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The Key Factors for Local Development towards Sustainable Smart City and Quality of Life Enhancement

Natnicha Chotpittayanon[1]

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Abstract

The purpose of this research was 1) to examine the factors that influences local development for a sustainable quality of life in a sustainable smart city, 2) to study the relationship of these factors and 3) to provide guidelines for enhancing local development. The research employed a combination of quantitative and qualitative approaches. Data was gathered from a sample group comprising local government officials who were involved in smart city development. The sampling methods utilized probability sampling with a total of 395 participants. The study involved in-depth interviews with key informants totaling 10 individuals. Data analysis was conducted using mean, standard deviation, Pearson's correlation coefficient, multiple regression analysis, and content analysis. The findings of the research were 1) Overall, the level of local development aimed at achieving a sustainable quality of life in a sustainable smart city was high. Smart government management was ranked as the most influential factor. 2) The local leadership had the most significant impact on the development of the region for a highly. Moreover, it demonstrated a positive correlation in the same direction, ranging from 0.727 to 0.851. The foundational structural factors of a smart city exhibited the highest level of interrelation, and 3) Guidelines for the development of a smart city should focus on establishing an environmental system to foster the development of digital infrastructure and the implementation of smart city solutions in all areas. Collaboration between the public and private sectors in utilizing technology and innovation to enhance the quality of life.

Keywords: Local Development, Sustainable Smart City, Quality of Life

Introduction

Currently, Thailand faces multifaceted challenges that impact its development. Societal and economic dimensions both underscore the populace's aspirations for higher income levels and the resolution of poverty and inequality issues. Development concerns encompass unequal access to public services and opportunities, necessitating ongoing developmental efforts. The economic structure has yet to fully embrace innovation, and productivity remains relatively low in the service and agricultural sectors. The workforce's quality and capabilities have not kept pace with the country's development needs. Motivating investment and economic development

[1]College of Politics and Government, Suan Sunandha Rajabhat University, Thailand
E-mail: natnicha.ch@ssru.ac.th

remains a critical focus. In the realm of public sector management, there is a need for enhanced continuity and adaptability to address diverse challenges and meet population demands in resolving various issues. Additionally, environmental considerations, such as natural resource restoration and preservation, play a pivotal role in sustainable national development. Climate change and environmental degradation present new challenges in this dimension. Furthermore, rapid demographic shifts, including a declining working-age population and an aging demographic, bring about significant changes. Advances in science and technology, intricate regional integration, and openness across sectors contribute to novel challenges in terms of national stability, economy, society, and the environment (Office of the National Economic and Social Development Council, 2018).

The proportion of people residing in urban areas compared to rural areas has been steadily increasing, leading to rapid and continuous urbanization. This trend has spawned a range of associated problems, including overcrowding in housing and workplaces, as the workforce seeks convenient and cost-effective living arrangements for their daily commutes. This, in turn, has driven up urban housing prices, making such accommodations accessible to only a minority with sufficient income. Transportation systems often struggle to meet both the quantity and quality demands, exacerbating the situation. Environmental concerns, such as air pollution, noise pollution, water contamination, and waste accumulation, pose significant threats to the health of urban residents. Moreover, they negatively impact the overall quality and efficiency of urban life and work. The development of smart cities in Thailand is imperative as it can alleviate population congestion in major urban areas by redistributing growth to surrounding regions. This can reduce disparities and enhance national competitiveness by modernizing cities to align with community social ideals. This entails leveraging digital technology and information communication to boost the efficiency and quality of community services, ultimately reducing costs and consumption while improving residents' quality of life (National Economic and Social Development Council, 2021).

The well-being of the population requires attention and development because when people enjoy a good quality of life, they can contribute to the stability and advancement of their families and the nation. A good quality of life encompasses elements such as reducing inequalities, fostering a healthy environment, and promoting a high standard of living (Trevittaya, 2016; Chittmittrapap et al., 2022; Thabngern et al., 2022).

Local governance plays a crucial role in enhancing the quality of life for the population through the implementation of smart city management. This approach aims to improve the efficiency, effectiveness, and safety of local areas, with a strong emphasis on innovation and the use of modern technology to establish interconnected communication networks within the city's systems. The goal of local governance in smart city management is to ensure that residents enjoy a high quality of life while promoting livability, sustainability, and efficiency within the city (Chaiprasert, 2022). This approach seeks to enhance service delivery and city management efficiency while simultaneously reducing costs and resource consumption. It places a significant focus on well-designed solutions and collaboration with various stakeholders (Digital Economy Promotion Agency, 2022). The success of a smart city is assessed across seven dimensions, which include: 1) Smart Environment, 2) Smart Energy, 3) Smart Economy, 4) Smart Living, 5) Smart Government, 6) Smart Transportation and Logistics, and 7) Smart Citizens (Giffinger et al., 2007; Glasmeier & Christopherson, 2015; Dameri, 2017; Smart City Thailand Office, 2019; Kokpol et al., 2020; Raksapol & Phosing, 2021).

The infrastructure of a smart city serves as the core for development and operations in a city that aims to promote connectivity and collaboration among organizations and residents in that area. The development of smart city infrastructure comprises three main components: 1) Traditional public infrastructure, 2) Digital public infrastructure, and 3) Natural public infrastructure, also known as green infrastructure (Chourabi et al., 2012).

Local readiness for transitioning to a smart city, with the goal of enhancing service delivery efficiency and resource management, leads to the city's sustainability and the creation of value for its residents. The readiness for smart city transformation is based on three key components: 1) Organizational and personnel readiness, 2) Resource readiness, and 3) Community and citizen readiness (Leatchaturanon & Boonsaya, 2021; Kokpol et al., 2020).

The potential of local leaders serves as a gauge of an organization's success, underscoring their crucial role. In the realm of smart city development, relying solely on traditional leadership skills may fall short when confronting intricate challenges. Furthermore, the continually evolving technological landscape necessitates leaders to adapt and enhance their skills and innovative thinking to effectively navigate these changes. Leaders should possess the ability to construct collaborative networks, forging connections among individuals both within and outside the organization, including stakeholders (Johansen, 2012; Jaitip & Chienwattanasook, 2018). The potential of leaders in smart city development encompasses three facets: 1) Local leadership attributes, 2) a growth mindset, and 3) network-building for collaboration.

Smart city development entails the integration of data and telecommunications technology with infrastructure and public services. This aims to enhance the convenience of life for the population, foster improvements in urban governance and creative urban innovations, and utilize the city as a hub for local economic development (Chaiprasert, 2022). To materialize smart cities, it is imperative to oversee three pivotal technology domains: 1) Smart power grids, 2) City data management, and 3) Smart information and communication systems.

The research questions for this study aim to seek answers regarding: What factors influence the development of a high-quality life in sustainable smart cities? How do local development factors affect the quality of life in sustainable smart cities? Considering the variables: Smart City Infrastructure, Smart City Readiness, Local leadership potential and Technology and Innovation Management. In order to generate ideas for the development of smart cities in various dimensions, to promote long-term smart city development, and to lead to improved quality of life for the population. It can propose guidelines for improving the quality of life of the population in smart city areas for government agencies, local authorities, and urban development organizations to be incorporated into clear plans or policies that serve as effective tools to drive sustainable development.

Research Objectives

1. Investigate factors contributing to sustainable local development for improving quality of life in smart cities.
2. To study the relationship of local development for the sustainable improvement of quality of life in smart cities.
3. Propose guidelines for local development to achieve a sustainable improvement in the quality of life in smart cities.

Research Questions

1. What factors influence the development of a high-quality life in sustainable smart cities?
2. How do local development factors affect the quality of life in sustainable smart cities?

Literature Review

"Smart city" refers to a city that leverages technology and innovation to enhance the efficiency of services and city management, as well as to reduce city expenses and resource consumption. It emphasizes well-designed solutions that integrate contributions from various sectors, including the public sector, private sector, and civil society. It involves the integration of data and digital technologies into infrastructure and various services with the aim of addressing collective issues and making the urban environment more sustainable and livable. It is a city that is still in the investment and development phase, continually improving its basic systems and public services by using intelligent solutions to enhance capabilities and extend the lifespan of infrastructure assets. This is done with the goal of improving the quality of life for residents, making it a modern and desirable city where people enjoy a higher quality of life, happiness, and sustainability. Efforts are made to address various public issues by applying information and communication technology based on the involvement of stakeholders in urban development and local governance (European Parliamentary, 2014).

Smart city is a form of applying technology or information and communication to increase the efficiency and quality of community services, while also helping reduce costs and consumption for the population. It aims to enhance the efficiency of living for residents. It is a city capable of creating a connection between the conventional or physical assets of the city with its existing social assets to develop services, infrastructure, and improvements in various aspects of the city, such as roads, bridges, tunnels, railways, subways, airports, ports, communication, water, electricity, and significant buildings, to make the most of these resources. It plans preventive maintenance activities and surveillance in the dimension of security while providing the best service to the citizens (Dameri, 2017). It is a city with waste management, traffic control, and the use of technology to facilitate sub-systems of the city, such as energy, water, environmental management, employment opportunities, economic prosperity, and innovation. However, it also emphasizes healthcare, sustainability, quality of life, work, public convenience, and data disclosure (Glasmeier & Christopherson, 2015).

The Smart City Office in Thailand was established under the supervision of the Ministry of Digital Economy and Society's Digital Economy Promotion Agency on October 15, 2017. Its primary mission is to formulate a comprehensive master plan, and action plans, and execute initiatives for advancing smart city development, all in alignment with the Thailand 4.0 development roadmap and the 20-year national strategy. In the second phase of this strategy, it has actively championed the growth of smart cities through the application of cutting-edge technology to enhance urban environments, thus rendering them more habitable, secure, and ecologically sound. Additionally, it has strategically designed infrastructure that corresponds with economic potential and societal needs, with particular attention given to accommodating the increasing elderly demographic in the years ahead.

Furthermore, an imperative exists for the efficient management of public transportation within urban regions, ensuring widespread accessibility for residents and reducing operational expenses for businesses in these areas. Over the long run, the ultimate goal is to establish seamless connectivity among service systems and infrastructure networks linking central cities across the nation, thereby enhancing the quality of life for individuals residing in diverse locales and propelling the digital economy. It is of paramount importance that all segments of society possess a clear understanding of the operational mechanisms and methodologies involved in this endeavor, placing significant emphasis on enhancing quality of life, resource management, and technological innovation. The overarching objective is to transform cities into more livable, efficient, and environmentally sustainable hubs.

The sustainability of success in smart city development relies on a well-defined, flexible, and responsive urban system framework. This framework should leverage current technology and incorporate a participatory approach that involves local residents. It should effectively integrate physical, digital, and human resource components. To achieve this, four primary focal points need comprehensive design and planning (Iamtrakul et al., 2021): 1) Accessibility of Data and Technology: Ensuring access to data and technology resources is fundamental. It guarantees that citizens can easily access information and technology, 2) Sustainability through Adaptable Transformation: Sustainability should take the form of a flexible and self-sustaining transformation, capable of continuous maintenance and adaptation, 3) Prioritizing Transparency and Open Data: The practice should prioritize transparency and the availability of data that can be practically utilized, and 4) Promoting Public-Private Collaboration: Attention should be directed toward stimulating private sector investment motivation to achieve public-private partnerships. This involves establishing a government data platform and allocating city management budgets to cover local and other levels effectively.

The characteristics of smart city development and the goals of assessing its success according to central government policy involve a city that has been certified as a smart city by the Smart City Development and Management Committee and has received approval from the Smart City Development Promotion Committee. The design of smart city success encompasses seven dimensions (Office of the Digital Economy Promotion, 2022) such as 1) Smart Environment 2) Smart Energy 3) Smart Economy 4) Smart Living 5) Smart Government 6) Smart Mobility and Transportation, and 7) Smart People or Citizens (Giffinger et al., 2007; IBM Global Business Services, 2009; Glasmeier & Christopherson, 2015; Dameri, 2017).

The role of local authorities in smart city management is to enhance local efficiency, effectiveness, and security through innovation and the use of modern technology to establish an interconnected communication network within the city. Local authorities play a significant role in transforming their regions into thriving, sustainable, and efficient urban centers by leveraging information technology to drive urban development. This involves enhancing residents' quality of life (livability), bolstering urban sustainability, improving management efficiency, and utilizing information technology for urban development. Local government organizations are integral to regional development, fostering innovation, and adopting contemporary information technology systems to effectively manage and develop their areas. They also strive to enhance the skills of local administrators and civil servants, ensuring they maintain high levels of professionalism, respond promptly, and meet the public's needs in an era where technology plays a pivotal role in all aspects of local development (Chaiprasert, 2022).

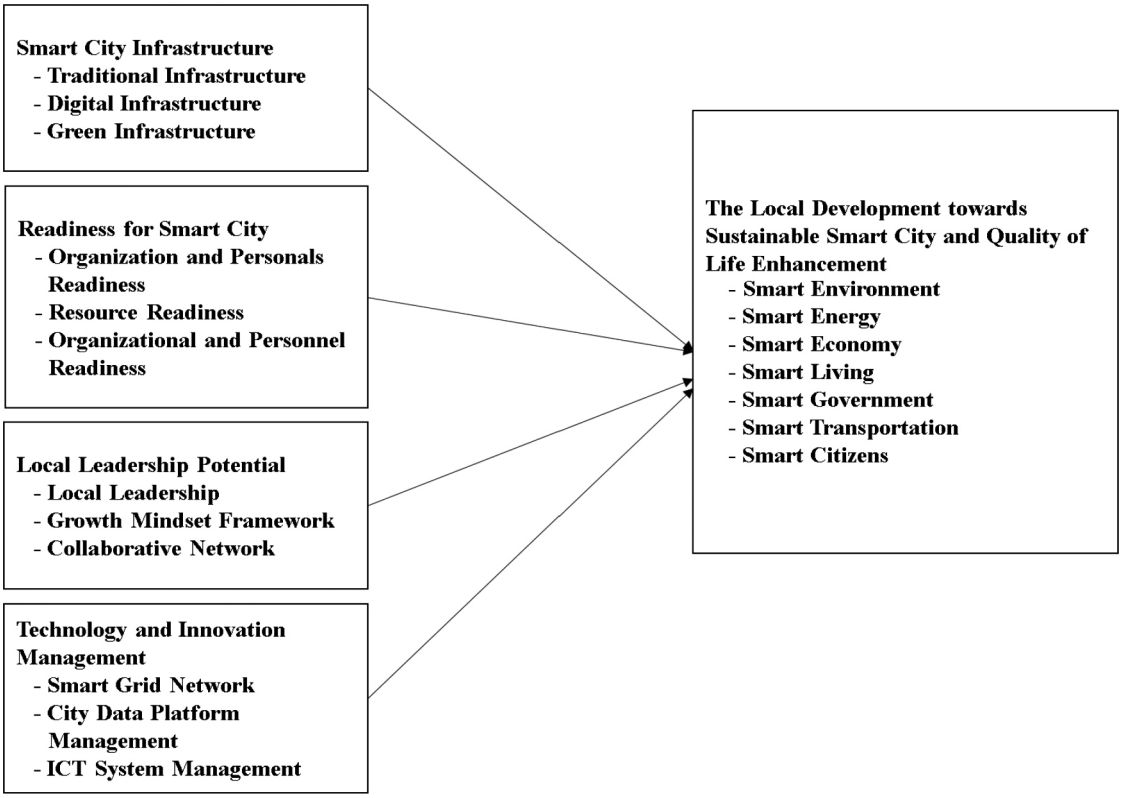

Figure 1 Conceptual Research Framework

From the research framework, it highlights independent variables: Smart City Infrastructure, encompassing traditional, digital, and green infrastructure. Smart City Readiness, which involves organizational and personnel readiness, resource readiness, and community and citizen readiness. Local leadership potential, composed of local leadership, a growth mindset framework, and a collaborative network. Technology and Innovation Management, covering smart grid, city data management, and smart information and communication technology systems. Dependent variables encompass the development of localities for a high quality of life in sustainable smart cities, including smart environment, smart energy, smart economy, smart living, smart governance, smart transportation, and smart citizens.

Through the researcher's study of relevant concepts, theories, and research, significant factors that drive the success of smart city development for the improved quality of life of the population have been identified. These key factors include: 1) Smart city infrastructure is a crucial system for developing cities efficiently and sustainably. These foundational structures serve as the core for using technology and innovation to promote smart city development. 2) Readiness for smart city development involves harnessing existing technology and innovation to benefit the city or fostering new innovations to meet the current and future needs of the population and society. 3) Leadership capability, in smart city development, traditional leadership skills alone may not suffice to address complex challenges. The rapidly changing technological landscape has shortened the development cycle due to the swift pace of transformative change and global volatility. Consequently, leaders must adapt, cultivate new skills and mindsets, harness creative potential, build networks, foster collaboration, and strengthen relationships both within and outside the organization, including stakeholders. 4)Technology and innovation management,

the core of smart city development is an information technology system that can be applied to the development of smart cities in diverse contexts. This includes transportation and traffic systems, electricity management systems, safety and security control systems, infrastructure monitoring and management systems, waste management systems, and government agency service systems, among others. As a result, residents experience a more convenient and secure way of life, increased access to crucial information, and a city that effectively utilizes technology to enhance service delivery and urban governance, and 5) Sustainable smart city development, the design of the smart city's success characteristics consists of 7 dimensions, namely: smart environment, smart energy, smart economy, smart living, smart governance, smart mobility or transportation, and smart people or smart citizen. This represents the characteristics of smart city development and the objectives for assessing smart city success in accordance with state policy.

Methodology

This research employs a mixed-method approach, primarily utilizing quantitative research and complementing it with qualitative research to enhance data quality.

1. Population and Sample Groups

1.1 The population for quantitative research comprises personnel from local government organizations in Thailand (Department of Local Administration, 2020), totaling 7,850 individuals. The population for qualitative research includes managerial and expert-level individuals associated with smart city development, representing both the public and private sectors.

1.2 The sample group in this research consists of personnel from local government organizations. The sample size is determined using the Yamane formula (1973) to ensure a higher level of research credibility. As a result, the researchers have selected a sample size of 400 individuals, meeting the specified criteria.

1.3 Key informants for this research are chosen through Criterion Sampling, following the methodology outlined by Miles and Huberman (1994). These informants are individuals who hold significance and relevance in the context of smart city development in Thailand. They are categorized into two groups: Group 1) Comprising key informants from government agencies responsible for formulating policies and strategies for local smart city development, with a total of 5 individuals. Group 2) Comprising key informants from private sector organizations actively engaged in providing smart city products and services, also totaling 5 individuals. All selected informants have given their consent for interviews, resulting in a combined total of 10 individuals participating in this study

2. Sampling Methodology

The sampling process adheres to the principles of Probability Sampling and utilizes both Stratified Random Sampling and Simple Random Sampling techniques. Each respondent represents a local government organization actively involved in driving smart city initiatives at the grassroots level. To facilitate quantitative data collection, the research team has designed and developed an online questionnaire using Google Forms. Data is collected via this platform and subsequently transmitted to the respective local government organizations in accordance with predefined sample proportions. A total of 400 samples were allocated, and the research team conducted follow-up phone calls to verify the responses received. In the end, a total of 395 responses were successfully obtained.

The researcher employed the following random sampling method:

1) Selection of Provinces: The researcher selected 76 provinces, excluding Bangkok, which is governed under a special administrative structure, to be included in the study. These provinces were chosen based on their population size and the presence of local government organizations relevant to the research.

2) Stratified Random Sampling: Within each province, a stratified random sampling method was used to categorize the local government organizations. Samples were then selected proportionally based on the number of organizations in each province.

3) Simple Random Sampling: To complete the sample of 400 respondents, a simple random sampling method was used. The names of local government organizations in each province were assigned numerical labels. Then, a random drawing was conducted to select respondents from these organizations, with one representative from each organization. These representatives are individuals with relevant experience in smart city development within their respective local government organizations, and they served as survey respondents.

3. Research Tools

In this study, the researchers designed a questionnaire that encompasses variables specified in the measurement index. The questionnaire comprises seven sections: Section 1 General information about the questionnaire respondents. Respondents can choose answers using a checklist and a rating scale to evaluate the general situation, Sections 2-6 Surveys focusing on local development for sustainable high-quality living in smart cities, addressing seven dimensions, and Section 7 Comments and suggestions (if applicable). For Sections 2 to 6, criteria and result interpretations were established based on Gleim and Gleim's (2003) scoring criteria. Respondents' opinions were converted into levels of agreement using a 5-point Likert scale (Likert, 1967).

Qualitative research data were gathered through in-depth interviews conducted individually. Semi-structured interviews were utilized for this purpose. The interviews use questionnaires that cover variables based on the measurement index. There are a total of 5 questions, each addressing the following key dimensions of smart city development:

1) What are the strategies for developing the smart city's infrastructure?

2) How should readiness for becoming a smart city be developed?

3) What strategies should be adopted to enhance the capabilities of local leaders?

4) What are the strategies for technology and innovation development and management?

5) How should local areas be developed for sustainable, high-quality living in a smart city?

The researchers performed an Item-Objective Congruence Index (IOC) analysis to evaluate the consistency between questionnaire items and objectives. Five qualified individuals assessed the congruence level. To assess the questionnaire's reliability, the researchers conducted a pilot test on local government personnel who were not part of the sample, totaling 30 sets. This aimed to determine the questionnaire's reliability using Cronbach's alpha coefficient analysis, resulting in reliability values for each dimension ranging between 0.976 - 0.986. The overall questionnaire reliability was determined to be 0.993, indicating a high level of reliability (Cronbach, 1970).

4. Data Analysis and Statistical Methods

4.1 Descriptive Statistics: Computed frequency, percentages, means, and standard deviations to describe respondent characteristics and variable distributions, explaining questionnaire respondent traits and variable nature. Conducted factor analysis to explore factors influencing sustainable high-quality living in smart cities. Respondent opinions were measured on a 5-level Likert scale (Likert, 1932), and mean values were interpreted following Gliem and Gliem's (2003) criteria for Objective 1.

The interpretation of scores based on the following criteria:

Average Score 4.21 - 5.00	=	Highest level
Average Score 3.41 - 4.20	=	High level
Average Score 2.61 - 3.40	=	Neutral level
Average Score 1.81 - 2.60	=	Low level
Average Score 1.00 - 1.80	=	Lowest level

4.2 Inferential Statistics: Utilized correlation coefficient and multiple regression analyses for Objective 2 and hypothesis testing.

4.3 Content Analysis: Analyzed data from in-depth individual interviews in the qualitative research component to describe factors influencing sustainable high-quality living in smart cities. This data helped build a conceptual framework, enhancing clarity in discussing quantitative research findings, and addressing Objective 3 in proposing guidelines for local development to achieve a sustainable improvement in the quality of life in smart cities.

Research Results

In terms of the general information about the respondents in the questionnaire, it was observed that the majority of the sampled individuals were males aged between 41 and 50 years, holding bachelor's degrees. They held positions as academic staff members in local government organizations at the sub-district level, serving populations of no more than 10,000 people, with their respective organizations maintaining an annual budget of less than 50 million Baht.

The research analysis results, presented in alignment with the research objectives, are detailed as follows:

The analysis outcomes regarding the level of local development for sustainable high-quality living in smart cities and the factors contributing to sustainable smart city development in Thailand are presented, including mean values and standard deviations.

Table 1 The level of Local Development for Sustainable Improvement Quality Living in Smart Cities

No.	The Level of Local Development for Sustainable	$\bar{X}$	S.D.	Level	Rank
1	Smart Environment	3.65	0.74	High	4
2	Smart Energy	3.50	0.74	High	7
3	Smart Economy	3.60	0.78	High	5
4	Smart Living	3.81	0.69	High	3
5	Smart Government	3.92	0.71	High	1
6	Smart Transportation	3.59	0.77	High	6
7	Smart Citizens	3.84	0.79	High	2
Overall		**3.70**	**0.64**	**High**	**-**

Table 1 shows that the overall level of success in sustainable smart city development is high ($\bar{X}$ = 3.70, S.D. = 0.64) When examining individual dimensions, it is evident that the dimension of smart government management has the highest level of success ($\bar{X}$ = 3.92, S.D. = 0.71), whereas the dimension of smart energy exhibits the lowest level of success ($\bar{X}$ = 3.50, S.D. = 0.74).

Table 2 The Level of Factors Contributing to Sustainable Local Development for Improving the Quality of Life in Smart Cities.

Factors	$\bar{X}$	S.D.	Level	Rank
Smart City Infrastructure	3.64	0.68	High	2
Readiness for Smart Cities	3.60	0.73	High	3
Local Leadership Potential	3.85	0.79	High	1
Technology and Innovation Management	3.49	0.71	High	4
Overall	**3.64**	**0.64**	**High**	**-**

Table 2 shows that, overall, factors contributing to sustainable local development for improving the quality of life in smart cities have a high level ($\bar{X}$ = 3.64, S.D. = 0.64) Specifically, the dimension of smart city infrastructure has the highest level ($\bar{X}$ = 3.85, S.D. = 0.79), while technology and innovation management exhibit the lowest level ($\bar{X}$ = 3.49, S.D. = 0.71).

2. Multiple Regression Analysis Results: Examining the Relationship between Smart City Infrastructure, Smart City Readiness, Local Leadership Potential, Technology, and Innovation Management with Sustainable Local Development for Quality of Life Improvement in Sustainable Smart Cities.

2.1 Smart city infrastructure significantly influences sustainable local development for improving the quality of life in sustainable smart cities, with a substantial coefficient of determination (R2 = .722, F = 103.70, β = .850, p = .000) at a statistical significance level of

.01. Specifically, smart city infrastructure, represented by green infrastructure, has the highest predictive power, with a regression coefficient of .314 (B = .314), followed by digital infrastructure with a regression coefficient of .268 (B = .268), and traditional infrastructure with a regression coefficient of .156 (B = .156).

$$Y = .814 + .314x_1 + .268x_2 + .156x_3$$

2.2 Smart city readiness significantly influences sustainable local development for improving the quality of life in sustainable smart cities, with a coefficient of determination (R2 = .651, F = 740.78, β = .807, p = .000) at a statistical significance level of .01. Specifically, community and citizen readiness have the highest predictive power, with a regression coefficient of .285 (B = .285), followed by organizational and personnel readiness, with a regression coefficient of .318 (B = .318), and resource readiness, with a regression coefficient of .109 (B = .109).

$$Y = 1.102 + .285x_1 + .318x_2 + .109x_3$$

2.3 The potential of local leadership influences sustainable local development for improving the quality of life in sustainable smart cities, with a coefficient of determination (R2 = .530, F = 448.79, β = .728, p = .000) at a statistical significance level of .01. The highest predictive power is attributed to the establishment of collaborative networks, with a regression coefficient of .352 (B = .352), followed by local leadership status, with a regression coefficient of .305 (B = .305), and the growth mindset framework, with a regression coefficient of .163 (B = .163).

$$Y = 1.226 + .352^{**}x_1 + .305^{**}x_2 + .163^{**}x_3$$

2.4 Technology and innovation management significantly influence sustainable local development for enhancing the quality of life in sustainable smart cities, with a coefficient of determination (R2 = .626, F = 666.85, β = .791, p = .000) at a statistical significance level of .01. Specifically, smart information and communication technology system management has the highest predictive power, with a regression coefficient of .303 (B = .303), followed by smart electrical network management, with a regression coefficient of .176 (B = .176), and city data management, with a regression coefficient of .231 (B = .231).

$$Y = 1.213 + .303x_1 + .176x_2 + .231x_3$$

Table 3 Results of Correlation Coefficient Analysis

Factors	(r)	Sig.	Level	Direction
Smart City Infrastructure	.851**	.000	Highest	Positive
Readiness for Smart Cities	.806**	.000	High	Positive
Technology and Innovation Management	.791**	.000	High	Positive
Local Leadership Potential	.727**	.000	High	Positive

** Significance level of .01

Table 3 reveals a positive and significant correlation among the factors contributing to sustainable local development for enhancing the quality of life in smart cities. The correlation coefficients between the independent and dependent variables range from 0.727 to 0.851, with statistical significance at the 0.01 level. In simpler terms, an improvement in smart city

infrastructure, higher smart city readiness, increased local leadership potential, and enhanced technology and innovation management all lead to a better quality of life in sustainable smart cities. Specifically, the strongest correlation exists between smart city infrastructure and the improvement of local quality of life (r = 0.851), followed by smart city readiness (r = 0.806), technology and innovation management (r = 0.791), and local leadership potential (r = 0.727).

Table 4 Analysis Results of Correlation Coefficients Considered by Dimension

Factors	(r)	Sig.	Level	Direction
Traditional Infrastructure	.752**	.000	Highest	Positive
Digital Infrastructure	.770**	.000	High	Positive
Green Infrastructure	.803**	.000	High	Positive
Organizational and Personnel Readiness	.757**	.000	High	Positive
Resource Readiness	.690**	.000	High	Positive
Community and Citizen Readiness	.767**	.000	High	Positive
Local Leadership	.677**	.000	High	Positive
Growth Mindset Framework	.566**	.000	Moderate	Positive
Collaborative Network	.696**	.000	High	Positive
Smart Grid Network	.691**	.000	High	Positive
City Data Platform Management	.756**	.000	High	Positive
ICT System Management	.771**	.000	High	Positive

** Significance level of .01

Table 4 shows that green infrastructure has the highest positive correlation (r = 0.803) with local development for a better quality of life in sustainable smart cities, followed by the Smart Information and Communication Technology system (ICT) (r = 0.771) and digital infrastructure (r = 0.770). Conversely, the growth mindset framework among local leaders exhibits the lowest correlation (r = 0.566) with local development. Encouraging the adoption of a growth mindset among local leaders in government organizations can enhance local development to enhance the quality of life in sustainable smart cities.

The results of the qualitative research data analysis from key informants are comprised of two groups: Group 1 includes key informants from government agency administrators who play a role in implementing policies for regional development towards smart cities, consisting of 5 individuals. Group 2 encompasses key informants from private sector agency administrators who are involved in smart city products and services, totaling 5 individuals. All informants have given their consent or permission for the interviews, making a total of 10 individuals. It was found that guidelines for developing smart city infrastructure that align with the population's needs include planning urban areas that are in line with the community's requirements, creating public spaces that are creative and beneficial for the public, such as parks, sports fields, libraries, and health and wellness facilities. Leveraging technology to improve city management and

development, such as smart traffic systems, sensor-based environmental control, convenient and efficient transportation, and using information technology to develop digital public service systems. The significance of having an efficient transportation system, promoting creative urbanization, emphasizing the development of infrastructure that focuses on distributing benefits and resource accessibility to reduce inequality and enhance the well-being of the population. It is crucial to adapt and flexibly adjust smart city systems in changing scenarios. Connecting to the internet and communication systems to enhance data exchange between different smart city systems and the importance of creating an environment that efficiently supports people's work and lifestyles.

Discussion

Regarding research objective 1, the study revealed that the factors influencing sustainable local development for enhancing the quality of life in smart cities, overall, are at a high level. Local leadership potential has the highest average value, followed by smart city infrastructure, smart city readiness, and technology and innovation management, which have the lowest average values.

The level of sustainable local development aimed at improving the quality of life in smart cities is notably high. This assessment encompasses seven key dimensions, including smart environment, smart energy, smart economy, smart living, smart governance, smart citizens, and smart transportation. These findings are consistent with prior research (Dameri, 2017; Theeramonpraneet, 2023; Jumnong & Lowatcharin, 2022) that underscores the integration of information and communication technology, coupled with urban planning and design, as instrumental in enhancing the effectiveness of governmental systems and fostering innovation in tackling urban complexities. The success of smart governance is characterized by unwavering commitment to ethical practices, transparency in operations, public convenience, and the accessibility of government information through diverse channels. The array of services offered is diverse, with ongoing enhancements in operational efficiency, along with the application of innovative service strategies to make government services more accessible, efficient, and comprehensive (Giffinger et al., 2007).

The accomplishments in the realm of smart citizens are apparent through the collaborative endeavors of diverse social groups, the cultivation of a creative environment for the public, the promotion of communal learning, and the empowerment of citizens with knowledge to harness technology for improved livelihoods (Giffinger et al., 2007). In terms of achievements in smart living, there is ample telephone and internet coverage, spaces designed to contribute to the well-being of the populace, and advancements in safety measures, such as widespread closed-circuit camera installations. The community benefits from disaster alert systems and a range of means for hazard monitoring and warning. Moreover, convenient educational facilities, technology, and learning tools are readily accessible (Jensantikul, 2020).

Success in the realm of the smart environment is realized by leveraging technology for waste management, disposal, and recycling. Effective management of green spaces adheres to established standards to mitigate carbon dioxide emissions. Additionally, technology is instrumental in water quality management, wastewater treatment, and drainage systems. Community engagement in natural resource conservation is evident, and efficient technology is deployed for disaster monitoring (Giffinger et al., 2007).

Success in the realm of smart economy involves developing the city as a business hub through innovation and creative thinking, utilizing technology to support the growth of the local economy (Jensantikul, 2020; Raksapol & Phosing, 2021). Success in smart transportation entails connecting transportation networks within the area through diverse and accessible modes of transportation. Effective management of public transportation systems is achieved through the application of various technologies, incorporating environmentally friendly vehicles, and establishing interconnectivity in transportation networks via information technology (Sutthi-amporn et al., 2022). Success in smart energy involves advocating for reduced electricity consumption, raising awareness, promoting the use of alternative energy sources, and applying information technology to develop community energy systems (Raksapol & Phosing, 2021).

In research objective 2, it becomes evident that factors such as smart city infrastructure, local leadership potential, smart city readiness, and technology and innovation management exert a significantly positive influence on sustainable local development, ultimately enhancing the quality of life in sustainable smart cities in Thailand. These factors exhibit a strong statistical correlation, with a significance level of 0.01. This correlation underscores that the presence of smart city infrastructure, preparedness for smart city development, effective local leadership, and enhanced technology and innovation management lead to a higher degree of sustainable development in Thailand's smart cities.

Conversely, the growth mindset framework among local leaders demonstrates the weakest positive correlation with the success of sustainable smart city development in Thailand. This observation aligns with the findings of Theeramonpraneet's (2023) research, emphasizing the transition to smart cities through the utilization of technological tools to enhance the operational efficiency of the public sector. This transformation involves streamlining administrative processes in public service delivery, expediting services, conserving energy, optimizing resource utilization, and delivering comprehensive benefits to the local population. Such development initiatives aim to enhance the local population's quality of life across various dimensions while adapting to the available human resources, budget constraints, local context, and indigenous knowledge to effectively harness technology and innovation.

Furthermore, the strategy for smart city development within local municipalities and government organizations extends beyond mere reliance on central policies. It necessitates the cultivation of innovative solutions for local development using digital technology to facilitate the emergence of new developmental frameworks within the legal boundaries defined by local governments. In this context, local leaders must possess a visionary perspective on technological advancement and foster a culture of continuous learning among their personnel. This cultivation of digital technology expertise enables the creation of innovations across diverse domains, thereby ensuring maximum benefits for the local population.

Research objective 3 aims to propose strategies for local development that enhance the quality of life in sustainable smart cities. It commences with an analysis and assessment of the city's readiness for development, encompassing infrastructure, budget, and local leadership. Clear objectives and development areas are delineated. Subsequently, the focus shifts to planning and developing the city's infrastructure, including the establishment of a secure data collection and management system. Additionally, data custodians are designated to ensure orderly data access and management.

Prioritizing sustainable and efficient city development is of paramount importance. This entails giving due emphasis to existing infrastructure and transitioning toward digital and green infrastructure to facilitate sustainable and efficient urban growth. Multidimensional preparedness is imperative, including the equipping of government personnel with digital skills and knowledge of smart city technologies. It also entails developing personnel capable of driving smart city policies through appropriate digital skills.

Creating a thriving and well-connected urban environment in a smart city necessitates a focus on services and urban development that align with the needs of the population. This endeavor aims to establish a sustainable city for the future. Local leaders must possess the knowledge and digital communication skills required for smart city development. They assume a pivotal role in shaping policies and legislation pertinent to smart city development. Furthermore, fostering a positive attitude toward adapting to smart cities is crucial, along with the establishment of collaborative networks with relevant agencies to propel smart city development.

Highlighting the use of technology and innovation to foster sustainability across economic, social, environmental, and quality of life dimensions is paramount. Prioritizing the application of technology and innovation will yield sustainable economic growth and enhance the quality of life for the local population. Specifically, efficient city data management assists in decision-making and problem-solving, thereby enhancing administrative efficiency. Establishing a central data repository that consolidates data from various agencies facilitates efficient data management and processing.

Furthermore, the development of an ICT system that connects resources and services within the city enhances citizen-friendly service delivery and supports communication and information sharing between government agencies and the public.

Conclusions

Based on the findings of earlier quantitative and qualitative research, the researchers have proposed strategies for local development to address research objective 3. These strategies are aimed at enhancing the quality of life in sustainable smart cities and encompass several key aspects:

1) Community and Citizen Needs: Prioritize the development of an efficient transportation system, foster a culture of creativity, and build infrastructure that emphasizes the equitable distribution of benefits and improved resource accessibility. Utilize technology to enhance the daily lives of all city residents.

2) Environmental Considerations: Create environmentally friendly living conditions to minimize environmental impact and enhance the value of local resources. Promote awareness and understanding of smart cities among both public and private sector personnel.

3) Education and Access: Strengthen knowledge and expertise in smart city-related fields, especially among local leaders and personnel. Establish educational systems and ensure access to information to facilitate the sustainable use of natural resources. Foster collaborative and cooperative communities for local decision-making and problem-solving.

The long-term outcomes of sustainable smart city development are expected to result in an enhanced quality of life and increased happiness among residents in growing and evolving cities.

The model of guidelines for local development in a sustainable smart city, depicted in Figure 1, positions Smart City Infrastructure as the foundational element at the bottom. This infrastructure serves as the cornerstone for advancing local development towards a sustainable quality of life in smart cities. Smart City Readiness and Technology and Innovation Management are positioned in the middle, while Local Leadership Potential assumes a central role in driving local development towards a high-level, sustainable quality of life in smart cities, as illustrated in the model.

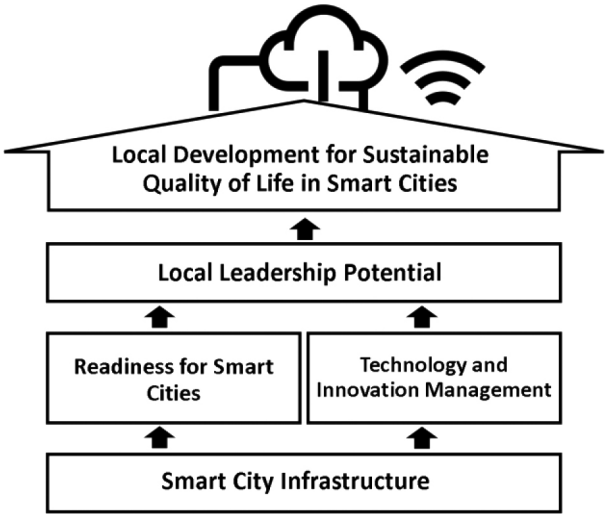

Figure 2 The Guidelines for Local Development in a Sustainable Smart City

The study, as depicted in Figure 2, concludes that the key success factors for local development aimed at improving the quality of life in sustainable smart cities in Thailand encompass Smart City Management, Leadership Potential, Smart City Readiness, and Smart City Infrastructure. These factors are harmoniously integrated, leveraging cooperation from the public sector, private sector, civil society, education sector, and the general public to propel the most sustainable and efficient development of smart cities in Thailand. The guidelines for sustainable smart city development in Thailand revolve around Smart Government Management, which employs innovative services to offer convenience to citizens and stakeholders, ensuring convenient access to comprehensive public services while upholding the principles of transparency in operations and continuous improvement. The primary objective is to establish an informed smart city capable of effectively harnessing technology for the well-being of its residents, nurturing a high quality of life. Infrastructure development includes bolstering safety through disaster monitoring, intelligent water management, waste and pollution control, air quality management, and the creation of green spaces to foster an environmentally friendly smart environment. Transportation is seamlessly interconnected within the area through various transportation modes, and urban and community development aligns with local identities to bolster innovative and creative economic growth. Particular emphasis is placed on the development of smart energy through the utilization of renewable energy sources to ensure the long-term sustainability of the smart city.

Recommendations

1. Applying Research Findings

Based on the research findings, several recommendations emerge for implementing smart city development in diverse dimensions to foster long-term smart city growth and improve the well-being of the population. Critical success factors for driving smart city development encompass efficient technology and innovation management, intelligent technology application across various smart city domains such as transportation and traffic systems, smart energy management, security and safety control systems, status monitoring, infrastructure management systems, waste management, and public service delivery. Organizations should undergo digital transformation, integrating technology into every facet of their operations and establishing forward-looking growth objectives to adapt to the digital era effectively. Furthermore, preparing communities and citizens in smart cities is crucial, with a focus on smart city infrastructure development, secure data storage and management, and sustainable management practices.

2. Academic Research Recommendations

Sustainable smart city development offers a vision for propelling the nation forward, necessitating the appropriate adoption of technology and innovation to generate economic and social value across various sectors, including industry, agriculture, and services. This approach creates a value chain across all sectors, enhancing the quality of life for the populace. Leveraging smart technologies to attain efficient, precise, and effective production processes while fostering seamless collaboration among various smart technologies ultimately improves the quality of life. Developing smart city infrastructure should prioritize providing easy access to public services that are convenient, rapid, and secure, all while reducing environmental impact, minimizing energy consumption, and simultaneously stimulating economic growth.

3. Policy Recommendations

The development of smart cities in Thailand should be an inclusive, collaborative process involving both public and private sector entities. It should also account for technological advancements and societal changes to achieve sustainable and advantageous development for urban and rural populations alike. Smart city development in Thailand must align with the goals and requirements of the population.

4. Future Research Recommendations

Subsequent research endeavors should concentrate on the study of leading smart cities as templates for smart city development in Thailand, offering insights into the promotion of smart cities in diverse provinces throughout the country. Furthermore, conducting more comprehensive data analysis employing Structural Equation Modeling (SEM) can augment our comprehension of smart city development factors and their interrelationships.

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