THE CHALLENGES AND OPPORTUNITIES IN DEVELOPING SMART CITY: THE CONSTRUCTION PRACTITIONERS' PERSPECTIVES

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A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Quantity Surveying

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

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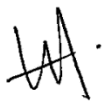
Signature : 

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ABSTRACT

Rapid urbanisation and overpopulation are global issues. The breakneck pace of urbanisation and overpopulation brought numerous problems to the existing city such as lack of accommodation, traffic congestion and environmental problems. Smart city concept is one of the optimal solutions applied by many countries to overcome the problem of the existing city. Previous studies were carried out on the smart city concept. Nonetheless, there are limited studies focused on the smart city concept in Malaysia. On top of that, as the smart city concept varies in different countries due to social, geographical, economic, environmental and political differences. Thus, the smart city concept adopted in other countries may not suit to adopt in Malaysia. Thus, this study aims to uncover the smart city implementation in Malaysia from the perspective of construction parties in Kuala Lumpur and Selangor. Four (4) aspects of problems of the existing city, five (5) aspects of opportunities of implementing smart city and five (5) aspects of challenges of implementing smart city were identified through literature review. Questionnaire surveys were sent to the construction practitioners in Kuala Lumpur and Selangor. 129 responses were returned and analysed by using Cronbach's Alpha Reliability test, Arithmetic Mean test, Spearman's Correlation test and Mann-Whitney U Test. The results revealed that the respondents perceived that traffic congestion was the most severe problem in the existing city; minimisation the construction and maintenance cost was the most possible opportunity of implementing smart city while poor planning was the most potential challenge of implementing smart city. The results of Spearman's Correlation test showed that overpopulation was the most significant problem, minimisation of the deadlocks in the parking problems and offered a better quality of services for the citizens was the most noteworthy opportunity, and the current technology did not consider the variety and complication of the system was the most momentous challenge in three relationships. This study also demonstrated that there were significant differences across different current residential states on three objectives. The findings in this study would benefit the Malaysian government, professional bodies, non-profit organisation and researchers to aware the problems of the

existing city, opportunities and challenges of implementing smart city in Malaysia which in turn could assist in smart city development.

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LIST OF SYMBOLS / ABBREVIATIONS

n	sample size
z	z-scores of the desired confidence level
p	estimated proportion of the population with attributes in study
q	1 - p
e	margin of error
ρ	Spearman's rank correlation coefficient
d_i^2	difference between the two ranks of each observation
n	number of observations

AC	Air conditioning
ASCN	ASEAN Smart Cities Network
ASEAN	Association of Southeast Asian Nations
BIM	Building Information Modeling
BQSM	Board of Quantity Surveyors Malaysia
CDRs	Call detail record
CIDB	Construction Industry Development Board
CLT	Central Limit Theorem
CVs	Connected vehicles
DOSM	Department of Statistics Malaysia
EIP	European Innovation Partnership
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIS	Geographic Information System
GPS	Global Positioning System
ICT	Information and communication technology
IoT	Internet of Things
IT	Information Technology
MSCF	Malaysia Smart City Framework
NFC	Near Field Communication
REHDA	Real Estate and Housing Developers' Association
RFID	Radio-frequency identification

RISM	Royal Institution of Surveyors Malaysia
SC	Smart city
SEM	Structural Equation Modeling
SM	Smart Manufacturing
SMEs	Small and Medium Enterprises
SPM	Sijil Pelajaran Malaysia
SPSS	Statistical Package for Social Science Software
STPM	Sijil Tinggi Persekolahan Malaysia
UK	United Kingdom
UN	United Nations
US	United States
WtE	Waste-to-energy
WWF	World Wide Fund

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

This chapter includes the overview of the study such as background, problem statement, research purpose, research objectives, research methodology, research scope and chapter outline.

1.2 Background of the Study

Cities can be defined as residing organisms dominated by humans and conduct their most vivid demonstrate human activities (Dizdaroglu and Yigitcanlar, 2016). Consequently, it proved the importance of a city for the inhabitants of the country. United Nations (UN) stated that exceeding half population in the world, approximately 55.3% live in the city in 2018 and predicted that one out of three citizens would stay in the urban area by the year 2030 (United Nations Population Division, 2018). According to the statistic revealed by Worldometer (2020), it emphasised that the population of Malaysia had a significant proliferation compared to the past few decades. In 2020, 25 million people, around 78.4% of the residents in Malaysia resided in the city (Worldometer, 2020). Although rapid urbanisation can accelerate economic growth, but it still brings some problems such as environmental degradations and social problems (Mohamed and Manaf, 2019). To overcome these problems, the smart city (SC) concept can be applied.

SC is a city that is quality, sustainable, happy, flourishing and suitable to inhabit due to the development and growth in the aspect of economic, political and administrative, legal and environmental perspectives, infrastructural and info-structural, cultural and social features, inventive, demographic, technological and educational (Malek and Baharudin, 2019). Lafioune and St-Jacques (2020) indicated that SC is seen as an initiative proposed and implemented by the government of a country. It was adopted based on the sustainable development scheme that expected to improve the inhabitants' quality of life.

Due to the breakneck pace of urbanisation and overpopulation, the existing city cannot provide adequate accommodation, infrastructure and services for the citizens of the city. It also degrades the residents' quality of life in the city because they may be stuck in traffic for a few hours every day or replete into overcrowded public transport. Millions of the occupants will not be able to stay in a better living environment and may force to stay in slum dwellings because they fail to obtain affordable residence. Thus, the attainment of SC concept is crucial because it can solve the problems of the existing cities.

Various studies have been conducted and demonstrated that the advantages of SC implementation. McKinsey Global Institute (2018) reported that 270,000 kilotons of greenhouse gas (GHG) had been reduced every year after implementing the SC concept. Besides, the residents can cut down their commuting time up to eight million man-years yearly through transit solutions and intelligent traffic. For the economic aspect, the attainment of SC provides 1.5 million jobs due to the practical and dynamic environments for business (McKinsey Global Institute, 2018). Furthermore, the emergence of the SC concept also can produce economic and social well-being, diminish the consumption on cost and resource, associate the citizens in the city by using smart devices and boost the quality of services by utilising information and communication technology (ICT) or digital technology (Kumar, et al., 2020). Henceforth, SC can overcome the problems of the existing city and bring numerous benefits for the country. Therefore, this research dedicates the focus to the SC concept.

1.3 Problem Statement

The attainment of the SC concept had to be carried out worldwide no matter for developed or developing countries (Alizadeh, 2017). The previous studies demonstrated that most researchers paid close attention to the definition and concept of SC technology. Kim, Ramos and Mohammed (2017) delineated SC as an urban area that adopted modern technology to cater better services to the inhabitants. It is aimed to deliver a more comfortable living environment for the citizens, improve the quality of life and maximise social inclusion. According to the research done by Adnan, et al. (2016), some of the researchers also named SC as future cities, intelligent cities, wireless cities, virtual cities, information

cities and digital cities. However, a study done by Umdu and Alakavuk (2020) argued that the concept of SC, intelligent city and digital city are slight different. Although these three concepts appeared in the 90s but SC concept occurred after the digital city and intelligent city concept. It also has better sustainability than the other two concepts.

In addition, most of the researchers focused on the technology and system of SC. Lv, Hu and Lv (2019) applied the wireless network of ZigBee to build the smart urban environment monitoring system and verified that it is useful to satisfy the needs of the residents and undertake the real-time collection of the information of the city. Besides, Oralhan, Oralhan and Yiğit (2017) emphasised that smart waste management systems can reduce the oil cost of the truck, carbon emissions, noise and environmental pollution, work hours, truck abrasion and others. Furthermore, a case study conducted in Malaysia articulated that implementing a Smart Parking system can lessen traffic problems and enhance mobility in the city (Kee and Ching, 2020). Several researchers were concentrated on the utilisation of Internet of Things (IoT) in SC. Raghuvanshi and Singh (2020) highlighted the security issues and challenges of IoT for SC in the research. Similarly, Kee and Tan (2020) compared Malaysia's SC initiative progress with Singapore and Indonesia, which also mainly focused on the IoT.

Despite that, it is found that there are a few studies dedicated to the challenges of the development and growth of SC technologies. Aghimien, et al. (2020) in Nigeria explained the barriers of adopting SC in different dimensions which are economic, social, technology, governance, environmental and legal and ethical barriers. Mondschein, Ginsberg and Kuehn (2020) stressed that the massive challenge for SC concept is the organisational aspect. Moreover, Silva, Khan and Han (2018) discovered that the challenges of a SC include design and maintenance cost, gigantic data collection and analysis, information and privacy security, heterogeneity and sustainability.

Based on the past studies conducted, it is discovered that there are limited studies focused on the concept of SC in Malaysia. Therefore, the implementation of the SC concept in Malaysia remains unclear. Additionally, the SC concept varies in diverse countries due to geographical, environmental, political, social and economic differences. Hence, the SC concept applied in

other countries may not be suitable to apply in Malaysia. As a result, it is crucial to conduct a study to uncover the SC implementation in Malaysia.

1.4 Research Aim

This study is intended to uncover the issues of SC implementation in Malaysia.

1.5 Research Objectives

To achieve the aim of this study, three objectives had to be constructed:

i. To investigate the problems of the existing city in Malaysia.
ii. To identify the opportunities of implementing a SC in Malaysia.
iii. To examine the challenges of implementing a SC in Malaysia.

1.6 Research Methodology

To obtain a large response, a questionnaire was prepared and sent to construction practitioners in the construction industry. 129 responses were obtained and the data were then analysed by adopting Cronbach's Alpha Reliability test, Arithmetic Mean test, Spearman's Correlation test and Mann-Whitney U test.

1.7 Research Scope

The research scope is constricted to the construction practitioners (Architect, Quantity Surveyors, Engineers, Contractors, and etc) in Kuala Lumpur and Selangor to uncover the SC concept, which does not set a boundary on the respondents' age, gender, profession, highest educational level, working experience, and position in the company. The purpose is to collect as much responses as possible from the respondents, which are diverse in the demographic profiles. The reason for selecting Kuala Lumpur and Selangor as these two locations are two main states in Malaysia.

1.8 Chapter Outline

There are five chapters in this study. Chapter one is the introduction of this study, which defines the research background of SC. Additionally, the problem statement outlines the research problem and the research gaps by referring to

previous studies. The aim and objectives of this study also include in this chapter. Lastly, the research method, scope and summary of the chapter also be covered. Chapter two discusses previous studies about SC in Malaysia which cover the introduction of SC, the problems of the existing city, the opportunities and challenges of implementing SC. Subsequently, chapter three incorporates the approach of the research design, which is constructed to attain the aim and objectives of the study. The strategy data collection and data analysis approach also be comprised in this chapter.

Next, chapter four presents and discusses the findings after data collection. Last but not least, chapter five concludes the whole research study by referring to the accomplishment of the objectives of the research. The constraints and recommendations are highlighted for future research.

1.9 Summary of Chapter

As a conclusion, the research gap on the challenges and opportunities of SC was figured out and the problem statement was clarified. Therefore, the aim and objectives of this research were proposed and identified to fill the research gap. Furthermore, the methodology was identified and the chapter outline had been emphasised in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the definition and concept of the smart city (SC) will be explained. Besides, the problems of the existing city, the opportunities of implementing SC and the challenges of implementing SC will also be covered in this chapter.

2.2 Smart City

SC had been applied and implemented in many countries to solve the problems such as rapid urbanisation and lack of resources. It is a crucial concept because it is not only solve the problems of the existing city but also brings a lot of benefits and advantages to the city.

2.2.1 Background of Smart City

In 1994, the first digital city concept had adopted in Amsterdam (Jameson, Richter and Taylor, 2019). Internet was provided to a large number of citizens in the city to build an online community. It was the first digital technology that was implemented in a specific city at that time and all inhabitants from different occupations (not just include the computer experts) had a chance accessing to the Internet (Anthopoulos, 2017). It was the initial idea of SC. However, SC not only encountered the advancement of technology but also considered the people in the cities, the built and natural environment (Heaton and Parlikad, 2019).

Many countries had practised the concept of SC. Alizadeh (2017) had invited approximately 140 SC as the participating cities for the research purpose. In this research, thirty-nine (39) cities came from North America, eighteen (18) cities from Europe, nine (9) cities from South American, nine (9) cities from African, thirty (30) cities from Asia, one (1) city from New Zealand, five (5) cities from Australia and thirty-one (31) cities from the United States (US). It showed that the SC concept had been widely implemented and became a global phenomenon in the 21st century.

Malaysia also commenced the journey towards SC. The examples of SC in Malaysia are Cyberview SC, Iskandar SC and Smart Selangor. In the year 2014, Malaysia had started the development of SC by working together with Malaysia's national applied research and development centre - MIMOS Berhad.

The Malaysian government had decided to implement the City Brain SC's ecosystem by Alibaba in 2018 after adopting the LoRa Network Ecosystem to control and command the traffic and the ambulance call (Kee and Tan, 2020). To further provide a better implementation and development of SC in Malaysia, the government had launched Malaysia Smart City Framework (MSCF) in 2019 (The Malaysian Administrative Modernisation and Management Planning Unit, 2019). MSCF is the guideline for the local authorities, academicians, industry players and others to plan SC holistically and commensurate with the existing developments (Lim, et al., 2020). The Malaysian government also had set seven components of SC, which are Smart Digital Infrastructure, Smart Mobility, Smart Government, Smart People, Smart Environment, Smart Living and Smart Economy (The Malaysian Administrative Modernisation and Management Planning Unit, 2019). Nevertheless, SC's development in Malaysia is still considered slow as compared to other countries such as Singapore and Indonesia (Kee and Tan, 2020).

2.2.2 Definition of Smart City

SC can be illustrated as an exhilarating theory with crucial characteristics of "smart" which can promote a better economy, diminish the cost and resource consumption, connect distinct areas in the urban area through smart devices and improve the quality of services by adopting digital technology or information and communication technology (ICT). Many traditional cities had implemented the SC concept for a better living standard (Kumar, et al., 2020). Kim, Ramos and Mohammed (2017) supported this view and further elaborated that the implementation of the SC also targets maximising social inclusion and imparting a better living environment for the inhabitants.

SC is also known as a future city, wireless city, digital city, intelligent city, virtual city or information city (Adnan, et al., 2016). Umdu and Alakavuk (2020) argued that SC's theory is not similar to the intelligent city and digital

city. SC can furnish better sustainability and the SC concept appeared after the other two concepts. Besides, Lafioune and St-Jacques (2020) articulated that although digital cities and SC are technology-based, but theoretically, there are still some differences. The digital city is aimed to connect the citizens through the efficient utilisation of technology. Nevertheless, it does not take the quality of life of the inhabitants into consideration. Conversely, SC is targeted to boost the quality of life of the residents by using technology.

2.2.3 Concept of Smart City

The concept of SC came from the US, formed in the 90s and is still emerging now. In 2008, the European countries had applied this concept due to the financial crisis. There have many explanations for the emergence of this idea in Europe, including cost savings through the adoption of ICT, attempts to exchange information with the public online and so on (Bubelíny, Kubina and Varmus, 2021).

According to Al-Masri, Ijeh and Nasir (2019), there are eight factors to be considered for the SC concept which are management and organisation, technology and innovation, governance, policy context, people and communities, economy, built infrastructure and natural environment as shown in Figure 2.1. First of all, the management system of SC takes a significant role because each part of the SC is required to amalgamate together. As a result, the SC is large and complicated. Therefore, the government shall take care of evolving and executing strategies that allow a city to achieve its maximum possible and practical day-to-day processes simultaneously. Nonetheless, less attention is paid on management than on other aspects such as technology (Praharaj, Han and Hawken, 2017).

Secondly, the digitalisation aspect had been used in many countries due to society’s needs and globalisation (Umdu and Alakavuk, 2020). People's connectivity and communication have improved as a result of digitalisation. Smart Technology is adopted for better digital transformation and cooperation (Nasiri, et al., 2020). The multi-faceted and multi-level environment with different authorities and stakeholder groups such as municipal councils, dwellers and urban planners that are frequently motivated by competing agendas make city planning highly complex. Consequently, to optimise their

socioeconomic and environmental efficiency, SC needs a proper governance system for binding all powers at work, enabling information transfers and promoting decision-making (Ruhlandt, 2018).

On the other hand, the policy background is also one of the considerations. It is better for a country to own a policy context. For example, the European Commission was organised in Brussels, Belgium on 26 November 2013 to issue a call for participation to develop "SC and Community Commitments". In this event, the necessity of the European Innovation Partnership (EIP) was pointed out. The EIP is concentrated on practical solutions to the barriers met by European cities, SC, and societies face. In the 2014–2015 budget of the Horizon 2020 Research and Innovation Programme, the European Commission had reported that it intended to spend about €200 million in SC and communities. As a consequence, countries such as the Netherlands, Spain and United Kingdom (UK) have some well-developed SC (Myeong, Jung and Lee, 2018).

Furthermore, people and society also take a crucial role in the SC concept because citizens can create a city through non-stop connections (Myeong, Jung and Lee, 2018). Fernandez-Anez, Fernández-Güell and Giffinger (2018) stressed that SC attainment shall be people-centric, although various cities have different endowments for SC growth and SC programmes. It means that it must meet residents' interests with the overall goal of enhancing their well-being and quality of life. However, it is always be neglected in reality compared to the technology component (Heaton and Parlikad, 2019; Umdu and Alakavuk, 2020). Moreover, the economy is one of the considerations as well. One of the objectives of SC development is to raise economic growth (Li, et al., 2021). Thus, it proved the importance of the economic aspect of the SC concept.

Additionally, the availability of building facilities is boosted by the comfortable built infrastructure, which can improve productivity for all parties. For instance, due to the systems integration and standard communication protocols used along with the society and buildings' programmable controllers, data communication can be transmitted quicker (Al-Masri, Ijeh and Nasir, 2019). Last, the attainment of the SC is to solve the negative impact of urbanisation on the natural environment. Examples of the negative influences of urbanisation are climate change and the upsurge of temperature (Gamit and Gandhi, 2019).

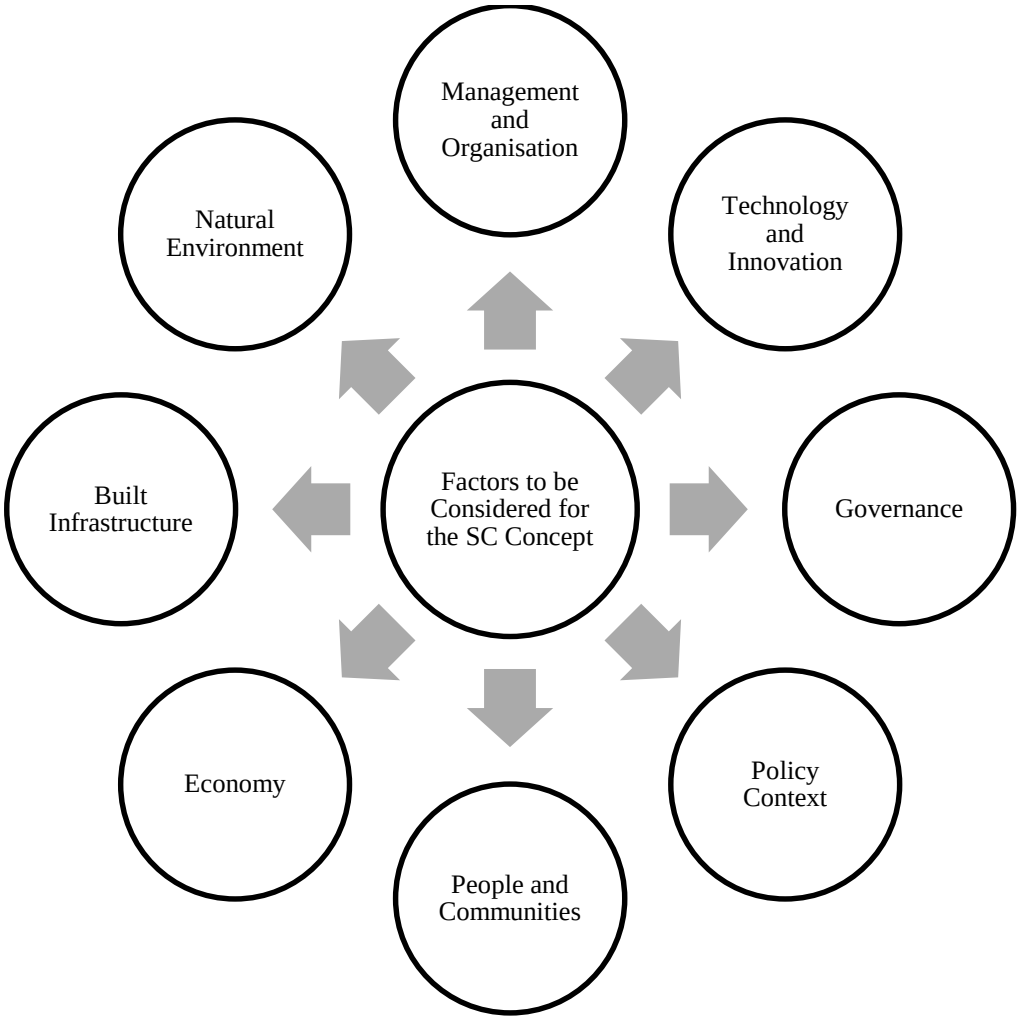

Figure 2.1: Factors to be Considered for the SC Concept

2.3 Problem of Existing City

Cities can be defined as units that work on various approaches and models (Umdu and Alakavuk, 2020). In these few decades, the number of cities and megacities has escalated especially for developing countries due to the increase in population and migration (Vershinina and Volkova, 2020). Compared to other countries globally, Africa and Asia have the fastest urbanisation rates (Uprety, 2020). Nevertheless, the urbanisation process and the rise in the population rate in the cities lead to some problems of the existing city.

2.3.1 Social

Urbanisation occurs when many people in the rural area moved to the urban area due to the significant variation in wealth and resources in the urban area (Liddle, 2017). The estimated population in Malaysia is around 32.7 million in 2021

(Department of Statistics Malaysia Official Portal, 2021a). Selangor has the highest population composition in 2021, which is approximately 20.1% (Department of Statistics Malaysia Official Portal, 2021a). Nevertheless, Malaysia's highest population density state is Kuala Lumpur, which with 7,188 people per square kilometre (Department of Statistics Malaysia Official Portal, 2021a). Kuala Lumpur also had faced a quick urbanisation procedure, particularly in infrastructure development (Sanusi, et al., 2017).

Nonetheless, urbanisation caused inequality because the citizens who moved to cities are unskilled rather than skilled (Uprety, 2020). As an illustration, the people from rural areas who are unskilled or less skilled may not fulfil the job demand of the firms or companies in the cities. Hence, people will not be employed or be paid lower salaries compared to skilled labour. Wage inequality will inevitably be created between rural migrants and urban dwellers. The wage gap also will worsen in the future if this problem remains unsolved (Sulemana, et al., 2019). A research done in China supported that the biggest reason for urban wage inequality is the difference between low-wage manufacturing and high-wage producer services (Yang, Hu and Wang, 2020).

Apart from that, many problems will appear when many rural inhabitants migrate to the urban area especially for the poor. The first problem is lack of accommodation. All the family members will come along with the rural migrants when the rural migrants planned to settle in the cities. As the poor cannot afford a better living environment, the slum may be the only choice. However, the environment may be unregulated, overcrowded and dangerous to live in. The examples of locations of the slum are beside riverbanks, water basins and others which may have a higher risk of flood and landslide. Thus, it will increase the chances of communicable and non-communicable diseases and pollutions (Kuddus, Tynan and McBryde, 2020).

Next, food insecurity is one of the problems in the existing city. It appears in both developed countries and developing countries. One example of the developed countries that met food insecurity is US (Hobbs and King, 2018). Nevertheless, this issue happens typically in developing countries because most developed countries have experiences on how to solve this hindrance (Liu, et al., 2021). Besides, food insecurity occurs typically in the families of minoritarian groups such as orphans, Africans, Afro-Americans and others. This

hassle will negatively impact people's lives especially children (Hobbs and King, 2018).

Furthermore, urbanisation also caused traffic congestion. Traffic congestion appeared when the demand for road space more than the supply and it had surged and became worsen in all the countries due to the population growth, rapid urbanisation, rise in the number of infrastructures and motor vehicles, development of technological advancement and augmentation of delivery services and rideshare (Afrin and Yodo, 2021). It is such a universal global problem that will lead to delays, economic losses, inconvenience and air pollution (Afrin and Yodo, 2020). As a result, it will lower the citizens' quality of life because they may be stuck in traffic for a few hours every day or replete into overcrowded public transport. McKinsey Global Institute (2018) underlined that each inhabitant in Kuala Lumpur needs to spend RM3,100 on the congestion on roads annually, which contributes around 2.0% to 5.0% of Gross Domestic Product (GDP). Rasheed, Yau and Low (2020) stated that the Malaysian weather would worsen traffic congestion, especially during peak hours.

Moreover, health problems will also exist due to rapid urbanisation. Due to the living environment of the slum, the probabilities of communicable and non-communicable diseases will increase. Because of this, it caused the urban transmission cycle. Additionally, as the poor do not have adequate salaries to afford the cost of living and food in the cities, they may lack nutrition and lead to illness (Kuddus, Tynan and McBryde, 2020). Urbanisation also results in an escalation in energy consumption and intensification in carbon emission (Feng, Huang and Wang, 2018; Huo, et al., 2020a). Lu, et al. (2021) emphasised that traffic congestions contribute a large amount of carbon emission and nitrogen oxides to total emission. The proportion of carbon emission had gained around 60.0% of the total emission in the US (Lu, et al., 2021). As the rise of carbon emissions will cause the temperature increase, therefore it escalates the risk of illness. Watts, et al. (2019) mentioned that the high temperature would surge respiratory and cardiovascular diseases. In addition, the problem of industrialisation also instigated a health problem in the city. The growth of the industrialised sector will bring to climate change and give rise to health hazards

especially for the inhabitants who stay in the industrialist area (Dong, et al., 2021).

On the other hand, educational attainment is identified as one of the problems in the existing city. Cheng (2021) articulated that most higher-income citizens have better educational attainment than residents with lower incomes. Besides that, the rural migrants, females, self-employed, the citizens older than 45 years old, larger families and the families without adult members also have lower educational attainment. However, educational attainment is crucial because it contributes to consumption inequality. Urban wage inequality within the producer services was found to be caused by the spatial concentration of a disproportionate number of high-paying jobs in a few developed, high-tier city-regions on the eastern coast.

2.3.2 Governance

City is complex because it was made up of many components and multiple actions were carried out. Due to the complexity of the city, it instigated difficulties to the policymakers in governing the city as there are more restrictions in reality. It means that the government may not able to control all the activities in a city or only control a partial part of the entire development of a city. Besides, as the problems and challenges of a city will change from time to time, it is difficult for the urban administrators to pre-define the direction of the city. As a consequence, the government cannot predict and plan the management of the city due to the circumscribed circumstances. Hence, it is vital to have an engineering sense for the policymaker to govern and manage the city efficiently (Moroni and Cozzolino, 2019). Boykova, Ilina and Salazkin (2016) had supported this perspective and stressed that if the government does not transform according to external conditions, it cannot solve the obstacles faced by an existing city.

Apart from that, the administration's failure in the private and public sectors will lead to the failure of the development of a city. Thus, the urban administrators must have a deep understanding of the city's situation rather than focus on a specific topic in the city (Malekpour, et al., 2017; Rogers, 2018). Nonetheless, most decision-makers in the city were only 'see' the city but not 'read' the city. The process of 'seeing' only has a view of the city but not

understanding what is happening in the city, while ‘reading’ discovers the city’s problems. For example, a study done by Ramakreshnan, et al. (2019) showed that the government had a very shallow awareness than the practitioners on urban heat island in Kuala Lumpur. Achmad, et al. (2018) further highlighted that the government’s purposes and prioritisations shall consider the needs of inhabitants as one of the characteristics of good governance.

Furthermore, the governance of the city is varied for all the countries due to the policymakers solving the urgent problems in the city or solving the problems that fulfilled the available fund only (Leach, et al., 2019). In the contrary, the other low-priority problems or do not fulfil the condition may be ignored. However, these problems may have a severe impact on the cities.

2.3.3 Environmental

Urbanisation also degrades the environmental aspects of the cities. For example, India faced problems such as land insecurity, lower water quality, air pollution, noise and waste disposal problems due to uncontrolled urbanisation (Kumar, 2017). The first problem is greenhouse gas (GHG) emissions. China is the largest contributor to GHG emissions among the countries in the world. Nevertheless, the amount of energy consumption and emission is still rising due to the speedy growth of China’s economics (Mi, et al., 2017; Huo, et al., 2019). Besides that, due to urbanisation, the energy consumption in China increases and leads to a worsening impact on the environment because it upsurges the carbon emission (Feng, Huang and Wang, 2018; Huo, et al., 2020b). Bekhet and Othman (2017) also pointed out that urbanisation causes the growth of carbon emission in Malaysia. Additionally, the building sector contributes the most GHG emissions among the sectors of the countries because it is one of the main energy users. Around 36.0% of the total carbon emission had produced by the global building sector (Kwok, et al., 2016). Some developed countries such as North America and Europe had even produced 40.0% to 50.0% of carbon emission (Kwok, et al., 2016). Nonetheless, Huo, et al. (2020b) articulated that the amount of carbon emission produced by the building sector will continue to upsurge due to urbanisation as large numbers of people congregate in cities. In addition, road transport also produced GHG. 72.0% of the total GHG emissions

in the transport sector in the European Union are caused by road transport (Fan, et al., 2018).

Pollution is identified as one of the problems that occurred in a city. Lu et al. (2021) emphasised that 97.0% of the air quality in the cities of developing states of Asia is unhealthy. The occurrence of urban haze has been increasing due to the rise in the number of cities. As many citizens live in the cities, hence it leads to traffic congestion. As a result, it worsens air pollution in the cities. Kumar (2017) also indicated that vehicles are the primary sources of air pollution in cities. If the concentration of air pollutants is high enough, it can bring mortality. In addition, water pollution also happened in the cities. The reasons for water pollution are the landfilled or cut off of the river channels, destruction and hardening of land plants and the irresponsible actions that directly discharged the waste from the domestic and production sewage to the river channels (Wan and Wang, 2021). Malla, et al. (2018) outlined that the contaminated urban water will cause approximately 1.7 million deaths per year due to diarrhoea and infections in human beings. Exceed 90.0% of this case arose in developing countries and nearly half are youngsters.

From other points of view, climate change is also a problem in the existing city. Climate change is provoked by the growth of GHG emissions and global warming and household is one of the main contributors to climate change (Brizga, Feng and Hubacek, 2017; Berlie, 2018; Jakučionytė-Skodienė and Liobikienė, 2021). Sasaki, et al. (2021) articulated that 23.0% of the global carbon emission is produced from tropical deforestation in Southeast Asia. Global warming will lead to climate change and other effects such as a rise in the manifestation and intensity of heat waves and drought (Cline, 2007; Mazdiyasni and AghaKouchak, 2015; Gray, et al, 2016; Anderson and Song, 2020). Instead of that, climate change will generate the melting of the glacier because the glacier is sensitive to the escalation of temperature and reduction of rainfall. Moreover, the melting of the glacier will cause the rise of sea levels and affect the coastal environment (Manquehuai-Cheuque and Somos-Valenzuela, 2021). Freer, et al. (2017) mentioned that climate change has a significant influence on marine biodiversity. One of the biggest hazards and threats to the marine ecosystem is the rise of the temperature of the ocean due to the upsurge

of carbon emissions. Furthermore, climate change will result in flooding and damaging the coastal areas in the world (Hsiao, et al., 2021).

2.3.4 Economics

Urbanisation leads to the development of countries and enhances the economy and society of the countries (Wang, et al., 2021). The top 600 cities in the world had contributed 20.0% of the world's population, produced 60.0% of GDP and released 70.0% of GHG (Un-Habitat, 2016). It proved that urbanisation could boost economic growth. Conversely, it still causes some problems for the existing city.

Firstly, the agriculture and livestock sectors will be affected. Godde, et al. (2021) revealed that more than 844 million people worldwide had gained income from agriculture and the livestock sector supplied around 40.0% of agriculture value-added. It demonstrated the importance of the agriculture and livestock sector for economic growth in the world. However, urbanisation resulted in climate change and global warming, which will influence the agriculture sector's production. For instance, climate change leads to extreme climate events such as floods, wildfires, droughts, cyclones and heat waves. Due to these reasons, farm production will be reduced and it caused negative impacts to the processing procedures, storage, transportation, trading and consumption of humans. On the other hand, the decline of agriculture production will also cause a fall in the amount of forage and affect the grazing sector. In addition, the heat waves are such a hazard for the health of animal and human labour and it might worsen the production of agriculture and livestock (Godde, et al., 2021).

Furthermore, tourism is also one of the sectors influenced by the negative impact of urbanisation. A research in Austria outlined that winter tourism is such an important sector for the economy. The average daily expenditure in 2018/2019 was € 185 in winter, which was more than € 160 in the year 2018 summer season (Pröbstl-Haider, et al., 2021). Nevertheless, climate change had affected winter tourism in Austria (Pröbstl-Haider, et al., 2021). Besides, Xiao, et al. (2020) articulated that as climate change had declined the number of days of adequate snow cover, the snowmobilers had lessened the number of days of snowmobiling and led to the downturn in tourism. Additionally, a case study in Koh Chang of Thailand highlighted that due to the

growth of tourism and urbanisation, natural diseases such as flash floods and landslides had happened (Nitivattananon and Srinonil, 2019). Apart from that, as there is a lack of a proper sewage system in Koh Chang, thus the rainwater directly drained to the sea. Consequently, the beach and shoreline erosion occurred and land has been lost due to the sea level rise annually (Nitivattananon and Srinonil, 2019). As the damage of coastal areas happened, therefore it will reduce the number of tourists in Koh Chang. In Malaysia, the travel and tourism industry has proliferated over the past few decades and has contributed 13.1% share in GDP, which is encouraged by governmental endeavours and intensive campaigning (Ng, Lye and Lim, 2016; Azam, Alam and Hafeez, 2018). Redang Island is a famous maritime tourism sport in Malaysia, with over 40.0% foreigner tourists and the rest are local tourists (Marine Park of Malaysia, 2017). Nevertheless, the number of tourists dropped due to the Covid-19 pandemic (Foo, et al., 2020).

2.4 Opportunities of Implementing Smart City

Moosavi (2018) stressed that the SC concept is thought to be an advanced method to ease hurdles prompted by burgeoning urban digitally-oriented population and rapid urbanisation, which is intending to benefit the policymakers and the communities. Hence, it proved that the implementation of SC could bring many benefits and advantages.

2.4.1 Social

Smart People are aimed to deliver equal access to knowledge and electronic services for all citizens (Vershinina and Volkova, 2020). The inhabitants can communicate through services to exchange common and critical online social participation and share physical space with users. In other words, it not only designed for connection between the people, but it also encouraged the users to deliver the data for the services (Kirimtat, et al., 2020). As an illustration, Niforatos, Vourvopoulos and Langheinrich (2017) suggested a crowdsourcing weather application. It analysed the automatic sensor readings from smartphones and manual input by the users. As a result, it can evaluate the data on current and upcoming weather events. Hence, it proved that the adoption of technology is relatively crucial in the Smart People aspect. As an analogy, social

networking services are applied to educate the citizens about SC smart systems and services (An, et al., 2019). Thus, it can lessen inequality caused by the gap of educational attainment.

As mentioned in Chapter 2.3.1, traffic congestion is one of the problems of the existing city, therefore Smart Transportation is proposed to minimise this problem. Traditionally, the transportation data is collected via surveys which makes the process costly and inefficient. Henceforth, a few technologies are implementing to make the process of transportation data collection efficient and economical. In particular, the Global Positioning System (GPS) and Geographic Information System (GIS) data, smart card and call detail record (CDRs) are some of the data resources in Smart Transportation analysis. Additionally, connected vehicles (CVs) is one of the Smart Transportation systems that can raise the efficiency and reliability of independent transportation, upsurge mobility and safety and increase the driver's comfort because it can supply the traffic conditions on a real-time basis (Karami and Kashef, 2020). Furthermore, the implementation of Smart Parking can minimise the deadlocks in the parking problems and offer a better quality of services and profit for the inhabitants by using the sensors embedded in the vehicles and infrastructures (Al-Turjman and Malekloo, 2019).

On the other hand, the Smart Healthcare system helps to improve the healthcare of the occupants in the cities. The data was collected from the patient's body through wearable devices, mobile internet and Internet of Things (IoT) (Tian, et al., 2019). Through the data collected, the doctor can make a better diagnosis. Moreover, it is also useful for self-diagnosis, monitoring, early detection and treatments. Hence, the Smart Healthcare system is defined as a pipeline that involves data collection, networking and computing technologies, data security and privacy, data processing, and data dissemination (Rayan, Alfonse and Salem, 2019).

2.4.2 Governance

Due to the needs of society and globalisation, the local government of each city tried to develop or had been developed the digital transformation (Umdu and Alakavuk, 2020). Smart Governance is one of the digital technologies adopted by the policymaker. Glybovets and Alhawawsha (2017) pointed out that Smart

Governance is a process in which the government executes a set of working or business procedures by using supportive information technologies. As a consequence, knowledge and information can share flawlessly in each arm of the policymaker in governing the city. Besides that, Vershinina and Volkova (2020) had defined Smart Governance as the collaboration of different authorities, which can be attained and achieved by applying the rapid response system and electronic government. These systems can help to receive the data of the population on time and improve the state services.

Smart Governance is not only utilising the technology but also more towards finding effective governance approaches and accomplishing the objective of enhancing the outcome of the city (Jiang, 2021). In addition, it can also solve the restrictions of governance of the existing city and integrate communication, leadership, collaboration, partnership and data exchange solutions (Heaton and Parlikad, 2019). Glybovets and Alhawawsha (2017) highlighted that the critical point of Smart Governance is the connections between the policymaker and the inhabitants. It is crucial because Smart Governance is able to ameliorate the quality of citizen service. As a result, the government can discover the problems of the city and make a better policy or programme to solve the problems of the city.

Apart from that, Smart Governance is mainly focused on citizen participation, collaboration and information transparency. Firstly, citizen participation means the involvement of residents in government decisions which can enrich the government decision. Subsequently, collaboration aims to cooperate all the government levels by utilising innovative and effective techniques or systems. Lastly, information transparency is expected to provide access to information related to the government's decisions and executions via technologies (Glybovets and Alhawawsha, 2017).

2.4.3 Environmental

Smart Environment means the reduction of human effects on the environment by implementing technologies such as new energy-saving (Vershinina and Volkova, 2020). Smart Environment aims to provide a positive outcome to the whole community such as ameliorating the citizens' quality of life, enhancing efficiency in the industrial systems and optimising energy consumption. Smart

Manufacturing (SM) and Smart Homes are some of the Smart Environment domains (Asensio, et al., 2021).

SM is proposed to fulfil the customer's needs for personalised products and faster delivery. It is a fully-integrated and cooperative manufacturing system that adopts the internet-connected machinery and new hardware approaches such as Additive Manufacturing, Simulation, IoT, Augmented Reality, Collaborative Robotics and Data Analytics aimed to solve the changes of demands of the customers and circumstances of the Smart Factory in a real-time basis. Besides, it is also used to monitor and control the production procedure, help the workforces in their daily routine through novel ways of human-computer-interaction and increase flexibility (Zenisek, Wild and Wolfartsberger, 2021). Supekar, et al. (2019) mentioned that the adoption of SM could reduce the cost, make the production flexible, lessen the times to market the products, increase energy efficiency, minimise the impact on the environment and produce greater productivity.

On the other hand, Smart Home is a critical concept discussed widely in the policy and technology aspect as it related to climate change, energy efficiency and sustainability of the building. The Smart Home is adopted by applying advanced communications, electronic and electrical, networks and sensor devices in the houses (Basarudin, et al., 2016). The devices that provide digitally connected, automated or improved services to the residents of the buildings are called Smart Home technologies (Sovacool and Rio, 2020). Additionally, Smart Home technology shall be easier to control, access and remote by smartphone or tab (Basarudin, et al., 2016). Smart door, smart light and smart air conditioning (AC) are examples of Smart Home appliances (Challa and Soujanya, 2021). The implementation of these Smart Home technologies can reduce the energy consumption, improve the quality of life of the user due to the convenience and controllability, save money, minimise pollution, waste and carbon emission, enhance better health, social and educational benefits and others (Sovacool and Rio, 2020).

2.4.4 Economics

The attainment of SC will bring a good impact on the economy. In 2016, the global market size of SC was approximately US dollar 550 billion and it is

expected to rise to US dollar 2.57 trillion in the year 2025 because there are many investments chances for digital technologies in SC (Anand and Navío-Marco, 2018). A Smart Economy is a concept that is used to expand economic growth. The Smart Economy is related to smart business and mobile commerce (Kirimtat, et al., 2020). In other words, a Smart Economy is the proliferation of the business's chances and opportunities by applying different forms of electronic commerce (Vershinina and Volkova, 2020). The e-commerce service can increase the customers' attention to the retailers (Kirimtat, et al., 2020). Department of Statistics Malaysia Official Portal (2019) underlined that 18.5% of the national economy was contributed by the digital economy in 2018. Apart from that, 8.0% of the GDP was devoted by e-commerce in the same year. Selangor topped the list with 24.2% GDP in 2019, which followed by Kuala Lumpur (16.4%). Contrariwise, Kuala Lumpur is the major contributor to the GDP per capita in 2019 which was RM129,472, higher than Selangor with RM54,995. Additionally, the labour force participation rate in Kuala Lumpur is increased (Department of Statistics Malaysia Official Portal, 2020). Henceforth, the economic growth in Kuala Lumpur may be higher.

As explained in Chapter 2.3.4, climate change and global warming affect the agriculture and tourism sectors. Thus, Smart Agriculture and Smart Tourism can reduce the negative influences caused by these problems. Smart Agriculture is adopted to improve agricultural processes by implementing technologies, protocols, devices and computational paradigms. The enormous data such as climate or environmental data was collected from the sensors and then kept, stored and analysed using the technologies such as Big Data, cloud, edge computing, artificial intelligence and others (Zanella, Silva and Albini, 2020). Apart from that, the smart irrigation management system is one of the systems adopted in Smart Agriculture. It is used to save water and improve production (Goap, et al., 2018). In addition, some researchers concentrated on the vineyard, smart hydroponic farming ecosystem, horticulture and leaf disease defection as some of the technologies in Smart Agriculture (Ruengittinun, Phongsamsuan and Sureeratanakorn, 2017; Thorat, Kumari and Valakunde, 2017; Kaburuan, Jayadi and Harisno, 2019; Trilles, et al., 2020).

From other points of view, Smart Tourism focused on tourism destinations or sectors. It highlights three crucial features, which are

instrumented, interconnected and intelligent by applying the technologies. For instance, the implementation of sensors can measure the circumstances of the environment and the use of other tourism assets by implementing the technologies such as IoT, smartphones, radio-frequency identification (RFID) networks and others. Moreover, interconnected systems are the platforms used to collect, combine and share the data or information with other travellers. The mixture of these characteristics enables the tourism sites successfully incorporated, assessed, and eventually promoted optimised decisions based on collective knowledge. As a consequence, it can increase the visitor experience, open up new market possibilities and enhance the governance of the place of tourism intelligently. In other words, the attainment of Smart Tourism needs cooperation from the companies of the tourist centres to incorporate personalisation, context awareness and real-time monitoring into their management activities via data collection, pervasive connectivity and real-time synchronisation. Therefore, it can form a better environment for the companies, occupants and travellers in the place of tourism and the ecosystem of the destination (Xiang, Stienmetz and Fesenmaier, 2021).

2.4.5 Technology

As revealed in most of the opportunities of implementing SC such as SM, Smart Agriculture and others, most of them are functioning by adopting advanced technologies such as Building Information Modeling (BIM), Big Data and IoT.

BIM is such an enabler to assist the SC development and emergence because it spans the whole life of engineered assets in the contents of information management procedures, data structure and exchange protocols (Heaton and Parlikad, 2019). This technology can be used for the whole construction process, starting from inception, design, modeling, planning, operation and decommission (Borrmann, et al., 2018). The adoption of BIM can minimise the construction and maintenance cost, enhance transparency and cooperation among various stakeholders, manage complex projects and adjust to the changes rapidly. The benefit of lessening construction cost had ranked third out of the twelve benefits in the study done by Chan, Olawumi and Ho (2019) about the advantages and obstacles to adopt BIM in Hong Kong construction.

On the other hand, the attainment of Big Data will improve the implementation of SC. Traditional datasets such as national census, government reports of personal knowledge and geographic statistics are implemented via surveys that have restricted variables and time scales. Hence, the adoption of Big Data can solve this problem by capturing a wide real-time scale of datasets created by sensor-based sensors, cameras, RFID tags and smartphones via wireless networks (Khatoun and Zeadally, 2016). Big Data analytics have four elements which are volume, variety, velocity and veracity (Herschel and Miori, 2017). Volume means to the enormous amount of data being stored, variety defines as the collection of various kinds of data, velocity refers to the speed at which data is processed and veracity is the capacity to correctly disclose the essence of a person or entity (Erevelles, Fukawa and Swayne, 2016; Herschel and Miori, 2017).

Besides, IoT is a system used to enhance the daily atmosphere computationally. To achieve this objective, a variety of active and smart data-sensing devices such as laser scanners, infrared sensors, accelerometre, RFID, GPS, Near Field Communication (NFC) and others will be applied. These devices are used to augment the atmosphere in which the physical world and the informational world are interconnected within the ever-growing Internet infrastructure (Bibri and Krogstie, 2017). People, highways, railways, bridges, parks, houses, water systems, electrical networks, cars, equipment, products, machinery, livestock, trees, soil and air are all expected to be included in the IoT as it is an interesting concept that is developing into a more and more complex network of sensor devices and physical items. Through conducting information exchange and communication, the IoT can accomplish various intelligent functions (Bibri, 2018).

2.5 Challenges of Implementing Smart City

The implementation of the SC concept can bring lots of benefits and advantages as mentioned in Chapter 2.4. However, it is impossible to implement a “one size fits all” approach to SC due to the dynamic nature of the cities (Heaton and Parlikad, 2019). Henceforth, the challenges of implementing SC in various aspects will be further explained in this section.

2.5.1 Social

People are an essential component for a successful SC. Nevertheless, it is always be ignored compared to the technology component (Heaton and Parlikad, 2019; Umdu and Alakavuk, 2020). Umdu and Alakavuk (2020) stressed that the inhabitants of the country may not know about any developments of the technologies if the local government does not inform the citizens. As an illustration, although Kuala Lumpur is one of the pilot cities in the Association of Southeast Asian Nations (ASEAN) Smart Cities Network (ASCN) and one of the global and regional urban hubs in ASEAN, but the citizens in the city may not know the SC development in city (Kong and Woods, 2021). It is because The Malaysian Administrative Modernisation and Management Planning Unit (2021) did not provide the articles about the Greatest Kuala Lumpur but provided articles for others SC such as Smart Selangor and SC Iskandar Malaysia. Jee, Han and Kim (2021) articulated that the relationship between the policymaker and dwellers shall be collaborative, communicative and trustworthy. As a result, the citizens will be conscious, learn, apply and accept the services and system provided in the SC. Heaton and Parlikad (2019) continued to mention that there is still a lack of understanding of society on urban technologies, no matter the individual level or the collective level. Therefore, it caused the implementation and attainment of SC to become difficult or unachievable.

Additionally, residents may not fully understand the SC concept. Some researchers define SC as an intelligent city or digital city (Adnan, et al., 2016; Kumar, Goel and Mallick, 2018). Nonetheless, Umdu and Alakavuk (2020) highlighted that there are some differences between these three concepts. Besides, some websites will be mixed up or combined with the SC concept with other concepts such as intelligent city and digital city. Consequently, the citizens may be confused about the SC concept with other concepts, especially for the inhabitants who are incapable of fully understanding and differentiated these concepts or are non-disciplinary. Thus, it is relatively vital to provide education for the people. It may help to develop and implement the SC concept in the future (Heaton and Parlikad, 2019).

2.5.2 Governance

Many people will only think that the demographic trends, public finances and climate change caused the problems in the cities. Yet, no one considers that the organisational culture, fractured policy circumstances or partisan politics are the reasons that lead to the urban problem. As a result, policy economy becomes one of the drawbacks of the SC approaches (Praharaj, Han and Hawken, 2017).

Governance is a considerable challenge for the attainment of SC. The inadequate transparency, liability, isolated city services and absence of human resources are some of the challenges in terms of governance (Joshi, et al., 2016). Heaton and Parlikad (2019) emphasised that the SC framework was failed to align the current emergence procedure such as BIM with the construction and maintenance process in the cities because there is a lack of sufficient guidance on the development of SC. It proved that governance is such a crucial issue for the success of the attainment of SC. In addition, much fractured governments from different countries do not want to provide the transparency and leadership needed. Moreover, some governments are also unwilling to uncover their services procedure and related data to other countries. Due to these reasons, the implementation of Smart Governance becomes limited.

In spite of that, the SC concept is applied by adopting urban technologies such as BIM, Big Data, IoT and others. The adoption of the technology may not consider the variety and complication of the system of the urban area and the technology approach is mainly used by the cities that applied the top-down approach rather than the bottom-up approach. Generally, the top-down approach is adopted in Asian countries compared to European countries (Boykova, Ilina and Salazkin, 2016).

On the other hand, there are too many policies and development plans are implemented in the cities in developing countries. Nevertheless, these policies and development plans may have overlapping visions due to the lack of coordination or communication between the central and municipal level. As an analogy, Bhubaneswar, the smartest city in India had been burdened with around eight planning documents regarding the development of various sectors in the city and the infrastructure components. As some of the development plans are executed by the city level and some by the state level, hence it leads to complex political commands (Praharaj, Han and Hawken, 2017).

Furthermore, as SC is a new concept that burgeons in these few decades, some local authorities may not understand clearly on the SC concept because it does not have a clear definition (Praharaj, Han and Hawken, 2017; Gupta and Gupta, 2018). Therefore, the implementation of SC is to rely heavily on the federal government to define the crux matters of the SC concept. If the federal government failed to do so, the state government may fail to plan the development plans and policies according to the SC concept and lead to the failure of SC implementation. Additionally, some governments will divide the funding based on the ranking of cities and their competencies. For example, the Ministry of Urban Development of India distributed the funding for the execution of SC projects by relying on the cities' ranking and their abilities (Praharaj, Han and Hawken, 2017). Consequently, some of the cities cannot execute the SC concept due to the lower capabilities.

2.5.3 Environmental

Environmental is a crucial aspect of the SC concept. Henceforth, all the parties such as citizens and government shall pay attention to this issue to reduce the negative impacts on the environment such as pollution, global warming, climate change and GHG emissions. However, there are some challenges of the SC concept in the environmental aspect. Aghimien, et al. (2020) pointed out that the poor planning of cities, high rate of urbanisation, rise in population rate, traffic congestion in the urban area, lack of sustainability consideration and poor waste management are the barriers of SC. Rana, et al. (2019) added out that the carbon emissions effect and lack of ecological view in behaviour also are the hinders of SC.

First of all, the poor planning of the cities is the main challenge of the emergence of SC. The management's failure can lead to natural disasters such as earthquakes, floods, tornados and others. Meanwhile, it also causes that failures of the system like network unavailability and infrastructure malfunction. Thus, designing sustainability is essential to recover the tactics immediately, solve the failure and revert the urban area's execution to normal. Nonetheless, the determination and adoption of recovery and fault tolerance approaches raise both the design and operating costs. The hinder will be to incorporate failure

recovery strategies with the least cost and organisational inefficiency (Silva, Khan and Han, 2018).

Subsequently, rapid urbanisation is also one of the barriers in SC. Africa and Asia have the fastest urbanisation rates in the world (Uprety, 2020). As stated in Chapter 2.3, rapid urbanisation will negatively influence the environment such as climate change, GHG emissions, global warming, coastal damage and others. Therefore, it may make the emergence of SC difficult.

Moreover, the growing population will upsurge the size of the labour force population and escalate economic production. Nevertheless, the proliferation of economic growth will produce an enormous amount of emissions and lead to climate change. Climate change will then bring illness and may influence the mortality rate and in turn affect the population growth rate (Sulemana, et al., 2019). Thus, it proved that the growth of the population rate would significantly affect the environment. On the other hand, overpopulation and rapid urbanisation will cause air pollution. The level of air pollution depends on the scales, economic and social development of the cities. As an illustration, a super city whose population of the urban area exceeds 10 million will have serious air pollution than a mega city with less than 10 million but more than 5 million residents (Lu, et al., 2021).

In spite of that, one of the main concerns is the lack of sustainability considerations. The SC concept is mainly focused on digital development and emergence, but there is still a lack of intention on social and environmental sustainability (Evans, et al., 2019). In addition, the waste management of a city is critical due to pollution and landfilling (Silva, Khan and Han, 2018). Yet, the waste volume had risen due to inefficient waste management and collection (Jacobsen, et al., 2018).

A modern city must concern the minimisation of carbon footprint and utilisation of resources to protect the environment and resources of the city for future generations (Silva, Khan and Han, 2018). However, urbanisation causes more energy consumption and soar in carbon emissions (Yang and Meng, 2018). Last but not least, one of the barriers of SC attainment is lack of ecological perspective in the behaviour. Illustrated by the river basin management, the collaboration between the government and the stakeholders is crucial to solve the water pollution problem (Baudoin and Gittins, 2021). In this case, it

demonstrated that the lack of perspective on the ecological aspect would lead to a bad result.

2.5.4 Economics

The economic aspect is also one of the challenges that hindering the implementation and attainment of SC. Rana, et al. (2019) stressed that there are five challenges and hinders of SC development and attainment which are lack of competitiveness, global economic volatility, high infrastructure and intelligence deficit, high operational and maintenance cost and cost of IT training and skills development. The lack of competitiveness happened because of the homogeneity of some SC in the urban systems and way of life (Abusaada and Elshater, 2020). Nonetheless, a city shall have competitive advantages (Abusaada and Elshater, 2021). By having these competitive advantages, the SC's opportunities will be varied from each other and had various features against these competitive (Barbehön and Münch, 2016). Tokoro (2016) highlighted that those excellent businesses with a sustainable competitive advantage would create social value. For instance, Selangor Advance is a programme that assists Small and Medium Enterprises (SMEs) with the cash flow problems in the COVID-19 (Selangor Advance, n.d.). This programme may help to reduce the problems of lack of competitiveness.

Furthermore, global economic volatility is caused by global uncertainty (Gómez-Pineda, 2020). It will affect the subsidies provided by the city players and then influence the GHG emissions produced (Rana, et al., 2019). Other than that, the high infrastructure and intelligence deficit is also one of the challenges. It proved that the cities required extensive infrastructure and intelligent systems to emerge the SC (Rana, et al., 2019). Nevertheless, some countries cannot achieve it due to the lack of funds (Araral, 2020).

Apart from that, the higher operational and maintenance cost also caused the failure of the attainment of SC. Silva, Khan and Han (2018) emphasised that the design cost is one of the costs that hinder the attainment of SC. Design cost is the financial resources required to deploy a SC. Hence, the lower the design cost, the greater the likelihood of implementing SC in the real world. Additionally, operation expenses are defined as the cost spent on the operations of city and maintenance activities every day. In other words, it is better to

minimise the operational costs because it can ensure the sustainability of the service supply without putting an undue financial strain on municipalities. However, it is hard to do a good cost optimisation in the entire period of SC. Therefore, it is necessary to boost the efficiency of the system to increase sustainability (Rana, et al., 2019). Lastly, the higher cost of Information Technology (IT) training and skills development is costly for companies. Henceforth, it leads to the failure of the SC (Rana, et al., 2019).

2.5.5 Technology

One of the challenges of implementing the SC concept is technology. The main issue that may cause by the current technology does not align with the SC concept. Heaton and Parlikad (2019) articulated a lack of alignment between the SC standards and BIM standards although both of these standards are having overlapping in the interoperability data models and information decision frameworks. It indicated that both of these standards are developing in parallel but isolating from each other. Besides, there are some limitations in current technology and data analytics procedure to assist data capture, integration and exploitation within the SC framework although there is some development in the SC technology solutions such as IoT, Big Data and others (Heaton and Parlikad, 2019). For instance, one of the components of SC in Malaysia is Smart People, but Smart People is not the main SC focus area in Klang Valley (Arup and Think City, 2021). However, some of the current technology aligns with the SC concept in Malaysia. For example, Kuala Lumpur faced a high number of solid waste generation and the Malaysian government had adopted the waste-to-energy (WtE) technology to solve this problem (Ministry of Housing and Local Government, 2018; Yong, et al., 2019).

Moreover, some countries failed to adopt the SC concept due to lack of adoption and poor emergence especially for most African countries (Aghimien, Aigbavboa and Oke, 2019; Bibri, 2019). As mentioned in Chapter 2.4.5, the IoT is such a critical technology for the attainment of SC. Nonetheless, it is failed to implement due to the security and privacy of data, limited skilled workforce, poor data availability and others. As there is interoperability between the communication standards, hence it causes security and privacy are difficult to achieve (Gupta and Gupta, 2018; Sharma, et al., 2020). As a consequence, it

leads to the failure of the attainment of SC. In addition, the limited skilled labour will hinder the attainment of SC (Gupta and Gupta, 2018; Kumar, Goel and Mallick, 2018; Sharma, et al., 2020). The implementation of IoT required skilled labour to operate (Sharma, et al., 2020). Nevertheless, the lack of these skilled labours will adversely affect the system (Talavera, et al., 2017). The poor data availability will block the flow of information and lead to the failure of the IoT and SC (Liono, et al., 2019). In spite of that, Araral (2020) stressed that the development and emergence of these smart technologies depend on the city player's funding, availability of technical support and branding of the city.

2.6 Summary of Key Findings from Literature Review

This study is intended to uncover the issues of SC implementation in Malaysia. To achieve this aim, a comprehensive literature review was carried out on the problems of the existing city, opportunities and challenges of implementing SC. Figure 2.2 summarises the problems that existed in the existing city, opportunities and challenges of implementing SC. Table 2.1 tabulated the previous researches that related to this study.

Based on the findings, it can conclude that the increment in the population and the rapid urbanisation will result in the problems of the existing city which need the implementation of SC concept. However, it possesses some of the opportunities and challenges as stated in Chapter 2.4 and 2.5.

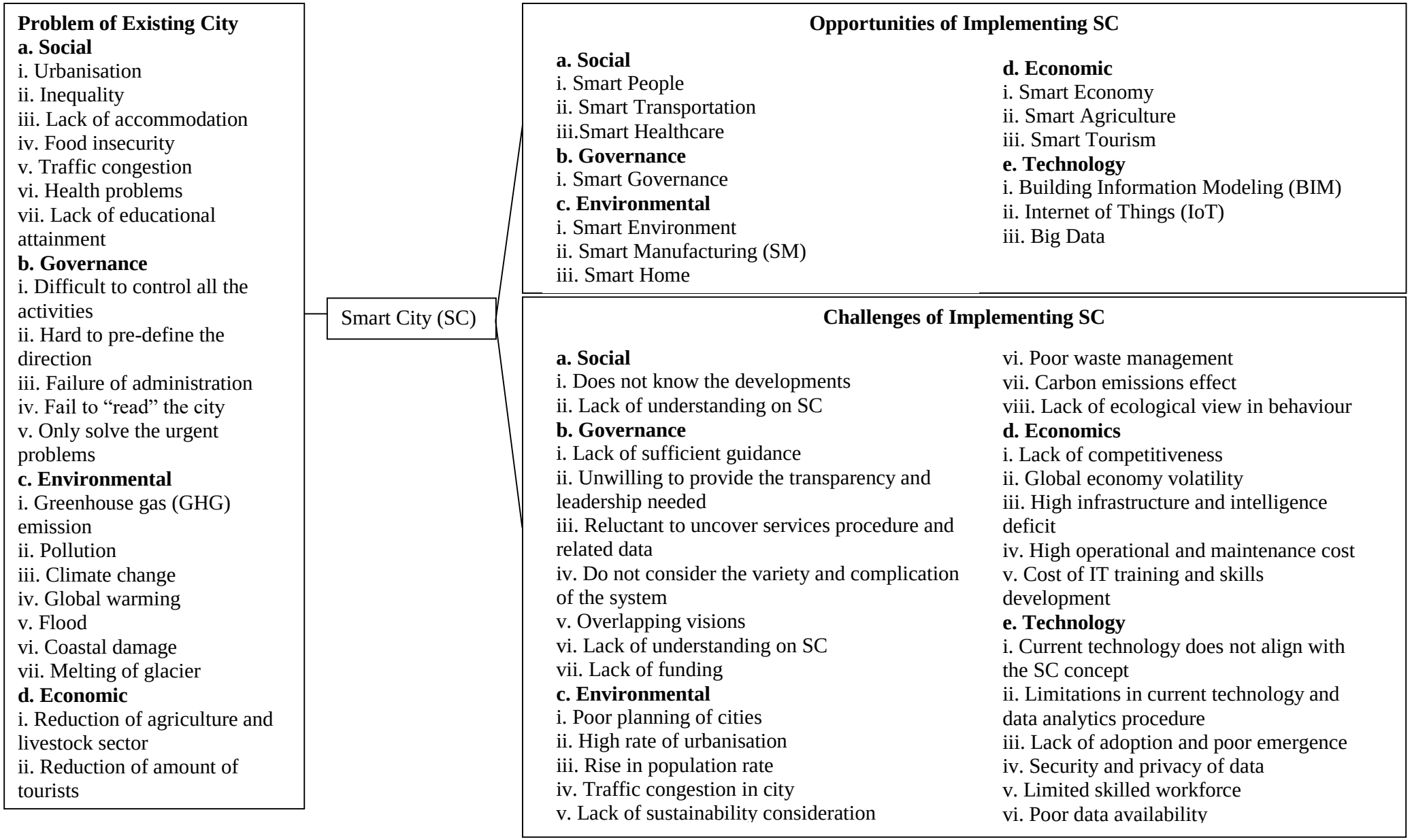

Figure 2.2: The Problem of the Existing City, the Opportunities and Challenges of Implementing Smart City

Table 2.1: Literature Map of Challenges of Implementing Smart Cities

No	Parameter	Previous Studies																
		Umdu and Alakavuk (2020)	Heaton and Parlikad (2019)	Adnan, et al. (2016)	Aghimien, et al. (2020)	Kumar, Goel and Mallick (2018)	Boykova, Ilina and Salazkin (2016)	Praharaj, Han and Hawken (2017)	Gupta and Gupta (2018)	Rana, et al. (2019)	Silva, Khan and Han (2018)	Sulemana, et al. (2019)	Evans, et al. (2019)	Yang and Meng (2018)	Gómez-Pineda (2020)	Aghimien, Aigbavboa and Oke (2019)	Bibri (2019)	Sharma, et al. (2020)
1	Social																	
a.	Does not know the developments	/																
b.	Lack of understanding on SC		/	/	/	/												

Table 2.1 (Cont'd)

2	Governance					
a.	Lack of sufficient guidance	/				
b.	Unwilling to provide the transparency and leadership needed	/				
c.	Reluctant to uncover their services procedure and related data	/				
d.	Do not consider the variety and complication of the system		/			
e.	Overlapping visions			/		
f.	Lack of understanding on SC			/	/	
g.	Lack of funding			/		

Table 2.1 (Cont’d)

3	Environmental							
a.	Poor planning of cities	/		/				
b.	High rate of urbanisation	/						
c.	Rise in population rate	/	/		/			
d.	Traffic congestion in city	/						
e.	Lack of sustainability consideration	/	/			/		
f.	Poor waste management	/	/	/				
g.	Carbon emissions effect		/	/			/	
h.	Lack of ecological view in behaviour		/					
4	Economic							
a.	Lack of competitiveness		/					/

Table 2.1 (Cont’d)

4	Economic (Cont’d)															
b.	Global economy volatility								/							
c.	High infrastructure and intelligence deficit								/							
d.	High operational and maintenance cost								/	/						
e.	Cost of IT training and skills development								/							
5	Technology															
a.	Current technology does not align with the SC concept	/														
b.	Limitations in current technology and data analytics procedure	/														
c.	Lack of adoption and poor emergence														/	/

Table 2.1 (Cont'd)

5	Technology (Cont'd)			
d.	Security and privacy of data		/	/
e.	Limited skilled workforce	/	/	/
f.	Poor data availability			/

2.7 Chapter Summary

In conclusion, this chapter comprised the theory of SC, problems of existing city, the opportunities and challenges of implementing SC as shown in Figure 2.2. The background, definition and concept were included in the theory of SC. The problems of the existing city had been subdivided into four subtitles which are social, governance, environmental and economics. Meanwhile, one other subtitle is technology had added into the opportunities and challenges of implementing SC.

CHAPTER 3

METHODOLOGY AND WORK PLAN

3.1 Introduction

In this chapter, the steps and processes of data collection and data analysis are discussed in detail which cover the literature review steps, the questionnaire design, the sampling determination, the questionnaire distribution and four data analysis tests.

3.2 Research Methodology

Research methodology is defined as a research approach that converts ontological and epistemological concepts into rules, principles, processes and practices that regulate research. The concepts of ontology, epistemology and methodology affect the selection of research methodology (Nayak and Singh, 2015).

There are three types of approaches which are quantitative, qualitative and mixed research method (Creswell and Creswell, 2018). The mixed method is the combination of quantitative and qualitative research methods (Oflazoglu, 2017). In this chapter, it discusses the quantitative and qualitative method. The differences between these two approaches are shown in Figure 3.1 and further explained in a further section.

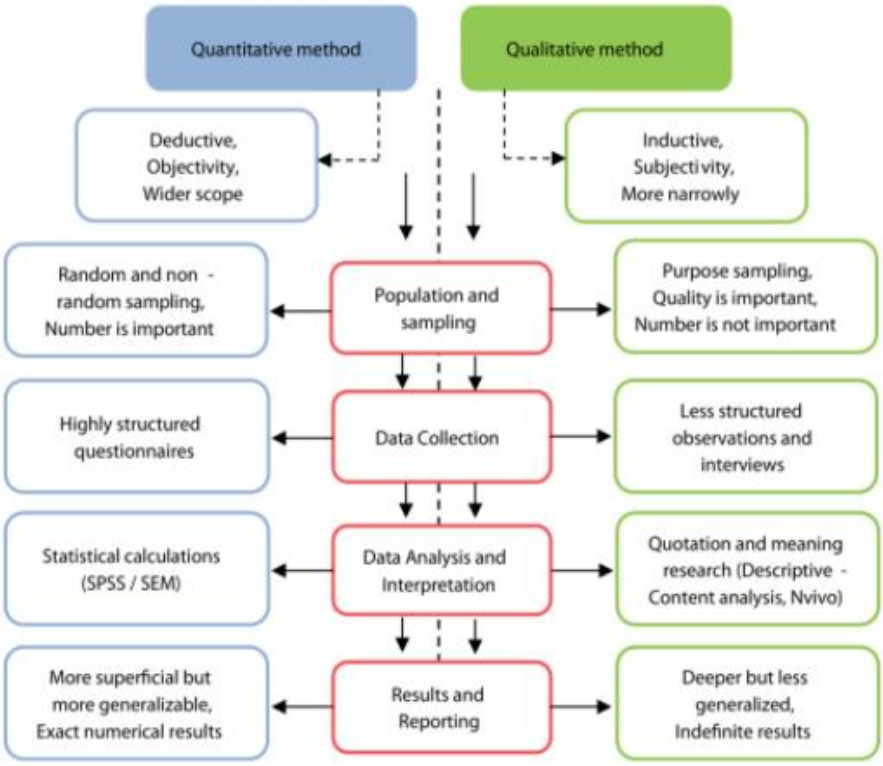

Figure 3.1: Difference between Quantitative and Qualitative Method (Source: Oflazoglu, 2017)

3.2.1 Quantitative Research Methodology

According to Devi (2017), the quantitative research method focused on determining the quantity or amount. It is useful especially when a large scale is required to collect. The identical findings can be obtained regardless of who performs the analysis. In addition, it also can be applied to monitor tendencies as well (Nayak and Singh, 2015). Esteban-Bravo and Vidal-Sanz (2021) articulated that the quantitative research method is suitable to use when harsh procedures regarding social or natural events are needed.

The strengths of this method are the data can be analysed objectively and the common rules respecting the general actions of the system can be deduced. Hence, it is suitable for the conclusive research stage, which suggests a final path of behaviour (Esteban-Bravo and Vidal-Sanz, 2021). Besides, as the data is collected in numerical forms and analysed through statistical calculations such as Statistical Package for Social Science Software (SPSS) and Structural Equation Modeling (SEM), therefore it can give precise differences between the realities and judgments. Additionally, the highly structured questionnaires that

used to collect the data from random and non-random sampling can reduce biases because the process is conducted rigorously (Oflazoglu, 2017; Esteban-Bravo and Vidal-Sanz, 2021). Henceforth, it can conclude that the result will be more generalisable and has precise numerical results, but more superficial (Oflazoglu, 2017). On the other hand, the benefits of this method are that the changes over time can be seen and a clear and quantitative measure can be provided.

Conversely, there are a few weaknesses in this method. As the sample is large, it requires more time to collect and analyse the data and results. In addition, the researcher needs to enter, clean and analyse the data, which is also time-consuming. Most importantly, this method aims for the numerical result. In other words, it neglects the human element in the research (Nayak and Singh, 2015). Other than that, it will also be a fatal problem if the wrong question was asked in the survey (Esteban-Bravo and Vidal-Sanz, 2021).

3.2.2 Qualitative Research Methodology

Devi (2017) pointed out that the qualitative research method is more concerned with qualitative phenomena regarding quality or kind. For example, the qualitative research methodology applies to study human behaviour such as why people do or think something.

There are a few strengths when adopting the qualitative method. Through this method, the participants' feelings, views, experiences and the reasons to do such actions can be known well. In other words, the human experience in specific settings can be interpreted holistically (Rahman, 2017). Besides that, it has a flexible structure that can be created and recreated to a greater extent due to the adoption of less structured or unstructured observations and interviews (Oflazoglu, 2017; Rahman, 2017).

Compared to the quantitative method, the qualitative method is inductive, subjective and narrow because this method applies a lot of data sources such as observations and interviews (Oflazoglu, 2017; Creswell and Creswell, 2018). Henceforth, the result is more profound than the quantitative method but less generalised and lacks numerical support (Oflazoglu, 2017). In addition, as the data is collected through purpose sampling and analysed through quotation and

meaning research, the boundaries between the realities and judgments are unclear (Oflazoglu, 2017; Esteban-Bravo and Vidal-Sanz, 2021). Sometimes the researcher will only focus on the meanings and experiences but ignore the contextual sensitivities. Furthermore, it may have lower credibility than the quantitative method because of a lack of numerical value. Moreover, it is more difficult or complex in the process of interpretation and analysis of data. Lastly, as limited time is provided to analyse the cases, hence it only has a limited way to generalise the results (Rahman, 2017).

3.3 Justification of Selection

The quantitative research methodology is selected rather than the qualitative research methodology due to the objectives of this study. In this study, the aim is to uncover the issues of smart city (SC) implementation in Malaysia. As a large population is required to understand the perspective of construction parties in Malaysia, therefore the quantitative research approaches are more suitable for adoption. The questionnaire survey is selected to distribute to the potential respondents because it can be distributed in a shorter period than other methods such as interviews or observations in the qualitative method. Henceforth, a massive amount of data can be extracted quickly and then analysed rapidly compared to other research methods.

Apart from that, there are two reasons that the qualitative research methodology is less suitable to be adopted in this research. First of all, as the target participants are the construction parties in Malaysia, a small number of respondents is challenging to represent the whole construction parties because many occupations comprise in the construction industry such as Architect, Engineer, Quantity Surveyor and so on. Subsequently, the result is non-numerical. It means that there will not have any figure to summarise the result of the study. It is mainly focused on quality rather than number. In other words, it is more suitable to be used for research that required a deeper understanding of human behaviour. Nevertheless, as this research aims to discover the problems of existing cities, opportunities and challenges of implementing SC, a superficial result will be adequate rather than a deep understanding.

3.4 Literature Review

A research literature review is a systematic, precise and repeatable way to define, analyse and synthesis the current body of published and recorded work created by academics, scholars and practitioners (Fink, 2019). The literature review is a crucial step for the research process because it can provide some ideas for the researcher to determine the research's focal point and enable the researcher to discover the main point and the way to perform the study. Besides, it can also figure out the topics that other researchers had done in the same area to prevent previous repeating work, recognise the key individuals, organisations and texts pertinent to the research and provide a broad list of objectives for the researcher. There are a few sources of information such as books, journal articles and so on (Ridley, 2012).

According to Efron and Ravid (2019), the literature review is not necessarily in a linear procedure. However, six steps are recommended to conduct a literature review as illustrated in Figure 3.2. The process starts by choosing a literature review topic. The topic of SC had been narrowed down based on the aim and objectives of this research. The next step is locating literature review sources. To search the appropriate databases in the research field, the researcher can define the relevant terms and keywords, create search strategies and search the records. For this research, the keywords such as "SC", "problems of the existing city", "opportunities of implementing SC" and "challenges of implementing SC" are used to narrow down the topic. The books, journals, websites are some of the resources of the literature review. For instance, most of the journals or articles used in this research are from Science Direct, IEEE Explore, Research Gate and Google Scholar while the books are mainly from Google Book.

Subsequently, the third step is analysing and evaluating sources. After searching all the related sources regarding the topic, the resources had been analysed and evaluated. Then, the sources that are related to the research questions are summarised. Moving on with the step of organising and synthesising the literature and building an argument. The sources were then be structured to themes. In this study, the related sources were subdivided into three subtitles: problems of the existing city, opportunities of implementing SC and

challenges of implementing SC. There are four aspects for the problems of the existing city, five for opportunities of implementing SC and five for challenges of implementing SC. The aspect of social, governance, environmental and economic are included in these three subtitles and one additional aspect is technology is comprised in opportunities and challenges of implementing SC. The relationship between these three subtitles was shown in Figure 2.2.

The following step is developing a writer voice and following writing conventions. The content had been writing in a better way to deliver a message to the reader. Additionally, the intentional and unintentional plagiarism had been avoided and with an appropriate citation and reference. Last but not least, the last step is writing, editing and refining the literature review**.** The content of the literature review had been changed to in line with the research question.

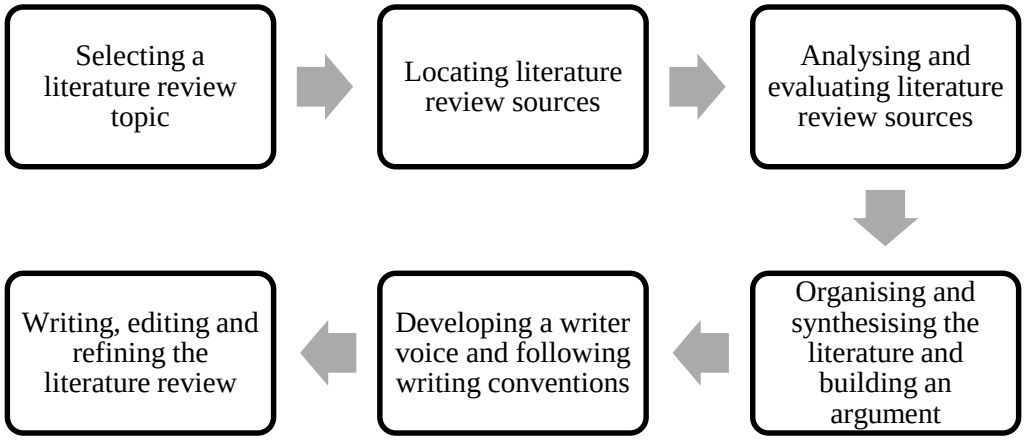

Figure 3.2: The Steps to Conduct a Literature Review
(Source: Efron and Ravid, 2019)

3.5 Quantitative Data Collection

Quantitative research methodology was adopted to get numerical and quantifiable results. The method used to collect data in this study is a questionnaire.

3.5.1 Questionnaire Design

There were four sections in the questionnaire survey: Section A, Section B, Section C and Section D. Section A was designed to collect respondents'

backgrounds such as gender, age group, profession, working experiences, job position, highest educational level and current residential state. As the target participants were the construction parties in Malaysia, hence the respondents needed to fill in this information. The summary of the questionnaire's sections was displayed in Table 3.1. In Section A, the closed-ended questions were more appropriate to adopt compared to open-ended questions. Through this form of question, the respondents can answer the questions faster and efficiently because they do not require to fill in the answer. Furthermore, it also makes the process of data analysis easier (Kumar, 2011).

Apart from that, Section B, C and D were intended to fulfil objectives 1 to 3. A list of problems of the existing city, opportunities of implementing SC and the challenges of implementing SC were included in these sections. The 5-points Likert scale was used as the evaluation method for the respondents to rank the aspects based on their experiences and perspectives. The ranging of the 5-points Likert scale are from 1=strongly disagree, 2=disagree, 3=neutral, 4=agree to 5=strongly agree. In this questionnaire, there were four aspects (social problems, governance problems, environmental problems and economic problems) for problems of existing city, five (social, governance, environmental, economic and technology) for opportunities of implementing SC and five (social, governance, environmental, economic and technology) for challenges of implementing SC. A sample of the questionnaire survey was attached in Appendix A.

Table 3.1: Summary of Questionnaire's Sections

Section	A	B	C	D
Types of question	Closed-ended	5-points Likert scale	5-points Likert scale	5-points Likert scale
No. of aspect	-	4	5	5
No. of question	7	21	34	28
Scale	Nominal scale	Ordinal scale	Ordinal scale	Ordinal scale

Table 3.1 (Cont'd)

Section	A	B	C	D
Purpose	To obtain demographic information of the respondents	To achieve objective 1	To achieve objective 2	To achieve objective 3

3.5.2 Sampling Determination

It is challenging to get responses from the whole population. Therefore, it is better to choose the sample as representative of the whole population. Sekaran and Bougie (2011) highlighted that sometimes the result might be more reliable when studying a sample than the whole population because the errors can be reduced in data collection. The targeted respondents for this research are the construction parties in Malaysia such as Architects, Quantity Surveyors, Engineers, Developers and so forth. In this study, simple random sampling in probability sampling design was selected. As all the construction parties have an equal opportunity to be selected as the respondents, so the result may be more generalisable and least biased (Sekaran and Bougie, 2016).

To calculate the acceptable and logic sample size, the Cochran formula is applied. The Cochran formula is:

$$n = \frac{z^2 pq}{e^2}$$

Where,

n = sample size

z = the z-scores of the desired confidence level

p = the estimated proportion of the population with attributes in study

q = 1 - p

e = margin of error

The sample size is based on this formula with 95.0% of confidence level, which turns to 5.0% of margin of error. Hence, the z-scores is 1.96. According

to the Department of Statistics Malaysia (DOSM), the total employed persons in the construction industry in Selangor and Kuala Lumpur in 2020 were 355,600, which was 277,200 in Selangor and 78,400 in Kuala Lumpur. Meanwhile, the total employed persons in Selangor and Kuala Lumpur in 2020 were 4,321,100, which was 3,446,500 in Selangor and 874,600 in Kuala Lumpur respectively (Department of Statistics Malaysia Official Portal, 2021b). Henceforth, the value of p is equal to 0.082 and the value of q is 0.918. Thus, the sample size calculated will be 116 individuals by using the Cochran formula.

Nevertheless, the Central Limit Theorem (CLT) is chosen to calculate the sample. Kwak and Kim (2017) stressed that the CLT is the most crucial theory in modern statistics. The CLT is such the keystone of the probability theory because it comes together with the theorems called laws of large number (Salkind, 2010). It means that the researcher will make inferences on the mean of the population when large sample size is needed for a study. Sheldon (2014) highlighted that normal approximation could be trusted if the sample size n is at least 30. Therefore, the sample size for this study is set as thirty (30) per category.

3.5.3 Questionnaire Distribution

The questionnaire is created by using online Google Forms and distributed via email or social media such as WhatsApp and LinkedIn. As the target respondents are the construction practitioners in Malaysia, the potential respondents can be Architects, Quantity Surveyors, Contractors, Developers and others. The email addresses and information of the target respondents were obtained from the board websites such as Board of Architects Malaysia, Board of Quantity Surveyors Malaysia (BQSM), Royal Institution of Surveyors Malaysia (RISM), Construction Industry Development Board (CIDB), Real Estate and Housing Developers' Association (REHDA) and others. The email was then sent to these companies within six weeks after the questionnaire had been done.

3.6 Data Analysis

The SPSS software is used to analyse the data collected. This study adopted four statistical tests which are Cronbach's Alpha Reliability test, Arithmetic Mean test, Spearman's Correlation test and Mann-Whitney U test.

3.6.1 Cronbach's Alpha Reliability Test

Cronbach's Alpha Reliability test is applied to calculate the internal consistency or scale that falls into a number between 0 and 1. It is also used to measure the reliability of the test (Tavakol and Dennick, 2011). According to Stephanie (2014), the value of alpha exceeds 0.7 is encountered as acceptable. Conversely, the value of alpha below 0.7 is unacceptable.

Tavakol and Dennick (2011) stated that the value of alpha is higher when the measurement elements are linked with one another. However, the length of the test will also influence the alpha. Hence, it cannot judge that the test with a high coefficient alpha has a high degree of internal consistency. In this research, this method is used to test the consistency and reliability of each aspect of Section B, C, and D in the questionnaire survey.

3.6.2 Arithmetic Mean Test

Arithmetic Mean test is the most well-known measure of central tendency. By using this test, the centre of the frequency distribution of a quantitative variable can be described by taking into account all of the observations with the same weight assigned to each (Dodge, 2008). In this study, the mean result of each aspect of Section B, C, and D in the questionnaire survey was ranked to discover the rank of each problem of existing city, opportunity and challenge of implementing SC by the respondents.

3.6.3 Spearman's Correlation Test

Spearman's Correlation test is a nonparametric rank-based test. It is used to determine the relationship between two sets of data (Spearman Rank Correlation Coefficient, 2008). The objective of adopting this test in this study is to examine the relationships which are the relationship between the problems of the existing city and the opportunities of implementing SC; the relationship between the

problems of the existing city and the challenges of implementing SC; and the relationship between the opportunities of implementing SC and the challenges of implementing SC. The calculation of this test is according to this formula.

$$\rho = 1 - \frac{6\sum d_i{}^2}{n(n^2 - 1)}$$

Where,

ρ = Spearman's rank correlation coefficient

d_i^2 = difference between the two ranks of each observation

n = number of observations

The r- or ρ-value will be obtained from this test. The correlation direction can be determined by this correlation such as positive, negative or non-existent. The ρ-value is between -1 and +1. It means that if the ρ-value is positive, the relationship between the two variables is positive. Conversely, if the ρ-value is negative, the relationship between the two variables is negative. The strength of the relationship between the two variables is shown in Table 3.2. According to Table 3.2, the relationship between the two variables is strong if the ρ-value is more than 0.40. Conversely, the relationship between the two variables is weak if the ρ-value is less than 0.39. Nevertheless, if the ρ-value is less than 0.19, there is no or negligible relationship between the two variables (Dancey and Reidy, 2004).

Table 3.2: Strength of Correlation (Dancey and Reidy, 2004)

Spearman ρ	Correlation
≥0.70	Very strong relationship
0.40-0.69	Strong relationship
0.30-0.39	Moderate relationship
0.20-0.29	Weak relationship
0.01-0.19	No or negligible relationship

Moreover, the relationships between the two variables will affect the direction of the relationship. For instance, if variable A rises, then variable B will also rise in the positive relationship. On the contrary, if variable A rises, then variable B will reduce in the negative relationship (Weaver, et al., 2018).

For this research, the null hypothesis and alternative hypothesis are formed:

Null hypothesis (H_0): There is no significant relationship between the problems of the existing city and the opportunities of implementing SC; the problems of the existing city and the challenges of implementing SC; and the opportunities of implementing SC and the challenges of implementing SC.

Alternative hypothesis (H_1): There is a significant relationship between the problems of the existing city and the opportunities of implementing SC; the problems of the existing city and the challenges of implementing SC; and the opportunities of implementing SC and the challenges of implementing SC.

3.6.4 Mann-Whitney U Test

Mann-Whitney U test is a nonparametric statistical test applied to find out whether there is a difference between two discrete independent variables (Weaver, et al., 2018). In this research, this test evaluates the data based on the respondents' perspectives and opinions in Kuala Lumpur and Selangor towards the aspects of the problems of the existing city, opportunities and challenges of implementing SC.

In this study, the problems of the existing city, opportunities and challenges of implementing SC are the dependent variables while the current residential state is the independent variable. The null hypothesis and alternative hypothesis are stated:

Null hypothesis (H_0): There is no significant difference across the current residential state (Kuala Lumpur and Selangor) on the problems of the existing city, opportunities and challenges of implementing SC.

Alternative hypothesis (H_1): There is a significant difference across the current residential state (Kuala Lumpur and Selangor) on the problems of the existing city, opportunities and challenges of implementing SC.

3.7 Summary

In short, the quantitative research methodology was adopted for this study. A questionnaire survey was prepared and distributed to the target respondent via email and social media to obtain the primary data. Additionally, the literature review is written as secondary data. The Cochran formula and CLT are used to set the number of respondents for this research who are the construction practitioners in Malaysia. Besides, simple random sampling is used to select the participant. Last but not least, the SPSS was used to analyse the data collected and the data analysis tests used were the Cronbach's Alpha Reliability Coefficient test, Arithmetic Mean test, Spearman’s Correlation test and Mann-Whitney U test.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the data collected from the construction practitioners from Kuala Lumpur and Selangor. It begins with a summary of the demographic background of the respondents. After that, Cronbach's Alpha Reliability test is adopted to verify the reliability and internal consistency of the data collected. Then, the arithmetic means of 3 objectives are ranked and tabulated. Next, Spearman's Correlation test is carried out to examine three relationships. Additionally, the Mann-Whitney U test is adopted to identify the differences in 3 objectives between the respondents of different current residential states.

4.2 Demographics of Respondents

The questionnaires were distributed to the construction practitioners in Kuala Lumpur and Selangor via email and social media such as WhatsApp and LinkedIn. The data was collected from 14th June 2021 to 25th July 2021, which was 6 weeks. A total set of 135 respondents had been returned. However, there were 6 sets of questionnaires that were out of the scope of Selangor and Kuala Lumpur. Hence, the remaining 129 sets of questionnaires were used for analysis. Table 4.1 displayed the data collected from the respondents.

Table 4.1: Demographic Information of 129 Returned Respondents

Demographic Information	Frequency (n)	Percentage (%)
Gender		
Male	65	50.4
Female	64	49.6
Age Group		
21 years old and below	11	8.5
22-44 years old	77	59.7

Table 4.1 (Cont'd)

Demographic Information	Frequency (n)	Percentage (%)
Age Group (Cont'd)		
45-59 years old	20	15.5
60 years old and above	21	16.3
Profession		
Architect	12	9.3
Developer	14	10.9
Engineer	29	22.5
Main Contractor	17	13.2
Project Manager	15	11.6
Quantity Surveyor	24	18.6
Sub-Contractor	11	8.5
Others	7	5.4
Working Experience		
Less than 6 years	51	39.5
6-10 years	22	17.1
11-15 years	20	15.5
16-20 years	9	7.0
More than 20 years	27	20.9
Job Position		
Director	7	5.4
Technical Director	5	3.9
Contract Manager	2	1.6
Contract Executive	14	10.9
Assistant Quantity Surveyor	12	9.3
Team Leader	16	12.4
BIM Coordinator	8	6.2
Project Manager	18	14.0
Project Executive	19	14.7
Others	28	21.7

Table 4.1 (Cont'd)

Demographic Information	Frequency (n)	Percentage (%)
Highest Educational Level		
High School	3	2.3
Sijil Pelajaran Malaysia (SPM)/ GCE O-Level/ equivalent	5	3.9
Sijil Tinggi Persekolahan Malaysia (STPM)/ GCE A-Level/ equivalent	0	0
Foundation	0	0
Diploma	16	12.4
Bachelor's Degree	71	55.0
Master's Degree	30	23.3
PhD	4	3.1
Current Residential State		
Kuala Lumpur	64	49.6
Selangor	65	50.4

As shown in Table 4.1, 50.4% of respondents are males and 49.6% are females. Besides, 59.7% of the respondents are from 22-44 years old, followed by 16.3% from 60 years old and above. The remaining respondents are from the age group of 45-59 years old and 21 years old and below, which are 15.5% and 8.5% respectively. There are eight professions comprising Engineer (22.5%), Quantity Surveyor (18.6%), Main Contractor (13.2%), Project Manager (11.6%), Developer (10.9%), Architect (9.3%), Sub-contractor (8.5%) and others (5.4%).

Majority of the respondents have less than 6 years of working experience, which gain 39.5%. The remaining respondents are with more than 20 years of

working experience (20.9%), 6-10 years of working experience (17.1%) and 11-15 years of working experience (15.5%). Minority of the respondents from 16-20 years of working experience, which only has a frequency of 7.0%. In terms of job position, 21.7% of respondents are from other job positions, 14.7% are project executives, 14.0% are project managers, 12.4% are team leaders, 10.9% are contract executives, 9.3% are assistant quantity surveyors, 6.2% are Building Information Modeling (BIM) coordinators, 5.4% are directors, 3.9% are technical directors and 1.6% are contract managers.

Moving on to the highest educational level, most of the respondents with bachelor's degree holders, followed by 23.3% of respondents are master's degree holders. Additionally, 12.4% of respondents obtained a diploma certificate. The rest are graduated with Sijil Pelajaran Malaysia (SPM) or GCE O-Level or equivalent (3.9%), PhD (3.1%) and high school (2.3%). The results demonstrated that 50.4% of respondents were from Selangor and 49.6% from Kuala Lumpur. According to Central Limit Theorem (CLT), the normal approximation can be trusted if the sample size is more than 30. Therefore, the data collected from the construction parties from Kuala Lumpur and Selangor could represent the opinion of the particular current residential state.

4.3 Cronbach's Alpha Reliability Test

Cronbach's Alpha Reliability test is applied to determine the reliability of the data collected from the 129 construction practitioners from Selangor and Kuala Lumpur. For this study, three Cronbach's Alpha Reliability tests are carried out due to the three objectives of this research.

Table 4.2 presents the result of the reliability test of the three objectives in this study. The Cronbach's Alpha value for problems of the existing city, opportunities of implementing smart city (SC) and challenges of implementing SC are 0.914, 0.954 and 0.950 respectively, which are higher than the acceptable value of 0.700. Stephanie (2014) emphasised that the value of alpha more than 0.700 is encountered as acceptable. Thus, the values of alpha tabulated in Table 4.2 are reliable and can be applied for further analysis.

Table 4.2: Reliability Statistics of Three Objectives

Objectives	Cronbach Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
Problems of Existing City	0.914	0.914	21
Opportunities of Implementing Smart City	0.954	0.955	34
Challenges of Implementing Smart City	0.950	0.951	28

4.4 Arithmetic Mean Test

In this section, the mean ranking of the three sub-sections, which are problems of the existing city, opportunities and challenges of implementing SC will be discussed according to the data gathered from the respondents. The details of these three sub-sections will be listed and explained in the further sections.

4.4.1 Mean Ranking of Problems of Existing City

The overall mean ranking of the four aspects of the problems of the existing city is tabulated in Table 4.3. According to Table 4.3, it is noticeable that the respondents are aware that the environmental problem is the most severe problem in Kuala Lumpur and Selangor while they consider that the economic problem is the least important problem in the areas.

Table 4.3: Overall Mean Ranking of Problems of Existing City

Code	Aspect of Problems of Existing City	Mean	Ranking
AC	Environmental	4.25	1
AA	Social	4.05	2
AB	Governance	4.03	3
AD	Economic	3.94	4

The means of the 21 problems of the existing city are examined, compared and ranked in Table 4.4. The problem with a higher rank of mean denotes the serious problem from the perspectives of the construction practitioners in Kuala Lumpur and Selangor.

Table 4.4: Mean Ranking of Problems of Existing City

Code	Problems of Existing City	Mean	Ranking
AA5	Traffic congestion	4.57	1
AC4	Global warming	4.37	2
AC1	Greenhouse gas emissions	4.32	3
AC2	Air and water pollution	4.31	4
AC3	Climate change	4.30	5
AC5	Flooding	4.26	6
AB1	Difficult to control all the activities in the city	4.12	7
AB3	Administration's failure in the private and public sectors	4.12	7
AC6	Coastal damage	4.12	7
AB5	Solved the urgent problems in the city or solved the problems that fulfilled the available fund	4.11	10
AA2	Wage inequality	4.11	10
AC7	Melting of the glacier	4.09	12
AD1	Reduction of agriculture and livestock sector	4.04	13
AA3	Lack of accommodation	4.02	14
AA1	Overpopulation	3.95	15
AA6	Health problems	3.94	16
AB4	Does not understand what is happening in the city and cannot discover the city's problems accurately	3.93	17
AA4	Food insecurity	3.92	18

Table 4.4 (Cont'd)

Code	Problems of Existing City	Mean	Ranking
AA7	Lack of educational attainment	3.90	19
AB2	Difficult to pre-define the direction of the city	3.88	20
AD2	Reduction of the number of tourists	3.84	21

Referring to Table 4.4, the problem with the highest mean ranking is AA5 = "Traffic congestion", categorised under "Social" with a mean value of 4.57. It indicates that the construction parties in Kuala Lumpur and Selangor consider that traffic congestion is a serious problem in their current residential state. McKinsey Global Institute (2018) articulated that the traffic congestion in Kuala Lumpur costs 2.0% to 5.0% of Gross Domestic Product (GDP) annually, which means that each inhabitant spends RM3,100.00 on the congestion on roads. Besides, the Malaysian weather would worsen traffic congestion, especially during peak hours (Rasheed, Yau and Low, 2020).

The following top mean ranking is AC4 = "Global warming" under category of "Environmental" with a mean value of 4.37. This result showed that global warming was a severe issue in Kuala Lumpur and Selangor. The increase in human activities led to the accumulation of greenhouse gas (GHG) in the atmosphere, resulting in global warming (Berlie, 2018). For instance, Sasaki, et al. (2021) emphasised that tropical deforestation in Southeast Asia produces 23.0% of the global carbon emission. Global warming will bring an extreme change to the climate, which is climate change and other influences such as an upsurge in the occurrence and intensity of heat waves and drought (Cline, 2007; Mazdiyasni and AghaKouchak, 2015; Gray, et al., 2016; Anderson and Song, 2020).

The third highest mean ranking also comes from group "Environmental" which is AC1 = "Greenhouse gas emissions" with a mean value of 4.32. It can be observed that GHG emissions are another environmental problem highly considered by the construction practitioners in Kuala Lumpur and Selangor. The largest contributor of GHG emissions in the world is China and the amount of GHG emission still escalates due to the rapid growth of economics (Mi, et al.,

2017; Huo, et al., 2019). In Malaysia, the growth of GHG is caused by urbanisation (Bekhet and Othman, 2017). Henceforth, the building sector produces the most GHG emissions among the sectors (Kwok, et al., 2016). On the other hand, Fan, et al. (2018) pointed out that road transport contributes 72.0% of the total GHG emissions in the transport sector in the European Union. As the traffic congestion in Malaysia is serious, thus the GHG emission may be rise.

The lowest mean ranking of the problems of the existing city is AD2 = "Reduction of the number of tourists" which is categorised under "Economic" with a mean value of 3.84. Based on the result, the construction parties in Selangor and Kuala Lumpur perceived that the fall of the number of tourists is not a serious issue in their current residential state as compared to other problems. The travel and tourism industry is upsurged rapidly over the past few decades due to the governmental endeavours and intensive campaigning, which contributed 13.1% share in GDP of Malaysia (Ng, Lye and Lim, 2016; Azam, Alam and Hafeez, 2018). One of the most well-known maritime tourism sport is Redang Island. Exceed 40.0% of the tourists are foreigners and the remaining are local tourists (Marine Park of Malaysia, 2017). However, due to the Covid-19 pandemic, the number of tourists declined (Foo, et al., 2020). According to the result, the reduction of number of tourists is a trivial problem. Nevertheless, it is a crucial problem in other countries. For instance, the number of tourists in Koh Chang of Thailand has lessened due to the damage of coastal areas caused by the breach and shoreline erosion (Nitivattananon and Srinonil, 2019). Additionally, winter tourism is an important sector for the economy in Austria (Pröbstl-Haider, et al., 2021). Nonetheless, due to climate change, winter tourism in Austria declined as the number of days of snowmobiling reduced (Xiao, et al., 2020; Pröbstl-Haider, et al., 2021).

The second lowest mean ranking is AB2 = "Difficult to pre-define the direction of the city" under "Governance" with a mean value of 3.88. This study revealed that the construction practitioners in Selangor and Kuala Lumpur less consider that the government is challenging to pre-define the direction of the city is a severe issue in Kuala Lumpur and Selangor. However, Moroni and Cozzolino (2019) outlined that as the problems and hinders of a city modify

from time to time, hence the policymaker cannot foresee and plan the management of the city.

4.4.2 Mean Ranking of Opportunities of Implementing Smart City

Table 4.5 presents the overall mean ranking of the five aspects of the opportunities of implementing SC. Most of the respondents agreed that the technology aspect is the most possible opportunity of attaining SC. Conversely, the governance aspect is the least possible opportunity of emerging SC.

Table 4.5: Overall Mean Ranking of Opportunities of Implementing Smart City

Code	Aspect of Opportunities of Implementing Smart City	Mean	Ranking
BE	Technology	4.31	1
BD	Economic	4.23	2
BC	Environmental	4.14	3
BA	Social	4.12	4
BB	Governance	4.04	5

Table 4.6 shows the mean ranking of the 34 opportunities of implementing SC. The higher rank of mean indicates the opportunities are more significant in the respondents' opinion.

Table 4.6: Mean Ranking of Opportunities of Implementing Smart City

Code	Opportunities of Implementing Smart City	Mean	Ranking
BE1	Minimise the construction and maintenance cost	4.39	1
BE5	Capture a wide real-time scale of datasets	4.37	2
BD1	Expand economic growth	4.36	3
BA6	Improve the healthcare of the citizens in the cities	4.35	4

Table 4.6 (Cont'd)

Code	Opportunities of Implementing Smart City	Mean	Ranking
BD6	Open up new market possibilities	4.33	5
BE2	Enhance transparency and cooperation among various stakeholders	4.27	6
BA5	Minimise the deadlocks in the parking problems and offer a better quality of services for the citizens	4.27	6
BE3	Manage complex projects and adjust to the changes rapidly	4.26	8
BC1	Provide a positive outcome to the whole community such as improving the citizens' quality of life, enhancing efficiency in the industrial systems and optimising energy consumption	4.26	8
BD3	Save water and improve production	4.26	8
BE4	Enhance the daily atmosphere computationally	4.26	8
BC2	Fulfil the customer's needs for personalised products and faster delivery	4.26	8
BD7	Enhance the governance of tourism intelligently	4.25	13
BC8	Produce greater productivity	4.22	14
BC10	Improve the quality of life of the citizen	4.20	15
BD5	Increase the visitor experience	4.19	16
BC6	Increase energy efficiency	4.19	16
BC9	Reduce energy consumption	4.19	16
BA4	Raise the efficiency and reliability of independent transportation, upsurge mobility and safety and increase the driver's comfort	4.19	16

Table 4.6 (Cont'd)

Code	Opportunities of Implementing Smart City	Mean	Ranking
BB1	Able to receive the data of the population on time and improve the state services	4.15	20
BC12	Minimise pollution, waste and carbon emission	4.15	20
BC7	Minimise the impact on the environment	4.15	20
BD2	Improve the agricultural process	4.14	23
BD4	Increase the growth in the tourism sectors	4.13	24
BC13	Enhance health and social	4.13	24
BC4	Make the production of the personalised product flexible	4.05	26
BC5	Lessen the time to market the personalised products	4.02	27
BC11	Save citizens' money	4.02	27
BC3	Reduce the cost of production of the personalised product	4.02	27
BA2	Communicate and connect with others easily	4.01	30
BA1	Equal access to knowledge and electronic services	4.00	31
BB2	Solve the restrictions of governance of the existing city	4.00	31
BB3	Discover the city's problems easily and implement a better policy or programme to solve the problems of the city	3.99	33
BA3	Deliver the data for the services and the other citizens can get the information through the services	3.93	34

Based on Table 4.6, it is clear that most of the respondents agreed that the BE1 = “Minimise the construction and maintenance cost” under “Technology” with a mean value of 4.39 is the most substantial opportunity. Borrmann, et al. (2018) supported that the adoption of BIM can minimise the construction and maintenance cost. Chan, Olawumi and Ho (2019) studied the advantages and obstacles to adopt BIM in construction in Hong Kong. The advantage of reduction of construction cost had ranked third out of the twelve options.

The second top mean ranking also comes from category “Technology” which is BE5 = “Capture a wide real-time scale of datasets” with a mean value of 4.37. According to the study, capturing a wide real-time scale of datasets is a significant opportunity for the construction parties in Kuala Lumpur and Selangor. Khatoun and Zeadally (2016) had supported that the datasets can be generated by sensor-based sensors, cameras, radio-frequency identification (RFID) tags and smartphones through wireless networks in the Big Data.

The followed top mean value is BD1 = “Expand economic growth” under group “Economic” with a mean value of 4.36. It demonstrated that the construction practitioners in Kuala Lumpur and Selangor highly prioritised the expanded economic growth. Kirimtat, et al. (2020) mentioned that the Smart Economy is a concept regarding smart business and mobile commerce that can expand economic growth.

The least remarkable opportunity is BA3 = “Deliver the data for the services and the other citizens can get the information through the services” under “Social” with a mean value of 3.93. This result revealed that the delivery of the data for the services and the other citizens can get the information through the services less prioritise by the respondents as compared to other opportunities. Nonetheless, Kirimtat, et al. (2020) had an opposite view. As an analogy, the crowdsourcing weather application can evaluate the automatic sensor readings from smartphones and manual input by the users and the other users can obtain the weather information from the application (Niforatos, Vourvopoulos and Langheinrich, 2017).

The second least significant opportunity is BB3 = “Discover the city’s problems easily and implement a better policy or programme to solve the

problems of the city" under group of "Governance" with a mean value of 3.99. Based on the research, the construction parties in Kuala Lumpur and Selangor less consider that discovering the city's problems easily and implementing a better policy or programme to solve the problems of the city is an opportunity of SC. However, Glybovets and Alhawawsha (2017) stressed that the adoption of Smart Governance could enhance the connections between the policymaker and the inhabitants so that the policymaker can notice the problems of the city and create a better policy or programme to unravel the problems of the city.

4.4.3 Mean Ranking of Challenges of Implementing Smart City

The overall mean ranking of the five aspects of the challenges of implementing SC is tabulated in Table 4.7. Unlike the opportunities of implementing SC, the technology aspect is the least hinder to the emergence of SC. The construction parties in Kuala Lumpur and Selangor consider that the social aspect is the most significant obstacle of SC.

Table 4.7: Overall Mean Ranking of Challenges of Implementing Smart City

Code	Aspect of Challenges of Implementing Smart City	Mean	Ranking
CA	Social	4.27	1
CC	Environmental	4.16	2
CB	Governance	4.16	3
CD	Economic	4.09	4
CE	Technology	4.05	5

The means of the 28 challenges of implementing SC are ranked and tabulated in Table 4.8. The challenges with a higher rank of mean signify the challenges are noteworthy from the respondents' view.

Table 4.8: Mean Ranking of Challenges of Implementing Smart City

Code	Challenges of Implementing Smart City	Mean	Ranking
CC1	Poor planning	4.36	1
CA1	Do not know/ or unsure about the SC developments	4.33	2
CC7	Carbon emissions	4.24	3
CA2	Lack of understanding on SC implementation	4.22	4
CB1	Lack of sufficient guidance for the government	4.22	4
CC8	Lack of an ecological perspective on behaviour	4.21	6
CB4	Does not consider the variety and complication of the system	4.19	7
CB3	Reluctant to uncover service procedures and related data	4.19	7
CB2	Unwilling to provide the transparency and leadership needed	4.19	7
CC6	Unables to formulate a proper waste management	4.19	7
CC5	Lack of sustainability consideration	4.18	11
CB7	Lack of funding	4.17	12
CD5	Higher cost in Information Technology (IT) training and skills development	4.16	13
CD4	Operational cost and maintenance cost of the technologies in the SC is costly	4.16	13
CE4	Security and privacy of data may not be secured	4.16	13
CC2	High rate of urbanisation	4.13	16
CE5	Limited skilled workforce	4.10	17
CC4	Traffic congestion	4.09	18

Table 4.8 (Cont'd)

Code	Challenges of Implementing Smart City	Mean	Ranking
CD1	Lack of competitiveness between each business	4.09	18
CB5	Overlapping visions	4.08	20
CB6	Lack of understanding on SC	4.06	21
CE6	Poor data availability	4.05	22
CE3	Lack of adoption and poor emergence of the technology	4.05	22
CD3	High infrastructure and intelligence deficit	4.05	22
CD2	Global economy volatility	4.02	25
CE2	Limitations in current technology and data analytics procedures	4.00	26
CE1	Does not align with the SC concept	3.98	27
CC3	Population growing too fast	3.91	28

According to Table 4.8, the highest mean ranking is CC1 = "Poor planning" from group "Environmental" with a mean value of 4.36. According to the respondents' perspective, it can be observable that poor planning is the most significant challenge of SC attainment. Aghimien, et al. (2020) supported this perspective and poor planning gained a mean value of 3.06 in the study, which greatly influences on the SC implementation in Nigeria as well.

CA1 = "Do not know/ or unsure about the SC developments" under "Social" with a mean value of 4.33 ranked the second top challenges of implementing SC. It can conclude that the citizens do not know or are unsure about the SC developments is a significant obstacle. If the local government does not update the residents, the residents may not know about any developments of the technologies, leading to the barriers of SC emergence (Umdu and Alakavuk, 2020). Besides, Heaton and Parlikad, 2019 highlighted that the inhabitants are lacking of understanding on urban technologies in both individual and the collective levels.

The next top mean ranking is CC7 = "Carbon emissions" under the category of "Environmental" with a mean value of 4.24. According to the viewpoint of the construction parties in Kuala Lumpur and Selangor, carbon emissions are also one of the major hinders of SC attainment. Nevertheless, a study done in India demonstrated that the carbon emission effect is considered a less significant barrier of SC development, ranking 25th out of 31st obstacles (Rana, et al., 2019).

The lowest mean ranking also comes from category of "Environmental" which is CC3 = "Population growing too fast" with a mean value of 3.91. This study showed that the construction practitioners less consider that the population growing too fast is hindering the implementation of SC. Nonetheless, a study done in Nigeria exhibited that the rise of population rate had a mean value of 3.56, which is higher than the poor planning that is ranked first in this study.

The followed lowest mean ranking is CE1 = "Does not align with the SC concept" under "Technology" with a mean value of 3.98. Based on the study, the respondents perceived that the current technology does not align with the SC concept is not a noteworthy barrier of SC emergence. However, Heaton and Parlikad (2019) argued that the SC and BIM standards are isolating from each other although overlapping in the interoperability data models and information decision frameworks.

4.5 Spearman's Correlation Test

In this section, Spearman's Correlation test is adopted to examine three relationships which are the relationship between the problems of the existing city and the opportunities of implementing SC; the relationship between the problems of the existing city and the challenges of implementing SC; and the relationship between the opportunities of implementing SC and the challenges of implementing SC.

4.5.1 Problems of Existing City and Opportunities of Implementing Smart City

Table 4.9 reveals the correlation between problems of the existing city and the opportunities of implementing SC. There is a total of 574 correlations. 7.3% of

the relationship had a strong strength of relationship, 32.4% had a moderate relationship, 50.4% had a weak relationship and 9.9% had no or negligible relationship.

Each problem has at least 4 significantly correlated influential opportunities, while each opportunity has at least 11 significantly correlated influential problems. Based on Table 4.9, “Overpopulation” (AA1), “Difficult to control all the activities in the city” (AB1) and “Solved the urgent problems in the city or solved the problems that fulfilled the available fund” (AB5) are the most significant problems, which with 34 significant correlations.

In Malaysia, the estimated population is approximately 32.7 million in 2021 (Department of Statistics Malaysia Official Portal, 2021a). Selangor is the highest population composition state, which contributes around 20.1%. Meanwhile, Kuala Lumpur has the highest population density, with around 7,188 people per square kilometre (Department of Statistics Malaysia Official Portal, 2021a). Due to the overpopulation and complexity of the city, the policymaker is hard to control all the activities in the city (Moroni and Cozzolino, 2019). Additionally, the problems of a city will change from time to time, leading the government to solve the urgent problems in the city or solve the problems that fulfilled the available fund only (Moroni and Cozzolino, 2019; Leach, et al., 2019).

Conversely, “Minimise the deadlocks in the parking problems and offer a better quality of services for the citizens” (BA5) and “Produce greater productivity” (BC8) are the most noteworthy opportunities, which with 20 significant correlations. The benefit of minimising the deadlocks in the parking problems and offering a better quality of services for the citizens can be achieved by implementing Smart Parking. The Smart Parking concept uses the sensors embedded in the vehicles and infrastructures to minimise the deadlock (Al-Turjman and Malekloo, 2019). On the other hand, Smart Manufacturing (SM) can provide the opportunity of producing greater productivity (Supekar, et al., 2019).

The highest correlation is “Overpopulation” (AA1) and “Able to receive the data of the population on time and improve the state services” (BB1) with the ρ-value of 0.553. Due to momentous variation in wealth and resources in

the city, many inhabitants in the rural areas moved to the city and resulted in urbanisation (Liddle, 2017). However, urbanisation leads to many problems in the city such as inequality, lack of accommodation, health problems and others (Uprety, 2020; Kuddus, Tynan and McBryde, 2020). Therefore, it is crucial to collect the data of the population on time and allow the government to improve the state services. Glybovets and Alhawawsha (2017) articulated that the adoption of Smart Governance can provide this opportunity because knowledge and information can share impeccably in each arm of the government in governing the city. In addition, each authority can collaborate to each other by using the rapid response system and electronic government (Vershinina and Volkova, 2020). As a consequence, the data can be received on time and can be used to improve the state services.

The second highest correlation is "Difficult to control all the activities in the city" (AB1) and "Equal access to knowledge and electronic services" (BA1) with the ρ-value of 0.546. There are many components and multiple actions conducted in a city, leading to a complexity of a city. It then leads to more restrictions in reality for the policymaker and makes the government is difficult to control all the activities in the city (Moroni and Cozzolino, 2019). Nonetheless, the implementation of Smart People can provide equal access to knowledge and electronic services for the citizens (Vershinina and Volkova, 2020). Henceforth, as the inhabitants are able to know more about the SC development and are willing to cooperate with the government, it might make the management of the city easier.

"Difficult to control all the activities in the city" (AB1) also significantly correlated with the "Able to receive the data of the population on time and improve the state services" (BB1), with the ρ-value of 0.501. The decision-makers of a city are difficult to control all the activities in the city due to the complexity of a city and more restrictions in reality (Moroni and Cozzolino, 2019). Nevertheless, Smart Governance is one of the digital technologies that the government can implement. The local authorities can use this technology to share the knowledge and information impeccably and collaborate by using the rapid response system and electronic government to obtain the data on time and

improve the state services (Glybovets and Alhawawsha, 2017; Vershinina and Volkova, 2020).

Table 4.9: Correlation between Problems of Existing City and Opportunities of Implementing Smart City

Opportunities \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
BA1	0.457**	-0.183*	0.314**	0.342**	-0.186*	0.271**	0.326**	0.546**	0.234**	0.266**	0.334**	0.365**	0.367**	-0.174*	0.177*	-0.197*	-0.204*	0.214*	0.286**	0.467**	0.486**	16
BA2	0.360**	-0.294**	0.319**	0.192*	-0.298**	0.214*	0.190*	0.337**	0.198*	0.244**	0.254**	0.374**	0.207*	-0.203*	0.191*	-0.245**	-0.209*	0.181*	0.207*	0.221*	0.320**	16
BA3	0.254**	0.183*	0.310**	0.186*	-0.271**	0.309**	0.191*	0.251**	-	-	-	0.221*	0.256**	-	0.237**	-	-	0.259**	0.209*	0.244**	0.233**	14
BA4	0.283**	-0.266**	0.221*	0.326**	-0.180*	0.281**	0.230**	0.287**	0.232**	-	-	0.323**	-	-	-	0.197*	-0.185*	0.195*	0.290**	0.321**	0.238**	13
BA5	0.377**	0.294**	0.298**	0.356**	-0.239**	0.379**	0.374**	0.444**	0.293**	0.441**	0.309**	0.410**	0.400**	0.174*	0.203*	0.245**	0.204*	0.256**	0.311**	0.470**	0.323**	20
BA6	0.316**	0.266**	0.271**	0.180*	-0.201*	0.433**	0.239**	0.260**	0.201*	0.334**	0.286**	0.316**	0.249**	0.196*	-0.210*	0.209*	-0.203*	0.304**	0.211*	0.304**	19
BB1	0.553**	0.199*	0.300**	0.450**	-0.289**	0.393**	0.349**	0.501**	0.289**	0.239**	0.330**	0.451**	0.373**	-0.277**	0.229**	0.185*	-0.321**	0.332**	0.472**	0.396**	19
BB2	0.368**	0.186*	0.219*	0.210*	-0.255**	0.241**	0.322**	0.178*	0.225*	-0.267**	0.184*	0.255**	-0.288**	0.260**	14
BB3	0.423**	0.299**	0.310**	0.288**	-0.253**	0.197*	0.283**	0.187*	0.278**	0.241**	0.347**	-0.220*	-0.181*	0.377**	0.255**	15
BC1	0.463**	0.203*	0.260**	0.434**	-0.284**	0.416**	0.429**	0.276**	0.296**	0.349**	0.412**	0.313**	-0.211*	0.247**	-0.365**	0.406**	0.356**	0.321**	18
BC2	0.402**	0.252**	0.240**	0.305**	-0.356**	0.256**	0.394**	0.257**	0.262**	0.248**	0.378**	0.295**	-0.208*	-0.243**	0.278**	0.366**	0.263**	17

Table 4.9 (Cont'd)

Opportunities \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
BC3	0.453**	0.199*	0.204*	0.353**	0.206*	0.318**	0.215*	0.358**	0.282**	0.243**	0.311**	0.395**	0.293**	-	-	-	-	0.271**	0.228**	0.369**	0.302**	17
BC4	0.412**	0.195*	0.204*	0.276**	-	0.312**	0.197*	0.259**	0.254**	0.217*	0.227**	0.367**	0.284**	-	0.240**	0.258**	-	0.221*	0.296**	0.368**	0.252**	18
BC5	0.444**	0.294**	0.297**	0.316**	-	0.378**	0.298**	0.313**	0.343**	0.299**	0.375**	0.531**	0.345**	-	0.348**	0.361**	-	0.369**	0.354**	0.372**	0.334**	18
BC6	0.270**	0.246**	0.228**	0.320**	-	0.281**	0.236**	0.296**	0.319**	-	0.257**	0.351**	0.312**	-	0.321**	0.281**	-	0.310**	0.296**	0.341**	-	16
BC7	0.311**	0.265**	0.270**	0.264**	-	0.311**	0.322**	0.361**	0.376**	0.285**	0.274**	0.377**	0.304**	-	0.231**	0.246**	0.180*	0.315**	0.250**	0.365**	0.217*	19
BC8	0.232**	0.200*	0.282**	0.189*	0.195*	0.290**	0.202*	0.224*	0.282**	0.229**	0.188*	0.279**	0.214*	-	0.174*	0.246**	0.180*	0.222*	0.207*	0.282**	0.192*	20
BC9	0.294**	0.325**	0.271**	0.334**	-	0.308**	0.271**	0.358**	0.362**	0.313**	0.241**	0.334**	0.280**	-	0.200*	0.177*	0.225*	0.315**	0.332**	0.371**	0.185*	19
BC10	0.350**	0.358**	0.255**	0.327**	-	0.227**	0.312**	0.362**	0.336**	0.325**	0.326**	0.408**	0.363**	-	0.266**	0.289**	0.190*	0.404**	0.359**	0.363**	0.198*	19
BC11	0.378**	0.259**	0.305**	0.297**	-	0.293**	0.384**	0.355**	0.306**	0.343**	0.332**	0.353**	-	-	-	-	-	0.253**	0.276**	0.318**	0.237**	15
BC12	0.314**	0.292**	0.313**	0.360**	-	0.282**	0.272**	0.333**	0.277**	0.284**	0.357**	0.365**	-	-	0.301**	0.187*	-	0.336**	0.256**	0.360**	0.224*	17
BC13	0.293**	0.235**	0.247**	0.384**	-	0.285**	0.267**	0.231**	0.314**	0.291**	0.279**	0.338**	0.176*	-	0.242**	-	-	0.205*	0.213*	0.269**	-	16

Table 4.9 (Cont'd)

Opportunities \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
BD1	0.492**	0.336**	0.269**	0.362**	-	0.279**	0.453**	0.414**	0.246**	0.280**	0.451**	0.443**	0.405**	-	0.274**	0.282**	0.280**	0.386**	0.318**	0.438**	0.309**	19
BD2	0.296**	0.245**	0.205*	-	-	-	0.249**	0.201*	0.195*	0.272**	0.296**	0.392**	0.277**	0.187*	0.191*	-	0.305**	0.299**	0.233**	-	-	15
BD3	0.234**	0.230**	0.256**	0.212*	-	0.311**	-	0.249**	0.285**	0.249**	0.277**	0.287**	0.199*	-	0.298**	0.213*	0.219*	0.234**	0.224*	0.264**	-	17
BD4	0.354**	0.264**	0.294**	0.359**	-	0.234**	0.241**	0.261**	0.260**	0.267**	0.386**	0.380**	0.200*	-	0.203*	0.181*	0.273**	0.217*	0.187*	0.313**	0.321**	19
BD5	0.337**	0.241**	0.255**	0.323**	-	0.220*	0.294**	0.320**	0.321**	0.232**	0.376**	0.391**	0.212*	-	0.226*	0.177*	-	0.242**	0.290**	0.307**	0.314**	18
BD6	0.214*	0.261**	-	0.180*	-	0.219*	0.264**	0.224*	0.206*	0.235**	0.219*	0.238**	-	0.261**	-	-	0.180*	0.308**	0.292**	-	-	14
BD7	0.314**	0.294**	0.321**	0.241**	-	0.268**	0.260**	0.305**	0.224*	0.335**	0.303**	0.344**	0.304**	-	0.309**	0.293**	0.198*	0.363**	0.262**	0.260**	0.229**	19
BE1	0.411**	0.245**	0.202*	0.281**	-	0.367**	0.361**	0.499**	0.361**	0.248**	0.410**	0.392**	0.400**	-	0.212*	-	-	0.327**	0.346**	0.437**	0.213*	17
BE2	0.236**	0.249**	-	-	-	0.215*	-	0.216*	-	-	0.221*	0.228**	0.193*	-	0.177*	-	-	0.256**	0.200*	0.214*	-	11
BE3	0.204*	0.246**	0.191*	-	-	0.228**	0.238**	0.218*	0.286**	-	0.251**	0.198*	0.225*	-	-	-	-	0.266**	0.186*	0.193*	-	13
BE4	0.210*	0.327**	0.182*	-	0.184*	0.332**	0.300**	0.264**	0.356**	0.267**	0.291**	0.315**	0.220*	-	0.343**	0.248**	0.174*	0.340**	0.274**	0.316**	-	18

Table 4.9 (Cont'd)

Opportunities \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
BE5	0.279**	0.395**	-	0.262**	0.233**	0.348**	0.238**	0.370**	0.332**	0.380**	0.319**	0.379**	0.298**	-	0.283**	0.237**	0.244**	0.422**	0.390**	0.321**	0.201*	19
Total Correlation	34	31	31	30	4	33	32	34	32	29	31	34	29	5	25	22	15	32	33	32	26	

Note: **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4.5.2 Problems of Existing City and Challenges of Implementing Smart City

The correlation between problems of the existing city and the challenges of implementing SC was displayed in Table 4.10. There are 485 correlations between the problems of the existing city and the challenges of implementing SC. 10.7% of the relationship had a strong strength of relationship, 35.7% had a moderate relationship, 43.5% had a weak relationship and 10.1% had no or negligible relationship.

Each of the problems was correlated with at least 5 challenges, while each of the challenges was found correlated with at least 11 problems. The most imperative problems are "Overpopulation" (AA1), "Lack of educational attainment" (AA7) and "Coastal damage" (AC6), with 28 significant correlations. It is noticeable that "Overpopulation" (AA1) is a significant problem no matter in the relationship between problems of the existing city and the opportunities of implementing SC or problems of the existing city and the challenges of implementing SC.

Many of the problems in the existing city are caused by overpopulation. Due to the overpopulation, human activities upsurge quickly, results in climate change and leads to coastal damage in the world (Hsiao, et al., 2021). Lack of educational attainment is also one of the problems of the existing city. It is because educational attainment will affect consumption inequality. For instance, the spatial concentration of an unbalanced number of high-paying jobs in a few developed, high-tier city-regions on the eastern coast leads to the urban wage inequality of the producer services (Cheng, 2021).

Meanwhile, the most substantial challenges are "Does not consider the variety and complication of the system" (CB4) and "High rate of urbanisation" (CC2), with 20 significant correlations. Most of the Asian countries are using the top-down approach rather than the bottom-up approach (Boykova, Ilina and Salazkin, 2016). Nevertheless, the adoption of technology such as Big Data and BIM may not consider the variety and complication of the system. In spite of that, one of the challenges of implementing SC is the high rate of urbanisation. Asia and Africa have the fastest urbanisation rates globally (Uprety, 2020).

Rapid urbanisation will cause many problems such as climate change, global warming and others that make the attainment of SC difficult.

The highest correlation is “Reduction of agriculture and livestock sector” (AD1) and “Does not align with the SC concept” (CE1), with the ρ-value of 0.550. The reduction of agriculture and livestock sector are caused by climate change and global warming (Godde, et al., 2021). Therefore, it is imperative to adopt some technologies such as Smart Agriculture and smart irrigation management system, which can save water, improve production and develop the agricultural process by using technologies, protocols, devices and computational paradigms (Zanella, Silva and Albini, 2020; Goap, et al., 2018). Nonetheless, these technologies are not applied in Klang Valley as the SC technologies (Arup and Think City, 2021). Hence, the current technology does not align with the SC concept is one of the barriers of implementing SC and may worsen the problem of reducing the agriculture and livestock sector.

The result demonstrated that there are two subsequent high correlations with the ρ-value of 0.533. The “Reduction of agriculture and livestock sector” (AD1) is significantly correlated with “Poor planning” (CC1). Godde, et al. (2021) indicated that climate change and global warming affect the agriculture and livestock sectors. Climate change causes extreme climate events such as floods, cyclones and heat waves, in turn to the reduction of farm production, fall in agriculture production, and decline of the amount of forage and grazing sector. However, the poor planning of cities when implementing SC will worsen this problem. It is because the failure of the management leads to natural disasters and failures of the system, which deteriorates the agriculture and livestock sector (Silva, Khan and Han, 2018).

Another high correlation is the “Lack of educational attainment” (AA7) and “Does not align with the SC concept” (CE1). Cheng (2021) articulated that families without adult members, larger families, citizens older than 45 years old, rural migrants, self-employed and females have lower educational attainment. Furthermore, most inhabitants with higher educational attainment have higher incomes than the citizens with lower educational attainment. It inferred that educational attainment is imperative for a resident to gain a higher income. There are seven core components of SC in Malaysia, which are Smart Digital

Infrastructure, Smart Mobility, Smart Government, Smart People, Smart Environment, Smart Living and Smart Economy (The Malaysian Administrative Modernisation and Management Planning Unit, 2019). The adoption of Smart People can reduce this problem. Nonetheless, Smart People is not the main SC focus area in Klang Valley (Arup and Think City, 2021). Thus, it can conclude that the current technology does not align with the SC concept.

Table 4.10: Correlation between Problem of Existing City and Challenges of Implementing Smart City

Challenges \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
CA1	0.392**	0.282**	0.243**	0.333**	-	0.269**	0.444**	0.499**	0.279**	0.258**	0.344**	0.300**	0.299**	-	0.175*	0.181*	-	0.303**	0.262**	0.433**	0.266**	18
CA2	0.204*	0.230**	0.184*	-	-	0.239**	0.286**	0.225*	-	-	0.213*	-	-	0.225*	0.182*	-	-	0.253**	-	0.212*	0.210*	12
CB1	0.362**	0.328**	0.221*	0.196*	-	-	0.404**	0.433**	-	0.236**	0.403**	0.347**	0.337**	-	0.229**	0.305**	0.174*	0.430**	0.212*	0.465**	0.279**	17
CB2	0.326**	0.231**	-	-	-	0.310**	0.351**	0.405**	0.295**	0.363**	0.422**	0.307**	0.235**	-	0.266**	0.180*	-	0.364**	-	0.266**	0.286**	15
CB3	0.319**	0.242**	-	0.261**	-	0.283**	0.376**	0.456**	0.401**	0.246**	0.317**	0.347**	0.373**	0.274**	0.314**	0.234**	-	0.346**	0.245**	0.407**	0.196*	18
CB4	0.374**	0.281**	0.307**	0.294**	-	0.319**	0.344**	0.482**	0.405**	0.300**	0.481**	0.401**	0.415**	0.229**	0.272**	0.273**	0.249**	0.366**	0.315**	0.453**	0.324**	20
CB5	0.338**	0.333**	0.278**	0.322**	-	0.347**	0.358**	0.374**	0.456**	0.332**	0.469**	0.467**	0.256**	-	0.237**	0.216*	0.199*	0.331**	0.281**	0.343**	0.294**	19
CB6	0.320**	0.303**	0.322**	0.297**	-	0.234**	0.370**	0.243**	0.260**	-	0.304**	0.336**	0.196*	-	0.258**	0.194*	0.183*	0.298**	0.300**	0.290**	-	17
CB7	0.249**	0.244**	-	0.191*	-	0.214*	0.339**	-	-	-	-	-	-	-	0.244**	0.213*	0.181*	0.233**	0.188*	0.227**	-	11
CC1	0.413**	0.227**	0.259**	0.339**	-	0.293**	0.405**	0.465**	0.198*	0.284**	0.390**	0.347**	0.378**	-	0.237**	0.295**	0.187*	0.279**	0.230**	0.533**	0.398**	19
CC2	0.304**	0.193*	0.247**	0.278**	-	0.218*	0.350**	0.330**	0.188*	0.266**	0.289**	0.229**	0.206*	0.189*	0.288**	0.303**	0.182*	0.279**	0.230**	0.421**	0.286**	20

Table 4.10 (Cont'd)

Challenges \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
CC3	0.438**	0.221*	0.301**	0.361**	0.216*	0.361**	0.346**	0.383**	0.304**	0.274**	0.330**	0.330**	0.297**	-	0.287**	0.229**	-	0.259**	0.207*	0.395**	0.345**	19
CC4	0.364**	0.173*	0.291**	0.367**	0.175*	0.329**	0.247**	0.333**	0.277**	0.240**	0.314**	0.289**	0.298**	-	0.261**	-	-	0.173*	-	0.401**	0.279**	17
CC5	0.366**	0.273**	0.242**	0.210*	-	0.279**	0.401**	0.370**	0.230**	0.240**	0.328**	0.220*	0.297**	-	0.198*	0.184*	-	0.305**	0.178*	0.398**	0.186*	18
CC6	0.401**	0.403**	0.290**	0.352**	-	0.343**	0.383**	0.347**	0.277**	0.295**	0.333**	0.285**	0.296**	-	0.287**	0.308**	0.184*	0.320**	0.316**	0.464**	0.301**	19
CC7	0.203*	0.179*	0.230**	0.292**	-	0.335**	0.292**	0.224*	-	-	0.200*	0.263**	0.236**	0.197*	0.389**	0.297**	-	0.286**	0.249**	0.348**	0.242**	17
CC8	0.372**	0.222*	0.219*	0.343**	0.276**	0.346**	0.284**	0.320**	0.286**	0.230**	0.277**	0.327**	0.285**	-	0.244**	0.181*	-	0.337**	0.324**	0.337**	0.375**	19
CD1	0.435**	0.180*	0.290**	0.346**	-	0.238**	0.481**	0.401**	0.207*	0.232**	0.309**	0.366**	0.330**	-	0.276**	0.198*	-	0.342**	0.267**	0.443**	0.352**	18
CD2	0.424**	0.322**	0.246**	0.302**	-	0.328**	0.339**	0.417**	0.308**	0.320**	0.446**	0.357**	0.344**	-	0.239**	-	0.232**	0.346**	0.269**	0.393**	0.371**	18
CD3	0.366**	0.398**	0.332**	0.247**	-	0.334**	0.375**	0.355**	0.184*	0.241**	0.311**	0.367**	0.283**	-	0.326**	0.207*	0.235**	0.338**	0.309**	0.374**	0.236**	19
CD4	0.423**	0.301**	0.321**	0.410**	0.207*	0.367**	0.374**	0.318**	-	0.299**	0.376**	0.373**	0.309**	-	0.286**	0.263**	-	0.416**	0.317**	0.328**	0.325**	18
CD5	0.447**	0.287**	0.286**	0.305**	0.237**	0.377**	0.317**	0.346**	0.224*	0.283**	0.292**	0.340**	0.245**	-	0.286**	0.233**	0.194*	0.315**	0.266**	0.395**	0.242**	20

Table 4.10 (Cont'd)

Challenges \ Problems	AA1	AA2	AA3	AA4	AA5	AA6	AA7	AB1	AB2	AB3	AB4	AB5	AC1	AC2	AC3	AC4	AC5	AC6	AC7	AD1	AD2	Total Correlation
CE1	0.412**	0.398**	0.288**	0.400**	-	0.320**	0.533**	0.473**	0.337**	0.287**	0.437**	0.403**	0.265**	-	0.189*	0.196*	0.189*	0.307**	0.247**	0.550**	0.348**	19
CE2	0.231**	0.323**	0.318**	0.305**	-	0.247**	0.376**	0.278**	0.284**	0.264**	0.400**	0.269**	-	-	-	-	-	0.276**	0.210*	0.308**	0.263**	15
CE3	0.315**	0.350**	0.235**	0.242**	-	0.252**	0.338**	0.276**	0.265**	0.244**	0.361**	0.259**	0.213*	-	0.296**	0.204*	0.222*	0.345**	0.267**	0.260**	-	18
CE4	0.257**	-	-	0.199*	-	0.337**	0.343**	0.323**	0.285**	0.234**	0.249**	0.207*	-	-	-	-	-	0.237**	-	0.291**	0.250**	12
CE5	0.213*	-	-	0.233**	0.199*	0.268**	0.299**	0.281**	0.196*	0.196*	0.198*	-	0.218*	-	-	0.195*	0.265**	0.354**	0.186*	-	0.233**	15
CE6	0.273**	0.180*	-	0.302**	0.174*	0.274**	0.389**	0.337**	0.286**	0.300**	0.339**	0.300**	0.338**	-	0.243**	0.198*	0.295**	0.371**	0.292**	0.323**	-	18
Total Correlation	28	26	22	26	7	27	28	27	23	24	27	25	24	5	25	23	15	28	24	27	24	

Note: **. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.5.3 Opportunities of Implementing Smart City and Challenges of Implementing Smart City

Table 4.11 presents the correlation between opportunities of implementing SC and challenges of implementing SC. There are a total of 852 correlations between these two objectives. 12.2% of the relationship had a strong strength of relationship, 36.3% had a moderate relationship, 44.1% had a weak relationship and 7.4% had no or negligible relationship.

Each opportunity was found correlated with at least 17 challenges, while each challenge was correlated with at least 12 opportunities. There are 10 most significant challenges with 34 significant correlations, which are "Does not consider the variety and complication of the system" (CB4), "Overlapping visions" (CB5), "Poor planning" (CC1), "Population growing too fast" (CC3), "Lack of sustainability consideration" (CC5), "Unables to formulate a proper waste management" (CC6), "Lack of an ecological perspective on behaviour" (CC8), "Global economy volatility" (CD2), "High infrastructure and intelligence deficit" (CD3) and "Operational cost and maintenance cost of the technologies in the SC is costly" (CD4). "Does not consider the variety and complication of the system" (CB4) is a significant challenge no matter in the relationship between problems of the existing city and the challenges of implementing SC or opportunities of implementing SC and the challenges of implementing SC.

In the governance aspect, the government does not consider the variety and complication of the system and the overlapping visions between the policies and development plans are the barriers of implementing SC. The reason of overlapping visions is the lack of coordination or communication between the central and municipal levels. An example of the SC with overlapping vision is Bhubaneswar, which had been burdened with around eight planning documents concerning the development of several sectors in the city and the infrastructure components (Praharaj, Han and Hawken, 2017).

For the environmental aspect, "Poor planning" (CC1), "Population growing too fast" (CC3), "Lack of sustainability consideration" (CC5), "Unables to formulate a proper waste management" (CC6) and "Lack of an ecological perspective on behaviour" (CC8) are the significant obstacles. The

population growing too fast will lead to many problems such as climate change, increment of carbon emission, bringing illness, influencing the mortality rate and affecting the population growth rate (Sulemana, et al., 2019). The poor planning will worsen this situation as the poor planning of the cities will cause natural disasters such as earthquakes, floods, tornados and others, and failures of the system like network unavailability and infrastructure malfunction (Silva, Khan and Han, 2018). If the citizens lack of sustainability consideration, lack of an ecological perspective on behaviour and unable to formulate a proper waste management, it will further deteriorate the situation and hinder SC development.

The "Global economy volatility" (CD2), "High infrastructure and intelligence deficit" (CD3) and "Operational cost and maintenance cost of the technologies in the SC is costly" (CD4) are the challenges of implementing SC in economics aspect. The global economic volatility will influence the subsidies provided by the government and then affect the GHG emissions produced (Rana, et al., 2019). Additionally, some cities fail to emerge SC due to insufficient funds as extensive infrastructure and intelligent systems are required for SC attainment (Rana, et al., 2019; Araral, 2020). Lastly, the costly IT training and skills development will also cause the failure of the SC (Rana, et al., 2019).

Besides, there are 4 most noteworthy opportunities with 28 significant correlations, which are "Minimise the deadlocks in the parking problems and offer a better quality of services for the citizens" (BA5), "Fulfil the customer's needs for personalised products and faster delivery" (BC2), "Lessen the time to market the personalised products" (BC5) and "Save citizens' money" (BC11). Similarly, "Minimise the deadlocks in the parking problems and offer a better quality of services for the citizens" (BA5) also is a significant opportunity in Chapter 4.5.2.

It is noticeable that the other three opportunities are from an environmental aspect. SM is one of the technologies in Smart Environment, which can fulfil the customer's needs for personalised products and faster delivery and lessen the time to market the personalised products (Supekar, et al., 2019; Zenisek, Wild and Wolfartsberger, 2021). The Smart Home is another technology in Smart Environment. The adoption of a Smart Home can save

citizens' money because the implementation of the Smart Home can reduce energy consumption (Sovacool and Rio, 2020).

Based on Table 4.11, the highest correlation is the "Equal access to knowledge and electronic services" (BA1) and "Do not know/ or unsure about the SC developments" (CA1), with the ρ-value of 0.573. Vershinina and Volkova (2020) emphasised that the adoption of Smart People can provide equal access to knowledge and electronic services for all inhabitants. Nonetheless, if the local policymaker does not inform the citizens, then the residents of the country may not know about any developments of the technologies (Umdu and Alakavuk, 2020). It is because the relationship between the government and citizens shall be collaborative, communicative and trustworthy (Jee, Han and Kim, 2021). Henceforth, if the communities do not know/ or are unsure about the SC developments, the opportunity of equal access to knowledge and electronic services could not be achieved.

"Able to receive the data of the population on time and improve the state services" (BB1) is significantly correlated with "Do not know/ or unsure about the SC developments" (CA1), with the ρ-value of 0.571. The implementation of Smart Governance can help the government collect the data of the population on time and develop state services (Vershinina and Volkova, 2020). However, if the citizens do not know/ or unsure about the SC developments, the inhabitants cannot coordinate with the policymaker. As a consequence, the local authorities are hard to collect data of the population and causes the SC emergence to fail.

Apart from that, "expand economic growth" (BD1) is also significantly correlated with "Do not know/ or unsure about the SC developments" (CA1), with the ρ-value of 0.538. Economic growth can be expanded by using Smart Economy, a concept regarding smart business and mobile commerce (Kirimtat, et al., 2020). If the citizens do not know/ or unsure about smart business and mobile commerce, the monetary transaction may become lesser and result in more nominal economic growth in Malaysia.

Table 4.11: Correlation between Opportunities of Implementing Smart City and Challenges of Implementing Smart City

Opportunities \ Challenges	CA1	CA2	CB1	CB2	CB3	CB4	CB5	CB6	CB7	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CD1	CD2	CD3	CD4	CD5	CE1	CE2	CE3	CE4	CE5	CE6	Total Correlation
BA1	0.573**	0.348**	0.365**	0.192*	0.320**	0.416**	0.340**	0.316**	0.258**	0.514**	0.261**	0.439**	0.351**	0.323**	0.348**	0.246**	0.334**	0.499**	0.402**	0.397**	0.371**	0.300**	0.415**	0.253**	0.222*	-	0.201*	0.355**	27
BA2	0.396**	0.319**	0.264**	0.184*	-	0.331**	0.355**	0.269**	0.226*	0.386**	0.219*	0.367**	0.262**	0.260**	0.254**	0.186*	0.391**	0.321**	0.315**	0.364**	0.338**	0.246**	0.196*	0.214*	-	-	-	0.264**	24
BA3	0.370**	0.370**	0.254**	0.259**	0.275**	0.268**	0.284**	0.359**	0.268**	0.326**	0.241**	0.495**	0.400**	0.334**	0.383**	0.436**	0.347**	0.360**	0.330**	0.500**	0.448**	0.391**	0.222*	0.208*	0.276**	-	0.204*	0.278**	27
BA4	0.256**	0.258**	-	-	0.217*	0.239**	0.321**	0.352**	-	0.218*	0.191*	0.265**	0.237**	0.228**	0.332**	0.254**	0.337**	0.198*	0.209*	0.332**	0.326**	0.205*	0.178*	-	-	-	-	0.204*	21
BA5	0.431**	0.203*	0.253**	0.215*	0.297**	0.334**	0.383**	0.246**	0.191*	0.420**	0.319**	0.406**	0.418**	0.375**	0.475**	0.296**	0.341**	0.347**	0.358**	0.347**	0.407**	0.363**	0.348**	0.261**	0.255**	0.208*	0.227**	0.300**	28
BA6	0.337**	0.246**	0.211*	0.232**	-	0.316**	0.256**	-	-	0.353**	0.283**	0.327**	0.325**	0.256**	0.303**	-	0.225*	-	0.262**	0.303**	0.291**	0.201*	-	-	0.186*	-	0.177*	0.240**	20
BB1	0.571**	0.311**	0.429**	0.309**	0.367**	0.462**	0.456**	0.341**	0.279**	0.536**	0.290**	0.488**	0.408**	0.354**	0.367**	0.288**	0.452**	0.405**	0.402**	0.392**	0.440**	0.347**	0.360**	-	0.219*	-	-	0.238**	25
BB2	0.403**	0.331**	0.211*	-	0.373**	0.316**	0.257**	0.216*	0.194*	0.321**	0.206*	0.341**	0.219*	0.254**	0.256**	0.219*	0.369**	0.282**	0.320**	0.348**	0.311**	0.276**	0.249**	-	0.173*	-	-	0.250**	24
BB3	0.349**	0.273**	0.312**	0.248**	0.267**	0.277**	0.345**	0.259**	0.239**	0.345**	0.187*	0.382**	0.301**	0.299**	0.358**	-	0.354**	0.271**	0.333**	0.307**	0.305**	0.310**	0.244**	-	-	-	-	-	22
BC1	0.403**	-	0.252**	0.290**	0.311**	0.329**	0.355**	0.321**	0.273**	0.497**	0.360**	0.372**	0.301**	0.296**	0.360**	0.270**	0.351**	0.385**	0.319**	0.290**	0.425**	0.342**	0.263**	-	0.261**	-	0.319**	0.413**	25
BC2	0.376**	0.195*	0.326**	0.293**	0.349**	0.464**	0.341**	0.223*	0.255**	0.502**	0.371**	0.448**	0.394**	0.397**	0.407**	0.384**	0.413**	0.329**	0.341**	0.363**	0.299**	0.284**	0.292**	0.286**	0.314**	0.208*	0.250**	0.321**	28
BC3	0.264**	-	0.264**	0.307**	0.277**	0.317**	0.405**	0.292**	-	0.450**	0.380**	0.422**	0.396**	0.345**	0.339**	0.348**	0.409**	0.348**	0.359**	0.300**	0.361**	0.322**	0.263**	0.272**	0.275**	0.289**	0.223*	0.312**	26
BC4	0.261**	-	0.180*	0.252**	0.365**	0.307**	0.378**	0.312**	0.266**	0.424**	0.295**	0.406**	0.361**	0.288**	0.416**	0.346**	0.351**	0.345**	0.374**	0.301**	0.380**	0.305**	0.199*	0.233**	0.271**	0.179*	0.204*	0.304**	27
BC5	0.345**	0.182*	0.306**	0.360**	0.392**	0.360**	0.441**	0.374**	0.310**	0.421**	0.305**	0.420**	0.345**	0.335**	0.427**	0.440**	0.413**	0.333**	0.350**	0.368**	0.462**	0.426**	0.272**	0.279**	0.347**	0.254**	0.223*	0.314**	28
BC6	-	-	0.243**	0.289**	0.328**	0.368**	0.310**	0.267**	0.282**	0.335**	0.257**	0.411**	0.387**	0.239**	0.283**	0.375**	0.351**	0.247**	0.249**	0.366**	0.374**	0.320**	-	0.201*	0.253**	-	-	0.206*	23
BC7	0.239**	-	0.264**	0.264**	0.310**	0.406**	0.298**	0.207*	0.196*	0.417**	0.289**	0.380**	0.324**	0.276**	0.259**	0.259**	0.224*	0.312**	0.290**	0.329**	0.325**	0.235**	-	-	0.192*	-	0.255**	0.268**	24

Table 4.11 (Cont'd)

Opportunities \ Challenges	CA1	CA2	CB1	CB2	CB3	CB4	CB5	CB6	CB7	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CD1	CD2	CD3	CD4	CD5	CE1	CE2	CE3	CE4	CE5	CE6	Total Correlation
BC8	0.241**	-*	0.179**	0.249**	0.282**	0.311**	0.199**	0.239**	0.197**	0.383**	0.296**	0.356**	0.303**	0.177**	0.243**	0.314**	0.247**	0.236**	0.192*	0.290**	0.282**	0.237**	-	-	-	-	-	0.181*	22
BC9	0.290**	0.182*	0.214**	0.271**	0.249**	0.328**	0.303**	-	0.210**	0.442**	0.310**	0.331**	0.375**	0.247**	0.275**	0.248**	0.284**	0.298**	0.278**	0.381**	0.356**	0.346**	0.176*	0.175*	0.240**	0.225*	0.196*	0.260**	27
BC10	0.281**	-	0.313**	0.176*	0.342**	0.407**	0.369**	0.240**	0.308**	0.440**	0.276**	0.400**	0.386**	0.345**	0.358**	0.280**	0.284**	0.314**	0.378**	0.418**	0.374**	0.345**	0.229**	0.254**	0.341**	0.216*	0.275**	0.344**	27
BC11	0.381**	0.289**	0.281**	0.374**	0.406**	0.451**	0.424**	0.374**	0.219*	0.442**	0.441**	0.519**	0.426**	0.438**	0.504**	0.224*	0.335**	0.309**	0.457**	0.436**	0.402**	0.404**	0.339**	0.401**	0.423**	0.244**	0.215*	0.306**	28
BC12	0.244**	0.183*	0.291**	0.337**	0.265**	0.399**	0.377**	0.317**	0.213*	0.421**	0.338**	0.423**	0.327**	0.238**	0.286**	0.283**	0.266**	0.294**	0.400**	0.384**	0.388**	0.292**	0.197*	0.184*	0.258**	-	0.210*	0.280**	27
BC13	0.327**	-	-	0.298**	0.310**	0.355**	0.393**	0.271**	0.173*	0.373**	0.370**	0.401**	0.290**	0.336**	0.460**	0.176*	0.341**	0.343**	0.315**	0.417**	0.390**	0.315**	0.273**	0.305**	0.377**	0.234**	0.236**	0.294**	26
BD1	0.538**	0.277**	0.458**	0.343**	0.338**	0.398**	0.401**	0.402**	0.274**	0.471**	0.283**	0.309**	0.290**	0.385**	0.386**	0.279**	0.353**	0.392**	0.319**	0.405**	0.451**	0.385**	0.459**	0.264**	0.386**	-	0.276**	0.422**	27
BD2	0.237**	0.186*	0.275**	0.201*	0.271**	0.350**	0.401**	0.260**	0.229**	0.233**	-	0.217*	0.210*	0.249**	0.235**	0.179*	0.237**	0.203*	0.319**	0.266**	0.263**	0.265**	0.192*	-	0.295**	-	0.282**	0.292**	25
BD3	0.224*	0.179*	0.213*	0.291**	0.352**	0.391**	0.329**	0.233**	0.237**	0.301**	0.224*	0.314**	0.298**	0.238**	0.225*	-	0.260**	-	0.289**	0.287**	0.316**	0.214*	-	-	0.204*	-	-	0.257**	22
BD4	0.347**	0.181*	0.262**	0.219*	0.196*	0.306**	0.381**	0.223*	0.223*	0.345**	0.282**	0.376**	0.368**	0.217*	0.241**	0.224*	0.366**	0.190*	0.335**	0.226*	0.337**	0.293**	0.277**	0.273**	0.239**	-	0.227**	0.318**	27
BD5	0.365**	-	0.247**	0.210*	0.275**	0.331**	0.453**	0.306**	0.180*	0.341**	0.257**	0.374**	0.236**	0.260**	0.312**	0.273**	0.367**	0.279**	0.294**	0.370**	0.372**	0.305**	0.262**	0.247**	0.295**	-	0.304**	0.416**	26
BD6	0.334**	0.247**	0.179*	0.204*	0.281**	0.291**	0.370**	0.237**	0.181*	0.213*	0.236**	0.269**	-	0.184*	0.182*	0.343**	0.421**	-	0.225*	0.346**	0.379**	0.274**	-	0.214*	0.346**	-	0.380**	0.350**	24
BD7	0.438**	0.254**	0.327**	0.241**	0.272**	0.367**	0.446**	0.291**	0.289**	0.405**	0.291**	0.389**	0.286**	0.365**	0.361**	0.265**	0.324**	0.367**	0.328**	0.372**	0.289**	0.289**	0.286**	0.285**	0.357**	-	0.312**	0.412**	27
BE1	0.397**	0.212*	0.338**	0.340**	0.327**	0.423**	0.316**	0.205*	0.186*	0.400**	0.242**	0.402**	0.254**	0.336**	0.361**	0.220*	0.325**	0.300**	0.278**	0.359**	0.352**	0.280**	0.262**	-	0.258**	0.233**	0.178*	0.236**	27
BE2	0.252**	0.262**	0.210*	0.203*	-	0.273**	0.180*	-	-	0.277**	0.197*	0.227**	-	0.237**	0.265**	0.192*	0.261**	-	0.188*	0.339**	0.275**	-	-	-	0.209*	-	-	-	17
BE3	0.198*	0.177*	0.188*	-	0.213*	0.272**	0.250**	0.214*	0.222*	0.252**	0.182*	0.282**	-	0.327**	0.257**	-	0.207*	0.200*	0.250**	0.319**	0.213*	0.188*	-	0.205*	0.221*	-	-	0.218*	22

Table 4.11 (Cont'd)

Opportunities \ Challenges	CA1	CA2	CB1	CB2	CB3	CB4	CB5	CB6	CB7	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CD1	CD2	CD3	CD4	CD5	CE1	CE2	CE3	CE4	CE5	CE6	Total Correlation
BE4	0.270**	-	0.227**	0.272**	0.236**	0.288**	0.286**	0.291**	0.204*	0.246**	0.206*	0.286**	0.194*	0.261**	0.312**	0.289**	0.222*	0.270**	0.238**	0.355**	0.332**	0.330**	0.222*	-	0.274**	0.239**	0.242**	0.256**	26
BE5	0.341**	0.199*	0.240**	0.188*	0.256**	0.353**	0.350**	0.211*	-	0.307**	-	0.288**	0.223*	0.267**	0.291**	0.204*	0.303**	0.239**	0.291**	0.413**	0.355**	0.283**	0.192*	0.233**	0.293**	0.291**	0.212*	0.222*	26
Total Correlation	33	24	32	31	31	34	34	31	29	34	32	34	31	34	34	30	34	30	34	34	34	33	26	21	30	12	24	32	

Note: **. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.6 Mann-Whitney U Test on Current Residential State

Mann-Whitney U test is used to recognise the significant difference on the problems of the existing city, opportunities of implementing SC and challenges of implementing SC between Kuala Lumpur and Selangor. The p-value adopted in this test is 0.05.

4.6.1 Mann-Whitney U Test on Problems of Existing City

Two hypotheses are set for this test as stated:

Null hypothesis (H_0): There is no significant difference across the current residential state (Kuala Lumpur and Selangor) on the problems of the existing city.

Alternative hypothesis (H_1): There is a significant difference across the current residential state (Kuala Lumpur and Selangor) on the problems of the existing city.

Table 4.12: Mann-Whitney U Test of Problems of Existing City across Current Residential State

Code	Problems of Existing City	Mann-Whitney U	Wilcoxon W	Asymp. Sig. (2-tailed)
AA1	Overpopulation	1591.000	3736.000	0.016
AB4	Does not understand what is happening in the city and cannot discover the city's problems accurately	1567.500	3712.500	0.011

Table 4.12 illustrates the result of the Mann-Whitney U test according to the different current residential states on their perspectives on problems of the existing city. Based on the result, two problems of the existing city have significant differences across different current residential states, which are AA1 = "Overpopulation" and AB4 = "Does not understand what is happening in the city and cannot discover the city's problems accurately". These problems have a p-value less than 0.05, which the null hypothesis (H_0) is rejected.

Table 4.13: Mean Rank of Problems of Existing City across Current Residential State

Code	Problems of Existing City	Respondent	N	Mean Rank	Sum of Rank
AA1	Overpopulation	**Kuala Lumpur**	**64**	**72.64**	**4649.00**
		Selangor	65	57.48	3736.00
AB4	Does not understand what is happening in the city and cannot discover the city's problems accurately	**Kuala Lumpur**	**64**	**73.01**	**4672.50**
		Selangor	65	57.12	3712.50

Note: **Bold** indicates the highest mean rank

The construction parties in Kuala Lumpur have a higher mean rank in both problems than the construction parties in Selangor as shown in Table 4.13. The mean rank of the overpopulation problem for the construction parties in Kuala Lumpur is 72.64, while for the construction parties in Selangor is 57.48. It indicated that the problem of overpopulation is more serious in Kuala Lumpur. The population of Malaysia is predicted at 32.7 million in 2021 (Department of Statistics Malaysia Official Portal, 2021a). The highest population composition in 2021 is Selangor, which gains 20.1%. However, Kuala Lumpur has the highest population density compared to other states, with 7,188 people per square kilometre (Department of Statistics Malaysia Official Portal, 2021a). Sanusi, et al. (2017) also pointed out that Kuala Lumpur is experiencing a speedy urbanisation process, especially in infrastructure development.

For the problem of the policymaker does not understand what is happening in the city and cannot discover the city's problems accurately, the mean rank is 73.01 for the respondents in Kuala Lumpur, which is higher than the mean rank of 57.12 for the respondents in Selangor. Most of the authorities were only 'see' the city but not 'read' the city. Another way of saying that the decision-makers just have a view of the city but not understanding what is happening in the city and cannot discover the problems in the city (Rogers, 2018; Malekpour, et al., 2017). As an illustration, Ramakreshnan, et al. (2019) had

conducted a study on the awareness of the policymakers and practitioners on the problem of urban heat island in Kuala Lumpur. The result indicated that the government had a very shallow awareness compared to the practitioners.

4.6.2 Mann-Whitney U Test on Opportunities of Implementing Smart City

Two hypotheses are formulated for this test as stated:

Null hypothesis (H_0): There is no significant difference across the current residential state (Kuala Lumpur and Selangor) on the opportunities of implementing SC.

Alternative hypothesis (H_1): There is a significant difference across the current residential state (Kuala Lumpur and Selangor) on the opportunities of implementing SC.

Table 4.14: Mann-Whitney U Test of Opportunities of Implementing Smart City across Current Residential State

Code	Opportunities of Implementing Smart City	Mann-Whitney U	Wilcoxon W	Asymp. Sig. (2-tailed)
BD1	Expand economic growth	1504.000	3649.000	0.003

Table 4.14 demonstrates the significant difference in the Mann-Whitney U test towards the opinions of the opportunities of implementing SC across different current residential states. The result revealed that there is only one opportunity has an asymptotic significance which less than 0.05. Therefore, the null hypothesis (H_0) is rejected.

Table 4.15: Mean Rank of Opportunities of Implementing Smart City across Current Residential State

Code	Opportunities of Implementing Smart City	Respondent	N	Mean Rank	Sum of Rank
BD1	Expand economic growth	**Kuala Lumpur**	**64**	**74.00**	**4736.00**
		Selangor	65	56.14	3649.00

Note: **Bold** indicates the highest mean rank

Based on Table 4.15, the significant difference between construction practitioners in Kuala Lumpur and Selangor is the opportunity of expanding economic growth. Kirimtat, et al. (2020) highlighted that applying the Smart Economy can achieve this opportunity. The digital economy devoted 18.5% to the national economy in 2018 and e-commerce devoted 8.0% to GDP in the same year (Department of Statistics Malaysia Official Portal, 2019). According to the Department of Statistics Malaysia Official Portal (2020), Selangor was the main contributor to Malaysia's economy, contributing 24.2% GDP in 2019 while Kuala Lumpur contributed 16.4% of GDP in the same time year. However, in terms of GDP per capita, Kuala Lumpur topped the list with RM129,472, higher than Selangor with RM54,995 in 2019. Moreover, Kuala Lumpur also experienced an increased labour force participation rate (Department of Statistics Malaysia Official Portal, 2020). Because of that, Kuala Lumpur may have higher expansion on economic growth than Selangor.

4.6.3 Mann-Whitney U Test on Challenges of Implementing Smart City

Two hypotheses are expressed for this test as stated:

Null hypothesis (H_0): There is no significant difference across the current residential state (Kuala Lumpur and Selangor) on the challenges of implementing SC.

Alternative hypothesis (H_1): There is a significant difference across the current residential state (Kuala Lumpur and Selangor) on the challenges of implementing SC.

Table 4.16: Mann-Whitney U Test of Challenges of Implementing Smart City across Current Residential State

Code	Challenges of Implementing Smart City	Mann-Whitney U	Wilcoxon W	Asymp. Sig. (2-tailed)
CA1	Do not know/ or unsure about the SC developments	1562.500	3707.500	0.007
CB1	Lack of sufficient guidance for the government	1592.500	3737.500	0.013
CD1	Lack of competitiveness between each business	1500.000	3645.000	0.004
CD5	Higher cost in IT training and skills development	1632.000	3777.000	0.022
CE1	Does not align with the SC concept	1454.500	3599.500	0.002
CE6	Poor data availability	1666.000	3811.000	0.036

Table 4.16 presents the results of Mann-Whitney U test of challenges of implementing SC across the current residential states. There are six challenges with a p-value of less than 0.05, which are “Do not know/ or unsure about the SC developments” (CA1), “Lack of sufficient guidance for the government” (CB1), “Lack of competitiveness between each business” (CD1), “Higher cost in IT training and skills development” (CD5), “Does not align with the SC concept” (CE1) and “Poor data availability” (CE6). The null hypothesis (H_0) for these challenges is rejected.

Table 4.17: Mean Rank of Challenges of Implementing Smart City across Current Residential State

Code	Challenges of Implementing Smart City	Respondent	N	Mean Rank	Sum of Rank
CA1	Do not know/ or unsure about the SC developments	**Kuala Lumpur**	**64**	**73.09**	**4677.50**
		Selangor	65	57.04	3707.50
CB1	Lack of sufficient guidance for the government	**Kuala Lumpur**	**64**	**72.62**	**4647.50**
		Selangor	65	57.50	3737.50
CD1	Lack of competitiveness between each business	**Kuala Lumpur**	**64**	**74.06**	**4740.00**
		Selangor	65	56.08	3645.00
CD5	Higher cost in IT training and skills development	**Kuala Lumpur**	**64**	**72.00**	**4608.00**
		Selangor	65	58.11	3777.00
CE1	Does not align with the SC concept	**Kuala Lumpur**	**64**	**74.77**	**4785.50**
		Selangor	65	55.38	3599.50
CE6	Poor data availability	**Kuala Lumpur**	**64**	**71.47**	**4574.00**
		Selangor	65	58.63	3811.00

Note: **Bold** indicates the highest mean rank

Table 4.17 depicts that the construction parties in Kuala Lumpur have a higher mean ranking than the construction parties in Selangor for all these six challenges of implementing SC. The respondents in Kuala Lumpur have a higher mean ranking on the challenges of CA1 = "Do not know/ or unsure about the SC developments" and CB1= "Lack of sufficient guidance for the government". Umdu and Alakavuk (2020) mentioned that if the policymaker does not update the inhabitants, the inhabitants may not know about any developments of the technologies. Kuala Lumpur is one of the global and regional urban hubs and is nominated as one of the pilot cities in the Association

of Southeast Asian Nations (ASEAN) Smart Cities Network (ASCN) (Kong and Woods, 2021). However, The Malaysian Administrative Modernisation and Management Planning Unit (2021) provided the articles about the Smart Selangor but did not provide for the Greatest Kuala Lumpur. As a result, the citizens in Kuala Lumpur might not know or unsure about the SC development. Nevertheless, it is possible that the local authorities may not get sufficient guidance on the emergence of SC and leads to failure to inform the inhabitants about the SC development. For instance, Heaton and Parlikad (2019) revealed that the SC framework was failed to align the existing emergence technique with the construction and maintenance procedure in the cities due to the lack of adequate guidance on the attainment of SC.

In terms of the barriers in the economic aspect, a higher mean ranking was obtained by the construction parties in Kuala Lumpur on CD1 = "Lack of competitiveness between each business" and CD5 = "Higher cost in IT training and skills development". One of the developments of Smart Selangor is the Selangor Advance, which aimed to help Small and Medium Enterprises (SMEs) with the cash flow problems due to the COVID-19 pandemic (Selangor Advance, n.d.). Due to this programme, the competitiveness between each business in Selangor may be higher than in Kuala Lumpur. The higher competitiveness between each business may lead to higher costs in IT training and skills development because the companies want to survive in the market. Nonetheless, it does not tally with the result shown.

Construction practitioners in Kuala Lumpur also have a higher mean ranking in the obstacles in technology aspect, which are CE1 = "Does not align with the SC concept" and CE6 = "Poor data availability". One of the urban challenges in Kuala Lumpur is a high number of solid waste generation and it is one of the focus points in the proposed initiative of the SC framework of Greatest Kuala Lumpur (Ministry of Housing and Local Government, 2018). The Malaysian government had implemented the waste-to-energy (WtE) technology to solve this problem (Yong, et al., 2019). It proved that the current technology aligns with the SC concept which is against the result. Nevertheless, poor data availability will cause the failure of the technologies due to the blockage of the flow of information (Liono, et al., 2019).

4.7 Chapter Summary

There are 135 sets of questionnaires were returned and 6 sets had been rejected as the respondents were not staying in Kuala Lumpur and Selangor. The data obtained were evaluated by adopting four tests which are Cronbach's Alpha Reliability test, Arithmetic Mean test, Spearman's Correlation test and Mann-Whitney U test.

Based on the result of arithmetic mean, the environmental problem was the most severe problem while the economic problem was the less severe problem for the problems of the existing city. In terms of opportunities of implementing SC, technology was highly prioritised by the construction parties but governance was less prioritised. However, technology was less prioritised while social was highly prioritised in the challenges of implementing SC. Additionally, Spearman's Correlation test showed that the most significant correlation in three relationships. Lastly, Mann-Whitney U test demonstrated the significant difference in three objectives across different current residential states.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter is the conclusion of this research. The accomplishment of three objectives is stated. Consequently, the contributions, limitations and recommendations of this research are identified and discussed. Lastly, the summary of the chapter is outlined.

5.2 Accomplishment of Research Objective

Urbanisation has risen rapidly in the past few decades and is expected to upsurge in the future. However, the breakneck pace of urbanisation will lead to several problems of the existing city. To solve these problems, smart city (SC) concept can be adopted. The attainment of SC can bring numerous benefits and opportunities. Nevertheless, there are some challenges of implementing SC in Malaysia. Based on the past studies, many researchers focused on the definition and concept of SC, system and technology of SC and challenges of the development and growth of SC technologies. Nonetheless, most of the study did in foreign countries. Henceforth, there are limited studies focused on the concept of SC in Malaysia and the emergence of the SC concept in Malaysia remains unclear. In addition, the SC concept varies in various countries, which the SC concept used in other countries may not fit to the conditions of Malaysia. Thus, this study aims to uncover the SC implementation in Malaysia. Meanwhile, three objectives were formulated and the accomplishment of the research objectives were discussed in further sections. The summary of the key findings is illustrated in Figure 5.1.

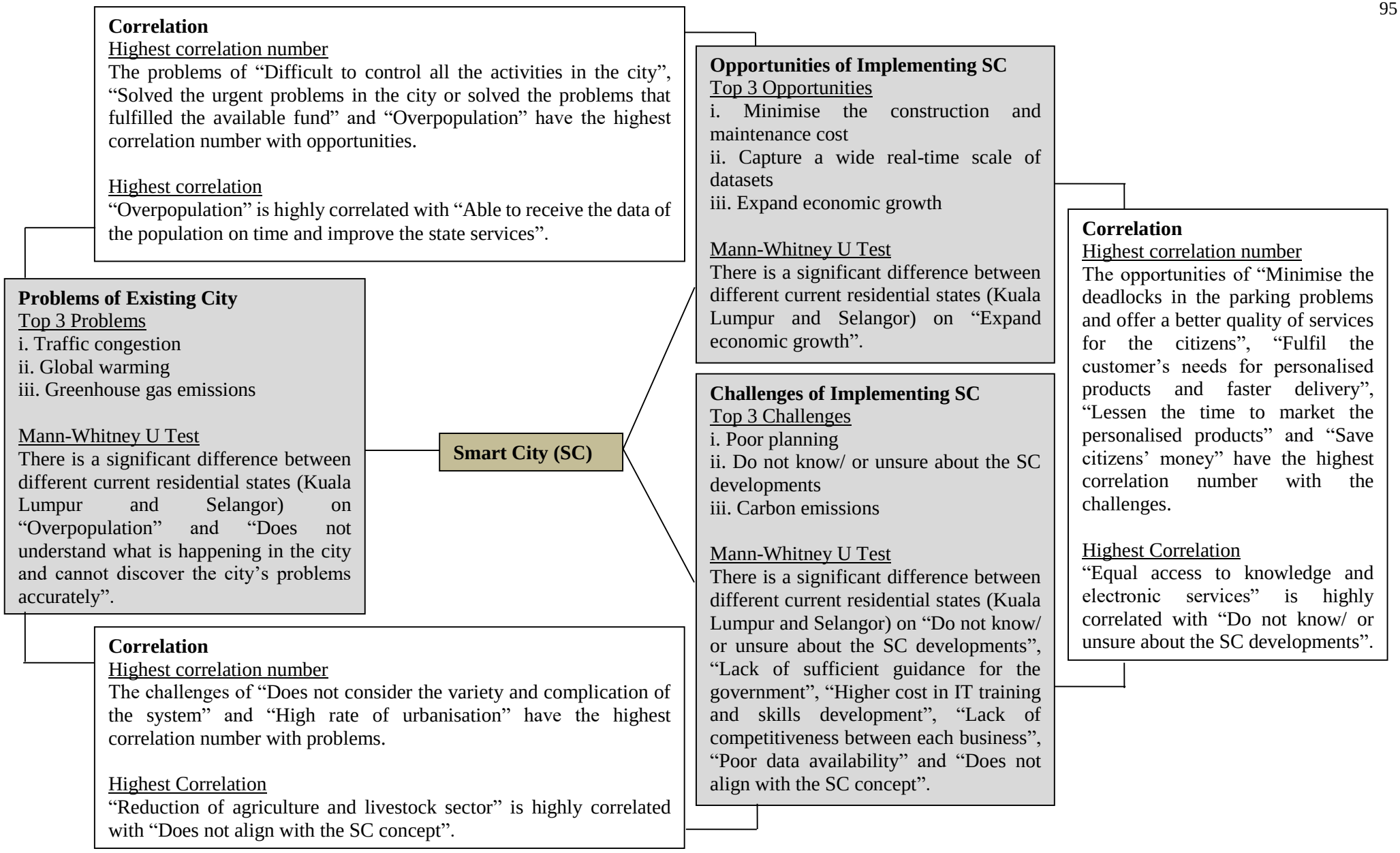

Figure 5.1: Summary of Key Findings

5.2.1 Objective 1: To Investigate the Problems of the Existing City in Malaysia

The first objective of this research was accomplished through distributing the questionnaire and analysing by the Arithmetic Mean test, Spearman's Correlation test and Mann-Whitney U test.

The results of the Arithmetic Mean test were tabulated in Table 4.3 and Table 4.4. The results indicated that the more severe problem was "Environmental" (AC) from the respondents' perspective. "Economic" (AD) was the least serious problem according to the respondents' opinion. The construction practitioners in Kuala Lumpur and Selangor considered that AA5 = "Traffic congestion" under "Social", AC4 = "Global warming" and AC1 = "Greenhouse gas emissions" under category of "Environmental" were the top three problems of the existing city. Conversely, the less serious problem that was less perceived by the construction parties in Kuala Lumpur and Selangor was AD2 = "Reduction of the number of tourists" under "Economic".

Spearman's Correlation test revealed that "Overpopulation" (AA1) was a noteworthy problem no matter in the relationship between problems of the existing city and the opportunities of implementing SC or problems of the existing city and the challenges of implementing SC. Apart from that, "Difficult to control all the activities in the city" (AB1) and "Solved the urgent problems in the city or solved the problems that fulfilled the available fund" (AB5) were the most significant problems correlated with the opportunities of implementing SC. The highest correlation in the relationship between problems of the existing city and the opportunities of implementing SC was "Overpopulation" (AA1) and "Able to receive the data of the population on time and improve the state services" (BB1).

Additionally, the result of Mann-Whitney U test showed that there were two significant differences between different current residential states onto the problems of the existing city, which were AA1 = "Overpopulation" and AB4 = "Does not understand what is happening in the city and cannot discover the city's problems accurately". Interestingly, the respondents in Kuala Lumpur had a higher rank in both problems than respondents in Selangor.

5.2.2 Objective 2: To Identify the Opportunities of Implementing Smart City in Malaysia

The second objective was achieved by using the same method with the first objective. The ranking and means of the opportunities of implementing SC were presented in Table 4.5 and Table 4.6. “Technology” (BE) was the most possible opportunity while “Governance” (BA) was the least possible opportunity based on the respondents’ viewpoint. The top three opportunities were “Minimise the construction and maintenance cost” (BE1) and “Capture a wide real-time scale of datasets” (BE5) under “Technology”, and “Expand economic growth” (BD1) under group of “Economic”. The respondents perceived that the “Deliver the data for the services and the other citizens can get the information through the services” (BA3) under “Social” was the least possible opportunity.

“Minimise the deadlocks in the parking problems and offer a better quality of services for the citizens” (BA5) was a major opportunity in the relationship between problems of the existing city and the opportunities of implementing SC, and opportunities of implementing SC and the challenges of implementing SC. On the other hand, “Fulfil the customer’s needs for personalised products and faster delivery” (BC2), “Lessen the time to market the personalised products” (BC5) and “Save citizens’ money” (BC11) were having significant correlations with the challenges of implementing SC. The highest correlation in the relationship between opportunities of implementing SC and challenges of implementing SC is the “Equal access to knowledge and electronic services” (BA1) and “Do not know/ or unsure about the SC developments” (CA1).

Mann-Whitney U test found that only one opportunity had a significant difference between different current residential states, which was “Expand economic growth” (BD1). The construction parties in Kuala Lumpur were found to have a higher mean rank in this opportunity as compared to construction parties in Selangor.

5.2.3 Objective 3: To Examine the Challenges of Implementing a Smart City in Malaysia

Correspondingly, the same method applied in the first and second objectives was applied in this objective. Table 4.7 and Table 4.8 displayed the results of Arithmetic Mean test. Amusingly, the respondents considered that "Technology" (CE) was the least potential challenge, unlike the result in the second objective. Meanwhile, the most potential challenge was "Social" (CA). The results discovered that CC1 = "Poor planning" from group "Environmental" was the most potential barrier, followed by CA1 = "Do not know/ or unsure about the SC developments" under "Social" and CC7 = "Carbon emissions" under category of "Environmental" based on the respondents' perspective. Conversely, the least potential obstacle also came from "Environmental" which was CC3 = "Population growing too fast".

Spearman's Correlation test found that "Does not consider the variety and complication of the system" (CB4) was a significant challenge no matter in the relationship between problems of the existing city and the challenges of implementing SC or opportunities of implementing SC and the challenges of implementing SC. Another most substantial challenge correlated with the problems of the existing city was "High rate of urbanisation" (CC2). The highest correlation in the relationship between problems of the existing city and the challenges of implementing SC was "Reduction of agriculture and livestock sector" (AD1) and "Does not align with the SC concept" (CE1).

In spite of that, there were six significant differences between different current residential states onto the challenges of implementing SC, which were "Do not know/ or unsure about the SC developments" (CA1), "Lack of sufficient guidance for the government" (CB1), "Lack of competitiveness between each business" (CD1), "Higher cost in Information Technology (IT) training and skills development" (CD5), "Does not align with the SC concept" (CE1) and "Poor data availability" (CE6). Intriguingly, the construction practitioners in Kuala Lumpur had a higher mean rank for all six challenges of implementing SC than construction practitioners in Selangor.

5.3 Research Contributions

This research is expected to benefit the Malaysian government such as Housing and Local Government, Federal Town and Country Planning Department, Malaysian Administrative Modernisation and Management Planning Unit and professional bodies. By referring to this study, the policymaker will have a better understanding on the problems of the existing city which in turn able to formulate more appropriate policies or planning in the cities. Moreover, the opportunities and challenges of implementing SC can be a reference for the local government and professional bodies to implement or improve SC in Malaysia in the future.

Moreover, this study contributes to the non-profit organisation and local government that cares of the environment such as World Wide Fund (WWF) and Ministry of Environment and Water. According to this study, the environmental problem is the most serious issue in Kuala Lumpur and Selangor. Thus, local authorities and non-profit organisation can refer to this study and plan more suitable policies or programmes.

This research also can contribute to the existing literature and future research. As mentioned in Chapter 5.2, there are limited studies focused on SC in Malaysia and the SC concept is varied in different countries. Therefore, the researchers or academicians can use this study as a basic and further improve the SC concept in Malaysia. In addition, other researchers from other countries also can refine the opportunities and challenges of implementing SC after considering the practice, geographical and cultural differences.

5.4 Research Limitations

There are several limitations in this research that are required to be considered. First of all, this research is restricted to Kuala Lumpur and Selangor. The sample size is also considered small, which might be less reliable to represent the whole population in Malaysia. The construction parties in other states may have different viewpoints on the SC concept in Malaysia. Thus, the involvement of the construction parties in other states or a larger sample size might provide a more comprehensive and reliable result. Additionally, the districts in Selangor

had been combined to fulfil the condition of Central Limit Theorem (CLT), which might influence the accuracy of the result.

Furthermore, the data was collected through questionnaire survey and distributed through email and social media such as WhatsApp and LinkedIn. The utilisation of the questionnaire survey limits the scope of the information because there is a lack of comprehensive explanation from the respondents. Besides, the respondents may not comprehend the questions stated in the questionnaire survey. However, the questionnaire survey was distributed through email and social media, which had limited the interaction and chance to clarify the puzzle question. Therefore, the data obtained may be less accurate.

5.5 Research Recommendations

A few recommendations are proposed for future research to overcome the limitations. First, the scope and extent of the study can be widened to obtain a more accurate and reliable result. As an illustration, the construction parties in the other states in Malaysia can be invited to participate in the study to identify the problems of their current residential states, the opportunity and challenges of implementing SC in the areas. In addition, the current residential state can be divided into smaller areas. For instance, the study can focus more on the districts such as Hulu Langat, Hulu Selangor and others rather than the whole Selangor.

Apart from that, it is recommended to apply the mixed method as the data collection method in future research. The mixed method combines the quantitative and qualitative methods, which can obtain the numerical data from the quantitative method and get the in-depth result through the qualitative method. Hence, the advantages of both methods can be obtained through the use of mixed method. To minimise the confusion of the respondents, the pilot test can be used to test the questionnaire survey before the main data distribution. Lastly, to increase the chance to clarify the puzzle question, the questionnaire survey can be distributed by hardcopy rather than softcopy. Henceforth, the respondents can ask immediately if they have any confusion on the questions.

5.6 Summary of Chapter

This chapter had summarised the background of study, research gaps, aim and objectives. All three research objectives had been successfully accomplished. Next, the research contributions were discussed. Last but not least, the research limitations were identified and the recommendations to overcome the limitations were proposed.

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APPENDICES

APPENDIX A: Questionnaire

Dear Sir/Madam,

I am Wong Jo Yee, a final year student from Bachelor of Science (Honours) Quantity Surveying from Lee Kong Chian Faculty of Engineering & Science (LKC FES) at Universiti Tunku Abdul Rahman (UTAR). Currently, I am conducting a survey for my Final Year Project entitled "The Challenges and Opportunities in Developing Smart City: The Construction Practitioners' Perspectives", a partial fulfilment of my Bachelor of Science degree programme in Quantity Surveying. This survey aims to uncover smart city implementation in Malaysia to provide a better living quality among Malaysian citizens.

I believe that your professional experiences will help on this survey. Your participation and opinion in this survey will contribute to this research significantly and add substantial value to the smart city development in Malaysia at the same time.

It would be highly appreciated if you could spend 5 minutes in completing this survey. Your responses will be kept confidential and used solely for academic purposes.

Please do not hesitate to contact me for further information and clarification if you have any inquiries about this survey.

Student name: Wong Jo Yee
Contact number: 012-4405490
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Thank you for your participation and time.

Smart city (SC) is a city that applied information and communication technology (ICT) or digital technology such as Internet of Things (IoT), Artificial Intelligence (AI) and others to supply services and address the issues of the city.

Section A: Demographical Section

Please tick (√) in the appropriate box.

1. What is your gender?
   - □ Male
   - □ Female

2. What is your age group?
   - □ 21 years old and below
   - □ 22-44 years old
   - □ 45-59 years old
   - □ 60 years old and above

3. What is your profession?
   - □ Architect
   - □ Developer
   - □ Engineer
   - □ Main Contractor
   - □ Project Manager
   - □ Quantity Surveyor
   - □ Sub-Contractor
   - □ Supplier
   - □ Other, please specify _____

4. How long have you been working in the construction industry?
   - □ Less than 6 years
   - □ 6-10 years
   - □ 11-15 years
   - □ 16-20 years

- More than 20 years

5. What is your job position in your company?
   - Director
   - Technical Director
   - Contract Manager
   - Contract Executive
   - Assistant Quantity Surveyor
   - Team Leader
   - BIM Coordinator
   - Project Manager
   - Project Executive
   - Other, please specify _____

6. What is your highest educational level?
   - High School
   - Sijil Pelajaran Malaysia (SPM) / GCE O-Level / equivalent
   - Sijil Tinggi Persekolahan Malaysia (STPM) / GCE A-Level / equivalent
   - Foundation
   - Diploma
   - Bachelor's Degree
   - Master's Degree
   - PhD
   - Other, please specify _____

7. Where is your current residential state?
   - Kuala Lumpur
   - Selangor - Gombak
   - Selangor - Hulu Langat
   - Selangor - Hulu Selangor
   - Selangor - Klang

- Selangor - Kuala Langat
- Selangor - Kuala Selangor
- Selangor - Petaling
- Selangor - Sabak Bernam
- Selangor - Sepang
- Other, please specify _____

Section B: Problem of the Existing City

This section contains a list of current city's problems. Referring to your current residential state, rank each of the following questions from scale 1 (Strongly Disagree) to 5 (Strongly Agree) by ticking (√) at the appropriate options about your opinions on the problems of the existing city.

Problem of Existing City	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
Social Problems					
Overpopulation.	□	□	□	□	□
Wage inequality such as the wages of the urban dwellers is higher than the wages of the rural migrants.	□	□	□	□	□
Lack of accommodation for the citizens especially the poor.	□	□	□	□	□
Food insecurity. The citizens especially the poor citizens have the disruption of food consumption due to the lack of money.	□	□	□	□	□
Traffic congestion.	□	□	□	□	□
Health problems such as respiratory and cardiovascular diseases due to the living environment	□	□	□	□	□

may be unregulated, overcrowded and dangerous to live in.					
Lack of educational attainment. For example, the highest level of education of an urban dweller is Bachelor's Degree but the highest level of education of a rural migrant is secondary education.	□	□	□	□	□
Governance Problems					
Government has a difficulty to control all the activities in the city.	□	□	□	□	□
The government has a difficulty to pre-define the direction of the city. For example, the government cannot predict and plan the management of the city due to the circumscribed circumstances.	□	□	□	□	□
The administration's failure in the private and public sectors which results in the	□	□	□	□	□

government only focuses on a specific issue in a city.					
The government in the city does not understand what is happening in the city and cannot discover the city's problems accurately.	□	□	□	□	□
The government solved the urgent problems in the city or solved the problems that fulfilled the available fund which ignored the other problems that are not critical or urgent.	□	□	□	□	□
Environmental Problems					
Greenhouse gas emissions have upsurged significantly.	□	□	□	□	□
Air and water pollution.	□	□	□	□	□
Climate change such as increase of temperature and heavier rainstorms.	□	□	□	□	□
Global warming which is rising in	□	□	□	□	□

average temperatures.					
Flooding in a city.	□	□	□	□	□
Coastal was damaged due to climate change and global warming.	□	□	□	□	□
Melting of the glacier due to rising in the temperature.	□	□	□	□	□
Economic Problems					
The reduction of agriculture and livestock sector. For example, climate change and global warming caused the reduction of the amount of forage and affected the grazing sector.	□	□	□	□	□
The reduction of the number of tourists.	□	□	□	□	□

Section C: Opportunities of Implementing Smart City

This section contains a list of opportunities in implementing a smart city (SC). Referring to your current residential state, rank each of the following questions from scale 1 (Strongly Disagree) to 5 (Strongly Agree) by ticking (√) at the appropriate options about your opinions on opportunities of implementing a SC.

Opportunities of Implementing Smart City	**Strongly Disagree 1**	**Disagree 2**	**Neutral 3**	**Agree 4**	**Strongly Agree 5**
Social					
All citizens have equal access to knowledge and electronic services.	□	□	□	□	□
The citizens can communicate and connect with others easily.	□	□	□	□	□
The citizens can deliver the data for the services and the other citizens can get the information through the services. For example, the application of crowdsourcing weather application allows the citizen in Klang to share the current weather and the other citizens able to know the weather in Klang.	□	□	□	□	□

The adoption of Global Positioning System (GPS) and Geographic Information System (GIS), smart card, call detail record (CDRs) and connected vehicles (CVs) can raise the efficiency and reliability of independent transportation, upsurge mobility and safety and increase the driver's comfort.	□	□	□	□	□
The implementation of Smart Parking can minimise the deadlocks in the parking problems and offer a better quality of services for the citizens by using the sensors embedded in the vehicles and infrastructures.	□	□	□	□	□
Improve the healthcare of the citizens in the cities.	□	□	□	□	□
Governance					

Able to receive the data of the population on time and improve the state services.	□	□	□	□	□
Solve the restrictions of governance of the existing city by integrating communication, leadership, collaboration, partnership and data exchange solutions.	□	□	□	□	□
The government can discover the city's problems easily and implement a better policy or programme to solve the problems of the city.	□	□	□	□	□
Environmental					
Provide a positive outcome to the whole community such as improving the citizens' quality of life, enhancing efficiency in the industrial systems and optimising energy consumption.	□	□	□	□	□

Fulfil the customer's needs for personalised products and faster delivery.	□	□	□	□	□
Reduce the cost of production of the personalised product.	□	□	□	□	□
Make the production of the personalised product flexible.	□	□	□	□	□
Lessen the time to market the personalised products.	□	□	□	□	□
Increase energy efficiency.	□	□	□	□	□
Minimise the impact on the environment.	□	□	□	□	□
Produce greater productivity.	□	□	□	□	□
Reduce energy consumption.	□	□	□	□	□
Improve the quality of life of the citizen due to convenience and controllability.	□	□	□	□	□
Save citizens' money by adopting Smart Home appliances such as smart door,	□	□	□	□	□

smart light and smart Air Conditioning.					
Minimise pollution, waste and carbon emission.	□	□	□	□	□
Enhance health and social by adopting Smart Home appliances such as smart door, smart light and smart Air Conditioning.	□	□	□	□	□
Economic					
Expand economic growth because the e-commerce service can increase the customers' attention to the retailers.	□	□	□	□	□
Improve the agricultural process by adopting technologies, protocols, devices and computational paradigms.	□	□	□	□	□
Save water and improve production by using the smart irrigation management system.	□	□	□	□	□

Increase the growth in the tourism sectors.	□	□	□	□	□
Increase the visitor experience.	□	□	□	□	□
Open up new market possibilities.	□	□	□	□	□
Enhance the governance of tourism intelligently.	□	□	□	□	□
Technology					
Minimise the construction and maintenance cost by adopting Building Information Modeling (BIM).	□	□	□	□	□
Enhance transparency and cooperation among various stakeholders by adopting BIM.	□	□	□	□	□
Manage complex projects and adjust to the changes rapidly by adopting BIM.	□	□	□	□	□
Enhance the daily atmosphere computationally by applied Internet of Things (IoT).	□	□	□	□	□
Capture a wide real-time scale of datasets	□	□	□	□	□

created by sensor-based sensors, cameras, radio-frequency identification (RFID) tags and smartphones via wireless networks.	

Section D: Challenges of Implementing Smart City

This section contains a list of challenges that hindering smart city (SC) implementation. Referring to your current residential state, rank each of the following questions from scale 1 (Strongly Disagree) to 5 (Strongly Agree) by ticking (√) at the appropriate options about your opinions on challenges of implementing SC.

Challenges of Implementing Smart City	**Strongly Disagree 1**	**Disagree 2**	**Neutral 3**	**Agree 4**	**Strongly Agree 5**
Social					
The citizens do not know/ or unsure about the SC developments. For example, the government does not inform the citizens on the development of technologies used for the emergence of SC.	□	□	□	□	□
There is a lack of understanding on SC implementation among the citizens.	□	□	□	□	□
Governance					
There is a lack of sufficient guidance for the government. For example, the state government does not know how to implement the SC	□	□	□	□	□

concept if the federal government does not provide guidance.					
Government unwilling to provide the transparency and leadership needed.	□	□	□	□	□
Government is reluctant to uncover service procedures and related data.	□	□	□	□	□
The technology that policymakers applied does not consider the variety and complication of the system.	□	□	□	□	□
The policies and development plans created by the federal government and state government have overlapping visions.	□	□	□	□	□
There is a lack of understanding on SC among policymakers.	□	□	□	□	□
There is a lack of funding provided by the federal government to the state government.	□	□	□	□	□
Environmental					

Poor planning in formulating a SC.	□	□	□	□	□
Many rural citizens immigrate to the city which result in a high rate of urbanisation and hampering implementation of SC.	□	□	□	□	□
Population growing too fast which makes it difficult to develop a SC.	□	□	□	□	□
The traffic congestion in the city hampering implementation of SC.	□	□	□	□	□
The government is lacking of sustainability consideration when formulating the SC.	□	□	□	□	□
The policymaker unables to formulate a proper waste management.	□	□	□	□	□
All sectors contributing to carbon emissions.	□	□	□	□	□
There is a lack of an ecological perspective on	□	□	□	□	□

behaviour. For example, the government and the stakeholders do not collaborate to solve the water pollution problem due to failure of river basin management.					
Economic					
There is a lack of competitiveness between each business. For example, better technology cannot be created because there is no competition among the sectors.	□	□	□	□	□
There is global economy volatility. The global uncertainty causes global economy volatility, and it will affect the subsidies provided by the government.	□	□	□	□	□
There is a high infrastructure and intelligence deficit. For example, the investment in the	□	□	□	□	□

infrastructure of SC is higher than the revenue gained.					
The operational cost and maintenance cost of the technologies in the SC is costly.	□	□	□	□	□
There is a higher cost in IT training and skills development. As the technologies of SC may be the new things for the companies, hence it requires the investment in IT training and skill development.	□	□	□	□	□
Technology					
The current technology does not align with the SC concept. For example, the Building Information Modeling (BIM) standards applied do not align with the SC standards in Malaysia.	□	□	□	□	□

There are limitations in current technology and data analytics procedures applied to assist data capture, integration and exploitation within the SC framework. For example, the application of Big Data in Malaysia is insufficient to solve the enormous amount of data in Malaysia.	□	□	□	□	□
There is a lack of adoption and poor emergence of the technology.	□	□	□	□	□
The security and privacy of data may not be secured.	□	□	□	□	□
There is a limited skilled workforce in term advance technologies implementation.	□	□	□	□	□
There is poor data availability.	□	□	□	□	□