PLANNING FOR INTEGRATED BUS STOP USING SPACE SYNTAX ANALYSIS

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DEDICATION

This thesis is dedicated to my Ma, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my Abah, who taught me that even the largest task can be accomplished if it is done one step at a time.

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Subhanallah, Alhamdulillah, In the name of Allah, the Most Beneficent, the Most Merciful. All the praises and thanks be to Allah, the Lord of the 'Alamin (mankind, jinns and all that exists). The Most Beneficent, the Most Merciful. The Only Owner of the Day of Recompense (i.e. the Day of Resurrection). You (Alone) we worship, and You (Alone) we ask for help. Guide us to the Straight Way. The Way of those on whom You have bestowed Your Grace, not (the way) of those who earned Your Anger, nor of those who went astray.

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ABSTRACT

A people-centric public transportation system is often ignored due to the lock-in effect of vehicle-oriented development. The system eventually affects pedestrians' accessibility to and from a transit stop and station, as they are the main public transport users. To resolve this issue, this study identified and measured pedestrians' accessibility to determine the location of a bus stop in Pasir Gudang within 3-kilometres (3-km) based on three parameters, which are pedestrian, syntactical and spatial as identified through literature reviews. To analyse the pedestrian parameter, data for pedestrian volume and static activity analysis were collected using gate count method proposed by Space Syntax University College London's (UCL) Laboratory. Next, under the syntactical parameter, axial lines of street network in Pasir Gudang were drawn and analysed using DepthMap's axial segment for the proposed 3-km, 1.2-km, 800-metres (800m) and 400-metres (400m) coverage. From an axial segment analysis, a 400m metric integration is shown to be suitable and appropriate accessibility coverage for pedestrians (significant at 0.05 level) in the study area. Then, based on the spatial parameter, a buffer analysis of 400 metres identified 46 zones within the 3-km studied area. Next, the 46 zones were then spatially analysed based on its mixed land use index and functional front index analysis using a land use map provided by the Pasir Gudang Municipal Council (MPPG). The correlation analysis results between the three parameters showed that 16 of the 46 zones were identified suitable for bus stop planning, which were significant at 0.05 and 0.01 level. The findings also showed that the pedestrian parameter in Pasir Gudang is more highly correlated to the spatial parameter compared to the syntactical parameter. This evidently showed that the pedestrian pattern of Pasir Gudang is more influenced by land use as compared to street integration. Furthermore, the three parameters discussed should be considered in order to find an optimised location for a bus stop, besides designing a better, liveable and successful street for an urban city. Accordingly, the findings of this research is expected to provide an evidence-based design approach to plan and design better transit stops for a people-centric public transportation system in the city.

ABSTRAK

Sistem pengangkutan awam yang mengutamakan orang awam sering diabaikan ekoran daripada kesan *lock-in* pembangunan berorientasikan kenderaan. Sistem ini akhirnya menjejaskan akses pejalan kaki ke dan dari stesen, sedangkan mereka adalah pengguna utama pengangkutan awam. Untuk menyelesaikan masalah ini, kajian ini mengenalpasti dan mengukur kebolehcapaian pejalan kaki untuk menentukan lokasi perhentian bas di Pasir Gudang dalam jarak 3 kilometer (3 km) berdasarkan tiga parameter, iaitu pejalan kaki, sintaksis dan keruangan seperti yang dikenal pasti melalui kajian literatur. Bagi menganalisis parameter pejalan kaki, data bagi jumlah pejalan kaki dan analisis aktiviti statik dikumpulkan menggunakan kaedah *gate count* yang dicadangkan oleh Makmal *Space Syntax University College London* (UCL). Seterusnya, di bawah parameter sintaksis, *axial* rangkaian jalan di Pasir Gudang dilukis dan dianalisis menggunakan perisian segmen *axial DepthMap* terhadap lingkungan jarak 3 km, 1.2 km, 800 meter (800m) dan 400 meter (400m. Dari analisis segmen *axial*, jarak lingkungan 400m didapati sebagai akses yang sesuai dan bertepatan untuk pejalan kaki (signifikan pada tahap 0.05) di kawasan kajian. Kemudian, berdasarkan parameter ruang, analisis penampan 400m mengenalpasti 46 zon di dalam lingkungan kawasan kajian 3 km. Seterusnya, 46 zon tersebut dianalisis secara spasial berdasarkan analisis indeks campuran guna tanah dan indeks fungsi hadapan dengan mengunakan peta guna tanah yang disediakan oleh Majlis Perbandaran Pasir Gudang (MPPG). Hasil daripada analisis korelasi antara ketiga-tiga parameter menunjukkan bahawa 16 zon daripada 46 zon dikenalpasti berpotensi untuk perancangan perhentian bas, dengan signifikan pada tahap 0.05 dan 0.01. Penemuan juga menunjukkan bahawa parameter pejalan kaki di Pasir Gudang sangat berkorelasi dengan parameter keruangan berbanding dengan parameter sintaksis. Ini jelas menunjukkan corak pejalan kaki di Pasir Gudang lebih dipengaruhi oleh guna tanah berbanding dengan integrasi jalan. Selain itu, ketiga-tiga parameter yang dibincangkan perlu dipertimbangkan apabila mencari lokasi yang optimum untuk perhentian bas, selain daripada semasa merancang jalan yang lebih baik, *livable* dan berjaya di bandar-bandar. Oleh itu, penemuan kajian ini dijangka menyediakan pendekatan reka bentuk berasaskan bukti untuk merancang dan merekabentuk perhentian transit yang lebih baik yang bergantung kepada sistem pengangkutan awam yang mengutamakan rakyat di bandar.

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LIST OF ABBREVIATION

COP	Conference of Parties
CDPii	Comprehensive Development Plan Iskandar Malaysia
DOSM	Department of Statistic Malaysia
ETP	Economic Transformation Program
GDP	Gross Domestic Product
GHG	Greenhouse gases
GTP	Government Transformation Program
IM-LCSBP 2025	Low Carbon Society Blueprint for Iskandar Malaysia 2025
IRDA	Iskandar Regional Development Authority
MPPG	Pasir Gudang Municipal Council
NCC	National Climate Change
NACTO	National Association of City Transportation Officials
OECD	Organisation for Economic Co-operation and Development
SDGs	Sustainable Development Goals
TOD	Transit Oriented Development
UNFCCC	United Nations Framework Convention on Climate Change
UN-DESA	United Nations Department of Economic and Social Affairs
WCED	World Commission on Environment and Development

LIST OF SYMBOLS

CO_2	-	Carbon dioxide
km	-	Kilometre
km^2	-	Square kilometre
m	-	Metre
tCO_2e	-	tonne carbon dioxide equivalent

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CHAPTER 1

INTRODUCTION

1.1 Research Background and Study

Sustainable development is a multi-disciplinary field that focuses on the three key elements which are economy, society, and the environment (Brundtland, 1987). "Sustainable developments is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 'WCED', 1987) that contains two key concepts; of "needs" in particular the essential needs of the world's poor to which overriding priority should be given and, the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs (Brundtland, 1987) (refer to Figure 1.1).

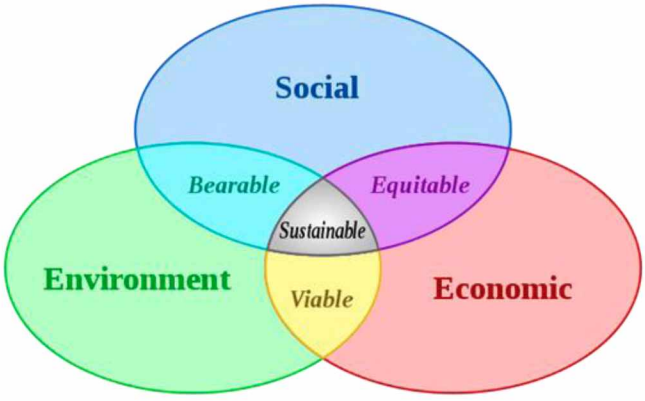

Figure 1.1 Component of Sustainable Development
(Source: Brundtland, 1987)

Sustainable development is also later translated into built environment into various city development plan nowadays. The characteristic of sustainable city embodied following an aspect of the affordable house, compact city, mixed-use

development, green industry, safe city, urban agriculture, cultural and identity, public information and education, climate resilient, cultural and identity, green building and renewable energy (Roberts et al., 2014). Climate change has been seen as the most significant challenge to sustainable development. While emissions from other sectors are generally falling, those from transport have continued to increase a past year and eventually in the future. It is reported the transport sector itself responsible for 22% of energy-related greenhouse gas (GHG) emissions worldwide, and its emission rapidly increases compared to other sectors (Lefevre et al., 2014).

Malaysia Government was also taking part in this sustainable development when our prime minister pledged that Malaysia would participate to reduce 40% carbon emission by 2025. Overall, Malaysia became a Non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC) when it consented the UNFCCC in 1994 and the Kyoto Protocol in 2002. During the 15th United Nations Framework Convention on Climate Change (COP15) held in Copenhagen on 2009, the Malaysian government has announced its commitment to reduce the country's carbon dioxide emission intensity to the GDP by 45% per GDP per capita by 2030, as compared to 2005 levels - conditional upon transfer of technology and finance from developed nations.

Moreover, the bus service has been the most feasible and affordable mode of transport. It is also the most convenient mode of transport given the massive investment in Malaysia transportation planning is on the road infrastructure. Besides, the bus has the smaller carbon footprints that could accommodate up to 30 and 40 people per boarding, even though it still uses petrol, compared to the 20 private vehicles on the road using the same petrol — furthermore, an increase in the use of public transport results in less pollution and better air quality. Using the bus helps to cut congestion which is a severe constraint on growth and costly to the economy. However, bus service system in Malaysia still suffered from inefficiency services in term of giving convenient and seamless journeys toward the customer.

Transit station and stops are one of the elements of transit planning. Good transit systems are transit stop and station that offer safe and convenient connections

for the public to other local destination. It is reported that the convenient location of transit station that has better coverage and accessibility for pedestrian would reduce people reliability to use the private vehicle and to switch to use public transport, especially during peak hour. Transit station or stops is regarded as one of the pedestrian facilities is an essential element to support Transit-Oriented Development (TOD), hence reducing traffic congestion. Transit stop and stations also serve as essential part of transit service thus it is essential to consider these facilities from the rider. It also serves as a node to bring people into the area and to become one of the focal points in a community.

However, people particularly pedestrian suffered in term of access and safety ever since the introduction of the automotive industry in the early 1860s. The expansion of this industry allowed for the planning paradigm to change dramatically over the decades from the people-centric to vehicle oriented. The vehicle oriented planning allowed most of the transportation investment focused on building vehicle facilities for the instance parking lot, expansion of the road, instead of focusing on non-motorised modes. Consequently, the physical design of the cities particularly streets layout tends to favour mobility over accessibility while neglecting pedestrian priorities. This, in fact, restricts walking activities and led people to be dependent toward private vehicles. Most of the traffic congested cities in the world has suffered from this vehicle oriented physical environment. Promoting and providing multimodal transportation will increase the quality of urban area where walking is prioritised, and pedestrian activities are encouraged. The increase in human movement can be seen as a positive effect on the cities. Most of the livable cities in the world have high pedestrian volume and movement in their cities.

There have been various studies on how urban spatial configuration has a positive impact on the human movement in cities. Understanding human movement behaviour is essential to promoting sustainable transportation, creating a better walking quality space and sustaining the economic and social benefits of development in the cities. There have been various models related to how to quantify pedestrian in cities. Space syntax methodology proposed by Bill Hillier (1993) can capture in understanding and predict human movement in the city. The methodology can predict

pedestrian movement over 75% that is caused by the urban street configuration. The fundamental concept of space syntax methodology explains how the movement of pedestrian and vehicular in an urban area are the result of people's cognitive topological-visual analysis (Hillier et al., 2007; Jiang 2009a). Besides, the component of the space syntax methodology allows researchers to quantify the integration (the level of interconnected) of a particular street to the rest of the streets network within cities.

Overall, climate change resilient growth strategies create a low carbon, livable and vibrant cities. One of the climate change strategies is by developing a people-centric public transportation system. People-centric public transportation offers a great benefit to the public particularly to the impoverished community that often suffered from the vicious cycle of lock-in effect of land and transport development. Appropriate with the national aspiration to develop a people-centric public transportation system it is essential that every Malaysia cities to the pursuit and fulfil the goal. Besides, these people-centric public transportation system could be one of the measures in reducing Malaysia's GHG emission reduction of 45% by 2030. TOD which is one of the climate change strategies prioritised accessibility-based paradigm of pedestrianisation activity. The fundamental concept of TOD focus on accessibility of pedestrian to and from the transit stops and stations and adjacent land uses.

Accessibility of the pedestrian can be measured using the pedestrian model. There has been a various pedestrian model developed over decades. The pedestrian model centred on investigating human movement pattern. The human movement analysis is proven to be one of the powerful tools in measuring the quality of cities specifically transit stop and station. Space syntax methodology concept suggested that the result of the human movement is through their cognitive perception toward space. People tend to use a route which seems closer, fewer obstacles (convenient) and interesting. Various studies have shown that space syntax methodology can provide a platform where the relationship between human movement and the urban street network can be investigated. Therefore, the centre of this research aims to develop a people-centric public transportation system by measuring human movement to plan for the suitable bus stop in Pasir Gudang.

1.2 Problem Statement

Even though there has been much emphasis on socially, economically and environmentally benefit of TOD, people often disregard its function due to the lack of understanding the technical details of TOD, hence failing on the public transportation modal share. Most of the public transportation user often suffered frustration on the poor services and ticket system, speed and punctuality, inconvenient in term of stop and station as well as safety concern particularly toward bus services. This whole perception has created an image where using the bus services is not convenient and preferable, inefficient and time-consuming. Albeit bus service is one of the major public transportation in Malaysia context, this mode of transport still suffers many challenges especially in term of the long waiting time, no declared time schedules for passengers and accessibility to the stops and station. Moreover, most of the public transportation system does not expand outside of the large urban areas. Recommendations to improve the service quality of public bus service is currently demanding, given with the current policy on the national public transportation toward people-centric.

Malaysia had reported an increase of three folds of private vehicles registration that over the past 20 years from 4.7 million (1990) to 18.6 million (2010) (SPAD, 2013). This scenario depicted the failing of public transport modal share in urban areas, mainly where mobility demands are intense which often lead to congestion. Travel vehicle demand is expected grew from 13 million trips per day in 1991 to 40 million in 2010 (SPAD, 2013). Projections point towards this trend continuing in Malaysia, with the figure expected to reach a staggering 133 million in 2030 (SPAD, 2013). With urbanisation expected to reach 75 % by 2020 (SPAD, 2016) there is a need to enable an efficient and smooth flow of people, which in turn also enables the growth of new urban areas through increased connectivity.

New urbanism practices are considered climate change measures as well as energy efficient planning (Litman, 2014). The main features of the new urbanism concept are its ability to maximise people connectivity, accessibility and reduced

private vehicles usage. One of the commonly well-known new urbanism practices is TOD. Its unique features centred around the development of a transit stop or station as a focal point of the development or neighbourhood where the distribution of residential, commercial and employment centres are within pedestrian scale distances. This design eventually improves the connectivity and accessibility of people to the transit services, and its adjacent land uses thus encourage and improve transit ridership (John et al., 2009). The demand for TOD neighbourhood is seen growing recently in many cars oriented development particularly in American cities (Renne et al., 2013).

Lately, most of the TOD studies consisted and focused on the public willingness and support to used alternative modes such as public transport system and walking in order to enhance public ridership. However, creating an attractive walking condition which is one of the basic active modes of transport and catalyst for TOD development is seen as the primary challenge in most of the TOD cities. TOD concept majorly emphasised on increase land use intensity within the specific ideal distance to transit services so that the people can be drawn to the area, however, its often overlooked the people movement mainly on accessibility from and to transit station which is seen only consider land use element. This eventually affects people to walk and use public transport willingly. For example, people are not willing to walk to stop or station that does not have direct access to the transit services even though the concentration of the land uses surrounding of the transit station is high.

It can be said that the current TOD development particularly in Malaysia is often neglecting the first and last mile connectivity of people to move around therefore create a non-friendly walking environment. Current local studies often empirical and considers only urban design concepts in TOD. All in all, there has been lacking empirically on how to incorporate the walking environment into the development of TOD as well as on how to operate them to fulfil the main goal of TOD (Li et al., 2014; Ozbil, 2009). As a result, these lead to vehicles oriented environment to dominate the TOD development (public transport environment).

Consequently, the choice of location public transport systems is biased toward the vehicle oriented environment which resulted in too many development issues for

example designing of the transit station and stop that does not integrate with the surrounding area and responsive to the pedestrian accessibility. Therefore, a study that investigates the pattern of people around the TOD development in order to demonstrate a sense of identity within the urban should be encouraged to change people's urban perspective toward using to public transport. Accordingly, this vehicle oriented practises can be changed and shifted toward public transport which is a people-centric development to stimulate positive people-urban interaction (Li et al., 2014). Thus, TOD development that caters to walking environment, should be studied in the search for optimal location wise for public transit station or stop to build a better living environment that fulfilling social, economy and environment as well as encourage efficient land uses.

Meanwhile, transit services for example bus systems should be able to realise and provide multimodal transportation by serving a variety of access needs and a limitless range of locations throughout the area. Even though bus service is one of the major public transportation in particularly in Asian cities, this mode of transport still suffers many challenges particularly in term of accessibility to the stops and station (refer to Figure 1.2). Recommendations to improve the service quality of public bus service is currently demanding, given with the current policy on the national public transportation toward people-centric particularly toward connecting first and last mile journey for transit user which mostly consist of pedestrian (SPAD, 2016). The pedestrian movement pattern is considered an essential element of transit planning (Daamen et al., 2005). Often, the behaviour of a transit user is significantly correlated by providing a convenient pedestrian environment (Guo et al., 2008) particularly in giving accessibility to and from transit stations and stops.

However, given on the current location of the transit station and services particularly bus stations and stops, there have been various issues arise. A problem such as most of the transit station and stops are neglected and their entity does not interact and engage with the surrounding. Poor placement of transit stations and stops allow for such problem to happen and lead to a negative domino effect of using transit services particularly safety reason especially toward women and children as well as reduced transit ridership. Optimal location of the transit station and stop should be

placed within transportation capacity of city network in this case road network which serves as transport infrastructure to support economic and/or residential activity (Bruun, 2014). Besides, transit stop and station planning method and guidelines insufficiently address particularly within the most Asian cities context particularly toward Malaysia cities (Japheth, 2012). Thus, intensive research on the transit station and stop planning should be broadly encouraged to fulfil both national aspirations of the people-centric public transportation system (SPAD, 2016).

Figure 1.2 Design of transit station/stop that does not integrate with the surrounding area and responsive to the pedestrian accessibility

Besides, being one of the Malaysia economic regions and its strategic location nearby to Singapore, Iskandar Malaysia has experienced an increased demand for the transportation sector due to rapid economic growth that brought an increase in population. Iskandar Malaysia currently recorded public modal split of 15: 85 in 2010. The percentage of the public modal split is expected to reduce up to 10% by 2025 business as usual scenario if there was no improvement regard on this issue. It is reported that GHG emission from the transportation sector in Iskandar Malaysia is expected to increase from 15% (2010) to 27% (2025) (Ho CS et al., 2013). The four (4) major transportation corridors in Iskandar Malaysia often suffered traffic congestion, particularly during peak hours.

These important routes connected to Iskandar Malaysia's main flagships that consist of most and important primary economic activities to the region. Hence this

route serves as the central platform for the daily commute. The four (4) major transportation corridors which are identified are (a) Skudai-Johor Bahru, (b) Johor Bahru – Pasir Gudang (c) Johor Bahru Ulu Tiram (d) Johor Bahru – Nusajaya. The Johor Bahru - Pasir Gudang corridor notably which is recorded to have the highest private vehicles volume travel daily even though it has the greatest bus operation. Therefore, the study on the implementation of the non-motorised planning within this corridor should be conducted in order to encourage transit ridership in this case using bus services- hopefully being one of the measures to reduce traffic congestion.

Space syntax methodology is one of the effective methods to determine the effective location of certain facilities related to movement within public urban space. Bertonlini and Spit (1998) stated that the transit station should be located in a "significant place" in an urban network. Some of the urban areas have high people movement, therefore, this characteristic should be considered in order to determine the best location for the transit station and stop. These potential areas can be used to influence people's natural movement and attract walking activities to happen. According to space syntax theory, the degree of street integration has influence spatial accessibility of an urban area (Hillier, 2007b) therefore attracting movement to exist. Thus, it shows that high integrated streets likely have the potential to develop transit stations and stops that could capture this movement pattern. Lacking accessibility of transit stations and stops have respectively negative impacts on safety and liveability of station areas; and subsequently, the public transport ridership is expected to continue to decline.

In addition, space syntax methodology also has the ability to investigate relationships between spatial layout and a range of social, economic and environmental context which is significantly important for urban planning study. These contexts include patterns of movement, awareness and interaction of people; land use density, land use mix and land value; urban growth and societal differentiation; safety and crime distribution (Charalambous et al., 2012). Besides, various research using the space syntax approach has shown how: movement patterns and flows in cities are powerfully shaped by the street network; this in return shapes the evolution of the centres and sub-centres that affects the movement of people in the city; accessibility is

affected by spatial design; spatial segregation and social disadvantage are related in cities (Hillier et al., 1987; Hillier, 2009). This evidence shows that space syntax has the ability to measure spatial accessibility through analysing the movement network of the city (Law et al., 2013).

Compares to other methodology, space syntax methodology offer solution in terms of (Charalambous et al., 2012);

a) Constraints and opportunities of urban areas with regard to the street network and how it can attract or deter pedestrian movement so that land use strategy is better aligned to the pedestrian movement opportunities;

b) Offer insights on how the area can be optimised in its context regarding its commercial viability, the potential for retail, the design of sustainable development and the creation of vibrant and lively urban spaces;

c) Offers the possibility to test different strategic guidelines and design proposals

Therefore it can be summarised that space syntax analysis is expected to fulfil sustainable transport policy under new urbanism practices (TOD) and pedestrian aspect in determining a suitable location for public transit station or stop using road network system of cities. The contiguous road network system can be studied mathematically using graph method due to its ability to perform analysis on particular road selection and its relationship with others road within the system (Hillier et al., 1993). Its unique features have shown how spatial layout powerfully shapes movement patterns, patterns of security and insecurity are affected by spatial design, and this relation shapes the evolution of the centres and sub-centres that makes cities liveable (Hillier, 2009) to find the optimal spot for a transit station and stop within the cities. Henceforth, this study aims to use space syntax analysis as one of the spatial methods to predict the suitable location for transit stops and station using pedestrian movement pattern. Figure 1.3 shows the formulation of the problem statement for this research.

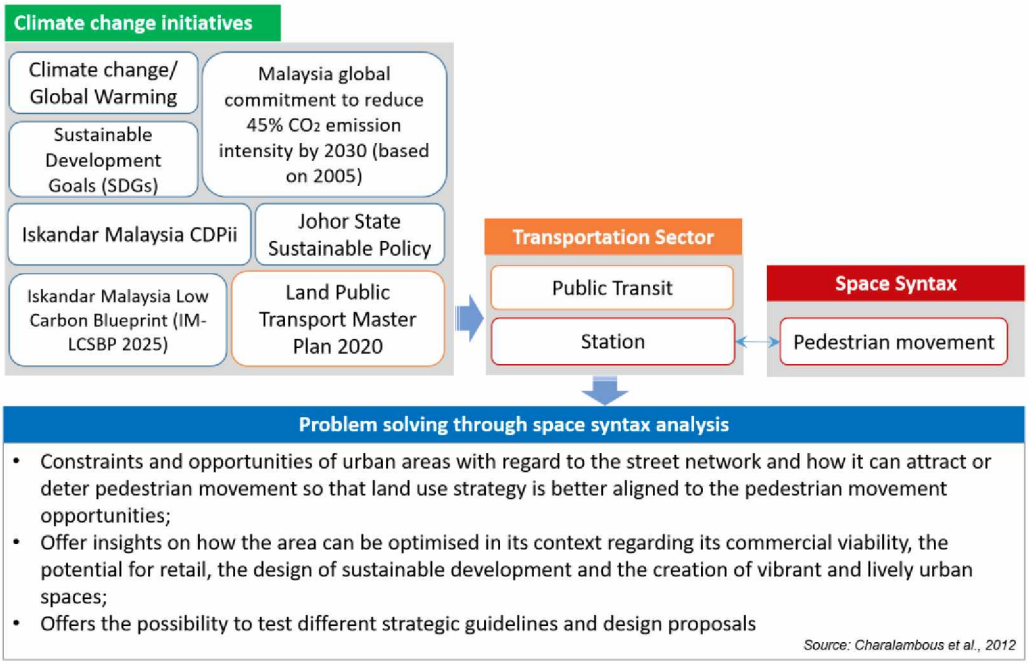

Figure 1.3 Formulation of the problem statement

1.3 Research Aim

Thus, in response to that problem statement this study aims to "Plan for Integrated Bus Stop for Pedestrian using Space Syntax Analysis" Thus strategy to developing a people-centric public transportation system is explored in this research. This component explained further in Chapter 2.

1.4 Research Objectives

To achieve the stated research aim, the following objectives are formulated:

a) To identify the pedestrian volume, axial segment property (integration), type of land uses (functional front and mixed land use index) and distribution of static activities in the studied zones

b) To correlate pedestrian volume with the axial segment property (integration), type of land use (functional front and mixed land use index) and distribution of static activities in the studied zones

c) To suggest the suitable/potential location of bus stops based on the correlation analysis result of axial segment property (integration), type of land use (functional front and mixed land use index) and distribution of static activities with pedestrian volume in the studied zones

1.5 Research Questions

The scope of this research is summarised based on the following discussion. Based on the above background scenario, three (3) research question is then tabulated to identify possible question raised while conducting the research.

a) What is pedestrian volume, axial segment property (integration), type of land uses (functional front and mixed land use index) and static activities distribution in the studied zones?

b) What is the relationship between the pedestrian volume with axial segment property (integration), type of land use (functional front and mixed land use index) and distribution of static activities in the studied zones?

c) Where is the suitable/potential location of bus stops based on the correlation analysis result between axial segment property (integration), type of land use (functional front and mixed land use index) and distribution of static activities with pedestrian volume in the studied zones?

1.6 Research Limitation

This study is limited to the area of Pasir Gudang. Pasir Gudang is selected due to its character as well as it is one of five (5) municipality regions in the Iskandar Malaysia. Pasir Gudang is also a crucial manufacturing hub as well as the location of a dense neighbourhood area. Moreover, this study only considers three (3) kilometres radius of Pasir Gudang as the study area. Apart from that, this research focuses only on defining the service coverage area of a transit service, which is the area within walking distance of a transit stop; does not include measuring the whole bus services system for examples the route network and ridership.

1.7 Thesis Structure

This thesis is a structure in five (5) stages, and each stage translates into Chapter 1, 2, 3, 4 and 5. Figure 1.4 shows the detailed framework of the thesis structure.

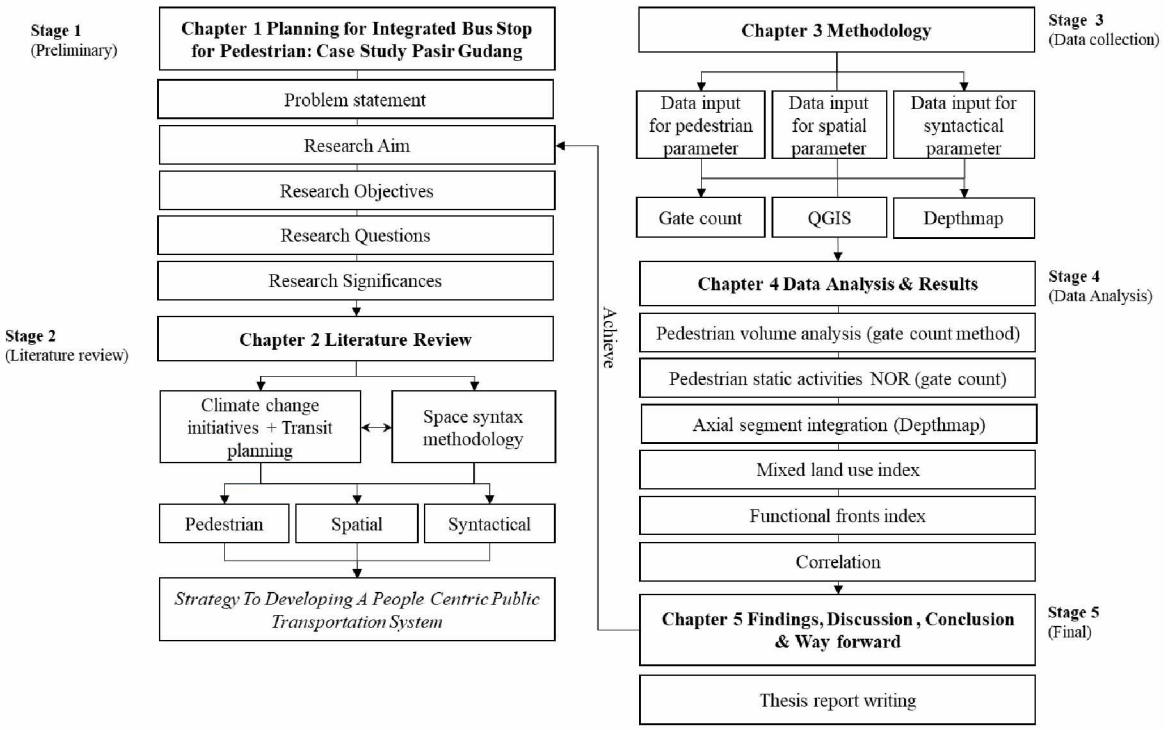

Figure 1.4 Thesis structure and framework

Chapter 1: Introduction

This chapter introduces the background and issues that need to address and initiate bus stop facilities planning in Pasir Gudang using space syntax analysis. The content such as research aim, objectives, research question and scope of this chapter defined in here.

Chapter 2: Strategy for Developing a People-Centric Public Transportation System

This chapter reviews on the climate change initiatives, the concept of urban planning as well as transit planning and transit stop and focus on the three parameters identified that promoted accessibility of people to and from transit station/stop (syntactical parameter, pedestrian parameter and spatial parameter) to set a model for the discussion on strategy to plan for integrated bus stop using space syntax analysis. This chapter also highlights the significant on the transit stop to urban planning by drawing links to sustainable development. Furthermore, a theoretical framework to develop a suitable methodology to achieve the research aim of this research is proposed.

Chapter 3: Research Methodology

This chapter discussed the significant data collection (data input) and analysis required to achieve the goal of this research. Furthermore, this chapter explained on rationales of the technique and instrument adopted to plan for an integrated transit stop in Pasir Gudang. A theoretical methodology framework to guide the research is proposed in this chapter.

Chapter 4: Data Analysis and Result

This chapter begins with a background of Pasir Gudang, and the result of analysis of data collection based on the methodology proposed in chapter three (3) are

shown and analysed. Then, a series of investigation of the relationship between the three parameters introduced which are syntactical, spatial and pedestrian. These parameters analysis and result are then explained further.

Chapter 5: Discussion and Conclusion

This chapter summarised on the finding from the theoretical review of Chapter two and methodology research of Chapter three. This chapter then discussed the findings and concluded on the spatial proposal to plan for integrated transit stops thus to enhance transit planning in Pasir Gudang and recommends possible future research directions in the topic.

1.8 Research Significance

The purpose of this study is to address people-based planning in TOD. People-centric planning is one of the strategies identified to reduce GHG emission from the highest emitter sector (transportation) through integrating land use and transport planning. Incorporating land use and transportation approaches, for example, TOD will encourage better connectivity and accessibility of people from and to the station with surrounding land uses. The station should be seen as another essential platform that bringing people in that could liven the area, particularly in Malaysia cities. By integrating land use and transport planning approaches for examples not only can socially benefit. However, the investment and demand for public transportation continue to increase over the years. Comprehensive and thorough planning of the public transport station elevated transit services quality thus improve the ridership.

In line with Malaysia's effort to achieve the target of 40% public transport modal share by 2030 in urban areas, this research hopefully supports the aspiration, particularly in the Iskandar Malaysia economic region. The 40% target can be achieved by focusing on the primary user of public transportation, people. People-centric public transportation can be studied by observing human movement in an urban area. Being

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