

BARRIERS TO DEVELOPMENT OF SMART CITIES: LESSONS LEARNED FROM AN EMERGING ECONOMY

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Abstract

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Smart city development is an urban strategy that harnesses technology and innovation to enhance residents' well-being. Its objectives encompass boosting economic competitiveness and advancing sustainable growth (Organisation for Economic Co-operation and Development [OECD], 2019, 2020; Digitalization of Public Administration and Services Delivery Act, B.E. 2562 2019). In this research, a qualitative study was conducted to study the steps to becoming a smart city in Thailand as well as the challenges in the urgent development of smart cities. Ten individuals were interviewed using a purposive sampling method. Content analysis and NVivo software were used to analyze the data. The findings revealed that to become a smart city, the steps involve preparing infrastructure, running projects for two years, and seeking certification from the Digital Economy Promotion Agency (DEPA). Certification offers Board of Investment (BOI) incentives, making it appealing to urban areas. In addition, the path to becoming a smart city in Thailand involves careful planning, substantial investment, skills development, collaboration, and regulatory adjustments. Addressing these challenges can help urban areas harness the benefits of smart city technologies, improve the quality of life for residents, promote economic growth, and beyond.

Keywords: Challenges, Development, Smart City, Technology, Emerging Economy

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1. INTRODUCTION

Smart cities aspire to transform into a citizen-centred urban environment where residents actively participate in urban activities and collaborate in sharing urban data through a sophisticated information and communication technologies (ICT) infrastructure. In addition, smart cities have risen to prominence on a global scale, offering tantalizing prospects for significant economic benefits.

In an age where technology and innovation reign supreme, these cities stand poised to revolutionize and bolster sustainable economic and social development. Their potential impact is far-reaching, encompassing the creation of jobs, the reinforcement of local industries, the opening of new investment avenues, and the nurturing of burgeoning business developments (Bibri, 2019; Shin et al., 2021; Ivaldi & Ciaci, 2023).

The economic advantages attributed to smart cities are manifold. They encompass a wide spectrum, ranging from the advancement of innovation and the promotion of entrepreneurship to the generation of fresh employment opportunities. These cities also enhance the competitive edge of urban centres, trim costs for both businesses and residents and optimize the efficiency of public services. In essence, smart cities represent a dynamic force capable of galvanizing economic growth on multiple fronts (Perng et al., 2018; Yigitcanlar & Cugurullo, 2020). At the heart of this economic transformation lies the acceleration of development, which smart cities facilitate at an unprecedented pace. Through the creation of new jobs and the invigoration of local economies, they contribute significantly to the augmentation of gross domestic product (GDP), increased employment rates, and the attraction of foreign investments. These are essential elements for revitalizing urban economies and ensuring their vibrancy (Kumar & Dahiya, 2017; Correia et al., 2022).

Furthermore, the development of smart cities extends its influence to social and environmental dimensions. Smart cities excel in the efficient management of resources, leveraging technology and innovation for resource and energy management. This includes the adoption of eco-friendly energy systems and the utilization of renewable energy sources. Moreover, smart cities employ cutting-edge technology in areas such as water management and environmental conservation, effectively minimizing resource depletion and conserving valuable assets. Simultaneously, they enhance the quality of life for citizens by streamlining public services through technology-driven service delivery, intelligent traffic management systems, and efficient waste and sewage management (Kim et al., 2021; Bouramdane, 2023; Gracias et al., 2023; Pandiyan et al., 2023).

Crucially, smart cities wield influence not only at the local level but also on a broader regional and international scale. They serve as incubators for organizations and businesses vying on the global stage, establishing themselves as hubs for economic innovation and dynamism. Furthermore, these cities create an environment conducive to investment and the incubation of future enterprises, positioning themselves as invaluable economic assets on the world stage. In this era of rapid technological advancement, the role of smart cities as catalysts for economic progress and innovation cannot be underestimated (Nam & Pardo, 2011; Parasol, 2018; Mishra et al., 2022).

Considering its importance, the concept of the smart city is a crucial subject for examination. Numerous studies have already delved into various aspects of smart cities. For instance, Naprathansuk (2017) conducted a study of smart city policies in Phuket, Khon Kaen, and Chiangmai provinces, using the smart city concept to provide essential data and recommendations for the executive committee. Kamnuansilpa et al. (2020) studied citizens' awareness and knowledge of Khon Kaen Smart City (KKSC) in Thailand. However, it is worth noting that there remains a scarcity of research that specifically delves into the barriers impeding the swift progression of smart city development. Consequently, this study embarked on a qualitative exploration aimed at

comprehensively examining the key stages involved in the transformation of a city into a smart city within the Thai context, along with a thorough investigation of the challenges encountered during the urgent pursuit of smart city development. The research uncovered a series of critical steps toward achieving smart city status in Thailand. These steps encompass the preparation of necessary infrastructure, the implementation of projects over a two-year period, and the acquisition of certification from the Digital Economy Promotion Agency (DEPA). Certification not only validates the smart city status but also offers attractive investment incentives through the Board of Investment (BOI), making it an enticing proposition for urban areas. Furthermore, the journey toward becoming a smart city in Thailand necessitates meticulous planning, substantial financial investments, skills development initiatives, collaborative efforts, and regulatory adjustments. Addressing these challenges is pivotal as it enables urban areas to fully leverage the advantages of smart city technologies. This, in turn, leads to an enhanced quality of life for residents and contributes to broader societal and economic improvements.

The rest of the paper is organised as follows. Section 2 provides a literature review. Section 3 outlines the research methodology, while Section 4 presents the study's results. Section 5 discusses the study's findings, and Section 6 includes conclusions, limitations, and recommendations.

2. LITERATURE REVIEW

In Thailand, the government places significant emphasis on the development of smart cities, considering it a national imperative that requires immediate attention. To facilitate this, a committee has been established with the authority to formulate strategies and master plans for smart city development, aligning them with the country's overarching development directions, including Thailand 4.0, the 20-year national strategy, and other national strategic frameworks. This committee also plays a vital role in monitoring and evaluating the progress of smart city initiatives and providing recommendations to enhance the efficiency of smart city development. The DEPA serves as the committee and its secretariat, serving as a central government entity responsible for promoting and advancing smart cities (Mesupnikom et al., 2019; Taweesaengsakulthai et al., 2019; Sarnrom et al., 2023).

As stated by Irvine et al. (2022), Irvine et al. (2023), and Phaiporn et al. (2023), the DEPA Thai smart city initiative outlines seven fundamental "smart pillars", including environment, economy, energy, mobility, people, living, and governance. These pillars encompass a holistic approach to creating sustainable and technologically advanced urban environments. The smart environment pillar focuses on environmental impact, climate change mitigation, and efficient resource management, including water, waste, and air quality. Smart economy promotes the use of digital technology to enhance economic value and resource management, fostering innovation in areas like agriculture and tourism. Smart energy seeks to strike a balance between energy production and consumption through conservation and efficiency measures.

Smart mobility prioritizes the development of intelligent and eco-friendly transportation systems. Smart people emphasize lifelong learning and skills development to reduce disparities and promote creativity and innovation. Smart living centres on creating safe, high-quality living conditions through advanced infrastructure. Smart governance strives to enhance transparency, participation, and accessibility in government services. Together, these pillars form a comprehensive framework for building thriving and sustainable smart cities.

Prawanne (2020) conducted a study examining the transformation process and the potential impacts of Khon Kaen municipality's transition into a smart city, along with how the city's residents were adapting to this transformation. The research revealed that the journey towards becoming a smart city commenced in 2013, with a strong focus on seven key aspects: 1) smart people, 2) smart living, 3) smart education, 4) smart environment, 5) smart economy, 6) smart mobility, and 7) smart governance. The study's key informants expressed optimism about the transition to a smart city, foreseeing a range of positive effects. These included increased learning opportunities for residents, the utilization of modern technology to control pollution, energy savings through the adoption of clean energy sources, reduced expenses, and an improved urban landscape that would enhance the overall quality of life for the city's inhabitants. Notably, it was observed that a significant portion of the younger to middle-aged population had already embraced and adapted to the evolving technologies across various domains, positioning themselves as future-ready smart citizens.

Junnong and Lowatcharin (2022) explored the implementation of the smart city policy of Phuket province in Thailand. The concept of a smart city involves utilizing digital technology to efficiently plan and enhance public services in urban development. Phuket, one of Thailand's pilot provinces, has embarked on implementing the smart city concept. The DEPA played a central role in leading the implementation of smart city policies in Phuket, with collaborative efforts from various other government agencies. Progress has been made through the application of digital technology in several dimensions of the city. However, the implementation had encountered numerous challenges and obstacles, with the most prominent being the lack of adequate budgetary support. To ensure the successful execution of the smart city policy in Phuket, it is imperative for the government to provide increased financial support. Additionally, DEPA should focus on enhancing knowledge and fostering a more unified understanding of the smart city policy among government officials and the public. This collective effort will be essential in realizing the full potential of the smart city concept in Phuket.

Chaiprasert (2022) investigated the critical roles of locality in smart city management. Local roles and city management in the context of smart cities are pivotal for enhancing the efficiency, potential, and safety of the local area. The primary objective is to prioritize innovation and the utilization of modern technology to establish a comprehensive communication network that spans the entire city. The role of local governance in smart city

management is to ensure that residents enjoy a high quality of life in a city that is both livable and sustainable. Sustainability, in this context, involves efficient resource management, often referred to as "efficiency", and the strategic application of information technology for urban development. The local government emerges as a critical entity and the primary driver behind the prosperity of local cities. Local administrative organizations play a central role in fostering innovation through the integration of modern information technology systems. This approach aims to establish effective governance structures and systems that prioritize efficiency and capacity development among local administrators and government officials. These professionals are expected to operate with precision and speed, aligning with the demands of an era characterized by advanced technology. Their crucial role in local development extends to all dimensions, ensuring the well-being and progress of the community they serve.

According to Theeramonpraneet (2023), smart city development is a strategic approach that harnesses the power of technology to transform local communities and cities. It aims to make government operations more efficient, streamline administrative processes, and provide public services that are not only faster but also cost-effective. Furthermore, it promotes energy conservation, maximizes the use of limited resources, and ultimately seeks to enhance the overall quality of life for the people residing in these urban environments. Municipalities play a crucial role in this transformation, ensuring that it aligns with established laws and regulations while taking into account local factors such as human resources, budget constraints, cultural context, and indigenous wisdom. The goal is to create cities that leverage technology and innovation to improve the well-being of their residents. In the pursuit of becoming smart cities, areas such as public health, transportation, disaster management, economic development, education, safety, energy conservation, and governance are prioritized, paving the way for a more connected, efficient, and sustainable urban future.

3. RESEARCH METHODOLOGY

This research utilized a qualitative methodology, primarily focusing on conducting comprehensive interviews. According to Taherdoost (2022), the essence of qualitative research is to delve into the underlying reasons for certain occurrences by examining the decision-making processes and behaviours of individuals or groups. Interactive interviews facilitate the gathering of extensive data, evolving with the conversation. Such in-depth interviews are instrumental in acquiring detailed responses on specific topics, thereby providing critical information to meet the research goals.

The research design included an interview framework targeting experts, employees, and stakeholders involved in Thailand's smart cities, aiming to extract insightful perspectives. The framework comprised a well-crafted questionnaire to gather in-depth responses on key issues in five areas: Steps to becoming a smart city, knowledge and skills of citizens, budget constraints, smart city development plan, and collaboration from

all sectors. Interviews were conducted either face-to-face or virtually, as per the participants' convenience, and were audio-recorded for detailed examination later. A preliminary pilot test was implemented to validate the question's clarity and effectiveness.

The study used purposive sampling, a strategy common in qualitative research where researchers strategically choose samples based on their expertise. This method aims to garner a holistic understanding of a specific subject or group. Limna (2023) suggests a minimum of six interviews for qualitative research to ensure data saturation. Following this guidance, the study encompassed ten interviews with experts, workers, and stakeholders in smart cities, all over 18 years of age and based in Thailand, conducted in November 2023.

In order to address ethical considerations, the current study employed several measures aimed at safeguarding the validity and protection of participants. Ensuring the reliability of data collection instruments, the surveys utilized a rigorous validation process, which enlisted the expertise of three specialists with backgrounds in both business and social science disciplines. Adhering to established ethical guidelines, stringent protocols were established, notably including the explicit exclusion of individuals below the age of 18 from participating, thereby safeguarding the rights and well-being of vulnerable populations. Participants were provided with comprehensive information pertaining to the research objective, accompanied by a clear and unequivocal statement emphasizing their voluntary participation and their prerogative to withdraw from the study at any juncture, should they elect to do so. These measures were implemented proactively to address potential ethical concerns and to uphold the principles of participant rights, autonomy, and informed consent.

For data analysis, the study employed content analysis, a method defined by Thetlek et al. (2024) as a systematic and objective approach to identifying and quantifying specific phenomena

from textual, visual, or spoken sources. This methodological choice was made to ensure a rigorous and structured analysis of the data. Furthermore, as highlighted by Kraiwanit et al. (2023), the use of NVivo software was deemed advantageous for deepening and broadening the scope of analysis. Thus, the research integrated both content analysis and NVivo for evaluating the data derived from the in-depth interviews. The utilization of both content analysis and NVivo offers several benefits. Firstly, the content analysis provides a systematic framework for categorizing and analyzing textual data, facilitating the identification of patterns and themes within the dataset. NVivo, on the other hand, enhances this process by offering advanced functionalities such as visualization, thereby enabling a more nuanced and comprehensive analysis. This combination of methodologies ensures a thorough examination of the complex and voluminous dataset, enhancing the validity and reliability of the research findings. By employing a multifaceted approach to data analysis, the study strives to maintain rigour and integrity in its research process, ultimately contributing to the advancement of knowledge in the field.

4. RESULTS

The study conducted a thorough examination of a range of significant opinions expressed by participants concerning the steps involved in Thailand's journey towards becoming a smart city and the pressing challenges in smart city development. These topics included citizen knowledge and skills, budget allocation, smart city development plans, cross-sector collaboration, and legal regulations. The interviews were analyzed using content analysis with the assistance of NVivo software. To improve result clarity, a word frequency query was utilized, and the terms frequently used by the interviewees were visually represented in a word cloud (Figure 1).

Figure 1. Word cloud



Source: Authors' elaboration.

4.1. Steps to becoming a smart city in Thailand

To become a smart city in Thailand, urban areas need to prepare their infrastructure and run smart city projects for at least two years. They can then apply for certification from DEPA, meeting five key criteria. Certified cities are eligible for BOI incentives, and digital infrastructure development is vital for success.

“To achieve recognition as a smart city in Thailand, there are specific steps that must be followed. The urban area must submit a project proposal that has been in operation for a minimum of two years to the DEPA. The project proposal will be evaluated by DEPA based on five key criteria for smart city development: a) clearly defining the area and objectives; b) developing a city infrastructure development plan; c) establishing a secure City Data Platform for data collection and management; d) implementing smart city services across seven dimensions; and e) ensuring sustainable management and governance. Cities that receive certification or meet these criteria will be entitled to investment incentives from the BOI” (R1, personal communication, November 20, 2023).

“The expansion and improvement of digital infrastructure, including high-speed Internet networks, wireless networks, and cloud computing, are crucial for the success of smart cities in Thailand. Equal access to these digital resources should be ensured across all areas, and the development of city infrastructure, such as roads, electricity, and water supply, is also of paramount importance” (R2, personal communication, November 20, 2023).

4.2. Knowledge and skills of citizens

The rapid advancement of digital technology necessitates an adequately skilled workforce. Hence, government agencies should invest in education and training programs to bridge the skill gap, with a particular focus on digital skills.

“As technology advances rapidly, there is a need for a workforce that can keep up with these technological advancements. This is a significant concern, and government agencies should invest in education and training programs to bridge the skill gap” (R6, personal communication, November 21, 2023).

“Emphasizing the development of digital skills is crucial to ensure that citizens can actively participate in the digital transformation happening in smart cities. It may start with digital education and training and extend to the workforce in various industries” (R6, personal communication, November 21, 2023).

“Employees with digital knowledge and skills alone may not be sufficient, so it is advisable to provide digital skills training and digital education funding, benefiting businesses, the public, and government personnel. This will enhance the city’s competitiveness, create economic opportunities, and improve the quality of life for the residents” (R1, personal communication, November 20, 2023).

“Citizens lacking knowledge and skills in technology should be addressed through government policies that support digital development. Programs should be implemented to enhance the skills of employees and entrepreneurs in the region, in

collaboration with universities and educational institutions in the area” (R8, personal communication, November 21, 2023).

4.3. Budget constraints

Developing smart cities requires a significant budget. Government support alone may not be sufficient, so a gradual approach to development is recommended.

“Importance should be placed on budget support because developing smart cities requires significant financial resources” (R2, personal communication, November 20, 2023).

“Support from government agencies alone may not be sufficient, so a gradual approach to smart city development, learning, and progression should be adopted” (R5, personal communication, November 21, 2023).

“An obstacle to smart city development is budget constraints. Developing infrastructure, whether digital, transportation, or utilities, within a smart city, requires a substantial budget that may not be adequate for project implementation” (R10, personal communication, November 24, 2023).

4.4. Smart city development plan

Thailand’s smart city development plan lacks clear and specific objectives for each area, leading to delayed progress and a lack of direction. It also does not consider the context of each region, which may hinder alignment with local needs.

“Thailand’s smart city development plan sets aims for development in seven areas. Yet, the development goals in each area are not clear and are somewhat abstract. This has resulted in delayed progress and a lack of direction in smart city development” (R4, personal communication, November 20, 2023).

“Thailand’s smart city development plan establishes a national framework for smart city development but does not consider the context of each region. As a result, smart city development may not align with the needs of the local population and may not maximize benefits” (R5, personal communication, November 21, 2023).

“Thailand’s smart city development plan lacks emphasis on citizen participation, leading to a lack of ownership among citizens and potential disagreement with smart city development efforts. Smart city development requires collaboration from all sectors” (R8, personal communication, November 21, 2023).

4.5. Collaboration from all sectors

Collaboration between the private and public sectors is crucial for the success of smart city projects. The private sector can leverage technology for business efficiency, while government agencies need to create a conducive environment and offer policy support.

“Collaboration between the private and public sectors in smart city development is crucial to the project’s success. The private sector can leverage technology for business efficiency, while government agencies play a vital role in creating a conducive

environment, including policy and regulation support for innovation” (R2, personal communication, November 20, 2023).

“Public-private collaboration can lead to better city development, creating a win-win situation where the private sector can invest in infrastructure projects that align with the government’s long-term development goals” (R7, personal communication, November 21, 2023).

“The government, with the power to set policies and regulations, may lack understanding of the private sector’s needs and may not receive cooperation from various sectors in driving smart city development” (R9, personal communication, November 23, 2023).

4.6. Legislation, regulations, and rules

Laws and regulations should keep pace with technological advancements to promote innovation. Some existing laws may be outdated and not aligned with new technologies, potentially hindering smart city development.

“Adapting to regulations is essential, and laws and regulations should keep pace with technological advancements to promote innovation. Government agencies must proactively create an environment conducive to smart city development” (R7, personal communication, November 21, 2023).

“Some laws may be outdated and not aligned with new technologies and innovations. For example, current cybersecurity laws may not cover cyber threats arising from artificial intelligence and automated systems” (R1, personal communication, November 20, 2023).

“Traffic and construction regulations may not support new forms of smart city development, such as smart public transportation systems or smart city infrastructure” (R3, personal communication, November 20, 2023).

5. DISCUSSION

This study explored the steps to becoming a smart city in Thailand as well as the challenges in the urgent development of smart cities. To become a smart city, the outlined steps include preparing infrastructure, running smart city projects for a minimum of two years, and applying for certification from the DEPA based on five key criteria. Certification brings eligibility for investment incentives from the BOI, making it an attractive proposition for urban areas.

Digital infrastructure development is a fundamental aspect of smart city success. It underpins various smart city initiatives, enabling efficient data collection, connectivity, and service delivery. Investment in digital infrastructure is crucial for reaping the benefits of smart city technologies. The study’s findings align with those of Law and Lynch (2019), where it was noted that a prevailing theme in most definitions of smart cities is the utilization of ICT as a catalyst to facilitate urban development, improve city services, and broaden stakeholder access to information. Based on this central theme, smart cities are rapidly emerging globally, characterized by comprehensive investments in ICT infrastructure. These investments aim to stimulate technological innovation, foster

the growth of new industries, boost economic strength, promote environmental sustainability, and elevate the overall quality of life for residents. In terms of knowledge and skills of citizens, the study’s findings were consistent with Taweesaengsakulthai et al. (2019), indicating that early smart city demonstration projects in Thailand faced several challenges leading to their lack of success. Key reasons included a deficiency in knowledge and understanding among government agency personnel (both at the central and local levels). As technology evolves rapidly, the workforce must be equipped with digital skills to participate in and contribute to digital transformation. Government investment in education and training programs is vital to bridge the skills gap. These programs should focus on equipping citizens with digital literacy and proficiency in emerging technologies. Spurava and Kotilainen (2023) also affirmed that digital literacy serves as a critical pathway for individuals to advance professionally in today’s algorithm-driven world.

Smart city development requires a significant budget. In line with Taweesaengsakulthai et al. (2019), it was indicated that insufficient budget allocation was one of the several challenges. To address this issue, adopting a gradual development approach enables cities to allocate resources strategically and consider partnerships with private stakeholders. By diversifying funding sources, including engaging in public-private collaborations, cities can better navigate and overcome budget constraints. Regarding the smart city development plan, the importance of having a clear and comprehensive smart city development plan is emphasized, as supported by Hameed (2019). This plan should establish specific objectives for various areas and take into account the distinct context of each region to ensure alignment with local needs and priorities. A well-defined plan offers guidance and expedites progress.

Collaboration between the public and private sectors is emphasized as a key factor for success. The private sector can bring expertise, technology, and innovation to smart city projects, while government agencies must create a conducive environment and provide policy support to facilitate such collaborations. Cankar and Petkovsek (2013) emphasized the significance of cooperation between public and private entities, highlighting its potential to enhance the quality and effectiveness of both public and private services and products. Collaboration facilitates the exchange and sharing of knowledge, experiences, expertise, and know-how among participants. It also contributes to infusing a wider range of skills, talents, and a more adaptive work culture into public sector organizations. Additionally, collaboration fosters innovative thinking and creativity. Furthermore, private companies can leverage collaboration to innovate more efficiently and achieve their specific objectives more effectively. For legislation, regulations, and rules, as noted in the study by Taweesaengsakulthai et al. (2019), early smart city demonstration projects in Thailand encountered substantial challenges that contributed to their lack of success. One critical issue highlighted in their findings was the absence of a well-defined policy statement to establish the project’s objectives and goals. Outdated or

insufficient regulations have the potential to impede the progress of smart city development and hinder innovation. Thus, it is imperative to take measures to address these regulatory shortcomings and bring them in line with the evolving digital landscape.

6. CONCLUSION

This study examined the steps towards achieving smart city status in Thailand, along with the challenges involved in expediting this development. The findings underscored that the journey to becoming a smart city entails infrastructure preparation, a two-year project commitment, and certification from the DEPA, unlocking coveted BOI investment incentives for urban areas. Moreover, this path necessitates meticulous planning, substantial investments, skills enhancement, collaborative efforts, and regulatory adaptations. Addressing these challenges holds the potential to empower urban regions to harness the advantages of smart city technologies, thereby enhancing residents' quality of life, stimulating economic growth, and achieving broader societal benefits.

The research findings offer valuable practical and policy implications for the development of smart cities, particularly in the context of Thailand. The study involved ten individuals who were interviewed using a purposive sampling method, comprising experts, workers, and stakeholders in smart cities. Key takeaways include clear steps for urban areas to become smart cities, the importance of DEPA certification as an incentive, the need for diverse funding sources, the emphasis on skills development, the role of intersectoral collaboration, and the necessity of adapting regulations to technological advancements. These insights can

guide city planners, policymakers, and local authorities in advancing smart city initiatives and improving the quality of life for residents while fostering economic growth. In terms of academic implications, this research contributes significantly to academic discourse by providing empirical data and in-depth insights into the complexities of smart city development. It offers a nuanced understanding of the challenges faced by urban areas striving to become smart cities. Additionally, the findings can serve as a basis for expanding future research by incorporating additional factors and dimensions that influence smart city development. The study's outcomes can guide and inform future research endeavours, fostering a deeper understanding of the intricacies involved in the evolution of smart cities.

It is important to acknowledge certain limitations in this study, including the relatively small sample size and the regional specificity of the research. To advance our understanding of smart city development, future studies should aim for larger and more diverse samples, engage in comparative analyses across different contexts, adopt mixed-methods approaches, and conduct longitudinal studies to track the progress and sustainability of smart city initiatives. Additionally, exploring the influence of government policies and regulations on smart city development through policy analysis is a promising avenue for future research. By addressing the study's limitations and pursuing future research avenues, Thailand's transition to smart cities hinges on addressing these key factors identified through fieldwork research. However, generalizing these findings requires further studies with broader data collection methods to ensure wider applicability.

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