

# A Conceptual Framework to Develop Smart Cities in Thailand

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**Abstract**—This conceptual paper focused on investigating smart city's factors and how these factors could apply to the current cities in Thailand. The significance of this research was a sample model for governments, policy makers, city-planners, architects, civil engineers, IT and IoT specialists or other relevant responsibilities to plan and develop cities in Thailand in the same way concurrently. This research collected both quantitative and qualitative data from official information sources to find out what is the feasible model of Thailand from its specific factors. The sample model of Thailand's smart cities from this research would be as a guideline for following deep investigation researches from other types of method and data collection, and it would also contribute to following researches in more specific and on the different fields or types of smart cities in Thailand in the near future which could enhance citizens well-being and meet the need of future development strategies of Thailand.

**Keywords**—Smart City, Smart Technology, Internet of Things, Sample Model, Future Technology, Social Needs, Thai Smart City

## I. INTRODUCTION

Nowadays, in mid 2017, there were more than 7.5 billion people around the world [1] and the number was steadily increasing [4]. In contrast, the land had not been much changed in its size since the human race was first appeared [5]. From the reason above, it could be seen that while the size of land and number of resources were maintained, the world population keep increasing. The problem would be more intense in the urban areas where people from the other area came for better opportunities and colonized from generation to generation. The speed of population increasing made the areas grow more complex [7]. The complex led to physical problem of pollution and transportation, and the economic problem of unemployment for example [7]. These needed the smarter ways from governments, and responsible institutions and officers to manage and accompany [7]. Since technologies were changing though time, it directly affected to the needs of cities and the definition of smart cities which definitely changed from the past depending on the impact of technology on each moment.

This would be a good first step to investigate the current characteristics of smart city that would be apply to cities in Thailand to support the current governmental policy on developing smart city for boosting the country's main economic development strategy of digital economy [7].

## II. BACKGROUND

From the seven continents of the world, Asia was the highest population at more than 4.3 billion inhabitants, accounting for 60 % of world population [6]. Thailand itself also had the population of 0.9% of the world [6]. researchers found that more than 50% of people nowadays lived in urban areas [7], in city of Bangkok (the capital city of Thailand) alone, there were more than 9.5 million citizens which were almost ten times of its past 67 years in 1950. The population of Bangkok would increase to more than 11.5 million in 2030 or the next 13 years from the prediction of worldpopulationreview [8]. From the high increase of Bangkok's population, it had been decades facing the problem of overflow garbage, rapid flood, transportation (ex. traffic congestion), pollution (ex. air and water pollution) etc. and it might face more grievously if these were not planned to cope in early. Since other big cities in Asia (such as Bangalore (India), Hyderabad(India), Rajasthan (India), Chingqing (China), Jia Ding (China), Shanghai (China), Tianjin (China), Doha (Qatar), Seoul (South Korea), Suwon (South Korea), HwaSeong DongTan (South Korea), Hong Kong, Ichikawa (Japan), Mitaka (Japan), Yokosuka (Japan), Kabul (Afghanistan), Singapore, Taipei (Taiwan), Taoyuan County (Taiwan), Tel Aviv (Israel)) had been developed for smart city strategies for more than six years [9], however Thailand had just launched the project of its first smart city this year (Thailand had the idea of smart city development since early in 2003 or 14 years ago) [10]. From a long time of hesitation, Thailand needed a guideline to develop its smart cities that meet the current needs based on its specific context from its characteristics and related factors.

## III. DEFINITION OF SMART CITY

From the description of Annalisa Cocchia (2014). It was difficult to determine the definition of smart city since the word "smart" alone was still hard to define [11]. There had been tons of the word "smart" meanings which made the word smart city was more complex to describe [11], moreover there was also tons of other smart city names: intelligent city,

knowledge city, ubiquitous city, sustainable city, digital city [11], cyberville, electronic communities, flexibility, information city, knowledge-based city, MESH city, telecity, teletopia, wired city etc [12].

Annalisa Cocchia (2014) found from her research in 2014 that most common words for smart city were "smart city" and "digital city" and the perception of people to smart city was the smartness of a city [11]. Paolo Neirotti et al (2014) termed the concept of smart city as enhancing the quality of life of citizens [22]. From their research, it found that there was no rigid definition of smart city since the trends of technology had been changing always [22]. To predict smart city model and definition, it should be predicted from a global trend of technology [22].

To understand smart city definition better, initially understand the word "smart" was one of the important method since the word "smart" was hard to define with its tons of meaning, as it was mentioned in the previous chapter. Taewoo Nam & Theresa Pardo investigated the meaning of "smart" from the context of smart city [9]. They found that in user perspective the word "smart" was more than just only intelligent, however, it represented "user-friendly" [9]. Smart city from users perception was a city that could adapt itself to their needs and customized ability [9]. However, in the other field, the word "smart" was represented differently. For example, urban planning field saw it as "Strategy"; the smart of the city represented on policy, strategy and program to

sustain city's development [9]. In the perception on technological aspect itself, the word smart represented on automatic computing like self-configuration, self-healing, self-protection, and self-optimization [9]. This term influencing the adoption of sensed and connected devices, it had been developed from small size of area and community to bigger ones from smart home, smart building, smart university, smart airport to smart city [9].

From that reasons above, smart city became more and more important to policy makers. From Paolo Neirotti research, they found that there were two main characters of smart city. The first character looked city as a factory for life or a machine to living in [22]. In this character, ICT was a center of a city and represented the word "hard" [22]. The second character allowed more bottom-up approaches of citizens to access data and make decisions [22]. In this character, ICT played more limited role and was called "soft" [22].

However, it would be hard for policy makers or cities managers to take their action on smart city strategies without an proper guideline [22]. Cities in nowadays were complex due to the massive numbers of citizens, businesses, transportations, networks, and services [22]. Since the trend of population growth which would rise the number of urbanization, cities tended to be more and more complex [22]. This would later have caused problems of traffic, pollution, and social that several cities in nowadays had already and currently faced [22]

#### Terms of Smart City from Literature

Author	Year	Term
Robert E. Hall	2000	A city that maintain making use of advanced, integrated materials, sensors, electronics and networks on computerized systems of databases, tracking, and decision making.
Robert E. Hall	2000	A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.
H. Partridge	2004	A city where the ICT strengthen the freedom of speech and the accessibility to public information and services
Giffinger et al.	2007	A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.
P. Rios	2008	A city that gives inspiration, shares culture, knowledge, and life, a city that motivates its inhabitants to create and flourish in their own lives

Forrester (Washburn et al)	2010	The use of smart computing technologies to make the critical infrastructure components and services of a city - which include city administration, education, healthcare, public safety, real estate, transportation, and utilities - more intelligent, interconnected, and efficient
Harrison et al.	2010	An instrumented, interconnected, and intelligent city. Instrumentation enables the capture and integration of live real-world data through the use of sensors, kiosks, meters, personal devices, appliances, cameras, smart phones, implanted medical devices, the web, and other similar data-acquisition systems, including social networks as networks of human sensors. Interconnected means the integration of those data into an enterprise computing platform and the communication of such information among the various city services. Intelligent refers to the inclusion of complex analytics, modeling, optimization, and visualization in the operational business processes to make better operational decisions.
From users' perception (Taewoo Nam & Theresa Pardo)	2011	A city that adapt itself to the user needs and to provide customized interfaces.
From urban planners' perception (Taewoo Nam & Theresa Pardo)	2011	A city that has new policies, strategy and programs for targeting sustainable development.
NRDC (Natural Resources Defense Council)	2011	A city striving to make itself "smarter" (more efficient, sustainable, equitable, and livable)
Rob Kitchen	2013	A city that was composed and monitored by pervasive and ubiquitous computing, and driven by innovation creativity and entrepreneurship enacted by smart people.

#### Important Factors for Smart City

Author	Year	Positive Important Factor
Forrester	2010	Smart Computing (A new generation of integrated technology that provide real-time awareness and analysis of the real world)
Taewoo Nam & Theresa Pardo	2011	Technology, Management and Policy (Technology, People and Institutions)
Nathalie Mittion et al.	2012	IoT and Cloud
Rob Kitchen	2013	Big Data Technology
Luis Sanchez	2014	IoT and Internet Service
Joing Jin et al.	2014	Cloud based IoT
Paolo Neirotti	2014	ICT and Policy

#### IV. INTERNET OF THINGS

From the rapid development and application of worldwide ICT, that made number of powerful devices such as smartphones, sensors, household appliances, RFID etc [16]. These had been developed for the service of SAaaS (Sensing and Actuation as a Service) [16]. The SAaaS service needed the connection between Sensor and Cloud, which IoT came as the intermediary or a bridge between those two [16]. From the

prediction that connected devices would be reach to 30 billion in 2020 or the next 3 years and to 50 billion in 5 years or 2023 [23] made IoT to seemingly become more important [16].

From Nathalie Mittion et al. (2012) research, they found that the factor that support the evolution of IoT were people's devices. Smartphones contain sensors, It also compute, share, and access data [16]. This made a new trend of Participatory or Mobile Crownsensing which change people's everyday lives to the lives of social networks [16].

The distinctive point of IoT on smart city was the ability to manage real-time data that can interact, share and combine data and services automatically [23]. For the so called "analog city", the traditional cities that operate or manage their cities on traditional ways would gain huge benefit from IoT adoption [23]. The benefit was from the possibility on efficient connection, integration and utilization of city's information [23].

#### V. DEBATES ON THE TECHNOLOGY FACTOR IN SMART CITY

Even the trend of using technology such as IoT, faster and more broadcast internet, Big Data, Cloud etc. had been dominated for decades. However, there had been a doubt on that technology alone might not be a main factor to solve the current cities' problems [22]. There had been debates on that topic and the results found that just equipped ICT systems to cities did not guarantee their successes and performance of smart city [22]. This was because technology still needed

humans to apply for smart cities [22]. Technology, for example ICT, was the general purpose for smart city development (Bresnhan and Traitenberg, 1995) [22]. The same systems might be applied to different cities; however, the patterns of usage quite be different due to the different needs and conditions on each city's/local's context [22].

## VI. GOVERNMENT POLICIES

Government policies could be an important factor equaled to technology factor, since the technology needs human to manage, operate and apply its usages [22]. Government policies were able to increase city's capacity on education and innovation [22]. On education side, government could support more on technology learning to make people be comfortable on using new technologies which also raise their quality of lives. However, education alone was not complete, innovation strategies on supporting investors, entrepreneurs and start-up companies were also important to the development and sustainability of smart city [22]. Government was a main factor behind smart of a city on its performance on generating innovations and applied them to its local [22].

## VII. OUTPUTS OF SMART CITY

From previous researches, they had been found that smart city was be able to optimize the use and exploitation of both tangible and intangible assets of a city [22].

## VIII. LIST OF THE OUTPUTS OF SMART CITY

Type of Output Asset	List of assets
Tangible Asset	Transport Infrastructures, Energy Distribution Networks, Natural Resources
Intangible Asset	Human Capital, Intellectual Capital, Organizational Capital

## IX. SMART CITY IN THE CONTEXT OF THAILAND

The debates in past 10 years on smart city found that there was not an only unique paradigm for smart city development. The reason behind that was there were different needs in different cities. Thai government had planned for a smart city development since 2003, however, the project had just been shown up last year in 2016 [10]. Thai government chose Phuket to be the first smart city project of Thailand and called "Phuket Smart City Project"[10]. From the timeline of the project, Phuket was expected to be a smart city in the next 3 years in 2020 [24]. The reason behind the smart city project was the Digital Economy Policy the project would be developed for a better smart digital service in the city as well as encouraging the development of digital industry in the country, this would support the bigger plan of Thai government to become a digital services hub of ASEAN region and be more connected with the global digital business to drive domestic digital industry [24].

Phuket city was the capital of Phuket Province which was an island in Thailand [26]. The province covered 2 subdistricts (Tambon) with the area of 12 square kilometers [26]. Phuket was one of the oldest cities in Thailand as an important port in the south [27]. Phuket had been officially city status since 2004 [27].

Information from Phuket Statistic Office, shown that in 2015 Phuket city had the population of 235,311 [28] which was a small town. From Paolo Neirotti (2014), the small size city with low population was good for a pilot project, less population mean less amount of technology installation, public utility supply and management. The disadvantage of a small-size city was less population mean less data and investment opportunities. However, since Phuket had been one of the most tourist attraction cities in Thailand with tons of tourists and lots of money flow in the city, this could wipe the disadvantage factor of its small size out.

From the economic development aspect, Phuket had been the most tourist attraction city of Southern Thailand [29] with more than 32 million tourists in 2016 [30]; nearly haft of Thai population. The number of tourist had been increasing continually, from 2015 to 2016 the percentage of tourists was rising 8.91% [30]. From Paolo Neirotti (2014), this was a positive factor for smart city development when local economy was high [22]. Including the budget to be a smart city from government, the city's budget could be provided for new and better transportation, utility, telecommunication and education. In addition, increasing standard of local people' lives which was one of the important factor for smart city (Human Capital). From Paolo Neirotti (2014), Human Capital was a very important for being an active contributor to the developmental stage of smart city [22]. It drove the development of new technological tools to improve urban life [22].

In the aspect of technology development, SIPA (which was currently Depa (Digital Economy Promotion Agency)) had established Phuket Smart City Innovation Park as a place to promote innovation development, learn technology, consult on digital business [24]. From the Phuket development plan of 2015 - 2018, technology development was one of a focusing factor as well [29][31]. Smart city of Phuket was one of the governmental model for technological and digital business for initiating Digital Thailand 4.0 strategy [24]. These made Phuket currently be one of the high technology development cities in Thailand.

On the environmental policy, Phuket had developed 7Gs from its development plan for increasing quality of local's lives. The 7Gs contained of Green City, Give Society, Good Life, Growing Balance, Global Knowledge, Glass Root Focus, and Gold Medal [29]. Not only for local citizens, Thai government also took actions on developing facilities such as light sky train, international convention hall, a new road from

Katoo to Pathong, Chalong to Pathong, Ban Saku to Ban Kho Khaw, and development of the current roads [31].

## X. CONCLUSION AND FURTHER RESEARCH

From this paper's analysis, pushing forward Phuket to be the first smart city of Thailand would be a right decision of Thai government. Phuket had the proper factors to become a pilot model for smart city. The concern was the intention to keep this development from future governments. The future work should focus more on on-site data collection and opinion form experts since this research focused on only data collection from literature. The more development on smart city of Phuket is to study on the other models of tourist-attraction smart cities and how to apply them to Thailand context. In addition, the tool of technology forecasting is also important to develop in order to see the trend the future technology for planning the development of Thai smart cities in the future.

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