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THE SUCCESS FACTORS FOR THE SUSTAINABLE SMART CITY DEVELOPMENT IN THAILAND

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A B S T R A C T

This research paper scrutinizes the connection between demographic aspects and the perception of executive leadership at Suan Sunandha Rajabhat University (SSRU), as perceived by academic and support staff. Emphasizing demographic factors such as gender, academic qualifications, and job type, the study explores staff perspectives and their influence on the perception of executive leadership. Data was collected from 253 participants using stratified random sampling and a questionnaire, with findings analyzed via t-Test and One-way ANOVA. The results revealed no significant correlation between gender or academic qualifications and goal-directed leadership. However, a statistically significant difference was found between job classification and goal-directed leadership. These findings offer valuable implications for tailoring leadership approaches at SSRU, suggesting that job type may play a more significant role in shaping leadership perceptions than previously assumed. Consequently, this could inform future leadership strategies, contributing to improved staff engagement and organizational success at SSRU.

1. INTRODUCTION

The process of urbanization is rapidly expanding. According to the United Nations, it is estimated that by 2050, nearly 68 percent of the global population will reside in urban areas, equivalent to approximately 6.7 billion people. Cities play a significant role as employment centers, providing well-developed public infrastructure, efficient transportation systems, and a range of social welfare services. Consequently, ensuring the quality of urban living, promoting a favorable environment, ensuring safety, and preserving the natural surroundings have become critical concerns across all sectors. Furthermore, urban development must prioritize social dimensions, particularly inclusivity for vulnerable groups such as individuals with disabilities, the elderly, pregnant women, and those with low incomes. It is essential to ensure they can enjoy a high-quality urban life and have equitable access to essential services. The ongoing trend shows a continuous increase in the proportion of people migrating to cities compared to those residing in rural areas. The concept of sustainable development plays a significant role in the global development agenda, which includes 17 Sustainable Development Goals (SDGs). Goal 11 specifically focuses on smart city development, aiming to create inclusive, safe, resilient, and sustainable cities and

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human settlements (National Economic and Social Development Council, 2021). These sustainable development goals align with the current government's economic development model, known as "Thailand 4.0". The model aims to propel Thailand's economy beyond the middle-income trap by prioritizing an innovation-driven, value-based economy. Technology plays a crucial role in this approach, particularly in the development of cities, ultimately enhancing the quality of life for the people.

Due to the disproportionate urban population, which exceeds more than half of the global population (United Nations, 2014), various problems have emerged. These issues include overcrowded living and working conditions, where workers seek convenient and cost-effective housing options closer to their workplaces. This has resulted in soaring housing prices in city centers, which only a minority with higher incomes can afford. Insufficient transportation infrastructure poses challenges in meeting the increasing demand for transportation, both in terms of quantity and quality. Furthermore, environmental problems such as air and noise pollution, water contamination, and improper waste management pose significant health risks to urban residents and undermine the quality and efficiency of their work. Additionally, insufficient public utilities fail to meet the demands, resulting in densely populated communities of low-income individuals residing in deteriorating conditions that are unsuitable for good living and carry health risks and social issues. The impact of these problems is more significant in densely populated urban areas compared to rural regions.

The concept of the Smart City has gained considerable attention as the proportion of people migrating to cities continues to increase continuously. This rapid and continuous urbanization necessitates the development of smart cities in Thailand. It is crucial to reduce population density in major urban areas by redistributing prosperity to surrounding areas, mitigating disparities, and enhancing the country's competitiveness through the development of cities aligned with social aspirations. This approach aims to create livable cities with a high quality of life and a favorable environment, meeting the evolving needs and improving the well-being of people in all aspects (Hongnapa, 2020).

2. LITERATURE REVIEW

The researcher conducted a literature review by gathering theories, concepts, and related research works, and summarizing key findings to propose a research framework on the success factors of sustainable smart city development in Thailand. These factors include sustainable smart city development, technology and innovation management, potential of leaders, readiness for smart city development, and smart city infrastructure.

2.1 Sustainable smart city development

A smart city refers to a city that leverages technology and innovation to enhance the efficiency of service delivery and city management while reducing costs and resource consumption. It places emphasis on good design and involves various stakeholders, including the government, private sector, and the public. By integrating digital technologies and data with infrastructure and various services, smart cities aim to address collective issues and create livable, sustainable urban environments that promote increased productivity. Currently, smart cities are in the investment and development phase, with a focus on improving infrastructure and public services through intelligent solutions that enhance the capabilities and lifespan of foundational assets. Furthermore, their goal is to enhance the quality of life for residents, aspiring to be modern, livable cities where people can enjoy a good and sustainable life (Digital Economy Promotion Agency, 2022).

Through the exploration of different approaches to addressing public issues, the application of information and communication technologies, and the involvement of stakeholders in urban development and local participation, the design of successful smart cities is categorized into seven dimensions: smart environment, smart energy, smart economy, smart living, smart governance, smart mobility, and smart people (Giffinger et al., 2007; IBM Global Business Services, 2009; Glasmeier & Christopherson, 2015; Dameri, 2017; Kokpol, 2020; Raksaphol & Phonsing, 2021)

2.2 Technology and innovation management

Smart city development involves integrating a vision for urban development that focuses on intelligent resource management to foster sustainable growth and enhance the quality of life for city residents. By leveraging technology, smart cities strive to efficiently manage resources while minimizing environmental impact. The process of building smart cities relies on advanced data and telecommunications technologies in conjunction with infrastructure planning to bolster capacity and effectiveness. The fusion of urban development knowledge with technology and information systems has led to innovative solutions that shape the urban landscape and contribute to a better living environment and improved quality of life for urban dwellers. For instance, smart city initiatives utilize information systems to gather data and manage infrastructure and public services, offering convenience to residents and boosting efficiency in urban management. Alternatively, creative cities emphasize enhancing the urban atmosphere and establishing user-friendly public service systems to attract creative thinkers for urban development or utilize the city as a base for local economic growth (Chaiprasert, 2022). To establish smart cities effectively, it is imperative to manage three

key technology groups: smart grid, city data platform, and smart information and communication technology (Office of the National Smart City Committee, 2019; Green Network, 2020).

H1: The management of technology and innovation has correlated and influential in the sustainable success of smart city development in Thailand.

2.3 Potential of leaders

The potential of leaders plays a crucial role in determining organizational success. It is evident that leaders serve as essential drivers, particularly in unpredictable situations that may or may not arise in the world. They can act as catalysts in guiding an organization through crises. However, if leaders lack the necessary skills or new perspectives to adapt to potential situations, they can lead the organization towards a disadvantageous position. To fortify and sustain organizational stability and growth, leaders must align their vision with strategies and tactics, translating them into agile actions. Effective communication is paramount for leaders to provide followers with knowledge and comprehension of the mission, enabling them to execute the designated direction. These processes demonstrate the capabilities of leaders who must confront and navigate ever-changing events, situations, and environments characterized by volatility, uncertainty, complexity, and ambiguity (VUCA) (Myeong et al., 2018). Therefore, leaders must be well-prepared in all aspects to promptly protect and resolve issues. The potential of leaders in smart city development encompasses: local leadership, a growth mindset, and collaborative networks.

H2: Potential of leaders has correlated and influential in the sustainable success of smart city development in Thailand.

2.4 Readiness for smart city development

Readiness refers to the implementation of specific activities aimed at instilling confidence and intention to effectively carry them out. It also encompasses the attributes and conditions of individuals who are prepared to work or engage in activities with a high likelihood of achieving desired outcomes (Lerdturadon & Boonsayam, 2021). The readiness for smart city development begins with the formulation of policies that establish collaborative practices and management decisions, maximizing the utilization of resources and enabling organizations to achieve their efficiency and effectiveness objectives. Public organizations must adapt to digital transformations in order to successfully develop smart cities that align with societal norms (Francesco et al., 2021; Kumchai, 2019; Boonmeesuwan, 2020. This necessitates several components of readiness for smart city development (Kokpol et al., 2020), including: organizational and

personnel maturing, resource maturing, and community and people maturing.

H3: Readiness for smart city development has correlated and influential in the sustainable success of smart city development in Thailand.

2.5 Smart city infrastructure

In addition to the previously mentioned seven dimensions of smart cities, there are criteria for promoting smart city development. These criteria include the clear delineation of areas and objectives, development strategies for urban infrastructure, secure data collection and management systems, and sustainable governance. Urban infrastructure plays a crucial role in driving the success of smart city development and improving the quality of life for residents. Therefore, effective project management is essential for driving efficient and impactful smart city initiatives in each city and attracting investments from the private sector. The development of smart city infrastructure encompasses three main components: traditional infrastructure, digital infrastructure, and green infrastructure (Mueangrat, 2018; Thiengburanathum, 2020)

H4: Smart city infrastructure has correlated and influential in the sustainable success of smart city development in Thailand.

3. METHODOLOGY

3.1. Population and sample

The population for this research consists of personnel from 7,850 local government organizations. The sample size was determined using the Yamane formula (Yamane, 1973), a sample of 400 respondents, selected through a multi-stage sampling technique with probability random sampling. The process of administering the online questionnaire to facilitate convenient and comprehensive responses from the sample group. The projected timeline for completing the survey. Prior to taking the survey, the respondents gave their informed consent. The data collection spanned three months, specifically April and June of 2023, during which 400 individuals completed the questionnaire.

The researchers created a comprehensive questionnaire that addressed variables defined by indicators and employed a combination of checklist and rating scale responses to examine the overall state and sustainable factors of smart city development. To evaluate the instrument's quality, they calculated the Item-Objective Congruence Index (IOC), was determined by assessing the congruence level according to the opinions of five research assistants, who received through training to ensure appropriate execution. This research proposal

and the survey questions were approved by the Research Ethics Review Committee for Research Involving Human Research Participants at Suan Sunandha Rajabhat University, Bangkok, Thailand (Certificate Number #COE. 2-074/2023).

The demographic analyzing the returned questionnaires, it was found that the majority of the respondents were females aged between 41- 50 years old. They held undergraduate degrees and worked as academic personnel in sub-district administrative organizations with a population of fewer than 10,000 people. The total annual income of these local government organizations was less than 50 million baht.

3.2 Measure

The researchers developed a questionnaire of 116-items measure that covered variables specified by indicators. Once the complete questionnaire was finalized, a pilot test was conducted with 30 samples. Analyzing the Cronbach's alpha coefficient, which a reliability coefficient of 0.993, indicating that the questionnaire high reliability and strong internal consistency (Cronbach, 1970).

3.3 Data Analysis

The researchers utilized various statistical analysis techniques, including: 1) descriptive statistics: they calculated frequencies, percentages, means, and standard deviations to provide an overview of the respondents' characteristics and the distribution of variables in the questionnaire, 2) factor analysis: this analysis was conducted to explore the factors that influence the success of smart city development. The researchers used a consistent measurement scale, specifically the 5-point Likert scale (Likert, 1932), to measure the respondents' opinions. The interpretation of the scores was based on the criteria proposed by Best (1981) of research purpose, and 3) inferential statistics: for testing Hypotheses 1 - Hypotheses 4 (H1-H4), the researchers employed multiple regression analysis and Pearson correlation analysis as inferential statistical techniques. These analyses aimed to examine the relationships and correlations between variables.

4. RESULTS

The analysis results reveal the level of sustainable success in smart city development in Thailand, as well as the factors that contribute to its sustainability. These factors encompass technology and innovation management, potential of leaders, readiness for smart city development, and smart city infrastructure.
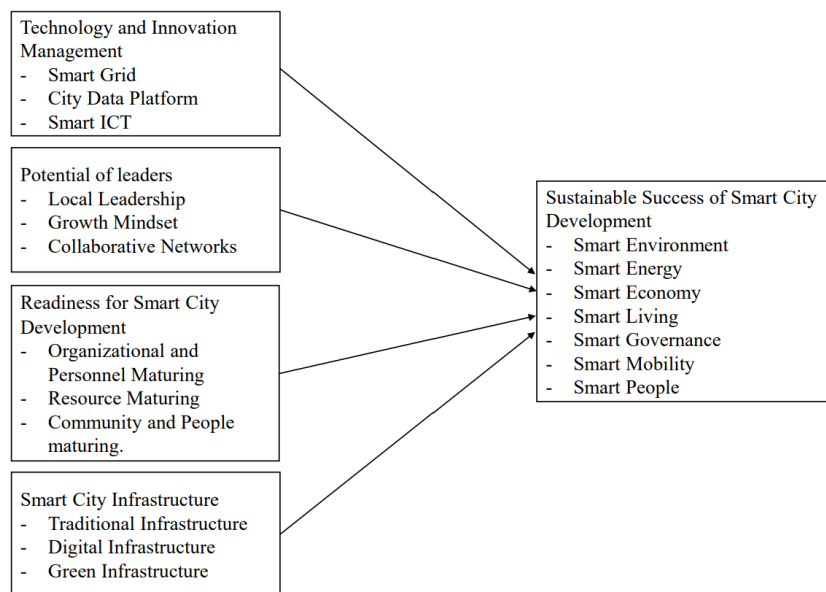

Figure 1. The Conceptual Framework

Table 1. Sustainable Success Level of Smart City Development in Thailand

Sustainable success in smart city development	$\bar{x}$	S.D.	Interpretation	Rank
Smart environment	3.65	0.74	High	4
Smart energy	3.50	0.74	High	7
Smart economy	3.59	0.78	High	5
Smart living	3.80	0.69	High	3
Smart governance	3.92	0.71	High	1
Smart mobility	3.59	0.77	High	6
Smart people	3.83	0.69	High	2
Overall	**3.70**	**0.64**	**High**	

From Table 1, the findings indicate a high overall level of sustainable success in smart city development ($\bar{x}$ = 3.70, S.D. = 0.64), examining the specific dimensions, it is noteworthy that smart government management exhibited the highest level of success ($\bar{x}$ = 3.92, S.D. = 0.71), while smart energy had the lowest level of success ($\bar{x}$ = 3.50, S.D. = 0.74)

The level of factors influencing sustainable smart city development in Thailand is high overall ($\bar{x}$ = 3.70, S.D. = 0.65) Among these factors, smart city infrastructure has the highest level of influence ($\bar{x}$ = 3.85, S.D. = 0.72) while technology and innovation management have the lowest level of influence. ($\bar{x}$ = 3.43, S.D. = 0.71)

The researchers conducted a multiple regression analysis to examine the relationships between the independent variables, namely technology and innovation management, leadership capabilities, readiness for smart city implementation, and smart city infrastructure, and the dependent variable, which is the sustainable success of smart city development in Thailand. The results are as follows:

The analysis of the relationship between technology and innovation management and the sustainable success of smart city development in Thailand, using one-way ANOVA, a statistically significant at .01 (R^2 = .626, F = 666.85, β = .791, p = .000). Among the variables, smart information and communication technology management exhibited the highest predictive, followed by smart grid management and city data platform management. The regression equation is as follows:
$Y = 1.213 + .303x\_1 + .176x\_2 + .231x\_3$

The analysis of the relationship between potential of leaders and the sustainable success of smart city development in Thailand revealed a statistically significant at .01 (R^2 = .530, F = 448.79, β = .728, p = .000). Among the factors examined, the establishment of collaborative networks demonstrated the highest predictive, followed by local leadership. The regression equation is as follows:
$Y = 1.226 + .352x\_1 + .305x\_2$

The analysis of the relationship between readiness for smart city and the sustainable success of smart city development in Thailand revealed a statistically significant at .01 (R^2 = .651, F = 740.78, β = .807, p = .000). Among the factors examined, community and people readiness showed the highest predictive, followed by organizational and personnel readiness, and resource readiness. The regression equation is as follows:
$Y = 1.102 + .285x\_1 + .318x\_2 + .109x\_3$

The analysis of the relationship between smart city infrastructure and the sustainable success of smart city

development in Thailand revealed a statistically significant at .01 (R^2 = .722, F = 103.70, β = .850, p = .000). Among the different types of infrastructure, green infrastructure exhibited the highest predictive, followed by digital infrastructure and traditional infrastructure. The regression equation is as follows:
$Y = .814 + .314x\_1 + .268x\_2 + .156x\_3$

The analysis of the Pearson correlation coefficient (r) (Pearson, 1920) demonstrated a positive relationship. The correlation coefficients ranged from 0.443 to 0.680, all of which were statistically significant .01. The pair of variables with the highest correlation was smart city infrastructure and readiness for smart city (r = 0.680) The pair with the lowest correlation was technology and innovation management and Potential of leaders (r = 0.443)

5. DISCUSSSION

The sustainable success of smart city development in Thailand can be assessed across seven dimensions: smart environment, smart energy, smart economy, smart living, smart governance, smart people, and smart mobility. Previous research (Dameri, 2017) supports this approach, emphasizing the integration of information and communication technology, as well as urban planning and design, to enhance government efficiency and innovation in addressing complex urban challenges. The sustainable success of smart city development in Thailand is highly regarded, with smart governance being the most successful aspect. It places a strong emphasis on transparency, convenient public access to government information, and continuously improving diverse service systems. Innovative service applications are employed to provide convenient public services, with the goal of establishing comprehensive citizen service centers (Giffinger et al., 2007).

Concerning smart people, there is a focus on promoting social cohesion among different citizen groups, creating an environment that fosters creative thinking. Collective learning is encouraged among the population, emphasizing the acquisition of knowledge and the application of technology to enhance the quality of life (Giffinger et al., 2007). In terms of smart living, Thailand ensures sufficient internet services to meet the needs of its citizens. Priority is given to creating spaces that contribute to a good quality of life. Various amenities are developed, and comprehensive disaster surveillance measures, such as widespread installation of closed-circuit television cameras, enhance safety. Multiple channels are utilized for disseminating disaster warnings and community surveillance. Additionally, convenient educational facilities, technologies, and learning tools are provided (Jensantikul, 2020).

In the realm of smart environment, technology is utilized for waste disposal, destruction, and management. Green spaces are maintained according to

established standards to reduce carbon dioxide emissions. Efficient technologies are employed for water management and drainage systems. Community participation is encouraged in the conservation of natural resources, and advanced technologies are employed to monitor disaster risks (Giffinger et al., 2007).

Regarding smart economy, urban development in Thailand aims to promote a business-oriented city through innovation and creative thinking. Technology is harnessed to support the growth of the local economy, such as through electronic channels that promote the sale of local products and the utilization of innovation in developing smart tourism cities. These efforts contribute to the growth of the local economy (Jensantikul, 2020; Raksaphol, & Phonsing, 2021).

In the domain of smart mobility, transportation systems within Thailand are interconnected, offering diverse and accessible options. Modern management systems are implemented to keep public transportation up-to-date with various technologies. Parking systems are available within city areas, utilizing technology to efficiently manage internal transportation. The use of electric and environmentally friendly vehicles is encouraged, and transportation networks are integrated through information technology (Sutthi-amporn, Aussawariyathipat, & Anurak, 2022). Regarding smart energy, efforts are made in Thailand to reduce electricity consumption and raise awareness through campaigns encouraging communities to adopt alternative energy sources such as wind energy, hydropower, and solar energy. Information technology plays a role in developing community energy systems (Raksaphol, & Phonsing, 2021).

The factors of technology and innovation management, readiness for smart city implementation, local leadership capabilities, and smart city infrastructure exert a positive influence on the sustainable success of smart city development in Thailand. This correlation is consistent with previous research conducted by the Smart City Thailand Office (2019) and Green Network (2020). Technology and innovation management encompass the effective administration of smart information and communication technology systems. These technologies are utilized for tasks such as data recording, online data storage, sensor installations, and data processing, as highlighted by Kankla, Aekphet, & Charuensuk. (2022). City Data Platforms play a vital role in connecting and leveraging data to enhance decision-making processes for smart city development. The data systems remain up-to-date and adaptable to different situations, facilitating the seamless integration of government agencies, private sectors, and the general public. To ensure rapid and secure access to data for relevant stakeholders, data catalogs, data exchanges, and data governance systems have been established, as stated by the Digital Economy Promotion Agency

(2022). Moreover, Smart Grids, an intelligent electricity network, play a crucial role in accurately responding to energy demands while efficiently managing electricity consumption in the area. This promotes environmentally friendly electricity usage and sets the stage for sustainable energy practices in the future.

Potential of leaders have an influence on the sustainable success of smart city development in Thailand, which aligns with previous research conducted by Myeong et al. (2018) Jaitip and Chienwattanasook (2018). This influence is considered within the context of building collaborative networks, where local leaders exchange information and news with stakeholders involved in smart city development. They can establish partnerships across sectors to drive smart city policies, foster cooperation at various network levels, and collaborate with technology service providers, as noted by McGuire (2006). Local leadership is crucial as it requires a clear vision for smart city development, knowledge in smart information and communication technology management, digital skills, and modern innovation management practices to connect community aspirations and effectively address community needs (Chittmittrapap et al, 2022).

Readiness for smart city also plays a significant role in the sustainable success of smart city development in Thailand, which is consistent with previous research conducted by Kokpol et al. (2020). It involves creating awareness among communities and individuals regarding ongoing smart city development initiatives. It cultivates a strong sense of consciousness among the public about the value of development and smart city initiatives. Efforts are made to promote English language learning and technological literacy among the population to enhance their quality of life. Additionally, community involvement is encouraged to drive smart city initiatives. The readiness of organizations and personnel, referred to as organization and personnel maturing, involves enhancing the understanding and utilization of digital tools and technologies among organizational personnel. It fosters a culture of critical thinking and innovation in the use of digital technologies at both individual and organizational levels. It requires adaptation to the rapid changes of the digital era, as highlighted by Francesco et al. (2021). Adequate resource readiness, known as resource maturing, includes having sufficient budget allocations, essential materials and equipment for managing activities, and appropriate, up-to-date, and efficient technologies for smart city development (Lerdturadon, & Boonsayam, 2021; Chittmittrapap et al. 2022).

Factors related to smart city infrastructure exert influence on the long-term success of smart city development in Thailand, which is supported by previous research conducted by Chourabi et al. (2012), Mueangrat (2018), and Thiengburanathum (2020). This influence is particularly evident in the realm of green

infrastructure, which entails the development of natural spaces that benefit individuals of all ages and genders. These spaces contribute to addressing environmental challenges in urban areas by facilitating rainwater absorption, filtering pollutants, mitigating urban heat, and sequestering carbon dioxide. Moreover, they encompass community forests and urban green spaces that aid in reducing global warming and promoting chemical-free agriculture for the production of safe and high-quality food for the community. Digital infrastructure, known as digital infrastructure, plays a pivotal role in the transformation of cities into smart cities across various dimensions. It encompasses the establishment of large-scale databases, commonly referred to as big data, for data analysis to support urban development. Automation systems and artificial intelligence are leveraged to integrate digital technologies and connect diverse devices, thereby facilitating the Internet of Things (IoT). Wireless communication systems, 5G technology, and widespread access to high-speed internet are implemented to ensure efficient connectivity for the general public (Bukht & Heeks, 2018; Loetamnatkitseri, 2022). Traditional infrastructure, recognized as conventional infrastructure, caters to the needs of the population concerning transportation systems, water supply systems, electricity systems, and communication systems (Mueangrat, 2018).

6. IMPLICATIONS

The research findings provide valuable insights for developing various factors that drive the sustainable success of smart city development across the country.

6.1 Practical Implications

These practical implications aim to improve the quality of life for the population by fostering long-term smart city development and enhancing efficiency. They underscore the importance of effectively managing technology and innovation to meet the diverse contexts of smart city development. For example, this includes the development of transportation and traffic systems, electricity management systems, security and resilience control systems, infrastructure monitoring and management systems, waste management systems, and government service delivery systems. These advancements lead to increased convenience, safety, and access to critical information, ultimately enhancing the population's quality of life in smart cities. Regarding leadership capabilities, the research findings highlight the need for adaptability, acquiring new skills, and cultivating a new mindset to foster transformational leadership. Additionally, it emphasizes the importance of preparing communities and individuals for smart cities by leveraging digital technologies in all aspects and establishing digital infrastructure, which includes secure data storage and sustainable management.

6.2 Theoretical Implications

The development of sustainable smart cities entails driving all sectors to contribute to the country's progress. It necessitates adopting appropriate technology and innovation to generate economic and social value and establish an interconnected economic chain encompassing industries such as manufacturing, agriculture, and services. This fosters equitable income distribution and enhances the population's quality of life. Working within an efficient communication technology system is crucial, as it promotes effective collaboration among diverse smart technologies, thus augmenting the population's well-being. This involves developing accessible, convenient, and secure public service infrastructure while simultaneously mitigating environmental impact, reducing energy consumption, and fostering economic growth.

6.3 Policy Implications

These research findings can be leveraged to assess the preparedness for smart city development in Thailand and offer practical guidance to government agencies, local authorities, and urban development sectors in formulating clear plans and policies that effectively propel sustainable smart city development.

7. RECOMMENDATIONS FOR FUTURE RESEARCH

Further research is recommended to delve deeper and gather qualitative data and insights. It should explore the application of smart city development in conjunction with the BCG Economy Model and the principles of a self-sufficient economy. Additionally, studying and evaluating the outcomes of Thailand's smart city development strategies would provide valuable insights for the implementation of sustainable smart city policies in the country.

8. CONCLUSION

Based on the study, it has been concluded that the sustainable success of smart city development in Thailand relies on several factors, including effective technology and innovation management, potential of leaders, readiness for smart city, and the presence of smart city infrastructure. These factors necessitate collaboration among the government, private sector, social sector, educational sector, and the community in order to drive sustainable and efficient smart city development across Thailand. The management and governance of smart city development in Thailand entail the application of innovative services to provide convenience for the public and stakeholders, ensuring easy access to comprehensive government services within a transparent governance framework. Continual improvement in operations and workflows is crucial in

cultivating an informed smart community capable of leveraging technology to enhance their quality of life and promote overall well-being. This encompasses the development of diverse amenities, as well as the implementation of comprehensive disaster management strategies, water and waste management systems, pollution control measures, and the creation of green spaces to foster an environmentally conscious smart city. Interconnected and diverse transportation systems are vital, while urban development should align with the local identity, thereby supporting an innovative and creative economy. Additionally, emphasis should be placed on the development of smart energy by harnessing renewable energy sources to ensure the long-term sustainability of smart cities in the future.

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