Citizen Engagement in a Smart City:
A Case Study of Phuket, Thailand

Phanaranan Sontiwanich

A Thesis Submitted in Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Environmental Management Technology
(International Program)
Prince of Songkla University
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I hereby certify that this work has not been accepted in substance for any degree and is not being currently submitted in candidature for any degree.

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ABSTRACT

Citizen engagement is a crucial strategy in smart city development. This study highlights how citizen engagement contributes to smart city initiatives and outcomes. The study examined how smart city projects worldwide engaged citizen and dug deeper into the citizen engagement process using Phuket, Thailand as a case study.

The research used a pragmatic approach comprising of a desktop research, observations, semi-structure interviews and surveys. The data included 123 articles on Scopus documents between 2014 and 2019 with updated documents in 2021,17 official smart city websites, observation notes from 49 Phuket smart city and related meetings, 12 stakeholder interviews and 409 questionnaires collected during April to September 2018.

The findings compose of five parts following five research questions. The first question on citizen engagement as part a characteristic of a smart city is addressed through causal loop diagrams of citizen engagement in a smart city framework and its subsystems. The second question on the usage of open data platforms in relation to citizen engagement highlights four main purposes namely environmental monitoring and management, city data service, citizen feedback, and citizen support and empowerment. The third question analyzes and classifies the citizen engagement strategies from 17 smart cities before and after the COVID-19 pandemic. The fourth question describes how citizen engagement was perceived and contributed to the evolution of Phuket smart city development. The last question shows the level of awareness and engagement of Phuket residents in Phuket smart city. The study concludes that active citizen engagement requires participatory governance and collaborative culture of all stakeholders, especially

youth, elderly and marginalized groups in order to ensure smart city implementation that is inclusive and socially. Meaningful efforts to improve the trust and interactive communication between city administrators and citizen need to be prioritized as a central process guiding the smart city planning and development.

Keywords: Civic culture, social capital, public-private-people partnership, sustainable development, urban sustainability

ชื่อวิทยานิพนธ์ การมีส่วนร่วมของประชาชนในสมาร์ทซิตี้: กรณีศึกษา จังหวัดภูเก็ต, ประเทศไทย
ผู้เขียน นางสาวพณรนัรช์ สนธิวานิช
สาขาวิชา เทคโนโลยีการจัดการสิ่งแวดล้อม (หลักสูตรนานาชาติ)
ปีการศึกษา 2564

บทคัดย่อ

'การมีส่วนร่วมของภาคประชาชน' คือ กลยุทธ์ที่สำคัญในการพัฒนาสมาร์ทซิตี้ การศึกษานี้ให้ความสำคัญต่อการมีส่วนร่วมของประชาชนในการริเริ่มและผลสัมฤทธิ์ของโครงการสมาร์ทซิตี้โดยใช้การวิเคราะห์แนวทางการมีส่วนร่วมของภาคประชาชนในโครงการสมาร์ทซิตี้ของเมืองต่างๆทั่วโลกและวิเคราะห์เชิงลึกของกระบวนการสร้างการมีส่วนร่วมของภาคประชาชนโดยใช้จังหวัดภูเก็ตในประเทศไทยเป็นกรณีศึกษา

งานวิจัยนี้ได้ประยุกต์ใช้การวิจัยเชิงคุณภาพและปริมาณ ซึ่งประกอบด้วย การค้นคว้าเอกสาร การสังเกตการณ์ การสัมภาษณ์กึ่งโครงสร้าง และ การทำแบบสำรวจ ข้อมูลที่ประกอบด้วยบทความในฐานข้อมูลวารสารระดับนานาชาติ (Scopus) รวมทั้งสิ้น 123 บทความซึ่งตีพิมพ์ในระหว่างปี พ.ศ. 2557 ถึง 2562 และค้นหาเพิ่มเติมในปี พ.ศ. 2564 เว็บไซต์อย่างเป็นทางการของสมาร์ทซิตี้จาก 17 เมืองทั่วโลก บันทึกจากการสังเกตการณ์ในการประชุมภูเก็ตสมาร์ทซิตี้และงานประชุมที่เกี่ยวข้อง 49 ครั้ง การสัมภาษณ์เชิงลึกของผู้มีส่วนได้ส่วนเสีย 12 คน และแบบสอบถามจำนวน 409 ชุด ซึ่งดำเนินการในระหว่างเดือนเมษายน ถึง กันยายน พ.ศ. 2561

ผลการศึกษาแบ่งออกเป็น 5 ประเด็น ซึ่งเชื่อมโยงกับคำถามงานวิจัยหลัก 5 ข้อ ดังนี้ ส่วนแรก แสดงให้เห็นว่าการมีส่วนร่วมของภาคประชาชนเป็นส่วนสำคัญของสมาร์ทซิตี้ โดยใช้การวิเคราะห์เชิงระบบ ซึ่งอธิบายผ่านแผนภาพความเชื่อมโยงเหตุและผลของปัจจัยที่เกี่ยวข้องกับสมาร์ทซิตี้ ส่วนที่สอง แสดงให้เห็นถึงการใช้ฐานข้อมูลแบบเปิดเพื่อให้เกิดการมีส่วนร่วมของภาคประชาชนซึ่งมี 4 รูปแบบหลัก คือ การเฝ้าระวังและจัดการสิ่งแวดล้อม ข้อมูลเกี่ยวกับเมือง การสะท้อนความคิดเห็นของประชาชน และ การสนับสนุนและเพิ่มอำนาจให้กลุ่มเปราะบาง ส่วนที่สาม แสดงกลยุทธ์การสร้างการมีส่วนร่วมของภาคประชาชนในสมาร์ทซิตี้ 17 เมือง ทั่วโลกทั้งก่อนและหลังการระบาดของโรค COVID-19 ส่วนที่สี่ แสดงถึงการดำเนินการสร้างการมีส่วนร่วมของภาคประชนในแนวทางการพัฒนาภูเก็ตสมาร์ทซิตี้ และ ส่วนสุดท้าย แสดงระดับความตระหนัก

และการรับรู้ในการมีส่วนร่วมของประชาชนในจังหวัดภูเก็ตต่อภูเก็ตสมาร์ทซิตี้ งานวิจัยนี้สรุปได้ว่าการมีส่วนร่วมของภาคประชาชนในการพัฒนาสมาร์ทซิตี้จำเป็นจะต้องได้รับการสนับสนุนจากการบริหารจัดการของภาครัฐแบบมีส่วนร่วมและการสร้างวัฒนธรรมการมีส่วนร่วมจากทุก ๆ ภาคส่วนที่เกี่ยวข้อง โดยเฉพาะอย่างยิ่งในกลุ่มเยาวชน กลุ่มผู้สูงอายุ และ กลุ่มชุมชนชายขอบ เพื่อให้เกิดสมาร์ทซิตี้ที่ส่งเสริมความเท่าเทียมกันในสังคม นอกจากนี้การสร้างความไว้ใจและปฏิสัมพันธ์ระหว่างหน่วยงานภาครัฐและประชาชนยังเป็นปัจจัยสำคัญที่ควรได้รับการส่งเสริมมากขึ้นในการวางแผนและการพัฒนาสมาร์ทซิตี้

คำสำคัญ: วัฒนธรรมพลเมือง, ทุนทางสังคม, ความร่วมมือภาครัฐ-เอกชน-ประชาชน, การพัฒนาอย่างยั่งยืน, ความยั่งยืนของเมือง

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LIST OF ABBREVIATIONS AND SYMBOLS

AFNC	Anti-Fake News Center
AIT	Applied Information Technology
AR	Augmented Reality
BBC	British Broadcasting Corporation
BOI	Board of Investment
CAT	Communications Authority of Thailand Telecom Pub Co., Ltd
CCTV	Closed-Circuit Television Analytic System
CECC	Central Epidemic Command Center
CLD	Causal Loop Diagram
CODE	Center of Digital Excellence\
DEPA	Digital Economy Promotion Agency
DL	Digital Literacy
DI	Directly Interview
EOC	Emergency Operations Center
EU	European Union
FP	Framework Programmed
FWMOM	Foreign Worker under the Ministry of Manpower
HKBU	Hong Kong Baptist University
IBM	International Business Machines Corporation
ICT	Information and Communication Technology
IDT	Innovation Diffusion Theory
IEE	Intelligent Energy - Europe

LIST OF ABBREVIATIONS AND SYMBOLS (Cont.)

IFC	International Finance Corporation
IMD	Institute for Management Development
IOP	Internet of People
IOT	Internet of Thing
ISO	International Standardization Organization
IT	Information and Communication Technology
KKTT	Khon Kaen City Development
KPI	Key Performance Indicator
LAOs	Local Administration Organizations
LRT	Light Rail Transit
MDE	Ministry of Digital Economy and Society
MICT	Ministry of Information and Communication Technology
MIL	Media and Information Literacy
MM	Motivational Model
M2M	Machine to Machine
MOU	Memorandum of Understanding
MPCU	Model of PC Utilization
NECTEC	National Electronics and Computer Technology Center
NII	National Information Infrastructure
NITC	National Information Technology Committee
NNT	National News Bureau of Thailand
NSTDA	National Science and Technology Development Agency
Obs	Observation

LIST OF ABBREVIATIONS AND SYMBOLS (Cont.)

OGD	Open Government Data
OPTs	Online Participation Tools
OTA	Online Travel Agent
PAO	Provincial Administrative Organization
PKCD	Phuket City Development Co., LTD.
P2M	People to Machine
PPO	Phuket Provincial Office
PPPs	Public-Private Partnerships
PRD	Public Relations Department
PSU	Prince of Songkla University
QoL	Quality of Life
R&D	Research and Development
RQ	Research Question
SAO	Subdistrict Administrative Organization
SC	Smart City
SCPs	Smart City Projects
SCT	Social Cognitive Theory
SMC	Surat Municipality Corporation
SUD	Sustainable Urban Development
SETIS	Strategic Energy Technologies Information System
SIPA	Software Industry Promotion Agency (Public Organization)
Sq.km	Square Kilometer
TAM	Technology Acceptance Model

LIST OF ABBREVIATIONS AND SYMBOLS (Cont.)

TAT	Tourism Authority of Thailand
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UCLG	United Cities and Local Governments
UNDP	United Nations Educational, Scientific and Cultural Organization
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
UTAUT	Unified Theory of Acceptance and Use of Technology
VR	Virtual Reality
WEF	World Economic Forum

CHAPTER 1
INTRODUCTION

This chapter presents the rationale of the research. It describes the significance and the objectives of the study. It starts with the introduction which provides the background of smart city concepts, the examples of smart cities worldwide, the initiatives in Thailand as well as their implications on the development of the cities. This is followed by the research objectives, scope, outputs, and questions.

1.1 Introduction

A 'smart city' has frequently been mentioned in urban planning, trade, energy, economic, academic and various disciplines in the last two decades (AlAwadhi, *et al*., 2012; Perboli, *et al*., 2014; Albino, *et al*., 2015). The smart city concept attempts to promote sustainability and the betterment of quality of life for the citizen using the technology (Lazaroiu and Roscia, 2012; Angelidou, 2015; Bouzguenda, *et al*., 2019). The challenge of a smart city is its implementation to achieve the most appropriate and optimal outcomes in reality. Although the advanced information and communication technology assumingly promotes the 'smartness' of the cities, there are several factors that play an important role in making the cities smart and sustainable. Furthermore, the cultural context in which the implementation of technology and innovation take place must be recognized within the sustainable urban development (SUD) field (Allam and Newman, 2018; Kagan, *et al*., 2018).

While there is a plethora of literature on smart city, many studies focus on the technologial applications or the 'hardware'. There is a lack of the scholarship into the 'soft' aspect or the intangible factors of smart city development especially culture, social values, citizen engagement, human values and how they shape smart city implementation. Communication technology such as an open data platform and public

Wi-Fi have a great potential to empower citizen to influence management and problem solving. Nevertheless, an effective use of digital tools cannot be guaranteed without an appropriate public education and positive participatory culture in the society. The technological solutions to city problems are often proposed or implemented based on the assumption that user engagement and adoption will eventually follow. However, the reality has shown that technology alone cannot solve complex issues and is almost always related to diverse groups of stakeholders (Green, 2019 and Liete, 2022). This highlights the need for more attention and research into the characteristics of the human and social capital of a smart city.

This study examines if the smartness of a city is influenced by the quality of citizen engagement in its planning and implementation. The study also explores how the smart city initiatives worldwide have engaged their citizens in smart city initiatives. Finally, the study investigates whether societal values and demographic factors have influence on the extent of citizen engagement in smart city development using Phuket, Thailand as a case study.

Thailand presents an opportunity for an examination of smart city development in a non-western country. Many previous studies in the field have focused on European cities while those outside of European region were mainly on smart cities in Indonesia, Japan, China and Australia (Mayangsari and Novani, 2015; Nakano and Washizu, 2021; Yang and Chong, 2021; Yigitcanlar, *et al*., 2021). This research into Thai's implementation of a smart city concept enriches the smart city discourse by providing an insight from a different cultural and geographical setting.

Thailand's smart city initiative was first mentioned in the second Thailand's Information and Communication Technology (ICT) Master Plan (2009 - 2013) by the Ministry of Information and Communication Technology (MICT) which was later named the

Ministry of Digital Economy and Society or MDE[1]. The 'Smart Thailand'[2] project aimed to promote the use of ICT and societal development following the principles of the sufficiency economy philosophy[3] to achieve a sustainable economy and innovation-based society (MICT, 2009; Prachathai, 2016). This concept continues in the draft of the third Thailand ICT Master Plan (2014 - 2018) which follows the roadmap of smart Thailand 2020 towards a 'Digital Society' (MICT, 2014). In 2015 following the digital economy and society development plan, Thailand Board of Investment (BOI) identified two provinces; Phuket and Chiang-Mai, the southern and Northern Province in Thailand respectively, as the 'Digital Economy Cluster' (Thailand BOI, 2015). In 2016, Thailand Cabinet declared the 20-Year National Strategy, 'Thailand 4.0', aiming for the national economic transformation to 'Value-Based Economy' (The Government Public Relations Department or PRD, 2016). Software Industry Promotion Agency (Public Organization) or SIPA (which was later changed to Digital Economy Promotion Agency or DEPA[4]) was the key facilitator in developing a road map for the 'Digital Thailand' policy in terms of a digital economy and a digital society (SIPA, 2015a; Smart Cities Councils, 2016). At global level, Thailand was ranked 38th from 120 countries in terms of global competitiveness index or GCI 4.0 by World economic forum (WEF) 2018 and 39th from 63 cities by International Institute for management development (IMD) 2018 for world digital competitiveness (Digital government agency (Public organization), 2019).

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[1]The Acts of Improvement of the Ministry, Department, Bureau (No. 17) 2016 announced the change of MICT to the Ministry of Digital Economy and Society. The new ministry has five public organizations; i) Office of the Minister ii) Office of the Permanent Secretary Ministry iii) Thai Meteorological Department iv) Office of the Council for Digital Economy and Society v) National Statistical Office (Prachathai, 2016).

[2]MICT officially launched the 'Smart Thailand 2020' vision on the second Thailand ICT Master Plan (2009-2013) to achieve the target of the National Economic and Social Development Plan. It is divided into 3 missions; 'Smart Business' to enhance the knowledge of ICT workforce, 'Smart Network' to speed up ICT network, and 'Smart Government' to provide suitable ICT for better governance (MICT, 2009).

[3]The Thai philosophy based on Buddhist principles was introduced by Majesty King Bhumibhol Adulyadej in 1997 to use sustainable development to cope with the economic crisis from globalization (Warr, 2007).

[4] The Royal Thai Government Gazette announced the change of SIPA to Digital Economy Promotion Agency or DEPA on January 24th, 2017 (DEPA, 2017).

The appropriateness of Phuket as a case study was supported by the national Thai government policy which chose the province as to be a pilot smart city. The selection was based on its readiness and suitability for 'Digital Hub' investment in the future (MICT, 2015; Smart Cities Councils, 2016). Five key domains for Phuket's smart city development were identified namely i) hard infrastructure, ii) soft infrastructure, iii) service infrastructure, iv) digital economy promotion, and v) digital society to develop the e-commerce, e-education, e-industry, and also e-government center (The Nation, 2015). Despite the establishment of the Phuket smart city committee in 2015, there is still a lack of clarity whether the smart city initiatives sufficiently engaged with the local stakeholders and would bring benefits to the local people. This research is based on the notion that a high quality, multi-stakeholder collaboration and citizen engagement is needed to support and sustain the smart city projects.

The uniqueness of this study is its exploration into the socio-cultural aspects of a smart city which remain a gap in smart city framework (Allam and Newman, 2018). Cities are influenced by societal values, livelihood and governance which presents both challenges and opportunities for a smart city initiative. Phuket is an important example that showcases how a city mainly known as a tourist destination in a non-western context evolves following smart city development concepts. This study presents the smart city vision and implementation through the interpretation of Thai and Phuket policy makers, authorities, businesses and citizens. It examines how the application of the information technology influences the citizen engagement in the city problem solving or vice versa. The research aims to deepen the understanding of citizen engagement in smart city development and identify the approach in which digital transformation can contribute to a more engaged society. Furthermore, the study explores the interactions between cultural values, personal attitudes and social behaviors and the citizen roles in the smart city activities.

1.2 Objectives

This research has four objectives.

1.2.1 To review citizen engagement approaches in smart cities.

1.2.2 To identify citizen engagement strategies used in smart cities worldwide for environmental and urban problem solving.

1.2.3 To investigate the citizen engagement strategies of the Phuket smart city initiatives.

1.2.4 To examine the socio-cultural characteristics that influence the citizen engagement in Phuket smart city initiatives.

1.3 Scope

1.3.1 Area: The primary data collection focuses the areas with the smart city projects (SCPs) in Phuket. For secondary data, smart city websites from criteria-based internet search are used.

1.3.2 Methods: This research applies both quantitative and qualitative data collection methods including web-based search, document analysis, interviews and surveys.

1.3.3 Population: This research uses two population samples. The first group focuses on the key actors of Phuket smart city initiatives, and the second group emphasizes on Phuket residents.

1.3.4 Time: This research collects data from 2016 – 2021.

1.4 Research outputs

The research presents the lessons learned from the smart city projects worldwide and highlights citizen engagement strategies that can be adapted to suit different citizen needs. The insights from Phuket smart city implementation can be used

to identify success factors and potential shortfalls of smart city initiatives with similar settings and support managers in improving the project implementation.

1.5 Research questions (RQs)

Five main RQs and associated sub-questions were identified.

RQ 1 Is citizen engagement a characteristic of a smart city?

This question explores whether citizen engagement is part of the smart city strategies.

RQ 2 What is the role of open data platforms and digital transformation in citizen engagement?

This question examines the effect of an open data platform and digital transformation on citizen engagement.

RQ 3 How do smart cities worldwide engage with citizens in solving environmental and urban problems?

This question aims to understand how the citizen engagement strategy relates to how a city solves environmental and urban problems.

RQ 4 How does Phuket smart city initiative influence citizen engagement in solving Phuket problems?

This question analyses the ways in which the smart city development in Phuket affects the citizen engagement and their contributions in solving the problems of Phuket.

RQ 5 How does socio-cultural context influence the citizen engagement in Phuket's attempt to become a smart city?

This question explores how the cultural values, personal attitudes and social behaviours affect the citizen engagement of smart city development in Phuket. It aims to interpret the attitudes of the citizens including needs and expectations towards the smart city initiatives

This research is presented into five chapters. The diagram the linkages between each chapter is illustrated in Figure 1.1. Chapter 1 presents an introduction of

the dissertation, which consists of rationale of the research, objectives, scope, research outputs and research questions. Chapter 2 is a literature review which gathers theories, concepts and background of relevant knowledge to the study from various fields. Chapter 3 shows the main methodology used in the research. Chapter 4 contains the findings from data collection and analyses which are organized in relation to 5 research questions and emerging events. The last chapter provides discussion and conclusion that addresses the research questions and highlight the contribution to knowledge and real-world application of the study.

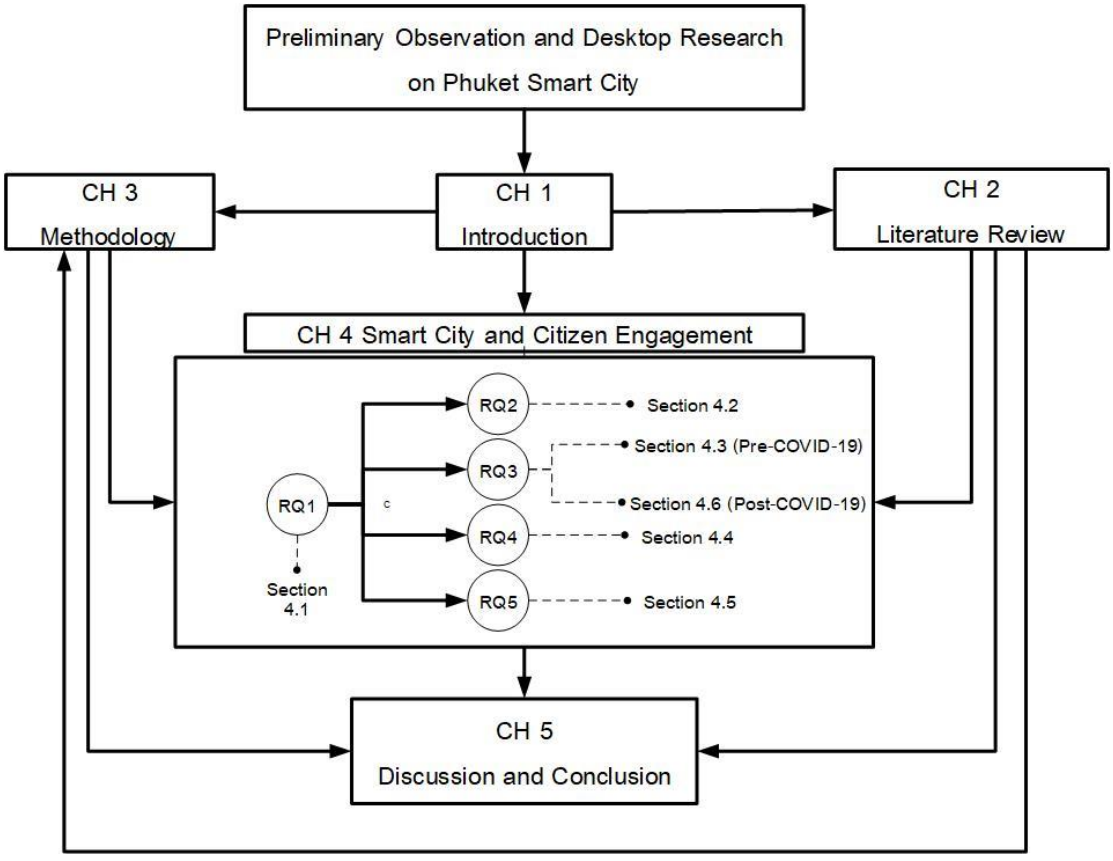

Figure 1.1 Chapter stucture

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CHAPTER 2
LITERATURE REVIEW

This chapter reviews the concepts, theories, and relevant documents related to smart cities. Both paper-based and electronic resources from journals, webpages, and organizations which were related to the smart city projects were explored and reviewed. The chapter is organized into four parts featuring i) the smart city theory and implementation, ii) citizen engagement in smart city context, iii) culture, attitude and technology and iv) Phuket, a smart city in Thailand.

2.1 Smart cities: theory and implementation

2.1.1 Theoretical background and components of the smart city concept

2.1.1.1 Evolution of the smart city concept

The smart city concept began to gain popularity in the late 1990s from the 'smart growth' notion which integrated information technology (IT) with new urban management (Harrison and Donnelly, 2011). The idea has generated several alternative discriptors including cyber city, information city, digital city, intelligent city, virtual city, ubiquitous city, creative city and knowledge city (Schaffers, *et al*., 2011; Lee, *et al*., 2014; Albino, *et al*., 2015). These terms were used varyingly depending on the scope, interest and context (Mattoni, *et al*., 2015). Despite the diverse terminologies and interpretations, the general principle of smart city aimed to make a city more sustainable using the modern, intelligent technological tools such as ICT services to improve citizens' quality of life by increasing economic opportunities, energy and resource provision, as well as citizen engagement (Caragliu, *et al*., 2009; Perboli, *et al.,* 2014; Digiesi, *et al*., 2015; Quwaider, *et al*., 2016).

2.1.1.2 Smart city components

Multiple studies have described the components of a smart city. The European Union (EU) identified six dimensions consisting of smart economy, smart governance, smart mobility, smart environment, smart people, and smart living (Giffinger, *et al*., 2007). Leydesdorff and Deakin (2011) proposed the triple-helix model which emerged from the knowledge-based innovation system consisting of i) university, ii) industry and iii) government. Nam and Pardo (2011) divided the concept into three characteristics of technology (hybrid, information, ubiquitous, digital, intelligent, wired cities), people (human, creative, knowledge, learning cities) and community (smart community). Another study proposed eight factors of a smart city including i) city administration and institutions, ii) governance, iii) policy framework, iv) technology, v) physical infrastructure, vi) natural environment, vii) economy, and viii) citizen (Chourabi, *et al*., 2012). Bakici *et al*. (2013) identified the smart districts, living labs, initiatives, e-services, infrastructures and open data as the smart city components in Barcelona. Neirotti, *et al.* (2014) described two main types of a smart city which were the hard or tangible domain (i.e. healthcare, energy grids, buildings, natural resources, water and waste management, mobility and logistics) and the soft or intangible domain (i.e. education and culture, policy innovations, social inclusion, economy and government). While a smart city's emphasis on ICT applications in urban development were prevalent (Hollands, 2008; Lazaroiu and Roscia, 2012), people and community engagement remained the crucial ingredient of the emerging smart city projects (Albino, *et al*., 2015).

2.1.1.3 Indicators of smart city

The framework of a smart city was shaped by its assessment. Contrary to the notion that *'smartness is not always easily measurable'* (Lazaroiu and Roscia, 2012), numerous indicators have been proposed to assess the effectiveness of a smart city. To operationalize the concept, the city's performance should be monitored, tracked and evaluated against its goals using relevant indicators (International Standardization Organization or ISO, 2014). The focus on performance indicators of smart cities led to

several research studies and varying approaches for city benchmarking. The Seventh Framework Programme (FP7) of Research by European Commission funded a research that revealed 74 smart city indicators from 70 medium-sized European cities which were classified into six categories of i) smart economy, ii) smart mobility, iii) smart governance, iv) smart living, v) smart people, and vi) smart environment (Perboli, *et al*., 2014; Mattoni, *et al*., 2015). Lazaroiu and Roscia (2012) classified four dimensions of a smart city with 18 indicators, these dimensions are smart environment, smart economy, smart energy and mobility and also smart governance (Appendix I). Marsal-Llacuna, *et al*. (2015) identified two fields of smart cities monitoring namely i) academic field (Giffinger, *et al*., 2007 and 2009) and ii) the key performance indicators (KPI) relevant to energy consumption and demand. Although there are many options for smart city indicators, the actual measurement of these items remains challenging in practice, especially for the intangible component such as citizen engagement. An attempt to address this issue by emphasizing both the soft and hard aspect of a smart city is the framework proposed by Sharifi (2019) (See in Figure 2.1). The seven themes of a smart city namely i) economy, ii) people, iii) governance, iv) environment, v) living, vi) mobility, and vii) data and their matching indicators highlights the emerging attention on intangibles including participation in governance and the culture of the population.

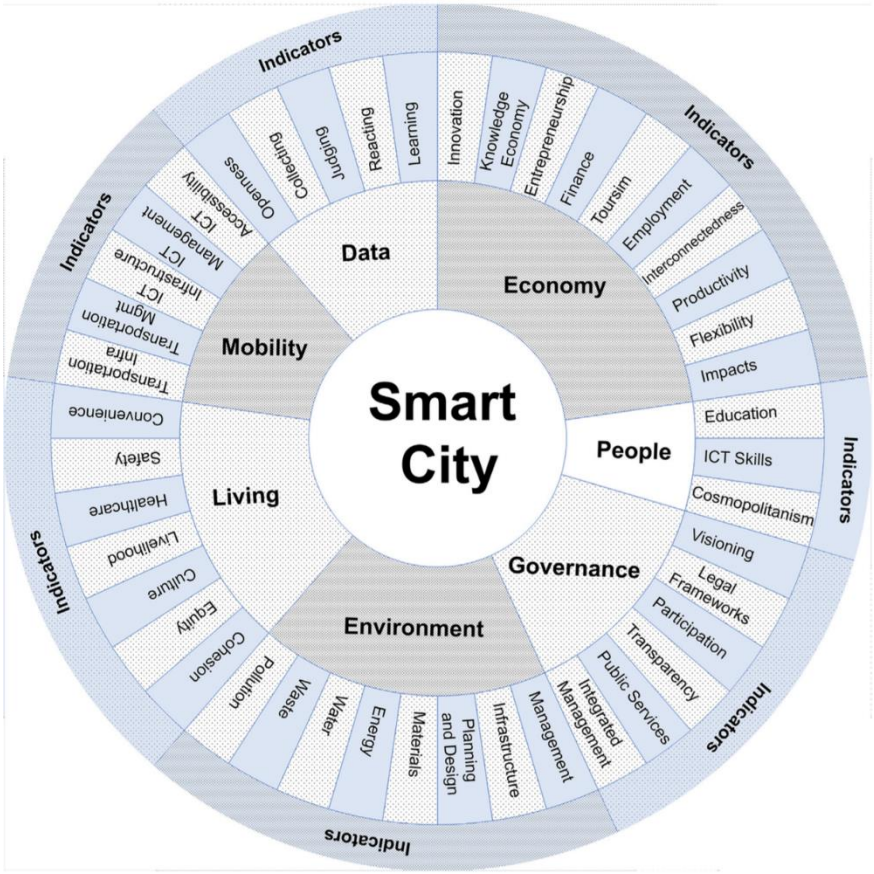


Figure 2.1 The smart city indicators (Source: Sharifi, 2019)

The city indicators for smartness and sustainability often overlap. Stratigea, *et al.* (2017) embedded smart and sustainable cities into sustainability performance. However, some studies argued that there was a different focus between smart and sustainable indicators suggesting the need to classify smart – sustainable indicators (Huovila, *et al.,* 2019). Monfaredzadeh and Berardi (2015) clarified the smart indicators as being mostly concentrated on living and people. The sustainability indicators were frequently stated to focus on environmental aspects (Ahvenniemi, *et al.,* 2017). The imbalance existed in the prioritization of these indicators both by the scholars and policy makers. The economic performance usually received more frequent mention than environmental conditions as well as the people and governance indicators (Ahvenniemi, *et al.,* 2017; Sharifi, 2019).

As the smart city concepts, components and indicators evolved and diversified so did the implementation and development projects conducted under its label.

2.1.2 Implementation of smart cities

Ideally, a smart city implementation should facilitate sustainable urban development. The concepts of 'smart city' have been highlighted as the future urban development in many countries (Hollands, 2008; Caragliu, *et al*., 2009; Staffans and Horelli, 2014) with the emphasis on sustainable development (Batagan, 2011). It aims to promote sustainability, competitiveness, growth, and mitigation of urban problems while improving the quality of life (AlAwadhi, *et al*., 2012; Roche, *et al*., 2012). Yet, there remains a debate whether smartness implies sustainability. Kramers, *et al.* (2014) and Ahvenniemi, *et al.* (2017) suggested the term "smart sustainable city" to highlighting the importance of both smartness and sustainability while Ahvenniemi, *et al*. (2017) stated that a city would be not smart if it was not sustainable. In recent years, the role of social awareness in ensuring sustainability in a city development has been highlighted (Silva, *et al*., 2018). The stance taken by the city leaders, managers and citizens regarding the interpretation of a smart city naturally influences its operationalization. The connection between the 'hard' (technology and infrastructure) and 'soft' (human, governance and social values) must be promoted and communicated to ensure a holistic understanding and implementation of a smart city framework.

The word 'smart' indicates intelligence in economic, environment, mobility, physical infrastructure, technologies and services that are supported by ICT (Caragliu, *et al.,* 2009; Bakici *et al*., 2013; Gretzel, *et al*., 2015). In fact, many cities do not use the word "smart" but other terms such as 'intelligent community' as in the cases of Chicago in U.S., Abbotsford in Canada, 'digital city' is used by Amsterdam in U.S., Kyoto in Japan, and 'creative city' by Yokohama in Japan (Ishida, 2002; Komninos, 2009; Neirotti, *et al*., 2014; the Intelligent Community Forum or ICF, 2019). Cities portray themselves using different

terms depending on the city vision and development focus (Nam and Pardo, 2011; Albino, *et al.,* 2015). It is noteworthy that while some cities highlighted the digitalization and ICTs as their key features, many highlighted creativity and intelligence as the city aspiration in which technology formed part of the tools to achieve these goals.

Early smart city initiatives were seen to aim at increasing the efficiency of resource usage. Smart city projects in European cities were announced by the Intelligent Energy-Europe (IEE) in 2003 to support clean technology investment and achieve energy sustainability (Lazaroiu and Roscia, 2012). Consequently, EU and major companies have invested in several projects to address EU 2020 energy targets (e.g. 20% reduction in greenhouse gas emissions, 20% improvement in energy efficiency and 20% of renewable in EU energy consumption) and improve the citizen's quality of life (Lazaroiu and Roscia, 2012; Perboli, *et al*., 2014). The approaches in which technology is used to improve city services and infrastructure are also influenced by technology companies. ICT companies such as International Business Machines Corporation (IBM), Cisco, Huawei, Siemens, Microsoft Corporation, Oracle, and Hitachi have offered various smart city solutions (Harrison and Donnelly, 2011; Anthopoulos and Fitsilis, 2013; Albino, *et al*., 2015). In 2008, IBM launched the vision of a smarter planet consisting of instrumented, interconnected and intelligent concepts (Paroutis, *et al*., 2014) and received the Frost and Sullivan's Global Visionary Innovation Leadership Award in 2014 (Trivedi, 2014). Meanwhile, CISCO's vision for a smart city highlighted the 'smart and connected communities' integration through internet-based functioning (Gawer and Cusumano, 2002; Elfrink, 2012).

Currently, technology vendors are provided through interconnected systems and physical gadgets such as 5G technology, Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), sensor, Internet of Things (IoT), robotics (Patel and Doshi, 2019). In the cyber blended with physical infrastructure or Cyber-Physical Convergence era, IoT is one of the challenges but plays an essential role in which humans are end users (Conti*, et al.,* 2017; Patel and Doshi, 2019). IoT has wide application in

engineering and scientific fields which are related to data building in smart city in Figure 2.2 (Silva, *et al*., 2016; Alavi, *et al.,* 2018).

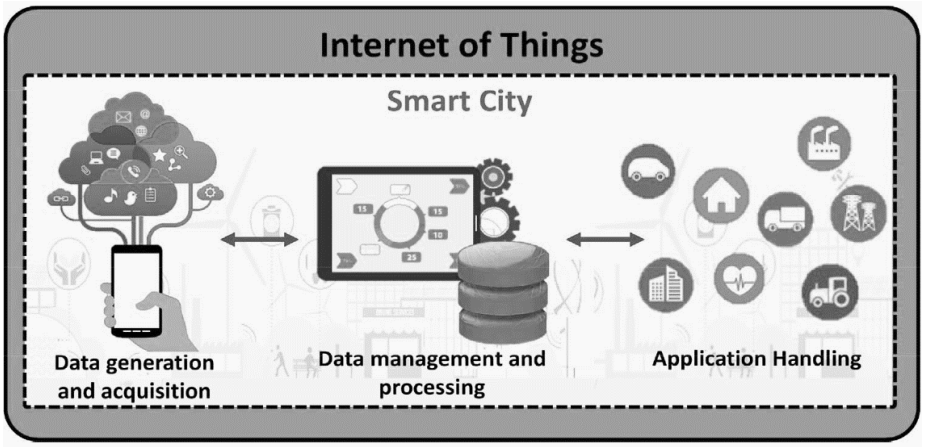


Figure 2.2 IoT involvement in the smart city (Source: Silva, *et al*., 2018)

Nevertheless, there is a shifting paradigm towards a human centric perspective in which the users of the technology and their interactions with their devices are central to data management (Conti*, et al.,* 2017, Conti and Passarella, 2018). This is called the Internet of People or IoP (See in Figure 2.3). Carpintero, *et al*. (2015) highlighted the notion that IoT should be transformed towards IoP which attempt to increase the interaction between IoT and people through their devices.

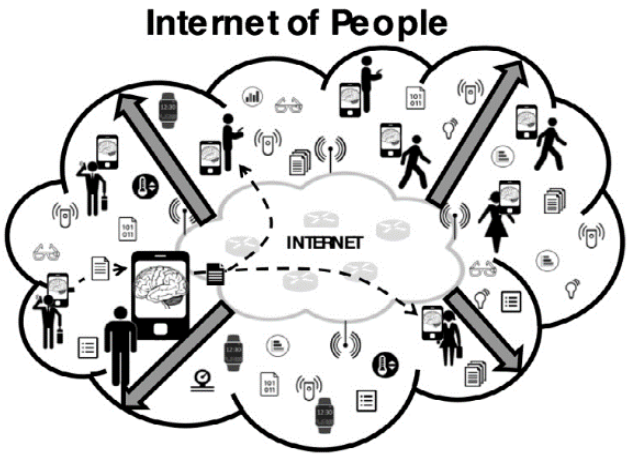


Figure 2.3 The IoP (Source: Conti, *et al*., 2017)

Although technological advancement can enhance the city efficiency and productivity, the importance of the intangible aspect such as human capital cannot be overlooked (Mattoni, *et al.,* 2015). Active citizen involvement is fundamental to the smart city implementation (Vassileva *et al*, 2016). While, an inclusive smart city focused on citizen-centeredness which was integrated between a various group of smart city services and citizens as shown in Figure 2.4 (de Oliveira Neto, 2018).

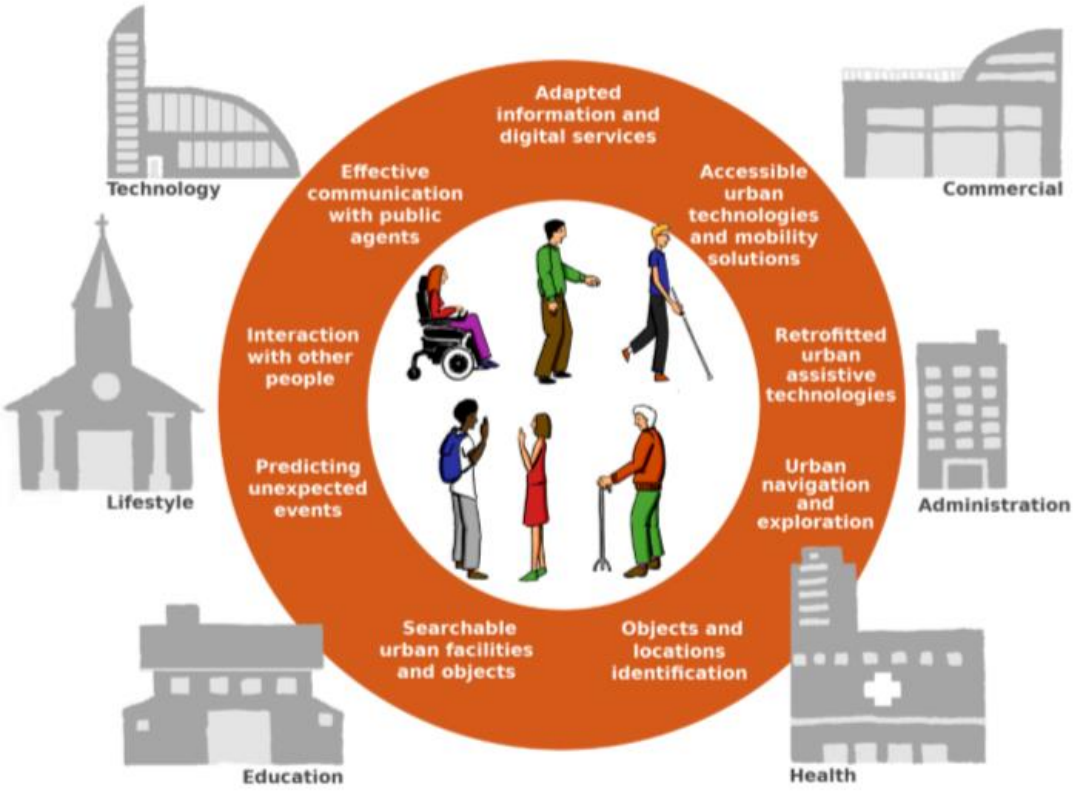


Figure 2.4 Inclusive smart city vision (Source: de Oliveira Neto, 2018)

2.2 Citizen engagement in smart city context

2.2.1 Citizen engagement definition and significance

Public participation and civic engagement in urban planning have been recognized as enhancing urban decision making (Davies, *et al*., 2012). Citizen engagement is a vital component of smart cities while ICTs act as the facilitating tools for participation (Benoit and Hiroko, 2016). The relationship between the government and citizen is key to effective citizen engagement. This can be promoted through the two-way exchange of information between the local government which provides support for the communication and the citizens who actively participate in the city matters (Dobos and Jenei, 2013). The use of online instruments and ICT tools can help local and central authorities cultivate and promote citizen engagement (Hand and Ching, 2011; Jones, *et al*, 2007; Haro-de-Rosario, *et al*. 2018). For example, cities can use ICT to provide reliable information, inform about public events, facilitate networking, and increase transparency and stakeholder participation in city governance. Nonetheless, there are limits to how meaningful ICT will actually be used by the citizens. Technology adoption and usage behavior of an individual depend on multiple factors including age, education, profession, digital literacy, and an interest (Talukder, 2012). Falco and Kleinhans (2018) argued that the poor proficiency in technology may not be the reason for unsuccessful citizen engagement suggesting that technology alone could not be blamed for the lack of engagement.

Although the terms engagement and participation are often used interchangeably, a debate remains on the detail about the differences between them. Engagement highlights more active investment and effort, whereas participation often refers to more passive involvement such as attendance size rather than the quality of the experience (Squiers, 2015). Often the initiation of engagement is seen as a top-down approach while participation suggests a bottom-up approach (Garrigues, 2019). For defining classification, engagement emphasizes willingness and participation created

motivation, but not forced (Davies and Simon, 2013). Hoffman, *et al.*, 2005 stated the importance of engagement over participation because it requires a higher level of involvement rather than a mere attendance or presence. Some studies have used the terms interchangeably (UNDP Global Centre for Public Service Excellence, 2016). It is noteworthy that many participation models were developed from the citizen participation ladder (Arnstein, 1969). Tadili and Fasly (2019) mentioned citizen participation as an essential portion of smart city development in terms of consumer, user, source of data and feedback, and decision-maker. The map of policy participation was designed by Bishop and Davis (2002) which described public participation ranging from minimum to maximum involvement in policy making (Figure 2.5).

Minimum participation → Maximum participation

Information	Consultation	Partnership	Standing	Consumer choice	Control
▪ Survey ▪ Focus group ▪ Public information campaign	▪ Key contact ▪ Town hall meeting ▪ Interest Group meeting ▪ Public hearing	▪ Citizen advisory committee ▪ Policy community forum ▪ Public enquire	▪ Open and third party court standing ▪ Review court and tribunal	▪ Competition between supplier ▪ Voucher ▪ Case management	▪ Referendum ▪ Electronic voting

Figure 2.5 Map of policy participation adapted from Bishop and Davis (2002)

Simonofski, *et al*. (2017) illustrated an evaluation framework of citizen participation (Figure 2.6) using the findings from interviews and online sources about smart city projects in Namur of Belgium. This evaluation was designed as a governance tool for governmental administration to guide a human-oriented smart city strategy.

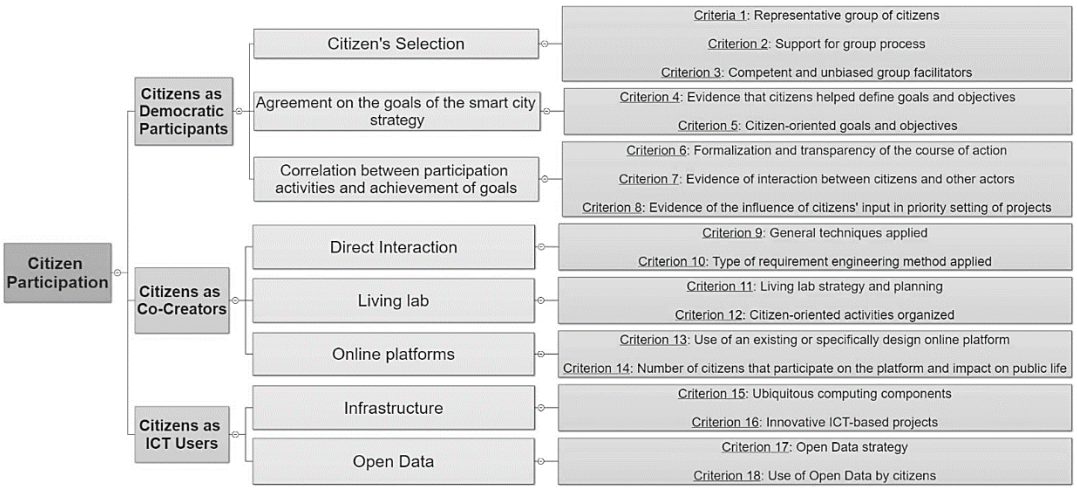


Figure 2.6 Citizen participation evaluation framework (Simonofski, *et al*., 2017)

Berntzen and Johannessen (2015) recognized competent and experienced citizens as a one of major outlines of citizen involvement in early stages which reduce the risk of failure. The high-quality participation entails citizen engagement through actively taking part in decision making processes and management activities.

The engagement of the grassroot community is necessary in sustaining smart city projects. Grassroot organizations refer to the organic formation of groups, clubs, and associations which aims at addressing the problems and desires of members at the local level. The collective activities by grassroot organizations such as craft workshop, free dance gathering, and acting performances in the public space encourage an effective citizen involvement at the community level better than government initiatives (Islar and Irgil, 2018; Gouthro, 2010). An active citizenship in grassroot organization is formed based on the need for the city to support life-long learning opportunities and initiate network towards equality and social movement (Banerjee, 2010; Gouthro, 2010).

In recent years, increasing attention has been placed on the importance of grassroot organization and a collaboration between the state and citizen in a co-production about city services using the bottom-up approach to facilitate the city and citizen relationships (Mitlin, 2008). The European Association for Local Democracy or ALDA (2016) promoted the grassroots approach through a multi-stakeholder empowerment process in order to support civic development. However, the top-down approach should not be ignored in stakeholder participation enhancement; it attempts to harmonize effective resource management and distribution at a larger scale (Achaerandio, *et al*., 2012). Hence, a balancing of top-down and bottom-up approaches should be considered by city planners and law makers.

The emphasis in the grassroot engagement and empowerment serves as a reminder that the top-down approach should not ignore stakeholder participation enhancement. Achieving a right balance of the top-down and bottom-up approaches can lead to a harmonized and effective resource management and distribution at larger scale (Achaerandio, *et al*., 2012). Ideally, the quality of stakeholder engagement processes in a smart city development requires consideration by both city planners and lawmakers.

2.2.2 cities Citizen engagement through open data platform and digital transformation in smart city

Open data platforms and digital transformation contribute to citizen engagement by increasing public access to information and facilitate check and balance of the city activities and governance. Public participation and civic engagement in urban planning have been recognized as enhancing urban decision making yet tend to be a challenge in some cities (Davies, *et al*., 2012). Benoit and Hiroko (2016) stated that the citizen engagement was a vital component of smart cities. While ICTs were the facilitating tools for reducing time-consuming processes and the cost of community participation activities (Berntzen and Johannessen, 2015; Tadili and Fasly, 2019), they did not necessarily improve or enable citizen engagement. The discussions in the use of ICTs in citizen engagement strategy often highlighted the connection speed and the real-time

feedback between the city government, community and the citizen through an open data platform which were communicated, elaborated as well as used for add value in citizen (Gagliardi, *et al*., 2017). The open data platforms are significant for governance in order to advance urban services and improve the interactions between the city and the community (Mellouli, *et al*., 2014). In recent years, some studies have been conducted in the area of open government data (OGD) platform utilization for urban management, co-creation, and policy-making (Safarov, *et al*., 2017; Mcbride, *et al*., 2019). Hielkema and Hongisto (2012) provided an example of the public open data utilization for increasing business opportunities using the mobile application. Nevertheless, actual evidence of citizen involvement in the development of smart city services are rare (Granier and Kudo, 2016).

Online participation tools (OTPs) represent the utilization of social networking and digital platforms for improving public engagement in city governance. The implementation of these tools involves a consideration of i) decision process, ii) leadership, iii) efficiency, iv) conflict management, and v) atmosphere (Afzalan, *et al*., 2017). The online participation platform facilitated decision making processes via rapid information distribution and gathering public feedback. It also encouraged diverse types of leadership (Crowe, 2013). An online channel increased efficiency by saving cost and time for invitation and information distribution. However, there is a need for a competent facilitator in OPTs to ensure meaningful online interactions and mitigate conflicts in the discussions. A facilitator or administrator of OPT is vital for creating a supportive atmosphere of online participation that encourages participants to stay interested and engaged. The organization capacity of the OPTs referred to the administrative approach which influenced the quality of the participation. This could be described as a top-down or bottom-up administrative style or being developed from a public or private sector or a single or multiple collaboration(s). The nature of the organization(s) which administrate the OPTs and the personnel in charge of managing them inevitably affected their usage. The behaviors, skills and attitudes of the organization personnel towards OPTs could affect the level of which inputs from these channels are incorporated in the planning and

decision making processes. The community capacity comprised the community character in terms of level of experience with OPTs, socioeconomic background, general attitudes towards technology and participation, available infrastructure and access to technology. Planning problems and participation goals should be considered along with the city's strategy, goal, timeline, scale, and the participation goals or desired outcomes from the usage of the participatory tools. Finally, norms and regulations must be acknowledged to respect the citizen's identity and privacy as well as to suit citizen's attitude, gain acceptance and satisfy their expectation in the planning process. However, the designing and utilizing of OPTs required careful consideration of several factors including tool capacity, organization capacity, community capacity, planning problem and participation goals, and norms and regulations (Afzalan, *et al.*, 2017).

Digital transformation influences the citizen's expectation, experience and evaluation of the city services. Digital transformation provides a pathway towards the digital nation in which urban and rural citizens, governments, and businesses interact and generate value using digital technology to benefit all stakeholders (Kar, *et al.*, 2019). Grounded in a business strategy, the digital transformation refers to a shift in business competitiveness and change of culture using digital technology and innovation to improve customer relation and value formation (Rudder, 2016; Goerzig and Bauernhansl, 2018). The term 'digital' is collection, storage, exchange, process, delivering and consumption of data based on new information technology or IT, and the term 'transformation' is fundamentally renovation of the model itself (Goerzig and Bauernhansl, 2018). Hinings, *et al.* (2018) defined the digital transformation term into influenced impacts from digital innovations in terms of innovative performance, training, approach, exchange and also attitude which lead to amendment, supplant within fields, organizations, or industries.

Currently, there is a lack of literature that addresses the citizen engagement and digital transformation relations. This provides the basis for this research to explore the empirical data on the role of citizen engagement in the implementation of a smart city (See in Section 4.1) as well as the open data platform and digital transformation (See in Section 4.2).

2.3 Culture, attitude and technology

Culture is influenced by attitude as well as technology. It is dynamic, messy and conditioned by politics, economics, corporate practices, markets, social and technological changes (Murphie and Potts, 2003). The study of culture involves multiple dimensions of both internal and external factors such as individual characteristics, attitudes, quality of life, and social network (Fu, *et al.*, 2007). Culture can be defined in different contexts as including innovation, creativity, art, ethics and morality, well-being (Hawkes, 2001; UNESCO, 2013a; Carlton, 2014; Vallicelli, 2018). Hall (1976) developed the cultural iceberg model for social context highlighting its non-visible aspects including perception, attitude, belief, values, opinion, and viewpoint and its visible aspects manifesting in behaviors (Figure 2.7).

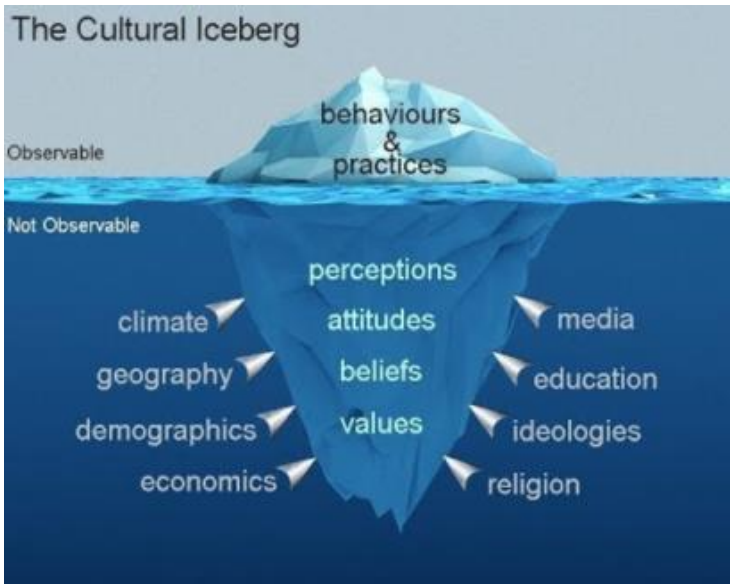


Figure 2.7 The cultural iceberg model (Source: Sharma (2019) based on Hall (1976))

Culture can influence participation and human interaction with technology. Afzalan, *et al.* (2017) reported that the participant capacities which were related to the individual characteristics and cultural contexts could influence the use of technology in

participation. Attitude and belief can influence the citizen's behavioral intention into ICT adoption and usage (Zhang and Aikman, 2007; Zhang and Sun, 2009). This was described by the unified theory of acceptance and use of technology (UTAUT) (Figure 2.8), UTAUT is based on eight social psychology theories the theory of reasoned action (TRA), the technology acceptance model (TAM), the theory of planned behavior (TPB), the motivational model (MM), Combined the TAM and TPB (C-TAM-TPB), the Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT); UTAUT highlights the role of attitude towards actual innovation on the usage (Fishbein and Ajzen, 1975; Ajzen, 1985; Venkatesh, *et al*., 2003).

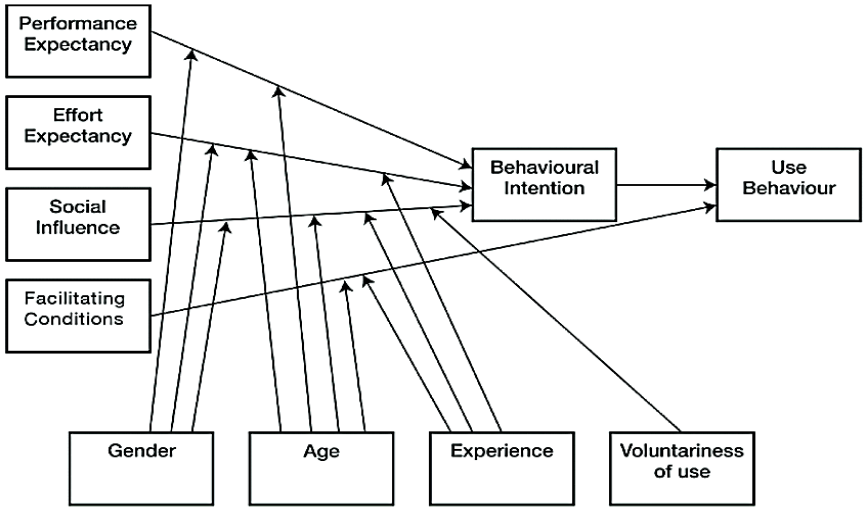


Figure 2.8 The unified theory of acceptance and use of technology (UTAUT) (Source: Venkatesh, *et al*., 2003)

The UTAUT model identified five direct determinants of intention and use behavior consisting of i) performance expectancy, ii) effort expectancy, iii) social influence, iv) facilitating conditions, and v) behavioural intention (Venkatesh, *et al*., 2003). Gender, age, experience and voluntariness of use were also considered as the influencing determinants in the UTAUT model. Other theories such as TAM, suggested that technology acceptance is influenced by user attitude and usage behavior (Figure 2.9). Chen and Chan (2014a) categorized four groups of influencing factors in TAM

namely 1) demographic information, 2) use of technology services and products, 3) quality of life and health abilities; and 4) attitude and perceptions about general technology products and innovation services. Studies on e-government services have identified factors such as ease of use, usefulness, external stimulus, interpersonal stimulus, cybersecurity, relative benefit, perceived risk, reliability, visual and facilitating environment as the determinants of user adoption (AlAwadhi and Morris, 2008).

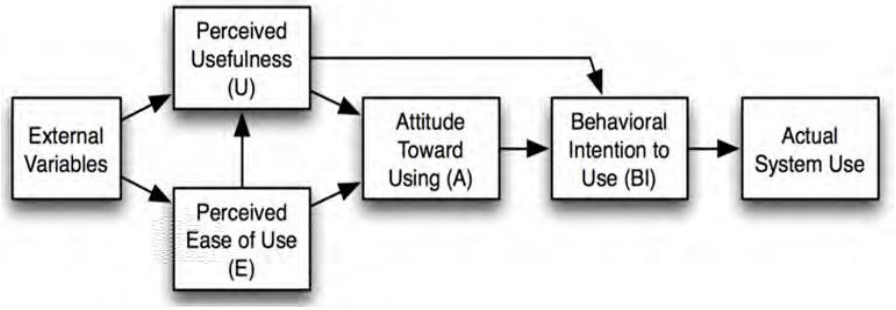


Figure 2.9 The technology acceptance model (TAM) (Source: Davis, *et al*., 1989)

According to UTAUT and TAM, psychological theories were merged with technology adoption effects on an individual's behavior of use (Venkatesh, *et al*., 2003; Chen and Chan, 2014a). This study applied this to assessment both perception and acceptance of technology use (See in Section 3.3.2.1).

Measurement of citizen behavior and attitude towards technology usage has been implemented in forms of frameworks such as digital literacy (DL) and media and information literacy (MIL) (Reineck and Lublinski, 2015). While there are still debates on the definitions and scopes of these terms, the importance of DL and MIL have increasingly been emphasized (Al-Tawisi, *et al.,* 2016). DL may encompass but is not limited to ICT literacy, technological literacy, media literacy. DL used by Thailand's Ministry of Digital Economy and Society contained broad competency based on 9 indicators; rights and responsibility, digital media and communication accessible, digital security, MIL, ethics in digital society, digital health, digital commerce, and digital law (ONDE(a), 2019). Meanwhile, MIL implies an individual's competency with both the environment and

information through online and offline sources for lifelong learning based on 3 indicators namely access, evaluation, and creation (UNESCO, 2013b). Both DL and MIL in Thailand surveyed the citizen's attitude, knowledge, and skills. The study was conducted by the Office of the National Digital Economy and Society Commission (ONDE) in 2019 to provide an overview of the standard level (ONDE(a), 2019).

Contemporary culture has been proposed as the fourth axis in sustainable policy planning and urban development (Hawkes, 2001). Moreover, the United Cities and Local Governments (UCLG) organisation promoted agenda 21 for culture which highlighted the relationship of culture, citizenship, and sustainable development (UCLG, 2004; Kagan, *et al*., 2018). According to Allam and Newman (2018), the new paradigm of smart city includes i) culture, highlighting the urban history and the benefits of the citizen involvement with their city), ii) governance, emphasizing on the public-private-people partnership and iii) metabolism, focusing on reducing the city waste and excessive use of resources.

The lack of literature discussing the role of culture on technological adoption and user behavior provides an opportunity for further enquiry and justify the research needed in this area. It supports the study's focus on the contemporary cultural aspects namely personal attitude and societal contexts and their influences on citizen engagement both in a smart city and urban planning towards sustainable development.

2.4 Smart city in Thailand

2.4.1 Smart Thailand

In 1996, the National Information Technology Committee (NITC) of Thailand highlighted the potential of IT in the "IT 2000" plan. There were three agendas; *"agenda 1 was the investment in equitable information infrastructure by National Information Infrastructure (NII)*, *agenda 2 was a well-educated populace and adequate IT manpower or the investment in people, and agenda 3 was the investment for good*

governance" (MICT, 2011). Subsequently, NITC recognized the global trend of the economy and society development towards the knowledge-based economy and society and produced "IT 2010 (2001-2010)" plan created by National Electronics and Computer Technology Center or NECTEC (NECTEC, 2003a).

The IT 2010 framework was aligned to the Ninth national economic and social development plan and initiated the strategies for the national ICT development. This was reflected in the First ICT Master Plan (2002-2006) which stated that "*Thailand is to become the regional center for ICT development and business, in particular for software technology."*

MICT officially launched the 'Smart Thailand 2020' vision on the second Thailand ICT Master Plan (2009-2013) to achieve the target of the National Economic and Social Development Plan. It is divided into 3 missions; 'Smart Business' to enhance the knowledge of ICT workforce, 'Smart Network' to speed up ICT network, and 'Smart Government' to provide suitable ICT for better governance (MICT, 2009).

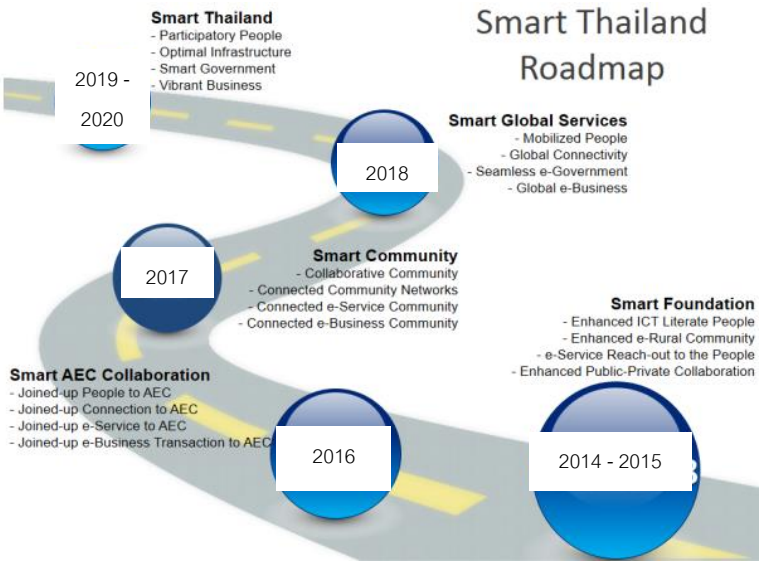


Figure 2.10 Smart Thailand roadmap (The draft of the third Thailand ICT Master Plan (2014-2018)

'Smart Thailand 2020' framework (Figure 2.10) continued in the draft of the third Thailand ICT Master Plan (2014-2018) which was geared towards the 'Digital Hub'

with the emphasis on sustainable economic growth, strengthening social capital at community level, and green environment (MICT, 2014). The summary of the history of the ICT framework in Thailand is displayed in Figure 2.11.

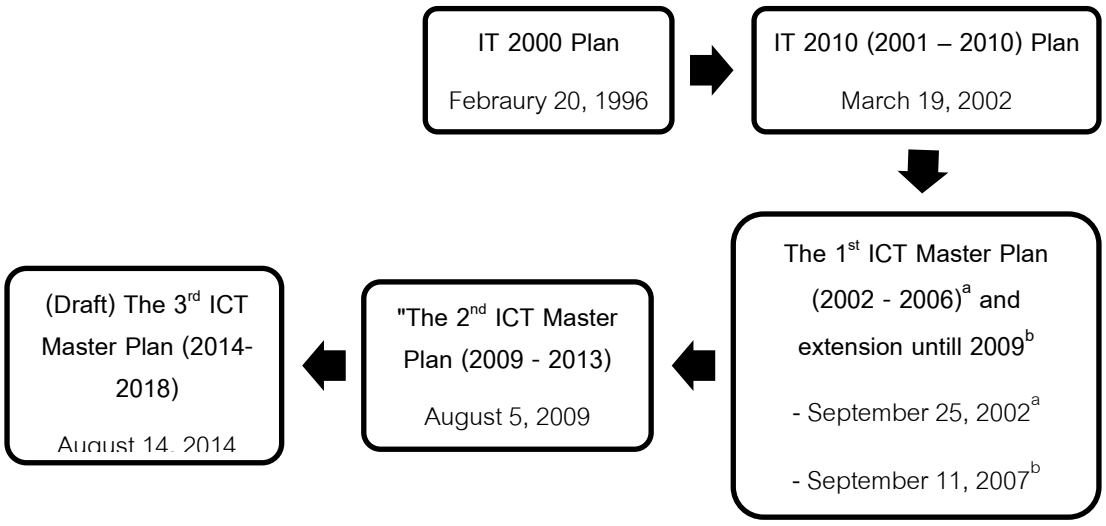


Figure 2.11 The ICT framework in Thailand (Adapted from the first ICT Master Plan (2002 - 2006); the second ICT Master Plan (2009-2013); and the draft of the third Thailand ICT Master Plan (2014-2018))

The smart city projects (SCPs) in Thailand are supported by the Ministry of Digital Economy and Society (MDE). The budget allocation for the three major provinces (Figure 2.12) was 386 million Thai Baht for Phuket (11.1 Million USD), 36.5 million Thai Baht for Chiang Mai (1.05 Million USD) and 15 million Thai Baht for Khon Kaen (43 Thousand USD) (PPO, 2016; Manager online, 2017).

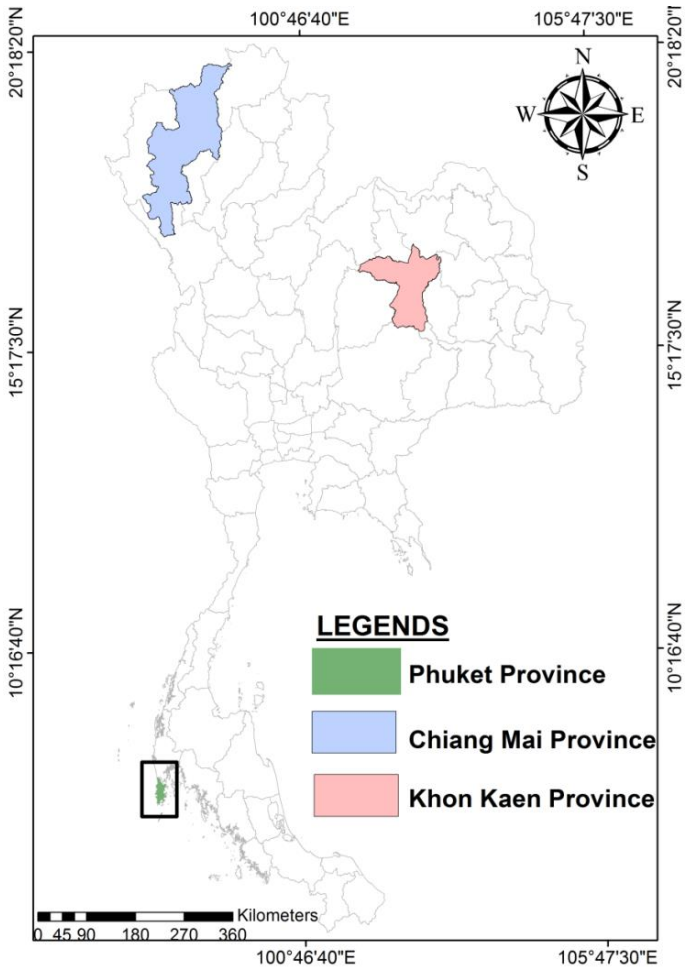


Figure 2.12 The smart city projects (SCPs) of Thailand's major cities. (Adapted from Manager online, 2017)

Phuket and Chiang Mai provinces have been officially assigned as the pilot smart city by the Thai government in 2015 following the 'Digital Economy' policy (DEPA, 2015; Wetprasit. and Nanthaamornphong, 2015). On the other hand, Khon Kaen smart city projects were initiated by the local private sector led by Khon Kaen City Development or KKTT (Manager online, 2017). This research focuses on Phuket smart city because it received the highest government budget despite having the smallest population and area.

2.4.2 Phuket smart city

In 2015, SIPA declared the Phuket smart city vision as *" The Tourism Island of Sustainable Growth by Enhancing Creative Economy to Provide Happiness for All "* (PPO, 2016). Phuket smart city themes consisted of i) smart economy (i.e. hub of creative entrepreneur, innovation park, smart city collaboration) and ii) smart living community (i.e. smart tourism, Phuket safe city, green city, IoT environment sensor) and iii) high speed internet and free Wi-Fi. The financial support of 386 million Thai Baht was allocated to 3 organizations: a) MICT received 240 million Thai Baht for high speed internet and free Wi-Fi projects, b) SIPA received 79 million Thai Baht for smart economy projects and, c) NSTDA or National Science and Technology Development Agency received 67 million Thai Baht for smart living community projects (PPO, 2016). Table 2.1 shows the themes and visions of Phuket smart city compiled by the Phuket Provincial Office (2016).

Table 2.1 Phuket smart city themes and 2020 visions

Theme	Vision
1. Smart economy	Hub of creative entrepreneurs
2. Smart education	Smart learning community
3. Smart environment	Phuket green city
4. Smart government	Smart and sustainable Phuket
5. Smart healthcare	Smart hospital and patient single ID
6. Smart safety	Phuket safe city (CCTV and Maritime)
7. Smart tourism	Tourism digital economy model

Note: Reprinted from Phuket Provincial Office or PPO, 2016

There were differences in the components of Phuket smart city initiatives that were highlighted by SIPA and the Phuket Provincial Office. The Phuket smart city road map presented by SIPA was classified into six activities of i) smart city collaboration, ii) investment center iii) international creative and innovation entrepreneur academy iv) smart

living community, v) startup ecosystem, and vi) digital content branding to overseas market (SIPA, 2015b) Meanwhile, the "Phuket smart city 2020" by Phuket Provincial Organization (2016) aimed for *"Smile Smart and Sustainable Phuket"* with seven themes of i) smart economy, ii) smart education, iii) smart environment, iv) smart governance, v) smart healthy vi) smart safety, and vii) smart tourism (Table 2.1). Despite the creation of roadmaps and policy documents, the engagement of the local communities and the benefits of the projects to the residents remain unclear.

This chapter concludes with three observations which support the rationale of the research and form the basis of this study:

- Firstly, there remains a knowledge gap in the guidelines of smart city implementations and the logic behind their directions. This supports investigation following RQ 1, this dissertation which examines smart city strategies in real places around the world.
- Secondly, there is a lack of literature on how the smart city projects promote citizen engagement in their contexts. This supports RQs 2 and 3 which focus on to the roles and approaches of citizen engagement in actual smart city projects.
- Thirdly, there is a shortage of empirical study that assesses the level of citizen engagement in smart city development. This supports RQs 4, and 5 in this dissertation which collect primary data related to factors influencing citizen engagement in Phuket smart city.

This study contributes to the current knowledge gaps by examining the role of citizen engagement in smart cities and the interactions between public participation and the technological advancement for the better management of cities.

CHAPTER 3
METHODOLOGY

This chapter describes the methods used in this research and illustrates their connections to the RQ identified in chapter 1. The study focuses on the citizen engagement strategies of the smart cities worldwide and the role of ICTs and culture in promoting the citizen engagement in solving the city problems. In addition, it asks how Phuket can best be developed as a smart city and effectively promote citizen engagement in this process.

The initial exploration into the importance of citizen engagement in smart city framework is partially confirmed in the literature review in chapter 2. RQs 1 to 3 explore the implementation of smart city in relation to citizen engagement and open data platform. These questions are addressed by an examination of the strategies of the smart city projects in selected cities using literature review and website research. The subsequent RQs 4 and 5 focuses on culturally sensitive engagement processes of the stakeholders in Phuket smart city development. RQ 4 is addressed from observations and interviews of key actors and processes that influence changes and collective actions in the Phuket community. Finally, RQ 5 is resolved through the quantitative survey and statistical analysis of Phuket citizen's perception and experience in Phuket smart city projects.

This chapter contains four parts. The first section describes the research design through the illustration of linkages between research processes. Section 2 iterates the RQs and process to be tested. Section 3 describes the methods used to collect data in each RQ. Section 4 concludes with the analytical tools utilised to manage and analyse the results.

3.1 Research design

The research uses the sequential exploratory mixed methods design consisting of two approaches; qualitative followed by quantitative stage. The research utilized several techniques such as desktop research, survey, observing relevant activities as well as interviewing the key stakeholders. There are four steps in this research. These steps are connected and form a part of a continuous process (Robson, 2011). The timeline of research activities is also presented in Figure 3.1.

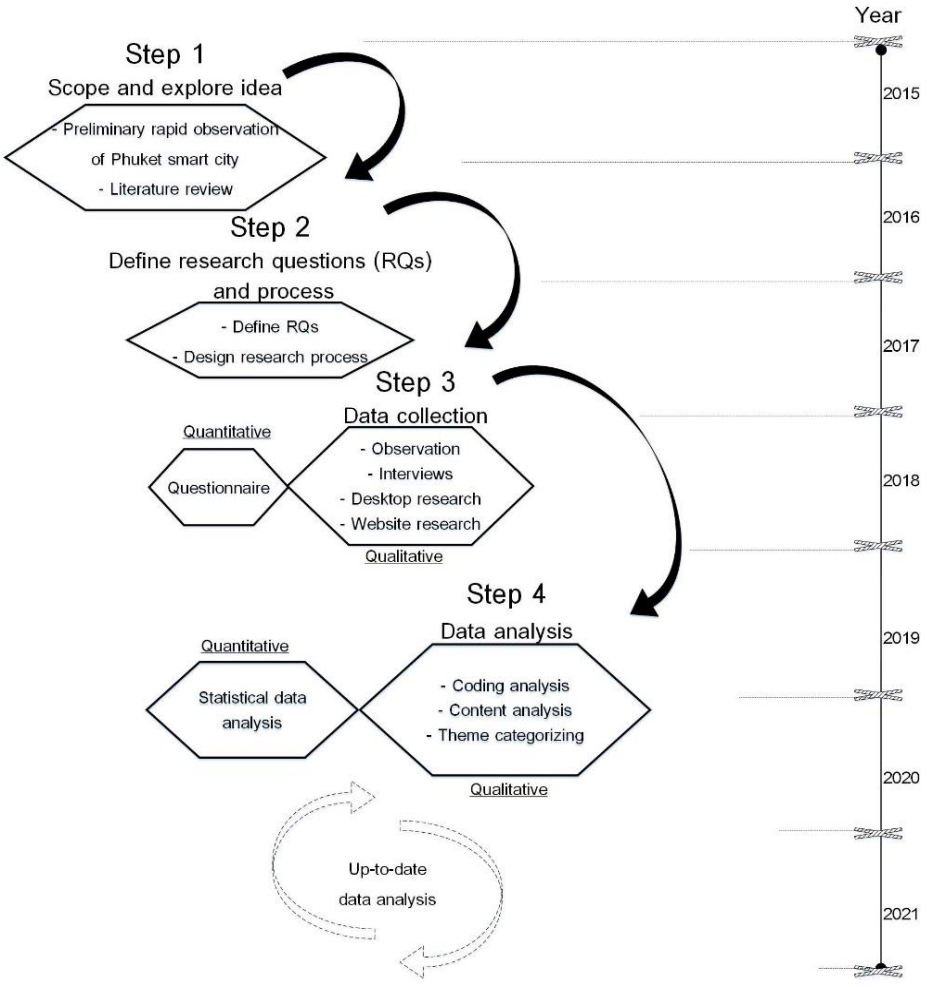


Figure 3.1 Research process and timeline

3.2 Research questions and methods

This section demonstrates the RQs and relevant methods that are used to address them (Table 3.1).

The research starts by obtaining an experience in the smart city concept from desktop research and observing relevant activities in Phuket smart city. Subsequently the literature review is conducted to refine the RQs, identify data gathering methods and select the analysis approach. The research is considered the explanatory design focusing on qualitative data analysis with the supplement of quantitative data collection.

Table 3.1 The RQs and their respective data gathering methods

Research Questions (RQs)	Methods	Section
RQ 1 Is citizen engagement a characteristic of a smart city?	Desktop research (Official reports and documents, Smart city websites), Observational study	4.1, 4.3
RQ 2 What is the role of open data platforms and digital technology in citizen engagement?	Desktop research (Official reports and documents, Smart city websites), Observational study	4.2
RQ 3 How do smart cities worldwide engage with citizens in solving environmental and urban problems?	Desktop research (Smart city websites)	4.3
RQ 4 How does Phuket smart city initiative influence citizen engagement in solving Phuket problems?	Observational study, Interviews, Desktop research (Official reports and documents)	4.4
RQ 5 How does socio-cultural context influence the citizen engagement in Phuket's attempt to become a smart city?	Observational study, Interviews, Desktop research (Official reports and documents), Questionnaires	4.5

3.3 Data collection

This research uses a multi-case based learning approach as it is the most appropriate technique for rapidly gathering a lesson learned from several cities (Robson, 2011). The information on citizen engagement and the context of different strategies are contextually analyzed from the content of the smart city websites. This study conducts a target case analysis by utilising a keyword search engine (Halavais, 2018).

Data collection for Phuket smart city case study consists of two approaches; i) primary data collection using observation and in-depth interview and ii) secondary data collection by obtaining official reports and press releases. Finally, a door-to-door survey (Agustini, 2018) was conducted across Phuket. A questionnaire was designed to assess the citizen engagement in Phuket smart city projects. The qualitative data was gathered, coded and analyzed to provide the insights from the case studies while the quantitative data is obtained to test the extent to which the insights apply in the general population.

3.3.1 Qualitative data collection

3.3.1.1 Desktop research

The desktop research was conducted through the gathering of literature evidence, official reports and documents, official websites, personal records, memoirs, diary, reports, letters, newspaper, and photographs relevant to the smart city, both in Thai and English, about smart cities and related topics, especially citizen engagement in smart cities. The collected resources were considered as trustful secondary data in ScienceDirect related to citizen engagement in a smart city. In all, more than 120 documents were reviewed dated between 2014 and 2019. This provided the information which contributed to the resolution of mostly RQs 1, 2, 3 and partly of RQ 4 on the citizen engagement of smart city development.

3.3.1.2 Website research

Researcher assembles a list of 17 official smart city websites worldwide through a keyword search with specific criteria performed during 2017- 2018. Figure 3.2 illustrates the 3 phases that comprise this part of data collection namely; i) website selection, ii) filtering and iii) theme categorizing. The keywords used for searching through Google search engine are *'smart city website'* and also the name of the famous smart cities which have an established reputation as a smart city. Initially, there were 26 possible case studies in the first ten pages (details of these cities are in Apeendix II). However, the information on smart city projects in some major cities were embedded in the governmental agency websites, for example, the information about Nice in France and Yokohama in Japan. Only the cities with a dedicated website for smart city projects were included in this study. The selection criteria used to select the cases were i) official smart city website, ii) available in English language or Google translated, iii) sufficient details on the projects with citizen engagement elements. Finally, 17 case studies were selected based on these criteria (See in Table 3.2). This list is used only as a starting point for the exploration of the smart city implementation. Details of the projects showcased in these websites were analyzed into themes. The activities included the processes and services provided city as well as collaborations among the citizen.

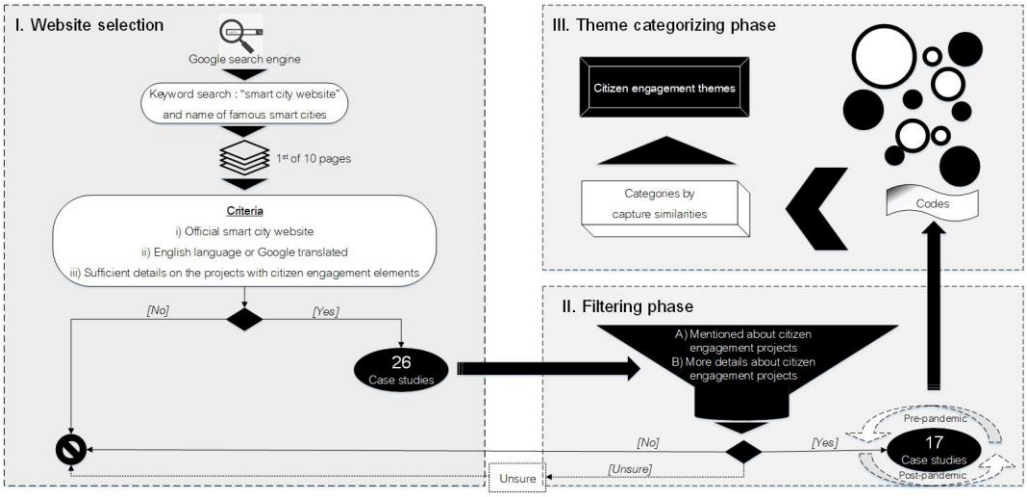


Figure 3.2 Website research steps

The website content of these cities act as a primary data for studying the characteristics and nature of the smart cities through the content analysis. The list is far from comprehensive and it is used only as a starting point for the exploration of the smart city implementation.

Table 3.2 17 Case studies worldwide

Cities (C)	Web sources
C1 Adelaide, Australia	https://www.adelaidesmartcitystudio.com/
C2 Agra, India	http://www.agrasmartcity.in/
C3 Amsterdam, Netherland	https://amsterdamsmartcity.com/
C4 Barcelona, Spain	http://ajuntament.barcelona.cat/estrategiadigital/en
C5 Berlin, Germany	www.smartcity.berlin
C6 Bhubaneswar, India	https://www.smartcitybhubaneswar.gov.in/
C7 Brussels, Belgium	http://smartcity.brussels/home
C8 Glasgow, Scotland	http://futurecity.glasgow.gov.uk/
C9 Hong Kong	https://www.smartcity.gov.hk/
C10 Nice, France	http://en.meet-in-nice.com/nice-smart-city
C11 Pune, India	http://www.punesmartcity.in/
C12 Seoul, South Korea	https://www.seoulsolution.kr/en/content/seoul-e-government-toward-smart-city
C13 San José, USA	http://www.sanjoseca.gov/index.aspx?NID=528"9
C14 Singapore	https://www.smartnation.sg/
C15 Surat, Gujarat, India	http://www.suratsmartcity.com/SuratSmartCity/SmartCityVision
C16 Taipei, Taiwan	https://smartcity.taipei/?locale=en
C17 Wein, Austria (Vienna)	https://smartcity.wien.gv.at/site/en/

Details of the projects showcased in these websites were organised into themes. The activities included the processes and services provided by the city as well as collaborations among the citizens.

3.3.1.3 Causal Loop Diagram

Causal loop diagram (CLD) utilizes systemes approach to describe the complexity of a wicked problem (Sahin, *et al*., 2020). Based on literature review and 17 case study analyses, A CLD facilitates the understanding of system dynamic by displaying the positive and negative connections between components of smart city development (Jamieson, *et al*., 2016; Coletta, *et al*., 2021). A CLD was drawn from recurring themes that were mentioned in the literature and smart city websites in relation to smart city development. Keywords were used in describe the components in the system and the interactions between them. Subsequently, five sub-systems (labeled as a, b, c, d and e) were drawn. The sub-system CLDs allows for more detailed explanations about how citizen engagement interacts with other key components of a smart city.

3.3.1.4 Observation

Observations from Phuket case study were based on attendance to Phuket smart city meetings and gatherings of related topics at both national and local levels. In a public forum, the researcher adopted the role of 'complete observer'. The position as researcher was unknown, and data were collected through note taking and photographs (Robson, 2011). In a local forum, the researcher adopted a 'participant observer' role to acquire data and probe for detailed information during discussion sessions. Although the observation and participation by the researcher can lead to biases, this was reduced by the triangulation of the findings from both qualitative and quantitative approaches. The researcher attended a total of 29 Phuket smart city meetings during October 2015 to September 2018 which equated to 146 hours of data (See in Appendix III). These methods are useful for understanding the research context which helped identify the active key players for in-depth interviews in the subsequent phase.

3.3.1.5 In-depth interview

In-depth interviews were conducted with key stakeholders of Phuket smart city including DEPA staff, Phuket provincial Governor's officers in charge of Phuket smart city project and the project participants who proposed the citizen engagement in Phuket smart city events. The participants were selected initially through the networks with Prince of Songkla University Phuket Campus, Phuket Provincial Office and DEPA Phuket branch. The informants were identified through the observation at various Phuket smart city meetings and forums to which the researcher attended (Appendix III). The researcher used semi-structured open-ended interviews to gain insights necessary for addressing RQ 4 and identify the socio-cultural factors in RQ 5. The interview questions explored the expectations and the visions for citizen engagement in Phuket smart city (Appendix IV). Figure 3.3 shows the positions and linkages of the interviewees and organizations who mentioned the citizen engagement during the meetings and forums. The circles represent the individuals and the rectangles signify their position and organization.

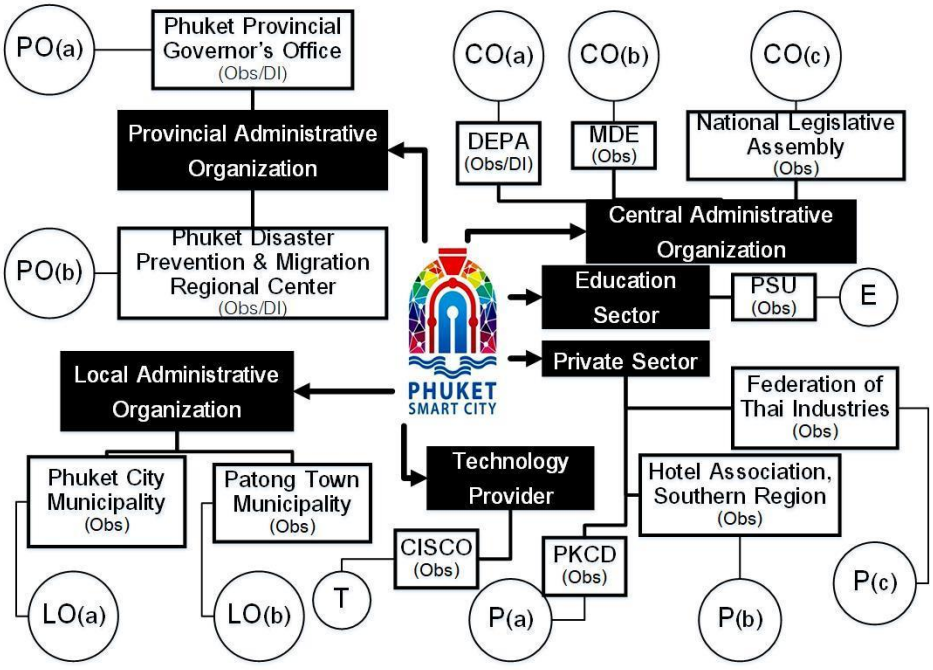


Figure 3.3 The mapping of key informants highlighting citizen engagement concept both in the directly interview (DI) and/or observation (Obs) in Phuket SC meetings

3.3.2 Quantitative data collection

3.3.2.1 Questionnaire

A questionnaire was used to evaluate the citizen engagement in Phuket smart city. Part of the questionnaire was developed from the results of RQs 3 and 4 and the prominent culture and tradition in Phuket. This provides the information needed to address RQ 5.

The questionnaire was designed in Thai language for people who currently live and work in Phuket. The questions were designed to assess the awareness of Phuket smart city and the personal characteristics that may influence the individual's technology usage and engagement in smart city initiatives (based on TAM, see Section 2.3). The sample size was calculated using the Taro Yamane formula (Yamane, 1967) which estimated at least 400 questionnaires had to be administered. The reliability analysis was examined using Cronbach alpha coefficient to check an internal consistency (Taber, 2018). The researcher used a door-to-door survey with 409 respondents during April to September 2018 (Table 3.3). During the survey, the researcher began with providing the objective of the survey and brief information about the smart city. After that the respondents were asked if they agreed to do the survey. The respondents' willingness to participate was necessary to ensure high quality data and honest response. The survey was conducted along the main roads in the populated areas during Saturdays and Sundays between 9 am to 4 pm.

Table 3.3 The population of three districts in Phuket and sample distribution (Sources: Department of Provincial Administration or DOPA, 2017)

Districts/Municipalities	Sample size (Dec. 2017)	Respondent	Percentage (%)
Phuket Mueang District	**242,821**	**249**	**60%**
Phuket CM	79,262	80	20%
Karon SM	8,168	8	2%
Ratsada SM	47,374	48	12%
Rawai SM	18,192	25	4%
Wichit SM	49,824	48	12%
Chalong SM	25,368	24	6%
Koh Keaw SAO	14,633	16	4%
Thalang District	**101,946**	**104**	**26%**
Cherng Talay SM and SAO	18,485	20	5%
Thep Kasattri SM and SAO	22,935	24	6%
Sri Sunthon SM	24,482	24	6%
Pa Klok SM	16,441	16	4%
Sakhu SAO	6,437	8	2%

Table 3.3 The population in Phuket three districts and sample size distribution (Sources: Department of Provincial Administration or DOPA, 2017) (Cont.)

Districts/Municipalities	Sample size (Dec. 2017)	Respondent	Percentage (%)
Mai Khao SAO	13,166	12	3%
Kathu District	**57,340**	**56**	**14%**
Patong TM	20,987	20	5%
Kathu TM	29,395	28	7%
Kamala SAO	6,958	8	2%
Total	**402,107**	**409**	**100%**

There were four sections in the questionnaires (Appendix V). Section one asked general information of the respondents. Section two enquired opinions about Phuket smart city and ICT usage as well as classified type of participation. Section three examined personal socio-cultural factors using rating scale 1 to 5 on 30 statements describing the citizen's mindset and behaviors towards smart city and technology. The last section gathered open-ended suggestions from respondents. Figure 3.4 represents an overall distribution of a questionnaire in each district in Phuket.

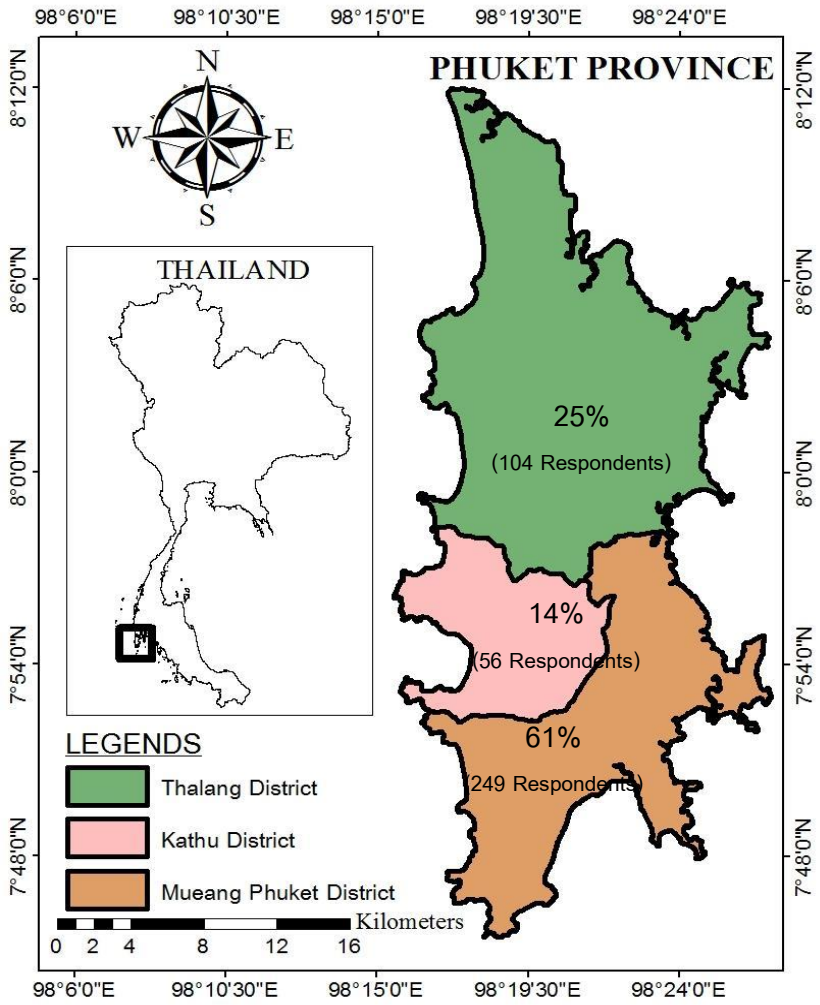


Figure 3.4 Sample size and distribution in the study area. There are 3 districts in Phuket province; 61% of the sample was in Mueang Phuket, 25% in Thalang, and 14% in Kathu districts.

3.4 Data analysis

This research used both qualitative and quantitative data analyses. A causal loop analysis (Spector, *et al*. 2001) was conducted using main nodes and feedback loops to highlight the conceptual smart city development with the focus on citizen engagement (Chapter 4, Figure 4.3). Subsequently, the citizen engagement strategy based on website content analysis was integrated into the conceptual model.

The results from the comparison between website research and desktop research were merged to identify the key categories and their relationships (Franks, 1999). The transcripts from the interviews with the key players who proposed the citizen engagement concept were coded using the frequency to represent the results that signified their organizations and linkages in Phuket smart city development. Furthermore, the comparative analysis was carried out by comparing and contrasting the strategies for citizen engagement in the smart city projects for the similarities and differences among real-world and academic contexts. The qualitative content analysis was facilitated by a CLD and category system. The participant observations and notes were used to enrich the findings.

The analysis of numerical data from the survey consisted of three main parts. The first part included the percentages and average of the demographic information and rating of the statement. The second part was prioritization of the smart city dimensions including suggestions for activities. Word frequency was also counted based on texts from the open-ended questions which were coded with themes using the frequency system to represent the results in word cloud that was created by Pro Word Cloud in MS Word (Chapter 4, Figures 4.24 and 4.25). The word frequency was presented in percentage calculated from the number of times particular words in comparison to the total word counts. The total of 1663 words were stated by 146 respondents in Phuket smart city project prioritization and 959 words were used in additional suggestions by 98 respondents (see Table 4.8 and 4.9 in Section 4.5.2). The internal consistency calculated using the Cronbach's alpha coefficient yielded the value of 0.92 which indicated high reliability. To investigate the relationships between types of participation and citizen's attitude, the responses in Question 2.1 in Part 2 and 30 questions in Part 3 were analysed using the Chi square method for testing hypotheses (McHugh, 2013). In addition, the relationships among the responses to 30 statements in Part 3 (see in Section 3.3.2) were analysed using Pearson correlation coefficient (r) to display the strength and direction of

the linear association (Bermudez-Edo*, et al.*, 2018). The interpretation of the relationship followed the identification by Hinkle (1998) which categorised the range of “r” or Pearson product into .5 - .7 (Moderate), .7 - .9 (High) and .7 – 1 (Very high) in which + value suggested the same direction whereas the value represented different direction.The statistical significance was identified by *p*-value that was less than .05 (Gill, 1999).The statistical data was used to supplement the qualitative results and infer the extent of citizen engagement in Phuket smart city.

The methodology for this research utilised mixed methods with both qualitative and quantitative approaches. Several methods were required to resolve RQs. The researcher was conducted as 4-step sequential processes (Figure 3.1). Step 1 helped shape the scope and sample of the study. Step 2 identified the RQs and potential methods to address each RQ. Step 3 focused on data collection using both quantitative and qualitative approaches. Desktop research was used primarily for RQs 1, 2, 3. Observations and interviews were conducted for solving RQ 4, and a questionnaire was applied to answer RQ 5. The last step involved analysing and interpreting the results from data collection in relation to the RQs. Triangulation from several data sources contributed to the discussions and interpretations of the findings (Robson, 2011). These steps yielded the results presented in the next chapter.

CHAPTER 4
SMART CITY AND CITIZEN ENGAGEMENT

This chapter presents the findings from a review of academic literature and online resources, interviews with Phuket smart city key stakeholders, and a survey with Phuket residents. These results are presented in five sections. Figure 4.1 shows the schematic of chapter structure and linkages relevant. RQ 1 is resolved through the CLDs from the content analysis of literature and online resources of 17 smart cities (Table 3.2) (section 4.1). RQ 2 is addressed using the in-depth analysis of smart city characteristics highlighting the role of open data platform and digital transformation in citizen engagement (section 4.2). RQ 3 resolution is based on the analysis of 17 smart city case studies worldwide (section 4.3) and the updated information during COVID-19 pandemic (section 4.6). RQ 4 is answered through the insights gained from the interviews with Phuket smart city stakeholders and the observations of relevant activities (section 4.4). RQ 5 is addressed using the qualitative as well as numerical data from a Phuket resident survey on social behaviour, attitudes and engagement in Phuket smart city project (section 4.5).

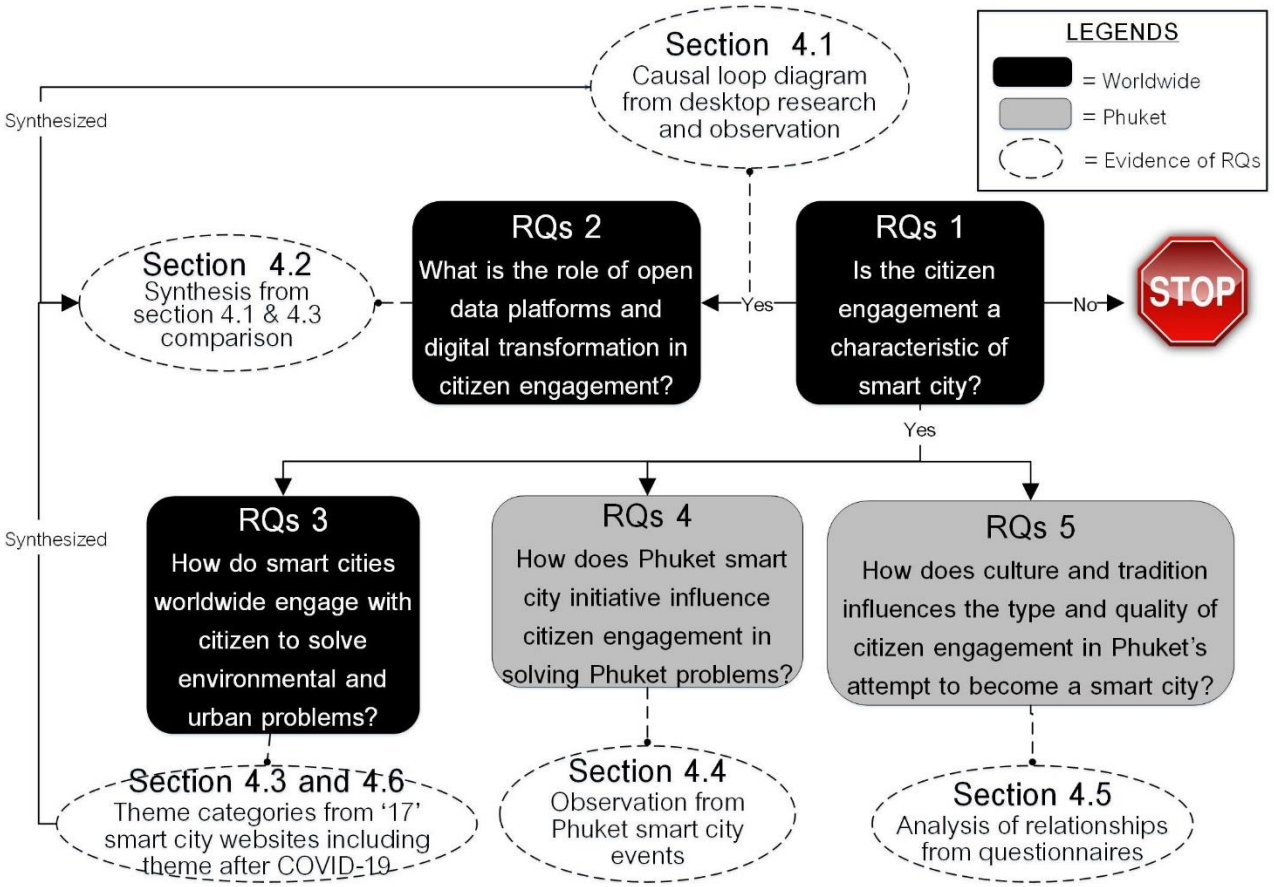
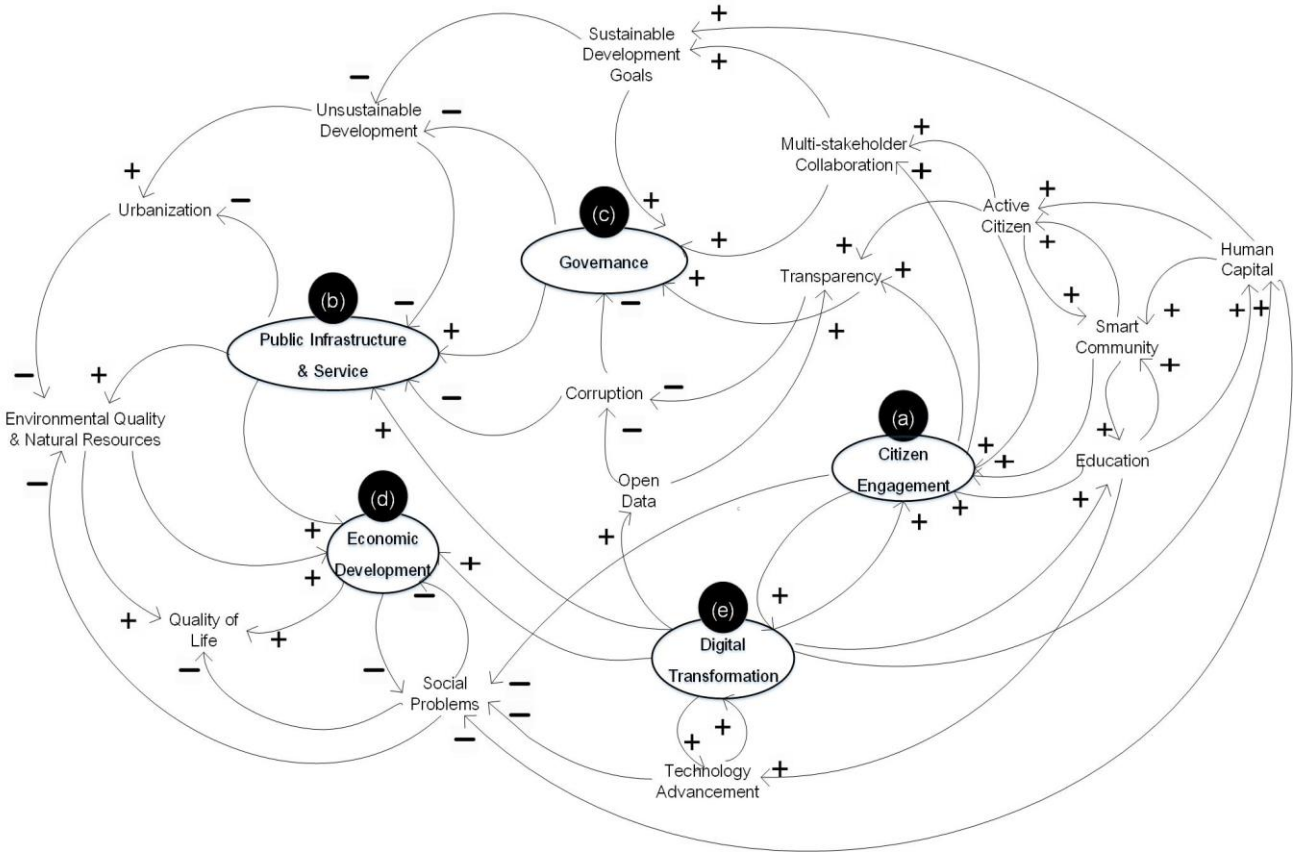


Figure 4.1 RQs and chapter structure

4.1 Citizen engagement in a smart city

This section presents data from desktop research and observations of smart city initiatives worldwide as well as in Phuket. The results highlight the characteristics of smart cities which relate to citizen engagement. Seven causal loop diagrams (CLDs) (See Section 3.3.1.3) were drawn to conceptualize the findings. Figure 4.2 illustrates the dynamic relationships between different factors in smart city development based on frequently mentioned themes in smart city projects and additional key factors from academic research. These linkages are further explained in 5 sub-systems namely citizen engagement, public infrastructure and services, governance, economic development, and digital transformation.



Note: (+) represents positive feedback, (-) represents negative feedback.

Figure 4.2 CLD of smart city development

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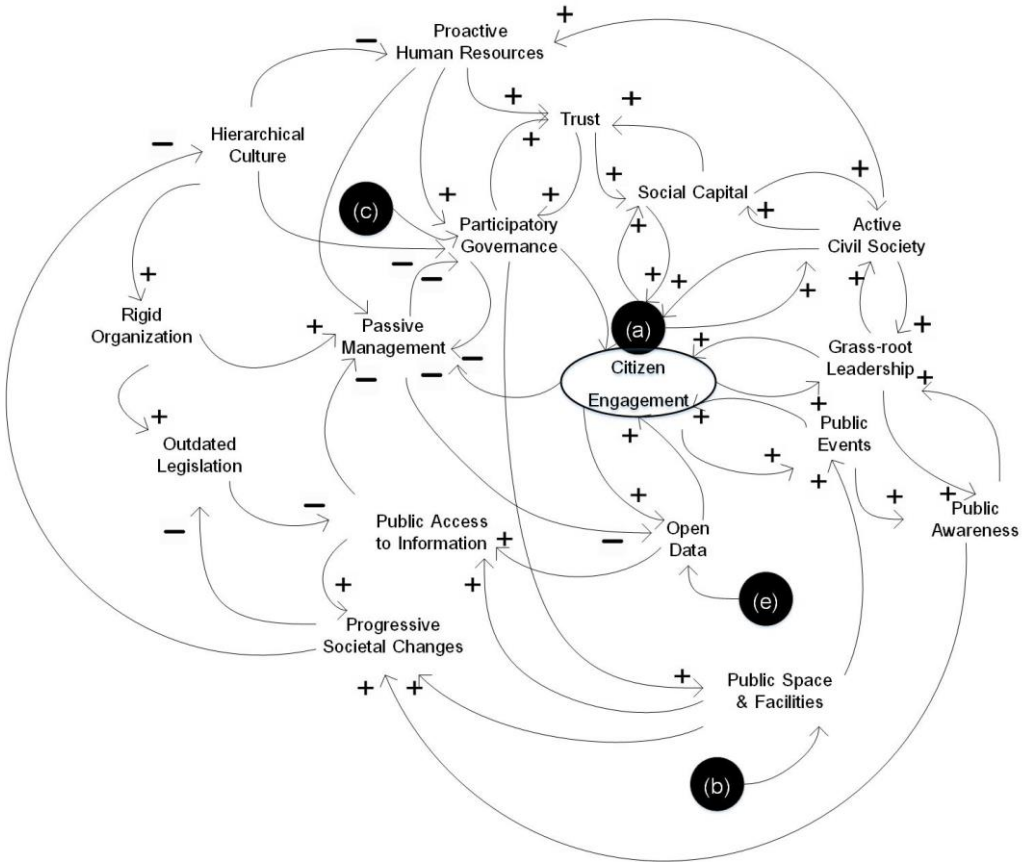
A smart city development is often aimed to improve public infrastructure and services. Good public infrastructure and services are linked to an effective governance which impacts the quality of life for people and environment. Active citizen engagement helps increase transparency and multi-stakeholder collaboration for city management and development projects. As environmental quality and natural resources support the economy and quality of life, negative impacts from urbanization and unsustainable development needs to be managed by good governance led by sustainable development goals (SDGs) and transparency. Transparency is enhanced by open data and active citizen engagement which can reduce corruption. SDGs are supported by multi-stakeholder collaboration and high human capital. Education increases human capital which leads to a smart community supporting effective citizen engagement. The digital transformation can facilitate better education, citizen engagement, public infrastructure and services and economic development when supported by good governance and education. Smart city development requires citizen engagement, educated human capital and appropriate use of technology to reduce social problems in order to improve the economic development and quality of life in the city.

To further explore the interrelationships in smart city development, the causal loop diagrams of five sub-systems were drawn. They are (a) citizen engagement, (b) public infrastructure and service, c) governance, (d) economic development, and (e) digital transformation. The citizen engagement sub-system is closely related to every sub-system (Figure 4.3).



Note: (+) represents positive feedback, (-) represents negative feedback, 0 represents neutral, black rectangles represent linkage nodes.

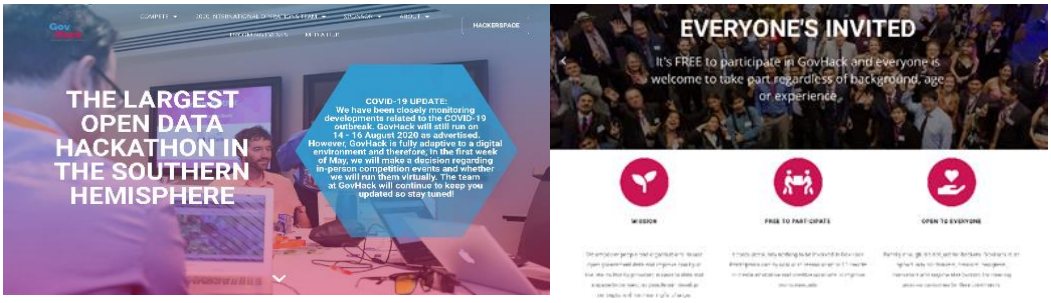
Figure 4.3 CLD of citizen engagement in a smart city

Citizen engagement and its interacting factors are displayed in Figure 4.3. It is supported by open data, public events, grass-root leadership, active civil society, social capital, and participatory governance. Trust contributes positively to social capital and governance while rigid organization and passive management are barriers to participatory processes and citizen engagement.

Public events enabled by public space and facilities can increase public awareness in city development facilitating grass-root leadership and progressive societal changes. Meanwhile, rigid organization, outdated legislations, hierarchical culture and passive management negatively impact participatory governance and public access to information. Open data and public spaces and facilities increase public access to information which stimulates progressive societal changes. Societal changes are essential in the reforming outdated legislations and hierachical cutlture that undermine participatory governance.

The impotance of citizen engagement in smart city implantation was observed in the projects from 17 case studies. This can be exemplified by GovHack (C1 Australia, https://govhack.org/), an initiative by Australia's ICT Research Centre of Excellence (NICTA) and LINUX which invited the public to participate in solving current city issues through an annual competition (Figure 4.4a). Making city-related data accessible and comprehensible were common in the projects that aimed to communicate and engage with citizen. For instance, Taiwan's g0v, a decentralized civic tech community, (C16 Taiwan, https://g0v.asia/) turned complex government budget data into visualizations that are easy to understand to facilitate public monitoring of government administration (Figure 4.4b).

(a)

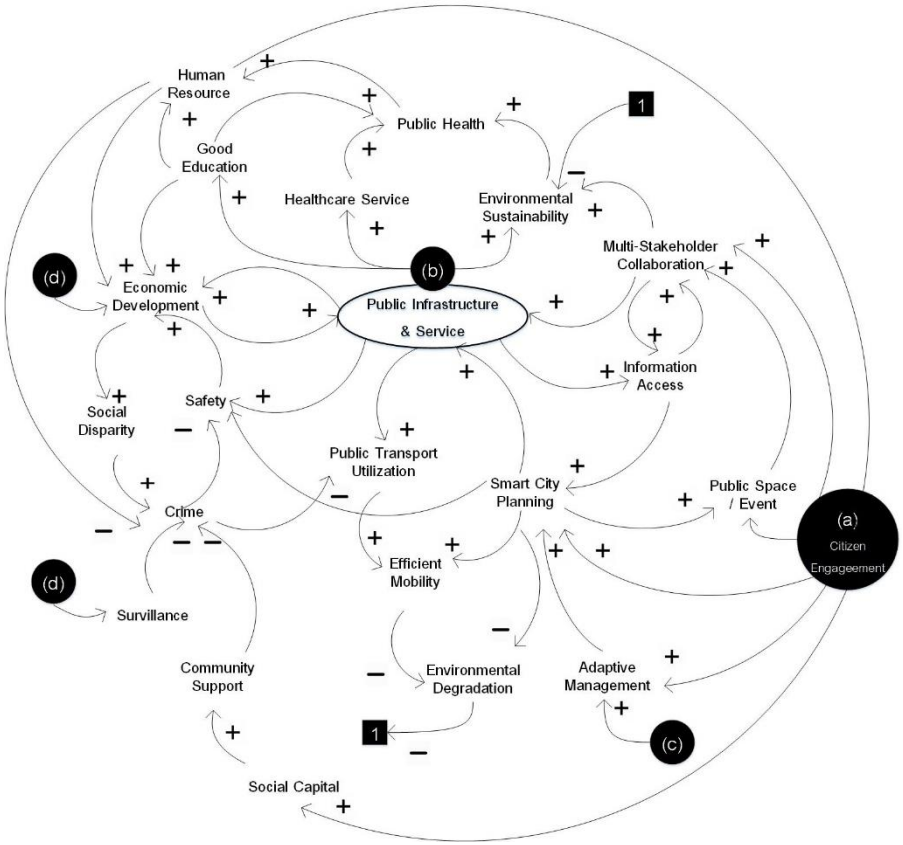


(b)

Figure 4.4 The example of citizen engagement in smart city projects (**a**) GovHack, Australia[5](C1). public competition on solving current city issues (**b**) "g0v", Taiwan[6](C16), citizen-created visualization of open government data

[5] https://govhack.org/

[6] https://g0v.asia/



Note: (+) represents positive feedback, (-) represents negative feedback, black rectangles represent linkage nodes

Figure 4.5 CLD of public infrastructure and services

Public infrastructure and services sub-system (Figure 4.5) displays the interrelationships city planning and management, multi-stakeholder collaboration, good education, safety, economic development, public transportation, environment sustainability, information access, and healthcare service (Figure 4.5). Having effective infrastructure and services provides positive impacts on public health, human resources, environmental quality and governance which contribute to a smart city development. This can be demonstrated by IoT infrastructure design under InfraLab (C5 Berlin, infralab. berlin/), the SENSARE project. The project aimed to keep traffic flowing during heavy rain using LoRaWAN (Long Range Wide Area Network) to support urban mobility (Figure 4.6a).

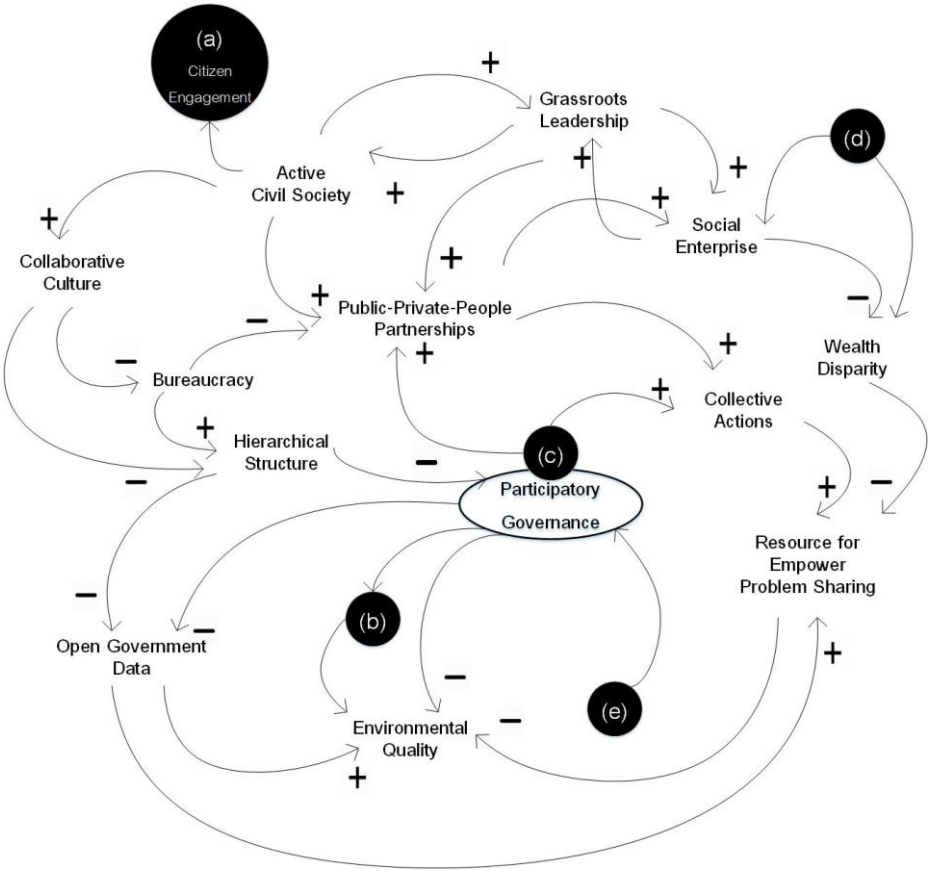
When utilized by citizen, public transport services contribute to efficient mobility that can reduce environmental degradation. However, the usage of publc infrastructure and services can be prevented by crime or the lack of safety. Crime and threats to public safety can be reduced by survillience enabled by technology and community support. is important in ensuring that public spaces and events are safe and utilized positively. Citizen engagement strengthen social capital and facilitate collaborations to help address city problems. Engaging the public in the development and management of public facilities and services is seen as a crucial step in smart city project implementation. This is demonstrated through the Aspern urban lakeside (C17 Vienna, smartcity.wien.gv.at), which involved community as a co-designer of urban space (See in Figure 4.6b). Citizen can act as enablers or barriers to the efforts to address complex city problems including healthcare, environmental sustainability, education, governance, safety and economy.

(a) (b)

Figure 4. 6 (a) Model of public infrastructure for effective moblity, Berlin[7](C5) **(b)** Visualization image of public space from citizen design, Vienna[8](C17)

[7] infralab.berlin/

[8] smartcity.wien.gv.at

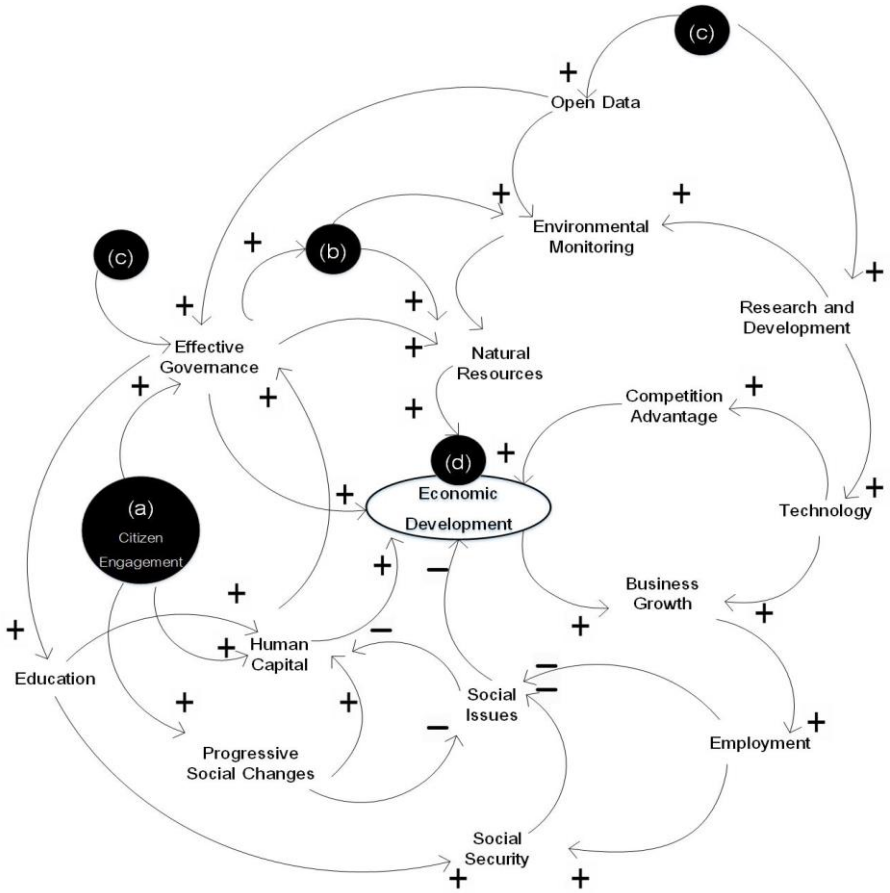


Note: (+) represents positive feedback, and (-) represents negative feedback

Figure 4.7 CLD of governance

Governance sub-system highlights the interrelationships between participatory governance, public-private-people partnerships, hierarchical structure environmental quality, economic development, public infrastructure and services, and open government data (Figure 4.7). Active civil society contributes to public-private-people partnership, grassroot leadership and collaborative culture. The positive interactions among the stakeholders enable collective actions to solve problems in the city. Grass-root leadership supports public-private-people partnerships, active civil society and social enterprise. Social enterprise is supported by public-private-people partnerships and grassroot leadership which can help reduce wealth disparity. The grass-root community provides human resources that support the operations in all sectors. Participatory governance is also facilitated by public infrastructure and service, digital transformation and economic development sub-systemes. Open government data promotes transparency and effective problem solving such as environmental quality. Economic development helps address wealth disparity and support social enterprise. The hierarchical structure of central and local governments can undermine participatory governance by reducing the efficiency of the way in which the city problems are solved.

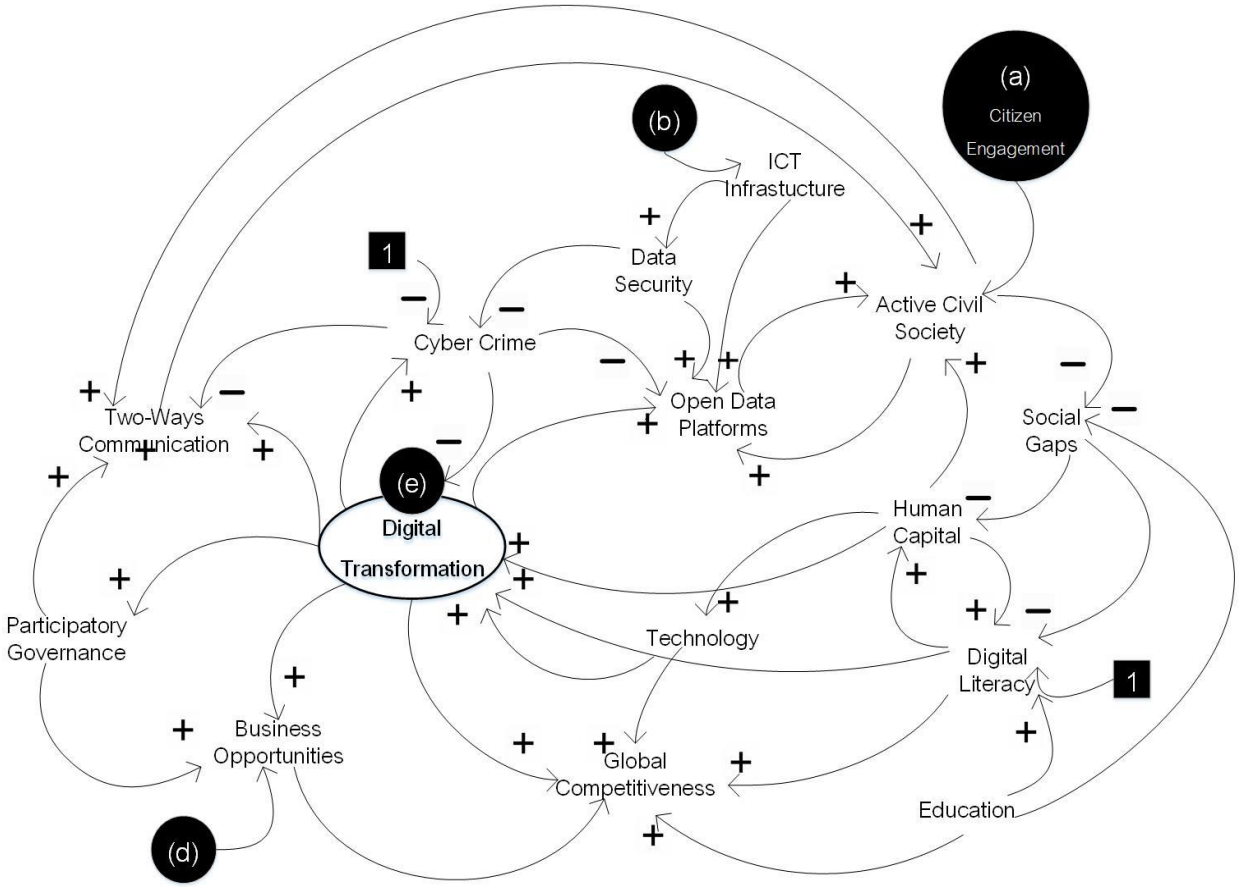
The bureaucracy within the hierachical structure creates barriers for public-private-people partnerships and open government data implemenation.



Note: (+) represents to positive feedback, (-) represents to negative feedback

Figure 4.8 CLD of economic development.

Economic development sub-system is depicted in Figure 4.8. Economic development depends on the quality of natural resources, human capital, effective governance, and competitive adavantage. Business growth and increased employment indicate positive economic conditions which can be promoted by technology. Technoloy suppoted by research and development helps increase the competitiveness of the city and business growth. Digital transformation sub-system is linked to the economic development through the use of technology and open data for effective governance and environmental monitoring as well as enhancing its competitiveness. Education promote human capital which is crucial for knowledge-based economic development and contribute positively to social security. Employment provides social security to the people which reduces social problems. On the other hand, social issues negative impact human capital and, eventually stifle economic development. Citizen engagement is linked to economic development through effective governance, human capital, and progressive social changes that address social disparity.



Note: (+) represents positive feedback, (-) represents negative feedback, black rectangles represent linkage node

Figure 4.9 CLD of digital transformation

The digital transformation sub-system shows the role of open data platforms as both a promoter and a result of active civil society (Figure 4.9). Open data platforms, human capital, technology as well as digital literacy support digital transformation. This is linked to citizen engagement sub-system as active citizen organizations increase socal awareness, the creation and utilization of open data platforms and two-way communication which positively influence human capital and participatory governance. Technology enables cities and nations to be globally competitive through innovations and new business opportunities. Technology creation and usage are driven by human capital with digital literacy. The digital services are sustained by ICT infrastructure and data security to ensure the meaningful communications and applications. On the other hand, cyber crime reduces the effectiveness of open data platforms and interactive communication which hinder the digital transformation. Good education is critical for the improvement of human capital, digital literacy and social awareness. Digital transformation provides tools and drivers for knowledge-based development.

The role of digital transformation in enabling cities to cope with emergencies and crises is evident during COIVD-19 pandemic. The public health crisis led to disruption in the economy and phenomenal changes daily lifes as well as business operations. There was a sudden demand for social distancing and touchless solutions which shifts organization's behavior and attention to digital technology. While technology was quickly adopted to respond to the pandemic, it also contributed to widening generational gap, income inequality, and social disparity.

The CLDs of the smart city development enable the visualization of relevant components and their interactions that contribute to the effectiveness of smart city initiatives. While the hard infrastructure and technology are important, the soft domain such as governance, human capital and social capital are crucial in ensuring effective utilizations of the physical resources. This necessitates citizen engagement as a key process in the smart city discourse.

There are several pieces of evidence on the important roles and actions of the citizens in a smart city in the academic literature. According to Lee and Lee's work (2014) in the Republic of Korea in 2009, 'citizen centricity' identified citizens as customers or users of city services. These services included 11 categories comprising public health, transportation, environment, medical care and welfare, tourism and sport, facilities management, culture, work and employment, distribution, crime and disaster prevention, education (Lee *et al*., 2014). The importance of 'smart community' was highlighted by Granier and Kudo (2016) in energy management initiatives of 4 cities; Yokohama city, Toyota city, Kitakyushu smart city and Keihanna Science City implemented by the Japanese government in 2010. In a study by Yeh (2017), the citizen's perspectives and actions as the user of ICT-based smart city services in Taiwan resulted in different kinds of smart city combinations. The study was based on a survey of 8 topics namely innovation concept, personal innovativeness, city engagement, service quality, acceptance/usage, perceived privacy, trust, and quality of life (Yeh, 2017).

An empowered citizen with appropriate skills and experience can help support a city as a co-producer of public services. This is demonstrated through Vanolo's (2016) prediction of the citizen's position in SC of the future. The study described four imageries of SC ranging from i) the ones with noiseless citizen where assumption on population needs are were made by planners themselves, ii) a dystopian city where technologies enabled a decadent city mostly in an entertainment business, iii) a city with active citizen whose actions, involvement, and responsibility supported the city development, and iv) the city with the next generation citizen who inspired eco-friendly technology improvement.

An aware, educated and trained citizen is instrumental for increasing citizen's acceptance and usage of digital city services. This is supported by the work of Vassileva, *et al*. (2016) which examined Swedish users in new technology services through smart electricity meters in Sweden during 2009. The study suggested that if the local government had invested in educating and providing knowledge to their citizens, the initiative would have yielded more effective output for the citizens. In another study by

Gagliardi, *et al.* (2017), the connection between city administrative organizations, as an e-services provider and citizen, as a user was necessary to provide an opportunity for citizens to express their ideas and form collaborations in the long term. In Curitiba, Brazil, Macke, *et al.* (2018) showed the importance of the involvement of policy makers, researchers, and citizens with different knowledge and skills for building a quality of life in SC through the citizen's perception as a user of city services.

This section addressed RQ1 by demonstrating that citizen engagement is a core influence of a smart city. Citizen enegagement sub-system was found to suppot key factors in every sub-system related in smart city development dynamic. The investigation into how citizen engagement relates to SC concepts and is mentioned in SC projects in cities around the world shows that the city population can act as a user and a co-producer of the digital services and tools. The significance of open government and partipatory culture contributes to effective of equality in society including Phuket (discussed further in Section 5.1). This leads to the question on the relationship between citizen engagement and open data platforms and digital transformation which is presented in Section 4.2.

4.2 Role of open data platforms and digital transformation in citizen engagement for smart city development

This section examines the usage of digital tools for data exchanging in digital transformation based on desktop research from academic literature and the websites of smart city case studies. Manual coding of these contents shows how open data platforms facilitate citizen engagement in smart city initiatives throughout the world.

At first glance, there were similarities across global case studies regarding to how digital tools contributed to citizen engagement by providing city services and enabling citizen feedback. Open data platforms allow users to access, transfer, share data based on security and privacy condition. Often the aim of these tools is to provide two-ways communication between city managers and citizen to promote transparency

and trust in a city management. The dynamic communication between a service provider or producer and a user is important for effective service delivery. In the context of SC, open data platforms have been used as part of an e-engagement system which aims to increase an access to public information. Meanwhile, the public can support city data platforms by providing and utilizing data. E-smart city services facilitated the communication and connection between the government organizations and citizen (Yeh, 2017). City governments play an important role in enabling data sharing among the stakeholders. A city usually created e-channel for the public inputs based on its goals and problems. The usage of such a channel by the population were influenced by several factors including the citizen's attitude, satisfaction, and perception (Afzalan, *et al*., 2017).

Various smart cities studied by scholars showed the application of open data platforms as part of smart city implementation (Bie, *et al*., 2012; Afzalan, *et al.,* 2017; Gagliardi, *et al.,* 2017; Praharaj, *et al*., 2017). The examples included an e-government platform for citizen's information sharing, e-voting, and online feedback. In Milan, Italy, the 'UrbanSence' platform promoted the city-citizen connection by providing an open and real-time feedback about the city government's new innovations which were presented in 3D (Gagliardi, *et al.,* 2017). Many cities have applied digital channels to engage their citizens in smart city living projects. For example, 'City Dashboard London' allowed people to use live data on service conditions through multiple media channels. Enschede of Netherlands, Gothenburg of Sweden, and Leeds of UK showed real-time data on travel information such as route, cost, reviews and comments by other visitors on 2D map through a 'Tripzoom mobile application' project (Bie, *et al*., 2012). 'MyGov.in.' launched in 2015 by the Indian government to engage citizens through online platforms across 100 smart cities (Praharaj, *et al*., 2017). This Indian e-engagement initiative promoted citizen's vision sharing through essays and debate collection as well as e-voting for service priority. Online technologies could be used to increase public participation in city management. For instance, 'Talk London' enabled Londoners to participate in the policy planning process. Similarly, 'My Ideal City Bogota' in Colombia was used to recruit citizen's new

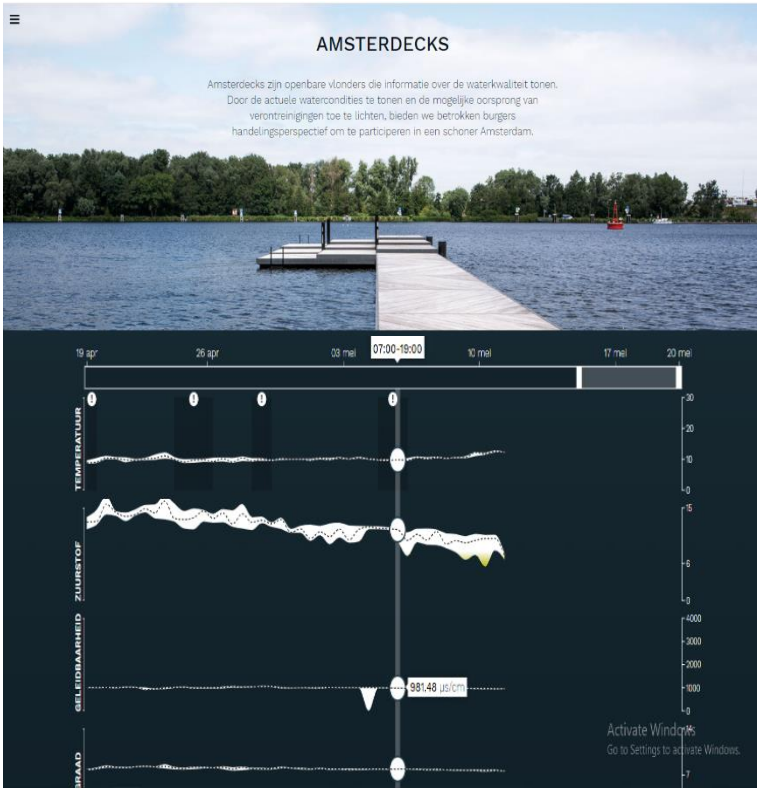
ideas on innovative designs. Social networking sites or web-based tools called the 'online participation tools' or OPTs have been utilized to help increase governance transparency based on support participatory planning (Afzalan, *et al.,* 2017). Furthermore, this was observed in Berlin (C5), as the Future Living project which integrated planning processes to conduct local residents into the space involved. It varied based on their contexts such as human capacity, natural resources, and cooperation in society. Public participation in smart city projects aimed to gain experience in technology and service their citizens.

Despite the diverse projects, four common themes emerged from the observations of 17 case studies on the usage of open data platforms in relation to citizen engagement. These are explained in the next sections.

4.2.1 Environmental monitoring and management

Several cities deployed technology to monitor and manage the environmental conditions. For instance, Amsterdecks.com (C3) in the Netherlands reported water quality in Amsterdam to citizens and visitors in its webpage (Figure 4.10a). The online display of the water condition helps the city maintain its position as one of the places with the highest water quality in the world. In Adelaide (C1), Australia, Smart Environment Monitor pilot projects were deployed to collect comprehensive environmental data such as air, sound, and other parameters through sensors (Figure 4.10b). MyGlasgow App in Scotland (C8), collected data about the solid waste management and road repair issues from the reports made to the city council by the public (Figure 4.10c).

(a)



(b)

(c)

Figure 4.10 (a) Amsterdecks.com, Amsterdam[9] (C3) **(b)** Smart LED light allows citizen to monitoring the energy consumption around the city under the Smart Environment Monitor pilot projects, Adelaide[10] (C1) **(c)** MyGlasgow App, Glasgow[11] (C8)

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[9] Amsterdecks.com

[10] www.infrastructure.gov.au

[11] www.glasgow.gov.uk/stgo

4.2.2 City data service

Open data platforms are instrumental for the cities to keep the citizen informed. In India (C15), Surat Municipal Corporation (SMC) website (Figure 4.11a) enables the citizens to stay updated with the latest happenings and project details under the smart city missions. An online communication channel can also act as a one-stop information portal for tourists and visitors to the city. This was demonstrated by Bhubaneswar.me (Figure 4.11b) in Bhubaneswar (C6) of India which presented sightseeing information as well as a survey forum on the topics relating to the city. The portal allows citizens and tourists to view an interactive city map, search for a variety of local data, and show information about public transportations. In Belgium, Citizenlab in Brussels (C7) (Figure 4.11c), a technology service provider and consultant, created an online information platform for community engagement about the municipalities such as services, news, and activities as well as digital services in form of electronic counters. This company collaborated with the Brussels-Capital Region under the 'Good move by citizens' campaign which mobilized the citizen to propose and vote on regional mobility plans. In Singapore (C14), Sgtrafficwatch.org (Figure 4.11d) was created to offered real-time traffic data, bus arrival timings, taxi availability, traffic conditions, and car park availability. The information on these services help the residents better plan their mobility in the city.

Figure 4.11 (a) Surat Smart City website, India[12](C15) (**b**) Interactive city map using search for a variety of local data on Bhubaneswar.me, India[13](C6) (**c**) Citizenlab, Brussels[14](C7) (**d**) Real time mobility data, Singapore[15](C14)

[12] www.suratsmartcity.com/SuratSmartCity/AreaBasedDevProjects

[13] www.bhubaneswar.me/

[14] www.citizenlab.co/case-studies-en/brussels

[15] Sgtrafficwatch.org

4.2.3 Citizen feedback

Online platforms help cities gain feedback from the citizens. There are many examples in European and Asian cities. In Berlin (C5), Germany, Mein.berlin.de (Figure 4.12a) allowed users to give ideas and suggestions through a registration system and find information about the city administration. Belgium's Smartcity.brussels (C7) (Figure 4.12b) acted as a portal for citizens and businesses to propose projects, vote on the suggestions and take part in a survey

(a) (b)

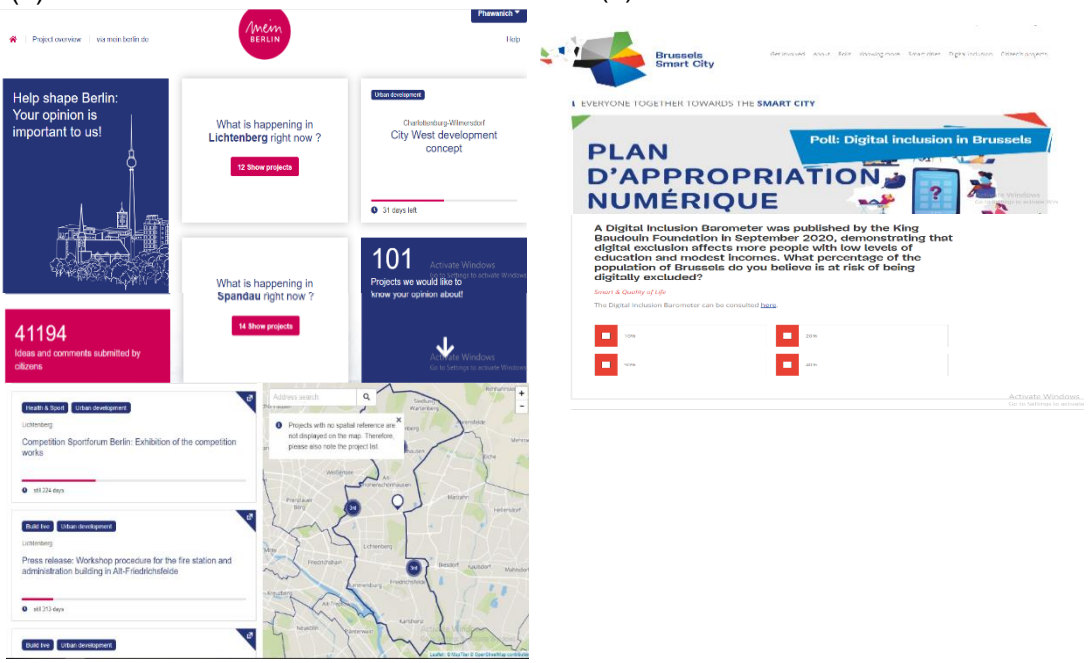


Figure 4.12 (a) City service for give ideas and suggestions from citizen, Berlin (C5) (translated from German to English language using Google Translate) [16] **(b)** Online vote by citizens, Brussels[17](C7)

[16] Mein.berlin.de

[17] smartcity.brussels/home

4.2.4 Citizen support and empowerment

Digital solutions have been used to support and empower vulnerable groups and those who were in need of assistance. In Singapore (C14), “The moments of life” application (Figure 4.13) supports families with young children aged 6 and below. The application allows Singaporean parents access to childcare services under key themes consisting of online birth registration, child’s medical appointments and immunization records, waitlisted for suitable preschool facilities, useful parenting advices via parenting articles, video. In Taipei (C16), Taiwan, the IoT and AR were used to provide the elders with an interactive mode of entertainment through the Compel physical fitness campaign. This activity encouraged elderly people to participate in community activities which could reduce illness and improve their physical and mental health. The app was however inactive at the time of writing this dissertation.

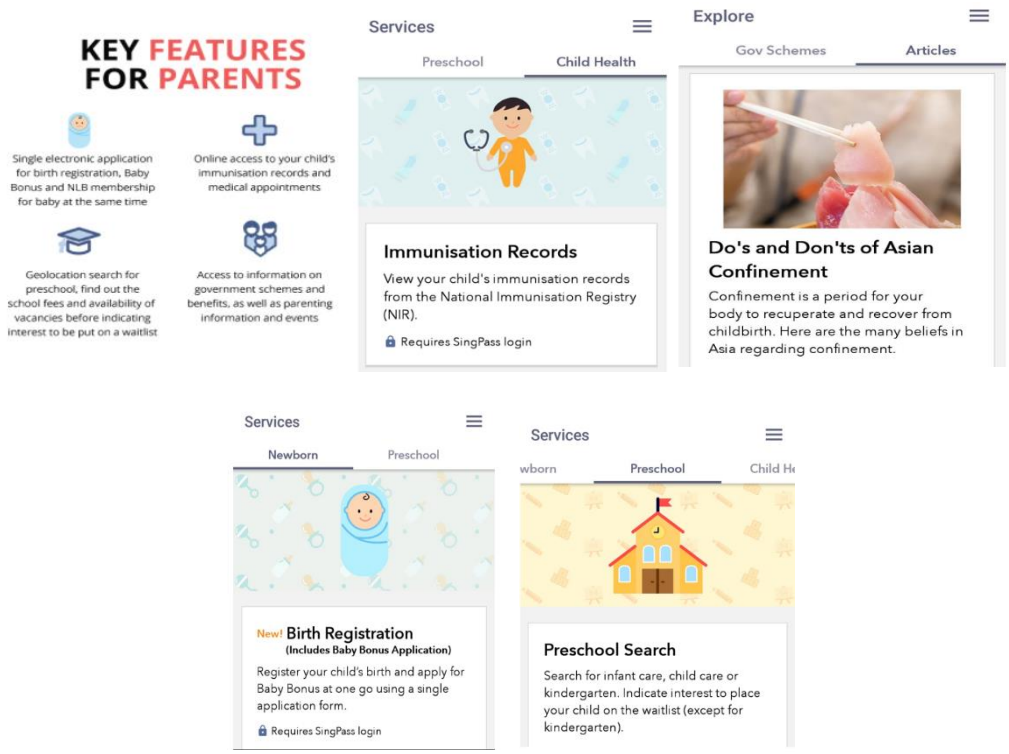


Figure 4.13 The moments of life application, Singapore[18](C14)

[18] https://www.tech.gov.sg/scewc2019/mol

Open data platforms and digital transformation have been used by cities around the world to engage and serve the citizens in various ways. Some applications focus on specific city problems or populations while others provide more general information for the public. The use of digital solutions for environmental monitoring and management, city data service and citizen feedback serve the general public whereas the online service for citizen support and empowerment targets the vulnerable population. Many digital services have been used as a virtual meeting place to exchange ideas and facilitate the discussions both among the citizens and between the citizens and city managers. However, these online tools are often used to support and strengthen the physical interactions rather than replacing them.

This section answers RQ2 on the role of open data platform on citzen engagement in smart city. Four main roles categorized from the smart city initiatives of 17 global case studies are environmental monitoring and management, city data service, citizen feedback, and citizen support and empowerment. Across these themes open data platforms are tools for active communication that could help increase transparency as well as efficiency in the way city problems are managed (discussed further in Section 5.2).

4.3 Citizen engagement practice in smart city

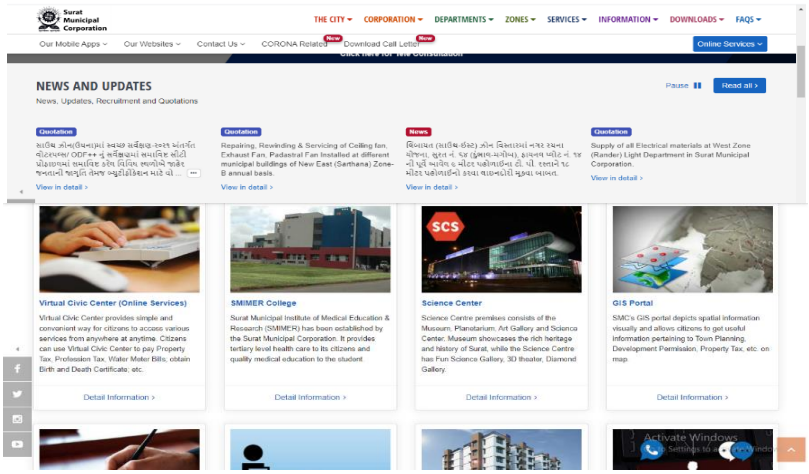
This section identifies the citizen engagement themes from 17 selected cases of smart cities. It captures how the cities engage the residents in their smart city implementation. Although different practices were deployed by the cities depending on their capacities and priorities, some common patterns could be found in the way citizens engaged in smart city projects. Three main themes of citizen engagement strategies were categorized namely open government data, interaction space and purposeful events.

4.3.1 Open government data

Open government data is represented by data portals and information sharing through online media and applications associated with governmental agencies and projects. Smart cities used an open data platform to engage with the people in several ways. Online tools were used to display event details such as date, time, place in Amsterdam (C3) and Surat (C15) (Figure 4.14a). The Austrian city of Vienna (C17) provided a free user account for contacting the city officers via message, map and contact list via Sag's Wien Application (Figure 4.14b).

Many open government data platforms were used to provide city data such as infrastructure, services and environmental conditions. Bhubaneswar (C6) conducted an online public vote while Brussels (C7) used a website to survey the citizen's opinion. Amsterdam (C3) and Adelaide (C1) used an online system for environmental monitoring. In Amsterdam (C3), sensors were used to detect water quality for swimming and tracking the movement of the citizen. Singapore (C14) used real time data to inform the people about the public transportation services and parking.how the government openness in data sharing can enable citizen to take action in the public. Transparent and accessible data sharing services provided by the city were aimed to help increase the citizen awareness and gain insights required in addressing complex city problems.

(a)



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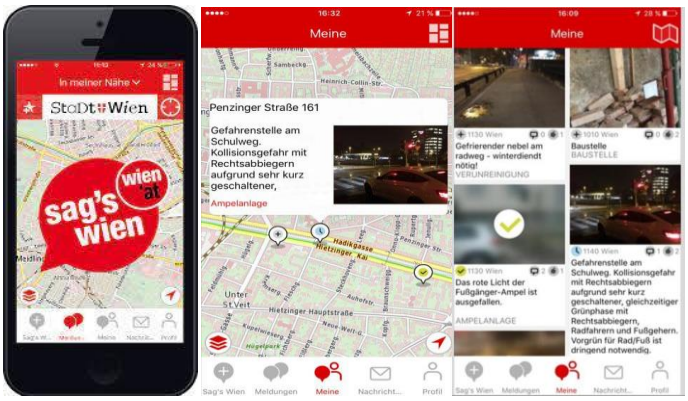

Figure 4.14 (a) Surat municipal cooperation, India[19](C15) **(b)** Sag's Wien Application, Vienna[20](C17)

Despite the similarity, there were some variations in target users of these services. In Glasgow (C8), an application was developed for waste management and public road repair for the general public while Teipei (C16) initiated an application for an aging population with the focus on elderly health care. In C14 Singapore, there were digital initiatives targeting families with specific needs for childcare support. The role of open data in citizen engagement was also described in detail in Section 4.2. It is noteworthy that the use of open government data focuses heavily on the technological

[19] www.suratmunicipal.gov.in/

[20] appadvice.com/

solutions as the services while treating the citizen as users rather than the co-creator of technology and solutions.

4.3.2 Interaction space and physical facilities

Many smart city projects worldwide focused on providing spaces for citizen interactions and service facilities. Interaction space is represented by the physical public space for people to meet, exchange knowledge and ideas. Many cities such as Amsterdam (C3), Seoul (C12), and Taipei (C16) provide physical facilities for people to use for leisure as well as business activities (Figures 4.15a, 4.15b, 4.15c, respectively). Two kinds of space utilization were observed, exclusive and inclusive spaces.

Figure 4.15 (a) The Co-Creating Responsive Urban Spaces (CO-REUS) project, Amsterdam[21](C3) **(b)** Innovation park, Seoul[22](C12) **(c)** IoT innovation lab, Taipei[23](C16)

[21] civicinteractiondesign.com/

[22] english.seoul.go.kr/ and https://english.visitseoul.net/

[23] medium.com

An exclusive space was characterized by an innovation hub or digital knowledge toolkits targeting the participants with specific technological skills. The examples include IoT living lab in Amsterdam (C3), Smart region living lab in Hong Kong (C9), Smart city innovation center in Nice (C10), Digital experience center in Pune (C11), Seoul's citizen innovators in Seoul (C12), and IoT innovation lab in Taipei (C16). In Berlin (C5), the smart city facilities included a counter service with a hotline and an expert consulting corner for reliable information about public administration services using a single telephone number.

An inclusive space was represented by providing a place for non-specific audience and generic topics. An inclusive space referred to the initiatives which catered to the general public regardless of their technological skills. For example, Amsterdam (C3) and Bhubaneswar (C6) provided a facility to increase the interaction culture among the citizens using urban development design and a public space. Contrary to common perceptions of information technology as a hallmark of smartness, not all smart city projects relied on digital technology. In Bhubaneswar (C6), better signages were deployed as a smart city initiative to increase the convenience and accessibility in wayfinding (Figure 4.16). Energy technology has also been used to 'smarten' the city. The city of Vienna (C17) collaborated with Wien Energie to initiate a solar panel rental in which the customers can give the panel back to the company and receive full refund under the rental agreement.

Figure 4.16 Digital City Signage, Bhubaneswar[24](C6)

[24] https://orissadiary.com/

4.3.3 Purposeful event

Purposeful events were represented by training, exhibitions and competitions aimed to create awareness about smart city projects. Several cities have conducted training activities for both IT-related and non-IT skills. The examples for training for IT skills include digital and innovation courses in Berlin (C5), digital e-learning courses in Brussels, and city innovation workshops in Seoul (C12) (Figure 4.17a).

For non-IT skills, training in leadership skill and self-defense technique for women and young people were conducted as part of the smart city projects in Bhubaneswar (C6) (Figure 4.17b). While in Agra (C2), cycling and running events were organized to raise awareness in energy consumption reduction which specifically organized for women and children. (Figure 4.17c).

(a)

(b) (c)

Figure 4.17 (a) City innovation workshops, C12 Seoul[25] **(b)** Socially Smart Bhubaneswar, C6 Bhubaneswar[26] **(c)** Cyclothon, C2 Agra[27]

[25] smartcityinnovationlab.com/

[26] mycitylinks.in/

[27] www.hindustantimes.com/

Non-technical activities and exhibitions were conducted in many cities. The examples included city tours and open city programs to provide smart city experience in Amsterdam (C3) and techno fair in Surat (C15) (Figures 4.18a and 4.18b). The Mayor's vision presentation was presented in Brussels (C7) as part of the smart city event (Figure 4.18c). Barcelona (C4) and Seoul (C12) organized smart city workshops, seminars, maker space events to increase local awareness and participation in the smart city (Figure 4.18d). In Bhubaneswar (C6), mural street arts were created to present a child-friendly smart city concept (Figure 4.18e). In Taipei (C16), a fitness program for elderly and people with disabilities was organized to engage a specific population.

Figure 4.18 (a) The Experiences/tours, Amsterdam[28](C3) **(b)** The Smart City Techno Fair (29th to 31st October 2015), Surat[29](C15) **(c)** 4th Smart City event, Brussels[30](C7) **(d)** Maker district event, Barcelona[31](C4) **(e)** STAMP (Street Art and Mural Project), Bhubaneswar[32](C6)

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[28] amsterdamsmartcity.com/

[29] everythingcivic.com/

[30] smartcity.brussels/

[31] ajuntament.barcelona.cat/

[32] www.smartcitybhubaneswar.gov.in/i-am-bbsr

Competition and awards on both technical and non-technical topics were organized as part of smart city initiatives. Hackathon in Surat (C15), Pune (C11), and Seoul (C12) (Figure 4.19a, 4.19b, and 4.19c, respectively) represented a technical contest aiming to inform and educate citizens in programming and design thinking. Non-technical competitions included calls for public health and technology proposals and essays in Singapore (C14), environmental protection and sustainable development initiatives in Brussel (C7) which citizens propose a sustainable ICT project under citizen-driven and benefit the residents by involving them in environmental protection and sustainable development (Figure 4.19d) and vertical herb gardens for young children in Vienna (C17) (Figure 4.19e), In Surat (C15), a logo design contest (Figure 4.19f), to promote the city identity was organized for students and the general public.

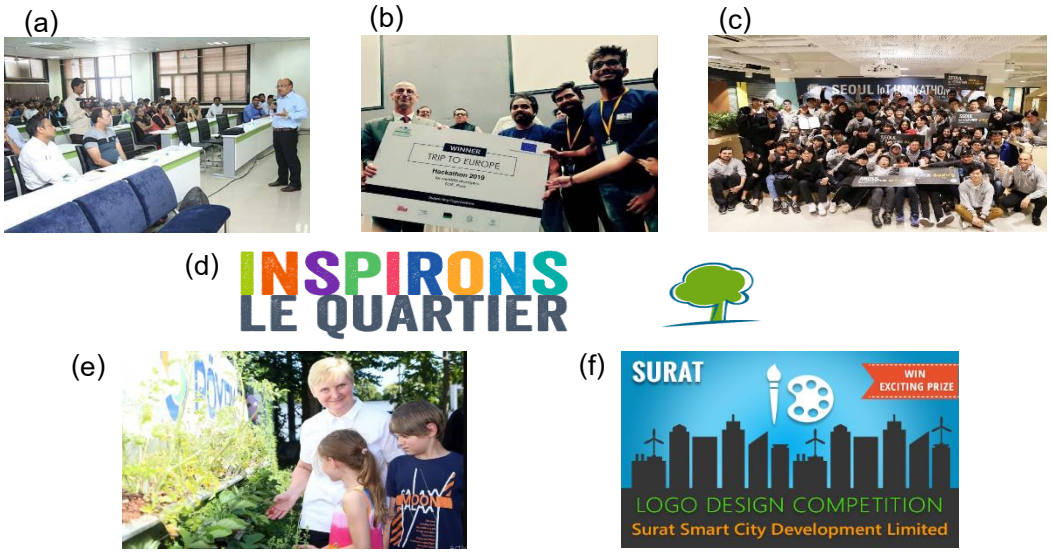

Figure 4.19 Hackathon in **(a)** Surat[33](C15), **(b)** Pune[34](C11), and **(c)** Seoul[35](C12) **(d)** Inspirons Le Quartier, Brussels[36](C7) **(e)** Smart city hanging gardens, Vienna[37](C17) **(f)** Logo design contest, Surat[38](C15)

[33] www.suratsmartcity.com/

[34] eeas.europa.eu/

[35] os.mbed.com/

[36] inspironslequartier.brussels/

[37] smartcity.wien.gv.at/

[38] smartnet.niua.org/

Events were effective in engaging with people from various target groups on diverse topics, through multiple channels. However, most events were in a way that the participants were the audience rather than the contributors. A few examples which engaged the citizen as a co-producer of the project were observed in the Co-creating Responsive Urban Space (Co-ReUS) in Amsterdam (C3). The project invited the citizens to design their public space in the context of the Arena Boulevard together with the aim of improving the liveliness in urban areas. In Berlin (C5), 'The Future Living' project in Adlershof district recruited the local residents and utilized the participatory planning process to create an urban plan using a combined technology such as solar power, light and ventilation conditions to improve living quality of elderly people.

This section resolved RQ3 by drawing on the example of citzen engagement strategies from 17 case studies worldwide. The findings highlight the significance of the mindset and attitude of the key stakeholders in smart city projects. This is further discussed as 4Ps or public-private-people partnerships in Section 5.3 in the next chapter.

4.4 Citizen engagement in Phuket smart city initiative

This section describes the findings from observations during 29 Phuket smart city meetings and 20 related documents on citizen engagement in Phuket smart city initiatives. It begins by identifying the key stakeholders in Phuket smart city. Next, the section explains the timeline of smart city initiatives in Phuket in relation to the stakeholders. Finally, the section shows how citizen engagement is perceived and implemented by key stakeholders in Phuket smart city initiatives. categorized namely open government data, interaction space and purposeful events.

4.4.1 Key stakeholders of Phuket smart city

Phuket smart city stakeholders comprised four main sectors; public organizations, private businesses, technology providers, education sectors and civil

society sectors (Figure 4.20). These stakeholders were identified from key meetings and documents related to Phuket smart city.

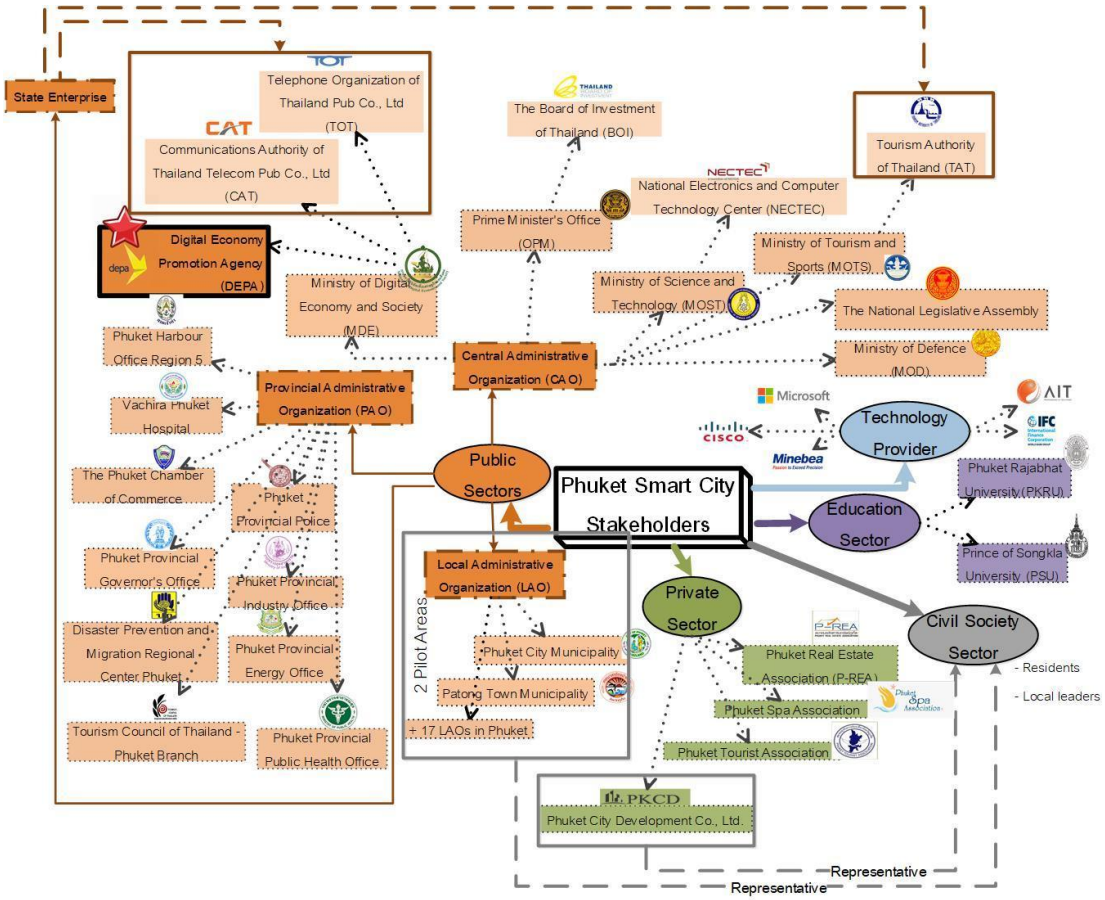

Figure 4.20 The map of Phuket smart city stakeholders (Adapted from Appendix III)

The public sector can be categorized into 4 groups namely central administration, provincial administration, local administration and state enterprise. Central administration referred to the Prime Minister's Office, Ministry of Digital Economy and Society, Ministry of Science and Technology, Ministry of Defence, Ministry of Tourism and Sports, National Legislative Assembly and their subordinate agencies. This included the Digital Economy Promotion Agency (DEPA) which was the main organization in charge of driving and facilitating the Phuket smart city projects. Provincial administrations included the Phuket Provincial Governor's Office, Public Health Office, Industry Office, Energy Office, Harbour Office, Disaster Prevention and Mitigation, Police and Vachira Hospital. Local administration mainly focused on the municipalities where the smart city project took place, especially in two areas, Phuket City, Patong Town Municipalities, out of 19 local administrative organizations. State enterprise described the Communication Authority of Thailand Telecom Pub Co., Ltd and Telephone Organization of Thailand Pub Co., Ltd. Private sector included business associations and prominent local business owners. Phuket Tourist Association, Phuket Spa Association and Phuket Real Estate Association were part of the inner circle in the smart city initiatives as they represented the main businesses which drive the Phuket economy. Phuket City Development (PKCD)[39]was set up in 2016 by influential business owners in Phuket to promote smart solutions for better urban development. Technology providers in Phuket smart city projects included IBM, CISCO, Microsoft, Minebea, IFC and AIT (see List of Abbreviations and Symbols). Education sector comprised Prince of Songkla University Phuket Campus and Phuket Rajabhat University located in the province.

The collaborations between these stakeholders were strategic in ensuring that smart city projects can be implemented and sustained in the long term. During numerous meetings, public-private partnerships (PPPs) were stated as an important mechanism for smart mobility and open data platforms. Similarly, citizen engagement strategy was frequently mentioned in the meetings at both national and local community levels. Nevertheless,

[39] www.pkcd.co.th

there was no concrete plan or organization to deliver such an idea into action. At the time of the study, it was unclear which stakeholder or organization were responsible for engaging the citizens and raising awareness in Phuket smart city.

4.4.2 Phuket smart city development

This section explains the timeline of key events in Phuket smart city development to provide a background on the factors that shape its implementations. Phuket smart city started from the national government policy implemented by the Ministry of Digital Economy and Society of Thailand (MDE) through the Digital Economy Promotion Agency or DEPA (formerly known as SIPA) as a facilitator (SIPA, 2015a). In 2015, DEPA proposed the Phuket Smart City 2020 roadmap which focused on smart economy growth and safety such as free Wi-Fi, CCTV analytics, and command center. The goals of Phuket smart city were set by the Phuket smart city committee with a motto “Smile, smart, sustainable tourism island”. The Phuket governer at the time acted as the Phuket smart city chairperson highlighted the need to address Phuket crises using technology especially for the issues of marine safety and terrorism. Two major events contributed to high prioritization of safety in Phuket. In 2016, Phuket faced two bomb threats in Patong town municipality (The Phuket news, 2016). Although there was no explosion or casualty, the tourism image was badly affected resulting in a temporary drop in the local economy. In 2018, a tourist boat from Phuket capsized off during a storm off the coast of Hey Island killing 47 tourists (BBC news, 2018). This incident caused several cancellations of hotel and trip bookings and greatly reduced Phuket competitiveness as a world-class tourist destination.

Since the announcement of the national policy to select Phuket as a smart city, there have been numerous meetings and events (See detailed timeline in Appendix III). By March 2016, Phuket had signed the Memorandum of Understanding (MOU) with Busan Metropolitan City, South Korea in order to learn from the experience of Busan smart city development, collaborate research on smart city and digital technology, and exchange Tech startups between the two cities (SIPA, 2016). Shortly after, Phuket

Provincial Office (PPO) organized the logo design and slogan competition for Phuket smart city in order to increase the public awareness on the upcoming smart city projects (PPO, 2016a).

In May 2016, PPO and DEPA presented the Phuket smart city vision "Smile, smart, sustainable tourism island" to Phuket local government officers. The meeting was organized to increase the understanding of Phuket government officers about the policy and propose pilot projects for the local areas. Consequently, Phuket smart city projects were designed based on local community requirements submitted to PPO. The Phuket smart city committee then selected the projects which were categorized into "7 Phuket smart city themes" (Table 4.1) for the 2016 budget. The budget came from several sources, including Ministry of Digital Economy and Society (MDE, formerly known as MICT or Ministry of Information and Communication Technology), DEPA, and National Science and Technology Development Agency (NSTDA), Andaman Provincial Cluster, Phuket Provincial Office and Prince of Songkla University Phuket campus (PPO, 2016).

Table 4.1 Phuket smart city themes and projects for 2016 budget

Theme	Project	Key facilitator
Smart healthcare	Real- time emergency operations center (EOC)	Vachira Phuket hospital
Smart governance	Phuket city data platform	Phuket Provincial Governor's Office
Smart education	Q-Info system in Phuket city municipality school	Phuket City Municipality
	Center of digital excellence Phuket (CODE Phuket)	Prince of Songkla University, Phuket campus
Smart environment	IoT environment sensors in pilot areas	Prince of Songkla University, Hat Yai campus

Table 4.1 Phuket smart city themes and projects for 2016 budget (Cont.)

Theme	Project	Key facilitator
Smart Economy	1. Innovation park 2. Startup training	DEPA
Smart safety	1. Implement CCTV and command center 2. Implement maritime management and control	1. Disaster Prevention and Migration Regional Center Phuket 2. Phuket Provincial Police 3. Harbour Office Region 5 Phuket
	Mobile unit car	Phuket provincial police
Smart Tourism	Public free Wi-Fi in Patong Town and Phuket City Municipalities	1. CAT Phuket (Communications Authority of Thailand) 2. TOT Phuket (Telephone Organization of Thailand)

Some of the proposed projects required a long term funding for maintenance and were subjected to multiple approval processes. Many proposals were not funded because they were deemed lacking tangible outputs and did not match with economic development goals of Phuket smart city vision, *"The tourism island of sustainable growth by enhancing creative economy to provide happiness for all"* (PPO, 2016b, also in Appendix III; No. 19). Nevertheless, projects on CCTV and public Wi-Fi were prioritized and implemented quickly in tourist areas. Phuket City and Patong Town Municipalities (Figure 4.21) were selected as pilot sites for 'the smart living community' and 'smart sensor' projects (SIPA, 2016b; SIPA, 2016c).

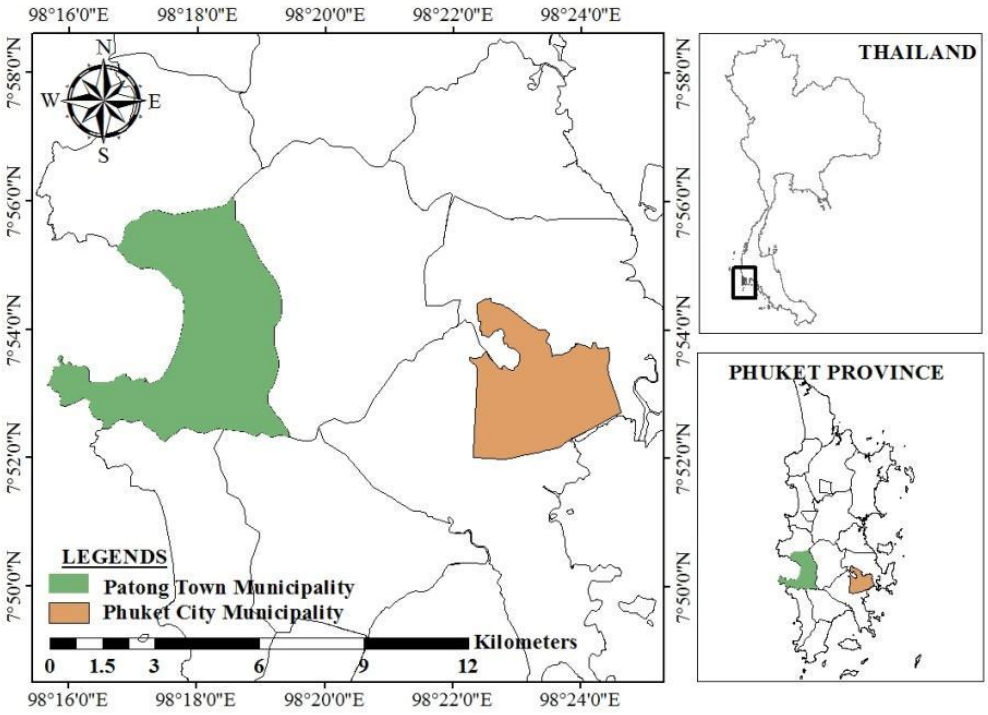

Figure 4.21 The map of pilot sites 'smart living community' and 'smart environment sensors' projects in Phuket smart city

Phuket City and Patong Town Municipalities were the initial focus for smart city initiatives as they oversee several important tourist areas such as old town roads and Patong beach. The mayors and senior managers of these municipalities were asked to identify emergent issues as inputs for the Phuket smart city proposal development (Table 4.2). This resulted in several projects for air quality, water quality, parking, disaster, disease control, CCTV and high speed free Wi-Fi covering a target area of 28.4 square kilometers (SIPA, 2016b). Three organizations; DEPA, PSU, and NECTEC, collaborated in managing these projects with Communications Authority of Thailand Telecom (CAT) acting as the tender for implementation in both areas. PSU and DEPA focused on environmental sensors for air and water qualities while NECTEC oversaw CCTV projects. CCTV analytics system and IoT environment sensors were integrated and installed in both pilot areas in 2016 with a plan for expansion (Leader, 2018).

Table 4.2 reflected some local problems that were identified by local mayors of Phuket City and Patong Town. This helped shape a smart city policy and roadmap promoted by the Phuket Provincial committee.

Table 4.2 Phuket smart city projects in Phuket City Municipality and Patong Town Municipality

Responsible Organization	Topic	Priority in Patong Town Municipality	Priority in Phuket City Municipality
DEPA and PSU Hatyai	Environmental Sensors		
	1. Air Quality	- Smoke from Indonesian forest burning	- Detect pollution from Solid Waste Incineration Plant
	2. Water Quality	- Wastewater treatment plant overflown into the sea - Flooding	-Flooding due to waste obstruction in canals - Wastewater management
	3. Others	- Landslide	- Parking management - Disease outbreak
NECTEC	CCTV	- Traffic management - Crime reduction - Beach and coastal encroachment	- Traffic light management - Illegal activity monitoring
CAT	High speed public free Wi-Fi	- Patong seaside road	- Phuket old town

(Adapted from researcher observation note on May 24th, 2016 meetings in Appendix III)

In July 2016, a series of seminars on Phuket smart city were organized by PSU Phuket campus and PIC Phuket Co., Ltd to increase the smart city understanding in the residents and private companies (Phuket Hot News, 2016; PPO, 2016a; PSU Phuket campus, 2016). The seminars presented seven themes of Phuket smart city, the

requirements in each theme. The presentations included the roadmap and vision as well as the issues identified by the pilot areas' mayors. Participants' comments and feedback on sustainable management and the benefits of smart city projects for Phuket people were also collected.

In August 2016, a follow up meeting was held by Phuket Governor to monitor smart city projects (National News Bureau of Thailand or NNT, 2016). The attendants were mainly the academics and officials in the public sector namely Prince of Songkla University, Provincial Administrative Organization, Tourism Authority of Thailand, Department of Disaster Prevention and Mitigation Phuket Provincial Public Health Office, Phuket Provincial Police (SIPA, 2016a). Phuket smart city progressed and problems were reported to the Phuket smart city committee during these meetings. Recurrent problems which were often mentioned were the lack of data integration in the OGD system, insufficient infrastructure maintenance especially for CCTV analytics, and command center. These follow up meetings were conducted again in June 2017, March 2018, and May 2018.

In September 2016, Phuket smart city project official launch was organized by DEPA and its partners (Manager Online, 2016). The event objectives were to introduce the Phuket smart city project to entrepreneurs and local communities. The launch presented the vision of Phuket smart city 2020 "Smile, smart and sustainable Phuket". In addition, an innovation park and smart city projects were showcased by DEPA.

In November 2016, Phuket city development Co., Ltd (PKCD) officially announced the Phuket smart transportation project. This private company was set up and funded by 25 business owners in Phuket. The company invested in the operation of Phuket smart bus with a plan to implement Light Rail Transit (LRT) in 2021 (Smart Growth Thailand, 2016).

In January 2017, brainstorming workshops were organized with local residents in three Phuket districts by Phuket PAO and PKCD to identify needs and requirements from the communities. Four topics were discussed namely transportation, public utility and environment, tourism, and smart city development. Overall participants

were more than 50 people in the workshops of which 11 people attended in the smart city subgroup. The main issues raised by the participants were smart lighting, smart security, tourist wristband and knowledge repository system. For smart lighting, there were calls for a solar-powered CCTV system and public free WiFi which was implemented in pilot municipalities – Phuket city and Patong town municipalities. In terms of smart security, the demands included the CCTV analytics for crime and accident prevention which transpired into projects under police and military authorities for border security covering air, land, and marine travels (MGR online, 2019). Tourist wristband[40] for marine safety and management, and emergency alerting system were to be implemented at pilot ports in Phuket (ELeader, 2019b). On the topic of knowledge repository system, data centre and sharing via 3D map layers were highlighted and later developed for Phuket provincial governor and executive team.

From March to September 2017, several workshops were organized by DEPA to improve technological skills of innovators and local city officers (DEPA news, 2017). These included a 3D visualization workshop for government officers, the digital technology and innovation seminars for startups, and digital marketing and strategy training for SMEs. There were also events hosted by other stakeholders, for example, a seminar showcasing IoT for environment monitoring systems based on Phuket local community requirements by PSU (Sparkbit, 2017).

In February 2018, DEPA proposed the Phuket big data platform project to the committees of Science and ICT and the National Legislative Assembly. At this meeting, the challenges on citizen engagement and universal design for vulnerable populations were raised. Subsequently, Phuket Digital Innovation Summit 2018 was hosted by DEPA and PKCD in June 2018. The seminar discussed the opportunities and limitations of virtual reality (VR) applications in business. The topic of citizen engagement was highlighted by DEPA as a challenge in Phuket smart city. Shortly after the summit, DEPA organized a seminar aiming to empower the smart enterprise for sustainable

[40] Device for tourist tracking who travel across island in Phuket (salika.co, 2018)

tourism growth in July 2018. The seminar discussed economic growth and the digital transformation mindset in the tourism sector using online travel agents (OTA) such as Traveliko and Web Connection.

In 2019, the Smart City Thailand Office was established by the Office of the Prime Minister using the operational workforce from DEPA and related central administrative organizations. The national smart city development steering committee was formed to identify the smart city regions according to predetermined criteria and allocate funds for smart city activities (15th NSTD Annual Conference, 2019). Consequently, the Phuket smart city committee needed to revise its previous plan in order to be consistent with the Smart City Thailand Office specifications. For instance, the seven Phuket smart city themes were adjusted to conform with the seven smart city components at national level (see in Table 4.3). The pilot area for project implementation was also reduced from two to one area under the budget support from the Smart City Thailand Office.

Table 4.3 Smart city themes of Phuket and the Smart City Thailand framework in 2020

Phuket smart city	Smart City Thailand
Smart environment	Smart environment
Smart governance	Smart governance
Smart economy	Smart economy
Smart tourism	
Smart healthcare	Smart living
Smart safety	
Smart education	Smart people
	Smart mobility
	Smart energy

The differences in the themes of the smart city of Phuket and the national committee reflect different perspectives and prioritizations. In Phuket, environmental management, living quality, security, and the free Wi-Fi for the public were the urgent

problems. However, the smart city projects to address these issues were limited by the budget allocated by the central government. Government officers and a designated committee made decisions on the funding of the projects. Some project proposals were rejected due to the perception that they did not align with Phuket smart city goals of 'Smile, smart sustainable tourism'. Proposals that were not funded included a drug dispensing robot and tele-video conference system for the government sector. Despite an emphasis on technology, Phuket smart city management and development remained dependent on the attitude and knowledge of key decision makers in a smart city.

During the COVID-19[41] pandemic in 2020, digital technology and information management were suddenly the lifeline of Phuket. "Phuket Smart Checkpoint" was quickly set up by the Phuket provincial police with the funding by private sectors in Phuket in order to track and reduce infection in the province (Phukethotnews, 2020). The Phuket Smart Checkpoint system was installed at the Phuket gateway for screening and tracking of high risk travellers and monitoring vehicle licence plates (Thansettakij, 2020). This platform was developed as a stepping stone towards smart tourism in Phuket (The Nation Thailand, 2020). It is noteworthy that this project was implemented through public-private partnership rather than by central government funding. This highlights an essential role of public engagement in implementing practical and relevant solutions in a smart city especially in the face of crisis.

4.4.3 Phuket smart city initiatives and citizen engagement

This section identifies citizen engagement strategy in Phuket smart city initiatives. The findings are from the contextual analysis of interviews and observation notes during key Phuket smart city events attended by the researchers. The topic of citizen engagement was mentioned in 13 meetings out of 43 events observed (See in Appendix III). It was highlighted in 6 internal meetings attended by Phuket smart city committee and

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[41] COVID-19 is the coronavirus disease 2019 which has rapidly spread worldwide with consequential human disease (Ceron, *et al*., 2020)

internal working groups and 7 public meetings which were open to the general audience. The rest of the events mainly focused on technology services and presentations on the Phuket smart city planning and projects and did not show any information on citizen engagement.

Since the announcement of the national policy to identify Phuket as a pilot smart city in 2015, citizen engagement has been a recurrent topic in several Phuket smart city committee meetings and seminars as well as in events organized by related organizations. Table 4.4 shows key events and organizers of early Phuket smart city meetings in which citizen engagement was mentioned.

Table 4.4 Summary of meetings related to Phuket smart city in which citizen engagement was mentioned

Host	Event frequency	Citizen engagement suggestions *(Organization which proposed the idea)*	Engagement strategy
DEPA with partners	16	- Increase participation among stakeholders in Phuket through training and certification. *(PSU Phuket)* - Educate and support the community. *(PAO and education sector)*	Purposeful event
		- Design equality channels to citizen participation including vulnerable groups. *(National Legislative Assembly Committee)* - Discuss citizen engagement methods with technology provider *(DEPA)*	Open government data
DEPA	13	- Increase understanding of people in smart cities. *(The Federation of Thai Industries)* - Digital literacy education and youth education. *(PAO)*	Purposeful event
		- Attitude management about data platform sharing. *(Hotels Association in Southern region)*	Open government data

Table 4.4 Summary of meetings related to Phuket smart city with citizen engagement mentioned (Cont.)

Host	Event frequency	Citizen engagement suggestions *(Organization which proposed the idea)*	Engagement strategy
PAO	8	- Appropriate methods for citizen agreement and understanding. (MDE) - Open data and sharing platform in public health and security. *(PAO)*	Open government data
		- Increase the participation among stakeholders. *(PSU)* - Human resource development in terms of digital literacy and creative thinking. *(PAO)*	Purposeful event
Private sector	7	Ubiquitous open data platform *(CISCO)*	Open government data
Education sector	5	Conduct smart people projects and set up innovation parks in collaboration with DEPA. *(PSU Phuket and Hat Yai)*	Interaction space

Table 4.4 presented how Phuket stakeholders think citizen engagement should be incorporated into Phuket smart city initiatives. In various meetings and events hosted by these organizations, the citizen engagement themes of open government data platforms and purposeful events were often proposed for Phuket smart city initiatives. The interaction space and physical facilities were primarily driven by DEPA and PSU through training and workshops for digital skills and start ups.

Citizen engagement strategy in Phuket smart city appeared more as ideas rather than concrete actions. Some stakeholders attributed the inaction to the lack of an organization to promote citizen engagement in Phuket. This was reflected through a statement from CO(a), an officer from a central government organization which was a key facilitator responsible for smart economy in Phuket smart city project, stating that

> *"….Citizen engagement is very important for sustainable mega project management but [we] lack expert organization in citizen engagement encouragement. If we have a specific organization for promoting community participation, it will be helpful for the sustainability of many city projects....]".*

CO(a) was from a government body which invested mainly in ICT infrastructure for public services such as free public Wifi and analytics CCTV with the main mission to promote innovation centers for startups. The statement reflects a bureaucratic culture that often works strictly within a clear boundary and refers to additional tasks beyond its scope of responsibility to other organizations.

Among the first to mention citizen engagement or public participation in Phuket smart city projects was E, a representative from the education sector which was a responsibility organization of smart education. The following quote by E demonstrates this point.

> *"……We should focus on increasing participation among stakeholders in Phuket to achieve the success of the city project. Digital training and related e-usage education both short or long courses will lead to smart people as a basis of Phuket smart city project"*.

E also helped organize public forums to elaborate the seven themes of Phuket smart city and provide information about Phuket smart city to the general public. The need to increase digital understanding and education in citizens, especially in youth, was important for increasing the public engagement in Phuket smart city. This notion was supported by PO (a), an officer from a provincial organization which headed Phuket smart city committee and responsible for smart government and PO (b), an officer from a provincial organization in charge of smart safety. PO (a)'s organization was the first among the public sector in Phuket to officially promote the Phuket smart city events to the general audience through logo and slogan competitions. PO (a) also proposed digital literacy education and creative thinking training in government officers at both managerial and operational levels. The emphasis on educating youth and the general population was demonstrated through the statement by P(c) from the private sector.

> *".....people are lacking the smart city knowledge especially in youth and elderly groups. We should educate the youth and then they will teach others in their families."*

Gathering the local community's needs was seen as a way to engage citizens in Phuket smart city projects by LO (a) and LO(b), representatives from local administrative organizations in the pilot areas. The importance of having suitable strategies to increase the citizen engagement in smart city projects was highlighted by CO (b), an officer from the central organization who was a direct manager of CO(a) and

a decision maker in smart city project funding allocation. CO (b) suggested that appropriate methods should be used to increase the understanding and acceptance of the projects among Phuket's citizens. Nevertheless, the challenges in raising the awareness and engagement of the citizen were exemplified in the statement by PO (b).

> "…..*Smart city project has been publicized for a long time but has not materialized in action. The reason is that people still have no clear understanding about what citizen's benefits in smart city projects are, even the government officers [don't know]".*

It was noteworthy that the need to increase engagement from disadvantaged or minority groups in the society was also mentioned as a way to promote an equitable society. This was highlighted by CO(c), an officer from a central organization in charge of Thailand smart city committee, who stated the importance of a universal design in city services in order to accommodate the vulnerable groups.

Meanwhile, effective governance and transparency improvement were mentioned by the technology providers (T) highlighting that ubiquitous open data platforms and city services could promote smart ideas in Phuket smart city stakeholders. T proposed an online platform as a way to increase knowledge and understanding in the digital city and projects in Phuket society. Moreover, T proposed smart lighting called "smart pole" which was installed in PSU for real-time collecting and analysing data through multi-sensor to enhance decision-making across city agencies (Eleader, 2019a). Big data solution using AI and IoT devices was proposed by IBM to increase the efficiency of open government data (Phuket Public Relations Department, 2017).

> *"……Many countries [T's case studies] identified stakeholder needs using a platform for connecting between their residents and stakeholders as ecosystem*

participants. Big data management was a vital tool to apply with connecting solutions."

Consequently, Phuket city data platforms for different user types were proposed by PO (a) as an attempt to engage the public as well as manage city problems. Users were classified into two levels namely city management and citizen. For the city management, local administrative organizations (LAOs) can access an online dashboard for information on water level, crime, air quality, and disaster. For the citizens, residents and tourists can find important information on emergency contact numbers and the free Wi-Fi locations as well as provide feedback through a city application (Figure 4.22).

Figure 4.22 Phuket smart application by CAT

Despite the benefits of an open data platform, data sharing faces obstacles in terms of governmental restriction and lax law enforcement. This problem was described by P(b), a hotel and tourism industry coordinator, when talking about sharing and collecting commercial data on a privately developed platform.

> *"…. We are facing some limitations from regulation and a negative attitude towards data sharing in the platform. It showed the lack of understanding and many illegal businesses especially in tourism operators."*

To achieve meaningful and effective citizen engagement, barriers to an effective management of open data platforms must be addressed. PO(a) suggested an education training for the government officers and users as the first step to ensure the quality of management and usage of open data platforms in the long term. T, a technology provider, emphasized on the ease and security of the platform to be developed and used. Having seen the problems in the projects previously implemented in their pilot areas, LO(a) and LO(b) stressed a budget plan for maintenance of the system as well as the balance between the real-time feedback and data accuracy. Many of these factors depend on having well-trained and active officers to be in charge of the platform or system operation as CO(a) had repeatedly stated.

Phuket smart city exhibited many citizen engagement strategies featured in the case study cities. However, the emphasis on the role of citizens as the beneficiaries and drivers of the Phuket smart city initiatives was limited. There was no mention of citizen engagement in city planning as part of Phuket smart city. While Phuket smart city stakeholders recognized the importance of citizen engagement as part of a sustainable future, most funded projects focused on infrastructure building such as public freeWi-Fi, CCTV, and command center for operation. Public participation was observed mainly through seminars and exhibitions. Nonetheless, these events were often organized to

promote the projects which have already been allocated budget by the central government.

Key actors in Phuket smart city often identified citizen as a 'user' of the city services while regarded the start up and innovator groups as a co-producer. The perception of the city managers on the citizen capacity and readiness in technology can influence the way the city engages its citizen. In Phuket, there were concerns on public acceptance of the smart city projects due to the lack of knowledge and understanding in the community. This suggests low trust in the ability of the citizen to participate effectively in smart city policy. As personal perceptions and attitudes could influence people's behaviours (Venkatesh, *et al*., 2003) and engagement, an understanding of residents' socio-cultural characteristics and awareness in Phuket smart city was necessary.

This section addressed RQ4 on how citizen engagement has shaped Phuket smart city. The wider public in Phuket has limited access to planning and implementation of the projects. Instead, the residents' needs are assumed through representation by local admintrative organizations in pilot areas (Patong and Phuket City) and key stakeholders from businesses and government authorities. Engagement activities mainly focused on contests, trainings, and workshops on specialized topics which were exclusive to certain target groups. The lack of inclusive public campaign contributed to low awareness of Phuket residents in smart city development shown as a result in Section 4.5.

4.5 Citizen's attitude towards engagement in Phuket smart city

This section reports data from a field survey with the residents who live in Phuket (See Table 3.3 and Figure 3.3 in Chapter 3). The survey asked Phuket residents about their perspectives and participation in Phuket smart city activities as well as selected topics related to personal attitudes and behaviors (See in Appendix V and VI). The findings are used to address RQ 5. The section begins with the description of

respondent profile namely demographics, awareness and interest in Phuket smart city activities, and digital media usage. Next, the respondent perspectives on Phuket smart city development priority and requirements are described. It concludes with the relationships between socio-cultural characteristics and smart city engagement of the respondents in Phuket. space and purposeful events.

4.5.1 Respondent profile

In total, 409 respondents from three districts in Phuket were surveyed. The demographic characteristics of the respondents are summarized in Table 4.5.

Table 4.5 Demographic data of the respondents

Main questions	Sub-questions	No. of people	Percentage (%)
1. Districts	Mueang District	249	61
	Thalang District	104	25
	Kathu District	56	14
2. Gender	Male	148	36
	Female	261	64
3. Age	< 21	43	11
(Years)	21 – 40	246	60
	41 – 60	103	25
	61 – 80	17	4
4. Birth place	Phuket	201	49
	Other provinces	208	51
	(Answer question 5)		
5. Length of stay	< 1	23	11
(Years)	1 – 5	77	37
For answer other provinces	6 – 10	47	22

Table 4.5 Demographic data of the respondents (Cont.)

Main questions	Sub-questions	No. of people	Percentage (%)
	11 – 15	27	13
	16 – 20	18	9
	> 20	16	8
6. Education	< Senior high school	43	10
	Senior high school	82	20
	Diploma	31	8
	Bachelor degree	215	53
	> Bachelor degree	38	9
7. Personal income (THB)	< 10,000	69	17
	10,000 – 20,000	154	38
	20,001 – 30,000	88	21
	> 30,000	99	24
8. Community position	Community leader	14	4
	Community member	395	96
9. Occupation	Government	20	5
	Private	78	19
	Personal business	116	28.3
	Agriculture	1	0.2
	Merchants	68	16.6
	Freelance	73	17.9
	Student	45	11
	Others	8	2
10. Ever heard about Phuket smart city	Yes	184	45
	No	225	55

Out of 409 respondents, 249 lived in Mueang district, 104 were in Thalang district, and 56 were from Kathu district. Most of the respondents were female (261 persons), from the age of 21 – 40 years old (246 people). The age distribution was skewed towards young people because many elderly people refused to participate in the survey because they felt unconfident with technology questions. In addition, many respondents at school age were shy towards providing information to the researcher. More than half of the respondents were born in other provinces. Among the non-native respondents, the majority had lived in Phuket for 1 – 5 years (77 people). Bachelor degree holders were the majority of the sample (215 persons). Income was omitted as most people did not want to provide information about their income. The occupations of the respondents in descending order were personal business (116), company employee (78), and freelance (73), respectively. Most respondents were community members (395 persons) while only a few hold a position of community leaders (12 persons) or LAO officers (2 persons). Most respondents (55%, 225 people) had never heard about Phuket smart city.

In the second part of the survey, respondents were asked about their desire to participate in Phuket smart city, preferred channels for engagement, the ranking of city development needs, as well as the ICT usage (Table 4.6).

Table 4.6 Awareness and participation desire in city management

Main questions	Sub-questions	No. of people	Percentage (%)
1. Participation desire in Phuket smart city	**Yes**	228	56
If answered yes, please selected process that wanted to join	1.1 Cause of problem and solution	99	43
	1.2 Planning and action	73	32
	1.3 Investment	40	18

Table 4.6 Awareness and participation desire in city management (Cont.)

Main questions	Sub-questions	No. of people	Percentage (%)
	1.4 Monitoring and evaluation	16	7
	No	181	44
2. ICT usage in daily life Show selection the first three rank	Reader	270	67
	Business operator	58	14.5
	Seacher	55	13.7
3. Phuket smart city development desire in each dimension	Economy	119	29
	Education	62	15.1
	Security	61	14.9
	Environment	58	14
	Tourism	54	13
	Governance	42	11
	Public health	13	3
4. Phuket smart city chanel desire Show selection the first three rank	Facebook	243	60
	Line	50	12
	Mobile application	41	10

More than half of the respondents (56%) stated the desire to participate in Phuket smart city projects. However, they were interested in different levels of participation. Most people were willing to contribute to the projects by identifying city problems and solutions (43%). Approximately one-third would like to take part in planning and implementing the projects (32%). Some showed an interest in investing in city development (18%) while the least number of respondents wanted to participate in project monitoring and evaluation (7%). Respondents who did not want to participate in Phuket smart city projects (44%) attributed the lack of time and knowledge as the main reasons for their refusal to get involved. This was reflected in the following statements, *"we don't*

have time because we have to work/study" (84%) and *"we don't understand and have no knowledge about technology"* (11%). Other reasons were aging and health problems in elderly (2%), temporary stay in Phuket (2%), and the perception that it is the responsibility of people in the position of power (1%). This was represented through one respondent's quote, "*we are users only, it is not our responsibility and it should be the leaders who take action"*.

In the ranking of seven Phuket smart city themes, economics (29%) was stated as the first priority. This was followed by education (15.1%), security (14.9%), environment (14%), tourism (13%), governance (10%) and public health (3%), respectively. When asked about a media channel for receiving Phuket smart city information and updates, most respondents identified Facebook (60%), Line (12%), and mobile application (10%) as the preferred methods. This was consistent with the result on online media behavior as most respondents identified their main purposes of using ICT as getting news update and socialization (67%), searching for information (14.5%) and conducting business (13.7%).

Table 4.7 Percentages of respondents who have heard (184 participants) about Phuket smart city, by demographic characteristics and participation desire in city management

Demographic characteristics	No. of people (N=409)	Percentage (%)	P-Value
1. Districts			<0.001
Mueang District	132	32	
Thalang District	42	10	

Table 4.7 Percentages of respondents who have heard (184 participants) about Phuket smart city, by demographic characteristics and participation desire in city management (Cont.)

Demographic characteristics	No. of people (N=409)	Percentage (%)	P-Value
Kathu District	10	2	
2. Gender			<0.001
Male	84	21	
Female	100	24	
3. Age (Years)			0.013
< 21			
21 – 40	10	2	
41 – 60	112	27	
61 – 80	52	13	
4. Birth place			<0.001
Phuket	110	27	
Other provinces (Answer question 5)	74	18	
5. Length of stay(Years) (For answer other provinces)	(N=208)		0.091
< 1	6	3	
1 – 5	22	11	
6 – 10	19	9	

Table 4.7 Percentages of respondents who have heard (184 participants) about Phuket smart city, by demographic characteristics and participation desire in city management (Cont.)

Demographic characteristics	No. of people (N=409)	Percentage (%)	P-Value
11 – 15	14	7	
16 – 20	7	3	
> 20	8	4	
6. Education			<0.001
< Senior high school	6	2	
Senior high school	21	5	
Diploma	13	3	
Bachelor degree	112	27	
> Bachelor degree	32	8	
7. Personal income (THB)			<0.001
< 10,000	19	5	
10,000 – 20,000	53	13	
20,001 – 30,000	48	12	
> 30,000	64	16	
8. Community position			<0.001
Community leader	14	4	
Community member	170	42	

Table 4.7 Percentages of respondents who have heard (184 participants) about Phuket smart city, by demographic characteristics and participation desire in city management (Cont.)

Demographic characteristics	No. of people (N=409)	Percentage (%)	P-Value
9. Participation desire in Phuket smart city			<0.001
Yes	140	34.2	
No	44	18	
Total	184	45	

Table 4.7 shows the p value calculated using the chi-square test that showed relationships between the awareness of Phuket smart city projects and demographic characteristics as well as the desire to participate in city management (See in Part I and 2.1 in Part II, Appendix V). The results show significant differences in smart city awareness among different areas where residents lived, gender, age, education, income, birthplace, and roles in the community. Respondents living in Muang district showed higher awareness than expected. Male were found to have higher awareness than female respondents. People aged 21 -40 years old with high education and income were more aware about Phuket smart city than other groups. Significantly more people who were born in Phuket knew about Phuket smart city while all respondents with leadership positions or working in local government have heard of it.

4.5.2 Citizen perspectives on Phuket smart city

This section summarizes the results from an open-ended question on suggestions for projects under seven themes of Phuket smart city (see Section 3.4). Out of 409 respondents, 146 people provided answers to this question. It also presents the

responses to an open suggestion in which 98 people answered. The results were analyzed using percentage of word count frequency (Tables 4.8 and 4.9). Word clouds (see Chapter 3, Section 3.4) of the comments were illustrated to provide an enriched picture of the topics raised by the respondents (Figures 4.24 and 4.25).

Table 4.8 Word count frequency and number of people who mentioned on Phuket smart city project prioritization and suggestions

Topics / Ranks	Phuket smart city project prioritization		
	Percentage (%)	Word frequency	No. of people
1. Development	3.7	61	49
2. Management	3.1	52	47
3. Education	2.6	44	41
4. Tourism	2.6	43	38
5. System	1.9	31	20
6. Tourist	1.7	28	24
7. Economic	1.6	26	26
8. Waste	1.3	22	19
9. Public	1.2	20	20
10. Government	1.1	19	21
11. Support	1	16	19
12. Destination	0.8	14	11

Table 4.8 represents the prioritization of the issues that the respondents were concerned with and their perceptions towards a smart city. The most frequently mentioned topic for Phuket smart city project prioritization with the highest number of respondents who mentioned them was development (61 times from 49 people). Management (3.1%), tourism (2.9%), and education (2.6%) were stated by more than 40 respondents. Other words that appeared frequently included system (1.9%), tourist

(1.7%), economic (1.6%), waste (1.3%), public (1.2%), government (1.4%), support (1%), and destination (0.8%) respectively.

Terms of tourism (rank 3) and tourist (rank 6) were different scope. Tourism mentioned general attribute of tourism sector e.g. ecotourism, community-based tourism, sustainable tourism development, tourism regulation and promote, tourism business operator, conservative tourism, tourism management, tourism application, smart digital in tourism sector, tourism route. Tourist presented quality of tourist, tourist destination, oversea tourist, tourist number, data and tracking of tourist system, tourist help application, tourism media suggestion for tourist.

Table 4.9 Word count frequency and number of people who additionally suggested on Phuket smart city project

Topics / Ranks	Additional suggestions on Phuket smart city project		
	Percentage (%)	Word frequency	No. of ppl
1. Development	3.3	32	30
2. Management	2.9	28	22
3. Public	2.6	25	23
4. Transportation	1.6	15	14
5. Tourism	1.6	15	13
6. Traffic	1.5	14	13
7. Community	1.4	13	7
8. Government	1.1	11	11
9. City	1.1	11	11
10. Smart	0.9	9	9
Phuket	0.9	9	9

Table 4.9 Word count frequency and number of people who additionally suggested on Phuket smart city project (Cont.)

Topics / Ranks	Additional suggestions on Phuket smart city project		
	Percentage (%)	Word frequency	No. of people
11. Environment	0.9	9	8
12. Education	0.8	8	8
13. Technology	0.8	8	7
14. Support	0.7	7	7
Safety	0.7	7	7
Economic	0.7	7	7

For an open suggestion, similar results were observed with the term 'development (3.3%) and management (2.9%) having the highest frequency of mentioning. There were differences of development term (both were rank 1) in Table 4.8 and 4.9. Development in Table 4.8 was mainly related to seven themes of Phuket smart city (see Table 2.1) e.g. tourism development, economic development, education system development, security development, local business development, IT system development. Development in Table 4.9 was proposed in term of other dimensions except for development that government were not invest in Phuket smart city e.g. moral development, public transportation development, socio-cultural development, public service development, community participation for sustainable development, landscape development, art and culture development, and human capital development. This was followed by the terms; public (2.6%), transportation (1.6%), tourism (1.6%), traffic (1.5%), community (1.4%), government (1.1%) and city (1.1%). Other recurrent words in the open suggestion included smart, Phuket, environment, technology, education, support, safety and economic. It was noteworthy that transportation, traffic, and community were mentioned considerably in an open suggestion when respondents were not limited by the prescribed themes of Phuket smart city. All words in the answers to Phuket smart city

prioritization and open suggestion questions were displayed as word clouds in Figures 4.24 and 4.25

The findings show a prominent focus on development and management in the resident's views on Phuket smart city. Specifically, the frequent mentioning of tourism, education and environment reflected the development priority from the local perspectives. The representation of the issues from local residents is important in ensuring that difficult problems receive attention from the city managers and responsible authorities. Interestingly, the issues of transportation and traffic, despite being raised numerous times by the residents, were not in the initial development plan of the Phuket smart city committee. This shows the different prioritizations and expectations on city development between policy makers and residents can create a gap that creates barriers against citizen engagement in smart city development. At the same time, the citizen's knowledge, skills, mindset, social values, sense of community, public-mindedness and willingness to participate in city management can shape the way the public engage in smart city initiatives. This notion prompted an investigation into the relationship between the socio-cultural characteristics of the participants and their engagement in Phuket smart city projects.

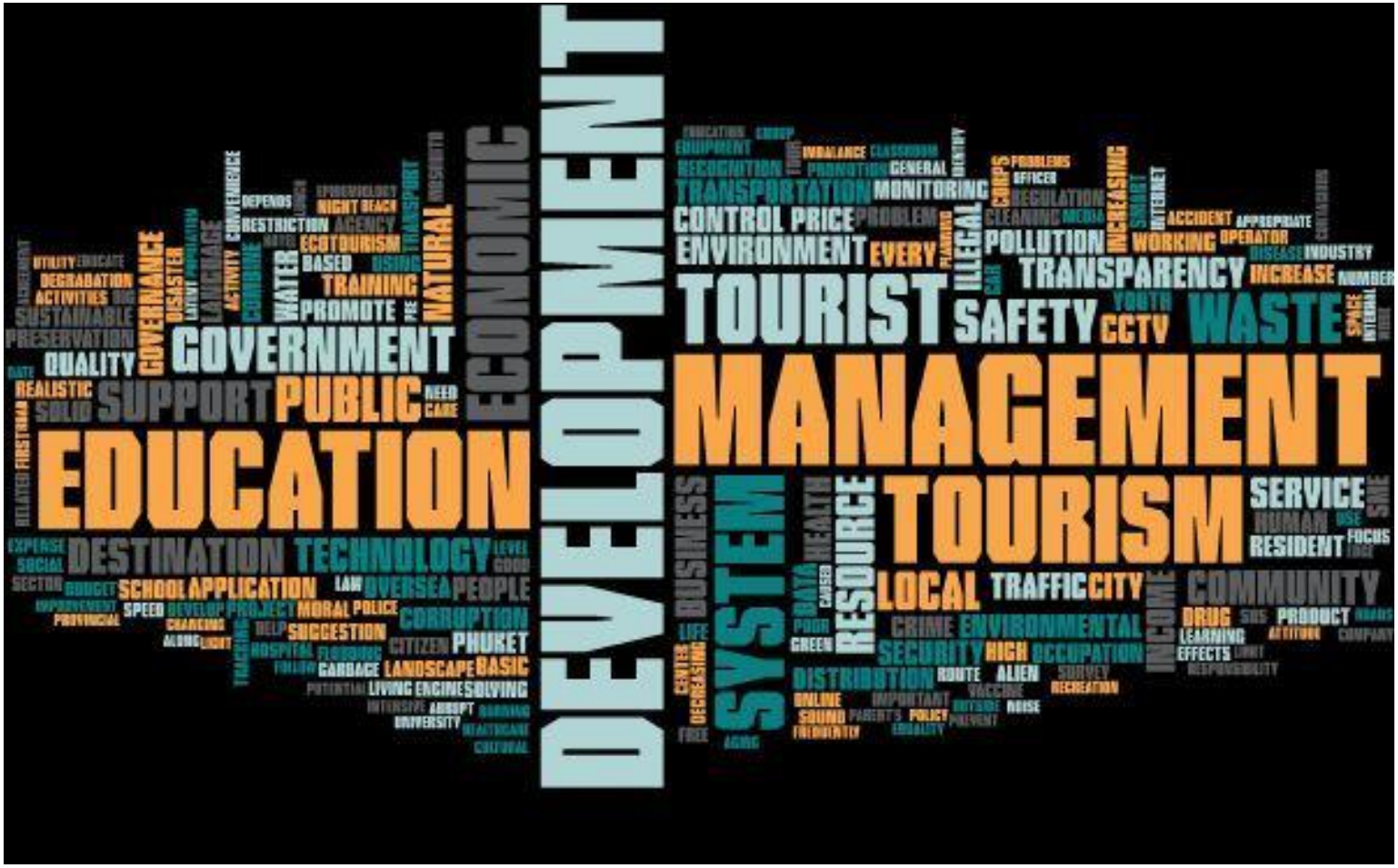

Figure 4.23 Word cloud of responses to Phuket smart city prioritization

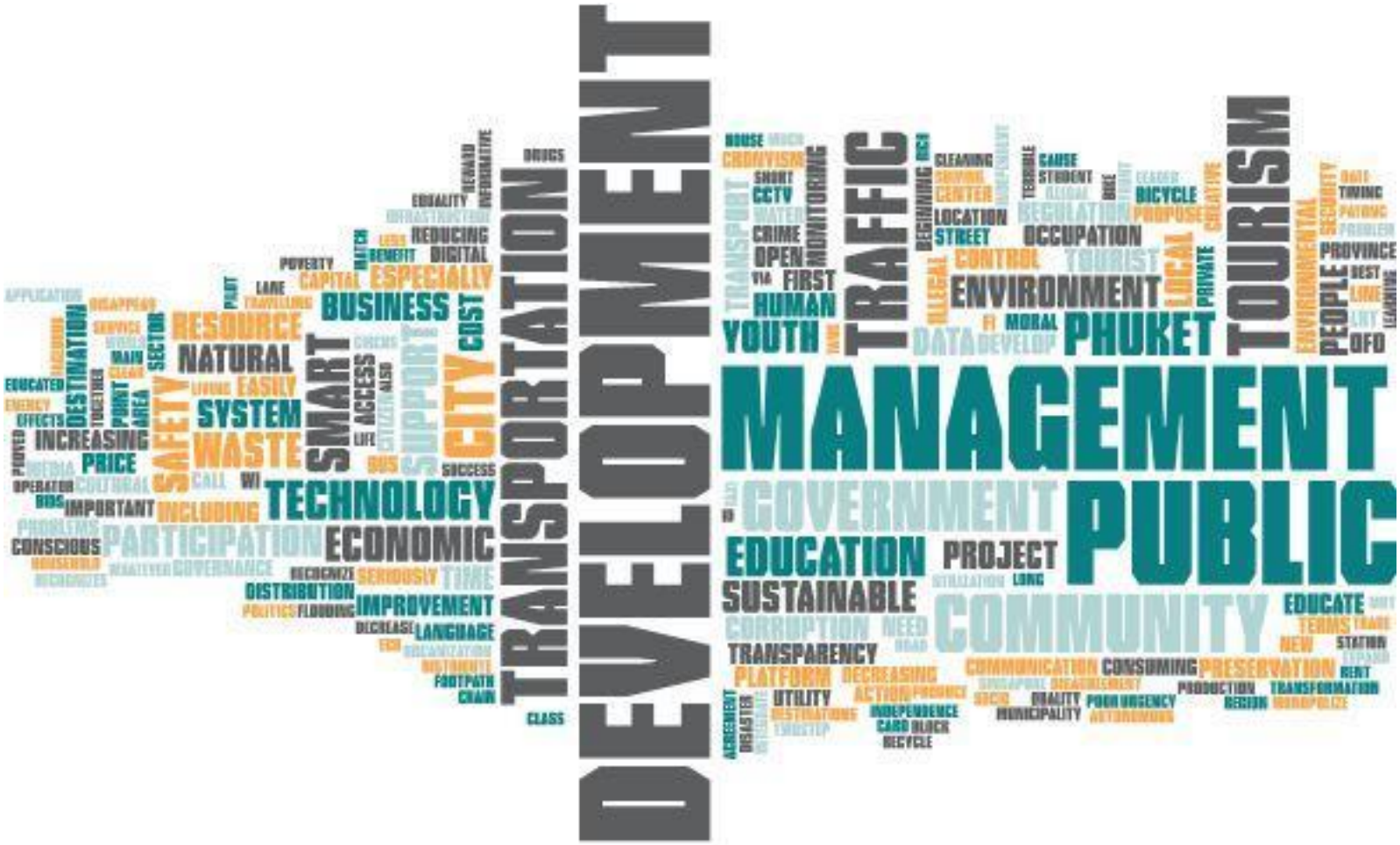

Figure 4.24 Word cloud of responses to an open suggestion for Phuket smart city project

4.5.3 Factors influencing citizen engagement in Phuket smart city

The mindset, attitude and social behavior of the citizen were examined through the rating of 30 statements in part III of the questionnaire. The question statements were mapped with a cultural iceberg model featuring non-visible and visible aspects (See in Section 2.3) to organize the questions into clusters (Table 4.10).

Table 4.10 The cultural iceberg and the clusters of factors influencing citizen engagement in Phuket smart city

The cultural iceberg aspect	Key factor cluster	Question prompt
Non-visible aspect	Knowledge-based creation	3.1 Understanding about Phuket smart city project
	Supportive desire	3.3 Support to Phuket smart city project
		3.30 Support to public-private-people participation
	Attention	3.4 Attention to Phuket smart city activities
		3.5 Attention to M & E in Phuket smart city project
		3.7 Attention to urban problem solving activities
	Quality of life satisfaction	3.6 Quality of life
	Sense of belonging	3.12 Feeling to community membership

Table 4.10 The cultural iceberg and the clusters of factors influencing citizen engagement in Phuket smart city (Cont.)

The cultural iceberg aspect	Key factor cluster	Question prompts
Non-visible aspect	Positive individual characteristic	3.13 Giver & charity
		3.14 Rules and regulation follower
	Self-awareness	3.15 Reasonableness
		3.16 Creative assertiveness
	Adaptive and open-minded	3.17 Change and challenge acceptance
		3.18 Risk avoid
		3.19 Multicultural living
		3.20 Different region and religion opinions
	Trustful	3.29 Trustful in governance
Visible aspect	Involvement opportunities	3.2 Role in Phuket smart city project
		3.8 Urban development involvement
		3.9 Environment development involvement
		3.10 Public hearing involvement
	Leadership skill	3.11 Community leader being
	Personal skill	3.21 Language skill
		3.22 Entrepreneur skill
	Enthusiastic to learn new things	3.23 Global news catching up

Table 4.10 The cultural iceberg and the clusters of factors influencing citizen engagement in Phuket smart city (Cont.)

The cultural iceberg aspect	Key factor cluster	Question prompt
Visible aspect		3.24 Innovation learning
	Technology influence skill	3.25 ICT fluent using
		3.26 Networking using through technology
		3.27 Government service using through online channel
	Inspector skill	3.28 Government and private sector monitoring using public data

Chi-square test analysis was conducted to examine an association between the respondent's willingness to be involved in smart city initiatives (engagement level) and the overall scores from their responses to 30 statements (civic activeness). The overall scores from the latter were classified into three categories namely low (1 - 30), medium (31 – 80) and high (81 – 150). Table 4.11 shows the number of respondents classified by their desired level of engagement and activeness as a citizen in Phuket smart city.

Table 4.11 Numbers of respondents classified by level of engagement and active citizen score

Civic activeness / Engagement level	High	Medium	Low	Total
Non-participation	12	145	20	177
City problem/ Cause of problem exploring	21	81	2	104
City plan	11	29	0	40
Investment/ Operation	6	9	0	15
Monitoring/ Evaluation	13	60	0	73
Total	63	324	22	409

Based on Table 4.11, Chi-square (x^2) calculation yielded the value of *55.5* with the *p value of 0.00000002.* Consequently, the null hypothesis (H_0) stating that 'there is no association between level of participation and citizen readiness for engagement in Phuket smart city' was rejected. The finding suggested that the association between engagement level and civic activeness in Phuket smart city was statistically significant.

In addition, Pearson's correlation coefficient (r) was calculated to examine the association among 30 socio-cultural characteristics of the respondents. The correlation was considered strongly positive when r value was more than 0.5 with the *p* value being less than 0.001 (See details in Appendix VI).

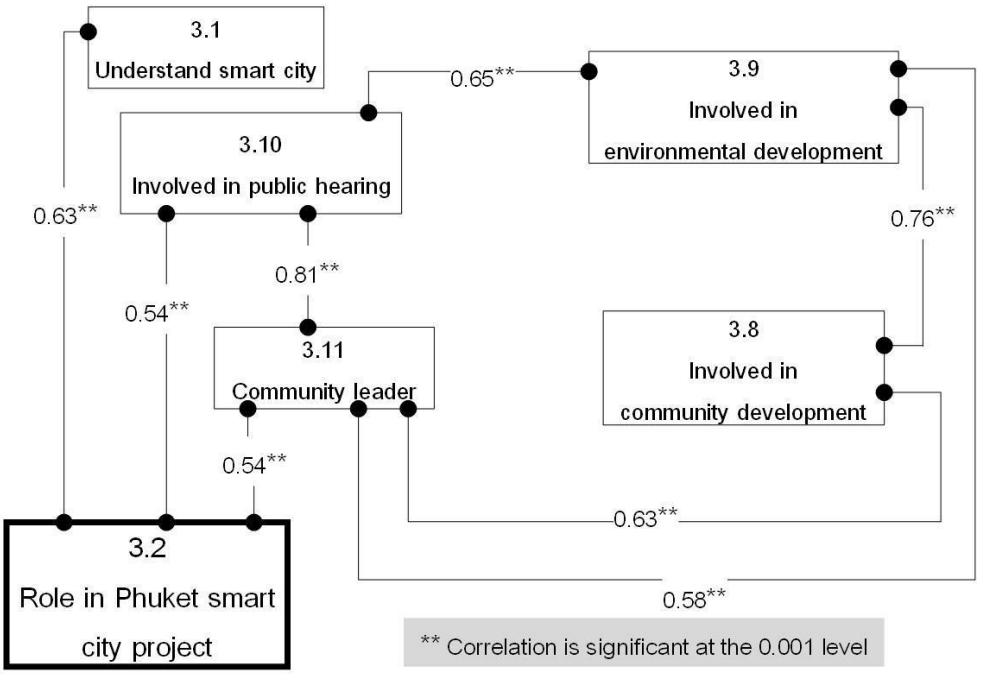

Figure 4.25 The association among socio-cultural features of the citizens and their role in the Phuket smart city project.

Figure 4.25 illustrated the statements with the highest r value in relation to the respondent's roles in Phuket smart city project. Respondents who reported high scores in their understanding of a smart city concept, involvement in a public hearing and holding a community leader role showed a statistically significant, positive correlation with their engagement in smart city initiatives. These factors were also observed to be highly correlated to the respondents' involvement in environmental problem solving and community development. Three statements which showed significant relationships with smart city engagement are explained in more detail below.

4.5.3.1 Understanding in Phuket smart city

The result showed that people were more likely to engage in the public discussions and project implementation when they understood the concept of smart city and its implications. This finding is supported by the work of Gonçalves *et al.* (2014) which highlighted the resident's socio-psychological characteristics, such as a sense of

belonging and citizenship, as a powerful motivation for engagement. The local government has a crucial role in enabling the resident to realize the value of the projects and contribute to the planning and implementation process of smart city projects including the marginalized group.

4.5.3.2 Community leadership

Leadership in the Phuket community appeared to be highly associated with the engagement level of the individuals in Phuket smart city projects. Citizen's attitude and their position in the society influence their participation in the public activities such as public hearing forum, and environment and community developments discussions. While leadership might be based on personal characteristics such as life experience, social connections, capabilities, supportive governance can increase leadership in the citizen and enable them to become an active agent of change rather than a passive audience.

4.5.3.3 Public hearing involvement

Engagement in a smart city development is linked to the involvement of the individual in the local activities such as public hearing. This can be influenced by the community values, personal values and interest in the public issues. Public hearing involvement can promote active citizenship through the non-political and political forums which allow the citizen to voice their concerns and ideas as well as being part of the solutions. The sense of commitment is often increased when people feel that their opinions are treasured. This highlights the importance of a transparent governance in which the local government ensures that citizen's real needs and voices are heard and addressed.

In summary, the socio-cultural characteristics examined in the survey suggested that citizen engagement in smart city projects in Phuket was enabled by an understanding of the concept, community leadership and public hearing involvement. While these factors can be personal characteristics, a supporting environment and norms reinforced by community participation and good governance can induce the development of these key traits in the citizen. Local governments and institutions play a major role in

educating the general public in sustainable development and digital literacy while providing an opportunity for the local residents to develop leadership skills necessary for an effective and meaningful civic engagement in the city planning and development.

This section demonstrated that social values and settings can influence citzen engagement in Phuket smart city development (RQ5). Leadership, and supportive participatory governance such as public hearing, and online forums are important for enabling human capital and social capital necessary for active engagement of the public in smart city initiatives.

4.6 Citizen engagement in smart city and COVID-19 pandemic

This section, although not in an original scope of the study, is added to examine how the COVID-19 pandemic affects smart city projects and citizen engagement in Phuket and cities around the world. It describes COVID-19 responses from Phuket as well as 17 smart city case studies based on the information gathered through social media and webpages

Many cities have increasingly relied on online channels to inform and engage their citizens about smart city projects in the wake of the pandemic. For example, the city of Vienna (C17) provided updates on smart city projects via Facebook (https://www.facebook.com/SmartCityWien). However, little online information was available about the smart city activities in Nice (C10) during the pandemic. It was found that these cities generally employed similar citizen engagement techniques to the pre-pandemic period especially through an online channel. The need for social distancing has necessitated the technology that allowed contactless public services. For example, a telemedicine application, eDoctor-Seva app, was deployed in Agra (C2) to deliver medical consultations to patients. Free Wi-Fi facilities were set up in Pune (C11) to isolate people at the quarantine center. A helpline for mental support from psychologists were made available in Bhubaneswar (C6), Pune (C11) and Surat (C15).

Many cities asked city's residents to share ideas and knowledge online for the city's activities such as 'How do smart cities combat COVID-19?' webinar in Seoul (C12), smart city ideation online workshop in Berlin (C5), and smart city transformation and innovation online conference in Taipei (C16). Citizens were also to propose or conduct projects to help alleviate problems in their areas. For instance, Barcelona (C4) called for public proposals targeting innovation for the Covid-19 solution. In Brussels (C7), the Ixelles web-TV allowed people to make their own videos to communicate useful tips and information and posed them on its platform.

As a result of the 'new normal[42]' protocols to curb the spread of COVID-19, citizen engagement practices in smart cities had been modified during the pandemic era. The modifications are based on three themes of citizen engagement strategies identified in Section 4.3. These are new normal open government data, new normal interaction space and physical facilities, and new normal purposeful event.

4.6.1 Online community and analytics

This theme emphasized citizen engagement through the openness in government data sharing through web portals and applications (See in Section 4.3.1). For example, the city of Adelaide (C1) invited its residents to share ideas on how they use the city and what it should do to improve via the Recover and Reimagine portal (Figure 4.26). The feedback was also tagged using hashtags: #live, #businessowner, #work, #study, #play, #shop, and #tourist.

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[42] An incident, or position, or era that before inexperience, or unusual status that has converted normal, or usual, or ordinary (Oxford Dictionary, 2020).

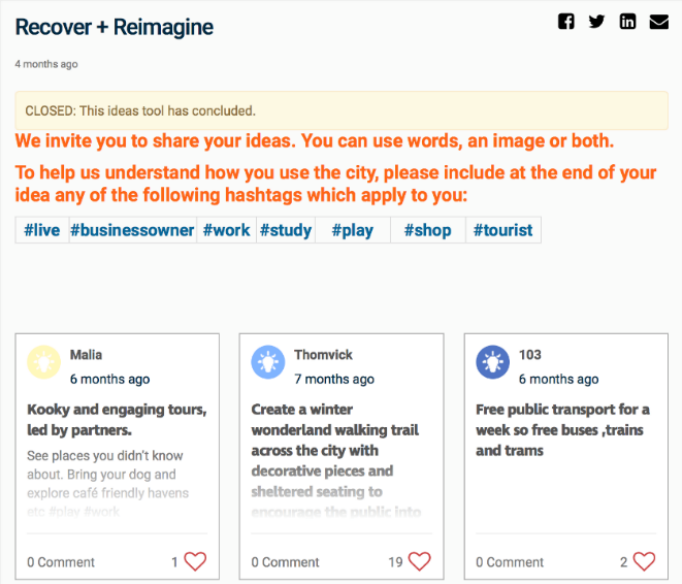


Figure 4.26 The Recover and Reimagine portal, Adelaide[43](C1)

The municipality of Ixelles in Brussels (C7) invited people to create their own shows to put on Ixelles web-TV platform (Figure 4.27). This activity enabled the residents to exchange experiences and create a sense of community during a lockdown period. The videos were categorized into topics of well-being, cooking recipes, culture, tips and tricks, events for children or other useful things of assisting each other.

Figure 4.27 The Ixelles web-TV, Brussels[44](C7)

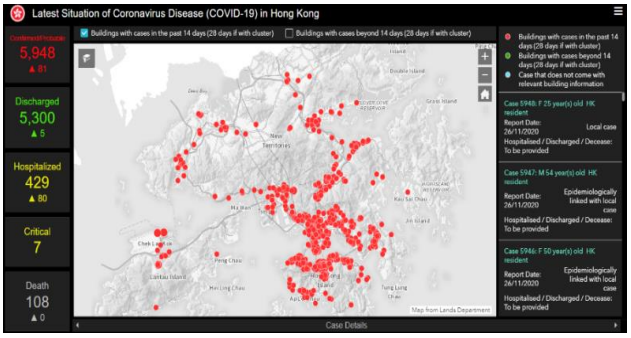
[43] www.cityofadelaide.com.au/reimagine

[44]: www.ixelles.be/site/809-Web-TV

Many cities such as Agra (C2), Hong Kong (C9), Seoul (C12) and Taipei (C16) designed a single data hub for reporting and monitoring important information related to the updated COVID - 19 situation. Various technology solutions were applied by the city authorities. The examples were heat maps, daily infection cases, locations where patients have visited, recovery statistics, death toll, precautions for high risk groups and related official news (Figure 4.28). For instance, Agra smart city (C2) used GIS processing, photogrammetry, computer aided design and local technologies. The Hong Kong (C9) Special Administrative Region (HKSAR) Government cooperated with volunteers from the smart city consortium, the department of health, hospital authority, and relevant governmental departments to develop an interactive map dashboard using geodatabase and ArcGIS online platform. In Taiwan (C16), the Center for Disease Control created the COVID-19 dashboard for presenting the confirmed cases through color scheme on a global map. The Seoul (C12) metropolitan government's (SMG) utilized municipality webpage to provide real-time city status on COVID-19 quarantined cases, safety, traffic, atmosphere, waterworks and trees through visualization and maps. Seoul's smart city (C12) data hub supported communications with local citizens and foreigners using interactive video meetings via mobile phone and laptop under the slogan "citizens are the mayor".

(a)

(b)



(c)

Figure 4.28 (**a**) Open government platform for reporting COVID-19 cases and locations based on heat maps, Agra[45](C2) (**b**) Hong Kong[46](C9) (**c**) Seoul[47](C12)

Some portals were developed to provide information about necessary items and where to find them. For instance, the MaskGoWhere website in Singapore (C14)

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[45] covid.sgligis.com/agra

[46] chp-dashboard.geodata.gov.hk/covid-19/en.html

[47] scpm.seoul.go.kr and www.cdc.gov.tw/En

announced the schedule and location for free mask distribution from the government. The Grocery information portal in Agra (C2) used RFID tag installation and GIS property survey to locate the top five sellers of food, fruits and vegetables via maps as well as offering online grocery shopping.

Many mobile applications were created in an attempt to assist the citizens and governmental agencies during the outbreak. For example, Agra's Lockdown monitoring application (C2) sent an alert with location and photograph to the nearby police station when AI analytics detect social gathering during a lockdown. In terms of general people, aimed to encourage an awareness of residence, tracking and alert application was adopted in Glasgow (C8) (Scotland), Pune (C11) (India), and Singapore (C14). Contact tracing application by the University of Glasgow utilized Bluetooth (nearby-object tracker) and GPS (location tracker) to identify the locations of COVID-19 positive cases. The application sent a notification to users who had close interaction with infected people so that they are advised to stay in quarantine at home immediately. Pune (C11) municipality used Sanyam application to alert users about distance from people with COVID-19 risk through color visualization with green being far and red suggesting nearby area. The application used geolocation and updated every ten minutes. In Singapore (C14), TraceTogether application by GovTech utilized bluetooth signals to identify people who were within two meters of exposure to confirmed COVID-19 cases including the duration of their encounters. Singapore (C14) also had an application called FWMOMCare (Foreign Worker under the Ministry of Manpower to monitor the health status of the migrant workers through self-reporting of temperature and flu symptoms.

Telemedicine was utilized widely to reduce the physical contact and risk of spreading the disease. Agra's eDoctor-Seva application (C2) facilitated video consultations with doctors with the upload function of related personal medical history and the download feature for the doctor's signed prescription. In Pune (C11), Arogya Dheer application provided medical information for people with mild symptoms via live audio and video consultations. In Vienna (C17), Can I care application provided essential information for homecare and informed the emergency medical team if the patient needed

assistance. The Sachetak application in Bhubaneswar facilitated the vulnerable elderly by providing medical consultation at home and videos on general health tips. In addition to the medical consultations, applications were used to inform the health workers as well as the public about health resource capacity. For example, iHealWell application in Pune (C11) reported the latest number of severe cases in ICU. Mental health services were also offered online for residents who were in distress. The Sarvam setu application in Agra (C2) installed an SOS button on the mobile phone in which local residents can contact the Agra municipal corporation (AMC) for support.

Combatting the outbreak required a strong cooperation from the public especially for social distance and contact tracing. In Singapore (C14), citizens were encouraged to scan QR code before entry into an area to help indicate the crowdedness of the place. This was done via SafeEntry application (Figure 4.29) which required users to register and provided personal information such as name, identity card number, and mobile number in order to facilitate contact tracing as well as determining the number of visitors in the venue.

Figure 4.29 SafeEntry application, Singapore[48](C14)

The post-pandemic citizen engagement using online platforms focused highly on essential information and services concerning health and the pandemic. These

[48] www.gov.sg/

initiatives relied heavily on having a system that can spread accurate and real-time information as well as citizen's ability to access and utilize digital services.

However, the abuse of social media platforms was widely observed through COVID-19 misinformation, global fake news, hate speech, and social bot interference. There severity of these problems led to the establishment of anti-fake news measures and organizations in several countries. Central epidemic command center (CECC) in Taiwan tackled a spreading of disinformation on social media during the pandemic by imposing fine of US$108,000 or three years prison (Taiwan News, 2021) The Anti-fake news center (AFNC)[49] Thailand established by MDE during the COVID-19 crisis (Figure 4.30a) focused on identifying news that were misleading or false from the true information through of the communications with relevant agencies (Bangkok Post, 2021a).

In Belgium, the Belgian Federal Public Service (FPS) has setted up a webpage, www.info-coronavirus.be, which provided official COVID-19 information (Figure 4.30b). Another example was seen in Hong Kong, in which a research team from Hong Kong baptist university (HKBU) has launched the HKBU fact check service for online misinformation detection in Chinese and English languages on Instagram or Facebook (Figure 4.30c).

[49] https://www.antifakenewscenter.com/

Figure 4.30 (a) AFNC in Thailand labelled online news into 3 colours, false news are red, true news are green, and misleading information are yellow, respectively. **(b)** Official Belgiam (C7) website for information about COVID-19[50]. **(c)** The HKBU fact check service on website[51] in Hong Kong (C9).

[50] https://www.info-coronavirus.be

[51] https://comd.hkbu.edu.hk/factcheckservice/

4.6.2 Surveillance and contactless facilities

The pandemic has necessitated social distancing and contactless services to prevent COVID-19 spread. Many cities implemented social distancing in public areas and transports. While personal transportation became more popular than public transport, there was a surge of eco-friendly travel via bicycle and non-motorized vehicles. Cycling paths and pedestrian ways were improved in Brussels (C7) and Glasgow (C8). Both cities expanded the bike lanes and pathways and separated them from the car lanes to increase safety and social distance in a public space. Surveillance became an important tool to support and enforce social distancing rules during the global pandemic. In Berlin (C5), the COVID-19 IoT shop window was developed to analyze data such as body temperature measured by an infrared sensor and visitor numbers using WIFI or Bluetooth signals from the personal electronic devices around the area. In Singapore (C14), the Robodog (Figure 4.31) was used to enforce social distance in a public area. This multi-terrain robot dog used cameras and video analytics to detect the amount of visitors in the parks, employed safety sensors to evade interpersonal collisions within one meter, and made barking sounds as a warning.

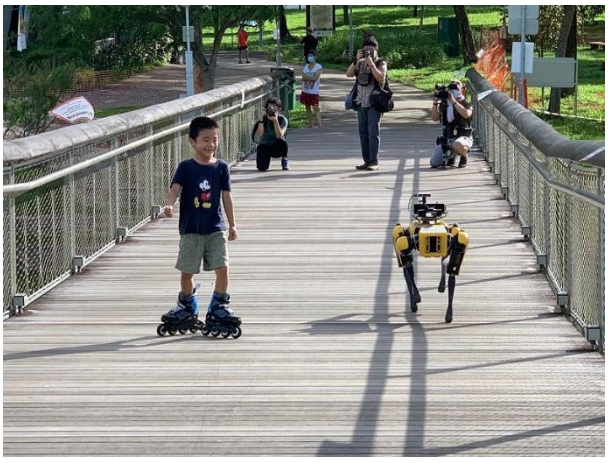

Figure 4.31 The robodog, Singapore's park[52](C14)

[52] www.smithsonianmag.co

Local government offices were transformed into command centers for managing the outbreak and emergency services. In Agra (C2), Pune (C11), and Surat (C15), the integrated command and control centre or ICCC became a COVID-19 war room. These ICCC were enabled by surveillance technologies such as CCTV analytics in public space, GPS tracking of healthcare staff, GIS mapping of confirmed cases, heat maps with predictive analytics for outbreak controlling, and real-time tracking of emergencies. These centers were also used as a one stop consulting and information service related to COVID-19 Helplines were set up in Bhubaneswar (C6), Pune (C11), and Surat (C15) to provide tele-counseling for people under quarantine or those who needed assistance both medically and psychologically (Figure 4.32).

Figure 4.32 The helpline in Bhubaneswar (C6), Pune (C11), and Surat[53](C15)

In some cities, delivery systems of essential items such as face masks, masks and eye protectors, medicine, and door openers to healthcare centers and residents were set up. This was demonstrated through the smart health center in Agra (C2) and Fab labs in Barcelona (C4) which distributed the healthcare products to users at a subsidized price (Info Barcelona, 2020). The need to decrease exposure to viruses has also prompted many services to go online and contactless. For example, parking, trash disposal and recycling, grocery shopping and public transport cards were shifted to touch-less mode in San José and Taipei. In Adelaide (C1), new pedestrian buttons for

[53] www.expresscomputer.in/indiaincfightscovid19

crossing using sensors were installed at intersections to reduce a physical contact (Figure 4.33).

Figure 4.33 The contactless pedestrian crossings, Adelaide[54](C1)

4.6.3 COVID-19 safe events

During the pandemic, competitions and grants for technological solutions were organized to recruit resources and expertise from the citizens. In Barcelona (C4), seven projects aiming at urban solutions for a sustainable city in the Covid-19 context were selected from a public competition. The examples of these projects were energy efficient homes and user-friendly public spaces, an intelligence system for nurturing consumable vegetation and products in a local community, an education for elderly people to be self-reliant and healthy, and innovations for enabling entrepreneurs.

Many cities conducted seminars, workshops, conferences through online channels both in relation to smart cities in COVID-19 situation and other development topics Amsterdam (C3), Berlin (C5), Brussels (C7), Seoul (C12), Taipei (C16), and Vienna (C17). In Berlin (C5), Berlin innovation agency (BIA) organized discussions on cities after COVID-19 with city stakeholders, experts, startups, and businesses. The smart city expo world congress in C4 Barcelona (SCEWC) Live was an online workshop about the future of cities after the COVID-19 pandemic which presented six main topics: i) local mobility to safe and sustainable travel; ii) technologies in global challenges; iii) ubiquitous city for

[54] www.smartcitiesworld.net/news

everyone; iv) inclusive economic recovery; v) infrastructure and environments for better renovation and vi) selling in the innovation age. Seoul (C12) conducted webinars on “How do smart cities combat COVID-19?” GO SMART Forum in Taipei (C16) attended by government councils and solution providers was an online forum about “smart Tech in fighting COVID-19”. In Amsterdam (C3), the CityFlows webinar promoted 5G applications for crowd management using crowd monitoring decision support systems (CM-DSS).

Despite the pandemic, discussions on the long-standing issues continued. An annual smart city summit and expo online conference was hosted in Taipei (C16) under the theme of “smart city transformation and innovation” to facilitate the exchange of smart city experience between mayors. The issue of conflicts between climate defense and the economic system was discussed via Zoom livestream in Vienna (C17).

Non-online activities during the pandemic were also organized. The Bhubaneswar (C6) smart city limited (BSCL) supplied 15 bikes to the volunteers who helped raise awareness about COVID-19 preventive measures in the activity called “Cycle for change”. The city’s COVID Sachetak committees collaborated with young leaders to raise awareness on COVID-19 in local communities by door-to-door knocking. The event recruited 120 youth representatives who were trained in a one-day program in how to use thermometer, pulse oximeter, face masks, gloves, and sanitizers. The Walkathon involving the mayor walking into communities to raise awareness about well-being, lifestyle, self-confidence, and Covid-19 was promoted by Pune (C11) Smart City. In San Jose (C13), financial aid was provided to 142 small businesses affected by COVID-19 crisis.

The advantages of a smart city on abilities to respond to the pandemic were evident. For example, transforming the command center to COVID-19 war room in Agra (C2), India and putting sensors at the pedestrian crossings in Adelaide (C1), Australia reflected swift actions by city management which were enabled by access to technology. In Phuket, Thailand, a registration system for deploy COVID-19 vaccination called Phuket Tong Chana[55] was instrunmental for achieving high vaccination rate in the

[55] www.ภูเก็ตต้องชนะ.com

population which enabled early opening of the borders for tourists through Phuket sandbox[56].

4.6.4 Classifications of engagement strategies in smart cities

This section provides a mapping of citizen engagement activities observed in smart city projects from 17 smart cities and Phuket during pre-COVID-19 and post-COVID-19 periods. Figure 4.34 displays the citizen engagement strategies in 4 classifications (Q1 – Q4) based on the active level of citizen engagement and types of interactions, whether they are virtual or physical engagement. Q1 represents a group of initiatives which require active citizen involvement in terms of feedback, discussions, which were conducted via technology such as online platforms and digital services. Q2 shows active citizen engagement activities using little or no technology such as face-to-face meetings, call center, and knowledge-sharing events or venues. In Q3, citizens act as users or recipients of information and do not rely on technology for participation. Lastly, Q4 features the citizens as users or observers of smart city activities through the use of technology.

Since 2020, COVID-19 pandemic has affected the way citizen engagement took shape in many smart cities. Physical events were conducted mainly in pre-COVID-19 period presented in Q2 (non-technology, active engagement) in Figure 4.34. The emphasis on social distancing following the pandemic led to most public eventsand city services being online as shown in Q1 (technology-based, active engagement). In the post-Covid 19 period, many initiatives featured the use of technology to provide information to the public regarding governmental e-services, supporting

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[56] Public project by the TAT International Public Relation Division is required personal information before entry the sandbox area in Thailand e.g. fully vaccinated certification, RT-PCR negative test, Phuket tracking application (TAT news, 2021).

infrastructure and facilities for disease control, vaccination processes and mandates, COVID-19 safe transportation, and education and training (Q4).

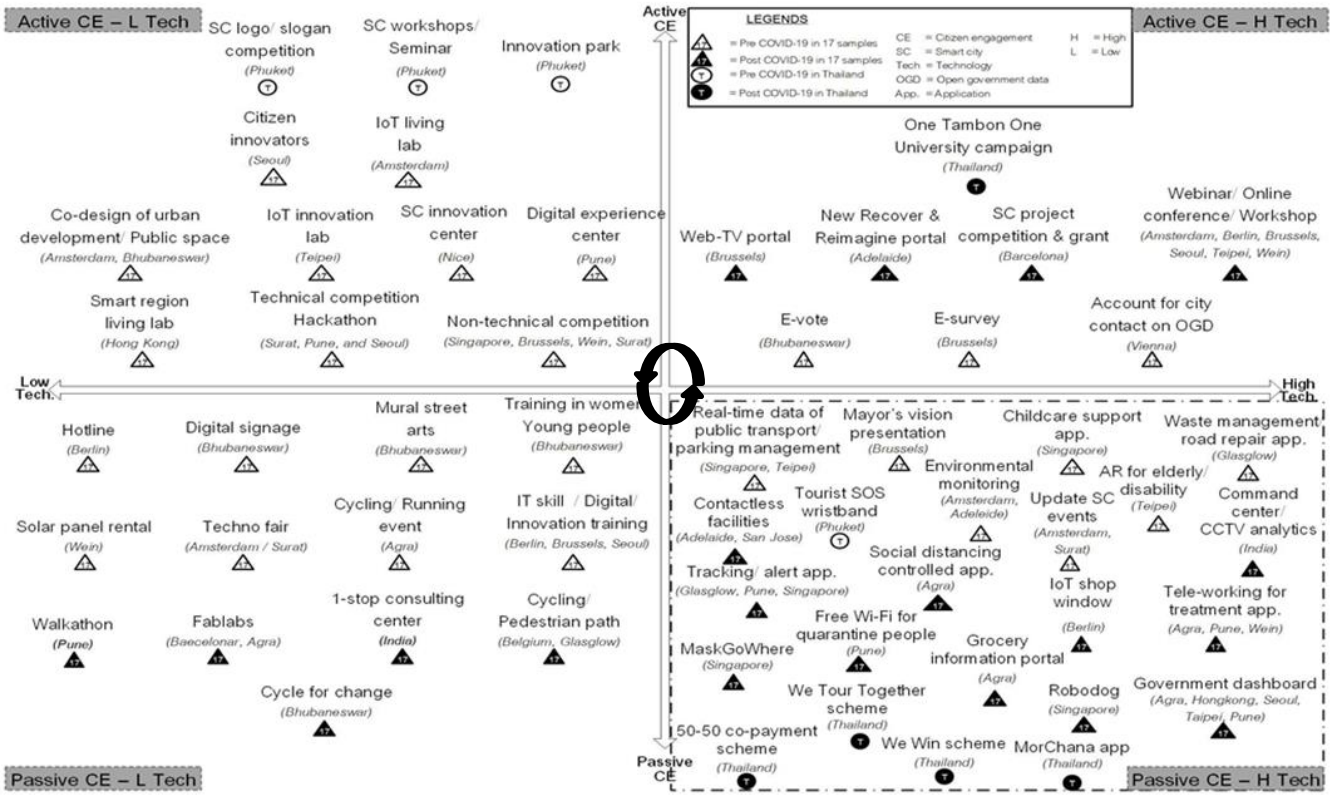

Figure 4.34 Citizen engagement initiatives in 17 smart cities worldwide and Phuket during pre- and post-COVID-19 periods The activities were classified into four quadrants (Q), the vertical line represents active – passive citizen engagement while the horizontal line shows the emphasis.

The findings in this section highlights the role of open data and digiral transformation on the adaptation of citizen engagement observed from 17 smart city case studies and Phuket smart city after COVID-19. This helps further address RQ3 by showing to how cities can utilize their technological infrastructure to facilitate collaborations and cooperation from the citizens in the face of public emergency. It also reveals the gap in current participatory culture in smart city development and urban planning. The lack of engagement and representation of the marginalized and minority population such as young children, elderly, foreign workers and disabled people in smart city initiatives was observed in the 17 case studies as well as in Phuket smart city. The survey finding from Phuket (Table 4.6) showed how youth, despite growin up with technology, did not automatically take an active role in urban problem solving. Empowering and engaging young generation in city management requires an inclusive governance and participatory culture from all stakeholders, whether they are the public sector, business and civil society. The participatory culture and inclusive mindset are critical in identifying the true needs and directions of smart city development and address social disparity that can be caused by the applications of technology.

This chapter provides the evidence that highlight the importance of citizen engagement in smart city development. The resolutions of RQs 1 - 5 emphasize that digital tools are means rather than an end in smart city development. The effectivenesses of smart city projects requires not only sound infrastructure and services but also participatory governance and civic culture that empower citizen to engage collectively in positive changes.

CHAPTER 5
DISCUSSION AND CONCLUSION

This chapter provides the summary of each chapter, discusses key results and concludes the findings in relation to RQs of the study. The research objectives focused on citizen engagement in a smart city implementation and socio-cultural contexts that influence their interactions. The study investigated the citizen engagement strategies of the 17 selected smart city case studies as well as the Phuket smart city development. Key outputs from previous chapters are summarized in this section.

Chapter 1 provided the rationale of the research highlighting the importance of citizen engagement in a smart city and identified RQs. Five RQs and background of a study area and scope were explained. Chapter 2 reviewed the smart city concepts and the implementation of smart city projects in various contexts. The definitions and applications of community engagement were discussed as well as the influence of socio-cultural aspects of the city on smart city discourse and implementation. Details of government policies and publication on Phuket smart city were also presented. The structure for the data collection and analysis were described in Chapter 3. Data collection involved document analysis, in-depth interviews, observation through various meetings and a survey with 409 Phuket residents. Chapter 4 provided the results which addressed the RQs. The findings included CLDs of citizen engagement in a smart city, the categories of citizen engagement strategies in smart city case studies from both academic literature and city websites. The evolution of Phuket smart city and perspectives of key actors on citizen engagement as well as the residents' opinion, awareness and readiness in smart city development. The socio-cultural traits contributing to participation in Phuket smart city projects were also explored. The findings are discussed in Sections 5.1 to 5.5 which

correspond to RQs 1 to 5. These discussions provided insights into the development and direction of citizen engagement in smart cities worldwide and in Phuket. Section 5.6 presents a conclusion based on the resolution of RQs. Finally, the challenges and limitations of the research are identified in Section 5.7.

5.1 Citizen engagement as a foundation of smart city development

This study addresses RQ 1 by demonstrating that citizen engagement a characteristic of a smart city. Citizen engagement is a vital strategy in smart city development. It is connected to other components namely governance, public infrastructure and services, economic development, and digital transformation (See Figure 4.2 in Section 4.1). CLDs in Chapter 4 demonstrated that citizen engagement can increase public awareness, grassroot leadership, active civil society, and social capital which lead to trust, participatory governance and progressive social changes (See in Figure 4.3). The sub-systems of smart city development namely public infrastructure and services, governance, economic development and digital transformation are all connected to citizen engagement (Figures 4.5 - 4.9).

The importance of people participation in technology implementation is emphasized across 17 smart city case studies. The examples included the future living project in Berlin (C5) which recruited residents to design eco-friendly, smart-living space and the Co-creating Responsive Urban Space project in Amsterdam (C3) which invited the stakeholders to co-create the public space for more attractive living environment (See Section 4.3.3). The implementation of a smart city concept requires the harnessing the human and social capitals of the city through an appropriate engagement process (Figure 4.2). Citizens are both users and producers of knowledge which is rapidly changing through open communication facilitated by digital technology (Figure 4.9, digital transformation sub-system). Without community engagement, technological solutionscould be underutilized and perceived as corruption channels especially in the

context where governance transparency was already questionable and trust between local administrative and citizen was in decline (Schmidthuber, *et al*., 2019; Sangkachan, 2021). The lack of citizen engagement could impeded progressive social changes which intensified society issues (Figure 4.8, economic development sub-system).

The literature review and 17 case study analyses show no universal guideline or indicator on achieving heightened community awareness and engagement in policy making of smart city development. Citizen engagement indicators are mostly assumed through participation in decision making under the smart governance dimension and the participation in public activities, lifelong learning, language course and involuntary work as part of smart people dimension (Sharifi, 2019). The approaches used to involve citizens in the city management projects depend largely on the city governance and culture which can be both tangible (skill, ability) and intangible (attitude, feeling, understanding) (Denhardt, *et al*., 2009; Capra, 2019). This supports the notion that participatory approach facilitated by smart city projects can promote transparency in governance. Cities where citizens were engaged in the smart city projects often deployed initiatives which were human-oriented and accessible to the general public. In Phuket case study, the need to engage the citizens was frequently mentioned by stakeholders, however, concrete implementation was sporadic. Budget limitation, time constraint, and the lack of expertise and responsible organization were stated as the barrier to active citizen engagement in smart city activities. Althouh public forums and seminars were often organized to showcase Phuket smart city projects and offer training courses, they were limited to the certain groups of participants who mostly have already been involved in many similar events (Section 4.4). Smart city development which primarily focused on technological expertise and technocrats without engaging with the disadvantaged and marginalized groups in the society were at risk of further increasing the social inequality and overlooking the deep-rooted developmental problems (Section 4.3.2 and 4.3.3).

The attitudes of the city administrators and residents towards governance and participatory process influence the way citizens are engaged in the development projects or the lack thereof (Section 4.5.3). Enabling and empowering the citizens to be

contributors to the smart city projects are part of the key success of a smart city development. In essence, citizen engagement recruits the sense of ownership and accountability, trust and collaboration towards the “citizen-centric governance” which forms a basis of meaningful smart city implementation.

5.2 The roles of open data platform and digital transformation in citizen engagement

RQ 2 on the role of open data platforms and digital transformation in citizen engagement is resolved by the findings on how open data platforms (ODP) were used to engage the public and target participants in a smart city initiative. Four main usage of ODP were identified in Section 4.2. These are city data service, citizen feeback, environmental monitoring and management, and citizen support and empowerment. ODP was mainly utilized as a city service that allowed citizens to be involved in city planning and reporting concerns (Section 4.2.3). Many cities designed e-system for feedback using an application and a website presenting information on various issues (the examples included Berlin and Brussel in Figure 4.12). Common topics in data presentation were mobility, transportation, environmental management and public services (Section 4.2.2). The online platform increases the public access to data and service as well as the support for marginalized groups such as elderly, people with disability, and minority groups (Figure 4.13 in Section 4.2.4). ODP also encourages transparency and accountability in the city management. Providing online communication and databases help increase the transparency of the city governance as well as the public awareness and support for new development initiatives (Section 4.2). This supports the notion that a smart citizen-centric governance requires local governments to adopt data-driven e-government strategy (Agbozo and Spassov, 2018). Grassroot organizations and community members should be empowered as big data co-generators and beneficiaries, especially in the environmental initiatives (Stevens and Morris 2001; Middlemiss and Parrish, 2010).

The implementation of ODP can also reflect the organizational culture of the city management authorities in relation to how they prioritize, engage and serve their citizens. The findings show that many smart cities employed interactive services and various channels for gaining citizen feedback and promoting public participation (Section 4.2.3). While ODP collects and generates large amount of information for business development and city management, serious effort must be made to ensure data security and personal privacy protection. The lack of attention to these issues could lead to cybercrime and misuse of city data and online platforms (Figure 4.30).

An effective management of the digital platform requires competent human capital with an understanding of the technology, legislations, and social contexts of the cities. Human resources form a vital part of the digital transformation through various roles e.g. co-creater, source of data and feedback, and consumer. This is evident in the literature review (Section 2.2.1) which showed active citizen engagement via online platform (Simonofski, *et al.*, 2017) and electronic votng in policy planning (Bishop and Davis, 2002). While the same technology applications maybe utilized by the city management organizations, the results can vary depending on the responsiveness of the personnel behind these tools. This was exemplified by the findings from Phuket smart city through the differences in the way LAOs managed their online media channels such as Facebook and websites for publishing news and announcements (Section 4.4.3). Some LAOs replied immediately to questions posted on these media while others gave no response or took a long time to react (Section 4.4.3). This highlights the fact that the availabilty of digital services alone did not necessarily guarantee the efficiency in communication. Digital transformation and ODP provide tools for improving communications and interactions between the city and citizens. Whether these platforms are utilized optimally or not depends on how the city approach citizen engagement (Section 4.2). Citizen-centric smart cities aiming require a shift from applying technology as a one-sided media channel towards an interactive cummunication that enables real-time and collective problem solving.

5.3 Citizen engagement strategies in a smart city

The resolution of RQ 3 on how smart cities worldwide engage citizens in solving environmental and urban problems is discussed from the findings of 17 smart city case studies. Section 4.3 shows three major themes of engagement stratigies namely open government data, interaction space and physical facilities, and purposeful events. Smart cities use both online and offline solutions to engage with stakeholders and public in city development and management. Many smart city initiatives use digital technology (web-based portals, applications) and open government data to facilitate online interactions among stakeholders across various sectors (See in Section 4.3.1) There are also several smart city projects which uitlize physical facilities and purposeful events to generate face-to-face interactions among the public and project participants (See in Section 4.3.2 and 4.3.3). Most smart city citizen engagement projects emphasized on knowledge creation, community awareness and equity in access to service and information (Section 4.3.1). This supports the notion that building knowledge and understanding using both offline and online channels in the local community are enablers of the smart city projects and urban problem solving.

Nevertheless, the ways in which smart cities provide engagement opportunities for the citizens differ with the purposes and contexts of each initiative. The common applications of digital platforms, as a public engagement tool were often related to environmental monitoring, city data service, resident feedback and social support (Section 4.2). This highlights the role of a smart city as a model for environmental sustainablity, participatory governance and inclusive society.

It is noteworthy that the target groups of many smart city initiatives tended to be technocrats and entrepreneurs (exclusive interaction space in Section 4.3.2 and IT skill training in Section 4.3.3). Only a few activities focused on children, elderly, or marginalized groups (non-technical activities in Section 4.3.3). This reveals the gap in a smart city ideology and implementation, in which the latter appears to emphasize heavily on the technological solutions and digitalization. This can lead to the unintended

consequence of widening social inequality. Human development and social processes are as much the part of a smart city as the physical and technological infrastructure (Angelidou, 2015). Many smart cities harnessed their human capitals through workshops and competitions such as Hackathons and Living Labs (Section 4.3.2 and 4.3.3). These activities enabled citizens to be a co-producer of knowledge and innovation rather than a passive user of technology (Cardullo and Kitchin, 2017a and Cardullo and Kitchin, 2017b). This promotes the collaborative culture in the society which helps drive innovative ideas into actions. The public perception towards the usefulness of smart city technology is ciritical for its acceptance and adoption (TAM in Section 2.3). This requires smart city stakeholders especially decision-makers and planners to adopt an inclusive culture and mindset in city management. The public attitudes which promote participatory governance and adaptive management were important enablers of citizen engagement in a smart city development (Docherty, *et al*., 2001).

Emerging from the findings is that the mindset of the public and business sectors towards citizen engagement is an important determinant of how much citizen's voices and feedback are incorporated in the implementation of a smart city activity (Section 4.4.2). Citizen engagement should not be treated as an empty buzzword to legitimize the project but a core component of the smart city implementation (Benoit and Hiroko, 2016). City development outcomes are influenced by the perceptions, knowledge and capabilities of the key decision makers and stakeholders. a smart city is shaped by the collaborative culture of the city's authority, businesses and the citizens.

5.4 Phuket smart city citizen engagement

This section shows the resolution of RQ 4 on how Phuket smart city initiatives influence citizen engagement in solving Phuket problems. Based on the findings in Section 4.4, Phuket smart city projects were mostly decided through a top-down process. The central government allocated the budget to specific projects to be implemented in a target area (See in Table 4.2, Section 4.4.2). Local organizations and

the regional offices of the ministries implemented the smart city initiatives with the collaboration from related authorities and companies (See in Figure 4.20, Section 4.4.1).

This leads to diverging viewpoints about Phuket problem prioritization between local and national key stakeholders. Although Phuket smart city key players and residents emphasized largely on economic development, similar to the national policy (Section 2.4), their interpretations and expectations of the solutions differed. The engagement of grass-root communities was not evident and their requirements were assumed through the representation of local government leaders. Meanwhile, the public organization, DEPA, tasked as a key facilitator of Phuket smart city was strongly influenced by tourism and technoloy businesses (see Figure 4.20 in Section 4.4.1). The Phuket smart city committee which was composed of mainly senior administrators from public organizations reflected a bureaucratic structure which limited participatory governance. The committee prioritized the implementation of central policies and national frameworks which determined the allocation of budget and projects (Section 4.4.2). Many Phuke smart city projects focused on digital and startup investment although Phuket residents were interested in tourism and increasing income in the local economy (see in Table 4.2 in Section 4.4.2). These community needs were expressed through local leaders and businesses. the local authorities and government. Despite the pre-approved smart city projects by the central government, local governments were asked to identify target areas and priorities as they were key facilitators of the project implementation. Local stakeholders play an important role in balancing the top-down policy and bottom-up feedback in the city development. Inadequate citizen engagement in the planning of smart city projects can lead to the lack of trust and support in the implementation. This is reprensented by the interviews which show that the private sector did not have a confidece in Phuket government administrators in leading a smart city project (Section 4.4.3). The differences in the understandings of a smart city according to different stakeholders were part of the challenge that limited the public engagement in Phuket smart city activities.

Public education was seen as an essential part of the citizen empowerment and engagement in the Phuket smart city project planning and implementation. Attempts were made by DEPA and its partners to promote the public understanding in smart city via websites, mobile application, social media, public meetings and events (Section 4.4.3). Phuket smart city stakeholders frequently stated the concerns over the sustainability of the smart city solutions and the need to equip Phuket people with the digital skills and the ability to solve city's problems in a creative and collaborative way. There were mentioning of 'digital literacy' but the interpretations of what it should entail varied among stakeholders. Universities and schools focused on computer, and programing skills while employees and authorities also related it to analytical, entrepreneurial and critical thinking abilities (Section 4.4.3). It was noteworthy that prior to the COVID-19 pandemic, the people's skills against misinformation or fake news were rarely mentioned. As the pandemic continued, the misunderstanding, misinterpretation of information and the spread of fake news spread through social media and online channels causing public confusion, privacy violation, bullying, hate speech, conflicts and difficulties in managing both new and existing problems (see in Section 4.6.1). The strong partnerships between private sector, government authorities and citizens were instrumental in helping Phuket cope with the unprecedented crisis as a result of the pandemic (Section 4.4.2).

Citizen engagement in Phuket smart city highlighted the role of business associations and educated young population in shaping the city development direction. The establishment of a Phuket City Development Company (PKCD) symbolized the strength of established local businesses and their willingness to invest in smart city projects. This has inspired other cities in Thailand to follow and set up their own companies to support smart city development (Khonkaenthinktank, 2017).

Phuket smart city showed that the competencies and attitudes of key stakeholders towards participatory governance were important promoters of citizen engagement. Phulet citizens were primarily considered users rather than co-creaters of smart city development (see Section 4.4.2). LAOs and project implementing authorities

acted as gatekeepers who identified participants and beneficiaries of the smart city projects. The public interest and awareness in smart city projects were low and there were doubts about how they benefit Phuket people (Section 4.4.3). Despite promotional events and educational workshops, it was unclear if the grass-root communities had gained more knowledge or better well being from a smart city development. Phuket smart city activities represent largely a top-down policy involving the inner circle of influential businesses and technologists rather than a citizen-centric development.

5.5 Socio-cultural values and citizen engagement in smart city

This section addresses RQ 5 on how socio-cultural contexts influence the citizen engagement in Phuket's attempt to become a smart city. This is interpreted from Phuket resident attitudes, social behavior, and expectations towards the Phuket smart city initiatives (see Section 4.5). In addition, the section offers the discussion on the relationships between social values and citizen engagement in smart city development from the 17 smart city case studies.

The study explored the relationships between citizens' engagement in Phuket smart city project and two types of factors. The first type encompasses basic demographic traits such as age, sex, financial condition, education background, occupation, involvement in public activities, and the use digital media (See Tables 4.5-4.7 in Section 4.5.1). The second type (of factors relate to the individual's attitudes and behaviors in terms of participation, governance, technology, citizenship, sense of belonging, trust, volunteerism, and change (see Table 4.10-4.11 in Section 4.5.3).

Lifestyle and demographic factors can influence the participatory culture and the residents' involvement in the city development. The study found that many Phuket residents wanted to be involved in the planning and implementation of the projects when most of them aware about Phuket smart city (see Table 4.6). Findings from the survey (Section 4.5.1) showed that those who refused to be involved in the smart city projects stated the lack of time due to study and work commitment (young population) and the

lack of ICT knowledge (aging population) as the main reasons. In addition, where and how residents lived could effect their awareness and engagement in Phuket smart city initiatives (see Table 4.7 in Section 4.5.1). Citizens in Mueang district were more aware than those in Kathu or Thalang district. This hightlights tha gap in the distributions of smart city events. Moreover, all respondents with leadership positions had heard about Phuket smart city while the majority of the sample was not aware of this concept (Section 4.5.1). The invitations and announcements of Phuket smart city activities mainly went to local government organizations and influential business associations (Section 4.4.2). This shows the limitation of Phuket smart city information by the government structure and the need to increase its reaches to wider community.

Phuket smart city development attempted to engage citizens in both online and offline activities. However, citizens were usually receivers of information rather than a co-producer of innovation (see Section 4.4.2). Project implementing authorities, attributing time and budget constraints to the lack of citizen engagement, were adamant towards the participatory process in the project development unless it was mandated by law (see Section 2.4.1). This highlights the gap between the idea and action in smart city implementation and reveals how technology, under the bureaucratic limitations, could result in the digital divide rather bridging it.

An inclusive engagement of society members across all age groups should be promoted. It was evident in Phuket that young and old people were not adequately involved in smart city development (Section 4.5.1). Youth engagement in urban development planning can be promoted through creative methods. E-tools such as games, design thinking courses, and simulation modelling techniques (Rexhepi, *et al*., 2018) could improve the engagement and co-creation opportunities for the young population. For elderly people, service and product designs should apply senior technology acceptance model (STAM) which take into the consideration the age-related health conditions, cognitive and physical limitations to increase technology adoption and effective usage in older population (Chen and Chan, 2014a and Chen and Chan, 2014b).

A smart city activity implemented through a traditional governance does not necessarily recruit a new generation of active citizens. This is showed in Section 4.4.3 in which participants who were involved in Phuket smart city projects were mainly those in leadership positions and frequent participants in community development activities such as public hearing. The study results in Section 4.5.3 indicated that leadership showed a positive association with smart city project involvement (Figure 4.25). While it is logical that people in the position of power are better informed of the development projects, technology can be utilized to communicate and increase public awareness about about the city direction and new initiatives in the area. A local leader has a key role in distributing accurate and appropriate information and understanding to the community members about a project implemented in their areas (Ozor and Nwankwo, 2008). Grass-root leadership beyond a political or social position remains an area that needs to be further promoted in smart city development (Vadiati, 2022). Having active and informed citizen is crucial for an implementation of digital technology to facilitate open governance and promote a constructive use of online channels. Information and communication technology upgrade as part of a smart city development should enable citizens to directly voice out their needs, concerns and ideas about how to improve the city, in addition to the representation through community leaders.

The findings from Phuket case study highlight the reality of smart city implementation which differs from those found in the literature and worldwide case studies. Ideally, active citizen enhances the success of a smart city initiative in the long term by creating champions and sense of ownership through grassroot organizations and public education which enables citizens to co-produce and manage projects with the state (see Section 2.2.1). Increasing and sustaining citizen engagement in city development in practice requires changes in public, business and administrator mindsets and behaviors at multiple levels. Collaborations among central and provincial government authorities, local administrators, businesses, and community leaders are necessary for achieving citizen awareness and the shift in mentality and behavior of the citizens towards the smart city goals (Ahmad, 2005). This in itself is a challenge as the understanding and

expectations of a smart city may be diverse and even conflicting interests among the stakeholders (Section 4.4.3 and 4.5.2; Hoang, *et al.*, 2019).

Effective smart cities engage their citizen throughout the process of technology design and implementation, not just as an end-user. Some cities, for instance, Amsterdam and Berlin (Section 4.3.3) invited their citizen into the project as a co-designer through “inclusive design”. Both case studies engaged their citizens in an early phase of the city projects such as public space rejuvenation. The main challenge of the city leaders is dealing with the residents' expectations and harnessing their cooperation, a task which requires considerable skills in communication and participatory culture. As part of the smart city development, the public administrator has a crucial role of facilitating the networks and collaboration both between city managers and residents and among citizens themselves through an effective public participation process.

A smart city is characterized by the interconnectivity among people and places in a way that is efficient, effective and appropriate in its context. Its development should reflect the needs and priorities of its citizens. This was exemplified in Amsterdam, London, and Paris, workplace digitalization and surrounding design such as rail network, landscape, shops have been increasingly embedded to improve employee well-being and efficiency of production (Vallicelli, 2018; Papagiannidis and Marikyan, 2020). As cities are the melting pot of people from diverse socio-economic and culatural backrounds, city services and infrastructure must take into consideration multi-dimensional development and facilitate non-technology involvement of the citizens from diverse occupations in urban planning. Investment in technology should be made to address city pressing issues and support integrated urban planning, communication, and collaborations among the stakeholders.

The findings from both Phuket and worldwide smar city case studies highlight that the effectiveness of citizen engagement depends on the governance and participation culture of the city as well as the public mindsets towards the smart city development. As the city’s socio-cultural characters are shaped by its citizens, demographic factors, people’s attitude, technology usage, social behavior, and digital

knowledge and skills become the enablers or inhibitors of active engagement in smart city activities. The awareness and perception of the citizen towards their role in the society influence the quality of engagement in city development. Collaborative culture is necessary for a sustainable implementation of technological solutions in a smart city. In the cyber – physical merging era, human and personal devices such as smartphones, tablets have become the central and active element of the Internet system (Conti, *et al.,* 2017, Conti and Passarella, 2018). There is an increasing need for smart cities to focus on not only IoT but also IoP (See in Section 2.1.2). IoP does not define "people" as "things", which empower a new social behavior within cities to become smarter. Collaborative city culture which empowers citizens to become active in co-creating the solutions to city problems is as much part of smart city development as infrastructure and technological improvement. The view that a citizen is merely an end user of the ICT service should be challenged. This supports the adoption of technology adoption theories such as UTAUT and MM (See in Section 2.3) in the implementation of smart city.

5.6 Citizen engagement in smart city in a post-pandemic world

This section discusses the emerging findings on how 17 smart city case studies and Phuket utilized the technology to engage citizens during the COVID-19 pandemic. It highlights the importance of emergency response and strong support networks from all stakeholders in crisis management.

The 'new normal', a term for working and living with the pandemic, became a new framework for public administration, business operation, and way of life since 2020 (Hu, 2020; Neuman, *et al*., 2021). Smart city activities during the global pandemic were observed to utilize online channels such as webinar and online competition to maintain public engagement (See in Section 4.6.3). There was a rapid adoption of e-learning and e-working systems in all sectors. Technology was developed to facilitate social distancing in public areas and monitor large gathering for law enforcement (Section 4.6.2), illegal. Touchless technologies and crowd monitoring were rapidly deployed. The public was

invited to co-design and co-produce city solutions to reduce the spread of the disease and improve city service. As observed in many cities such as Adelaide (C1) and Brussels (C7), residents acted as a creative source that contributed ideas and skills to help solve city problems (Section 4.6.1).

The open government data platforms were quickly developed to enable real time reporting and monitoring the infections. Some cities used online channels for sharing personal experience and ideas for home quarantine (Ixelles web-TV platform in Brussels (C7), Section 4.6.1). However, misinformation and cybersecurity posed growing concerns for cities and nations. False information, hate speech, cyberbullying spreaded widely on social media and online platforms (Section 4.6.1). The attempts to address online misinformation and educate the public in digital media literacy were often slow. The severity of negative impacts from the misuses of information technology triggered nation-wide efforts to combat these situations as seen in Belgium (C7) and Hong Kong (C9) which set up webpages for verified information and online services to identify fake news. Furthermore, there were citizen-led projects which were created based on public doubts over the transparency and accuracy of the data presented by government officials (Taiwan (C16) in Section 4.1). This highlights the severe impact of the public trust towards the city management and its consequence on the society cooperation of the pandemic mitigation measures.

While the pandemic halted the economy and caused rising unemployment in cities around the world (BBC news, 2021), there was an increasing demand for digital technology and big data for digital governance and economic recovery. In Thailand, One Tambon One University project was established by the national government to employ local people, university graduates and students for community data collection and grass-root capacity activities (NNT, 2020). University graduates were recruited and posted at various governmental bodies to work on data digitization. E-commerce and digital payment tools were quickly adopted to mobilize the post-pandemic economy (Jílková and Králová, 2021). Thai government created several e-commerce initiatives to stimulate

economic recovery such as Khon La Krueng[57] (Half-half) co-payment scheme, Rao Thieu Duaykan[58] (We Travel Together) scheme, and Rao Chana[59] (We Win) scheme (Bangkok Post, 2020; Thai PBS World, 2020; Thai PBS World, 2021). These initiatives necessitated the access to mobile devices and internet as well as skills in digital technology which were often not applicable to marginalized groups (Bangkok Post, 2021b). Such socio-economic gap in the digital era highlights the challenges of equity and inclusiveness in smart city development (See in Section 2.1.2).

The public health crisis revealed social inequalities, some of which were intensified by technology applications. This was exemplified by the governmental mandate on the use of personal tracking applications for travelling which required the citizens to have smartphone with working internet (Section 4.6.2). The lack of inclusiveness in policy and technology implementation could lead to management failure. For instance, Thailand's MorChana application was developed as a disease control effort (Bangkok Post, 2021a) but its early deployment focused mainly on Thai residents using Thai language. This limited disease monitoring in non-Thai residents and migrant workers which contributed to clusters of outbreak in migrant worker's camps and expat communities (BBC news, 2020). Thailand's situation was in contrast to the Singapore's management and disease control measures for non-national residents (See in Section 4.6.1). The Ministry of Manpower (MOM) in Singapore invested in an application for monitoring daily health status of migrant workers in multiple languages including Bengali, Bermese, Mandarin, Tamil, and Thai. The employers were tasked with encouraging their workers to download application which were key to the compliance to and the effectiveness of the disease control policies. The COVID-19 outbreak has highlighted the

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[57] Customers pay half price for the services or products to the participating businesses, the other half is paid for by the government.

[58] Travellers pay 60% of the cost for accommodation, transport, food for domestic trips, the rest is paid for by the government.

[59] Eligible individuals with low income or loss income due to the pandemic are provided stipend to buy basic need items and services.

deep-rooted problems of social disparity especially in poor communities, illegal migrants, and foreign residents in many cities. Efforts to address labour's wellbeing and engage the employers in ethical workforce practices to reduce COVID-19 infection (Drake, 2020) could reflect the culture of empathy in smart cities. This was exemplified by FWMOMCare application in Singapore (C14) (Section 4.6.1; Gan and Koh, 2021).

Youth engagement plays an important role in reducing the infection through health literacy promotion. This was exemplified by the Bhubaneswar smart city initiative which invited youth leaders and representatives from slums to attend short course training programs about the identification of infectious symptoms and health awareness promotion (see Section 4.6.3). This aligned with the youth engagement framework in COVID-19 presented by WHO's Regional Office for the Eastern Mediterranean (WHO EMRO) which emphasized on youth empowerment, action, and participation (WHO EMRO, 2020). This supports the notion that including young people in a meaningfully organized, family-friendly urban and sustainable development is key to creating a sense of ownership and leadership in youth (Santo, *et al*., 2010). Furthermore, technology-savvy youth with fresh ideas and abilities can help improve human-computer interaction (Cohen, *et al*., 2017) as the society and economy become more digitized and robotized.

In the post-pandemic world, citizen engagement in smart city initiatives was even more critical for effective city management and economic recovery. The pandemic highlights the significance of digital literacy and adaptive management as much of human interactions were shifted from physical activities to the virtual platforms with communication and collaboration happening at a rapid pace (Castellani, *et al*., 2020). The citizen adaptiveness to changes, technology, and livelihood determine the survival of the city. This requires growth mindset and collaborative culture (Dweck, 2006; Tuurnas, *et al*., 2019). Smart cities thrive on citizens who are informed, empowered and engaged in the city management because they are pivotal to the solutions and mitigation of public crisises.

5.7 Conclusion

Active engagement of the citizens is an important process of smart city development. This research demonstrates that smart cities feature not only the efficient services and infrastructure enhanced by modern technology but also the participatory governance and interactive communication in urban development. The evidences that support this conclusion are displayed through the resolutions of five research questions. RQ 1 is addressed through the conceptual model of citizen engagement in a smart city development and implementation using the literature and case studies of selected smart cities. The results show citizen engagement as a key contributor to the smart city development which reflects the importance of governance and engaged citizens in the city. The conceptual models show how smart city sub-systems are connected to citizen engagement (Figure 4.2). RQ 2 focuses on the role of open data platforms and digital transformation in enabling citizen engagement. The research question was resolved using desktop research and observation. The results revealed four main usage of the open data platform in smart cities namely i) environmental monitoring and management, ii) city data service, iii) city feedback and iv) citizen support and empowerment. The resolution of RQ 3 on citizen engagement strategies from 17 smart cities worldwide yielded three approaches. These are i) open government data, ii) interaction space and physical facilities, and iii) purposeful events. Emerging findings on citizen engagement during the COVID-19 showed open government data and purposeful events as the main tools for participatory process. Physical distancing technology and contactless services were developed to faciliate face-to-face interactions while reducing infection risk. RQ 4 examines citizen engagement in Phuket smart city initiatives and urban problem solving. The results reflected a top-down approach. The importance of citizen engagement was recognized but its implementation was haphazard mainly through events in which citizens were users or observers of Phuket smart city public relation campaigns. Interaction space and physical facilities such as Phuket Innovation Park was promoted but their access tended to be limited to IT developers and startups. Beneficiaries of Phuket smart city were

shaped by key stakeholders, i.e. DEPA, business associations and universities which gravitated towards public authorities, scholars and entrepreneurs. This highlights the lack of inclusiveness in a smart city development at the operational level. RQ 5 explores the socio-cultural factors which contribute to citizen engagement in Phuket's attempt to become a smart city. Key findings revealed that location, gender, age, education, income, birthplace and leadership position influenced the awareness and willingness to be involved in the smart city initiatives. This is partly due to the governace structure and participatory culture of the key project implementing organizations. This highlights that human capital which is influenced by governance and its organization culture are vital to the implementation and adoption of smart city initiatives.

A smart city is characterized by active citizens who are informed and engaged in its development direction. The smartness of a city builds on constructive utilization of open data platforms and digital technology by city managers and the public to manage problems concerning economic, social and environmental sustainability. As cities are faced with future challenges and uncertainty as exemplified by the COVID-19 pandemic, cities' resilience depends on resourcefulness from having educated and engaged citizens. Smart cities are driven not only by technology but also the collaborative culture that empower the public to act as co-producers of innovations and form vital partnerships for collective problem solving.

5.8 Limitations and future research

This section identifies the challenges during this research and opportunities for future studies. The first obstacle of the research was the difficulty in contacting smart city project managers of the worldwide case studies. Initially, surveys were sent through e-mail to 26 administrators of smart city websites. Only one city, Amsterdam, responded with the information on lessons learned. This highlights the fact

that the quality of the information and communication through an online channel depends on the responsiveness of an organization and city officers in charge of the smart city projects. The lack of response could also be because most websites were used as static information displays rather than a feedback channel. This problem was overcome by adjusting the selection criteria for a case study and conducting content analysis of the websites which provided sufficient information on citizen engagement in the smart city projects. Secondly, the information based on the open data platform of a smart city was often presented by the technology companies rather than the city administrative organizations. This resulted in the information appearing as a marketing statement rather than an objective description of the project. This issue was addressed by identifying biases in the material presented by the stakeholders with vested interest and focused on neutral statements in the analyses. Thirdly, most official smart city webpages lacked information about lessons learned, impediments, and citizen-initiated projects. This was addressed by searching multiple resources about the cities through various literature and media such as news, academic articles, and videos.

Future studies could build on this research by conducting in-depth interviews with the city managers involved in the project implementation. The lessons learned from the case studies and best practices viewed by the city managers can be compared to the experiences of the residents and business stakeholders. Moreover, the projects initiated by the citizens could be further investigated to compare the grassroot approaches of smart city development with the state- and business- driven projects. A quantitative data analysis of the city performance indicators and the measurement of citizen participation could also be explored.

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APPENDICES

APPENDIX I

SMART CITY INDICATORS

Authors (Year)	Categories	Indicators
1. Giffinger, *et al.* (2007)	1. Smart Economy 2. Smart People 3. Smart Governance 4. Smart Mobility 5. Smart Environment 6. Smart Living	74 indicators; <u>Smart Economy</u> 1. R&D expenditure in % of GDP 2. Employment rate in knowledge-intensive sectors 3. Patent applications per inhabitant 4. Self-employment rate 5. New businesses registered 6. Importance as decision-making centre (HQ etc.) 7. GDP per employed person 8. Unemployment rate 9. Proportion in part-time employment 10. Companies with HQ in the city quoted on national stock market 11. Air transport of passengers 12. Air transport of freight <u>Smart People</u> 1. Importance as a knowledge centre (top research centres, top universities etc.) 2. Population qualified at levels 5-6 ISCED 3. Foreign language skills 4. Book loans per resident 5. Participation in life-long-learning in % 6. Participation in language courses

APPENDIX I

SMART CITY INDICATORS (Cont.)

Authors (Year)	Categories	Indicators
		Smart People
		7. Share of foreigners
		8. Share of nationals born abroad
		9. Perception of getting a new job
		10. Share of people working in creative industries
		11. Voters turnout at European elections
		12. Immigration-friendly environment (attitude towards immigration)
		13. Knowledge about the EU
		14. Voters turnout at city elections
		15. Participation in voluntary work
		Smart Governance
		1. City representatives per resident
		2. Political activity of inhabitants
		3. Importance of politics for inhabitants
		4. Share of female city representatives
		5. Expenditure of the municipal per resident in PPS
		6. Share of children in daycare
		7. Satisfaction with quality of schools
		8. Satisfaction with transparency of bureaucracy
		9. Satisfaction with fight against corruption

APPENDIX I

SMART CITY INDICATORS (Cont.)

Authors (Year)	Categories	Indicators
		Smart Mobility
		1. Public transport network per inhabitant
		2. Satisfaction with access to public transport
		3. Satisfaction with quality of public transport
		4. International accessibility
		5. Computers in households
		6. Broadband internet access in households
		7. Green mobility share (non-motorized individual traffic)
		8. Traffic safety
		9. Use of economical cars
		Smart Environment
		1. Sunshine hours
		2. Green space share
		3. Summer smog (Ozone)
		4. Particulate matter
		5. Fatal chronic lower respiratory diseases per inhabitant
		6. Individual efforts on protecting nature
		7. Opinion on nature protection
		8. Efficient use of water (use per GDP)
		9. Efficient use of electricity (use per GDP)

APPENDIX I

SMART CITY INDICATORS (Cont.)

Authors (Year)	Categories	Indicators
		Smart Living 1. Cinema attendance per inhabitant 2. Museums visits per inhabitant 3. Theatre attendance per inhabitant 4. Life expectancy 5. Hospital beds per inhabitant 6. Doctors per inhabitant 7. Satisfaction with quality of health system 8. Crime rate 9. Death rate by assault 10. Satisfaction with personal safety 11. Share of housing fulfilling minimal standards 12. Average living area per inhabitant 13. Satisfaction with personal housing situation 14. Students per inhabitant 15. Satisfaction with access to educational system 16. Satisfaction with quality of educational system 17. Importance as tourist location (overnights, sights) 18. Overnights per year per resident

APPENDIX I

SMART CITY INDICATORS (Cont.)

Authors (Year)	Categories	Indicators
		19. Perception on personal risk of poverty
2. Lazaroiu and Roscia (2012)		18 indicators
		1. Pollution
		2. Innovative spirits
		3. CO_2
		4. Transparent governance
		5. Sustainable resource management
		6. Separated litters
		7. Education facilities
		8. Health conditions.
		9. Sustainable, innovative and safe public transportation
		10. Pedestrian areas
		11. Cycle lanes
		12. Green area
		13. Production of municipal solid waste
		14. GWh household
		15. Fuels
		16. Political strategies & perspectives
		17. Availability of ICT-infrastructure
		18. Flexibility of labor market

APPENDIX II

26 CASE STUDIES IN THE FIRST TEN PAGES

Cities	Web sources	Remarks
1. Adelaide, Australia	https://www.adelaidesmartcitystudio.com/	
2. Agra, India	http://www.agrasmartcity.in/	
3. Amsterdam, Netherland	https://amsterdamsmartcity.com/	
4. Barcelona, Spain	http://ajuntament.barcelona.cat/estrategiadigital/en	
5. Berlin, Germany	www.smartcity.berlin	
6. Bhubaneswar, India	https://www.smartcitybhubaneswar.gov.in/	
7. Brussels, Belgium	http://smartcity.brussels/home	
8. Burmingham, UK	https://birminghamsmartcity.wordpress.com/	Insuffiecient details on project with citizen engagement.
9. Busan, South Korea	http://k-smartcity.kr/english/smartcity/business.php	Insuffiecient details on project with citizen engagement.
10. Casablanca, Morocco	http://www.smartcityexpocasablanca.com/	Insuffiecient details on project with citizen engagement.

APPENDIX II

26 CASE STUDIES IN THE FIRST TEN PAGES (Cont.)

Cities	Web sources	Remarks
11. Copenhagen, Denmark	https://www.copenhagencvb.com/copenhagen/copenhagen-everything-closer-2	Non-offiicial smart city website.
12. Denver, Colorado, USA	https://www.denvergov.org/content/denvergov/en/denver-smart-city.html	Insuffiecient details on project with citizen engagement.
13. Glasgow, Scotland	http://futurecity.glasgow.gov.uk/	
14. Hong Kong	https://www.smartcity.gov.hk/	
15. Jakarta, Indonesia	http://smartcity.jakarta.go.id/	Non-Google translated in English language.
16. Nice, France	http://en.meet-in-nice.com/nice-smart-city	
17. Pune, India	http://www.punesmartcity.in/	
18.Seoul, South Korea	https://www.seoulsolution.kr/en/content/seoul-e-government-toward-smart-city	

APPENDIX II

26 CASE STUDIES IN THE FIRST TEN PAGES (Cont.)

Cities	Web sources	Remarks
19. San Francisco, America	http://smartcitysf.com/	Insuffiecient details on project with citizen engagement.
20. San José, USA	http://www.sanjoseca.gov/index.aspx?NID=528"9	
21. Singapore	https://www.smartnation.sg/	
22. Songdo, South Korea	http://songdoibd.com/	Non-official smart cityh website.
23. Stockholm, Sweden	https://smartcitysweden.com/	Insuffiecient details on project with citizen engagement.
24. Surat, Gujarat, India	http://www.suratsmartcity.com/SuratSmartCity/SmartCityVision	
25. Visakhapatnam, India	http://www.visakhapatnamsmartcity.com/	Non-official smart cityh website.
26. Yokohama, Japan	https://www.city.yokohama.lg.jp/	Non-official smart cityh website.

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
1	26/10/2015	✓		2	Exploration of smart city framework in Phuket province with insider	PSU Phuket, DEPA, CAT, TOT, TSEP	*Increased participation among stakeholders in Phuket.*	PSU Phuket	DEPA
2	26/10/2015	✓		4	Exploration of smart city framework in Phuket province with PAO	Phuket provincial governor and vice governor, Phuket CM, PSU Phuket, DEPA, CAT, TOT, TSEP	*PSU roles are smart people training and identify short course certificated.*	PSU Phuket	DEPA with PAO
3	3/11/2015	✓		1.5	Internal meeting "Phuket smart city in PSU framework"	PSU Phuket and Hat Yai	*PSU have main action about smart people*	PSU Phuket and Hat Yai	PSU

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
3							*and cooperate with DEPA for innovation park building.*		
4	19/11/2015	✓		1	"Phuket smart city driven"	Vice minister of MDE, Phuket provincial vice governor, PSU Phuket, DEPA, Intel, Huawei University, Phuket PEA,	*Contribute appropriate methods for citizen agreement and understanding.*	MDE	PAO
							Increasing participation among stakeholders.	PSU	

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
4						CAT, TOT, Phuket CM, Thai hotels association – Southern chapter, Phuket spa association, Phuket provincial statistical officer			
5	30/11/2015	✓		2	"Phuket smart city road map driven"	Phuket provincial governor and vice governor,	Not mentioned		DEPA

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
5						PSU Phuket, DEPA, CAT, TOT, Phuket CMy, Thai hotels association – Southern chapter, Phuket spa association, Phuket provincial statistical officer			
6	4/12/2015	✓		2	Internal meeting "Phuket smart city in PSU framework	PSU Phuket	Not mentioned		PSU

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
7	22/12/2015		✓		"Phuket smart city Roadmap 2020"	N/A Proposed roadmap to MDE. (Source: http://www.sipa.or.th/th/news/2127)			DEPA
8	27/1/2016	✓		8	"CISCO workshop"	CISCO, PSU Phuket, Phuket National Statistical Office, Patong TM, Phuket CM, Phuket Tourism Authority of	Ubiquitous open data platform	CISCO	CISCO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
8						Thailand, Phuket Thai Real Estate Association, TOT, CAT, DEPA, Phuket Tourist Association, Phuket Ministry Tourism and Sport			
9	15/2/2016	✓		1.5	Internal meeting "Phuket smart city in PSU framework	PSU Phuket and Hat Yai	Not mentioned		PSU

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
10	17/3/2016		✓		"Patong smart free WIFI"	N/A Create the public free Wfi in Patong. (Source: http://www.sipa.or.th/th/news/2247)			DEPA with PAO
11	17/3/2016		✓		"Smart city forum" preparation	N/A Prepare the smart city forum. (Source: http://www.sipa.or.th/th/news/2245)			DEPA with PAO
12	21-24 /3/2016		✓		"MOU with Busan city, South Korea	N/A Study and exchange smart city in Busan consist of Busan center for creative economy and innovation center in BIPA [Busan IT Industry Promotion Agency]. (Source: http://www.sipa.or.th/th/news/2254)			DEPA with PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
13	22/3/2016		✓		"Phuket smart city logo and slogan competition"	N/A Phuket smart city promoted by official provincial letter. (Source: http://www.phuketprice.com)			PAO
14	18 /5 /2016	✓		1	"Smarter city application with IBM"	Vice of Phuket Provincial Governor, DEPA, IBM	Not mentioned		IBM
15	23/5/2016	✓		6.5	"Phuket smart city workshop"	Phuket Provincial Office, DEPA	Educate and support community	PAO and education sector	DEPA with PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
16	24 /5/2016	✓		2.5	"Identify the needs of Patong Town Municipality"	Patong TM, DEPA, PSU Hatyai, TAT, CAT, NECTEC	See in Table 4.2		DEPA with PAO
17	24 /5/2016	✓		2	"Identify the needs of Phuket City Municipality"	Phuket CM, DEPA, PSU Hatyai, TAT, CAT, NECTEC	See in Table 4.2		DEPA with PAO
18	25 /5/2016	✓		1.5	"Knowledge exchange of Phuket smart city" between DEPA and	BOI, DEPA, and ASEAN Korean center	Not mentioned		DEPA

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
18					ASEAN Korean center"				
19	27 /5/2016	✓		2.5	"Phuket smart city progress report"	Deputy Governor of Phuket, Phuket smart city committee	Not mentioned		PAO
20	3 /6/2016	✓		6	"CCTV installation in pilot areas"	DEPA, NECTEC, Patong TM, Phuket CM	Not mentioned		DEPA with PAO
21	14/6/2016	✓		6	"Review and clarify the Phuket smart city	DEPA, NECTEC, CAT, TOT, PSU Hatyai, CISCO,	Not mentioned		DEPA with PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
21					projects in both of pilot areas"	Patong TM, Phuket CM			
22	14/7/2016	✓		3.5	"Journey of Phuket Smart City Seminar"	PSU Phuket, DEPA, Phuket Provincial governor's office, Vachira Hospital, PKRU, Disaster Prevention and Migration Regional Phuket,	Not mentioned		PSU

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
22						Phuket Tourist Association			
23	30/7/2016	✓		3	"Inspiration for Startup, Phuket smart city, Marina city, and Civil State Project"	PIC Phuket, DEPA, Patong TM, NECTEC, Private business operators	Not mentioned		PIC Phuket
24	30 -31 /8 and 1/9/2016	✓		18	"The 2nd ASIA – Pacific Regional Forum on Smart Sustainable Cities	ITU, MICT, Phuket Provincial governor's office	Not mentioned		PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
24					and e-Government 2016"				
25	8 – 9 /9/2016	✓		12	"Innovation Center officially announcement and kick off the Phuket smart city"	MDE, BOI, DEPA, Phuket Provincial governor's office	Not mentioned		DEPA
26	8 /11/2016		✓		"PKCD collaborated with government sector for Phuket	N/A PKCD officially announced the master plan for Phuket smart city in terms of mobility, tourism in the next 20 years. (Source: http://thainews.prd.go.th/)			PKCD

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
26					Smart city development				
27	25 – 26 and 30 /1/2017	✓		12	"Brainstorming for International tourism and smart city master plan development in Phuket"	Phuket Provincial governor's office, PKCD, Phuket PAO, Harbour Office Region 5 Phuket, Phuket Provincial Industry Office, Phuket Real Estate Association,	Not mentioned		DEPA with PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
27						Phuket Tourist Association			
28	31/3 /2017		✓		"Moving Forward to Phuket SC Seminar" or "CODE Phuket"	N/A Showcase a collaboration in IoT technology through a smart environment. (Source: https://sparkbit.co.th/?cat=9)			PSU
29	30/5/2017		✓		"Smart Tourist Card & SOS in Smart Growth Workshop"	N/A Smart tourist card, sos and alien data management system in sustainable smart growth workshop. (Source: http://www.depa.or.th/th/news/)			DEPA

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
30	5 /6 /2017		✓		"Phuket Smart City Monitored No.1/2017"	N/A Phuket governor monitored the Phuket smart city development. (Source: http://www.depa.or.th/th/news/)			PAO
31	28 /6/2017		✓		"Phuket Smart City Informative Speech to Officer of the Permanent Secretary for Defense"	N/A DEPA explained the Phuket smart city development to the officer of the permanent secretary for defense. (Source: http://www.depa.or.th/th/news/)			DEPA with PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
32	1/7/2017		✓		"3-D City Model Planning Workshop"	N/A DEPA educated 3-D city model planning to government officers and the private sector for Phuket smart city development. (Source: http://www.depa.or.th/th/news/)			DEPA
33	24 /7/2017		✓		"IBM Corporate Service Corps Opening Ceremony"	N/A IBM cooperates with PAO in terms of special clinics of government hospitals in Vachira Hospital, disaster management in PSU Phuket, environmental management in Patong TM and smart city data platform in DEPA. (Source: http://www.depa.or.th/th/news/)			IBM

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
34	23/8/2017		✓		"Smart City for smart tourism; Digita marketing"	N/A DEPA educated SMEs for digital marketing and strategy development. (Source: http://www.depa.or.th/th/news/)			DEPA
35	2/9 /2017		✓		"Startup Hack (Making Makers for Smart City)"	N/A DEPA educate startup for digital technology and innovation using. (Source: http://www.depa.or.th/th/news/)			DEPA
36	29/9/2017		✓		"BIM City Model: 3D Visualization"	N/A DEPA trained the BIM city model: 3D visualization skill to the government officer for city planning, regulation and Phuket smart city development. (Source: http://www.depa.or.th/th/news/)			DEPA

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
37	3/2/2018	✓		3	"National Legislative Assembly Committee Discussing"	DEPA, Phuket Vice Governor, Phuket smart city committee, the National Legislative Assembly	Not mentioned		DEPA with PAO
38	5 /2/2018	✓		3	"Phuket Big Data Platform Framework"	DEPA, Phuket Governor, Phuket smart city committee, the Committees of	*Design equality channels to citizen participation including vulnerable group*	National Legislative Assembly Committee	DEPA with PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
38						Science of ICT, the National Legislative Assembly			
39	8 /2/2018		✓		"Smart City Data Platforms Committees Meeting 1/2018"	N/A Phuket Vice Governor and DEPA clarified the smart city data platform in terms of target group, planning etc. (Source: http://www.depa.or.th/th/news/)			DEPA with PAO
40	2/3/2018		✓		"Consulting w/t Australian Ambassador	N/A			Australian Ambassador

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
40					Extraordinary & Plenipotentiary	DEPA consulted the Phuket smart city driven with Australian Ambassador Extraordinary & Plenipotentiary and Commercial Minister Counselor. (Source: http://www.depa.or.th/th/news/)			Extraordinary & Plenipotentiary
41	15 – 17 /3/2018		✓		"Phuket Smart City Monitored in 4 themes"	N/A 1) MDE monitored the Phuket smart city projects in terms of smart tourism, smart safety, smart environment, and smart economy. 2) Private sector cooperation such as PKCD. 3) Smart city data platform planning for tourism development. (Source: http://www.depa.or.th/th/news/)			DEPA

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
42	28/3/2018	✓		3	"Phuket Smart City Monitored No.1/2018"	Phuket Vice Governor, DEPA, Phuket smart city committee	Not mentioned		PAO
43	25/5/2018		✓		"Phuket Smart City Monitored No. 2/2018"	N/A 1) Phuket vice governor promoted Phuket province attend to the smart city Asia Pacific awards SCAPA 2018 competition in terms of tourism, arts, libraries, culture , open spaces with China, Singapore, and South Korea. 2) DEPA clarified the Phuket smart city already done such as 1,000 points of public free WiFi, IoT Network for smart tourism and safety development, Analytics CCTV, Command			PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
43						center, marine safety, sensor for wastewater and disaster management, and City data platform for open data in Phuket. (Source: http://nwnt.prd.go.th/centerweb/news/)			
44	29 - 30 /6/2018	✓		6	"Phuket Digital Innovation Summit 2018" And PKCD officially opening	General people especially digital startup	*Discuss citizen engagement methods with technology provider*	DEPA	DEPA with PKCD

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
45	8 /7/2018		✓		"MOU with UNDP"	N/A DEPA signed an MOU with the United Nations Development Program (UNDP) for Phuket smart city and safety development. (Source: http://www.depa.or.th/th/news/)			DEPA with UNDP
46	10/7/2018	✓		9	"DEPA Transformation in Action 2018"	General people	Not mentioned		DEPA

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
47	20/7/2018	✓		3	"DEPA Transformation: Phuket Smart City Tourism"	Phuket Tourist Association (PTA) members	Not mentioned		PTA
48	27-29 /8/2018	✓		15	"Strategic Planning Review of Andaman Provinces in 4 years (2018-2021)"	Government officers in Andaman Provinces	*1) Open data and sharing platform in public health and security* *2) Human resource development in terms of digital literacy and creative thinking*	PAO	PAO

APPENDIX III

PHUKET SMART CITY MEETINGS RECORDS BY ATTENDED AND GATHERED SECONDARY RESOURCES (Cont.)

No.	D/M/Y	Researcher attended	Secondary resource	Hours	Topic	Participants	Citizen engagement proposed	Organization proposed	Host event
49	7/9/2018	✓		3.5	Smart City Master Plan of DEPA	DEPA, General people	*Lack of understanding of people in smart city*	The federation of Thai Industries	DEPA
							Digital literacy education and youth education	PAO	
							Attitude management about data platform sharing	Hotels Association in Southern region	

APPENDIX IV

MAIN QUESTION PROMPT USING SEMI-STRUCTURED OPEN-ENDED INTERVIEWS

- What is your opinion about the smart city project especially in Phuket cultural context?
- How about your role in the Phuket smart city project?
- What expectations do you have for the Phuket smart city project?
- What is your opinion about sustainable development in Phuket smart city project?

If the interviewee thought that this project might face any problems, refer to the next question.

- How do you solve problems?

If the interviewee mentioned citizen engagement, refer to the next question.

- How to engage citizens into the Phuket smart city project?

APPENDIX V

QUESTIONNAIRE FOR RESPONDENTS WHO LIVE CURRENTLY IN THREE DISTRICT OF PHUKET

Questionnaire

Community engagement in "Phuket smart city"

Faculty of Technology and Environment, Prince of Songkla University Phuket Campus

Explanation

1.**Objective** This questionnaire is part of a PhD research to investigate the citizen engagement in "Phuket smart city". The data will be used to enable urban decision makers in creating appropriate planning for Phuket smart city in the future.

2. **Definition**

"Phuket smart city" is the project managed by the Ministry of Digital Economy and Society of Thailand (MDE). This project aims at human capital development to drive digital innovation in Thailand and connecting urban services through digital infrastructure to improve quality of life and economic growth in Thailand. There are 7 compartments and example projects in an initial phase as follows:

1.Economy: Innovation park, start-up training program, the digital economy investment support

2.Education: Human capital development, creative digital learning support

3.Environment : Environmental sensor monitoring level of water, air quality, local solid waste management system

4.Governance : Open data platform, command center

5.Public health: Patient single ID, refer system development

6.Safety: Land (CCTV analytic system and command center), Marine (identity remember and analytic system for identify individual tourist's data and location).

7.Tourism: Tourism information application including local product information, SOS

(Ref: MDE, 2017)

3. Please provide accurate and complete data to ensure optimal inputs.

4. Your answers are kept anonymous and used only for student and university development. Please feel free to provide your opinion in this survey.

Thank you very much for your time

APPENDIX V

QUESTIONNAIRE FOR RESPONDENTS WHO LIVE CURRENTLY IN THREE DISTRICT OF PHUKET (Cont.)

No.....

Community survey on citizen engagement in "Phuket smart city"

Part 1 General information

Instruction Please tick ☑ in the option that is closest to the fact

1. Gender ☐Male ☐Female

2. Age ..... Years

3. Birthplace ☐Phuket ☐Others (please specify and answer Question 4) .....

4. Length of residency in Phuket ..... Month (in case of live less than 1 year) ..... Years

5. Current residence ☐Mueang district ☐Kathu district ☐Thalang district

6. Education ☐Lower than high school ☐High school or equivalent
☐Diploma /Vocational certificate ☐Bachelor's degree ☐Master degree or higher

7. Occupation ☐Government employee/State enterprises ☐Company employee ☐ Business owner
☐Student ☐Contractor ☐Merchant
☐Farmer/Fisherman ☐ Others (please specify) .....

8. Average monthly personal income ☐ Less than 10,000 THB ☐ 10,000 – 20,000 THB
☐ 20,001 – 30,000 THB ☐ More than 30,000 THB

9. Position in community ☐Member of the LAO[1] ☐Community/Group leader ☐Local resident

10.Have you ever heard about "Phuket smart city project" before?
☐Yes (please answer Question 11) ☐No (please answer Part 2)

11. If yes, which sources have you heard about Phuket smart city project from? (can select more than one answer)
☐Government organization ☐Facebook ☐Website
☐TV ☐Radio ☐Newspaper
☐Meeting/ Seminar ☐ Others (please specify) .....

1 LAO is the Local administrative organization

QUESTIONNAIRE FOR RESPONDENTS WHO LIVE CURRENTLY

IN THREE DISTRICT OF PHUKET (Cont.)

Page 2

Part 2 Citizen engagement interest in "Phuket smart city"

Instruction Please provide your opinion that is closest to the fact

2.1 Please select the stage that you would like to participate in "Phuket smart city"

☐ No [please give any reason] .....

☐Exploring city problem/ cause of problem ☐Planning ☐Investment/Operation ☐Monitoring/Evaluation

2. 2 Please rate the following themes according to the level of importance and urgency of " Phuket smart city" development by labeling No.1 as most importance, then 2, 3, 4, 5, 6 and 7 respectively

.....Economy .....Education .....Environment .....Governance

.....Public health .....Security .....Tourism

2.3 Please select only 3 projects of "Phuket smart city" development by labeling No.1 as the most important, then 2, and 3 respectively (please describe the project selected)

.....Economy(please specify).....

.....Education(please specify).....

.....Environment(please specify).....

.....Governance (please specify).....

.....Public health(please specify).....

.....Security(please specify).....

.....Tourism(please specify).....

2.4 Please select only 3 purposes of your ICT[2] usage by labeling No.1 as the most important, then 2, and 3 respectively

.....Information awareness/Keep up with news .....Knowledge and skill improvement

.....Giving opinion based on citizen rights .....ICT producer

.....Business operator .....ICT developer .....ICT Innovator

2.5 Please select only 3 channels to promote and support citizen engagement in Phuket smart city by labeling No.1 as the most important, then 2, and 3 respectively

.....Facebook .....Website .....Mobile App[3] .....Line

.....Twitter .....E-mail .....Meeting/ Seminar ..... Others (please specify) .....

2.6 Please select items that can send Phuket smart city information to you (can select more than one answer and please describe the selected item)

☐Mobile.....☐Facebook.....☐Line.....

☐Twitter.....☐E-mail.....☐ Others (please specify) .....

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2 ICT (information and communication technology) is the infrastructure and technology that access information and modern computing. (Rouse M,, 2019)

3 Mobile App is a software that designed to using on small, mobile, and wireless computing devices, such as a smartphone or tablet computer. (Rouse M,, 2013)

APPENDIX V

QUESTIONNAIRE FOR RESPONDENTS WHO LIVE CURRENTLY

IN THREE DISTRICT OF PHUKET (Cont.)

Part 3 Citizen engagement factors in "Phuket smart city"

Instruction Please tick ✓ in the option that is closest to the fact

Topic	Level of agreement				
	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
3.1 I understand "Smart city".					
3.2 I have a role in "Phuket smart city" project.					
3.3 I support "Phuket smart city" project.					
3.4 I am interested in engaging in "Phuket smart city" project.					
3.5 I am interested in monitoring and evaluation the success of "Phuket smart city" project.					
3.6 I have a good quality of life in Phuket.					
3.7 I am interested in engaging in the city problem solving activity.					
3.8 I am usually involved in the community development activity.					
3.9 I am usually involved in the environmental development activity.					
3.10 I am usually involved in the community public hearing activity.					
3.11 I am a community leader or initiator.					
3.12 I feel integrated in the community.					
3.13 I am involved in the charity activity or donation.					
3.14 I follow the regulations in the society.					
3.15 I am reasonable.					
3.16 I am assertive.					
3.17 I can accept the changes and challenges.					
3.18 I avoid all kinds of risks.					
3.19 I can adapt in multicultural society.					
3.20 I am tolerant to different culture and religion.					
3.21 I can converse in foreign language.					
3.22 I have an entrepreneurial skill.					
3.23 I usually follow the global news.					
3.24 I usually learn about technology and innovation.					
3.25 I use ICT fluently.					
3.26 I use technology for networking and building collaboration.					
3.27 I use the online government service.					
3.28 I use open data to monitor the government transparency.					
3.29 I have trust in the government projects.					
3.30 I support the public-private-people partnership.					

APPENDIX V

QUESTIONNAIRE FOR RESPONDENTS WHO LIVE CURRENTLY

IN THREE DISTRICT OF PHUKET (Cont.)

Part 4 Other suggestions

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..... Thank You Very Much for Your Time.....

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APPENDIX VI

CORRELATION CALCULATED (r) FROM 30 STATEMENTS IN PART 3[60]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	1																													
2	.63	1																												
3	.3	.15	1																											
4	.48	.36	.43	1																										
5	.38	.24	.52	.63	1																									
6	.19	.10	.22	.31	.34	1																								
7	.37	.30	.35	.61	.55	.32	1																							
8	.33	.43	.15	.32	.26	.20	.44	1																						
9	.32	.43	.14	.31	.29	.22	.43	.76	1																					
10	.42	.54	.01	.32	.23	.11	.40	.69	.65	1																				
11	.36	.54	.05	.31	.16	.06	.33	.63	.58	.81	1																			
12	.17	.26	.23	.22	.23	.19	.29	.46	.44	.40	.41	1																		
13	.23	.25	.22	.26	.24	.22	.32	.46	.41	.38	.39	.43	1																	
14	.18	.19	.32	.30	.35	.19	.33	.14	.15	.15	.10	.23	.39	1																
15	.25	.18	.27	.40	.42	.22	.37	.14	.19	.17	.14	.16	.31	.60	1															

[60] Orange color was represented the high correlation group; r > .5 -1

APPENDIX VI

CORRELATION CALCULATED (r) FROM 30 STATEMENTS IN PART 3[61] (Cont.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.32	.18	.28	.42	.41	.27	.42	.24	.24	.19	.16	.22	.29	.47	.66	1														
17	.22	.12	.26	.35	.39	.21	.40	.21	.18	.17	.17	.16	.21	.38	.55	.67	1													
18	.01	-.01	-.05	.02	-.03	-.01	.02	.03	.01	-.01	-.01	-.08	-.07	-.11	-.04	-.06	-.03	1												
19	.20	.11	.36	.39	.39	.25	.34	.07	.08	.04	.02	.12	.22	.44	.51	.49	.44	-.26	1											
20	.14	.05	.32	.39	.36	.24	.36	.06	.08	.03	-.04	.13	.20	.44	.47	.50	.42	-.20	.72	1										
21	.28	.23	.20	.37	.30	.21	.35	.21	.26	.18	.16	.14	.22	.23	.33	.34	.23	.03	.34	.38	1									
22	.32	.30	.18	.42	.34	.19	.45	.33	.26	.31	.35	.15	.36	.32	.42	.47	.41	.05	.35	.33	.52	1								
23	.30	.23	.32	.45	.43	.20	.38	.17	.19	.18	.16	.14	.25	.33	.40	.37	.27	-.07	.43	.42	.42	.49	1							
24	.36	.25	.27	.51	.48	.28	.47	.15	.18	.15	.14	.07	.17	.36	.44	.45	.36	.01	.46	.43	.43	.49	.62	1						
25	.37	.25	.26	.52	.43	.29.	41	.13	.16	.15	.11	.02	.14	.32	.37	.39	.30	-.01	.40	.43	.46	.41	.52	.81	1					
26	.33	.35	.19	.51	.39	.24	.44	.30	.30	.30	.32	.15	.24	.24	.39	.40	..34	.01	.33	.35	.44	.49	.49	.69	.69	1				
27	.34	.38	.16	.36	.31	.17	.37	.24	.31	.31	.30	.1	.23	.22	.24	.27	.24	.01	.20	.20	.35	.43	.34	.47	.49	.58	1			
28	.37	.45	.20	.43	.36	.21	.43	.33	.38	.39	.40	.21	.30	.25	.28	.28	.25	-.03	.29	.24	.25	.39	.37	.49	.47	.54	.61	1		
29	.10	.05	.08	.09	.09	.19	.05	.02	.01	.06	.05	.09	.09	.10	-.01	.11	.10	-.10	.11	.10	-0.03	.030	.020	.11	.13	.17	.23	.27	1	
30	.25	.21	.40	.32	..38	.20	.31	.26	.26	.24	.19	.39	.23	.22	0.27	.29	.26	-.14	.27	.29	.19	.19	.27	.16	.18	.21	.19	.28	.16	1

[61] Orange color was represented the high correlation group; r > .5 -1

VITAE

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List of Publication and Proceeding

Sontiwanich, P. and Boonchai, C. (2014). “Community-Based Tourism in Islamic Community; Case Study Bang Rong Village, Phuket Province.” Proceeding of The International Conference on Tourism and Development: Growth and Diversity 2014, Centre for Tourism Studies and Academic Services (CTSAS), Department of Tourism, Faculty of Humanities, Chiang Mai University, Thailand: 29th -30th August, 2014.

Sontiwanich, P. and Boonchai, C. (2016). “Smart Tourism Destinations: How should the Investment be?” Proceeding of The 2016 International Conference on Hospitality, Leisure, Sports, and Tourism Department of Tourism (HLST 2016), Bangkok, Thailand: 19th -21st January, 2016.