# FACTORS AFFECTING THE SUSTAINABLE DEVELOPMENT OF SMART CITIES IN NAKHON SI THAMMARAT PROVINCE

Isariya BOWONSETTHAWAT[1] and Tawee JAMJUMRUS[1]
1 Development Management Suan Sunandha Rajabhat University, Thailand;
isariya8999@gmail.com (I. B.); taweejam@gmail.com (T. J.)

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## ABSTRACT
The objectives of this research are 1) to study the level of sustainable smart city development in Nakhon Si Thammarat Province. 2) to study casual factors influencing sustainable smart city development in Nakhon Si Thammarat Province. A questionnaire was used to collect data from 232 personnel in local government organizations in Nakhon Si Thammarat Province. Statistics were used to analyze the data, including frequency, percentage, mean, standard deviation, and multiple regression analysis. The results of the research found that 1) Sustainable smart city development in Nakhon Si Thammarat Province overall and in each aspect is at a high level in the areas of smart public administration, smart economy, smart travel and transportation, smart environment, smart living, smart energy, and smart citizens. 2) Government policy factors, technology adoption, management innovation, and public participation influencing the sustainable development of smart cities in Nakhon Si Thammarat Province by 64.1 percent.
**Keywords:** Development of Smart Cities, Sustainable, Nakhon Si Thammarat Province

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# INTRODUCTION

The smart city is a form of application of digital technology, information and communication to increase the efficiency and quality of community services. To help reduce costs and reduce consumption by the population while still increasing efficiency so that people can live with a better quality of life. Smart cities are projects that many cities around the world are trying to develop in the 4.0 era by combining technology with people's lives, whether in terms of transportation, energy use, or infrastructure that will make cities convenient. Comfort like a dream can come true, and it also makes people live happily with the concept of smart cities emerging along with the rapid development of technology (internet of things: IOT), which is the foundation for connecting devices or things around us integrated with the internet communication network, including smart city planning to support convenient living and an urban management model. Smart cities are about creating cities that will have sustainable growth. Emphasis on balancing the environment, saving energy, and choosing clean energy to help reduce environmental problems, air pollution problems, wastewater, garbage, drainage, help promote a good environment, good air quality, increase green areas, and reduce the urban heat island phenomenon, even though Thailand does not yet have a complete smart city, it is taking shape but is driving the development of the target areas selected as prototype smart cities, including 7 provinces: Bangkok, Chiang Mai, Nakhon Si Thammarat, Khon Kaen, Chonburi, Rayong, and Chachoengsao. With the cooperation of 3 ministries: the Ministry of Energy, the Ministry of Transport, and the Ministry of Digital Economy and Society, a smart city development master plan has been developed that has guidelines for driving smart city development.(Engineering Today, 2020)

The term “smart city” does not refer to a city where fiber optic cables are laid. Then put various technologies in. Everything uses technology. Rather, it means that cities leverage modern and intelligent technology and innovation to increase the efficiency of city services and management, reduce costs, and use of city resources and target populations, with an emphasis on good design and participation of the business and public sectors in urban development. Under the concept of livable city development, a modern city provides its citizens with a good quality of life. Have lasting happiness (Kanoknukulchai, 2020). The need for developing cities to be smart cities 1) The need for smart cities to solve big city problems, small and medium-sized cities in each city have different problems, obstacles, and solutions. Which may have something similar or different, both in terms of size, quantity, population, and resources that are not equal. 2) Necessities and responses to the needs of society in the information age, globalization, digital society, and society of the elderly and disabled people. Information and communication technology can be used to respond. 3) Responding to the diverse needs of urban society and rural society, urban society and rural society have dimensions of diversity in area size and prosperity in urban resources. It attracts resources from outside the city to nourish it, such as water, food, and clean air, but the city retains prosperity and knowledge, causing income distribution to not trickle down to the countryside. Population migration occurred as more and more of the countryside came into the city, causing more and more urban problems as well. Distributing income, prosperity, and knowledge to the countryside will help reduce the problem of urban density and 4) the urgent need for participation Public participation is essential. (Sumalee & Tanchai,2019)

“Smart city” means a city that makes use of modern and smart technology and innovation to increase the efficiency of city services and management, reduce costs, and make better use of the resources of the city and its target population. The emphasis is placed on good design and the participation of the business and public sectors in urban development under the concept of developing a livable city, a modern city, and providing citizens in the city with a good quality of life, happiness, and sustainability through the development of smart cities. There are many dimensions of development. There are 7 important dimensions: 1) smart environment (smart

environment); 2) smart travel and transportation (smart mobility) 3) smart living (smart living) 4) smart citizens (smart people) 5) smart energy (smart energy) 6) smart economy (smart economy) 7) smart public administration (smart governance) (Digital Economy Promotion Agency, 2020) for Thailand Announcing the policy to drive the digital economy and society (digital economy) that will focus on pushing smart cities. to be a mechanism that will create opportunities for expansion The economy at the local level will be better. (Ministry of Digital Economy and Society, 2017) But there are various questions that arise in pushing for success and sustainability like in countries that develop cities. The genius has arrived. What are the components? How will it be? And how should it be changed so that it is appropriate and consistent with the Thai way of life? smart city development It is considered an important city development plan according to the "Thailand 4.0" strategy to provide a place for housing in the future. Taking into account the dimensions of quality of life, environment, culture, as well as comfort and safety. There is energy saving management, it is an educational center, and it is an important source of knowledge. Digital technology is used to manage resources, and various public utility services necessary for future economic and social development. An example of a pilot project currently underway is the Nakhon Si Thammarat project. Smart City of the Ministry of Digital Economy and Society in collaboration with the private sector citizens and urban and industrial estate development projects towards a smart city of the Ministry of Energy and the private sector, etc. (Araya Preechametta, 2018)

Nakhon Si Thammarat, a province in southern Thailand, is the second-most populous province after Surat Thani and is part of the Thai ax handle. It is outstanding in many cultural tourist attractions and is quite famous, such as the Pak Phanang Hundred Years Market or Wat Phra Mahathat Ratchaworamahawihan, etc., with the uniqueness of the tourist attractions in Nakhon Si Thammarat. There is a concept to fully drive the economy and develop the province into a smart city (smart city). A plan has been created to drive Nakhon Si Thammarat province into a smart city (smart city) under the project to promote tourism activities, culture, and tradition, which the Nakhon Si Thammarat Provincial Office organized. The objective is to allow all sectors to participate in the preparation of plans and projects. This is a solution to concrete problems and a guideline for development. Nakhon Si Thammarat Province towards a smart city or smart city with the goal of driving the development of the province to be a main tourist city in the southern region on the Gulf of Thailand and developing the infrastructure system, including developing the airport into an international airport, developing the road network to connect traffic within the province and the region, developing the southern distribution center (Thung Song) to be the center of the southern region, and expediting the establishment of the zone. Nakhon Si Thammarat Industrial Estate By giving importance to the government's Thailand 4.0 policy and the government's project to drive the economy and digital society in Nakhon Si Thammarat Province, it has been proposed to the Ministry of Digital Economy and Society that the province is ready to efficiently drive towards a smart city in the future. (Digital Economy Promotion Agency, 2017) At the same time, Nakhon Si Thammarat Province is one province that is well prepared for information technology infrastructure, such as a communication network that is comprehensive, fast, and highly stable. It is also one of the cities designated as an industrial city of the future for high-tech businesses. This will help build industrial strength throughout the system.

Nakhon Si Thammarat Province has joined forces with the Digital Economy Promotion Agency (DEPA) to drive smart city policy with Nakhon Si Thammarat Municipality being the pilot area and expanding to other municipalities in Nakhon Si Thammarat Province. The main goal is to provide personnel for local government organizations and government agencies have knowledge and ability to use digital platform tools and use them as a channel to solve problems of living and well-being for the people of Nakhon Si Thammarat Province. (Digital Economy Promotion Agency, 2017) In addition, Nakhon Si Thammarat Municipality has driven the

smart city policy as “Smart City Nakhon Si Thammarat” by developing online services through the LINE OA application. The smart city system solves problems and disasters in Nakhon Si Thammarat, or @Nakhoncity, consisting of a citizens' manual. Tour information the municipality's service reservation system Municipal CCTV viewing system and online complaint system. The complaints were classified into 24 categories, such as electricity, water, sidewalks, etc. These problems were handled by the Nakhon Si Thammarat Municipality. It assures residents that complaints will be resolved within 48 hours from the time they receive them. The online complaint system was developed to solve a key problem in local development: difficulty in contacting customer service. Especially complaints and problem solving from citizens. In the past, people had to wait for work results for up to 15 working days. Therefore, the municipality has promoted an online complaint system. Through the channel of LINE OA (LINE OA) @Nakhoncity to solve such problems. From the results of the said smart city development work, it has been successful. Ministry of Digital Economy and Society It was considered that it should be submitted to an international competition at the World Smart City Expo 2023 (WSCE 2023). As a result, Nakhon Si Thammarat Province won the Smart City Solutions Awards 2023 competition, receiving 4 excellent awards, including the Rangsit Canal Management System. Prayoonsak Smart Fee Management Software is an online veterinarian and intelligent surveillance system. (Smart City Office Thailand, 2019)

From the importance of smart cities above, it can be considered that a smart city is a form of application of digital technology, information, and communication to increase the efficiency and quality of community services. To help reduce costs and reduce population consumption, Thailand faces problems of congestion in both residential areas and traffic congestion. and environmental conservation. The sustainable development of smart cities requires support from government policies. There is a smart city office in the country. It is an agency established under the supervision of the Digital Economy Promotion Agency. The Ministry of Digital Economy and Society, dated October 15, 2017, has a mission to prepare a master plan. Action plan and driving the development of smart cities in line with the country's development direction according to the guidelines for driving Thailand 4.0 and the 20-year national strategy. We have prepared a policy plan and driven the development of smart cities at the local level. The criteria for the elements of the development plan have been determined, consisting of 5 pillars as follows: 1) target areas; 2) infrastructure development plan; 3) information and security system development plan; 4) 7-aspect smart city services; and 5) sustainable management. (Digital Economy Promotion Agency, 2019) In addition, the implementation of smart city development projects requires cooperation from civil society, including local people and private businesses that cooperate to carry out projects that require participation, planning, and decision-making; participation in project implementation; participation in perceived benefits; and participation in project monitoring and evaluation (Araya Preechametta, 2018). Additionally, a smart city is a city that takes advantage of modern and intelligent technology and innovation to increase the efficiency of service delivery and city management. Rely on the participation of the public sector. Therefore, people must accept the technology and apply it, including becoming aware of the benefits of using it. Perceived difficulty of use and have a good attitude towards use (Office of the Council of State, 2021) and management innovation factors applied in providing services and managing smart cities to reduce costs and the efficient use of city resources, which includes product and service innovation, marketing innovation process innovation, and organizational innovation (Jung & Wu, 2016: 28). These factors contribute to the sustainable development of smart cities. Therefore, the researcher is interested in studying “Casual factors influencing the sustainable development of smart cities in Nakhon Si Thammarat Province” in order to use the information obtained as a guideline for developing smart city innovation in Nakhon Si Thammarat Province to be more efficient.

# LITERATURE REVIEWS

## Concepts and theories about smart city development

Smart city (smart city) refers to a city that uses digital technology or information and communication technology to promote the quality and efficiency of city services, reduce costs and use of resources, and play a role and participate in the lives of the people who are increasing This will allow the city to more efficiently utilize its existing transportation, infrastructure, and public facilities. It helps you learn about changes or developments in the city more quickly. It can also reach people of all classes. and various conditions under the same conditions, which helps reduce social inequality (Tapananont, 2019), in line with Glasmeier and Christopherson (2015: 6), who said that smart cities (smart cities) are new markets with waste management, traffic control, and using technology to facilitate city sub-systems such as energy, water, mobility, and the built environment, employment opportunities, wealth creation and economic growth demand added value and innovation. But they also neglect health care and sustainability, living and working mobility, public convenience, and information disclosure. Meijer and Bolívar (2016: 393, 399) state that a smart city is a focus on technology, human resources and governance, making choices. Policy and policy implementation, decision-making processes, structural changes and Angsukanjanakul (2017: 252) stated that smart city is the concept of developing an innovative city that can reduce pollution problems, promote a friendly environment, increase the use of clean energy, and manage resources efficiently and effectively. Moreover, the Office of Strategy and Evaluation (2019) concluded that a smart city means a city that takes advantage of modern and smart technology and innovation to increase the efficiency of city services and management. Reduce costs and resource use. The emphasis is placed on the participation of the business sector and the public sector in urban development. Under the concept of developing a livable, modern city for the people in the city to live happily and sustainably.

In conclusion, smart city (smart city) is a management concept that covers urban development, emphasizing the development of quality of life, employment, increasing business opportunities and competition, creating innovation, and using information technology. Applied to increase the efficiency of service in all sectors, such as transportation systems, water supply, electricity, safety systems, etc., in order to provide comprehensive and comprehensive services for urban areas.

The Digital Economy Promotion Agency (2019) has classified smart cities into 7 elements, as follows: 1) A smart environment is a city that focuses on improving quality and increasing efficiency. Management effectiveness and monitoring Environment and environmental conditions in a systematic way, such as water management and climate care Disaster monitoring as well as increasing public participation in natural resource conservation. 2) Smart mobility is a city that focuses on increasing convenience, efficiency, and safety in travel and transportation while being environmentally friendly. 3) Smart Living is a city that focuses on providing services that facilitate living, such as health services, to keep citizens in good health and well-being. Especially to prepare to enter an aging society. Increasing public safety through crime surveillance and promoting the creation of appropriate living facilities. 4) Smart People is a city that focuses on developing citizens to have knowledge and be able to apply technology to benefit both the economy and livelihood. Create an environment that promotes creativity and informal learning. Including promoting coexistence through social diversity. 5) Smart energy is a city that focuses on increasing the city's energy efficiency. or use alternative energy, which is clean energy (renewable energy), such as biomass fuel, electricity from renewable energy, electricity from other energy sources, etc. 6) A smart economy is a city that focuses on increasing efficiency and flexibility in business operations. Create connections and business cooperation and apply innovation in developing to transform businesses (such as smart agricultural cities, smart tourism cities, etc.). and 7) A smart public administration (smart

governance) is a city that focuses on developing a service system for citizens to access government services conveniently and quickly, increasing channels for public participation. Including allowing the public to access information to make it transparent and verifiable.
Angsukanjanakul (2017: 252) casual factors that influence the sustainable development of smart cities were discussed: 1) Government policy means guidelines for promoting and developing smart cities by relevant government agencies. 2) Technology acceptance means using accepted technology. Work, which brings benefits to the individual, or various changes related to behavior, attitude, and easier use of technology. In addition, the use of technology gives each person additional experience, knowledge, and skills. 3) Innovation management means creating new knowledge and ideas. To get new business results, which gives importance to improving business processes within the organization and business structure to create products and services according to market needs and 4) Public participation means the joint behavior of citizens in various activities, both direct and indirect. In the form of joint thinking, joint decision-making, joint action to carry out activities in the community, and joint monitoring and evaluation, and sharing benefits. In order to achieve goals or objectives for oneself or society, one must act through a group or organization voluntarily and not be forced.
From the literature review, the following research hypotheses can be formulated.
H1 Government policy factors, technology adoption, management innovation, and public participation, affect the sustainable development of smart cities in Nakhon Si Thammarat Province.
From the literature review, the conceptual framework can be drawn as shown in Figure 1.

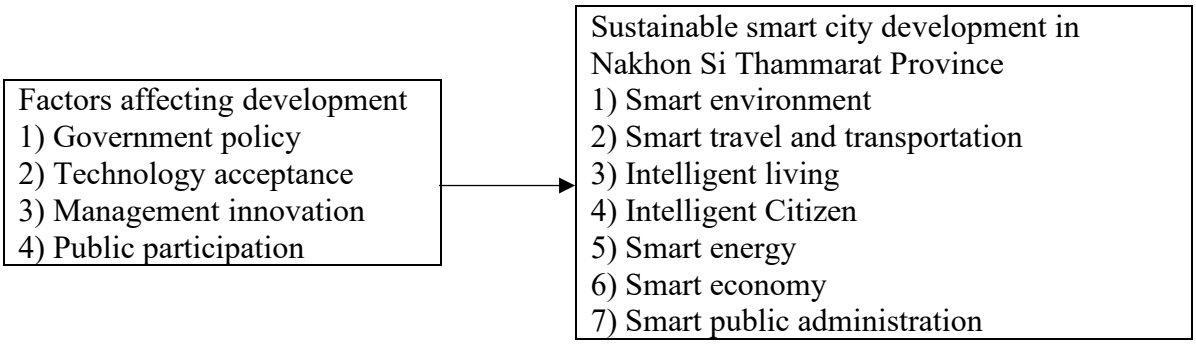


**Figure 1** Conceptual Framework

## RESEARCH METHODOLOGY

The population in this study includes: The population used in quantitative research includes: personnel in the local government organization of Nakhon Si Thammarat Province, 550 persons (Local Government Organization of Nakhon Si Thammarat Province, 2022), a sample size of 232 people obtained from Yamane's sample calculation formula (Yamane, 1973), and a belief value at the 95 percent level. A stratified sampling method was used.
The research tool is a questionnaire consisting of Part 1: personal factors of the respondents, including gender, age, education level, average monthly income, and the duration of the work. The questionnaire is a multiple choice type. Part 2: Factors affecting development. The nature of the questionnaire is a Likert scale with 5 levels of scoring criteria, including the highest equal to 5 points, the highest equal to 4 points, the moderate equal to 3 points, the slightest equal to 2 points, and the least equal to 1 point. Part 3: Sustainable smart city development in Nakhon Si Thammarat Province The nature of the questionnaire is a Likert scale with 5 levels of rating criteria, including the highest equal to 5 points, the highest equal to 4 points, the moderate equal to 3 points, the slightest equal to 2 points, and the least equal to 1 point.
Before using the data collection tool, objective consistency (IOC) testing and questionnaire reliability testing through Cronbach's alpha were systematically conducted. From the

examination, it was found that the IOC was equal to 0.839 and the Cronbach's alpha was equal to 0.917, indicating that the research tools were of sufficient quality (Polit & Beck, 2006; Hair et al., 2012) to get information. This study sent questionnaires to personnel in local government organizations in Nakhon Si Thammarat Province. Descriptive statistics were used to analyze the data, including frequency, percentage, mean, and standard deviation, and multiple regression analysis.

## RESEARCH RESULTS

1) Most of the respondents were female (68 percent), aged between 41-50 years (72 percent), graduated with a bachelor's degree (52 percent), had an average monthly income of 20,001-30,000 baht (58 percent), and the duration of working for 5-10 years, (45 percent).

2) Sustainable smart city development in Nakhon Si Thammarat Province overall and in each aspect is at a high level. In the fields of smart public administration, smart economy, smart travel and transportation, smart environment, smart living, smart energy, and intelligent citizens as shown in Table 1

**Table 1** Mean and standard deviation of sustainable smart city development in Nakhon Si Thammarat Province.

| Aspect | Description | $\bar{X}$ | S.D. | Result |
|---|---|---|---|---|
| 1) | Smart environment | 3.98 | 0.61 | Much |
| 2) | Smart travel and transportation | 4.05 | 0.47 | Much |
| 3) | Intelligent living | 3.89 | 0.42 | Much |
| 4) | Intelligent Citizen | 3.72 | 0.51 | Much |
| 5) | Smart energy | 3.69 | 0.43 | Much |
| 6) | Smart economy | 4.06 | 0.53 | Much |
| 7) | Smart public administration | 4.08 | 0.55 | Much |
| **Total** | | **3.60** | **0.42** | **Much** |

3) Government policy factors have a β value of 0.132, technology acceptance has a β value of 0.317, management innovation has a β value of 0.142, and public participation has a β value of 0.231, which shows that it has a positive influence on smart city development. Sustainable in Nakhon Si Thammarat Province Statistically significant at the 0.05 level, with Sig. values equal to 0.005, 0.000, 0.007 and 0.000, which are consistent with the set assumptions. When analyzing the correlation coefficient (R), the value is equal to 0.856, which indicates that the group of independent variables has a strong relationship with the dependent variable, and the prediction coefficient is equal to 0.641, which indicates that the group of independent variables influencing sustainable development in smart cities in Nakhon Si Thammarat Province received 64.1 percent.

In order, the equation can be written as follows.

$Y = 0.947 + 0.132X_1 + 0.317X_2 + 0.231X_4 + 0.142X_3$

From the analysis of the regression coefficients, it was found that government policy factors, technology acceptance, management innovation, and public participation have the ability to jointly predict the sustainable development of smart cities in Nakhon Si Thammarat Province. The government policy factor had the greatest effect on the forecast (Beta = 0.123), followed by public participation (Beta = 0.121), management innovation (Beta = 0.092), and technology acceptance (Beta = 0.043), with details as shown in Table 2.

**Table 2** Multiple regression analysis of casual factors influencing sustainable smart city development in Nakhon Si Thammarat Province.

| Factors | Unstandardized (b) | SE | Standardized (β) | t | Sig. |
|---|---|---|---|---|---|
| (Fixed value) | 1.121 | 0.106 | | 10.632 | 0.000 |
| Government policy | 0.123 | 0.023 | 0.132 | 3.662* | 0.005 |
| Technology acceptance | 0.043 | 0.021 | 0.317 | 7.865* | 0.000 |
| Management innovation | 0.092 | 0.042 | 0.142 | 2.402* | 0.007 |
| Public participation | 0.121 | 0.106 | 0.231 | 10.632* | 0.000 |
| R = 0. 856 | | Adjusted $R^2$ = 0. 641 | | | |
| $R^2$ = 0.730 | | SE = 0.142 | | | |

* Statistical significance at the 0.05 level

## DISCUSSION & CONCLUSION

Studying the casual factors influencing the sustainable development of smart cities in Nakhon Si Thammarat Province, the researcher has brought important issues to discuss the results according to the research objectives as follows:

1 ) The sustainable development of smart cities in Nakhon Si Thammarat Province is at a high level in the areas of smart public administration, smart economy, smart travel and transportation, smart environment, smart living, smart energy, and smart citizens. This may be due to the reason that the agencies responsible for driving the smart city development policy in Nakhon Si Thammarat Province, such as the local government organization, have joined with other government agencies and the public to jointly develop the development. Sustainable smart cities in Nakhon Si Thammarat province have proven results. Consistent with the research results of Smita Tempermpoon (2020), she studied the success factors that affect the development of smart cities in the People's Republic of China: a case study of Shanghai. The results of the research found that the development of smart cities in the People's Republic of China. The People's State of China is at a high level in every aspect.

2) Government policy factors, technology acceptance, management innovation, and public participation affect the sustainable development of smart cities in Nakhon Si Thammarat Province by 64.1 percent. This may be due to the influence of government policies. In addition, citizens and government officials accept technology that is used in management. Including the application of management innovations and people participating in driving projects or activities to be more successful. Consistent with the findings of Khoi & Ngan (2019), the research found that smart cities are influenced by six factors: technology adoption, innovation, participation, government policy, and development management innovation.

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**Data Availability Statement:** The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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