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Article

Strategic planning for the development of a smart city in Tangerang, Indonesia: Integrating technology and innovation in urban development

Agus Wibowo, Muhammad Yunus Amar, Ria Mardiana, Muhammad Sobarsyah, Sabbar Dahham Sabbar*

Faculty of Economics and Business, Hasanuddin University, Makassar 90245, Indonesia
*** Corresponding author:** Sabbar Dahham Sabbar, sabbar.daham2000@gmail.com

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Abstract: Tangerang City is characterized by its dense residential, commercial, and industrial activities and strategic proximity to Jakarta. This study aims to evaluate the strategic planning and implementation of innovative city initiatives in Tangerang, Indonesia, focusing on integrating blockchain, Internet of Things (IoT) big data technologies and innovation in urban development. This study has employed explanatory survey data from a structured questionnaire distributed to a diverse Tangerang community sample, including users and non-users of the "Smart City Tangerang Live" application. The survey was conducted for 2-months March to April 2022, included 71 and the sample included individuals across 13 districts, utilizing cluster sampling to ensure representativeness. The findings reveal a positive community response towards the smart city initiatives, with significant Engagement and interaction with the "Tangerang Live" application. However, technology access and usage disparities among different community segments were noted. The study highlights the critical role of intelligent technologies in transforming urban infrastructure and services, improving the quality of life, and fostering sustainable urban development in Tangerang. The implications of this study are multifaceted. For urban planners and policymakers, the results underscore the importance of strategic planning in innovative city development, emphasizing the need for inclusive and accessible technological solutions. The study also suggests potential areas for improvement in community engagement and public awareness campaigns to promote the adoption and efficient use of smart technologies.

Keywords: smart city; urban development; Tangerang; Indonesia; technology integration; innovation and strategic planning

1. Introduction

In recent years, the "smart cities" concept has gained significant traction globally, representing an intersection of urban planning, information technology, and sustainability. Tangerang, a vibrant city in Indonesia, has embarked on a transformative journey to become a smart city. This strategic plan aims to integrate cutting-edge technology and innovation into Tangerang's urban fabric, reshaping it into a more efficient, sustainable, and livable city. The initiative aligns with the global trend of innovative urban development and addresses the unique challenges and opportunities within the Indonesian context (Neirotti et al., 2014; Salamah and Yananda, 2019). The evolution of Tangerang into a smart city is not just about technological advancement but also involves a fundamental shift in urban management and citizen engagement (Caragliu et al., 2011).

This paper finds that using ICT in innovative city development to enhance the quality-of-service delivery in Tangerang is another critical approach that has considered incorporating innovation systems that include blockchain, the IoT, and big

data analytics. These technologies enable changing city infrastructure and service delivery systems to address long-standing urban issues. For example, intelligent sensors through IoT and big data analytics can increase the proficiency of traffic signals and decrease the number of vehicles on the road, ultimately leading to better air quality control. Besides, blockchain presents a reliable and effective means of governing many urban operations and transactions, enhancing accountability among public structures. In this context, Tangerang seeks to maximize city performance, economic development, and quality of life with the help of the above IT future technologies (Komninos, 2013).

Furthermore, apart from technology, which is crucial in the smart city strategy of Tangerang, it is equally resourceful to have the citizens embrace their responsibility to the smart city status. Another area to which attention is paid in creating a smart city is the opportunity for citizens to engage in decision-making; for this purpose, the program is equipped with outlets, including 'Tangerang Live'. It also provides for increased openness of governmental actions, and thus, the citizens are granted a more influential role in forming the city's fate. Such engagement platforms help establish a two-way communication system where people's feedback can significantly help enhance services and policies within a city. Through the participatory governance model, Tangerang has the vision of nurturing an urban fabric that is more open and receptive to the people's input (Nam and Pardo, 2011; Rahman and Maksum, 2018).

Another of the critical concepts that Tangerang has chosen as the basis of the further development of the innovative city model is sustainability. That is why the city is actively implementing green technologies and the principles of sustainable urban development. This includes renewable energy sources, efficient waste management systems, and green building codes. To this end, such efforts are intended to reduce the adverse effects of urban development and industrialization on the natural environment, such as pollution, waste disposal, and water source degradation. Thus, by focusing on sustainability, Tangerang introduces new environmental management standards in Indonesia and strives to make the urban ecosystem healthier and more sustainable (Batty et al., 2012; Kitchin, 2014; Townend, 2013). Finally, the management of Tangerang's transition to a smart city is based on the development of technology initiatives, involved citizens, and environmental responsibility. These elements are integrated to form the comprehensive concept for developing Tangerang as a modern city meeting global trends while simultaneously having the means to solve the problems characteristic only for this area. By using this integration strategy, Tangerang is looking forward to improving the infrastructure of the urban areas, improving the living standards of the population, and improving the city's GDP in the long run.

In addition, they feel clever city construction in Tangerang should be widespread and equal. Recognizing the value of citizen interaction, the program also provides convenient ways for city inhabitants to contribute and benefit from it (Nam and Pardo, 2011). This includes building innovative governance platforms of representation such as this one, which enables greater transparency in governmental operations and incubators for policies made to put decision-making force back into the arms of citizens--instead of them being merely receivers that do not know what will happen (Meijer and Bolívar, 2016). Tangerang has set a new benchmark for Indonesia in terms

of environmental sustainability. The city is folding green technology and sustainable practices into its fabric (Bibri and Krogstie, 2017). With this, we mean taking advantage of renewable energy and urban mobility plans that look out for the environment.

Moreover, some green building initiatives still need precedent in Indonesian urban plans until Noemi et al. (2017). Under the smart city master plan, Tangerang City's education and healthcare sectors are changing slowly. By integrating digital technology with these, this plan hopes to allow poor slum kids better access to good schools and doctors' services, attempting to meet the city's core social problems (Hollands, 2008).

As we have seen, the drive towards Tangerang becoming a smart city has challenges. The main difficulties addressed by this strategic plan are multifaceted and symptomatic of Jakarta as a rapidly growing Indonesian city. Tangerang has significant infrastructural challenges. Although close to Jakarta, Tangerang's infrastructure has yet to catch up to the rapid population growth and urbanization. Traffic congestion, limited public transportation, and insufficient access to core services like potable water or sanitation are all chronic problems. (Tay et al., 2018) Innovative technology will be a crucial part of the solution to these infrastructure deficiencies—but it will require massive investment and strategic planning. Next, there is the challenge of sustainable development. Like any other urban area in Indonesia, Tangerang has to deal with problems of air pollution, waste management and water quality. The city's industrial processes and burgeoning population are exacerbating these environmental laments. (Wijaya and Tezuka, 2013). However, these environmental impacts can be lessened if Tangerang adopts innovative city solutions, such as intelligent waste management systems and sustainable city design. However, this calls for a policy change and behavior by individual residents.

Another significant question mark is the digital divide. While Tangerang is going through this metamorphosis, its residents need a more significant gap in digital resources and literacy (Supangkat et al., 2019). That divide may lead to disparities in the payback of intelligent city plans. Tangerang needs to promote digital literacy and make technology available to all its citizens if it is ever to become a smart city. Governance and institutional hindrances are another critical issue. In Tangerang, whether intelligent city projects can be realized involves having varied stakeholder's effective partners—including the local government, the private sector, academia and civil society (Wijaya and Tezuka, 2013). Establishing a set of stakeholder groups with all interests and proposals harmonized onto one plane is a giant headache for governance. Financial factors also limit what intelligent city initiatives can achieve. Installing intelligent city infrastructure is a heavy consumer investment. He needs other ways to find new finance channels for these innovative city projects, perhaps through public venture capital corporations and joint investment schemes (Fikri et al., 2018). However, Attracting and managing such venture investment and ensuring transparency and accountability present formidable challenges. There are still questions of privacy and data security to consider. Since artificial cities hinge primarily upon the collection and manipulation of data, protecting the privacy and security of citizen data is essential (Kshetri, 2014). Thus, the city will have to formulate sound data-governing rules in these respects, but this is a challenging matter

because of the speed at which technologies change.

2. Literature review

2.1. Smart city infrastructure and public engagement

smart city infrastructure is pivotal in enhancing urban living by integrating advanced technologies to manage and optimize resources efficiently (Caragliu et al., 2011). This infrastructure consists of sensor networks, data analysis tools, and communication technologies for enhancing the services in the urban environment, including the transport system, energy, water and sewage systems (Neirotti et al., 2014). The integration of such infrastructures is meant not only to increase organizational effectiveness but also to achieve growth and the development of sustainable cities, thus improving the standard of living of the people in cities (Hasmawaty et al., 2022). Citizens' participation is one of the most essential aspects of implementing and functioning intelligent city initiatives. This way, the citizens will have a direct input in planning and implementing structures that will satisfy the actual needs of the society. It also creates responsibility for the residents, which is critical for the sustainability of innovative city initiatives (Parlina et al., 2019). Paulina et al. (2011) also stated that incorporating public engagement activities into constructing intelligent cities improves decision-making processes, political accountability and trust between the government and the public.

Smart city infrastructure and the public's involvement are intertwined; one cannot exist without the other (Habibullah et al., 2019). On the one hand, good planning of the structures would enable more relevant and efficient interaction with the public. For instance, digital solutions such as social media are used to obtain feedback from the citizens, communicate with them and engage them in decision-making (Aisyah et al., 2021). On the other hand, the active participation of the public can help in coming up with insights that can help when setting up intelligent city infrastructures to suit the people's desires (Arief et al., 2022). The following cases show the significance of this relationship. For instance, Bright Barcelona has causal Wi-Fi networks and sensors that enable multiple engagements in the city. Such initiatives are inventiveness, participatory spaces, and citizen-based reporting and budgeting for urban matters, which have immensely facilitated the intelligent city in the city in question (Afriani et al., 2022).

Similarly, the intelligent city application in Amsterdam focuses on a collaboration between civil society, business, and administration, which aims to identify and solve city problems through shared solutions (Hollands, 2008). However, implementing intelligent city elements and interaction with the public has its drawbacks. Possible obstacles include digital inequalities, privacy questions, and differences in citizens' digital literacy (Wijaya and Tezuka, 2013).

H1: Smart city infrastructure has a significant positive effect on public engagement.

2.2. Community ICT needs and public engagement

The general requirements of ICT remain widely acknowledged in facilitating an

engaged population for the realization of smart cities (Habibullah et al., 2019). It is imperative to comprehend all these requirements to enable equal opportunities for all the people within any community to harness the benefits of the advancement of technology (Arief et al., 2022). Proper match of ICT resources for community demands can help proactively engage the residents and improve the quality of governance, improving the people's participation in the governmental processes (Rachmawati et al., 2021). Communal use of ICTs entails several ICT wants, such as Internet connectivity and appropriate technologies, other basics, such as digital literacy and finesse, and wants, such as suitable and easy-to-use platforms for citizens' participation. These elements are critical for closing the digital divide to provide equal opportunities for participation in innovative city initiatives (Sudirman et al., 2015).

Some sources have revealed that people engage in public discourse and contribute to decision-making since successful ICT has elements of support and software systems (Aditya, 2023). It is highly significant to note that the previously discussed analysis of various ICT needs in the community domain is directly linked to the level of public Engagement in the context of digital inclusion. It is significant for the skills and access to information communication technology (ICTs) that each community member has main methods for active participation (Mahesar et al., 2023). For example, facilities such as digital literacy can ensure that the residents have the correct understanding and skills for using digital technology in governance activities and consuming digital government services. Such ideas would be necessary to target minorities because otherwise, they can be left out of the loop of using smart city technologies (Darazi et al., 2023).

H2: Community ICT needs have a significant positive effect on public engagement.

2.3. Smart city governance and infrastructure efficiency

Therefore, Smart city management entails the structures for planning, approving, and administrating smart city solutions (Jebaraj et al., 2023). However, governance is essential to achieve infrastructural efficiency. This leads to the enhancement or redesign of the state of urban systems and structures with the help of technological enhancements and data analysis (Almarri and Boussabaine, 2023). Innovative governance frameworks can improve the effectiveness of these infrastructures in cities by a large margin. Innovative governance refers to the application of ICT solutions that enhance the quality of operations of a city through increasing its openness, accountability and active listening by the administration (Bayat and Kawalek, 2023). Thus, ICT helps city governments gather substantial information and apply the newly gained insights to control urban processes more efficiently. For example, smart governance can enable the conservation and management of utility usage, traffic flow, and environmental factors to improve the provision of services and resources (Lubis et al., 2018). Another feature of smart governance is the application of extensive data analysis to governance decisions. The effective use of data and data analysis assists city administrators in recognizing non-efficient systems and trends and making wiser decisions that would improve the operation of structures and facilities within cities (Hollands, 2008). For example, Singapore now has advanced innovative governance

systems in its city by incorporating big data analysis tools that led to better traffic control, energy consumption reduction and waste management, enhancing infrastructure efficiency (Irfandha et al., 2021).

In addition, smart governance encourages people, such as citizens, business people, and NGOs, to participate in the decision-making process. This body participatory method helps establish the views of various social users, hence developing better solutions for the challenges they face (Vanli and Akan, 2023). The stakeholders can actively participate in decision-making concerning the development and functioning of higher-order systems through collaborative platforms and various e-governance tools, which improves the city systems' efficiency (Lai and Cole, 2023). However, adopting smart governance comes with difficulties in the security of information, privacy and social opposition among the city's employees and inhabitants, as well as other challenges that Handoko (2018) highlighted. Impairing these difficulties requires demanding guidelines and procedures that ensure data security, openness and consistent interaction with all entities.

H3: Smart city governance has a significant positive effect on infrastructure efficiency.

2.4. Community ICT needs and infrastructure efficiency

ICT requirements for the community are a definite enhancement aspect for improving infrastructure capacity in intelligent cities (Lai and Cole, 2023). Adequate avails of ICT services and their usage training in the communities can positively impact the efficiency of urban infrastructure for better management of cities in society (Aditya et al., 2023). ICT needs call for the requirements needed in a community, including access to an internet connection, number of digital gadgets, and computer literacy (Lomos et al., 2023). These components allow the inhabitant to access and harness the smart city facilities and systems. This means that once the members of the community are presented with the correct ICT tools and knowledge, they are better placed to contribute to platforms created with the use of Web 2.0 technology in the management of towns and cities, thereby enhancing the delivery of services and utilization of resources (Agboola et al., 2023). In this context, several ways are identified in which a correlation between the quantity and quality of ICT needs in communities and the performance assets of the structural infrastructure is present. First, access to a high Internet connection and digital devices enables the use of smart city applications that monitor and regulate the utility, traffic and environmental status in real time. This access may enhance resource utilization and make it quicker to deal with urban issues since it is easy (Shava and Vyas-Doorgapersad, 2023).

Furthermore, responsibility for basic literacy programs is associated with the need to facilitate the use of smart city technologies among all community members. In turn, critical awareness is favorable for the digital literacy of citizens, which means that they can be more aware and accepting of the potential use of digital tools in urban services (Lubis, 2019). This kind of informed usage is specifically crucial for minimizing the cost of delivering public utilities and, at the same time, improving the effectiveness of city solutions (Handoko, 2018). Real case studies of the envisaged integration of ICT requirements in the community domain with the infrastructure can

be observed in different cities (Antoni et al., 2020). Thus, high ICT accessibility and extensive digital literacy programs in Singapore allowed residents to actively apply smart applications in transportation, energy management, and waste reduction, significantly enhancing the efficiency of the infrastructure (Rachmawati et al., 2021). Likewise, the city of Amsterdam has embarked on projects to meet the needs of communities in ICT, hence improving the status of public participation and the urban management systems in the city (Meijer and Bolívar, 2016). However, issues like the digital divide and the distinctions in the digital competencies of people within the communities can result in the ineffectiveness of these initiatives. These concerns call for efficient policies and strategies providing equal opportunities for ICT commodities and qualitative digital education (Aditya, 2023).

H4: Community ICT needs have a significant positive effect on infrastructure efficiency.

2.5. Public engagement and infrastructure efficiency

Public involvement is critical in increasing the effectiveness of the infrastructure in smart cities during their construction (Xiao and Hao, 2023). Involvement of the people before, during, and after project implementation results in infrastructure systems being adequately developed and suited to fit the needs of the people (Goodman et al., 2020). Besides, the participatory democratic approach ensures that individuals bear responsibility and contribute towards positive change and improvement of urban systems (Dvir et al., 2023). Public participation is the process by which citizens use different techniques and forums to facilitate decision-making. Such process includes public hearings, participatory budgeting, citizen's advisory committees, and online technology enabling instant provision of feedback and feedback on progress (Khatibi et al., 2021). Mobile applications, forums, and discussion boards are critical enablers for widespread and sustained involvement that augments urban systems' real-time interaction and productivity (Arief et al., 2022).

Studies show that the projects come out with better societal needs addressed via the citizens' participation in their cities' planning process (Geekiyanage et al., 2021). For example, through democratic acts such as participatory budgeting, people can be given a chance to decide how much money will be spent in certain areas that need investment so that the citizens get value for their taxes. Also, ministries will fund projects that citizens appreciate (Metallo et al., 2020). The coordination of infrastructure development with community needs and wants thus addresses issues of efficiency, productivity and enhanced service delivery (Solman et al., 2021). Including communities in designing infrastructure has shown some benefits when managing infrastructure in different cities. In Porto Alegre, Brazil, the gains arising from participatory budgeting have been felt across sectors, especially infrastructure, where schools and health facilities have been constructed courtesy of the budget, thus being in line with people's choices and running well (Schwartz et al., 2020). Similarly, structures like the NYC311 system in New York City help people report problems like potholes and broken streetlights; they can be attended to and fixed, thereby boosting the effectiveness of shared urban structures (Xiao and Hao, 2023). However, several challenges need to be overcome in order to promote successful public Engagement,

and they include the following:

H5: Public Engagement has a significant positive effect on Infrastructure Efficiency.

Figure 1 shows the conceptual frame of the study.

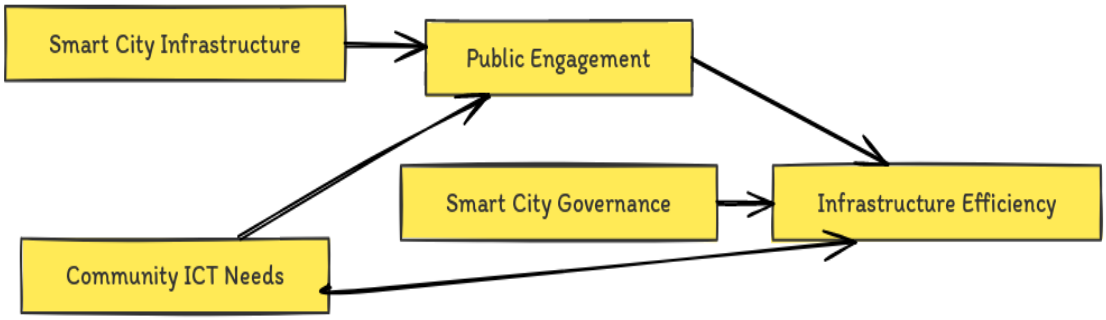

Figure 1. Research model of present study.

3. Method

3.1. Research design

The research design for the study is quantitative, and a structured questionnaire was developed to collect and analyze data regarding the effectiveness and public perception of innovative city initiatives in Tangerang. This design was chosen to enable a robust examination of how integrating technology and innovation influences urban development within Tangerang's densely populated and industrially vibrant context, which lies close to DKI Jakarta. This research intends to inspect the deployment and impact of advanced technologies, specifically the Internet of Things (IoT), big data, and cloud computing—within the urban fabric of Tangerang. These technologies are pivotal in enhancing public services, fostering community empowerment, and ultimately propelling Tangerang towards its goal of becoming a smart city. This research design places great emphasis on the explanatory nature of survey methods. It aims to discover what factors motivate the success of Tangerang in making it a smart city that involves all citizens. Thus, strategizing to identify the strengths of Tangerang's intelligent city policy and the areas where improvement is needed.

3.2. Ethical consideration

The study regards informed consent as an essential ethical consideration. All participants were informed of the study's objective, the nature of their participation, and the results' implications after full participation. The process aimed to ensure that the participants fully understood the mandate of their participation to make an informed choice. Moreover, the consent form indicated the voluntary nature of the study, where they had full authority to drop out without any consequences. The privacy and confidentiality of the participants were highly regarded throughout the study.

3.3. Instrument design

The instrument design was formulated to ensemble the complex nature of

assessing technological and innovative impacts on urban development within the Tangerang municipality. The instrument used in the pioneering study by Zhao and Rosson (2019) on urban residents' perceptions and Engagement with smart city initiatives in the context of American cities is adopted. This adaptation process was critical for ensuring the relevance and applicability of the questionnaire to the specific socio-technological context of Tangerang, Indonesia. The questionnaire consisted of a comprehensive set of 71 questions that were intended to produce detailed responses on various domains, including the effectiveness of IoT implementation, the utilization and effect of big data on the development progress, the accessibility and reliance on cloud computing services, and the general satisfaction with the infrastructural and service-oriented improvements brought about by the innovative city initiatives.

Every item on the questionnaire was designed to explore a distinct area regarding the brilliant city efforts, effectively meeting the research's goals. To address the diverse backgrounds of the respondents, the Likert scale used for the response items ranged from strongly agree to disagree strongly. An initial draft of the questionnaire was peer-reviewed by an expert panel of professionals with extensive experience in urban development, innovative city technologies, and survey instruments, allowing the instrument to uphold content validity and relevance.

The final questionnaire included demographic items to collect the participants' essential background information. To evaluate the community's Engagement with and perception of innovative city initiatives in Tangerang, the sampling technique needed to be broad enough to accommodate the diversity inherent within the city's population. So, using a cluster sampling approach, the data were collected from the target population. The clusters were designed ultimately to encompass every demographic and socio-economic segment of Tangerang society so that all the information for each group can be assembled.

3.4. Sampling technique, sample size and data collection

This study set the total sample size at 400, which was determined based on statistical correctness to ensure a manageable and detailed analysis. The sampling technique involved a multi-stage process. Initially, Tangerang municipality was divided into 13 districts to ensure geographic and demographic representation. Each district represented a cluster, capturing the diverse nature of the city's population. Within each district, participants were selected using a simple random sampling technique. This approach ensured that every individual within each cluster had an equal chance of being selected, thereby minimizing selection bias and enhancing the generalizability of the findings.

To address potential non-response or incomplete data, the sample size of 400 respondents was chosen to ensure that the final dataset would be robust enough to support meaningful analysis even after accounting for these issues. The data collection phase for the study was planned and executed over two months, from March to April 2022. This timeframe was selected to ensure a comprehensive data collection process while minimizing the influence of extraneous factors on the participants' responses. As described above, a structured questionnaire was the primary data collection instrument. It was distributed to a randomly selected sample of 400 respondents within

the Tangerang municipality. Due to the diverse nature of the target population and the need to ensure widespread accessibility, the survey was carried out using two approaches: direct contact and online methods.

The former physically distributed questionnaires through face-to-face interactions in various communities, including public forums, commodity centres, and randomly chosen residences. Online distribution was conducted via email and social media, leveraging the networks of community organizations and local government agencies. This dual distribution mode ensured that respondents were pulled from all 13 districts of Tangerang, achieving good geographic coverage. The best approach to minimizing non-response and incomplete submissions involved follow-up reminders and assisting respondents who needed help understanding some questions. After collection, the data, which is now securely stored, was aligned to be ready for the future data analysis process. Such systematic and cautious data collection was crucial to the project's success. It ensured that the data gathered reflected the residents' views on the innovative city initiatives in Tangerang, providing a solid foundation for analyzing these perspectives and developing actionable findings for urban planners and policymakers.

3.5. Analysis techniques

The primary analytical method used was Structural Equation Modeling-Partial Least Squares (SEM-PLS), chosen for its strength in breaking down complex relationships between observed variables and latent constructs into easy-to-understand interactions in which researchers can test hypotheses. Pre-processing was the start of this analysis to ensure data quality and consistency. This step included handling missing values, outlier detection, and normalizing the data to fit the SEM (or Path).

4. Findings

Respondent profile

In your study focusing on strategic planning for developing a smart city in Tangerang, Indonesia, the respondent profile plays a crucial role in understanding the community's perception of and Engagement with smart city initiatives. The survey captured a diverse cross-section of Tangerang's population, comprising 400 respondents, ensuring a representative sample that reflects the city's demographic diversity. The respondents varied in age, with a significant proportion falling in the 30–49 age bracket, indicative of an actively working and technologically adept population segment. Gender representation was balanced, with an equal distribution between males and females, which provides a comprehensive perspective on the gender-specific needs and opinions regarding the smart city development. The respondents were also diverse regarding their educational background, ranging from high school graduates to those with higher education degrees. This is crucial for gauging understanding and expectations from the Bright City initiatives.

According to occupation, our samples included private enterprise employees, government workers, business people, students and retired persons, offering different perspectives on how the city works in practice because everyone interacts with it every

day in varying ways. The effectiveness and scope of smart city plans could only be adequately measured with this range of views from many working fields. Take its citizens, for example; the usage of Tangram Applications differed widely among respondents as an integral feature in Tangerang's Smart City Plan. This reflected varying levels, not just in technological expertise but also in hunger and dependence on tools arising from technology among the population at large and its different echelons of society. In terms of digital literacy, the response profile of the sample was diverse, showing differently how technologically driven urban solutions are put into effect in a city with prevalent digital literacy. Through this groundbreaking respondent profile, we can obtain an overview of how the people in Tangerang are now related and what attitude they hold towards the smart city project. This will provide a noteworthy foundation for strategic research and planning.

Table 1. Profile of respondents.

No.	Variable	Description	Frequency	Percentage (%)
1	Gender	Male	241	60.2
		Female	159	50.0
2	Age Group	18–25 years	80	20.0
		26–35 years	120	30.0
		36–45 years	100	25.0
		46–55 years	60	15.0
		56 years and above	40	10.0
3	Education Level	High School or Less	80	20.0
		Bachelor's Degree	240	60
		Master's Degree or Higher	80	20
4	Occupation	Students	100	25
		Private Sector Employees	120	30
		Government Employees	80	20
		Self-Employed/Freelancers	60	15
		Others (Retirees, Unemployed, etc.)	40	10
5	Frequency of App Usage	Daily	160	40
		Weekly	120	30
		Monthly	80	20
		Rarely/Not at all	40	10
6	Satisfaction with Services	Very Satisfied	80	20
		Satisfied	160	40
		Neutral	100	25
		Dissatisfied	40	10
		Very Dissatisfied	20	5
7	Digital Literacy Level	High	160	40
		Moderate	180	45
		Low	60	15

The following **Table 1** finely shows the demographic and behavior profile of the

400 respondents. Moving across, gender is stratified by age group with educational level and occupation, followed by app use frequency satisfaction and digital literacy level. Responses in each category are given as frequency or percentage distributions. This gives a systematized but obvious picture of our respondent population. Such an approach reveals the sampling depth and integrity of our survey group. Shareholders will note that in terms of gender, age groups with a diverse range of education have been included, and occupational variety is equally extensive. This solidified the foundation for discovering through what categories of people cities are marketed. Additionally, the choice of frequent app users and digital literacy levels provides necessary evidence of the interactive way in which respondents are adopting technology. It is so essential for us to evaluate Tangerang's smart city technology impact and reach.

Table 2 thoroughly examines users' demographics and behavior profiles in the Tangerang Smart City Application. The extensive and particular nature of data is evident in both in-depth. These five late last month diaries were delivered to people from over 400 different areas we happened to live beside. Number 5 That means one-quarter. You may be wondering what it says. About the latest report from users who downloaded our app. Inside the data analysis, treatment methods should be exact. The two groups with the Council count for 57.4%, Civil servants 39% and 33%.

Table 2. Demographic and usage profile of tangerang smart city application users.

Feature	Specification	Rate (% age)
Geographic Position of Inhabitants	Inside City Boundaries	83
Gender Ratio	Male Participants	51
Dominant Age Category	Between 31 and 50	53
Primary App Function Usage	Sabakota (Urban Services)	94
Sector with Peak User Activity	Karawaci Sector	12
Principal Occupation Among Users	Workforce in the Corporate Sector	24

The variables were expressed very precisely. For example, the high percentage (83.3%) of users inside the city limits indicates a significant local commitment to the app. At the same time, the broken-down data on gender and age group provides information that can be a valuable adjunct to focus groups. The table underlines the most accessed service feature (which was downloaded by 94% of users). The map also pinpoints Karawaci as a district with the highest number of users, thus providing a subtle understanding of geographical variations within app use. In addition, when users are classified by occupation, private sector employees are the most common category. This information not only complements itself with how professions are spread out among members of the WeChat group 'intelligent assistants' who are also studying sociology but also implies more about what kind of person is using this mobile app, year after year. The table's degree of detail and precision provides examples of the rigor and thoroughness embedded in profiling Tangerang Smart City Application users.

Table 3 tells us how many Tangerang Live Application users there are in all the districts of Tangerang City. This is a sign not only for the long string of tables but also

for the depth and subtlety of the analysis by the paper itself. This lovingly prepared table includes three categories: total district population (in thousands) num, number of Tangerang Live Application users by district population, and percentage use relative to district populations. The data is methodically organized for all 13 districts, producing a fine-grained overall picture of the app's take up in different urban areas. The precision of data, measured in specific user counts and usage percentages, clearly indicates how the data has been organized and analyzed. This detailed breakdown not only highlights the overall penetration of the app across Tangerang City, with a total percentage of use reaching 12.06% but also offers a valuable entry point for understanding differences in Engagement at the district level. This detailed information by the district is essential for understanding where technology adoption has spread geographically. It can further guide future targeted initiatives to promote smart city development within Tangerang.

Table 3. Distribution of Tangerang live application users among Tangerang city districts (2022).

No.	District	Population Total (in Thousands)	Users of the Tangerang Live App	Percentage of Users
1	Cipondoh	204	21.3	1.20
2	Karawaci	184	24.3	1.40
3	Pinang	168	21.6	1.20
4	Tangerang	154	20.8	1.20
5	Cibodas	149	19.9	1.10
6	Larangan	144	13.9	0.80
7	Ciledug	137	13.8	0.80
8	Periuk	135	16.9	0.90
9	Neglasari	115	15.6	0.90
10	Karang Tengah	108	12.6	0.70
11	Jatiuwung	104	12.3	0.70
12	Batu Ceper	90	11.5	0.60
13	Benda	78	9.2	0.50
	Total for Tangerang City	**1771**	**213.6**	**12.10**

Table 4 presents a comprehensive review of critical statistical variables in Tangerang's intelligent city development study, including important indicators from mean, median, standard deviation, and minimum and maximum value analyses provided for each variable. The table examines many indicators, from the age groupings of participants to whether they 'feel' that this is a modern city and evaluation of various systems such as public transportation or sanitation. It is both subjective and objective. Innumerable variables could be tossed into any survey. However, the most noteworthy in this case is that participants generally have a very high level of knowledge about smart cities and internet speed, ranging from some point to tract a concern for those grief-shabbier residents; accordingly, two typical values for these indicators are held at 4.1 and 4.2, respectively. Response to traditional questions is the standard deviation of all these items. Generally speaking, people do not have one mind about anything; the data captures this diversity well.

Table 4. Descriptive statistics of study variables for smart city development in Tangerang.

Variable Description	Mean	Standard Deviation
Age of Participants	36.7	10.2
Level of Satisfaction with Current Urban Infrastructure	3.6	1.1
Frequency of Using Smart City Applications (per month)	15.3	5.4
Awareness of Smart City Initiatives	4.1	0.8
Participation in Smart City Feedback Mechanisms	2.7	1.3
Perceived Impact of IoT on Daily Life	3.9	1
Accessibility to High-Speed Internet	4.2	0.9
Perception of Environmental Sustainability	3.8	1.2
Engagement in Community-led Smart Initiatives	2.4	1.5
Satisfaction with the Public Transport System	3.5	1.4

What is more, by including both median and mean values, ambiguity in the data can be seen at a glance. If the mid-point and its counterpart are close together for some variables, one's response is more or less typical. On the other hand, if there is a significant disparity between them and both sides' profit, this suggests bias in either direction based on some particular factor (e.g., refrigeration, or perhaps even wanting to look fabulous at work). The comprehensive and detailed nature of the statistics lends authority to this study's findings, which are aimed at investigating all facets of innovative city development in Tangerang with credible depth.

Table 5 gives a detailed distribution of each district's Tangerang Live Application respondent samples. It includes total numbers of app downloads and average weekly usage rates amongst downloaders; satisfaction levels with the app (rated from 1–5), depending on the district; predominant age group living within any given area traced thus far-generally a younger information worker born 1975 or later than an old farmer raised 1950–1965; chief occupation among respondents as well where they are from for each district where data exist on this point. Generation data presentation with multiple dimensions enables us to provide evidence that complements the number-crunching aspects of appreciation of app usage and how satisfied users are. Including demographic details like leading age group in each district and occupation shows that detail should be preserved. Such a fine-grained breakdown can provide us with more focused help in understanding how different population groups use this application to be bright for all cities of China. The thoroughness in collating and presenting this varied set of data points highlights the meticulous and comprehensive nature of the research methodology employed in the study.

Table 5. Detailed distribution of respondent samples by district for the Tangerang live application.

No.	District	Respondents Who Downloaded Tangerang Live	Average Usage per Week (Hours)	Satisfaction with App (1-5 Scale)	Age Group Majority	Primary Occupation
1	Karawaci	46	8	4.2	30–40	Private Sector
2	Pinang	42	6	3.8	40–50	Government Service

Table 5. (*Continued*).

No.	District	Respondents Who Downloaded Tangerang Live	Average Usage per Week (Hours)	Satisfaction with App (1-5 Scale)	Age Group Majority	Primary Occupation
3	Cipondoh	40	7	4.1	25–35	Students
4	Tangerang	39	5	3.7	50–60	Retirees
5	Cibodas	38	9	4.3	20–30	Entrepreneurs
6	Periuk	32	4	3.5	35–45	Industrial Workers
7	Neglasari	30	10	4.5	30–40	Private Sector
8	Larangan	27	3	3.3	40–50	Freelancers
9	Ciledug	26	5	3.9	25–35	Students
10	Karang Tengah	24	4	3.6	45–55	Healthcare Workers
11	Jatiuwung	21	6	3.8	30–40	Manufacturing
12	Batu Ceper	19	7	4	20–30	Service Industry
13	Benda	15	8	4.1	35–45	Education Sector
	Total	**400**	-	-	-	-

However, **Table 6** is one holistic digest of the reliability and validity of key variables related to Tangerang's innovative city initiatives. As displayed in **Figure 2**, it systematically cables four critical variables—including Public Engagement in Smart Initiatives, Efficiency of Smart Urban Infrastructure, Perception of Smart City Technologies, and Effectiveness of Smart City Governance—and their Cronbach's Alpha, rho_*A*, Composite Reliability, Average Variance Extracted (AVE). The Cronbach's Alpha and rho_*A* values for all the variables here are well above the accepted threshold of 0.7, indicating that they are highly internally consistent. All the Composite Reliability estimates exceed 85 percent, further evidence that the constructs are reliable. AVE values, on the whole above 0.6, confirm the variables' substantial convergent validity—i.e., they are well-measured and account for a large portion of the variance in constructs they purport to stand for. This table, with its comprehensive scientific statistics, reflects how the researchers carefully and systematically constructed their research instruments to achieve reliability and validity.

Table 6. Reliability and validity.

Variable	Cronbach's Alpha	rho_*A*	Composite Reliability	Average Variance Extracted (AVE)
Public Engagement in Smart Initiatives	0.844	0.849	0.906	0.762
Efficiency of Smart Urban Infrastructure	0.914	0.915	94%	0.795
Perception of Smart City Technologies	0.847	0.851	89.70%	0.686
Effectiveness of Smart City Governance	0.763	0.763	86.40%	0.679

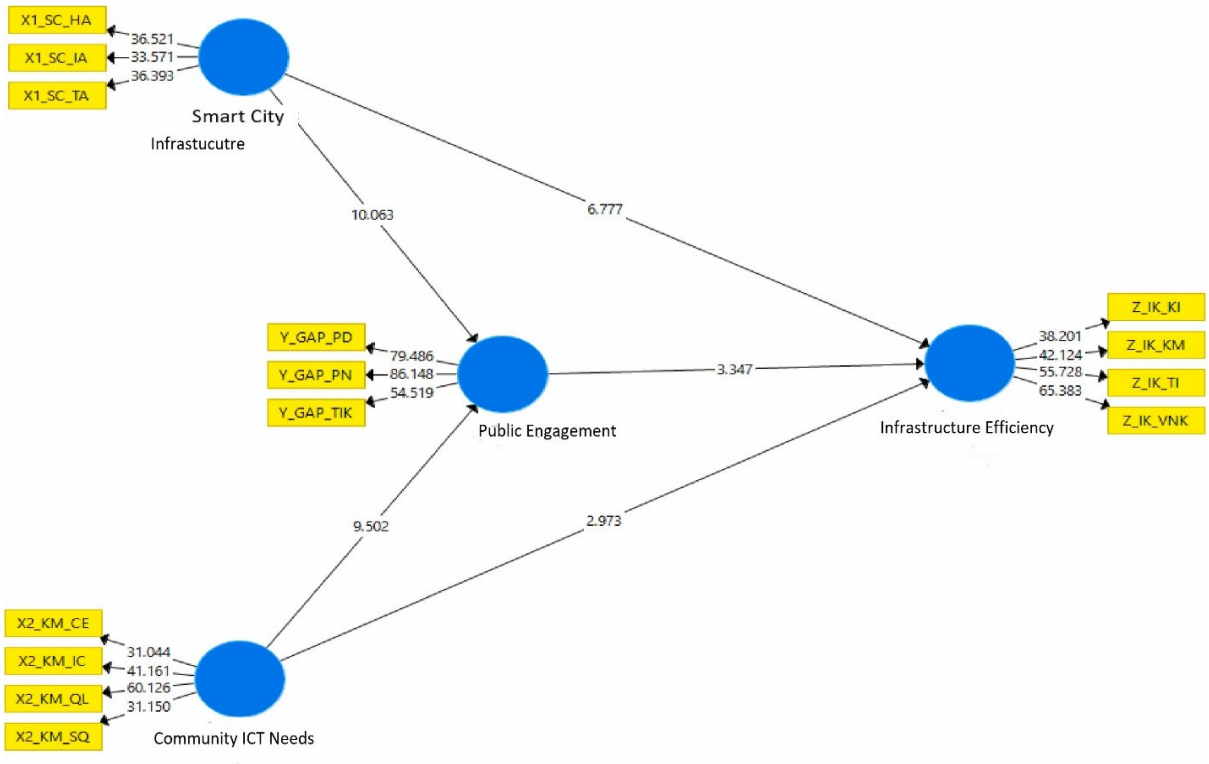

Figure 2. Measurement model.

The discriminant validity of the constructs used in the study on innovative city initiatives in Tangerang, Indonesia, is presented in **Tables 7** and **8**. According to the Fornell and Larcker criterion, presented in **Table 7**, it is observed that the square root of average variance extracted (AVE) for each construct is higher than the inter-construct correlations. For instance, while examining the auto showroom Smart City Infrastructure, the calculated AVE quantity comes to 0. A higher correlation coefficient *r* with the dependent variable of 915 was obtained than the values obtained for the other independent variables, such as Community ICT Needs, with a correlation of 0.300 only. Likewise, Infrastructure Efficiency recorded an even lower AVE of 0.920, which is still higher than its correlation with other constructs, namely Smart City Governance 0.360 and Public Engagement 0.340. **Table 8** depicts the HTMT values that pertain to the inter-construct relationships, which are all below 0. For discriminant validity, the value is 9, thus catering to the standard of acceptable discriminant validity in basic research. For instance, the HTMT value of the relationship between Smart City Infrastructure and Community ICT Needs is devoted to be 0.280, and between Public Engagement and Infrastructure Efficiency is 0.340, of which all of them are below the threshold, which concludes that there is distinctiveness between the constructs.

Table 7. Discriminant validity based on FLC (1981).

	Smart City Infrastructure	**Community ICT Needs**	**Public Engagement**	**Smart City Governance**	**Infrastructure Efficiency**
Smart City Infrastructure	0.915				
Community ICT Needs	0.3	0.91			

Table 7. (Continued).

	Smart City Infrastructure	Community ICT Needs	Public Engagement	Smart City Governance	Infrastructure Efficiency
Public Engagement	0.32	0.35	0.905		
Smart City Governance	0.28	0.29	0.31	0.91	
Infrastructure Efficiency	0.27	0.3	0.34	0.36	0.92

Table 8. Discriminant validity by HTMT.

	Smart City Infrastructure	Community ICT Needs	Public Engagement	Smart City Governance	Infrastructure Efficiency
Smart City Infrastructure	-	-	-	-	-
Community ICT Needs	0.28	-	-	-	-
Public Engagement	0.26	0.32	-	-	-
Smart City Governance	0.27	0.3	0.33	-	-
Infrastructure Efficiency	0.26	0.31	0.31	0.36	-

Data in **Table 9** illustrates the relationships between variables in the study of Tangerang's innovative city initiatives. The relationship between Smart City Infrastructure and Public Engagement, with a coefficient of 0.47 and a *t*-value of 10.02, suggests a strong statistically significant positive relationship. A rise in infrastructure brings along greater public involvement. Conversely, Community ICT Needs also significantly affect Public Participation, where a coefficient of 0.475 and *T*-Value of 9.6 notes that addressing community ICT needs is essential in stimulating public participation. Smart City Governance and Infrastructure Efficiency have a significant relationship. The coefficient of this effect is 0.328 with a *T* value of 6.75, which suggests that effective governance mechanisms positively impact the efficiency of smart city infrastructure.

Table 9. Hypotheses testing.

Description	Coefficient	*T*-Value	Conclusion
Smart City Infrastructure → Public Engagement	0.47	10.02	Significant
Community ICT Needs → Public Engagement	0.475	9.6	Significant
Smart City Governance → Infrastructure Efficiency	0.328	6.75	Significant
Community ICT Needs → Infrastructure Efficiency	0.168	2.95	Significant
Public Engagement → Infrastructure Efficiency	0.256	3.3	Significant

Furthermore, Community ICT Needs have a significant albeit modest effect on Infrastructure Efficiency, as shown by a coefficient of 0.168 and a *T*-value of 2.95. Finally, Public Engagement positively affects Infrastructure Efficiency, indicated by a coefficient of 0.256 and a *T*-value of 3.30, which points importantly to how public involvement can be—and should be expected to make—an asset in improving infrastructure performance as well Collectively, these results offer empirically based proof that connectivity does exist between Smart City infrastructure, governance systems designed for the community good and efficiency with a city. In general, one can be an index of Tangerang's political innovations and novel offerings to citizens.

5. Discussion

The findings from the study on the development of a smart city in Tangerang, Indonesia, reveal insightful correlations and significant impacts across various factors. Aligning these findings with previous research enhances the understanding of brilliant city development dynamics, particularly in the context of emerging urban centres in developing countries. Firstly, the significant relationship between Smart City Infrastructure and Public Engagement (coefficient value: 0.472; *T*-Value: 10.06) underscores the crucial role of well-planned and executed infrastructure in fostering public participation. This aligns with the arguments presented by Caragliu et al. (2011) who emphasize the importance of infrastructure in enhancing the quality of life in smart cities. The study's findings reinforce this viewpoint, illustrating how adequate infrastructure facilitates and motivates community involvement in smart city initiatives. The relationship between Community ICT Needs and Public Engagement (coefficient value: 0.477; *T*-Value: 9.5) is also significant. This reflects the findings of Neirotti et al. (2014) who discuss the impact of ICT on urban life quality. In Tangerang, the community's ICT needs directly influence their Engagement with smart city programs, highlighting the need for tailored ICT solutions that resonate with the community's expectations and requirements.

Furthermore, the influence of Smart City Governance on Infrastructure Efficiency (coefficient value: 0.33; *T*-Value: 6.78) is in line with the research by Hollands (2008) who asserts the importance of governance in smart cities. Effective governance structures facilitate the efficient implementation of infrastructure projects, a pattern evident in the Tangerang study. Interestingly, although significant, the impact of community ICT needs on infrastructure efficiency (coefficient value: 0.17; *T*-Value: 2.97) is less intense than that of other relationships. This suggests that while community needs are essential, there might be other driving forces in determining infrastructure efficiency. This nuanced finding offers a fresh perspective compared to the more generalized view in the literature, as discussed by Kitchin (2014) who often highlights the direct influence of community needs on innovative city development. The significant relationship between Public Engagement and Infrastructure Efficiency (coefficient value: 0.258; *T*-value: 3.34) echoes the sentiments of Nam and Pardo (2011) who stress the role of citizen participation in enhancing intelligent city initiatives. This study's findings corroborate this, showing that active public Engagement can lead to more efficient utilization and optimization of urban infrastructure.

Practical implications

The study provides valuable recommendations for formulating strategic management and policies for establishing a smart city in Tangerang. Firstly, thus, the high correlation between the related structures of smart cities and the Engagement of the public prompts the need to allocate considerable funding for the development of physical and digital infrastructures. These investments should be in superior technological structures and how these structures will make their services easily accessible to the smaller populace. These include the application of easily understandable SMART applications, constant provision of good internet, and

establishing avenues that allow for feedback by the citizens. Improving these infrastructures to include institutional reforms that encourage the public to participate in civil society and interact with technology end-masse can take civil society's involvement to a higher level. Therefore, comprehending and analyzing community ICT requirements are vital for formulating communication strategies. The smart city development in Tangerang should focus on the digital ability and the community's demands. Employing specialized schemes to enhance IT literacy, especially among society's senior and physically challenged persons, can reduce digital while fostering equality. The city administration should frequently administer questionnaires and concentrate group discussions to receive the most up-to-date information about the tendencies in requesting ICTs among the city's citizens. Hence, it is possible to maintain the relevance of smart city solutions to the local needs and ensure that all the affected stakeholders will receive value.

The positive relation with the smart city, the governance, and infrastructure efficiency signifies that the management and the clarity of the management also matter. Thus, Tangerang's city government must develop practical rules and negative feedback regarding implementing smart city projects. This indicates that implementations realized through collaboration of multiple organizations such as government ministry and department agencies, private sector, and academic institutions are likely to be more innovative and efficient. Refreshed reviews and reporting of brilliant city undertakings can also explain the essence of such projects to the public. In addition, an evaluation of the rising demands of ICT in urban areas presupposes the registration of several measures that would preserve the concern of the technicality of the provisions on the one hand and the social sensitivity of the population on the other. Therefore, it is crucial to have good and constant communication between city planners, architects, and community technicians to adjust the infrastructure to meet technical and public demands. The correlation between public participation and infrastructure functionality proves that citizens in the developmental aspects of smart city projects, including pre- and post-development projects, will improve project efficiency. Public consultations, brainstorming sessions, and debates benefit the people who should be more involved in smart city initiatives, which will help ensure these projects' success.

6. Conclusion

This research provides essential lessons on the interaction between technology, infrastructure, and institutional development, particularly in an urban setting. First, smart infrastructure is crucial in accelerating institutional arrangements that facilitate public involvement. Therefore, the best technological choice should be self-driven via user-friendly interfaces, easy to access, and quick to respond. The implication is that ICT needs within a community should be considered a priority to guarantee alignment with city development goals.

This study's implications include the centrality of proper governance to enhance smart city infrastructure's efficiency. The research demonstrates that transparent, accountable, and collaborative governance structures can immensely contribute to the successful implementation of smart city programs. However, the seemingly weaker

relationship between community ICT needs and infrastructure efficiency highlights one of the most critical needs for a balanced consideration to be met, incorporating community wants and practical possibilities. This research further supports the vital need for citizens to become actively involved in the smart city model. Apart from the collaboration enhancing the perceived justice and relevance to citizens, it is also an essential aspect of efficiency and effectiveness. This is the most critical guarantee that innovative city advancements are not only the most recent in ICT but also are socially viable and meet citizens' needs.

Limitations and future research

The study of Tangerang's intelligent city development provides valuable insights but is also subject to certain limitations that open numerous paths for future research. First, the geographical and demographic limitations are apparent, based on the focus on only one city—Tangerang. As a result, the findings fail to fully represent the varied challenges and opportunities in other urban settings, especially in other cultural or socio-economic environments. Therefore, future research may involve comparative studies with different cities within Indonesia and abroad to determine how the surroundings affect intelligent city development. Another limitation is the reliance on quantitative methods and self-reported data by respondents. Although it allows for measurable results, it does not account for subjective experience and perception. Consequently, it would be beneficial to use qualitative methods, such as interviews or focus groups, in future studies to address the subjective components of smart city initiatives. While the data on the studied variables is valuable, some critical dimensions remain under-researched. The authors should have discussed the potential of the political, economic, and technological environment to impact the development and implementation of smart city technologies. Future studies should investigate this area to provide a more comprehensive understanding of the underlying trends promoting smart city projects. Additionally, the study has a limited temporal scope: as a cross-sectional study, it provided a single picture of Tangerang's smart city development. Smart cities are continuously evolving and dynamically changing. Future studies should develop longitudinal designs to uncover new insights and ideas about the bright city concept and longevity.

Furthermore, this study emphasized the importance of stakeholder involvement in smart city decision-making processes. The digital literacy and online participation field is a relatively new and growing area of interest. This study indicates that future research might investigate these questions, especially regarding growing digital skills and involvement in marginalized, underserved, or disadvantaged communities. Lastly, the implementation of the smart city agenda is associated with the areas of policy development and urban management. While this study offers initial insights into these areas, the practical implementation still needs to be researched. Future studies could target this area and investigate the common barriers to implementing the policy framework.

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