URBAN PLANNING MEASURES FOR SMART CITY DEVELOPMENT

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Cities represent the driving force of urban development in economic, social, and cultural life which is reflecting on the spatial organization of human society. As a result, the formulation of the national strategic plan into action at the local level need to correspond the requirements of current development. Urban planning measures for controlling the development also plays an important role as an encouragement instrument as well as granting the right to utilize the land for public purposes. In this study, the application of urban planning measures under the concept of smart city development was studied to understand the needs of all stakeholders and create an appropriate investment model in Thailand by using factor analysis technique. The government sector is the key player on the role of providing infrastructure services in addition to support and guide the direction of smart city development. For the role of private sector, investment environment would encourage them to help on upgrading technology, infrastructure, and unlocking public data. The smart city development approach can open up new value chains and opportunities. Therefore, the utilize urban planning measures as a tool for urban development will bring benefit on transforming cities as well as making them smarter and more sustainable which are an important goal for integrated urban development approach.

Keywords: Urban development, Stakeholder, Sustainable development, Factor analysis.

1 INTRODUCTION

Human and Cities activities pushed the world into the Anthropocene epoch—characterized by vital impacts on social, economic, geology, ecosystems, and global climate change (Dizdaroglu and Yigitcanlar 2014). The goal is for making certain property development and quality of life that has been recognized as necessary considerations (Arbolino *et al*. 2017). Additionally, solely regarding two of the geographic house and accommodating over 50% of the world population, cities these days turn out eightieth of greenhouse emission (GHG) emissions and consume eightieth of the world's resources (Arbolino *et al*. 2017). At the identical time, this economic climate forces several cities to chop budgets and set priorities. Consequently, cities face robust challenges for consideration and upgrade ICT infrastructures and innovation policies. This paper attempted to explain the creation of a prototype smart city for urban innovation and economic development. It will help for enable urban future and supported all stakeholders and for addressing in agreement priorities, helps to search out on common long-term planning (Belanche *et al*. 2016). In particular, in Bangkok and metropolitan areas with the growth rate was 0.5%, had been loading to the deterioration of urban areas throughout the 1987s recovering from the

development of mass transit systems in the 1997s. Due to the higher efficiency of connectivity of urban areas, as a result, individuals access their different destinations. While the urban areas still expand outside town (urban footprint), the comparison between 2002 and 2015 demonstrated that the city has expanded over 16 times of the Bangkok Metropolitan Area (BMA) (Iamtrakul and Klaylee 2018a).

Currently, several cities have been developed by focusing on innovative development and management by applying science and technology platform. To reach the potential of efficiency, the preparation must be on the perspective of the readiness of personnel, areas, organizations, and various sectors in production that respond to the smart city. The goal of development is not only to increase the production based on agriculture, industry and services but also enhance the quality index including the human quality, education quality, public services, and public health services as well as alleviating social inequality (Iamtrakul *et al*. 2018a) and preserving the quality of the environment (Caragliu and Del Bo 2018). Thailand has begun to drive the development of smart cities with support from both the public and private sectors. In 2016, the Smart City Thailand Association was established as a direct coordination centre in this area. The development guidelines are required to demonstrate the usefulness of building a smart city as a model city for urban development (Harrison and Donnelly 2011, Smith and Zeder 2013, Battarra *et al*. 2016).

Due to the rapid urbanization, the current infrastructure plan is focusing on development of a mass transit system in connecting the city's business centers to its vicinities (Iamtrakul *et al*. 2018b). The urban area has been expanded to suburban communities for better connectivity by improvement of efficiency travel (Iamtrakul and Klaylee 2018b). This has resulted in direction of government investments in infrastructure and facilities to serve the needs of the population and promote a good quality of life (Iamtrakul *et al*. 2017). This includes investment in real estate related development, shopping centers and private housing that promote economic agglomeration in the city (Iamtrakul *et al*. 2018b). Smart city concept is considered to bring the maximum potential of city development by including innovation and linking with urban development. It is the solution for solving problems, upgrading ICT infrastructures and innovation urban planning measures for controlling urban development by establishing an efficient and smart infrastructure system (Tselentis *et al.* 2010). Thus, in order to incorporate smart city concept for city development, it is a must to seek for an appropriate planning measures and policy to recommend for sustainable development, particularly in rapid urbanizing areas.

2 LITERATURE REVIEW

2.1 Network Integrated of Smart City

In the field of cooperation integration, new models have also been developed of partnerships between the public and private sectors and cooperation. Business sector can lead an open innovation market led by the development of the city which each project has their limitations and different complexities (but often overlap) (Boyko *et al.* 2012). In solving the problem, it focuses on the core issues of solving problems that combine energy, transport, ICT infrastructure and focusing on initiatives involving people and communities (Battarra *et al*. 2016). In urban planning, it is transformed due to technological developments and innovations. The role of the private sector is increasingly affecting urban development by acting as investors, service providers and users (Iamtrakul and Klaylee 2021). With the increasing budgetary constraints and urban complexity in urban planning, it is required for the government to be involved. To adapt to the development model and attract the private sector with the management of the government in the area of integration for smart city planning, the detail is explained as follows (Yigitcanlar *et al.* 2008, Boyko *et al.* 2012, Snow *et al.* 2016):

1) *Integration of solutions to problems in coordination at the urban level*: there is still limitations in the solution of a comprehensive solution for many reasons.

    a. In particular, inter-agency coordination and cooperation, it can be solved by creating a central coordination office for integrated solutions and supporting urban planning with appropriate tools/approaches.

    b. Strengthening cooperation among stakeholders at all levels*:* Planning for smart cities is complex, which need public sector to cooperate with the private sector under interest's and skills for project development. It emphasizes the involvement of various parties involved in the private sector, universities/research centers and the public.

    c. The enabling framework for new business models*:* It should be flexible in determining the roles and responsibilities. The public sector may consider management, project design and initial stages. It should be guarantee for increasing the participation of the private sector.

2) *Create a blueprint for a data sharing platform*; open data provides interoperability, spanning urban and business, that can be aggregated over time and create an overview of the multi-level competition of platforms, services and applications.

3) *Data managing is a key to digital processes*; since the integrated smart city planner can apply the collected data for process and share in real-time, it is considered to verify that the data is as likely as possible and the more information available likely to solve the problem.

3 RESEARCH METHODOLOGY AND ANALYSIS

Residents as the main users in smart city planning and development, this study derived the needs of local people by gathering data of 1,000 sets of questionnaires from the residents who live in Pathumthani Province. It was input into the statistical analysis process to identify an appropriate model for recommending measurement planning for Pathumthani Province in the role of smart city development. The questionnaires can be divided into 4 parts with details as follows*:* *Part 1:* Understanding of smart city development in Thailand; *Part 2:* Issues from urban development inquire about the factors that affect the driving of smart city development towards the public sector role; *Part 3:* The need for smart city development to create a guideline for Pathumthani Province; *Part 4:* Personal data and level of participation in community activities. After that, the data were analyzed based on a statistical program. By using descriptive analysis, the factors affecting the driving for smart city development in Pathumthani Province could then be determined. This study showed the statistical analysis in Part 3, Pathumthani smart city development needs, especially opinions on the measure for granting rights in urban planning. In the rating of understanding, this research level of opinions into 5 levels, which are level 5 concept of that they agreed and support all cases and Level 1 represents not agree with smart city development at all. Based on statistical analysis, the group of factors was analyzed based on factor analysis. In the study, the classification of factor groups using the explanatory factor analysis method is used to determine the grouping of factors using factor analysis techniques. It is an analysis technique by reducing the number of variables with similar statistical characteristics to the same factor. To reduce the redundancy of variables, 15 factors were imported as shown in Table 1.

In order to avoid the interference of heteroscedasticity, some variables are processed in logarithms. The descriptive statistical analysis of the main variables is shown in Table 2 and analyzed by Principal Component Analysis*:* PCA. It was found that from 15 input factors, 4 groups of factors were extracted, and the eigenvalue of that factor was determined. When the statistical test exceeded 1.0 and rotation sums of squared loadings were considered and spindle factor, the cumulative percentage (cumulative %) found that the factors obtained after the analysis of all 4 factors were able to explain the total variability of the variables 67.76 percent.

Table 1. Input variable for analysis.

Variable name	X_n	Variable description
Land use plan	X_1	Measures for changing the land use plan
Special economic zone	X_2	Measures for requesting a special economic zone
Promotion zone for special activities	X_3	Measures for requesting a promotion zone for special activities
Test-bedding	X_4	Permission for new urban areas as a dedicated test-bedding ground for new technologies and protect those involved
Service provider	X_5	Requesting to be a service provider, for urban utilities in the new city
Public-Private Partnership (PPP)	X_6	Encouraging the public sector, together with the private sector, to establish a city development agency that is responsible for controlling the city
Exempting smart utilities in cities	X_7	Benefit by exempting smart utilities in cities
Tax reduction for people	X_8	Personal income tax reduction for people who promote the use of smart city developed platforms
Tax reduction benefits	X_9	Provides tax reduction benefits for attracting target industries in the city to located in Pathumthani
Reduced some city requirements	X_{10}	Reduced some city requirements of the building control law by allowing the use of internationally safe construction standards
Data analysis center	X_{11}	A city that is defined as a smart city must have a data analysis center
Feeder System	X_{12}	Providing connectivity of the feeder system to connect people to the main city areas (light rail or special express buses)
Increase the budget for education and research	X_{13}	Increase the budget for education and research as a basic for development and extension of urban development innovation
FAR Bonus	X_{14}	Increasing the ratio of total building area to land area (FAR Bonus)
Transfer of development right	X_{15}	Provide a transfer of development right (TDR) measure

Table 2 shows that the most important factor was Land use plan ($X_1 = 2.52$), followed by Special economic zone ($X_2 = 2.34$), Promotion zone for special activities ($X_3 = 2.27$) and Tax reduction for people ($X_8 = 2.12$). The analysis result showed that the residents who live in Pathumthani Province have a focus on urban planning and development factor, especially land use planning and special economic zone, which involves the development of a support urban planning measurement requirements for controlling urban development. In addition, there were factors related to exempting smart utilities in cities ($X_7 = 2.11$). Also, Infrastructure Investment, there were moderate level factors related to increase the budget for education and research ($X_{13} = 2.23$) and connected feeder system ($X_{12} = 2.01$). Factor analysis can be classified into 4 main factors, as summarized in Table 3. Four factors were generated by factor analysis were named as *Factor 1: Urban planning, Factor 2: Tax measurement, Factor 3: City data requirements and Factor 4: Infrastructure investment.* Factors of urban planning and infrastructure investment were related to town planning requirements. It is directly related to urban planners who have to plan and develop cities following the policies, as a result that the smart city development can be a part of improving the quality of life of the people. The factors of tax measurement were related to create attraction for investment in innovation and technology in urban development from the private sector. Especially development, it is in particular the development of a special economic zone to serve as a testing ground for urban innovation. Further innovation must be introduced to develop more in context with urban development, Thailand. The factors of city data requirements were related to establishing a city database, which is essential for city planning is to collect relevant city information across the travel system, infrastructure urban management system, which will provide information to make decisions about setting guidelines for future urban development.

Table 2. Statistical analysis of the main variables.

Variable	X_n	Mean	Minimum	Maximum	Std. Dev	N	Sig. (2-tailed)
Land use plan	X_1	2.52	1.00	5.00	1.156	1,000	.000
Special economic zone	X_2	2.34	1.00	4.00	1.017	1,000	.000
Promotion zone for special activities	X_3	2.27	1.00	5.00	1.076	1,000	.000
Test-bedding	X_4	2.14	1.00	5.00	1.076	1,000	.000
Service provider	X_5	1.94	1.00	4.00	0.938	1,000	.000
Public-Private Partnership (PPP)	X_5	2.03	1.00	5.00	0.911	1,000	.000
Exempting smart utilities in cities	X_7	2.11	1.00	5.00	1.056	1,000	.000
Tax reduction for people	X_8	2.12	1.00	5.00	1.101	1,000	.000
Tax reduction benefits	X_9	1.89	1.00	5.00	0.952	1,000	.000
Reduced some city requirements	X_{10}	1.90	1.00	5.00	0.998	1,000	.000
Data analysis center	X_{11}	1.87	1.00	5.00	0.958	1,000	.000
Feeder System	X_{12}	2.01	1.00	5.00	0.920	1,000	.000
Increase the budget for education and research	X_{13}	2.23	1.00	5.00	1.028	1,000	.000
FAR Bonus	X_{14}	1.79	1.00	5.00	0.864	1,000	.000
Transfer of development right	X_{15}	1.43	1.00	5.00	0.669	1,000	.000

Significance (p-value) < 0.05

Table 3. Results of factor analysis.

X_n	Variable	Factors			
		Urban Planning	Tax Measurement	City data requirements	Infrastructure Investment
X_1	Land use plan	0.157	-0.164	-0.031	0.018
X_2	Special economic zone	0.140	-0.210	-0.065	0.050
X_3	Promotion zone for special activities	0.129	-0.241	0.080	0.007
X_4	Test-bedding	0.127	-0.206	0.021	-0.042
X_5	Service provider	0.129	-0.063	-0.177	0.014
X_6	Public-Private Partnership (PPP)	0.107	0.089	-0.352	0.038
X_{14}	FAR Bonus	0.147	-0.016	0.066	-0.293
X_{15}	Transfer of development right	0.125	0.040	0.120	-0.358
X_7	Exempting smart utilities in cities	0.111	0.245	-0.255	-0.012
X_8	Tax reduction for people	0.091	0.280	-0.205	-0.030
X_9	Tax reduction benefits	0.086	0.274	0.070	-0.066
X_{10}	Reduced some city requirements	0.091	0.169	0.383	-0.102
X_{11}	Data analysis center	0.080	0.120	0.418	0.213
X_{12}	Feeder System	0.099	0.055	0.179	0.466
X_{13}	Increase the budget for education and research	0.069	0.020	-0.120	0.467

4   CONCLUSIONS

From result of the analysis, it can be seen that urban planning plays a very important foundation for each area of urban development. Especially today, the concept of smart city development is a global theme that each country has adopted. With urban development, it may vary according to the context of each country that has to be addressed in each area. Therefore, in addition to planning for formulate policies in each area, measures are also needed to attract investment and Public-Private Partnership (PPP) between the public and private sectors to accelerate the movement without the government having to invest in development. However, private sector can join in developing and creating mutual benefits, aiming for people to be the most beneficiaries.

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Acknowledgments

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