings revealed that Almaty and Astana possess the highest potential, while cities like Aktobe exhibit distinctive features that could either facilitate or hinder their smart city development. The study also highlighted significant regional disparities, suggesting that some cities may require more substantial investments to initiate smart city projects.

Urban Planning and Sustainability in Smaller Cities: Sustainable development in small towns is closely tied to socio-economic stability, effective use of local resources, and diversification of economic activities (Усенов et al., 2024). Kazakhstan's shift to a new phase of development requires balanced territorial planning and infrastructure enhancement

(Nyussupova et al., 2022). Cities, as hubs of human and material resource reproduction, are crucial to this transition. Kogabayev and Banerjee (2024) conducted a systematic review of smart governance in Kazakhstan, highlighting the role of digital infrastructure, citizen participation, transparency, and data protection. They advocate for a collaborative governance model aligned with global standards, particularly relevant for Small Cities implementing smart city strategies. In the case of Shu city, Sakhatbekovna et al. (2024) assessed urban planning based on residents' perceptions across six dimensions. The study found low sustainability in most areas, with relative strength only in cultural and religious aspects. The authors stress the importance of inclusive policymaking to improve planning outcomes in smaller cities.

Integration of IoT and AI in Smart Cities: Innovative development drives industrial, economic, and social progress in cities, yet a comprehensive analysis of influencing factors remains limited (Турданова et al., 2024). The integration of Internet of Things (IoT) and Artificial Intelligence (AI) is essential for advancing smart cities. Ishaq and Farooq (2023) reviewed IoT applications in urban settings, highlighting key challenges such as data privacy, security, interoperability, and standardization–issues particularly relevant for smaller cities with limited capacity. Similarly, Wang et al. (2021) emphasized the potential of IoT and AI in enhancing urban efficiency, citing global examples like Singapore and Copenhagen, while noting adoption barriers in developing countries.

Smart Cities and Sustainable Development Goals (SDGs): Aligning smart city initiatives with the SDGs is essential for balanced urban development. Smart cities, driven by digital technologies and data governance, can support economic, environmental, and social sustainability (Mehmood et al., 2024). A systematic literature review by Sharifi et al. (2024) identified both benefits and trade-offs in this alignment, noting risks like privacy issues and rising social inequality. Martin et al. (2024), in a review of over 200 studies, found smart cities can advance multiple SDGs, but warned that digitalization may deepen the digital divide, particularly in smaller or rural areas (SDG 10). In Kazakhstan, efforts like the "Digital Kazakhstan" program aim to foster sustainability through digital transformation. However, researchers stress the need for stronger integration of the SDG framework into local smart city strategies, especially in resource-constrained small cities (Sakhatbekovna et al., 2024).

Governance Challenges in Developing Countries: Governance is key to the success of smart city initiatives, yet developing countries like Kazakhstan face major challenges, especially in smaller cities with limited institutional and infrastructural capacity. A common issue is the lack of policy coherence and institutional strength. Historically, Kazakhstan's urban development was driven by industrial centers rather than strategic governance (Mishchenko & Mishchenko, 2023). Fragmented governance structures, as seen in many developing countries, result in poor coordination and unclear accountability (Tan & Taeihagh, 2020). Although national frameworks like Digital Kazakhstan and the 2019 Reference Standard for Smart Cities exist, regional implementation is inconsistent. Local governments often lack technical expertise and financial autonomy, particularly in small cities like Shu, Ayagoz, and Shalkar.

Budget constraints further hinder smart infrastructure investments, which are often deprioritized in favor of essential services like housing and water (Sargiotis, 2024). Socio-economic inequalities compound these issues, with limited internet access and digital literacy in smaller cities widening the digital divide (Martin et al., 2022; Omweri, 2024). Smart governance must go beyond top-down planning to include community participation. However, low civic engagement and public trust remain barriers. In Shu, for instance, citizens reported dissatisfaction with governance transparency, underlining the need for inclusive, community-driven approaches (Sakhatbekovna et al., 2024).

In the context of Kazakhstan, academic research on Smart Cities has largely concentrated on major urban centers such as Nur-Sultan and Almaty (Berdibekova et al., 2022; Mussabayeva et al., 2023). However, there is a noticeable gap in the literature concerning the applicability and potential of smart city frameworks in small and medium-sized cities. Government initiatives such as the "Digital Kazakhstan" program provide a national policy framework for digitalization, but local-level implementation varies significantly due to disparities in infrastructure, administrative readiness, and stakeholder coordination.

This study builds on the existing body of literature by addressing this gap, examining the Smart City Readiness of Shu, Ayagoz, and Shalkar. Through a multi-dimensional analysis involving digital, institutional, socio-economic, environmental, and governance indicators, it contributes to a more nuanced understanding of how small cities in

Kazakhstan can participate in the digital transformation agenda. Furthermore, it aligns with international discussions on equitable urban development and localized innovation pathways for smart urbanism.

Methodology

3.1. Brief Overview of the Study Areas (Shu, Ayagoz and Shalkar small cities)

These three cities have populations of less than 50,000 but serve as regionally important transit hubs. The introduction of smart technologies can enhance their efficiency and improve the quality of life for residents. They have the potential to serve as effective pilot areas for testing the "small smart cities" concept.

These three cities are located in different regions of Kazakhstan, are small in size, have a transit role, and face infrastructure limitations. The railway direction and transport infrastructure are the main economic pillars in all three cities. This commonality makes them pilot areas for implementing "smart transport" and "smart infrastructure" technologies. The population ranges from 35,000 to 47,000, fully meeting the criteria of small cities.

Table 1 – Key Railway Small Cities in Kazakhstan: Roles and Challenges (compiled by the authors)

City	Role / Direction	Location	Population	Economy	Issues
Shu	Railway logistics, agro	Zhambyl Region, South Kazakhstan	About 40–45 thousand	Agriculture and transport hub. One of the important railway junctions in Kazakhstan.	Deterioration of urban infrastructure, low level of digital technology adoption.
Ayagoz	Railway, military	Abai Region (formerly East Kazakhstan Region), East Kazakhstan	About 37–40 thousand	Railway hub, military-social services, small trade, and agriculture.	Economic mono-structure, migration, and weak digital infrastructure.
Shalkar	Railway, transit services	Aktobe Region, West Kazakhstan	About 45–47 thousand	Based on railway transport, the logistics and service sectors dominate.	Infrastructure deterioration, youth migration to large cities, and a lack of digital services.

Their economies are all undiversified, which, while making them flexible for implementing Smart City solutions, may lead to challenges in financing and staff shortages. By introducing Smart solutions, it is possible to optimize transport and logistics, improve public safety and environmental monitoring, and enhance the quality of public services.

All of them face infrastructure deterioration, low levels of digital technology usage, and demographic pressure. These issues are not only obstacles to introducing smart solutions but also priority areas to address. For example, Shu city should integrate digital agriculture and transport logistics. Ayagoz city needs to improve military and civil security management systems. For Shalkar city, automating public services and optimizing transport routes are important.

Materials and methods

This study employs a mixed-methods research design to analyze the potential for developing small smart cities in Kazakhstan. The approach combines quantitative spatial and statistical analysis with qualitative policy review and stakeholder insights, ensuring a comprehensive assessment of both measurable indicators and contextual governance factors. The methodology comprises three interrelated components: Smart City Readiness Index, Stakeholder Insights and Governance Challenges.

Smart City Readiness Index (SCRI) is an index that quantitatively assesses a city's readiness to implement smart technologies based on several criteria. Typically, 5 to 7 key categories are used (see Table 2).

Stakeholder insights refer to the perspectives, expectations, and feedback of all parties affected by or involved in the smart city development process. These insights are critical for ensuring that implemented solutions are inclusive, accepted, and effective. According to this method, the evaluation criteria used in our research are presented in Table 3. Effective governance is essential for translating smart city visions into reality. However, small and

mid-sized cities often face specific governance-related obstacles. The evaluation criteria of this method used in our research are presented in Table 4. Each evaluation criterion is assessed using a 1–5 point scale (1 – Very Low; 2 – Low; 3 – Medium; 4 – Good; 5 – High). The average score of the results is used as the quantitative indicator of the evaluation.

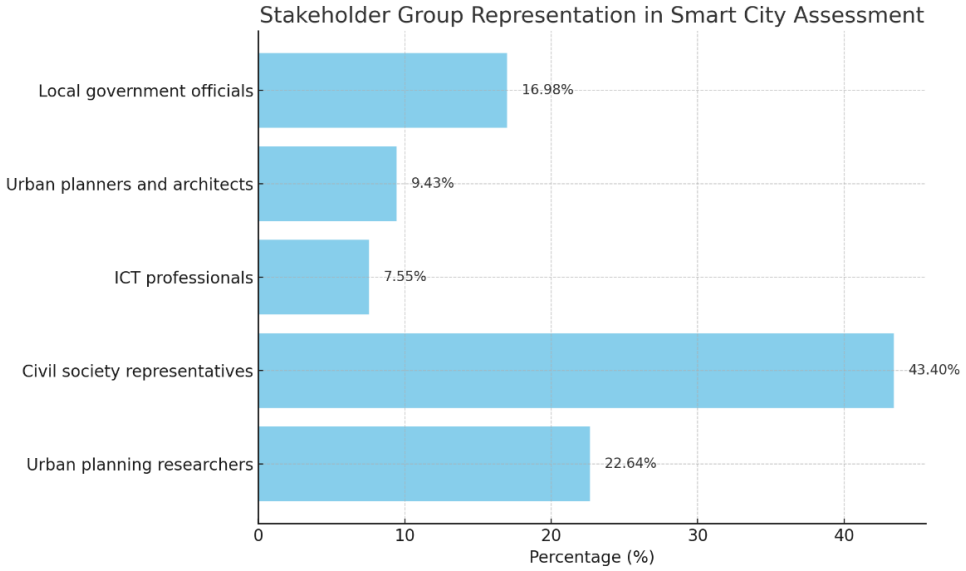

Figure 1 – Stakeholder Profile and Sample (compiled by the authors)

The main idea of this study emerged from the need to analyze the state of innovative development in small cities of Kazakhstan. Data collection was conducted over one week from May 18 to May 25, 2025. To gather relevant information for the chosen research direction, responses were obtained from 53 participants (including 9 Local Government Officials, 5 Urban planners and architects, 4 ICT professionals, 22 Civil society representatives and 12 Urban planning researchers) through a closed-end question survey (Figure 1). In addition, we reviewed several documents, including general reports and periodic reports prepared in recent years, for incorporation into the study.

Figure 1 illustrates the distribution of various stakeholder groups involved in the Smart City assessment process. A total of five stakeholder categories were considered, each contributing a different proportion to the overall composition. The analysis provides insight into the degree of inclusivity, balance, and interdisciplinary collaboration in the planning and evaluation of Smart City initiatives.

Civil Society Representatives (43.40%) form the largest share of the stakeholder mix. This suggests a strong commitment to community engagement and participatory governance. Public involvement is crucial for ensuring that Smart City solutions are people-centered and address local needs.

Urban Planning Researchers (22.64%) are the second most represented group. Their inclusion implies a focus on evidence-based policy-making and sustainable urban development. It shows the integration of academic insights into practical planning.

Local Government Officials account for 16.98%, indicating a moderate presence. As policymakers and implementers, their involvement is essential, but they are not the dominant force in this dataset. This may reflect a collaborative or decentralized governance approach.

Urban Planners and Architects (9.43%) and ICT Professionals (7.55%) have the lowest representation. These technical experts play a vital role in designing infrastructure and implementing digital technologies. Their limited presence could signal a need for stronger integration of technical knowledge into Smart City projects.

Results and discussion

By integrating these methodologies, the research aims to provide a comprehensive analysis of the potential for developing small smart cities in Kazakh-

stan, offering actionable insights for policymakers, urban planners, and stakeholders involved in urban development.

1. Smart City Readiness Index

The Smart City Readiness Index, based on seven dimensions (Digital Infrastructure, Physical Infrastructure, Institutional Readiness, Economic Potential, Social Inclusion and Education, Environmental Sustainability and Public/Private Partnership), revealed notable disparities among the case study cities. Table 2 presents the results of the evaluation of three small cities in Kazakhstan, Shu, Ayagoz, and Shalkar, based on the Smart City Readiness Index (SCRI). It includes the findings and facts identified based on the assessment of the survey participants.

Table 2 – Evaluation of SCRI for Three Small Cities: Shu, Ayagoz, and Shalkar (compiled by the authors)

№	Category / City	Shu	Ayagoz	Shalkar
1	Digital Infrastructure (Internet connectivity level, 4G/5G, Wi-Fi, IoT systems, digital platforms)	2	1	2
2	Physical Infrastructure (Transport system, energy, water, sewage, level of city infrastructure modernization)	2	2	2
3	Institutional Readiness (Digital transition of city management bodies, Smart City strategy, regulatory framework)	2	2	2
4	Economic Potential (Local economy, presence of digital business, startups, investment attractiveness)	3	2	2
5	Social Inclusion and Education (Digital literacy, IT education, accessibility of digital services for residents)	3	2	2
6	Environmental Sustainability (Waste management, energy saving, green transport, air quality monitoring)	1	1	1
7	Public/Private Partnership (Business community involvement in Smart projects, presence of PPP projects)	2	1	1
Total Score (max. 35)		15	11	12
Readiness Level (%)		43%	31%	34%

As far as Overall Readiness is concerned, Shu scores the highest overall with 15 points (43%), indicating relatively better preparedness for Smart City development. Shalkar follows with 12 points (34%), showing moderate readiness. Ayagoz ranks lowest with 11 points (31%), suggesting the greatest need for improvement (Table 2). Next, we will conduct a detailed analysis of each indicator presented in Table 2.

Digital Infrastructure: Shu and Shalkar score 2, showing moderate internet connectivity and digital platforms. Ayagoz scores 1, indicating limited digital infrastructure and low IoT integration.

Physical Infrastructure: All cities score 2, reflecting a moderate and similar level of urban infrastructure modernization.

Institutional Readiness: Each city scores 2, suggesting early efforts in digital governance, though frameworks remain underdeveloped.

Economic Potential: Shu leads with 3, indicating a stronger digital economy and investment appeal. Ayagoz and Shalkar score 2, reflecting moderate economic activity.

Social Inclusion and Education: Shu scores 3, showing better digital literacy and service access. Ayagoz and Shalkar score 2, indicating basic levels with room for improvement.

Environmental Sustainability: All cities score 1, revealing significant challenges in waste, energy, and air quality management.

Public/Private Partnerships (PPP): Shu scores 2, showing some business engagement in smart projects. Ayagoz and Shalkar score 1, indicating limited PPP development.

In conclusion, Shu demonstrates the highest overall readiness, particularly in economic potential, social inclusion, and PPP, which are crucial for smart city progress. Ayagoz lags in digital in-

frastructure and PPP, suggesting a need for focused investment and strategic partnerships. Shalkar performs slightly better than Ayagoz but shares similar weaknesses, especially in environmental sustainability and institutional readiness.

2. Stakeholder Insights

The following is a list of key evaluation criteria (indicators) for scientific research or project assessment under the Stakeholder Insights dimension. These criteria enable the evaluation of the role, perspectives, level of participation, and influence of various stakeholders in the implementation of Smart City initiatives. Table 3 presents the assessment results based on the responses of survey participants.

In general, Shu demonstrates the highest Stakeholder Insights with a score of 22/40 (55%), reflecting relatively stronger coordination, engagement, and support mechanisms. Ayagoz and Shalkar are at the same level with 14/40 (35%), indicating limited stakeholder participation and insufficient collaborative structures (Table 3).

Table 3 – Evaluation of Stakeholder Insights for Three Small Cities: Shu, Ayagoz, and Shalkar (compiled by the authors)

№	Indicators / City	Shu	Ayagoz	Shalkar
1	Mechanisms for interaction among stakeholders (Effective collaboration through councils, working groups, forums)	3	2	2
2	Level of public awareness and participation (Public awareness of Smart City initiatives and involvement in decision-making through online platforms and public hearings)	3	2	2
3	Level of investment, technological, or logistical involvement of business sectors in projects	3	2	2
4	Participation of universities and research institutions in providing scientific justification for Smart City projects	2	1	1
5	Involvement and support from international organizations (UNDP, ADB, ITU, etc.) in Smart City projects	2	1	1
6	Level of trust in the project's sustainability and transparency (based on quality communication, outcomes, and open data)	3	2	2
7	Availability of feedback channels that consider stakeholders' suggestions and opinions	3	2	2
8	Level of stakeholder agreement and interest in achieving shared goals related to Smart City projects	3	2	2
Total Score (max. 40)		22	14	14
Stakeholder Insights Level (%)		55%	35%	35%

Strengths of Shu: Shu leads across all indicators, especially in stakeholder interaction, public engagement, business involvement, transparency, and feedback mechanisms (all scoring 3). This reflects a moderately developed and inclusive governance environment with active participation from key sectors.

Common Weaknesses: All three cities show low academic (Indicator 4) and international (Indicator 5) involvement, with Shu scoring 2, and Ayagoz and Shalkar scoring 1. This highlights a significant gap in research-driven planning and global collaboration.

Challenges of Ayagoz and Shalkar: Both cities score 2 in six out of eight indicators, indicating limited stakeholder engagement, weak public participation, and underdeveloped feedback and business involvement structures. Their identical scores suggest similarly low levels of readiness.

Opportunities for Improvement: Shu should enhance ties with academia and international organizations. Ayagoz and Shalkar need to build stakeholder platforms, raise public awareness, and involve the private sector. All cities would benefit from better communication, feedback systems, and a unified strategic vision.

In summary, Shu is best positioned for Smart City initiatives thanks to stronger stakeholder collaboration. Ayagoz and Shalkar need focused efforts to improve engagement, particularly in research and international ties. All three cities should prioritize trust, communication, and inclusivity for sustainable Smart City development.

3. Governance Challenges

Identifying evaluation criteria related to Governance Challenges in the implementation of Smart City initiatives allows for a comprehensive assess-

ment of the key factors that influence the successful execution of such projects. Below, we will analyze the key evaluation indicators in this area based on the perspectives of survey respondents regarding the situation in the study region.

Overall, Shu demonstrates the highest governance readiness with a total score of 24/40 (60%), indicating relatively stronger institutional, financial, and administrative capacity to implement Smart City initiatives. Ayagoz and Shalkar both scored 16/40 (40%), reflecting moderate governance readiness but significant limitations across all indicators (Table 4). Based on the assessments of the survey respondents, the strengths and weaknesses in the governance mechanisms of the selected small cities can be identified through the following descriptions.

Table 4 – Evaluation of Governance Challenges for Three Small Cities: Shu, Ayagoz, and Shalkar (compiled by the authors)

№	Indicators / City	Shu	Ayagoz	Shalkar
1	Institutional Alignment (Level of clear distribution of roles and responsibilities between central and local government bodies.)	3	2	2
2	Capacity of Local Government Authorities (Availability of human, technical, and organizational resources necessary for managing and implementing Smart City projects.)	3	2	2
3	Effectiveness of Financing Mechanisms (Availability and accessibility of sustainable funding sources for Smart City projects.)	3	2	2
4	Public-Private Partnership (PPP) Mechanism (Existence of legal and practical mechanisms for involving the private sector in projects.)	3	2	2
5	Digital Governance Practices (Level of implementation of open data, e-government, and smart governance tools.)	3	2	2
6	Monitoring and Accountability System (Availability of systems for monitoring project implementation, evaluating results, and reporting.)	3	2	2
7	Legislative Environment (Existence of a clear legal framework related to Smart City development, digital infrastructure, data security, etc.)	3	2	2
8	Political and Governance Stability (Availability of long-term continuity and political support for ongoing Smart City projects.)	3	2	2
Total Score (max. 40)		24	16	16
Governance Readiness Level (%)		60%	40%	40%

Key Strengths: Shu stands out with consistent scores (3 in all categories), indicating balanced institutional support and stability across governance dimensions. Ayagoz and Shalkar share identical scores (2 across all indicators), suggesting uniform governance gaps in leadership, resource allocation, and legal infrastructure.

Common Weaknesses: Both Ayagoz and Shalkar require significant improvements in enhancing intergovernmental coordination, strengthening local administrative and financial capacity, developing public-private partnership (PPP) frameworks, and expanding digital governance and transparency tools.

In brief, Shu is better positioned institutionally to launch and manage Smart City projects due to its stronger governance framework. Ayagoz and Shalkar lag and require targeted capacity-building measures, legal framework upgrades, and stronger political support to enhance their readiness for Smart City transformation.

The findings of this study underscore the uneven readiness of small cities in Kazakhstan to embrace smart city initiatives. Among the three case studies, Shu demonstrates relatively higher preparedness due to stronger digital infrastructure, stakeholder engagement, and institutional support. This suggests that even within the category of small cities, localized strengths, such as transportation significance or historical development, can create favorable conditions for digital transformation. However, Ayagoz and Shalkar illustrate the structural and institutional barriers that many peripheral cities face. Their weak digital ecosystems, limited civic participation, and underdeveloped governance frameworks highlight the critical need for targeted policy support.

Another important observation is the lack of environmental sustainability and public-private

partnership mechanisms across all cities. This reflects a broader national challenge in integrating green technologies and inclusive economic collaboration into urban development plans. Moreover, the limited engagement of universities and international organizations suggests an untapped resource base for research, innovation, and capacity building.

Thus, the study emphasizes the necessity of a context-sensitive approach to smart city development, prioritizing local needs, existing capacities, and inclusive governance. Enhancing digital literacy, strengthening local institutions, and piloting scalable smart solutions in better-prepared cities like Shu could serve as strategic entry points for expanding the smart city model nationwide.

Conclusion

This study was aimed at assessing the potential for implementing the Smart City concept in small cities of Kazakhstan, using the cases of Shu, Ayagoz, and Shalkar to identify their respective levels of readiness and key challenges. Considering that digital urbanization trends in Kazakhstan have predominantly focused on major cities, this research is valuable in highlighting the untapped potential of smaller urban centers.

The findings derived from a mixed-methods approach demonstrate that Shu is significantly more prepared for Smart City transformation compared to the other two cities. Shu outperforms Ayagoz and Shalkar in terms of digital infrastructure, economic potential, and stakeholder engagement. It also exhibits relatively strong governance and institutional stability. Conversely, Ayagoz and Shalkar face notable issues, including institutional weakness, inadequate digital infrastructure, and low stakeholder participation.

All three cities recorded their lowest scores in environmental sustainability and public-private partnership (PPP) development–both of which are critical pillars of the Smart City model. Additionally, the participation of universities and research institutions, as well as international collaboration, remains limited across all cities. This restricts the adoption of evidence-based and sustainable solutions.

To address these challenges, it is essential to enhance the capacity of local government bodies, implement digital governance practices, ensure stable financing mechanisms, and clarify the legal and regulatory framework. The experience of Shu suggests that effective coordination among stakeholders–citizens, businesses, local authorities, and academia–plays a pivotal role in the success of Smart City initiatives. Ayagoz and Shalkar require targeted efforts to strengthen these aspects.

The research concludes that digital transformation in Kazakhstan should not be confined to major cities but must be systematically extended to small and medium-sized urban centers. Accordingly, the study recommends the development of pilot projects tailored to regional specificities, the establishment of broad-based stakeholder partnerships, and the adoption of targeted policy interventions.

By aligning the Smart City concept with balanced territorial development, this study contributes both scientifically and practically to identifying viable pathways for achieving social, economic, and environmental sustainability in Kazakhstan's small cities.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Acknowledgments

The author(s) received no financial support for the research, authorship, and/or publication of this article. We are grateful to our institutions. Also, many thanks to the anonymous reviewers for their helpful comments and guidance.

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Received: April 12, 2025
Accepted: May 30, 2025