School of Built Environment

To what extent can a future public transport system be designed to cater for private travel preferences?

- The role of individuals' attitude in two suburban neighbourhoods - Kangjian, Shanghai and Bull Creek, Perth

Shaoli Wang

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number #.... “HR64/2009” and “RD_37_14”.....

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Abstract

Public Transport has received renewed attention as a sustainable and environmentally sensitive alternative to car travel. Developed countries like Australia seek to move away from car reliance by developing public transport as an alternative mode of travel; developing countries like China seek to avoid increasing car use. A substantial body of literature on transport and land use planning strategies support and promote public transport use. However the outcome for travel behaviour change is still uncertain. Concerning public transport service effectiveness, both the provider side and the passenger side are important, since inefficiency is caused by the interaction of both sides. The overall interests of this PhD research are: from provider side, looking at how public transport is planned; from the passenger side, looking at what the individual attitudes to public transport are relative to other transport modes.

To draw a research from a world perspective this thesis examines residents attitudes in two suburban neighbourhoods located in Perth, Australia and Shanghai, China as case study cities. At the city level, it has been demonstrated that both Perth and Shanghai are predominantly monocentric urban structures. Also the public transport planning in both cities likely downplays the importance of a user focus in public transport planning. Residents will not see public transport as favouring their needs. Similar underlying urban structures and planning approaches have made public transport solutions particularly challenging in both cities. By controlling for the external urban structure and public transport accessibility variables this research uses household travel survey (secondary data) to look at the internal socio-economic and demographic factors impacting travel behaviour; and uses an attitudinal questionnaire survey (primary data) to examine travellers' travel attitude and preference. Content analysis and in-depth interview methods are applied to look at how public transport is planned and the policy directions.

By understanding the dimensions from provider as well as passenger, and the relationship between them in two different contexts, this research establishes the missing dimension of individual preference in the planning process in both cases. Both cities focus on continually increasing the service quality in terms of reliable service, coordinated network, efficient

schedule and minimum cost focused on technological solutions. From the planners' perspective to compete with the car a high frequency and large coverage network will favour every passenger's need. This is true for high public transport usage places like Chinese cities. However, for car dominated places like Australian cities, as the current demand for public transport is still quite limited, a high efficient and complete public transport network is not high up on the agenda for the provider at this stage. There is a need to more clearly understand the individual travellers' needs and add this step into the planning process in more goal-directed steps. This research offers new knowledge on public transport planning and also demonstrates that individual transport preference should be considered via public transport planning. The extent to which public transport policy aspirations can align with the attitudes and needs of residents in practice remains a significant challenge. This thesis provides policy suggestions for integrating a preference shaping process into public transport planning, and outlines the possible difficulties of each stage.

Acknowledgement

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Most importantly, none of this would have been possible without the love and patience of my family. My husband Honglei, my two lovely kids Daniel and Kelly whom this thesis is dedicated to, have been a constant source of love, concern, support and strength all these years. I would like to express my heart-felt gratitude to my mum, dad and sisters, for whom I warmly appreciate the generosity and understanding.

Chapter 1: Introduction and Background

This PhD research examines the importance of individual factors that influence travel behaviour, such as attitudes and preferences. In current transport planning practices, these individual factors are seldom integrated into planning policy. This research identifies this gap and explores the barriers that have contributed to it. This introductory chapter presents the motivation for this research.

1.1 Problems caused by wide use of cars

Nowadays, the private car has brought unprecedented levels of mobility and freedom to individuals. While we benefit from car use, there are negative effects of this mode of transport.

1.1.1 Environmental problems

The environment impact of the transport sector is of increasing concern. Environmental problems caused by the use of transport are mostly associated with the fuel crisis (shortage of non-renewable fuels), climate change (from man-made emissions), waste and air pollution (Table 1.1) (Banister 2000). Most road vehicles run on oil-based fuels. According to the Inter-governmental Panel on Climate Change (IPCC) (2007), three-quarters of transport energy is consumed by road vehicles, and this continues to grow. Also, car emissions contribute greatly to urban air pollution and global warming. Globally, greenhouse gas emissions from the transport sector have more than doubled since 1970, and around 80% of this increase is estimated to have come from road vehicles (IPCC 2014).

Table 1.1: Main environmental problems from transport

Transport caused problems	Environmental problems
Fuel crisis • Large amounts of oil-based resources used for transport • The material used to build a car • Infrastructure construction materials	Shortage of energy

Transport caused problems	Environmental problems
Climate change • Emissions of CO2 and other gases causing global warming	The global atmospheric change Habitat fragmentation Changes to water systems from infrastructure ……
Pollution • Waste: vehicles, fluids, construction materials • Emission of CO, PM, lead • Noise	Impact on water systems Air and noise pollution Concern about impacts on human health ……

Adapted from Banister (2000)

1.1.2 Social inequity

With the increasing use of the car, our social nature and lifestyle patterns have also changed (Hiscock et al. 2002). Where the car is widely used, most of the facilities related to our daily life, such as work places, shops and recreational facilities have relocated to suit car users. Societies also experience urban transport problems such as traffic congestion, traffic crashes, and dissatisfaction among public transport users who travel on crowded or unreliable services and experience long waiting times. Those who are without access to cars become more disadvantaged and socially isolated (Dodson, Gleeson and Sipe 2004).

1.1.3 Unsustainable land use patterns and travel behaviour

It has long been recognised by researchers (Banister, Watson and Wood 1997; Bayliss 1998; Straatemeier and Bertolini 2008) that the current dominant urban land use trends, described as sprawling, low-density, suburban developments, are not sustainable or desirable. This spread is largely driven by unbounded use of the private car and the travel behaviour associated with car travel (Banister 1997; Newman and Kenworthy 1999). The dominance of car use for almost all journeys leads to the reduction of physical activity such as walking and cycling, which also brings health problems (Gardner and Abraham 2007).

1.2 Public transport: a more sustainable transport mode

The problems caused by extensive car use have captured researchers' attention since the early 1960s (Buchanan 1963). The solution is either to continually find ways to accommodate car use to meet the demand for car travel, or find substitutes to reduce car use. Researchers such as Newman and Kenworthy (1999) argue that reducing automobile dependence is a major issue for cities around the world if they are to address viability and sustainability. There is a need to looking for more sustainable transport modes.

But what is sustainable transport? Sustainable transport ideas emerge from the discussions about sustainable development, and relate to the need to focus on the means of transport and the transport planning system (Litman 2009). A definition of a sustainable transport system would include social, economic and environmental characteristics. In the literature generally, the focus is on achieving the following outcomes for the transport system:

1. Accessible: allows the basic access and development needs of individuals (Goldman and Gorham 2006);
2. Efficient: operates efficiently, including support for a competitive economy (Rietveld and Stough 2005);
3. Equitable: affordable and operates fairly for everyone (Goldman and Gorham 2006);
4. Environmentally friendly: uses less energy or renewable resources and limits emissions to minimise the impact on environment (Bertolini and Dijst 2003; Rietveld and Stough 2005).

The above definition is placing transport in the context of a sustainable approach to meeting travel needs. Travel demand is a fact, yet travelling in a car is no longer considered as a smart choice if we are to achieve sustainable outcomes. To satisfy urban travel requirements, a more sustainable transport mode than cars has an essential role to play. Public transport, including buses, trolleybuses, trams and trains, rapid transit mechanisms (metro/subways/undergrounds and so on) and ferries. A shared passenger transportation service which is available for use by the general public is considered a more sustainable transport mode than the car (Banister, Watson and Wood 1997; Cervero 2003; Feitelson 1994; Handy, Weston and Mokhtarian 2005; Marshall and Banister 2000; Newman and Kenworthy 1999). Compared with the car, public transport not only serves environmentally friendly objectives, it also benefits the travellers and is a safer alternative. According to analyst Todd Litman's (2014) finding, in the US riding the bus is about 60 times safer than in an automobile. However, people do not realise that public transport, such as rail or bus, is safer than a car. Litman (2014) argues that various factors contribute to the excessive fear of using a transit travel including heavy media coverage of transit-related crashes and crimes. Economically, it is also a cheaper option, which can potentially lower congestion and transport costs (Gordge 2004). It also overcomes social exclusion (Bose and Nesamani 2001) and generally enables community interaction, which will benefit social sustainability

(Currie and Stanley 2008). Figure 1.1 shows the respective advantages of public transport and the car.

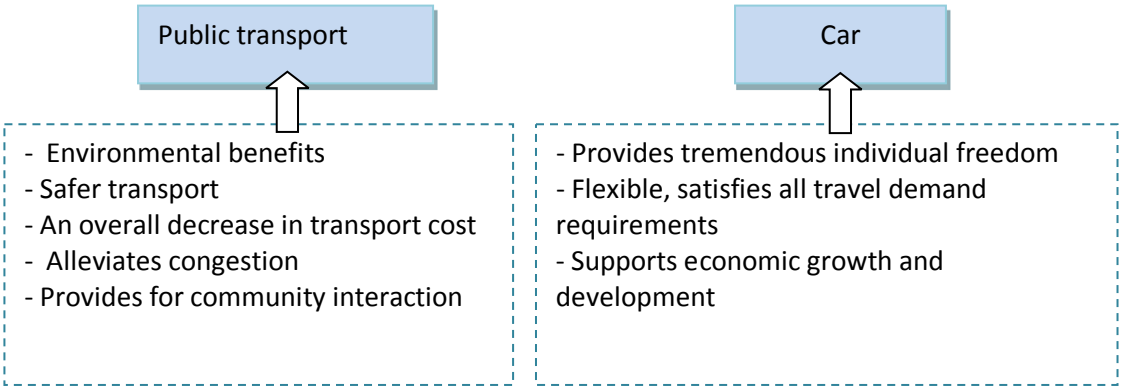


Figure 1.1: The respective advantages of public transport and the car. Source: Author

1.3 The global challenge of behaviour change in relation to sustainable transport

Despite the sustainable benefits of public transport use both to the environment and to travellers, as discussed above, public transport is seldom the transport alternative preferred by individuals. In western societies, individual responses have many contradictions. From 1960-2000, the world trend in car vehicle kilometres travelled shows that in developed regions such as USA, Australia and Western Europe, car usage increased (Figure 1.2). On the other hand, the speed of vehicles has slowed and congestion on the roads has become a problem in European, Australian and US cities (Tranter, Paul Joseph 2010). Recent data shows that VKT has become stable or even is decreasing in the developed world (Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2012). This trend may reflect a growing concern with the need to make their transportation systems more sustainable. At the same time, in fast developing countries like China, although car ownership remains quite low compared with Western societies, there is now a significant increase in motor vehicle ownership (Figure 1.3). With the quick pace of economic growth and urbanisation, the shift from non-motorised travel to motorised travel is quite obvious in developing countries (Pan et al. 2008). The challenge of changing behaviour towards sustainable transport in the face of the public's love affair with cars is a global problem (Alvord, Katharine T. 2000), not only for developed countries bit also for fast developing countries. Research from a global perspective needs to consider both of these contexts.

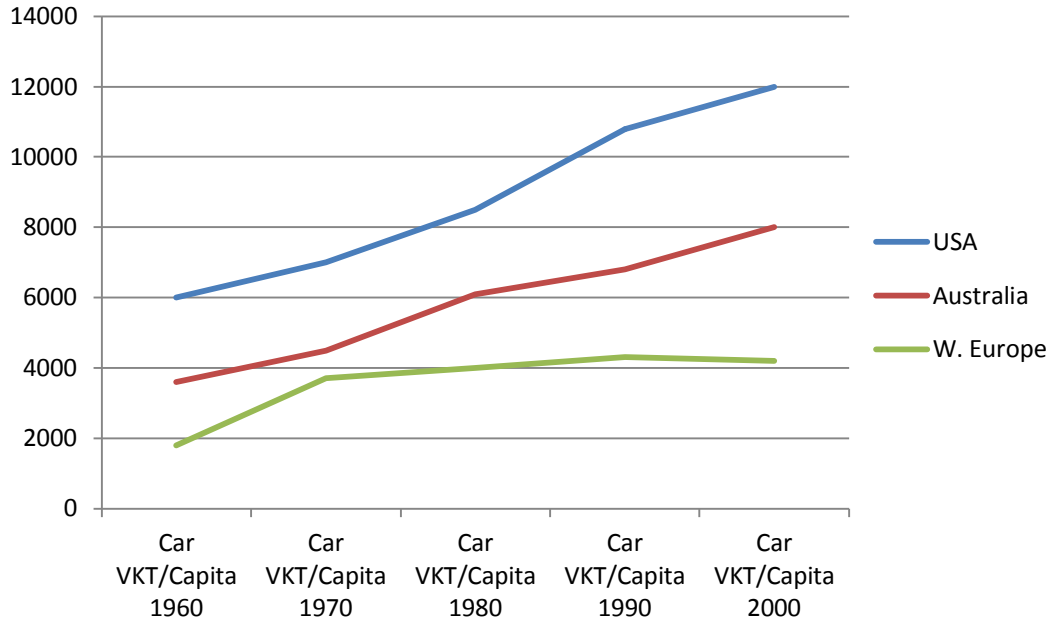


Figure 1.2: Trends in car vehicle kilometres travelled (VKT) and public transit passenger-kilometres (PT Pass) per capita in some developed countries from 1960-2000. Adapted from Newman and Kenworthy (2015)

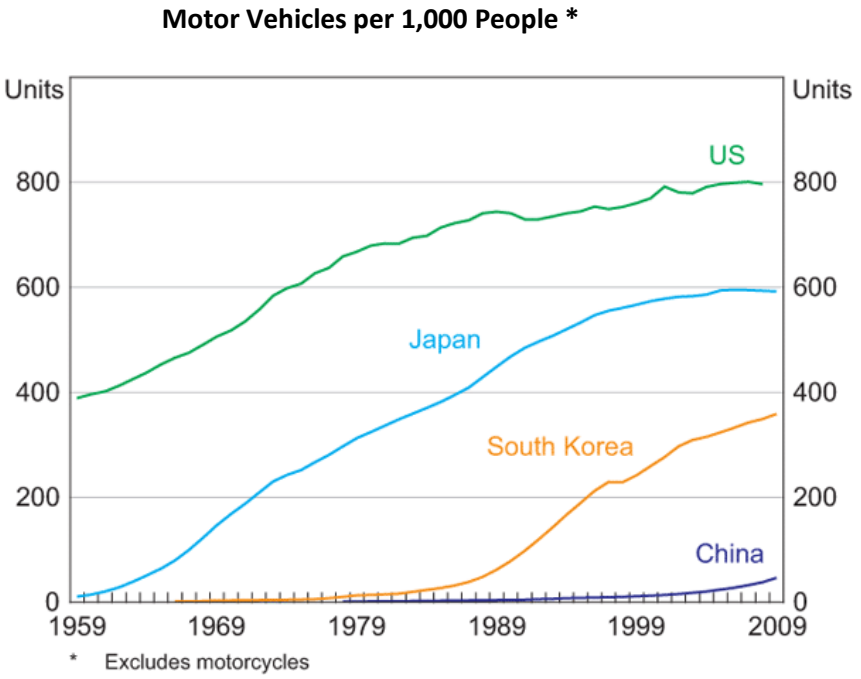


Figure 1.3: The world's increasing speed of motor vehicle ownership. Sources: Data are from Bureau of Transportation Statistics, United Nations. http://www.transtats.bts.gov/

1.4 Research focus

In the face of the increasing problems caused by extensive use of cars, people should be concerned with their continued tendency to drive alone. However, driving is not just the product of individual choices but also the outcome of the economic and social structures and public policies that have shaped our car-oriented landscape, and also how the alternatives — in this case public transport — are planned.

The main function of public transport service is to enable public transport users to travel from the original stop to the destination stop within a specified time frame. The providers of these transit services are a composite of vehicles, infrastructure, service lines, schedules and crew. The outcome for users is the actual trips from stop to stop which includes actual time and places. The outcome, however, is always different from the intended output of a schedule. This is due to outside reasons such as traffic conditions, weather, and human behaviour (of both passengers and crew), which leads to conflicts between the transit service provided by the supplier and the users' real needs. To make public transport services effective and efficient, both the provider's and the passenger's perspectives are important. Therefore, the overall interests of this research project are:

1. From the provider's perspective, how is public transport planned?
2. From the passenger's perspective, what are their individual attitudes to public transport compared to other transport modes?

By understanding these two dimensions and the relationship between them in two different locations, this research offers new knowledge on the extent to which individual transport preferences can be satisfied via public transport.

1.5 Researcher's background

I was born and educated in China, and worked as an urban planner in China for five years. This has given me a sound knowledge of planning in China. Australia is my second home; I have lived here for about five years. This has given me a keen interest in a comparative study of China and Australia on planning-related topics. The benefits to be gained through cross-cultural studies include drawing on the strong points of others and offsetting one's own limitations. Although China is a developing country and Australia a developed one, they both face transport problems in terms of sustainable development. To position my

research interests in a global context will enrich the international scope of this research theme and contribute to the exchange of ideas between countries.

1.6 The driving force of choosing representative cases

A comparative study method is widely used to explore knowledge in the social sciences (Dijst, Farag, & Schwanen, 2008). Robinson has found that "for some decades urban studies have analytically divided the world of cities into different regional grouping of cities, with subsequently very little comparative research across these divides" (2011, 1). The normal divides are "wealthy and poor" or "developed and developing" countries/cities (Figure 1.4). An interest in asking the questions: are there any similar issues or theoretical statements in cities across boundaries (such as between developed and developing countries)? Are they perhaps similar but for different reasons? This enquiry has drawn me into an attempt to read travel patterns in cities from different parts of the world. I believe it is important for urban planners to think across different urban experiences in an era of globalisation. The benefits to be gained through cross-cultural studies include drawing on the strong points of others and offsetting one's own weaknesses.

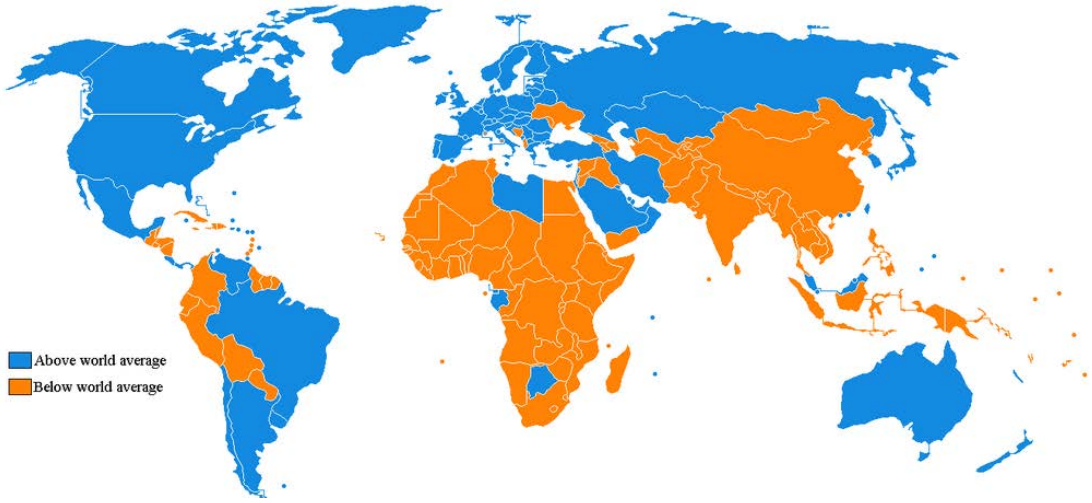


Figure 1.4: Countries above and below world average GDP per capita. Source: https://commons.wikimedia.org/wiki/File:Average_GDP_PPP_per_capita_2010.svg

1.7 Overview of thesis

The thesis will have two research focuses. One is on public transport planning; the other is on individual attitudes to public transport. Both will start with a literature review to highlight existing knowledge and identify gaps in knowledge in the research findings. These

reviews are followed with an outline of research methods and discussion of the research findings. The final chapters draw the two research topics together in the context of the overall problems, highlight the contributions of this research, and demonstrate its contribution to knowledge of this subject. The thesis is organised as follows.

Chapter 2 examines the literature on current public transport planning objectives and the planning process. The research questions on public transport planning and research objectives are defined. **Chapter 3** examines the literature on personal travel behaviour and travellers' attitudes to public transport planning. It defines the research questions on individual travel attitudes and travel preferences. **Chapter 4** Identifies the research questions and demonstrates how they are important in filling the knowledge gaps; an appropriate methodology to answer these questions is presented. The need for a case study approach is explained, and the choice of case study justified. The range of research methods that could be used to answer the research questions is discussed, and the most appropriate research methods (travel behaviour analysis; questionnaire survey; context analysis; in-depth interviews) to deal with various research sub-questions are described. The cities in which the research methods were developed and tested are described. The context of the two cities is described, showing why they are suitable for case studies to provide answers to the research questions. **Chapters 5, 6, 7** develop the research methods identified in chapter 4, and report the research findings for each research question. Finally, **Chapter 8** draws together the whole thesis and discusses the conclusions of this research and its contribution to knowledge of public transport planning.

Chapter 2: Review of literature on public transport planning

2.1 Introduction

We may all have had the experience of missing the nearest train by just one or two minutes when we arrive by bus, and having to wait for another half-an-hour. Getting off the bus and seeing the train depart, while you contemplate a long wait, is frustrating. This is caused by a lack of coordination between bus and train timetables. The consequence of poor coordination can be the loss of public transport users. A well operated transportation system depends greatly on the planning behind it. Urban transportation planning is a decision-making process, whereby planners help decision makers to choose transportation plans and related policies through various predictions (Pas 1986). These predictions include the effects of building a new freeway, or changing a bus route, or making parking restrictions, or increasing the price of a public transport ticket. Public transport planning is one part of the urban transportation planning system. The aim of planning for public transport is better operation (White 2008). Every city has its own public transport system. What can be done to increase patronage as well as achieving a better level of operation or return on investments? What is the public transport planning process, and for whom is it designed? To address these questions, this chapter reviews the literature on the design and operation stages of public transport planning. It explores the key variables of public transport planning from the perspectives of transport planning practitioners (Nielsen 2005) and planning theory (Vuchic 2005). The aim of this chapter is to understand the public transport planning process in theory and find out the knowledge gaps in public transport planning, by questioning the extent to which planners consult with all the stakeholders, especially the users. It presents the first research interest of this PhD thesis — "how is public transport planned?" from the literature which looks at the providers' perspectives.

2.2 General process of public transport planning

When doing transit planning, the first step is to have a general idea about the basic planning process in order to answer these basic questions: what (scope of the network),

who (stakeholders) and How (schedules). Typically, in strategic planning, the planning process comprises four distinct steps: Prepare, Plan, Implement and Review/Revise (Hax and Majluf 1991) (Figure 2.1). It can be seen from the circle below that all the steps are strongly connected.

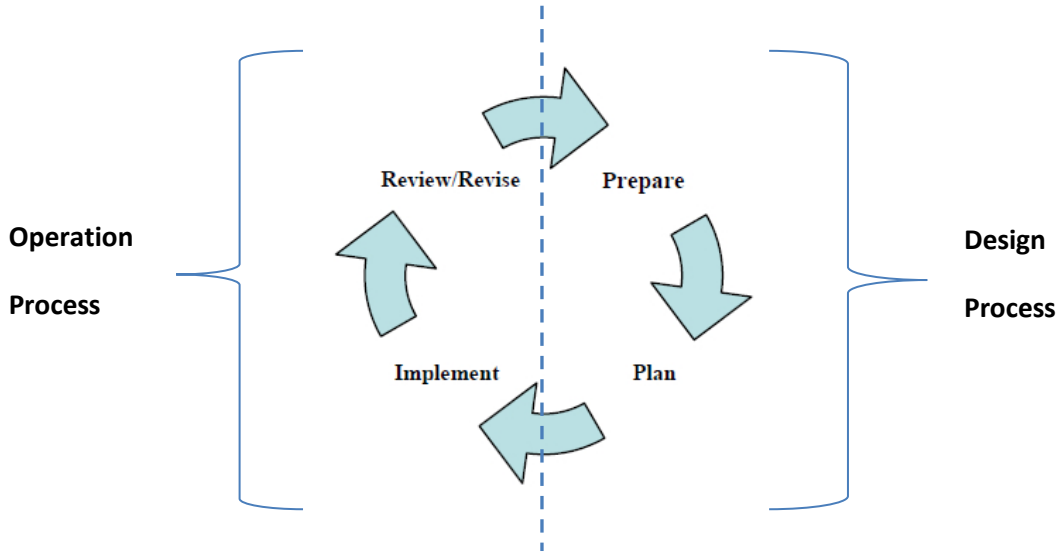


Figure 2.1 : The steps of strategic planning process. Source: Hax and Majluf (1991, 1)

An adequate transit design has four stages. The first two, Prepare and Plan, include decisions about the network and route of services and timetable development, and belong to the design process. The Implement and Review/Revise stages include strategies and institutional structures that support the plans, and revising the plan as appropriate after evaluating all the criteria to see whether the objectives have been achieved as expected; these stages belong to the operation process (Figure 2.2). The following sections will discuss the details.

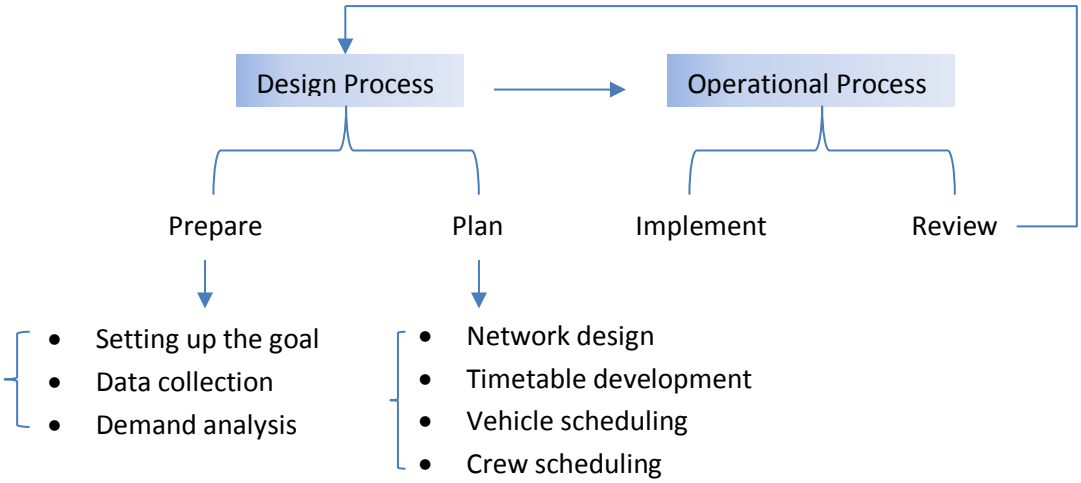


Figure 2.2: Public transport planning process. Adapted from Vuchic's (2005).

2.3 Design stage of public transport planning

2.3.1 Stage one: Prepare

At the Prepare stage of the process there are three steps: setting up the goals, data collection and demand analysis.

2.3.1.1 Setting up the goals

When embarking on public transport planning, the very first step is to define the planning goals which will direct the planning task in a targeted planning period (Vuchic 2005). This is just like any other planning exercise. Public transport, as well as providing mobility, has many other planning goals, such as relieving traffic congestion, reducing energy consumption, and achieving equity in the community. The planning task will also vary according to who is doing the planning (operator, government, or other professionals) (Nielsen 2005). Different goals reflecting different target markets will always lead to conflicts. For example, reducing operation costs can be an important planning goal to the transit agency, yet a poor level of service caused by cutting costs will not be acceptable to the passengers. On the other hand, simply increasing operational costs without regard to the transit agency's budget creates pressure on the running of the system. The community may want to reduce the environmental damage, and their goal may focus on energy consumption rather than operation cost. Planning outcomes are determined by planning goals.

2.3.1.2 Data collection

Data collection is one necessary step for scientific planning. Almost every phase of public transport planning requires the need for data collection and will employ basic statistical tools for analysis. The data collected may be the number of existing public transport users, where they are travelling from and how long they travel; it may include operating costs and other financial statements, or government reports on budget and financial subsidies (Ceder 2007; Vuchic 2005). These data determine the success of planning, but there are always difficulties and conflicts involved in real-life data collection. For example, to find a proper way to collect the right amount of data in a cost-effective manner is a real challenge to transit planners (Hiller and Self 2004). Data collection is needed to understand basic passenger needs such as proximity and frequency of service to the target population. In relation to the transit agency's planning and operation needs, data collection needs to answer questions such as whether the current network is sufficient for future development. Overall, data collection needs to provide a good understanding of the market or in other words, a good understanding of the users' or non-users' demands (Nielsen 2005). Travel demand analysis is the process of fully understanding the market and finding out the opportunities for future development, which is the basic and most important aspect of transit planning data collection. Most of the forecasting results, however, have limited reliability, and more troubling is that very few agencies have examined the accuracy of those data afterwards (Boyce, Day and McDonald 1970). A common conflict in many transit agencies is that they want to improve service quality but also wish to reduce the cost of data-collection. Under these circumstances, the potential customers' needs can often be ignored, yet their needs are as important as the existing passengers' needs, if the aim is to improve the service quality. The following section confirms the importance of demand analysis both for current and potential users further.

2.3.1.3 Demand analysis: understanding the market

To predict public transport demand, the first important thing is to understand the market. Travel demand forecasting is a complex process which involves detailed information about traffic volumes, bus patronage, population and urban land use (McFadden 1974). It involves predicting the future trips made by people in a certain area. No matter what kinds of methods have been applied, those four basic items are most relevant: trip generation, trip distribution, mode choice and trip assignment (Brand 1973). Trip generation is about how many trips people will make, which requires monitoring the number of trips generated by particular urban activities in a given location. For example, the number of trips to an

industrial area can differ from the number of trips to shopping centres. This requires information about population and urban land use, both current and future.

Trip distribution shows the travel flow between each pair of locations. It represents the relative attractiveness and accessibility of each area. Analysis of people's decisions on mode of travel is also very important to travel demand forecasting. This is determined by the characteristics of three items: type of trip, trip maker and the particular transport system. The planner's job is to assess the interactions of those characteristics and predict the choices of mode in the future. However, this is not easy, because the trip makers' decisions on mode of travel are determined by many factors. Is it enough for planners to predict travel mode choice by type of trip and transport system? What kind of individual factors will also affect traveller's mode choice? They are all important questions for the planners to consider during the stage of demand analysis. Trip assignment means predicting the paths that the traveller might take between any two activity places. This requires the planner to research the existing network maps to decide the possible paths that trips can take. Trip assignment analysis shows the number of passengers on each transit route (Brand 1973).

2.3.2 Stage two: planning

When the goal has been set and all the necessary data have been collected, the planning stage follows. Following the knowledge of the general production process (Utterback and Abernathy 1975) (see Figure 2.3), planning is a process of converting input into output. The process has to achieve the required level of performance.

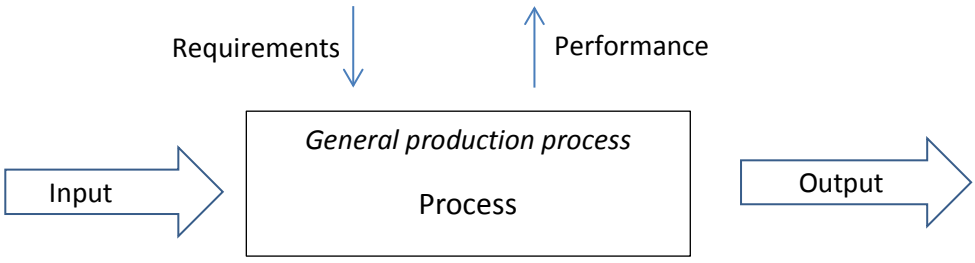


Figure 2.3:. Adapted from Utterback and Abernathy (1975).

In public transport, there are different stages of the production process (see Figure 2.4). At the planning level, the input includes the planning goal, data about current and potential

users, the physical character of the vehicle involved, and so on. The output includes the network, infrastructure, schedule, timetable and related aspects. At the operational stage, all the output in the planning stage will become input materials, and the output of the process will be actual vehicle trips from stop to stop, and actual services for passengers in time and space. From this analysis, we can see that public transport planning is actually a two stage production process. In each stage, however, the actual output is often not exactly as planned or promised (van Oort and van Nes 2004). This will lead to dissatisfaction in both users and providers, who suffer from the reduction of service quality. As mentioned, the main process of public transport is enabling passengers to travel from one place to another in a vehicle within a specified time frame. To make this happen, the supplier must make sure that the network route, the timetable, the scheduling of the vehicle and the crew, have all been properly planned.

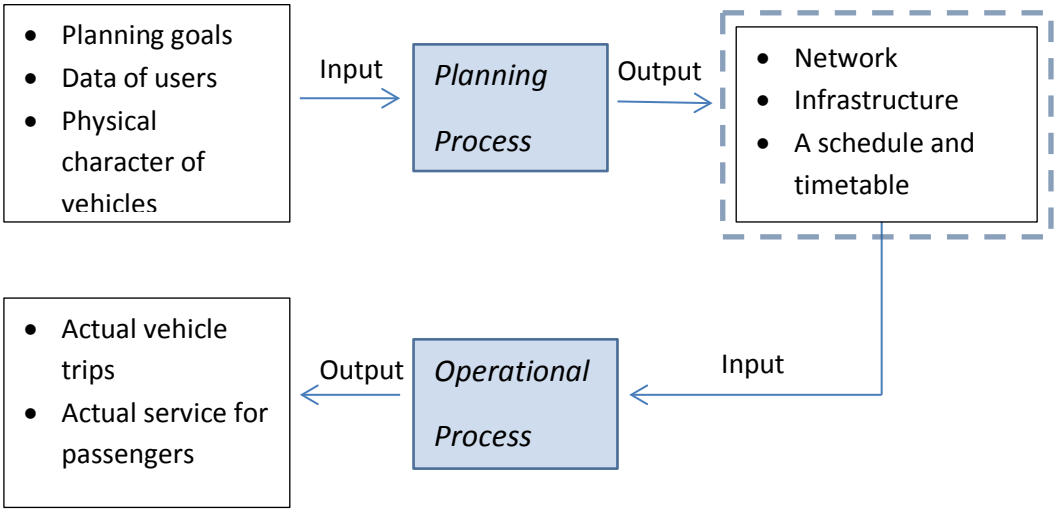


Figure 2.4: Input and output activities in the planning and operational process. Author.

2.3.3 Major activities in the planning process

To ensure different people travel from different origins to different destinations in the same vehicle within a certain time is a challenge. This challenge increases when the houses and workplaces become more and more dispersed. Network planning has a key role here. In the past two decades, a range of authors (Mees 2010; Nielsen 2005; Thompson and Matoff 2003; Vuchic 2005) have researched the main principles of network design. Compared with private cars, which serve a single person or a small group of passengers, public transport offers multi-modal and multi-destination travel, and a “seamless” service is

acknowledged as the key desire of public transport users. To achieve this seamlessness, trade-off items have to be considered in the network planning process.

2.3.3.1 Major trade-off items in network planning process

Network planning practice is important but is also the hardest part of the whole process. To satisfy different interest groups there are trade-off items that need to be balanced, and which form the basis of the network planning principles. Lack of adequate consideration of those items by the decision-makers will always lead to dissatisfaction in the users (Baaj and Mahmassani 1991). The following discussion identifies the most common trade-offs which need to be considered during the planning process.

A. Frequency and simplicity versus coverage

This is the most common trade-off in terms of transit stop distances and frequency. In particular, given finite resources, there are two options: one is to provide lots of closely spaced routes, short bus stop distances, but lower frequencies; the other is longer distances between bus stops and more direct routes with higher frequencies. The latter will have a faster running speed, but a high possibility of long distance walking/cycling or car use to access the transit stops. The former has good geographical coverage, but a lower running speed, which leads to more time spent in the vehicle. The actual travel time is the sum of all in-vehicle and out-of-vehicle time. Which of the above options will minimise total travel time is still under debate. Globally, research (White 2008) has shown that the standards for bus stop spacing vary according to different urban land use patterns

B. Stable geography versus flexible lines

From the perspective of the operator, operation costs are always the first priority to be considered. In some areas where the transport demand is quite low, operators will think of developing a network which can change over time, including the addition of some special services during high demand times. This is a smart way to save money and avoid empty services. Some argue, however, that rather than flexible services, a stable structure creates long term recognition of services (Dziekan 2008). It is necessary to build passengers' confidence in ease of use by leaving the major elements of a public transport network stable (Nielsen 2005). This is a consideration from the user's perspective.

C. Transfer versus direct route

Most public transport networks will require transfers between services. Transfers can bring new travel opportunities but also can inconvenience the passengers. This may include

waiting time, walk distance between services and/or cost. Easy transfer needs the support of a well-designed route, and a timetable and ticketing system to minimise the cost as much as possible. Stone and Mees (2010) have found that integrated fares and ticketing can avoid fare penalties, and high frequencies of service can minimise the waiting time between transfers. In addition, a well-designed information system can make these transfers easier. In the HiTrans Best Practice Guide (Nielsen 2005), a network with fewer and simple routes with convenient transfer is strongly recommended for its operational efficiency and simplicity for the users.

Public transport involves different interests groups. The idea of favouring all groups of users has led to a complicated and inefficient service supply; customer-oriented public transport planning has attempted to narrow the gap between public transport and car but has not been successful (Nielsen et al. 2006). A well-developed public transport system should find the right balance between demand and supply. Nielsen (2005) has developed a "two-tier system of urban public transport networks" with both stable and flexible services to cater for the demands of various groups.

2.3.3.2 Key principles of network planning

The above discussion has shown that conflicts always occur during the network planning process. Researchers from both academic and practitioner groups discuss the key principles of network planning. Mees and Dodson (2011) have reviewed the literature on public transport network planning principles and identify five major principles (Figure 2.5). They also consider further dimensions of network planning, including institutional arrangements and transition points in network design. In the HiTrans Best Practice Guide, Nielsen (2005) discusses a number of aspects of public transport network planning, including the planning process. The guide insists on the need for a good understanding of user requirements, travel demand factors, project assessment and institutional and political factors. But this practice is focused on small and medium sized cities. From Nielson and Mees and Dodson's research, we can see they employ different case studies, but the common aim is to transform a traditional public transport system of mostly low quality routes into an integrated network of high quality services. Many suggestions for the design principles are quite similar to each other: simple line structure, stable line and operating patterns, convenient transfer, and appropriate institutions and fare systems. However, in a particular city region with a different context, institutional arrangements and public transport policies will strongly influence the choice of network planning objectives. What works well in one

place will not necessarily be good in a different urban setting (Nielsen 2005). Also, public transport network planning will be influenced by local cultural, political and social factors. There is no one solution for all the problems.

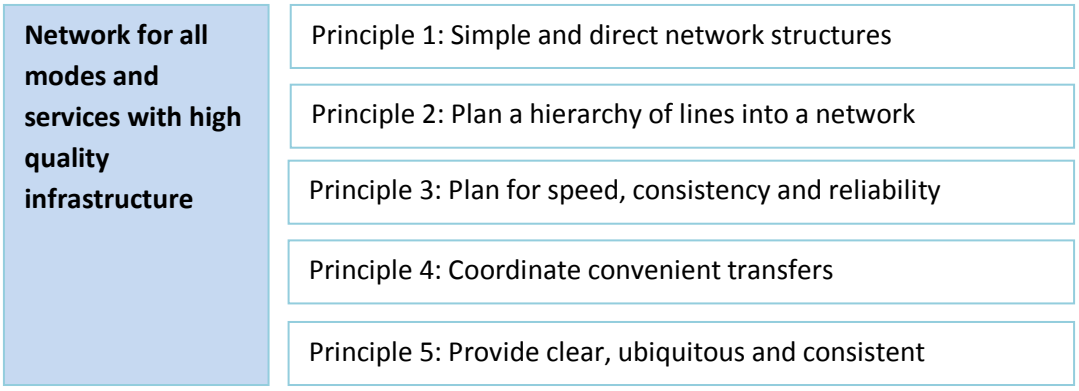


Figure 2.5 : Key principles of public transport network planning. Adapted from Mees and Dodson (2011)

2.4 Who is doing the planning and for whom the planning should be designed?

An adequate transit design is not limited to providing a superlative service to attract more passengers; it is also necessary to reduce its cost and increase its efficiency from the transit agency's perspective. Following the discussion above, besides planning steps and design principles, a more general view of who does the planning and who the planning is designed for is necessary. Generally, there are three groups of people participating in the public transport planning and operational processes: the transport policy maker who represents the government, is responsible for the delivery of transport policy overall; the transport planner who is from the perspective of academics is responsible for the designer of the policy; and the transit agency implements this policy through the day to day transport operations. While planning to achieve the basic transit goals, there is a need to consider three groups of interests: passengers, transit agency and community (Vuchic 2005). The multiple perspective requirements for public transport are shown in Table 2.1.

Table 2.1 : Multiple perspective requirements for a public transport system.

Multiple perspective requirements for public transport		
Passengers: Provide essential public services (mobility)	Transit agency: Achieve maximum operating efficiency (minimum total system cost for a required performance level)	Community: Create positive impact
• Availability • Accessibility • Capacity • Journey time • Comfort • Convenience • Security and safety • Comprehensibility • Economy	• Cost of system • Operating flexibility • Integrated with other mode • Integrated with public policy • Location of terminals, depots and yards • Distance to the lines	• Environmental impact– visual, noise, air quality etc. • Sustainability • Social objectives • Energy consumption • Long-range impacts

Adapted from Vuchic (2005)

From the provider's perspective, the passenger is mostly concerned about the service quality. They want sufficient services at or near their location, at times when they want to travel (Ceder 2007); this also includes the convenience of access and egress to and from the bus stops in a safe way, awareness of the service information and ability to use the service at a desired cost (Chen et al. 2009). If any of these factors is not satisfied, people may either choose a different mode or give up this trip. However, passengers' requirements may be wider than this. Good service sometimes also results in poor patronage. A deep investment in passengers' real needs is also important.

The transit agency also considers cost. When the requirements are mainly based on cost-efficiency, or minimising operating costs, conflicts may occur afterwards over service quality (Sheth, Triantis and Teodorović 2007). In current practice, the decline in transit patronage, increasing operational costs and privatisation have imposed big fiscal pressures on transit agents (Chen et al. 2009). This has made transit agent reallocate their limited resources, with much emphasis on how much it costs and how good the service can be within this cost. This performance-based measurement rather than passenger-oriented

service has been criticised for insufficient consideration of the users and the community's benefit (Ceder 2007). Public transport as a public service should be passenger-based to increase the ridership and achieve the goals of social equity. Poor levels of service led by cutting costs will result in the decline of transit patronage and competitive strength. Therefore, public transport services cannot be solely based on profit-making by the transit agent. A trade-off needs to be made to meet the principles of social welfare.

Public transport benefits the community as a whole by providing mobility to people without access to cars or who choose not to use their cars. Public transport also has to consider social variables such as air quality, energy consumption, noise pollution and sustainability (Sheth, Triantis and Teodorović 2007). The passengers are concerned about cost and as residents are affected by the negative aspects of public transport services.

2.5 Does the planning process consider all the stakeholders?

The above discussion shows that to evaluate how well a public transport service is delivered, it is important to be clear which perspective is being considered. The evaluation process will become even more complex when multiple goals from different stakeholders are under consideration (Chen et al. 2009). For successful transit planning, it is important to invite the entire stakeholder field to share ideas and concerns. However, whether this actually happens in practice is not clear. With its global review of the steps of transit planning, Vuchic's (2005) research is quite influential. It has clearly presented the necessary strategic and tactical steps of the network design and scheduling process (see Figure 2.6). However, Vuchic's research does not refer to stakeholders. The question arises, how to deal with multiple goals when conflicts occur between different stakeholders? Which perspective should be considered most important? Considering the perspectives of all the parties and obtaining a better balance among them is a challenge to planners.

It should be noted that Vuchic's (2005) transit planning is according to "performance requirements" (Figure 2.6) rather than "passenger's requirements". The concern is with the operators' side rather than the users' side. Passengers are the customers for whom the service is provided, and their perceptions need to be given more attention in the evaluation of public transport service quality. However, there has been an assumption that a specific emphasis on the passenger's perspective will decrease the operator's profit. The addition

of passengers' requirements to public transport planning is needed to change the measurement of success, which it is no longer acceptable to measure by profit alone. This shift will make the public transport planning process become more complex and possibly conflicted. Is there any way that the perspectives of both the passenger and the agency can be considered and successfully responded to? A clear insight into passengers' real demands is the key to success.

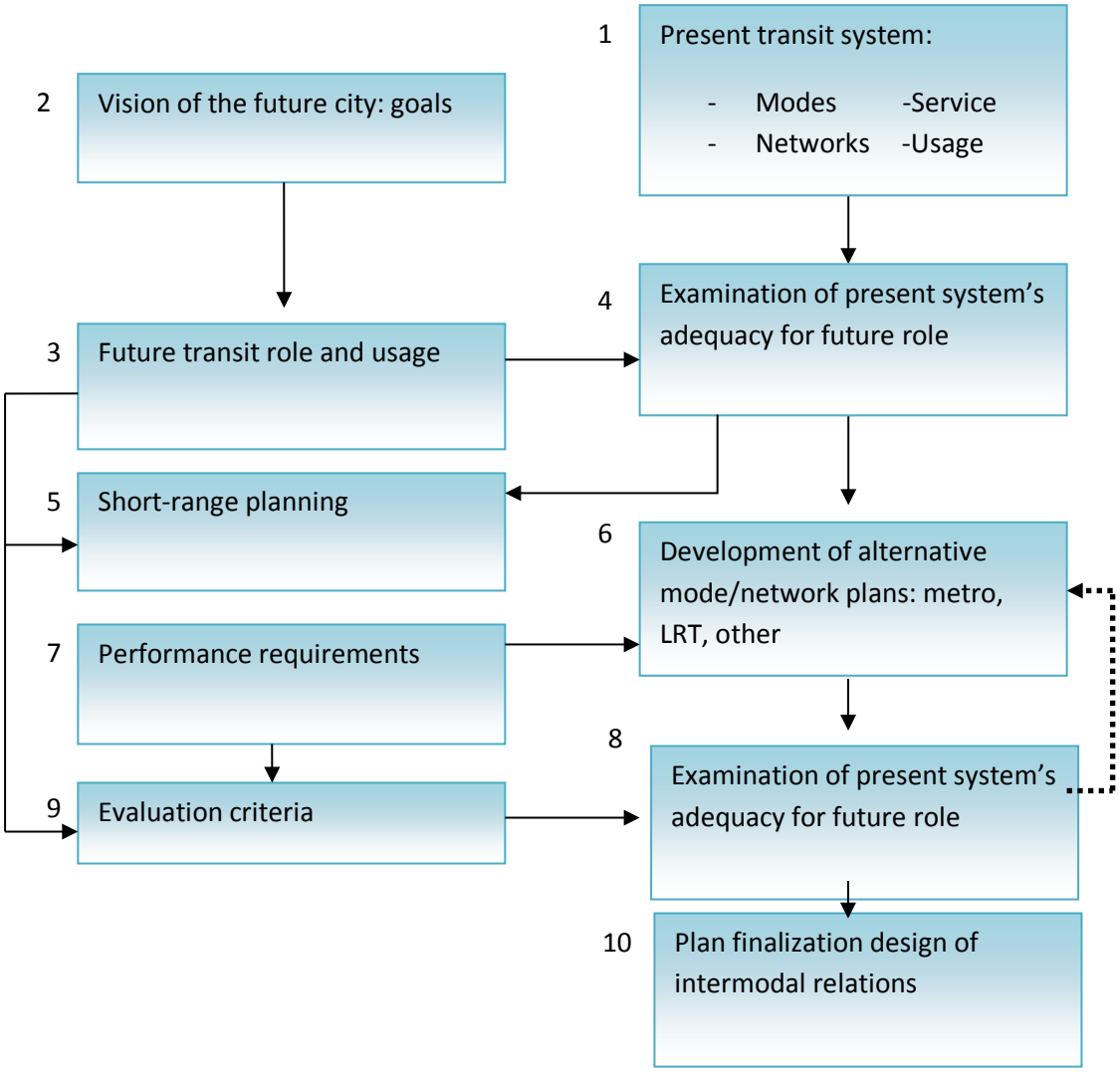


Figure 2.6: Transit planning process according to Vuchic's theory. Source: Vuchic (2005, 482)

2.6 Operation stage

The application of public transport planning principles is not sufficient to achieve high performance. Institutional factors also play a strong role in operating such systems.

However, there are not many studies that have investigated the institutional barrier to successful urban transport systems, whether within the economic or institutional efficiency context or the environmentally friendly one (Gleeson, Curtis and Low 2003). Mees (2010) has offered some insights into transport governance, particularly public transport. He praised the European Verkehrsverbund (EVV) model developed in Germany which embodies the institutional delivery of public transport planning principles (Stone and Mees 2010). These principles include: planning a fast efficient network; specifying all service characteristics for operators and managing subsidies; designing fare structures to support the network; undertaking marketing of the overall system; and managing the network financing. The EVV model plans and manages all aspects of the city's public transport network as a single integrated multi-modal network while the separate institutions manage different parts of the work (Stone and Mees 2010).

2.7 Discussion and Conclusion

This chapter presents the public transport planning process in theory, reviewing the main planning activities and design principles from the literature. The aim is to understand the public transport planning process in theory and highlight the knowledge gaps in public transport planning, questioning whether planners deliberate with all the stakeholders, especially the users. It argues that a clear view of who is doing the planning and who the planning is designed for is important. Generally, the government, the transport planner and the transit agency are the three representatives who participate in the planning. The three interest groups: passengers, transit agency and community, and their multiple perspectives and requirements, need to be considered. Accounting for the perspectives of all the parties and obtaining a better balance among them is then the key to success.

However, the analysis points out that Vuchic's very influential transit planning approach does not refer to stakeholders. This is a knowledge gap in transit planning theory which needs further discussion. Another focus of this research topic is to examine whether actual planning practices are following Vuchic's planning theory and whether they consider the stakeholders' requirements, especially the users'. Further research via case studies into public transport planning practices, including the practitioners' different responsibilities and concerns, is necessary for a deep understanding of public transport planning from the provider's perspective. This can afford us better understanding of who the planning is

designed for and whether it has considered the passengers' requirements. The following chapter will examine the passengers' requirements and what affects their travel choices.

Chapter 3: Review of literature on travel behaviour and travel attitudes

3.1 Introduction

The previous chapter provides a clear insight into current public transport planning design and operation objectives. Clearly the prevailing approach is from the provider's perspective, and views the public transport system with the operators' objectives in mind. From the users' point of view, in the face of ever-growing travel demands and unsustainable travel behaviour, there is a need to explore the key variables that affect individual demand for travel and subsequent travel behaviour. A comparison of the findings with the planning objectives of the public transport supplier will assist in developing sustainable transport schemes that encourage a modal shift and meet user needs. This chapter reviews the literature on travel behaviour with the aim of finding out the causal factors that influence travel behaviour. It focuses on the importance of travel attitude factors which tend to be ignored by transport planners. This chapter has three parts: an overview of travel behaviour research; an examination of the key variables that affect an individual's demand for travel and subsequent travel behaviour; and discussion of the importance of personal attitude factors on travel choice.

3.2 An overview of travel behaviour research

Our daily life is made up of a range of activities which are affected by transportation from one place to another. Among those travelling, some do so for the sake of it, driving for pleasure, but most people travel in order to undertake another activity. What then makes people travel differently, and what variables will affect people's travel-activity patterns? To find out the answers there is a need to review the literature on travel behaviour research. There is a substantial body of research on this topic. Researchers have described travel behaviour as an adaptive process between traveller and supplier: individuals, in order to meet their demand for activities, use the transport system provided by the supplier to reach these facilities (Jones et al. 1983; Van Wee 2002). It is the outcome of the interaction between individual activity demands and the transportation/land use system, which are the key variables in travel behaviour research. However, finding out the hidden mechanism of a particular travel activity choice is not easy, due to the multiple different factors which

influence this choice. These factors can be personal and household attributes such as vehicle ownership, or the residential environment, or the purpose of the trip undertaken. Empirical analyses have shown the difficulties in weighing up the relative importance of different impacts (Ortúzar and Willumsen 1990).

3.3 Causal factors of individual travel behaviour

As we know, travel is a complex process. Observing the purposes for trip making such as working, shopping or social activity is not sufficient to completely understand individual travel planning systems; this requires a deeper investigation. At the most general level observed travel behaviour depends on three main factors: a spatial perspective, the transport system, and the socio-economic background of travellers (Hanson and Schwab 1986). This can be summarised as external factors and internal factors (outlined in Table 3.1). The purpose of this review is to examine observed travel behaviour from diverse dimensions. In addition, this exploration, particularly of the data and methods used in other research, will provide a guide to my own research design. The following discussion discusses the details of some important external and internal factors.

Table 3.1: The external and internal factors affecting observed travel behaviour

Travel Components	**External factors**	**Internal factors**
	Policy, economic, physical environment while people are travelling	**Characteristics of travellers**
Trip purpose (activity choice) Travel mode choice Travel time Travel cost Travel distance Trip frequency	Built environment Infrastructure Transit service quality Transport policy Economic situation	Income Car ownership Possession of drivers' licence Working status Employment type Gender Age group Family structure Level of education Attitudes Personality type Cultural background

Source: Author

3.4 External factors in travel behaviour

3.4.1 Built environment

The built environment is related to the physical environment people are travelling in. It can determine, for example, whether it is possible to cross the street safely and conveniently by walking or whether it is easy to catch a bus in time through a neighbourhood. If transportation is about moving from one place to another, the built environment defines the nature of places and also provides the conditions that make the transport feasible (Cervero and Kockelman 1997).Travel behaviour research focusing on the spatial dimension is the earliest and largest stream of empirical research. Although the knowledge and the research skills have improved with years, there is still no common understanding of the strength of the relationship between the built environment and travel choices (Van Acker and Witlox 2005). Debates can be grouped. One group (Cervero and Kockelman 1997; Ewing, Haliyur and Page 1994; Kenworthy 1989) assert that various aspects of land use variables are closely associated with travel behaviour. The other group (Bohte, Maat and van Wee 2009; Bagley and Mokhtarian 2002; Kitamura, Mokhtarian and Laidet 1997) do not find much or any correlation between them. The former group usually uses land use variables such as density, spatial diversity, spatial design, and urban structure to explain variables in relation to trip generation, energy consumption, commuting time and modal choice.

3.4.1.1 The relationship between density and travel pattern

Density represents land use intensity, which measures the concentration of human activity (Brown and Vivas 2005). Density is important to transportation because it determines the number of potential travellers in a certain area. For decades, researchers have found significant relationships between density and travel patterns (Levinson and Wynn 1963). It has been found that persons who live in higher density neighbourhoods tend to own fewer cars and drive less (Cervero and Kockelman 1997; Hammadou et al. 2008; Schwanen, Dieleman and Dijst 2004), which consequently leads to higher levels of non-automotive use. Public transport has been found to be organised more effectively in high-density areas than in low-density places (Schwanen, Dijst and Dieleman 2004). This is not hard to understand. People who live or work in denser areas will have a much greater number of potential destinations nearby. This increases accessibility, lowers the rates of long distance travel and also lowers the rates of automobile use. However one researcher also argues that (Mees 2010) low density does not necessarily mean bad public transport. Even in low density urban areas such as Auckland is difficult, effective public transit can work.

3.4.1.2 The relationship between mixed land-use and travel pattern

In some old suburban areas only a limited number of land uses are found, and aimed at fulfilling basic needs (Cervero 1989b). Therefore an individual's daily activities are hard to be met locally. People have to travel to a city or town centre which contains a wide variety of commercial uses, including restaurants and cafes, book stores, hair salons, music shops and health spas. City centres may contain residential uses, such as rental apartments or condos mixed in with these commercial uses. These use patterns have been measured by several indicators developed by different researchers, such as jobs/housing ratio (Boarnet and Sarmiento 1998; Ewing, Haliyur and Page 1994) and the degree of balance within various land use types (Frank and Pivo 1994). It has been found that there is a close association between diversity of land use and travel patterns (Cervero 1989b; Kockelman 1997 and Næss 2009). Generally in a more mixed land-use neighbourhood people tend to drive less and use more of other transportation modes such as public transport (Cervero 1996). The reasons are similar to those discussed in the previous section: having more types of land use in a closely inhabited area can bring more choice for daily activities locally, with less travel.

3.4.1.3 The relationship between spatial design and travel patterns

Researchers have found that spatial design, such as urban design or neighbourhood design, is associated with travel patterns (Gorham 2002). For example, traditional suburban neighbourhoods designed with low density, limited diversity and car-orientated features will lead to more car use and less transit use (Gorham 2002). Also, at the micro scale of spatial design, street characteristics such as block size, parking spaces or footpath systems are also related to people's travel behaviour. It has been found that neighbourhoods with small block sizes, a complete footpath system and limited residential parking tend to encourage walking and cycling (Cervero and Kockelman 1997; Stead 2001). On the other hand, Meurs and Haaijer (2001) noted that although the macro or micro level of spatial characteristics may influence people's modal choice, this trend is not so obvious for working trips but holds true for shopping or recreational travels.

3.4.2 Infrastructure

Besides the built environment, another important physical characteristic which affects

travel patterns is the transportation infrastructure, which provides the basic hardware that makes travelling possible. For decades, the transportation infrastructure and travel demands have interacted intimately (Bartholomew and Ewing 2008). Transportation planning has been based on assumed travel demand determined by demographic features. When new facilities have appeared, people are apt to change their behaviours such as travel mode, travel time or route, to take advantage of the new facility (Bartholomew 2009). From this we can see that investment in infrastructure from the supply side can affect people's travel demands to a certain degree. Later, however, when new facilities become congested, more infrastructures have to be added in order to meet the increased demand. This could create an untenable situation, with no space for new infrastructure. People would thus have to choose other travel options. In practice we can take advantage of infrastructure investment. For example, negative trends can be reversed by investing more in facilities to support other modes such as transit, bicycles and pedestrians.

3.4.3 Transit service quality

Travellers' attitudes and choices can be impacted by the quality of the transit system, making public transport an attractive alternative to the private car, the quality of a transit service comprises many factors. The indicators which are more valued by users can be grouped under six categories: availability, travel time and reliability, travel cost, comfort and amenity level, safety, and information (dell'Olio, Ibeas and Cecin 2011; Stradling, Anable and Carreno 2007). Each of these aspects can be measured in many ways by considering different indicators, as documented below.

3.4.3.1 Service availability

Transit service availability is the basic concern for the potential traveller. When people complain about the public transport service, the most common focus is on lack of nearby services or lack of services during off-peak time. Concerns include availability, which is represented by route coverage (the spacing distance between adjoining routes), bus stops (locations and distance in between), and service frequency (how frequent the transit service is) (Eboli and Mazzulla 2012). Service availability determines the waiting time and also the travelling time, which is the users' greatest concern, as will be discussed in the following section.

3.4.3.2 Travel time and reliability

Travel time was found to be the most important service characteristic influencing demand for alternative travel modes (Wachs 1976). It is hard for public transport to compete with the private car in time benefit. This because the travel time by transit also includes out-of-vehicle time such as waiting, walking, transferring. In some circumstances the time spent on those is longer than riding time. Compared with the door-to-door travel convenience of the car, public transport is therefore characterised as a slow way to travel. Research has also found that out-of-vehicle time is less acceptable than in-vehicle time, especially with today's time-poor lifestyles (Wachs 1976). Another indicator, travel time-related service reliability, becomes more important. An unreliable service results in additional waiting and transferring time (Wilson et al. 1992) and eventually leads to loss of passengers.

3.4.3.3 Travel costs

Travel costs for transit includes both ticket price and ticket function. Is it a one way ticket or a period timed ticket which includes transfers? Does it have discounted fares for special groups like students, or have volume discounts like monthly passes? Ticket cost can affect travellers' travel mode choice, but to what extent depends on the economic status of the traveller (Willian Rex and Wright 1974). To low income families such as people from developing countries, the cost of public transport as a shared mode which is cheaper than cars can be a key factor for using public transport. For example in some Chinese cities, the fixed-fare policy (regardless of distance travelled) on bus systems has played a very important role in long distance travel mode choice on public transport. There is a misperception of the relative travel cost between transit and car. The transit ticket cost is seen as an out-of-pocket expense, whereas for car users there are hidden car costs such as insurance and maintenance; as a result people mistakenly believe that the actual costs of transit are higher than automobile costs. Wachs (1976) asserts that most car drivers do not even attempt to estimate the actual costs of using a car.

3.4.3.4 Comfort and amenity levels

Comfort on board or at stops relates to conditions on the transit vehicle and at stops, including seats, flooring and facilities such as shelters and benches on bus/train stops. The level of comfort is a subjective feeling in the traveller, and this is difficult to measure with a single standard. In the shared mode of public transport, passengers may report perceptions of noisy, smelly, crowded and airless spaces. This will be differently evaluated across

different groups of users (Eboli and Mazzulla 2012). For example, the degree of crowding plays a very important role in evaluating comfort during the trip. Different people will respond differently to this indicator. The concept of "crowding" will vary from those who come from high density places to those who live in low density areas.

3.4.3.5 Safety

Generally, safety refers to two aspects: one is related to road safety and the other is about personal security (safety from crime). The rates of car accidents are much higher than for public transport, which is advantageous to the choice of transit as a mode of travel. However, the bad reputation public transport tends to have for security negatively affects people's choice of public transport, especially for female passengers. This is not only related to crime rates but also relates to psychological traits in passengers (Eboli and Mazzulla 2012). Therefore, even though there is actually a quite low rate of crime during travelling, the factor of safety still attracts a great deal of attention (Solomon, Solomon and Sillien 1968).

3.4.3.6 Information

Information is likened to a manual for using the transit system. It tells passengers how to use a transit system, which is very important for retaining existing riders and attracting more potential riders. Without this information, it is difficult for passengers to use a transit service, especially in a city with large, complex transit system. Well-designed passenger information should be as clear as possible and be easily accessed at every stage of travelling (Eboli and Mazzulla 2012). Passengers' level of knowledge is always overestimated in the design of the information board. This misunderstanding creates difficulties for passengers (Beirão and Sarsfield Cabral 2007), especially for senior or junior and less educated ones.

The factors of service quality discussed above have affected users' or potential users' future choices of travel mode in varying degrees. Measurement of transit service quality has two dimensions: measures of passenger perceptions and of transit agency performance (Eboli and Mazzulla 2011). Traditional cost-efficiency or cost-effectiveness indicators are performance measures from the agency's perspective (Transportation Research Board 1999). They concern operating expenses per vehicle/per passenger/per hour. Clearly these are not indicators of concern to passengers, who are the real consumers of the services.

Eboli and Mazzulla (2011) argue that evaluation from the passengers' perspective is a very important indicator for changing travel behaviour. Passenger perception measures can be considered a more suitable evaluation of real service quality. Yet the passengers' evaluation does not always reflect reality, which is influenced by subjective factors. This makes it essential to identify the internal psychological factors.

3.5 Internal factors in travel behaviour

3.5.1 Socio-economic and demographic factors

The above discussion has shown that travel patterns are significantly influenced by various physical characteristics. All the studies reviewed reflect on the concept of "accessibility", which refers to "the ability to reach activities or locations by means of a travel mode" (Van Acker and Witlox 2010, 66). Generally, better accessibility of a transport mode will increase the usage of that mode (Geurs and van Wee 2004; Rajamani et al. 2003). Land use and transportation are important components of accessibility which affect travel behaviour. However, physical characteristics reflect only one group of the factors influencing travel behaviour; socio-economic and demographic factors also affect travel patterns (Kollmuss and Agyeman 2002). There are a large number of socio-economic and demographic variables that need to be taken into consideration. This section identifies the eight main factors and illustrates how each of these may affect travel patterns; details are in Table 3.2.

Table 3.2: Examples of how socio-economic and demographic factors affect travel patterns

Socio-economic and demographic factors	Travel Pattern	Reference
Household Income ↑	Trip frequency ↑	(Hanson 1982)
	Travel distance ↑	(Cervero 1996; Naess and Sandberg 1996)
	Proportion of car journey ↑	(Flannelly and McLeod Jr 1989)
	Transport energy consumption ↑	(Næss 1993)
Car ownership ↑	Trip frequency ↑	(Hanson 1982)
	Trip frequency →	(Prevedouros and Schofer 1991)
	Travel distance ↑	(Naess and Sandberg 1996; Kockelman 1997)
	Proportion of car journey ↑	(Næss 1993)
	Travel time ↑	(Ewing 1995)
Possession of driver's license per household ↑	Using car ↑	(Flannelly and McLeod Jr 1989)

Socio-economic and demographic factors	Travel Pattern	Reference
Workers per household ↑	Trip frequency (per household) ↑	(Ewing, DeAnna and Li 1996)
	Travel time ↑	(Ewing 1995)
Gender	Trip frequency →	(Hanson 1982)
Age ↑	Trip frequency →	(Hanson 1982)
	Proportion of car journey →	(Flannelly and McLeod Jr 1989)
	Transport energy consumption ↑	(Naess and Sandberg 1996)
Household size ↑	Trip frequency ↑	(Hanson 1982; Kockelman 1997)
	Travel time ↑	(Ewing 1995)
	Transport energy consumption ↑	(Boyce and Daskin 1997)
Level of education ↑	Proportion of car journey ↑	(Flannelly and McLeod Jr 1989)
	Proportion of public transport use↑	(Boarnet and Sarmiento 1998; Kockelman 1997; Stead 2001)

Note: " ↑ " denotes increasing the amount, speed or percentage. " → " denotes remaining the same. Source: author, summarised from the literature.

Table 3.2 indicates some research findings regarding the influence of socio-economic and demographic factors on travel patterns, which gives a general idea of the effect of individual variables on travel behaviour. Some factors have a significant relationship with travel variation; for example, higher income, more vehicles, more driver's licences, and more working people, will lead to more frequency of trips and miles of driving. The other factors such as gender or level of education do not have a clear relationship with trip frequency or travel. Measuring the socio-economic and demographic variables of a traveller, while not problem free, is said to be considerably less straightforward than measuring the spatial constraints facing an individual (Hanson 1982). Another difficulty is those factors are always interconnected and it is difficult to separate the effect of one from another (Hanson 1982). For example, household income is related to the number of people participating in the labour force and their working status (full/part time). Household vehicle ownership and use also relates to family income. The employment status of a family is influenced by the gender proportion in the household, the number of driving licenses, and the age of residents. The following discussion will highlight some of the important socio-economic and demographic factors, to ascertain whether travel behaviour is affected by those factors.

3.5.1.1 The relationship of income and car ownership with public transport usage

The relationships between income, car ownership and public transport usage have been widely investigated for quite a long time (Goodwin 1993; Kitamura 1989; Paulley 2006). Generally as income increases, car ownership will increase and so will car use. Also, higher income levels are related to more trips and longer distance travel (Paulley 2006). Income growth has decreased the real cost of car ownership, which will increase travellers' greater preference for using cars. From this we can see that an increase in income will affect the demand for public transport modes. Kitamura (1989) discusses the importance of analysing how income affects car ownership, explaining that car use determines transit use but not vice versa. Current unsustainable travel patterns (as discussed in Chapter 1) with cars widely used and a decline in transit use are largely connected with rising incomes and car ownership. This trend is especially obvious for developing countries (Dissananyake and Morikawa 2001). Investigation of transport policies in developing countries have been focused on vehicle taxes or increasing parking fees in city centres, together with reduction of public transport fares (Dissananyake and Morikawa 2001). However, those economic policies will become more and more inadequate as cost becomes less relevant compared with travellers' great preference for using private vehicles. In developed countries, nowadays, public transport usage is not so closely related to car ownership since other reasons like trip purpose (non-work or work trip) and travel attitudes also affect use. Germany provides an example for coexistence of high car ownership and relatively high PT usage. Research shows that Germany and America are both high car ownership courtiers; however "Germans are five times more likely to ride public transport for shopping or recreational activities as Americans" (Buehler 2011, 650).

3.5.1.2 The relationship of gender with work or non-work travel

The relationship between gender and travel patterns is still debated. This is because behaviour diversity in gender is also largely connected with culture or has great regional differences. For example, for non-work trips, studies in America specify that women travel by car more often and travel longer distances (Boarnet and Sarmiento 1998). However, studies in Europe have found the opposite: women prefer to go shopping nearby by walking or cycling, compared with men (Schwanen, Dijst and Dieleman 2002). All this can be explained by the characteristics of work and non-work travel; research has shown that women undertake less commuting travel because they are more involved in household maintenance jobs than men. However, preferences for mode of work travel or non-work travel, by car or public transport, differ in different countries and are determined by socio-

economic background, the physical structure of the cities, and also the public transport situation (Schwanen, Dieleman and Dijst 2004; Stead 2001).

3.5.1.3 Children, young adults and older people's travel characteristics

Age is another important variable in relation to travel patterns. It has been proved that children, young adults and older people travel differently in their daily life (Su and Bell 2009; Tranter and Whitelegg 1994). This is because they have different types of activities. Children's activities are mainly education and entertainment related. Young adults are mainly engaged in social, leisure and educational activities. Other adults, like parents, are undertaking more work-related or shopping-related activities. Older people are mostly engaged in social and leisure activities. Different activities combined with age characteristics will affect travel patterns, especially travel distance. Older people have physical constraints, and are likely to travel shorter distances, especially for non-motorised transport modes such as walking and cycling (Schwanen, Dieleman and Dijst 2004; Stead 2001). It is asserted that for adults (especially those with families), travel distance is always longer than for other groups because their activities are always scattered (Schwanen 2002).

3.5.1.4 The interaction of household size and structure with car use

Household size is related to travel and activity. Generally, where there are a greater number of household members, this will lead to more household vehicle ownerships and a greater number of activities; thus individuals who are from large households tend to travel more and have possibly a stronger reliance on cars (Kockelman 1997). Household structure also affects travel behaviour to a certain degree. For example, compared with single households or childless couples, the presence of children will increase the use of the car for longer distance travel; at the same time, the use of public transport, cycling or walking will decrease (Dieleman, Dijst and Burghouwt 2002). In a household, the number of people participating in the labour force will also determine the amount of car use (Cervero and Kockelman 1997). This is because the characteristics of commuting travel are different from journey purposes such as shopping for household needs or escorting the children to school, or other social travelling. Commuting travel always happens regularly in certain periods, and preferences for car or for public transport are determined by many other factors, as discussed in 3.5.1.2.

3.5.1.5 Educational level and employment status

The next important factor is educational level. Studies show that people who are highly educated will have more job opportunities in central business districts (CBD) or office parks with high employment density. The previous discussion has shown that there is plenty of research concerning the relationship between population density and travel patterns (see 3.4.1.1), but there is much less research that suggests a link between employment density and travel patterns (Stead and Marshall 2001). Some argue that high employment density area such as CBDs will have good public transport access and the use of public transport is likely to increase (Dissanayake and Morikawa 2002). Others assert that the daily commuter journey will result in a longer distance travelled and the car always will be the first option, especially for high income earners (Asensio 2002). The mode choices of commuting into the CBD are determined by several variables, including city structure, public transport accessibility and transport policies such as parking facilities in the central city area. Besides educational level, employment status also affects travel patterns. Researchers assert that people who are in part-time jobs travel longer than those who have full time jobs (Longhurst and Brebbia 2012). This is because the part-time workers usually have more spare time to be engaged in other activities such as recreation or socialising; also perhaps they have other part-time jobs which are scattered resulting in more travel.

3.5.2 The importance of attitude factors

The above external and internal factors of socio-economic and demographic dimensions have been extensively discussed by researchers to explain the variation in travel patterns. Travel behaviour is the outcome of a series of complex travel-related decision-making processes; therefore, travellers' attitude factors (attitude, preference, motivation) should also be examined when explaining observed travel patterns, but are often ignored by researchers (Bowman and Ben-akiva 1996). For example, from the perspective of attitude, it is common that despite sustained publicity about car pollution and environment protection, people appear conflicted about their travel decisions: they wish to protect the future environment and ease congestion but they are not ready to drive less. Another example is that the car is so popular, not only because of its instrumental functions (Steg 2005); some people buy and drive cars simply because they like to (for reasons such as a feeling of power, freedom or superiority). The car then is more than a means of transport. Thus there is a need to understand the motives for car use. To find out the reasons behind use or non-use of public transport, there is also a need to understand public transport

users/non-users, in terms of their desires or perceived attitudes and their social-spatial relationship (Hiscock et al. 2002).

Travel behaviour choices are closely related to individuals' attitudes to urban life (Kitamura, Mokhtarian and Laidet 1997). These attitudes can be concerned with the environment, prejudice towards public transport, preference for town (or suburban) lifestyles, love of adventure. For example, people with pro-car attitudes will, unsurprisingly, drive more; therefore, working on physical attributes can reduce the "need" for driving but cannot necessary decrease the "choice" of driving. Promoting measures to maximise the attractiveness of public transport or to minimise the attractiveness of car can both be options (Gärling and Schuitema 2007). However, as discussed in Chapter 1, public transport is not always competitive with a car, which is well known for its comfort, fast speed, direct route and individual freedom (Anable 2005). This means there is a need to improve the quality of public transport service to reduce the disadvantages (or perception of the same). Murray, Walton, and Thomas (2010) argue that to address the current problem of low use of public transport by both improving the quality of the service and reducing the levels of public transport prejudice are important solutions. Car drivers' perceptions of the quality of public transport are among the main barriers to change of travel mode (Stopher 1982). To present a clearer picture of this argument, one study from Perth (one of the case study areas for this research) can be used to provide some evidence. The Department of Planning and Infrastructure of West Australia has conducted research that reveals the misunderstandings of local people about public transport. It has published a brochure named The *truth about travel in Perth* (web: www.dpi.wa.gov.au), aimed at helping people to better understand public transport as well as the pros and cons of driving in their local areas. Table 3.3 summarises the key information about the "myths" and "truth" in the six criteria of public transport services discussed above. This shows that there is a big gap in real life between users' or non-users' perceptions of service quality and providers' count which has resulted in a low level of public transport usage. These prejudices also confirm the importance of perceived attitude factors in travel behaviour research.

Table 3.3: The myths and truth of travel in Perth

Most Concern	Myth	Truth
Availability	We have to drive because Perth is so spread out and public transport network has less coverage.	Across all suburbs, 3 out of 5 trips could easily be made by walking, cycling or public transport. Perth's public transport services and network of shared paths are ever-expanding, providing additional travel options in all areas of Perth.
Travel Time	People come to think this is normal: that slow journeys are a characteristic of public transport anywhere.	Many public transport trips – especially trips to the city – can actually be faster than driving. When people were asked how long they thought it would take to reach a destination by public transport they over-estimated the travel time by 50%. Car travel time was under-estimated by 20%.
Travel Cost	Driving is the most economical option	Owning and running cars represents a major cost for households and accounts for 15% of expenditure for WA households. The RAC estimates that a Holden Astra doing 15,000km/year would cost over $158 a week (standing and running costs) and a Nissan Patrol more than $290 a week! The discounts available with SmartRider tickets will make your trip even cheaper. On the other hand, walking is free, and improves your health.
Comfort	Driving is easier than catching public transport	Going by bus or train is often far less stressful than driving and gives you time to read, think or chat. By taking an alternative mode of transport (other than the car), you can avoid traffic congestion, parking issues and associated car running costs.
Safety	Driving is the safest method of transport	Public transport safety, especially on trains, has been raised as a concern in the past. The fact is that public transport is very safe, with relatively few incidents. However, in response to public concern, extra security measures have been introduced to improve safety for all public transport users. In terms of road safety, travelling by bus or train is far safer than car travel.
Information	We have no idea of which bus or train to catch	Planning your public transport journey is easy. Transperth has a website, phone information line and InfoCentres which can provide you with all the information you need to use public transport in Perth. The Transperth website features a Journey Planner, where you can enter your starting point and where you want to travel to. The planner provides the best options for getting to your destination including route map and travel time.

Source: Government brochure "The truth about travel in Perth", the Department for Planning and Infrastructure.
http://www.transport.wa.gov.au/mediaFiles/AT_LS_P_truth_about_travel_in_Perth.pdf

3.6 Interaction between external and internal factors

This review has shown that both external and internal factors affect travel behaviour and must be taken into account in travel behaviour research. In the past 30 years, many countries have set up studies to investigate the main factors affecting public transport patronage. The main focus is on external factors, but the relative importance of those external factors and the ways they influence travel choices is less well understood (Taylor and Fink 2013). This is due to the intensive interaction between various factors and difficulties in collecting accurate data. For example, some urban planners insist that transport patterns are an outcome of urban development, asserting that compact cities or transit-oriented designs are necessary to absorb more public transport riders (Cervero and Seskin 1995). But high patronage public transport also exists in some low density places (Breheny 2001) and effective public transport networking planning has achieved this (Mees 2010). External factors are always associated with internal factors; for instance, built environment characteristics are closely related to socio-economic characteristics. For example, when people choose their residential location they prefer to live in certain kinds of residential area, which are chosen according to a range of factors including affordability, which reflects their income level. Also, areas with high levels of car ownership and use may become car-oriented environments with high levels of parking facilities. Stead and Marshall's (2001) research provides evidence of such relationships. Besides the socio-economic factors, internal factors – travel attitude and preference —are also related to the built environment factor. There is a complex relationship between socio-economic factors and travel attitude factors (see Figure 3.1).

The above discussion has shown the complex relationship between external and internal factors in travel behaviour. This has made it extremely difficult to distinguish the impacts of one from those of another. Several studies have met this challenge. Some do not attempt to distinguish between the two kinds of factors at all, such as Ecotec Research and Consulting Ltd (1993); some recognise the relationship, but do not identify the separate effects — they treat external factors and internal factors both as explanatory variables by using multiple regression analysis (Cervero 1989a; Ewing 1995; Frank and Pivo 1994;

Kitamura, Mokhtarian and Laidet 1997; Næss 1993). Some other studies employed research methods which held internal factors such as socio-economic variables constant in order to observe the effects of external factors (Curtis and Headicar 1995; Handy 1992). The interest of this research project is in internal factors in travel patterns; therefore the external factors which affect accessibility, including land use characteristics and other factors such as transport facilities, will need to be held constantly. The selection of case study areas will be based on this focus.

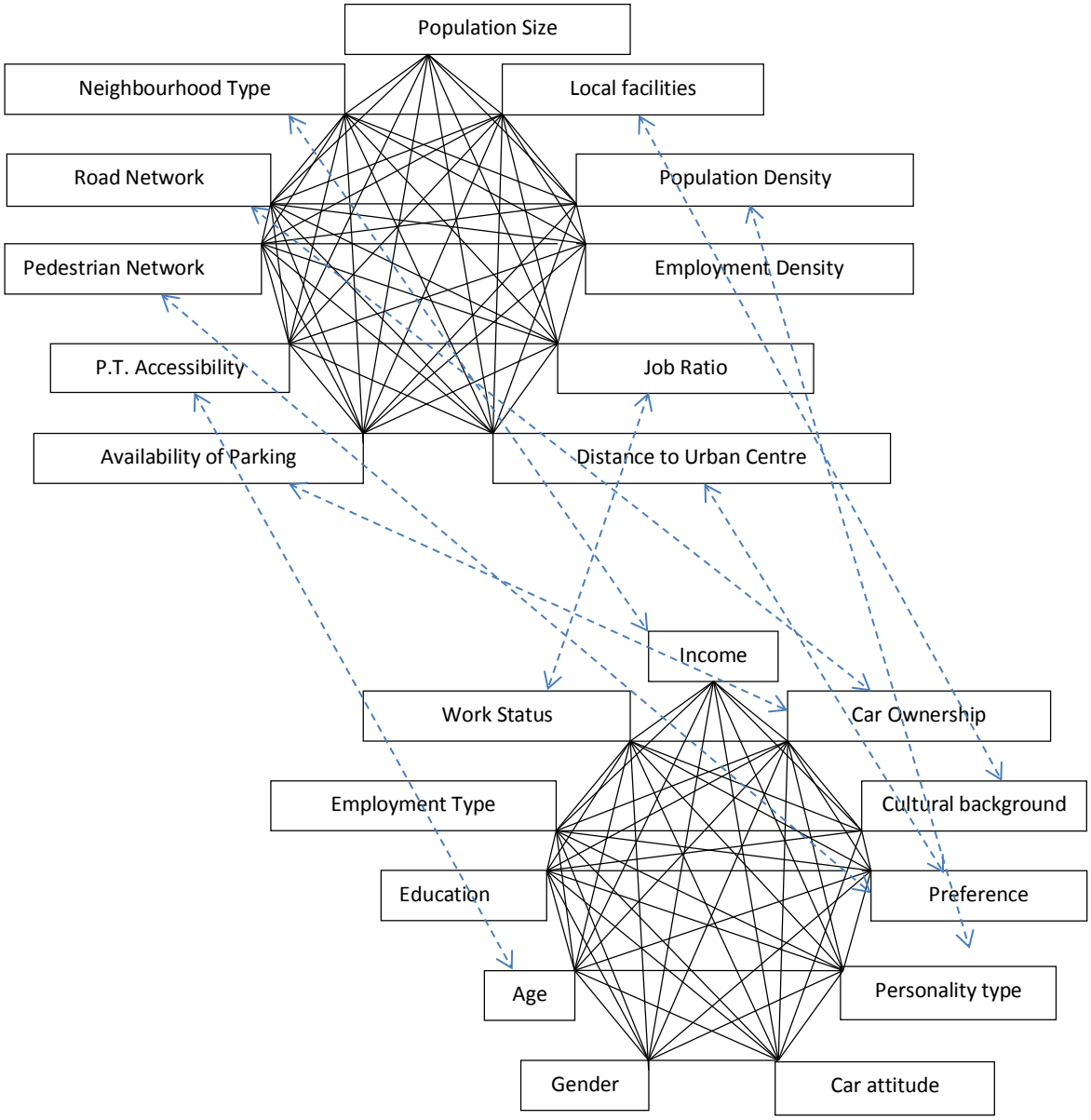


Figure 3.1: Interaction between built environment factors and socio-economic and travel attitude factors. Source: Adapted from Stead and Marshall (2001)

3.7 Conclusion

The review of the literature explores a large amount of research from around the world on the factors impacting personal travel behaviour, including external and internal factors. Of external factors, it considers the built environment and the quality of transit services. Of internal factors, it highlights several main socio-economic and demographic variables and perception variables. The review then illustrates from the literature how each of these main factors may affect travel patterns. Which factors have the stronger influence on personal travel decisions, however, is still debated (Handy 1996; Transportation Research Board 1995), and there is always a significant overlap among those factors. Built environment and infrastructure factors have been extensively discussed by many researchers in different ways. This research focuses on the impact of the internal factors of individual travellers on travel choice, since the literature has provided much evidence of the impact of different socio-economic and demographic factors. The internal factor of travel attitude has not attracted much attention in travel behaviour studies. Evidence of passengers' prejudices about public transport services reflects a disconnection between designed outcomes and the perceived quality of public transport service. This underlines the importance of travel attitude factors in travel behaviour research. Incorporating those individual factors, especially attitude factors, into transportation planning processes is essential. This raises the question of how much the internal factors affect travel choice, and how the existing public transport system can be designed to reflect this dimension. This research objective informs my empirical research design, discussed in the next chapter.

Chapter 4: Research methods and methodology

4.1 Introduction

After a review of the literature on public transport planning and travel behaviour in earlier chapters, this chapter identifies the knowledge gaps and research questions. It analyses the main research objectives behind each research question. It outlines the methodology and methods employed to explore the research objectives. Data collection methods are described, including secondary data sources and the ways of collecting primary data. The methods of data analysis are also discussed at the end of this chapter.

4.2 Knowledge gaps and research questions

The previous chapters (Chapter 2 and Chapter 3) have reviewed the literature of public transport from both the provider's and the user's points of view. Chapter 2 provides a picture of how public transport systems are designed and operated, and argues that the limitation of public transport planning is a failure to carefully consider and consult the users' requirements. Chapter 3 discusses how people's travel behaviour is shaped by a variety of internal and external factors. It highlights the importance of attitude factors, which are often overlooked by planners. As discussed earlier, under the objective of sustainable development, public transport has a greater contribution to make to sustainable mobility than does the private car. To attract more people to use public transport, there is a need to improve transport supply from the providers' side, and to manage transport demand from the users' side. "The most important challenge for transport industry is to implement environmentally sustainable transport within competitive market structures, leaning on coping with changes in transport demand while improving transport supply" (Rodrigue, Comtois and Slack 2013, 271). This reinforces that the connection between transport providers and transport users is important and challenging, and more attention needs to be paid to it.

Following the literature review, with the main research interests in mind, the overall aim of this research is to provide an understanding of the way in which public transport can be

adapted to the individual's travel activity demands and travel preferences. The main research objectives can be summarised thus:

To investigate:

1) public transport planning;
2) individual travel attitudes/preferences;
3) the gaps in public transport planning theory in terms of individual travel attitudes/preferences.

This research explores the reasons, motives and causes of individual travel behaviour and travel preferences, and why they are important to public transport planning. The ultimate goal is to suggest to decision makers the political direction and design principles that are needed to influence travel mode choices from the perspective of individuals. The research will answer the following four sub-questions:

1) What are the key socio-economic variables that affect individual travel mode choices?
2) To what extent do the travel attitude factors of the individual affect travel choices?
3) What are key objectives and design principles of public transport planning? Are they designed to take account of the needs of individuals?
4) To what extent can individual transport preferences be met via public transport?

To answer these research questions, it is important to explore the factors that underlay them. The research objectives can be summarised as follows (Table 4.1):

Table 4.1: Research questions and research objectives

Research questions	**Research objectives**
Question 1: What are the key socio-economic variables that affect individual travel mode choice?	To look at the ever-growing travel demand and unsustainable travel behaviour; explore causal factors of personal travel behaviour. Examine socio-economic characteristics of motor vehicle use
Question 2: To what extent do the travel attitude factors of the individual affect travel choice?	To explore an internal factor which affects travel choice - attitudes and perception: • Understand travellers' attitudes and preferences in car and public transport use • To what extent these factors affect travellers' mode choice?

Research questions	Research objectives
Question 3: What are key objectives and design principles of public transport planning? Are they designed to take account of the needs of individuals?	To gain clear insights into current public transport planning and its design and operation objectives, which includes: • The key objectives and design principles of public transport planning • The obstacles to public transport planning's satisfaction of individuals' needs
Question 4: To what extent can individual transport preferences be met via public transport?	• To explore the reasons behind the knowledge gap in public transport planning • To establish what would be involved in a public transport system designed to cater for private travel preferences

As discussed earlier, travel behaviour is affected by various factors, and to find out whether there are significant individual factors associated with mode choice, it is necessary to control the other factors — in this case land use and public transport service (Figure 4.1). This has directed the selection of case study areas.

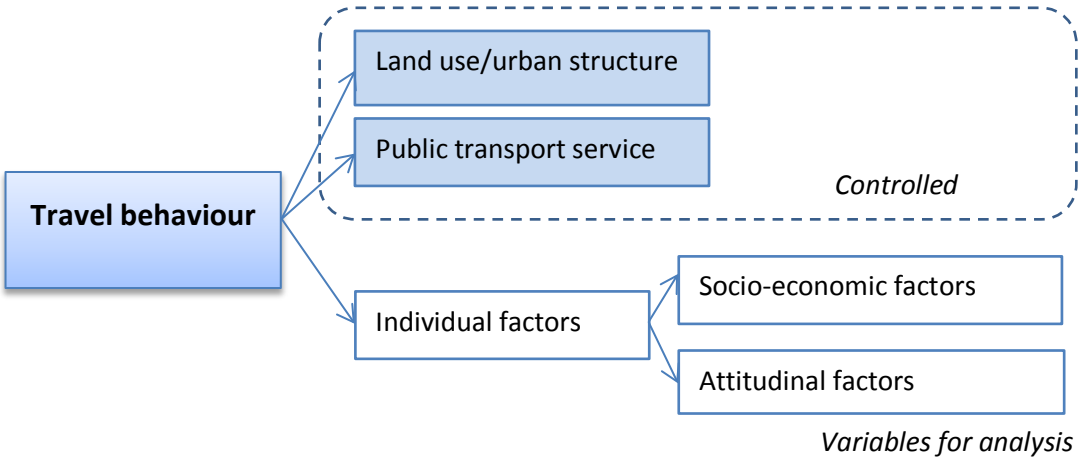


Figure 4.1: Research Approach: Conceptual Framework. Source: Author.

4.3 Research methodology and methods

Once the research questions have been determined, there is a need to identify relevant variables and research instruments that are instrumental to answering these research questions. As the literature review (Chapter 2 and Chapter 3) has outlined, each research

objective can be broke into several research variables, for which a methodology is needed to explore their effects. Table 4.2 summarises the research design, and the following discussion will give detailed descriptions of relevant research methods and methodology.

Table 4.2: Summary of research design

Background Work	Research questions	**Question 1:** What are the key socio-economic variables that affect individual travel mode choices?	**Question 2:** To what extent do the travel attitude factors of the individual affect travel choices?	**Question 3:** What are key objectives and design principles of public transport planning? Are they designed to take account of the needs of individuals?	**Question 4:** To what extent can individual transport preferences be met via public transport?
	Objectives	Traveller's socio-economic and demographic factors	Traveller's attitudes and preference factors	Public transport planning objectives	Public transport planning process
	Relevant variables	• Income • Car ownership	• Perceived public transport service • Desired public transport service	• Planning policy • Point of view of planners	• Institutional structure • The "black point" of public transport planning
Research Instrument		Household travel survey	Attitudinal questionnaire survey	Content analysis & in-depth interview	Synthesize
Data Source		Secondary	Primary	Primary	

4.3.1 Factors impacting travel behaviour: household travel survey

Research Question 1 is about individual travel behaviour. Travel surveys have a long history (Domencich 1975); among the extant travel behaviour studies, the most constantly used research method involves an analysis of travel survey data. The aim of travel surveys is "to collect data which represents as accurately as possible the travel behaviour of the

population of an area, and understand travel patterns in order to inform transport and land-use planning decisions" (Inbakaran and Kroen 2011, 1). A travel survey contains a series of questions related to daily travel activities, which helps to monitor travellers' habits, such as travel start time, travel mode, travel aim, and transfer time. It will produce a large amount of data which need statistical analysis. Household travel surveys can investigate the effects of built environment characteristics as well as socio-demographic variables on travel behaviour. This research focuses on the internal factors of individual travellers' travel choices, and to answer Question 1, pays particular attention to the socio-economic and demographic characteristics of people and households. The main issues of income and car ownership are investigated in relation to mode choices. A quantitative research method will be used to analyse the survey data.

4.3.2 Travellers' travel attitudes and preference: attitudinal questionnaire survey

To answer Research Question 2, it is necessary to understand travellers' attitudes and preferences. In psychology, an attitude is a person's point of view toward a person or a thing, and a way of saying and doing things (Petty and Krosnick 2014). Preferences are evaluative judgments, in the sense of liking or disliking an object (Lichtenstein and Slovic 2006). In the analysis of travel behaviour, measurement of personal attitudes is not often used because of the various difficulties encountered during the forecasting process (Kitamura, Mokhtarian and Laidet 1997). Experimental methods have been used by researchers to prove the significance of attitude factors (Handy, Cao and Mokhtarian 2005). Some have concluded that attitudes are more powerful predictors of behaviour than other physical factors (Kitamura, Mokhtarian and Laidet 1997).

What kind of methodology, then, is most suitable for measuring travellers' attitudes and preferences? Qualitative approaches, like interviews and focus groups, are powerful tools for gaining clear insights into the psychological issues of mode choice, and are a good option for research into travellers' attitudes and preferences. Yet it is more challenging to do qualitative research well than it is to do good quantitative research. Several issues — research design, data collection, analysis, and interpretation of conventional quantitative methodologies — challenge the qualitative researcher. Qualitative research has been criticised for lack of scientific rigour and the limitations of subjective interpretation

(Sandelowski 1986). It is clear that the experience and skill of the researcher is important in qualitative research.

To strengthen qualitative research into travel attitudes, there is a growing trend of adding attitudinal questions to supplement results of surveys into attitude-caused travel behaviour (Clifton and Handy 2001). Generally, attitudinal factors can be assessed through responses to a series of statements representing attitudes toward various aspects of lifestyle, such as work habits, outdoor activities, reasons for preferring particular modes of travel, and attitudes toward time, economy and environment. Respondents are asked to give a "yes/no" answer, or using a Likert Scale, state the degree to which they agree or disagree. The statements are collapsed into smaller set of factors for group attitude analysis using a quantitative method. In many cases there are 20-40 statements for participants to consider, and the final data need to be identified into principal types of attitudes (Jensen 1999).

In this part of the research, the aim is to assess the extent to which travel attitude factors can impact travel choices. Fixed items in attitudinal questionnaires for participants to respond to, as described above, will help the participants to concentrate on the research focus. This attitudinal questionnaire survey method enables the researcher to conduct the survey and to analyse the results within a framework.

There are reliable methods for conducting attitudinal questionnaire surveys. Attitudinal questions are used by researchers in the form of travel dairies. For example, Kuppam, Pendyala, and Rahman (1999) used the 1991 wave of the data set in the Puget Sound Transportation Panel Survey to explore the role of attitudinal and preference variables in explaining mode choice for commuter trips. Attitudinal questions were asked about the transportation system: performance ratings were surveyed for a variety of characteristics of different modes; a series of questions were asked about the need for a car, the availability of transit, and the availability of a possible co-rider; and importance ratings were elicited for various characteristics of transportation systems. Another travel diary survey of five neighbourhoods in the San Francisco Bay Area (Kitamura, Mokhtarian and Laidet 1997) also included attitudinal questions about respondent's neighbourhood preferences and feelings about their current neighbourhood. In addition, an individual questionnaire surveyed the reasons for selecting particular modes, and attitudes about time, the environment, housing, the economy, and lifestyle (Kitamura, Mokhtarian and Laidet 1997). For better analysis, the researchers collapsed the thirty-nine attitudinal questions into eight factors.

The two studies summarised above are evidence that attitudinal questionnaire surveys can be combined with travel dairies or can be conducted separately with individual travellers. The questions can be directly related to travel habits or can survey associated factors such as lifestyle, environmental concerns and so on.

4.3.3 Relevant transport policies: content analysis and in-depth interviews

Following the survey of the impact of internal factors on travel behaviour, the next step is to examine current transport policies and the extent to which the planning objectives have delivered the passengers' requirements. A content analysis of relevant policy documents is necessary to reveal the focus from the transport providers' side. Content analysis is a research method that provides a systematic way of describing and quantifying specific phenomena. A classification system was established for the purpose of investigation. Documents from the relevant transport bodies were coded to distinguish the differences and similarities between categories (Downe-Wamboldt 1992). Content analysis can measure within individual documents or do horizontal comparative analysis between policies from different level of authorities or across countries. In this research, the content analysis framework is made up of a set of public transport planning principles derived from the literature review (Chapters 2 and 3). Critical attributes of specific categories are selected for analysis.

Chapter 2 reviews existing theory and knowledge relating to the transit planning process. But reality does not always follow theory; to find out if there a mismatch between desired planning objectives and real outcomes, an in-depth investigation into practice is needed. An effective method is to explore how key objectives are understood by different participants, and also how these understandings will affect planning outcomes. For this research, in-depth interviews with different representatives of transport providers, such as transport policy makers, transit agents and public transport planners, will be necessary. The interview questions can be derived from the research findings from the above content analysis. Thus existing local transit planning policies are reviewed and related back to the theory of public transport planning (chapter 2), focusing on planning objectives, processes and outcomes. The aim is to provide an overview of contemporary public transport planning in the two case study areas, and thus contribute to further stages of the research program.

As this part of the research is designed to answer Research Question 3, to provide a significant insight into a given situation, a qualitative research method is employed in this part of research. Although qualitative techniques do not yield statistically significant results, they are ideally suited for exploratory research (Clifton and Handy 2001). Transport planning is a complex process; qualitative methods are powerful for exploring the complexities of participants' perceptions and attitudes. Unlike quantitative studies, most of the variables tend to be concentrated around a few attributes. A qualitative approach has the advantage of allowing people to raise points that are of importance to them and to express their feelings in their own words.

4.3.4 A comparative study: using a cross-cultural case study approach

Cities exist in a world of cities, and in urban studies, comparative methods are being used more often in an era of globalisation (Robinson 2011). To give the study a global perspective, Perth and Shanghai, which represent developed and developing cities, are chosen as case study areas for a comparative study. This gives the research topic very different perspectives since the significance that public transport has for urban mobility in those two cities varies greatly. Public transport is used for a much lower percentage of all trips in Perth than in Shanghai. The rapid rise in car ownership and the highly suburbanised and low density urban structure, by world standards, have made the car essential for most people in Perth. On the other hand, Chinese cities have maintained the level of car use at a low point. This pattern is influenced by many factors; for example, by economic development and the form of urban settlements, and by historic and current policy directions for infrastructure development. While identifying their differences, this research looks at the inhabitants in each case in terms of future trends. Despite considerable differences in 'mobility life-stage', both Chinese and Australian governments are taking action to develop and promote public transport as the preferred mode of motorised transport for their residents. At the whole city level, it has been demonstrated that both Perth and Shanghai are predominantly monocentric urban structures. Public transport planning in both cities downplays the importance of a user focus in public transport planning. Residents tend not to see public transport as favouring their needs. Similar underlying urban structures and planning approaches have made public transport solutions particularly challenging in both cities. Therefore, a comparative study of both contexts is both interesting and necessary. The comparative study of two diverse cities from developed and developing world with different economic/cultural backgrounds and also

within different mobility life stages contributes knowledge on public transport study, which has seldom been examined by other researchers. This will expand the scope of comparative study and also contributes to the research methods.

The challenge of conducting urban studies on a world scale is met by using a comparative approach (Robinson 2011). The methodology of comparative study involves contrasting two (or more) cases, paralleling several criteria and explaining their similarities and differences (Table 4.3). The items selected should be based on the target of the study, and decisions made about which interesting aspects will be noted and recorded for each of the cases. The design of comparative research follows a particular approach. Similarities in some aspects of two (or more) objects for case study will be controlled in order to compare their different attributes. The aim is to find out the various hidden reasons behind the differences. Another approach is to search for the similar aspects among the differences of the two (or more) objects. The enormous differences in socio-economic and cultural background as well as governance structures between developed and developing countries make it hard to decide the objectives for comparison in cross-cultural studies. These challenges have restricted current comparisons in urban research primarily to cities with similar backgrounds. However, with the trends to globalisation based on the intensive networks of communication, cities are being linked together and begin share certain commonalities. To apply the best available ideas in the area of urban studies, cross-cultural analysis has become even more important in a globalising world. Whatever the methods used, a sound knowledge of different national contexts such as socio-cultural setting is needed. A cross-cultural comparative study method is the core research method of this research project.

Table 4.3: The method of comparative study. Source: author

Criteria	Variations	
	Case 1	Case 2
A	A1	A2
B	B1	B2
C	C1	C3

4.4 Motivation for choosing the two case study cities

Urban transport, motorisation and the development of 'automobile dependence' have become critical factors in the future liveability of cities, not least in developed cities with their continued patterns of automobile dependence, but also in developing cities, where motorisation is increasing rapidly. Environmental problems in the context of sustainability are concerning among all the large cities around the world. Of interest is that the developed and developing cities are at different stages of automobile dependence – developed cities have high levels of car ownership and use and are seeking to reduce car dependence, while developing cities are developing apace and shifting from the slower modes of travel towards car use. In both cases, the policy solution is seen as public transport – in the first case as an alternative to what are now ingrained patterns of car use, in the second case as a means to stem the growth of emerging car use.

By international standards, Chinese cities, like cities in other Asian countries, are well-known for their wide use of non-motorised transport; for many years walking and cycling were the predominant mode. Also, the transport mode maintained the level of car use at a low point (Kenworthy 2002). However, with the Chinese economy booming, the speed of motorisation is rapid, beyond imagination. From 2000 to 2010, the total number of cars and motorcycles in China increased 20 times (National Bureau of Statistics of China, 2010). Chinese economic policies which support the car industry exacerbate this trend. It has become a great challenge to develop quality public transport systems to compete with private transport (Han 2009). On the other hand, Australia's major cities have an extreme reliance on the car, which gives them the reputation of being the most car dependent cities in the world, aside from American cities (Newman and Kenworthy 1999). The rapid rise in car ownership, and the highly suburbanised and low density urban structure, by world standards, has made the car essential for most people. Australians are now the highest emitters of greenhouse gases in the world, which is largely due to the nation's obsessive reliance on the private motor vehicle and prolonged major investment in public transport infrastructure that permits this obsession to continue (Taylor and Fink 2013). Governments in Australia respond in a number of ways to encourage public transport use to escape from this challenging situation.

Despite considerable differences in the economic situations, urban land use patterns and 'mobility life-stage' of the citizens, both Chinese and Australian governments are taking action to develop and promote public transport as the preferred mode of motorised

transport for their residents. The Australian response is seen as a solution to car dependence, and in China where car ownership is in its infancy, the concern is to ensure car dependence does not take hold (Næss 1993; Pacala and Socolow 2004; van Acker and Witlox 2005). The challenge to change behaviour towards public transport in the face of the love affair with cars is a worldwide problem, not only for developed countries but also for fast developing countries. To develop this research topic into a world-wide analysis will enrich the international scope of the research themes and help the exchange of ideas. This is the original motivation for a comparative study of a Chinese and Australian city. Also, as mentioned earlier, my Chinese and Australian background makes me familiar with the different national contexts, and fuels my keen interest in cross-cultural studies.

Perth is known as one the most car dependent cities in the world; it has become a sprawling metropolis of over one million inhabitants residing in a 5386 km² area today (see Table 4.4). It is a typical car dominated dispersed city. Shanghai, one of the world's busiest cities, with a dramatically growing economy, has an extraordinarily fast pace of motorisation: 23 million people reside in the 6,340 km2 area of Shanghai. The population density, using 2010 data, averages 3,632 persons per square kilometre, which is more than ten times that of Perth (see Table 4.4). Yet the average household income is less than one quarter of that in Perth (Table 4.4). Despite rapid economic growth, vehicle ownership remains remarkably low in Shanghai, which is far behind Perth. It is a typical public transport dominated high populated city.

Table 4.4: Basic statistical comparison of Perth and Shanghai

	Perth	**Shanghai**
Development	Developed city	Fast developing city
Total area	5386 km²	6,340.5 km²
Population	1.696 million (2010)	23.02 million (2010)
Population density (number of persons per km2)	308/km² (2010)	3632/km² (2010)
Household car ownership	1.03/house	0.053/house
Median household income	AU$56,472	AU$12,550

Source: Shanghai data is from Shanghai statistical yearbook (2005-2011); Perth data is from Australian Bureau of Statistics, Regional Population Growth, Australia, 2011

In many respects, despite considerable differences in scale, both cities are now facing environmental and social challenges associated with car use. In addition, researchers have found that both Perth and Shanghai are predominantly monocentric urban structures (Curtis 2005; Pan 2010). The municipal government of Shanghai has paid great attention to

de-centralising its city structure; however, the strategy of encouraging the people to stay in satellite towns has not been successful (Pan 2010). Perth developed historically with low density and mono land-use (Curtis 2005). Both cities' travel patterns have developed in a similar way, which has created congestion in the city centres and on radial links into the centre. As for the public transport planning policies, both cities appear to downplay the importance of a people-centred public transport system. Residents do not see public transport as supporting their needs. Similar underlying urban structures and planning approaches have made public transport solutions particularly challenging in both cities. Therefore, an investigation of travel behaviour is important for these cities.

4.5 Choosing the case study areas

At the neighbourhood level, prior to this research, there were two extant studies in Perth, Australia and Shanghai, China which examined residents' travel behaviour by using household travel surveys. These two studies coincide with the rationale for study area selection in this research project. The secondary data for this study, therefore, are from two household travel surveys (HTS): the Perth new railway station precinct HTS (Curtis and Olaru 2010), and the Shanghai four neighbourhoods HTS (Pan, Shen and Zhang 2009). Both of the surveys are neighbourhood scale, and travel information about households is obtained from individual household members. The details of those two projects are shown below (Table 4.5).

4.5.1 Basic information for the two extant projects

The Perth project was an Australian Research Council Linkage project based at the Department of Urban and Regional Planning at Curtin University (Curtis and Olaru 2010). The research assessed the behavioural responses of household residents to changes in accessibility following the opening of a new railway. As a quantitative study it used a 'longitudinal' approach, with three waves of survey spanning the period 2006 to 2009. 1034 households were surveyed pre-railway station opening (autumn 2006), 674 of them were resurveyed post-railway station opening (2008), and again, one year later (2009), 526 households were surveyed. Data on household travel behaviour and activity patterns was used to gain an understanding of behaviour changes following the construction of a new transit facility. The Chief Investigator (CI), Prof. Carey Curtis from Curtin University is the main supervisor of my PhD study.

In Shanghai, Tongji University has conducted a travel survey of 1709 individuals from four selected neighbourhoods in Shanghai to understand the effects of changing urban form on travel in Shanghai (Pan, Shen and Zhang 2009). Professor Pan, the project leader, is a partner of GAMUT (Australasian Centre for the Governance and Management of Urban Transport) and a research collaborator with my supervisor Prof. Curtis.

Table 4.5: General information for the two projects

	ARC TOD project, Perth	**Four neighbourhoods project, Shanghai**
Research purpose	To examine behaviour changes following the construction of a new suburban railway through southern Perth suburbs and the corresponding transit oriented development (TOD). Three railway station precincts were selected for longitudinal comparison study.	To understand the effects of changing urban form on travel in Shanghai, this research conducted a survey of residents in four representative neighbourhoods from the inner and outer city of Shanghai. The selection of these four neighbourhoods was mainly based on the time-periods during which they were developed.
Year of Travel data collection	2006-2009	2001
Survey Approach	The first three waves of survey were conducted with personal interviews. The last one was by mail-out and Internet.	The survey was conducted by means of on-street interviews in the four selected neighbourhoods.
Sample size and response rates (%)	Wave 1 (2006): 1034 (49%) Benchmarking (2007): 310 (34%) Wave2 (2008): 674 (25%) Wave3 (2009): 526 (9%)	1709/7634 (22%)

	ARC TOD project, Perth	Four neighbourhoods project, Shanghai
Contents of the survey	1. Information on households, such as size, type of dwelling and tenancy. 2. Information about vehicles, such as type, make, age, fuel, costs amount. 3. Information on household members, such as age, gender, education, work/education place, number of weekly hours. 4. Travel diaries: collected as daily logs of all trips made by each household member on the specified Wednesday such as origin, destination, departure and arrival time, purpose/activity, mode of travel, route, party size, out-of-pocket cost, parking, transfers. 5. Information on previous location and push and pull reason for moving from the previous residence.	1, Socioeconomic characteristics of the respondent, including age, gender, occupation, household size, household income and number of motor vehicles in the household. 2, Travel characteristics of the respondent, including all trips made in a typical day, daily trips, origin and destination of each trip, travel mode, purpose and trip time. 3, The respondent's travel mode evaluation, covering the dimensions of speed, comfort, flexibility, reliability and safety.
Major findings	Both TOD features and attitudinal predisposition for more sustainable travel were found to impact the choice of travel. Higher degree of TODness and access can help reduce car driving and substitution with public transport and more non-motorised transport. Households who value more TOD features are associated with increased non-motorised travel, increased physical activities and reduced car driving.	Pedestrian/cyclist-friendly urban form with higher-density, smaller blocks and denser street networks helps to reduce the need for a high level of motor vehicle ownership. Urban form through planning and design can lessen the demand for travel.

Adapted from Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

4.5.2 The selection of two case study areas

The Shanghai case study (Pan, Shen, and Zhang 2009) was based on a travel survey of 1709 individuals from four selected neighbourhoods — Luwan, Babaiban, Kangjian and Zhongyuan. The Perth study (Curtis and Olaru 2010) selected three railway station precincts — Bull Creek, Cockburn and Wellard as case study areas. Table 4.6 provides general information about public transport for the seven residential areas in Perth and Shanghai.

For this research, one neighbourhood out of the seven residential areas in each of the two cities was chosen as my case study area. Research indicates that the accuracy of travel data depends on the sample size and the time period over which the data is collected (Stead & Marshall, 2001). Besides a parallel comparison, the Perth project also drew on a longitudinal study examining behaviours during different time periods to monitor the changes (Year 2006, 2007, 2008 and 2009). Considering the data availability, sample size and relevant public transport accessibility (the train in Bull Creek was introduced in December 2007), this research will use Bull Creek data for 2009 to compare with Kangjian in 2001 (Table 4.7). Those two sets of data are similar in size and also in public transport accessibility at the time data were collected. They also are located a similar distance from the city centre in terms of urban structure (Figures 4.2 and 4.3). To provide further justification for the choice of cases, the use of the Spatial Network Analysis of Multimodal Transport System (SNAMUTS) tool to justify the selection will be explained in the next section.

Table 4.6: General transit access comparison of 7 neighbourhoods

Criteria		Perth			Shanghai			
		Bull Creek	Cock-burn	Wellard	Lu Wan	Ba Bai Ban	**Kangjian**	Zhong Yuan
Distance to CBD		12 kms	20.5 kms	37 kms	2.5 kms	4.8 kms	10 kms	10 Kms
Transit access in 1km radium (10-15 minutes walking distance)	Number of bus stops	32	29	20	10	32	56	30
	Number of rail transit stations	2	1	1	0	2	3	0

Adapted from Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

Table 4.7: Details of two case studies

	Bull Creek	**Kangjian**
City	Perth, Australia	Shanghai, China
Distance to CBD	12 kms	10kms
Population density	1925 persons/km^2	23000 persons/km^2

		Bull Creek	Kangjian
Transit access in 1km radius (10-15 minutes walking distance)	Number of bus stops	32	56
	Number of rail transit stations in 1 km radius	2	3
Year of data collection		2009	2001
Valid Number of Households		196 (drawn from a total population of 2081)	153 (drawn from a total population of 21,000)

Adapted from Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

Figure 4.2: Bull Creek location in map of Perth: distance to city centre. Source: "Directions 2031 and Beyond" (Western Australian Planning Commission 2010)

Figure 4.3: Kangjian location in map of Shanghai: distance to city centre. Source: Google map.

4.5.3 Research boundaries and neighbourhood units

In Bull Creek, the research boundary was defined as households within a 5, 10, or 15 minute walk of the Bull Creek railway station, and within a 5 minute drive to the station (Figure 4.4). In Kangjian, the research boundary was defined as the sub-district community of Kangjian Xin Cun (Figure 4.5). The maximum distances from the centre to the boundaries are quite similar for the two research areas.

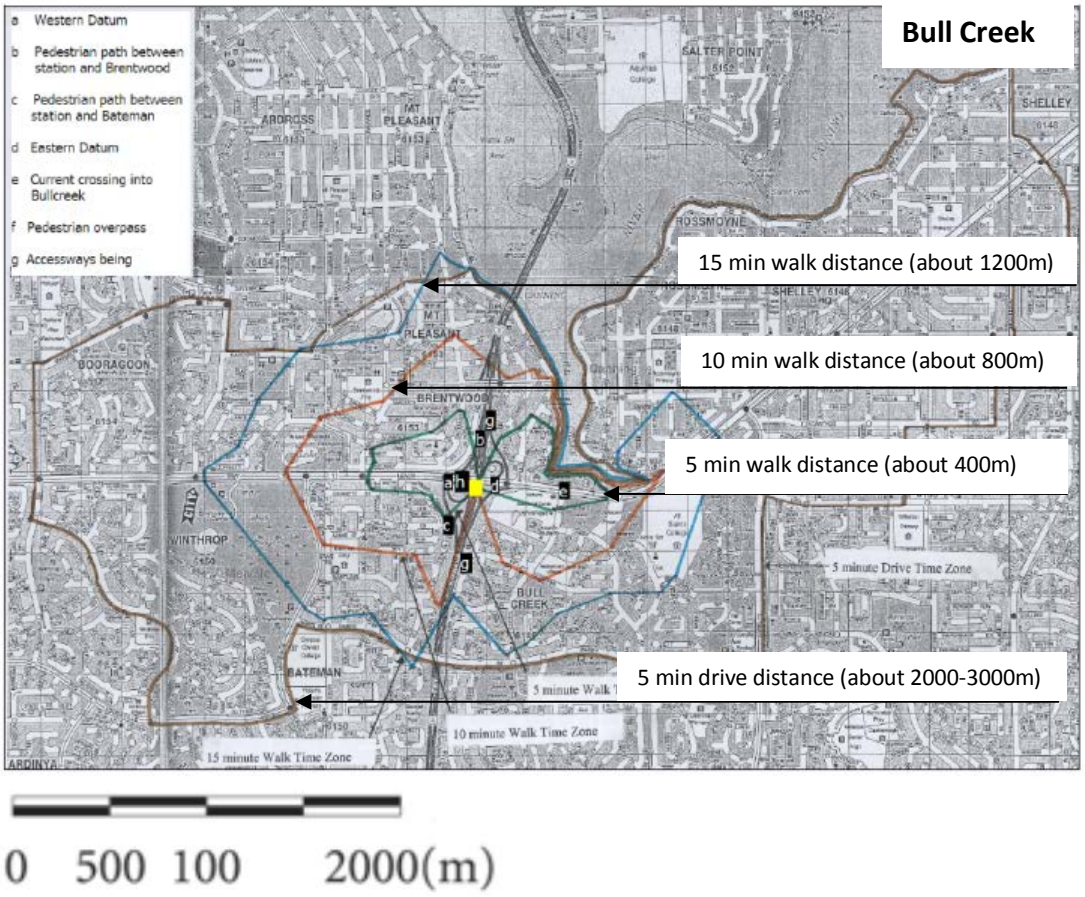


Figure 4.4: Research boundary map of Bull Creek. Adapted from Curtis and Olaru (2010)

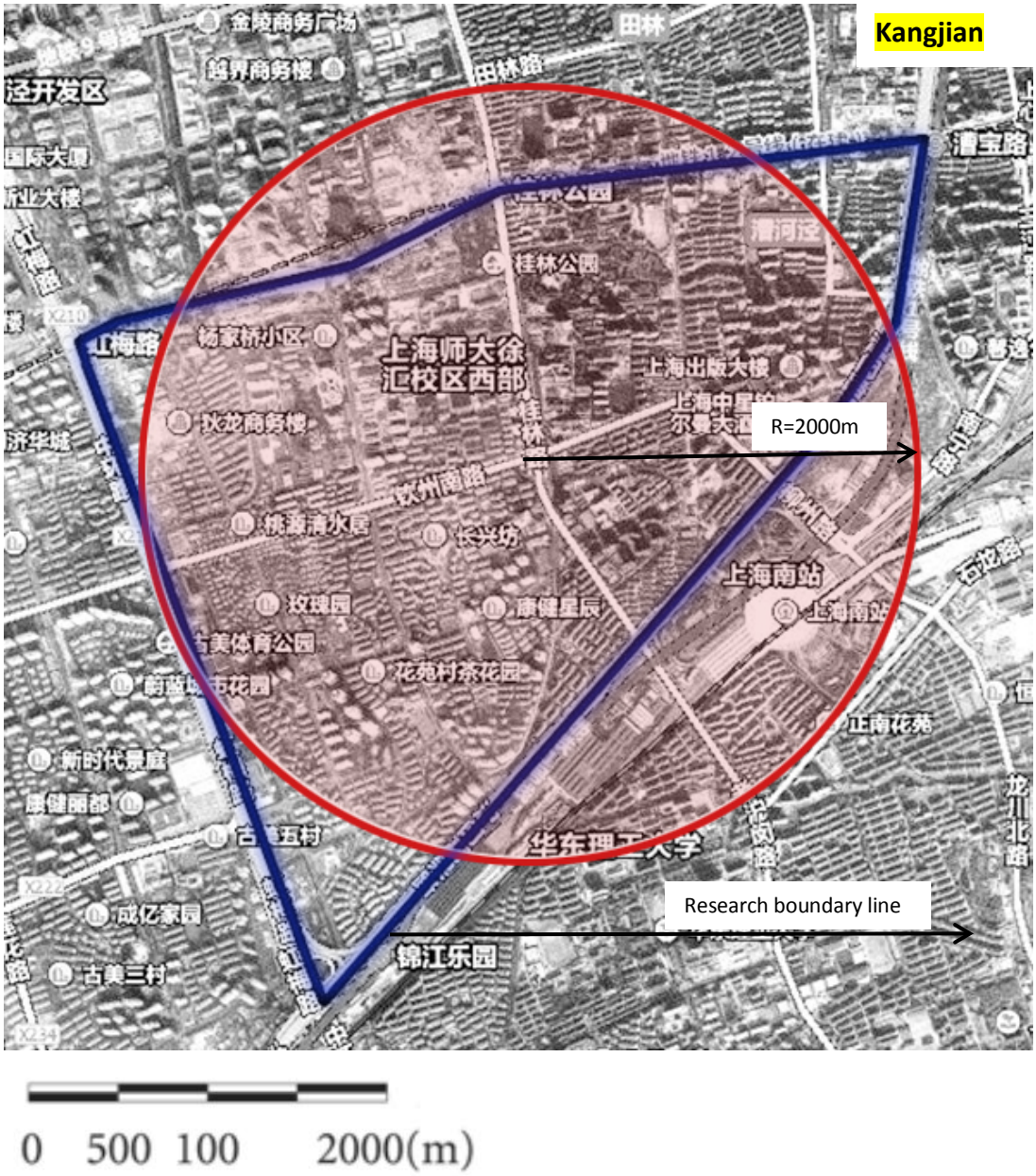


Figure 4.5: Research boundary map of Kangjian. Source: author

Bull Creek (Table 4.7, Figure 4.6)) is a suburb of Perth which was built after 1968, and is quite similar to Kangjian, with residential blocks consisting mostly of low-rise (1-2 stories) single-family dwellings, which is a typical Australian community. Its population density is less than 1/10 of Kangjian, which equals the average ratios for the two cities (Perth's population density is also less than 1/10 of Shanghai's). The train station is currently a transit interchange, sitting at a freeway interchange with a primary arterial road; its south-west quadrant is taken up with 610 surface level car parking bays.

Figure 4.6: Neighbourhood units of Bull Creek and Kangjian. Source: Google maps

Kangjian (Table 4.7, Figure 4.6) is located just outside Shanghai's inner ring road, 10 kms away from the CBD. It is a typical planned community built in the 1970s–1980s. Residential

blocks consist of mostly mid-rise (5-7 story) row houses or towers. Its planning and design generally follows the concept of the neighbourhood unit (Perry 1929) which is popularly named the “worker’s new village” in Shanghai.

4.5.4 Public transport accessibilities of those two research areas

The research’s conceptual framework (Figure 4.1) has directed the selection of case study areas; it emphasises the necessity for good public transport accessibility in both areas of comparative study. Selection of Bull Creek and Kangjian as suitable case studies based on this requirement will be explained further below.

SNAMUTS is a strategic planning tool to assess the congruence of movement and urban structure, developed by Scheurer and Curtis (Scheurer, Curtis and Porta 2008). It is a GIS-based tool designed to assess centrality and connectivity in urban public transport networks. The SNAMUTS tool can be used to justify the selection of the two case studies, by comparing the Closeness Centrality Values of nearby activity nodes with all the other activity nodes in the city. Closeness centrality describes the ease of movement along the public transport network, in terms of speed and service frequency (Curtis and Scheurer 2010). The lower the value the better is public transport accessibility. Figure 4.6 shows how Closeness Centrality Value is calculated.

Closeness centrality describes the *ease of movement* along the public transport network, in terms of speed and service frequency. It is a metric network indicator, measuring the minimum cumulative impediment value between each pair of activity nodes in each direction. It makes use of a GIS wayfinding tool which, out of all possible paths between the two nodes, automatically determines the path with lowest impediment while allowing up to three transfers. Closeness centrality is shown as an average across the network and as an average for each activity node. Lower values indicate greater centrality.

$$C_i = \sum_{j=1, j \neq i}^{N} \frac{L_{min,ij}}{N-1}$$

Closeness centrality

where:

C*i* = Closeness centrality of node *i*

L*min,ij* = Minimum cumulative impediment between nodes *i* and *j*

N = Number of activity nodes in the network

$$d_{ij} = 4 * \sqrt{t_{ij}/f_{ij}}$$

Travel impediment

where:

d*ij* = Impediment value of route segment between nodes *i* and *j*

t*ij* = Travel time between nodes *i* and *j* in minutes

f*ij* = Service frequency in departures per hour per direction between nodes *i* and *j*

Figure 4.7: How Closeness Centrality Value is calculated? (Source: http://www.snamuts.com/closeness-centrality1.html)

The database of Perth's 89 activity nodes in Curtis and Scheurer's research has been used in this study. The activity nodes in Perth are different from those in Shanghai in that they refer to both rail and bus routes. Because of the high usage of Shanghai's metro system, Shanghai's data only refers to its rail transit system and does not include bus routes. Altogether 232 rail nodes of Shanghai were included. It should be noted that due to the different analytical approaches (particularly the use of metro-only data for Shanghai and the multi-modal data for Perth), absolute results for the two cities cannot viably be compared. The results of the Closeness Centrality Values of both cities are shown below Figures 4.8 and 4.9). The case study area of Bull Creek has two nodes nearby: Bull Creek and Bull Creek Shops. The case study area of Kangjian has four nodes nearby: Caobao Road, Caohejing Hi-tech Park, Guilin Road and Shanghai South Railway Station. All the six nodes in the two case study areas have been highlighted in red in their city figures. The city-wide spread of results for Closeness Centrality Value clearly shows that the two case study areas have relatively good public transport accessibility compared to the rest of the network in their cities.

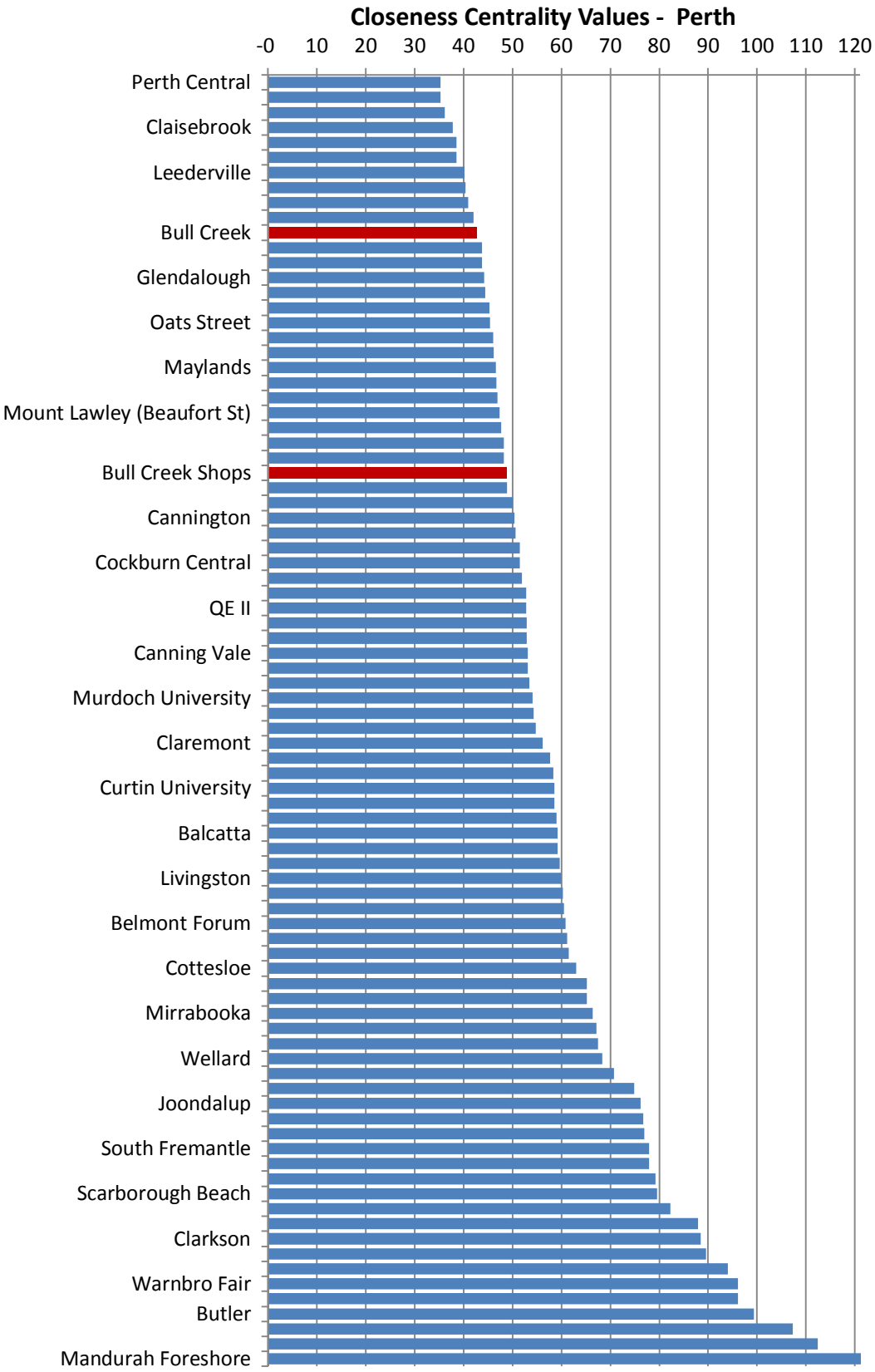


Figure 4.8: Closeness Centrality Values - Perth

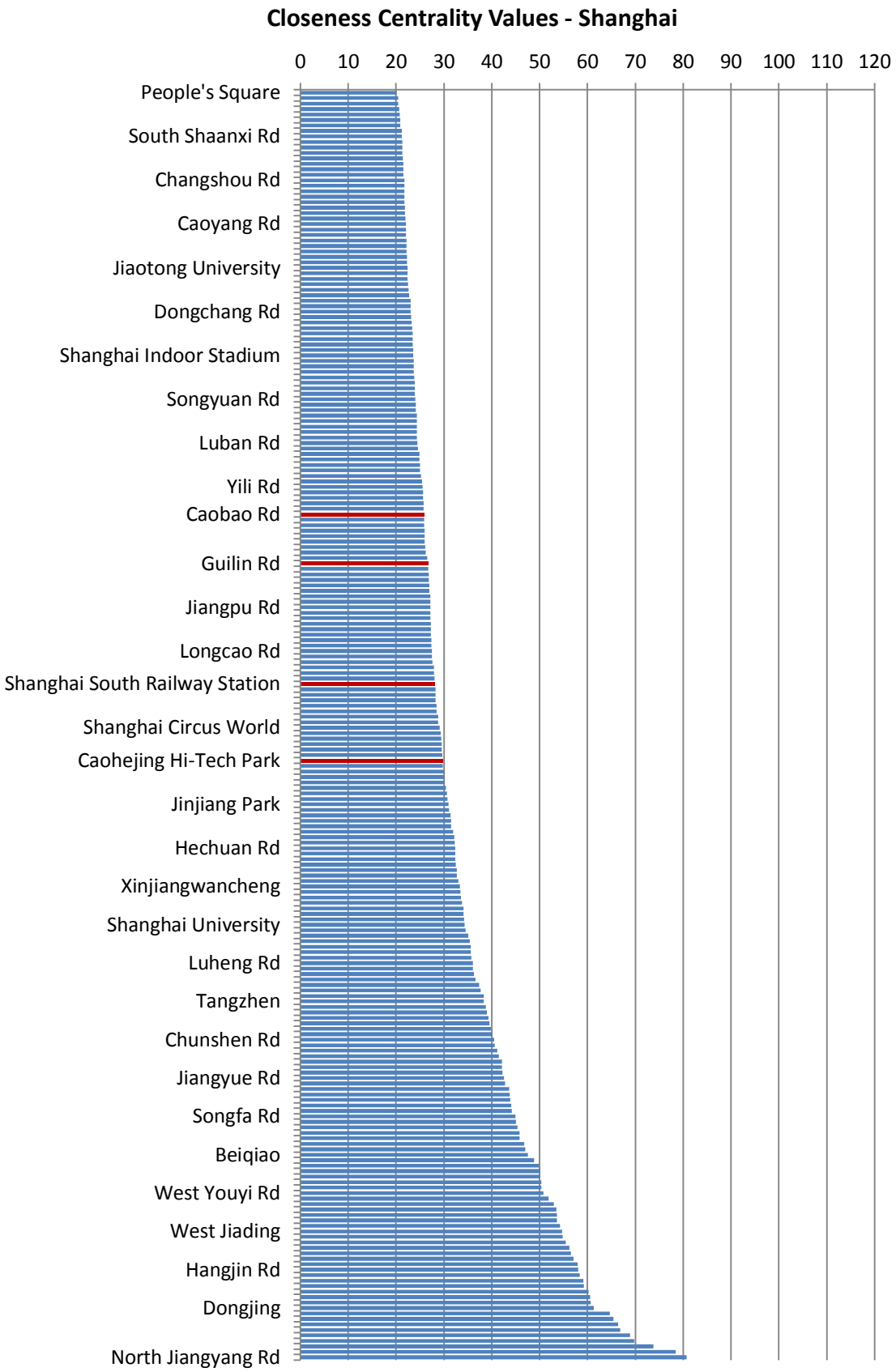


Figure 4.9: Closeness Centrality Values – Shanghai

4.6 Review of the overall research structure

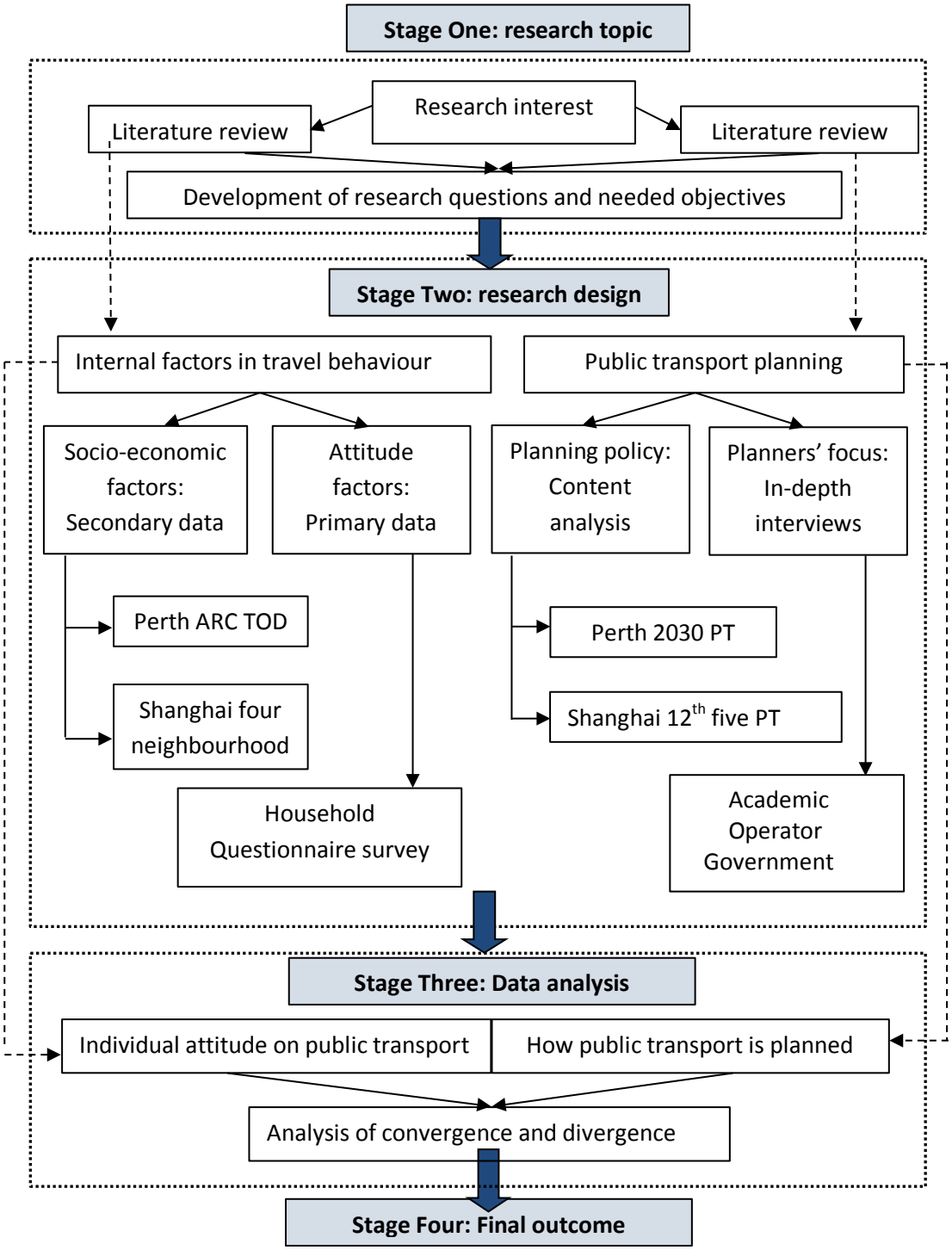


Figure 4.10: Overall structure of thesis. Source:Author

The overall research structure follows a step-by-step approach which is summarised in Figure 4.10. There are two streams of research: one looks at individual attitudes to public transport; the other looks at how public transport is planned. Each line follows the

trajectory of research topic → literature →research objectives → research method → data analysis → outcomes. The final outcome of this research is joining the two research lines together and analysing the disconnection between the two research objectives.

Chapter 5: The characteristics of travel behaviour in the two case studies: existing secondary travel data analysis

5.1 Introduction

The variables affecting individual travel choices have been summarised in the literature review chapters. Extant studies have illustrated the importance of internal factors that impact on travel behaviour, such as socio-economic circumstances. What are the different travel patterns, such as motorisation and travel mode choices, in the two case study areas, and to what extent do the socio-economic factors affect these travel patterns? This chapter analyses the secondary data from two existing household travel surveys (HTSs) of the two selected case study areas. It examines the details of travel patterns and the impact of certain socio-economic factors (in particular, vehicle ownership and income). This chapter is designed to answer Research Question 1 – "What are the key socio-economic variables that affect individual travel mode choices?" (See Table 4.1 in Chapter 4). The detailed travel outcomes in the two case studies underpin this research into new primary data on attitudes and public transport policies which will be discussed in next chapter.

This chapter has been organised as follows. It first discusses the limitations of the existing secondary data for this research topic. Then the research methods of this study — the measurement issues in the comparative analysis — are discussed. Finally, the empirical results are presented and discussed, concluding with an introduction to the necessity of studying the influence of attitudes on travel mode choice.

5.2 The limitations of the secondary data

The previous discussion has provided sufficient evidence for choosing Bull Creek and Kangjian as case study areas for this research. This chapter will use the existing data for Bull Creek (2009) and Kangjian (2001) for a comparative analysis. Previous discussion has explained the rationale for using these two sets of data in terms of data availability and sample size. However, there are three concerns with the secondary data which need

attention. Firstly, the eight-year gap between the two cases might affect the findings, especially the information which changes over time, like population and economic development. Secondly, comparing the sample size (Table 4.7), the number of households surveyed in Bull Creek is 196 out of 2081; given a Confidence Level (CL) of 95%, the value of Confidence Internal (CI) for this sample size is 6.7. Matching the same CL and CI value, ideally Kangjian's sample size should be 212 out of 21,000. The number 153 is 59 below this number, which will bring some bias to the results. Thirdly, the travel survey in Shanghai was carried out in 2001, more than 10 years ago. Since it is not possible to be granted access to the original databases, most of the data analysed in this research are cited from Professor Pan's published paper "Influence of Urban Form on Travel Behaviour in Four Neighbourhoods of Shanghai" (Pan, Shen and Zhang 2009).This is another limitation to the selection of comparable variables.

5.3 Research methods and methodology

The main focus of this part of the research is whether there are significant socio-economic characteristics associated with mode choice when land use and public transport accessibility factors are controlled. Bull Creek and Kangjian have been considered to have relatively high public transport accessibility within local areas, and are a similar distance away from the city centre in terms of the urban structure. Household travel surveys from the two neighbourhoods can give information about individual characteristics and travel patterns. Bearing in mind the research objectives of this part of the study and given the data availability, two aspects of socio-economic characteristics are considered for measuring travel behaviour outcomes: vehicle ownership and household income, which are commonly used measures of mobility and important indicators of travel demand. The travel patterns studied are trip distance and travel mode choice**.** Trip distance is a measure of revealed travel demand. It directly links travel outcomes with the distribution of homes, services and jobs. In this study the type of travel mode was divided into non-motorised, transit and private motor vehicle. Private motor vehicles are mostly passenger cars, but some motorcycles or mopeds are included in this group. Transit here includes the passenger tasks performed by all metropolitan buses, light rail and ferries. Non-motorised travel is defined as walking and cycling. Quantitative research methods will be applied in this part of research to analyse the data collected for the two extant research projects. Due to regional differences, some of the data needs to be re-calibrated for better comparison, such as income value and the division of income levels. Details are given below.

5.4 Research Findings: travel behaviour in Perth and Shanghai (secondary data)

5.4.1 Analysis of travel mode choice for all trips

This section looks at one specific aspect of travel — travel mode choices. The distribution of mode choice in the two neighbourhoods is shown in Table 5.1 and Figure 5.1. It is clear that mode share for car was very high in the Bull Creek area. The transit share is only 10.7%, about half the share for non-motorised travel (21.3%). In comparison, transit was the most popular transport mode in Kangjian with 50.1% share. Non-motorised travel also took a significant portion of the mode share (36.6%), much higher than Bull Creek. In Shanghai, in spite of rapid growth in income and motorisation, walking and cycling remained preferred modes of travel for work and non-work trips.

It is evident that travel patterns in the two cases display different pictures. In a policy environment aimed at high public transport use — how will governments maintain and increase Kangjian's high level of public transport use in the face of rising car ownership, and reduce Bull Creek's reliance on the car? — is it possible for travel to shift to public transport? Understanding where, when and for what purpose these samples use particular modes will give some insights.

Table 5.1: Travel modal shares (number of trips, all journey purpose) in the two neighbourhoods

Travel mode	**Bull Creek**		**Kangjian**	
	Number	Percentage	Number	Percentage
Non-motorised	337	21.3%	160	36.6%
Transit	168	10.7%	219	50.1%
Private Motor Vehicle	1077	68%	58	13.3%
Total	1582	100%	437	100%

Adapted from Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

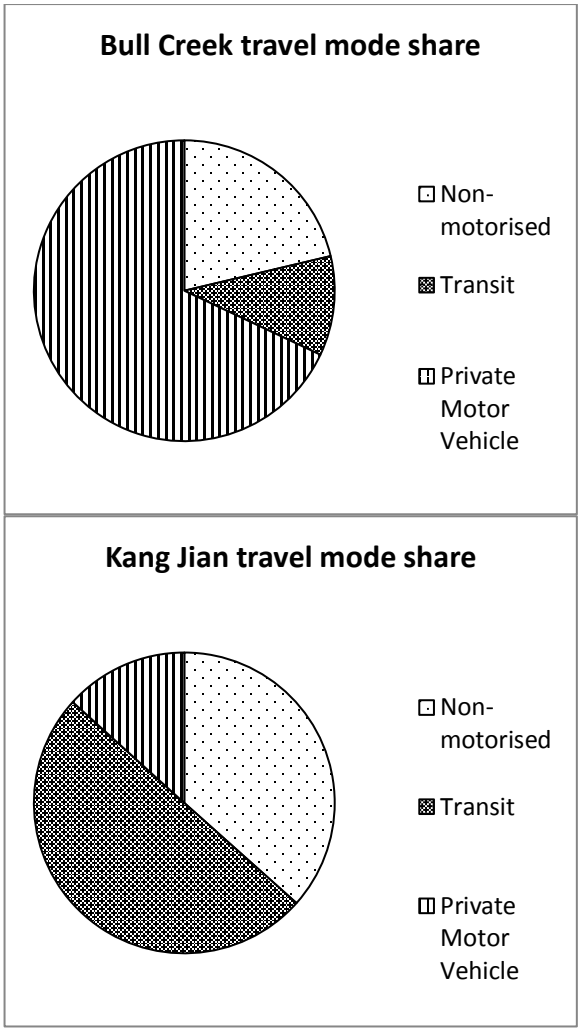


Figure 5.1: The pan map of travel mode shares (number of trips, all journey purpose) in the two neighbourhoods. Adapted from Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

5.4.2 Trip distance by mode in work and non-work trips

Trip distance is affected by many factors; for example, trip purpose (such as work or non-work), traveller characteristics (gender, age, etc.) and means of transport (details in Chapter 3). In this part of the analysis, the average trip distance of travellers from the two neighbourhoods is compared in terms of travel mode and trip purpose. Separating trips by purpose is necessary because factors affecting mode choice decisions tend to vary according to the purpose for which the traveller is making trips (Akiva and Lerman 1985). It is expected that travel behaviour for purposes other than work will be quite different from the journey to work, and other personal and spatial variables may influence travel behaviour for these purposes.

Table 5.2: Average daily trip distance (km) by mode

Travel mode		**Bull Creek** in Perth (n= 229)	**Kangjian** in Shanghai (n= 437)
Work trips	Walk	0.48	2.2
	Bicycle	5.86	4.4
	E-bike or motorcycle(moped)	6.73	5.9
	Bus or rail transit	9.24	8.5
	Car	12.54	12.8
Non-work trips	Walk	2.81	2.2
	Bicycle	3.44	4.0
	E-bike or motorcycle(moped)	2.31	5.4
	Bus or rail transit	7.98	8.1
	Car	19.98	8.5

Adapted from Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

Table 5.2 reports the results. A number of observations can be made from this table. First, looking at the trip distance changes from lower to higher motorisation, in Kangjian, the trip distance increased with motorisation for both trip purposes. For instance, average walking distance to work was 2.2 kms, the cycling distance doubled to 4.4 kms, trip distance by e-biking increased to 5.9 kms and, for those taking transit or driving to work, the distance increased further to 8.5 kms and 12.8 kms respectively. Slightly different patterns are observed in Bull Creek. In work trips the same trend is evident, but in non-work trips, the average bicycle trip distance was longer than by motorcycle. This suggests that non-motorised transport modes are preferred to motorised ones by people in Bull Creek for non-work trips in short distance travel.

The second observation compares trip distances for work and non-work purposes within those two neighbourhoods. In Figure 5.2 below, in general the difference between work and non-work trips in Kangjian was not as obvious as in Bull Creek for all five travel modes. The commute distance of any mode in Kangjian tended to be slightly longer than for non-work trips, except that driving distances are much longer than trip distances for non-work purposes in Kangjian, at 12.8 kms and 8.5 kms respectively. This is because many non-work travel purposes can be fulfilled locally and do not require long distance driving trips. Bull Creek is more complex. There was no clear difference between work and non-work trips for all five modes. The distances of work trips by walking and by car are even shorter than for non-work trips. However, it cannot be taken for granted that cycling and transit could be

more popular than cars for work trips than they are for non-work trip. The relatively higher car trip distances for non-work than for work purposes may due to the common Australian lifestyle: leisure activities such as the beach and sports events are mostly in a relatively distant location, and people in Perth get used to long distance leisure trips.

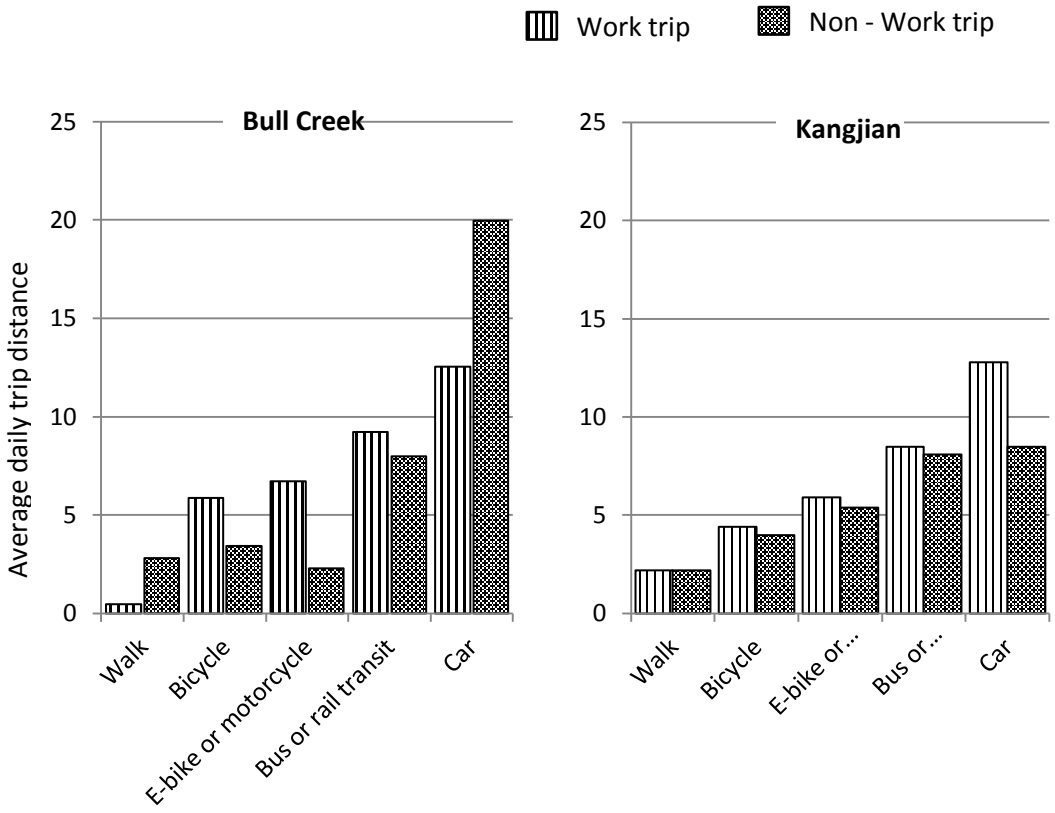


Figure 5.2: Average daily work and non-work trip distance: comparison of Bull Creek and Kangjian. Adapted from: Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

The third observation compares Bull Creek and Kangjian for each travel mode. It shows that, in work trips for each chosen means of travel, travellers living in Bull Creek commuted a similar distance to those in Kangjian neighbourhoods; except that walk distances in Bull Creek, with an average of 0.48 kms, are much lower than in Kangjian, with an average of 2.2 kms. Comparing driving distances to work, Bull Creek (12.58 kms) is almost equal to Kangjian (12.8 kms). The direct distances from those two neighbourhoods to CBD are respectively 12 kms (Bull Creek) and 10 kms (Kangjian). The previous discussion has demonstrated that Bull Creek and Kangjian both belong to monocentric urban structures and a large percentage of their workplaces are located in the CBD. Accordingly, the commuting distance is closely associated with the distance to the CBD. Bull Creek's

commuting distance by car is surprisingly lower than Kangjian, with a relatively longer distance to the CBD.

In conclusion, in Bull Creek and Kangjian, each a similar distance away from their city centre in terms of urban structure and with similar public transport accessibility, the travel distance for work trips by car and transit of both neighbourhoods did not show much difference. It is evident that by work trip, the high car mode share in Bull Creek does not necessarily lead to high travel distance, compared to Kangjian. Differences occur, however, for non-work trips. Here Bull Creek resident's driving distance is much higher than Kangjian residents. It is also apparent that trip distance increased with motorisation for both trip purposes in both neighbourhoods.

5.4.3 Vehicle ownership by income

Vehicle ownership, especially motor vehicle ownership, has historically become evidence of economic development (Dargay, Gately and Sommer 2007). The two case study cities were in different stages of economic development at the time data were collected. It was observed that in the year 2000, the number of Shanghai's registered automobiles was only 5 per 1000 people, and had risen to 15 per 1000 people about 10 years later (Statistical Yearbooks of Shanghai 2001-2011). The car in China at that time was only a requirement for people with high incomes or gave an indication of power and social status. In Perth, in the year 2010, with 641 private vehicles for every 1000 people (Australian Bureau of Statistics, 2011), the car is a very important vehicle for people's mobility, regardless of their income levels. It should be noted that vehicles considered in this research include cars, bicycles and mopeds. Mopeds are motorised, but have less engine power and lower operating speeds than cars. Mopeds are popular in China, not only because of their low operation costs, but also because they take much less road and parking space, which is so important in the high density cities. Mopeds often function as a transition mode from the non-motorised modes, such as bicycles, to fully motorised modes, such as cars.

Studies suggest a worldwide trend: as income grows, demand for faster and more comfortable transport means will increase, which leads to an increase in motorisation (Ingram and Liu 1999). Of interest for this research is whether there are trend variations between the two study neighbourhoods, Bull Creek and Kangjian. In order to assess this, vehicle ownership is compared to income using three income categories from the sample data for these two neighbourhoods. The three income categories are low, medium and

high. Obviously, there can't be a unique quantification to define the three categories. As mentioned earlier, Perth's average income is five times that of Shanghai during the data collection time. Pan, Shen, and Zhang (2009) define Kangjian's income level due to the data limitation; and Australian Bureau of Statistics Census 2009 is used to define Bull Creek's income level (Table 5.3). The division of low, medium and high income has been defined as respectively 25%, 50% and 25%. Monthly income has been applied for comparing the two case studies, and their respective income levels have been defined in Table 5.4.

Table 5.3: Weekly gross income levels in Perth 2009

Weekly income	Percentage of the population (%)
AU$2000 or more	17.4%
AU$1500 - $1999	10.0%
AU$1000 - $1499	14.6%
AU$400 - $999	18.9%
AU$200- $399	9.0%
Less than $199	13%
Not stated	16.9%
Total persons aged 15+	100%

Source: Australian Bureau of Statistics, 2009

Table 5.4: The defined income levels of Bull Creek and Kangjian. Source: Author

	Bull Creek (per month) Year 2009	**Kangjian (per month)** Year 2001
Low income	≤ AU$2500	≤ AU$250
Medium income	AU$2500-7000	AU$250-500
High income	≥ AU$7000	≥AU$500

Table 5.5: Vehicle ownership in Bull Creek and Kangjian (vehicles per 1000 persons) by income range

Income (see Table 5.4)		**Bull Creek** in Perth **(n=229)**	**Kangjian** in Shanghai **(n=437)**
Low income	Car	558	11
	Bicycle	317	454
	Moped	29	75
Medium income	Car	644	36
	Bicycle	362	390
	Moped	34	107
High income	Car	732	81
	Bicycle	667	337
	Moped	52	59

Source: Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

Data reported in Table 5.5 allows the re-examination of the income-vehicle relationship with cross-sectional observations between Bull Creek and Kangjian. Car ownership increases as income grows, a pattern existing in both neighbourhoods. For instance, in Kangjian, the lower income group has a car ownership rate of 11 vehicles per 1,000 people. The level of car ownership rises to 36 per 1,000 for the medium-income group and to 81 per 1,000 for the higher-income group. The level of moped ownership displays a pattern similar to that of cars in both neighbourhoods (with one exception in Kangjian for the higher-income group.) Conversely, bicycle ownership declines along with income growth in Kangjian. A different trend is seen in Bull Creek with bicycle ownership. This may be explained by car and moped ownership having a close association with motorised travel, but high bicycle ownership is not necessarily equal to non-motorised travel, especially in Perth, Australia. Riding a bicycle in a local area is more likely to be for leisure purposes than for transport. The general trend of car ownership increasing with income is evident in both neighbourhoods, but there is still some difference between them in the rate of increase. Comparing the growing rates of household car ownership across the three income categories, Kangjian shows a much stronger growth trend. This suggests strongly that there is a more sensitive relationship between household car ownership and income in Kangjian than in Bull Creek; increased income contributes a lot to the fast growing speed of motorisation in Kangjian.

Table 5.6: Average vehicle ownership across all income groups in Bull Creek and Kangjian

Income (see Table 5.4)		**Car ownership**	**Bicycle ownership**	**Moped ownership**
		per 1,000 persons	per 1,000 persons	per 1,000 persons
Bull Creek	Low income	558	317	29
	Medium income	644	362	34
	High income	732	667	52
Kangjian	Low income	11	454	75
	Medium income	36	390	107
	High income	81	337	59

Adapted from: Curtis and Olaru (2010); Pan, Shen, and Zhang (2009)

The next question is whether, when income is controlled for, there is a pattern of vehicle ownership generalizable from cross neighbourhood comparisons. Data in Table 5.6 show that, in all three income groups, households in Bull Creek have a much higher level of car

ownership and similar bicycle ownership, but a lower level of moped ownership than households in Kangjian. Mopeds often afford a transition mode from non-motorised to fully motorised. The large percentage of moped ownership as well as the increasing rate of car ownership indicates that Kangjian is in a period of transition from non-motorised to motorised travel; income growth will become an important catalyst for this transition. Overall, the consistent observations from the two neighbourhoods across the lower and the higher income groups strongly confirm the relationship between neighbourhood socio-economic characteristics (in this case income) and the level of vehicle ownership.

5.5 Discussion and conclusion

After the external factors of public transport accessibility and urban land use are controlled for as far as possible (the exception is density), the variation between the areas for internal factors such as vehicle ownership for an income level can assist in understanding the differences in travel behaviour. The research presented in this chapter for the two neighbourhoods in Perth and Shanghai compares the travel mode share of these two neighbourhoods, and also the travel distance by travel purpose, and finally compares vehicle ownership for income levels. Observations from the analysis are summarised below.

Mode share: the travel mode data showed a great difference between the two neighbourhoods. The car use rate in Kangjian was still quite small compared with Bull Creek, but the rate of public transport use was much lower in Bull Creek than in Kangjian.

Travel distance: with a similar distance away from their city centre in terms of urban structure and similar public transport accessibility, the distance travelled by car and public transport for both neighbourhoods did not show much difference for work trips, but differences are evident in non-work trips. These are likely associated with other factors such as lifestyle, or the level of mixed land use, which needs further study. The important observation is that trip distance increased with motorisation for both trip purposes. This suggests that travel behaviour is related to the built environment factor of urban structure more than it is to density. This hypothesis requires further study, which can be the subject of future research.

Income level: There is a significant variation in income levels and travel patterns between the two cases. People who live in Bull Creek had comparatively much higher incomes than that in Kangjian during the survey years (2009 for Bull Creek; 2001 for Kangjiian). Bull

Creek's vehicle ownership was much higher than Kangjian's at all income levels. Travel patterns in both places evidence the global trend that car ownership increases as income grows. Compared with Bull Creek, Kangjian's car ownership is sensitive to income. As Shanghai's economic growth speed is much faster than Perth's, the economic gap between these cities will narrow, resulting in less difference in household income, car ownership and car use. The effect of some socio-economic factors such as income and car ownership on travel behaviour is likely to become less pronounced over time. Given these assumptions, travel attitude factors must be paid greater attention if sustainable travel outcomes are to be achieved. The extent to which travel behaviour is affected by this dimension remains difficult to measure and will benefit from further research. Travel attitudes are another research interest of this study and will be discussed in following chapter.

Analysing the secondary travel data in the two case studies has enabled a detailed understanding of the travel patterns and related socio-economic factors (in this case income and car ownership). The analysis confirms the expected effects of socio-economic factors on motorisation and travel mode choices; it can also underpin new primary data on attitudes and public transport policies. Due to the secondary data limitations, this study does not cross-compare the socio-economic characteristics of the two cases based on travel mode choice, except for income. The following survey has collected primary data on travel preferences and participants' other socio-economic characteristics such as age and occupation to overcome the limitations of data on the socio-economic dimension.

Chapter 6: The effect of attitude factors on travel behaviour: attitudinal questionnaire survey analysis

6.1 Introduction

This chapter reports the findings on attitudes towards public transport from the primary data. It was designed to answer Research Question 2 – "to what extent do the travel attitude factors of the individual affect their travel choice?" (see Table 4.1 in Chapter 4). The first section reviews the literature on the detailed relationship between attitudes and behaviour. This provides the background for the conceptual model which guides the survey design and analysis. Then the responses to the interviewer completed attitudinal questionnaire are described. This survey was conducted in the two case study areas: Bull Creek, Perth and Kangjian, Shanghai. Finally, the specific research findings are reported and the research question is answered after intensive data analysis. This research follows the first stage of the research (Chapter 5) and produces detailed data from a smaller number of individuals, focusing on participants' attitudes toward travel. The smaller number of respondents adds depth to the earlier research, allowing better understanding of travellers' requirements.

6.2 Study context

The arguments for car use, including convenience, speed, comfort and individual freedom, are well known (for more detailed information see Chapter 1: Introduction). The question remains: what attributes can make public transport competitive with the car in modern society, where owning a car is no longer a problem? Without doubt, measures to restrict car use generate strong emotions and negative reactions to change. Chapter 3 argues that instrumental and built environment factors are insufficient to explain the reasons for choosing one mode of transport over another, and explains the importance of having a detailed understanding of the individual characteristics of the traveller. Chapter 5 shows how socio-economic characteristics affect travel mode choice. It is clear that the socio-economic circumstances of travellers have played an important role in affecting travel decisions, but some details such as the degree of socio-economic impacts are still not clear. At the same time, some other individual factors such as perception, identity, and social

norms and habits have attracted researchers' attention in the study of travel behaviour (Bamberg and Schmidt 2001; Lanken et al. 1994; Stradling 2003; Tertoolen, van Kreveld and Verstraten 1998). To build up a comprehensive framework of travel behaviour research, it is necessary to take all pertinent attributes into account, including objectively measured variables as well as subjective factors. This chapter will focus on travel attitudes/ preference of travellers in the two case studies.

Measuring personal attitudes in the analysis of travel demands is not easy. There will be various difficulties encountered when measuring and forecasting attitudes (Flamm 2006). The relationship between attitudes and travel behaviour is complex. Kitamura, Mokhtarian, and Laidet (1997) have pointed out a two-way relationship between attitudes and behaviour: "attitudes are formed through experience as a result of behaviour" and interactively, "attitudes prompt certain types of behaviour" (149). This suggests that attitudes are elements which need to be explored if we are to understand behaviour. This research looks at attitude factors as variables in observed travel behaviour. The intent here is not only to identify this causal relationship between attitudes and travel behaviour, but also to assess the strength of this relationship. The analysis is based on two sets of data from a completed attitudinal questionnaire survey of a sample of residents from the two case study areas. Understanding the association between travel choice and personal attitudes can direct further travel demand analysis. If it can be established that in addition to the association between neighbourhood characteristics and travel behaviour, attitudes are associated with travel, then this can be a basis for modifying travel demand by changing residents' attitudes, rather than working only on land use policy or transport facilities. At least, it will be evident that further travel demand analysis must involve knowledge of attitude factors.

6.3 Understanding the major research issues

The above discussion argues that the reasons behind travel choices are many and complex. The use of the private car has a role to play, not only as a means of transport, but also as an integral part of cultural and social life for individuals and families. Instead of simply asking participants' travel mode choice for a particular trip and giving a list of reasons for them to choose, there is a need to understand the potential influence of individual and household characteristics on travel choice. Those characteristics can be lifestyle-related, such as attitudes to time, the environment, housing, and the economy. Lifestyle-related factors are

manifold. Therefore, if the questions aim to cover all potential areas, the length of the survey would increase and there would be a resulting decrease in response rates. In this research, the questionnaire design was informed through an examination of travel behaviour and social psychology literature on behavioural choice (details are discussed in Chapter 3). In general, it is designed to answer the following questions or concerns about the major issues:

I. *What do individuals actually consider in their travel decision and which mobility type do they belong to?*

II. *How do individuals evaluate transit facilities and what factors matter to them in using the transit system?*

III. *What will encourage individuals to use more of the alternatives?*

6.3.1 Issue I: mobility type

The aim of this section of the questionnaire was to inspect the attitudes that drove travel decisions, seeking to reveal the individual's explanations and perceptions behind each travel decision, especially mode choice. In this study, mode choice was divided into two main mobility types: car drivers and public transport users. From a research perspective, well defined meaningful sub-groups can reduce the number of characteristics to a manageable number (Anable 2005). Once groups are identified, it is possible to conduct a comparative study about their response to various situations, with the final aim of creating more targetable polices.

To classify individuals into different travel groups through their attitudes to travel is not easy. A study of both travel behaviour and social psychology literature is a sound preparation. Among the studies of the links between attitudes and behaviour, Ajzen's (1991) theory of "planned behaviour" is quite influential. In the study, behaviour was determined by three intentions: (1) favourable/unfavourable responses to the behaviour; (2) subjective norm control; (3) perceived behaviour control. The first is the individual's intention without control, and the latter two refer to the behaviour under considerations of social pressure such as the environment, and anticipated obstacles such as constraints in terms of time, information or carrying luggage (Ajzen 1991). There is a general principle for the three intentions: the stronger the first intention the less effective the behavioural control, and vice versa (Ajzen 1991). Ajzen's knowledge has given a good explanation of attitude-caused behaviour which has been expanded into travel behaviour research.

Anable (2005) used Ajzen's knowledge and added additional factors to identify the mobility types, which is helpful for exploring Issue I. In Anable's research, the behavioural norm has been re-identified: besides the subjective moral of social pressures on the individual, others' behaviour or attitudes contribute to moral control on behaviour. Anable also argued the importance of habitual behaviour: "behavioural responses are activated automatically, and actions can be instigated without the mediation of attitudes or intentions" (Anable 2005, 68). The population was divided into six distinct groups in her Anable's study: malcontented motorists; complacent car addicts; die hard drivers; aspiring environmentalists; car-less crusaders; reluctant riders (Table 6.1). Anable's six groups were divided according to the theory of "planned behaviour", which looks at the effect of different levels of behaviour controlled by norms or perceived attitudes. This study is mainly about the choice of using a car, and does not look at intentions to use public transport.

Table 6.1: The general characteristics of Anable's research. Adapted from Anable(2005)

(1) Malcontented Motorists	Although they could be willing to reduce car use for altruistic motives and to avoid congestion, they are held back by weak perceptions of behavioural control.
(2) Complacent Car Addicts	The obstacles to using alternatives to the car are less related to Perceived Behavioural Control (PBC) than a lack of awareness of the environmental implications of behaviour and a moral imperative to change.
(3) Die Hard Drivers	A strong resilience to reducing car use as moral and social norms, attitudes and PBC are not in favour of forming intentions to change.
(4) Aspiring Environmentalists	Both moral norms and attitudes contribute to a high propensity to use alternatives. Perceived constraints limit choice, but these may be less 'perceived' and more 'real' than other groups.
(5) Car-less Crusaders	This group's tendency to favour alternative modes may be due to a high sense of environmental awareness and concern and fewer perceptions of the difficulties with these modes.
(6) Reluctant Riders	This group use alternatives less voluntarily than (5) as they are not motivated by altruistic motives and perceive many constraints with their use. Their older age profile and lower income point to 'actual' constraints on behaviour.

Another study of travel behaviour is Jensen's in 1999. The original intention of this research was to find out "how does the environmental strain from personal transport influence actual behaviour" (Jensen 1999, 21) which comes under "norm control" in Ajzen's research. In this research, Jensen (1999) has classified travellers into six mobility types (Table 6.2): the passionate car drivers, the daily life car drivers, the leisure time car drivers, the cyclists/public transport users of heart, the cyclists/public transport users of convenience, and the cyclists/public transport users of necessity. The interview questions involved life styles, attitudes towards transport, environmental consciousness and willingness to change. Jenson's research supports the argument that concern for the environment is a moral control on behaviour, and it follows on Ajzen's 1991 study. Jensen found that travel behaviour can be variously related to environmental concerns and knowledge, but not sufficiently to make car users in general change from driving to using public transport. Jensen's research does not refer to the role of perceived beliefs which are important elements of travel behaviour, such as ecological attitudes to efficacy or anticipated obstacles on travel. Put another way, the third determining factors of Ajzen's "planned behaviour" - perceived behaviour control, is missing in Jensen's research. Another limitation of Jensen's research is that the six mobility types were not divided by a unique criterion: some were defined by attitude factors, like "passionate" or "of heart" and some by the frequency of behaviour, like "daily" and "leisure time". This will limit further analysis if the aim is to get a clear understanding of attitude caused travel behaviour.

Table 6.2 : The general characters of six mobility types of Jensen's research

Major Groups		Car driver			Public transport users		
Six mobility subgroups :		Passionate car drivers	Daily life car drivers	Leisure time car drivers	Public transport users of heart	Public transport users of convenience	Public transport users of necessity
Characteristics	What car/public transport means?	Car is a symbol of freedom, stands for personality	Car is a habit, hard to live without it. Think it is the easiest, the quickest, and often the cheapest.	Car is a comfortable means of transport, but it is expensive.	Freedom from driving responsibilities that allows one to relax Sees the positive aspects of using public transport	They are urban dwellers, mostly in the larger cities; they are often young. They use public transport because it suits their needs, no need a car.	They cannot afford a car or incapable of driving. They have very different ideas about the public transport system.
	Activities/ feeling on vehicle	Listen to music or radio; Relaxed	listens to music or radio; can also think of solutions to work tasks	Car is a means of transport, nothing more	Reading, enjoy the view or the company of fellow passengers	They can use time to read or relax.	
	Environment concern	Do not believe the motoring cause extensive environmental problems	Sympathetic to the environmental problems but do not related to their own driving	They see the environmental problems resulting from automobiles	Concern for the environment, and they are aware of the traffic's contribution to these problems.	They are concerned with the development but rarely connect their own behaviour to those problems	They range widely from a great interest to a complete lack of interest and a total denial of any environmental problems

Major Groups		Car driver			Public transport users		
	During rush-hour traffic	Do not get stressed	Be stressful	Be both uncomfortable and stressful	Even though it takes longer time, the time can be used for enjoying other things	They care about the troublesome and inconvenient with many delays and cancellations.	
	Attitude to the other mode	Public transport also pollutes	They would not rule out that PT could be an alternative for the daily commute	They would like to get rid of the car and use the money for other things	It is on a desire not to own or drive a car.	A car would be annoying to get around in and difficult to park because of heavy traffic and parking problems.	They desire to own a car and a belief that the advantages of having a car are greater than the disadvantages
Possibility of mode change		Low	Depends	High	Low	Low	High

Adapted from Jensen (1999)

The above studies have guided the development of Issue I, which aims at classifying participants into several mobility types by attitude. In this study, group members are examined in relation to their evaluation of the public transport service to find out the motivation/constraints of the use/non-use of public transport, as described in the next section. The assumption is that sub-groups will be diverse in transport mode choice and travel attitude with respect to various components of the theory of "planned behaviour". By integrating both Anable and Jensen's research ideas into my classification, and referring to Ajzen's theory of "planned behaviour", three distinct attitude characteristics have been defined, as summarised below (Table 6.3).

Table 6.3: Attitude character of sub-groups for this study: both car and public transport use

Attitude character of each mobility type	Theory of Planned Behaviour (Extended)	Characteristic profiles	Indicator of mode change
(1) Lovers	Favourable/ unfavourable toward the behaviour	1) A strong reliance on current transport mode and are not in favour of forming intentions to change 2) Do not see or ignore many problems in using current transport mode 3). Low participation in other transport modes	Lowest desire to change to another mode no matter how good the alternative is
(2) Habitual user	Perceived behaviour (past behaviour) control	1) Frequency of prior behaviour a powerful predictor of later behaviour 2) Perceive difficulties of using alternative transport mode 3) Persuasion can reduce their use of current mode and will make a difference 4) Willing to change because of moral responsibility but held back by weak perceptions of behaviour control	Persuasion can make changes and better alternative experience can make differences
(3) User through necessity	Objective resource control or subjective norm control	1) Difficulties accessing alternative mode determined by individual's ability and facilities 2) Strong norm controlled behaviour	Changing the situation can make large differences

Source: Author

Integrating the above three attitude characters into the two major transport modes (car and public transport users) produces six mobility types for this research as below.

Car drivers are divided into:

1. Car lovers
2. Car users by habit
3. Car users by necessity.

Public transport users are divided into:

4. Public transport lovers
5. Public transport users by habit
6. Public transport users by necessity.

The first part of the survey was designed to define types of traveller and divide the participants into the above six mobility types. All the following parts of the survey are based on these six groups for the purpose of comparative analysis.

6.3.2 Issue II: evaluation on transit service

Research Issue II seeks to answer the question "*how do individuals evaluate transit facilities and what factors matter to them in using transit systems?*" and is designed to test whether there is prejudice among these six mobility types to public transport services in their local area. It is also designed to find out the biggest concerns about service quality which affect the travel choices of different groups. A car driver's perception of the quality of public transport service usually is one of the main barriers to his/her mode change (Beirão and Sarsfield Cabral 2007). Kenyon and Lyons (2003) found that the possibility of travellers' consideration of alternative modes is based on subjective perceptions of viability and desirability, which indicates that public transport needs to project a positive image to counter that projected by the car (Stopher 1982). As discussed in Chapter 3, the 'performance' and 'Importance' ratings were focused on six variables: availability, travel time and reliability, travel cost, comfort and amenity level, safety and information (dell'Olio, Ibeas and Cecin 2011; Stradling, Anable and Carreno 2007).

6.3.3 Issue III: triggers for behaviour change

Issue III asks "*what would encourage the individual to use more of the alternative modes of transport*?" This question is designed to monitor the trends for mobility changes in the future, and to explore the reasons that can motivate change. In order to cover all the possible reasons, rather than using closed questions, this part of the survey interviews people with open questions. Thus, people can express what is really important to them in their own words.

6.4 Research methods and methodology

To deal with research Issues I and II, a research design which measures travellers' attitudes towards car and public transport is needed. However, attitude itself is hard to measure. Social scientists have argued that no existing methods of attitude measurement are accurate (Crano and Prislin 2011). This is because qualitative information about attitudes,

such as feelings, opinions, performance and characteristics, must be converted into numerical form for further analysis. General methods of attitude measurement include:

- Questionnaires (self-report, verbal responses to situations)
- Observation methods (actions or physiological reactions) (Green 1954).

As discussed in Chapter 4, this part of the study uses a survey by questionnaire. The importance and the challenges of attitudinal questionnaire methods employed in travel behaviour research have been discussed in Chapter 4. From this, it is clear that high quality data is very important to the research results. The more accurate the design of survey questions, the less pain the researchers will have when they finally explore the information gained from the survey (Clifton and Handy 2001).

6.4.1 Questionnaire development

The following studies (Table 6.4) provide some examples of attitudinal questionnaire design for travel behaviour research. They include the questions about availability of transport facility, performance and importance ratings for a variety of transport system, also include attitude statements related to moral norms, environmental attitudes, efficacy, behavioural norms and habits and so on. They were all found useful in the development of the questionnaires for this study. My questionnaires draw and built on this work.

Table 6.4: Examples of attitudinal questionnaire design

Researchers	Aim of survey	Attitudinal questions
Kuppam, Pendyala, and Rahman (1999)	Exploring the role of attitudinal and preference variables in explaining mode choice for commuter trips	• Performance ratings of different modes • Questions about the need for a car, the availability of transit, the availability of a possible co-rider • Importance ratings for a variety of transportation system characteristics

Researchers	Aim of survey	Attitudinal questions
Kitamura, Mokhtarian, and Laidet (1997)	Exploring the association between attitude factors and travel demand	• Preferences and feelings about current neighbourhood • The reasons for selecting particular modes • Attitudinal questions about transportation, time, the environment, housing, and the economy • Lifestyle questions about reading habits, the use of leisure time, and participation in a variety of outdoor activities and sports, entertainment and events, and hobbies.
Anable (2005)	Comparing travellers' psychological sense with their observed travel behaviour	• 105 attitude statements related to moral norms, environmental attitudes, efficacy, behavioural norms and habits for identification • 25 statements measuring life values • 9 statements measuring attitudes to transport policy options
Jensen (1999)	Exploring how transport has become part of everyday life in behaviour, attitudes, environmental consciousness etc...	• Actual travel behaviour • Attitudes towards transport • Interest in and knowledge of environmental problems

Source: Author

6.4.1.1 Questionnaire design for Issue I: classifying six mobility types

In this study, the objective of the survey regarding Issue I was to use theoretical, psychological and attitudinal variables to identify the characteristics of groups of travellers. Based on the previous discussion of attitude characteristics of the defined six mobility types, 28 attitude statements were designed to identify the participants (Table 6.5). The questionnaire was largely constructed using psychology and attitude statements hypothesised as pertaining to the identified six groups, which can be summarised as follows:

- Favourable/unfavourable toward cars/public transport
- Past behaviour (travel habit, lifestyle)
- Subjective norm control (environmental beliefs)
- Objective resource control

Table 6.5: The attitude statements in the survey for classifying six mobility types

Mobility Types	Name	Main characters of each mobility type (according to literature review)	Attitude statements (variables most reflecting the mobility type)
Type 1	**CL**= Car lover	a) Enjoyment of driving b) No or less moral responsibility to use the car less	• Can express yourself through a car • Enjoy driving a nice car • Can distinguish yourself from others by the car you own • Driving is sporty and adventurous • Your car gives you power in traffic • Driving is relaxing • Driving is your hobby
Type 2	**CH**= Car habitual user	a) Attachment to the car b) Positive effects of car use c) Perceived behavioural control	• Using a car is a habit, it is hard to live without it • Using a car is the easiest way to travel • Using a car is the quickest way to travel • Using a car is often the cheapest way to travel • Your car is often the cheapest way to travel
Type 3	**CN**=Car user by necessity	a) Negative effects of public transport use b) Being ready to change when condition improves c) Social norms	• Your car is a means of transport, nothing else • Public transport is not available in your area • When public transport has a better service, you will use it
Type 4	**PL**=Public transport Lover	a) Enjoy riding on public transport b) Belief in freedom of using public transport c) View of nature	• You are free from driving responsibilities • Public transport provides time to relax/read/ listen to music • You enjoy the view from the window • You like the company of fellow passengers

Mobility Types	Name	Main characters of each mobility type (according to literature review)	Attitude statements (variables most reflecting the mobility type)
Type 5	**PH**=Public transport habitual user	a) Perceived behavioural control b) Effect of congestion	• Public transport is the cheapest option for this journey purpose • Public transport is the fastest option for this journey purpose • Public transport is the most reliable option for this journey purpose
Type 6	**PN**=Public transport user by necessity	a) Negative effects of car use b) Social norms c) "Green" activism d) Ready to change when conditions improve	• A car or using a car is too expensive, you cannot afford it • You can't drive • Using public transport is better for the environment • You like organic food • When you can afford a car, you will consider driving • When you get a licence, you will drive

Source: Author

The literature has shown that basic data collection techniques in questionnaire surveys include ranking (rank order preference), rating (estimates magnitude of a characteristic), sorting (arrange or classify concepts) and choice (selection of preferred alternatives) (Green 1954). Rating techniques were adopted in this research. Each attitude statement was scaled from 1 to 5 with higher scores denoting greater weighting for this factor. The population was divided into six distinct groups with respect to their scores on various factors.

6.4.1.2 Questionnaire design for Issue II: performance ratings and importance ranking of six attributes of public transport services

This section of the survey was designed for Issue II and sought to discover participants' overall perceptions of public transport services and their evaluation of each service item in their local area. All the items were informed by the literature, as discussed in Chapter 5. Choice techniques were adopted for performance rating. For each attitude statement there

were three choices (agree, neutral and disagree) to test the participants' level of agreement.

Table 6.6 : Performance ratings for local public transport services

Main characters of the public transport service (according to literate review)	Performance statements
Availability	The services are near where I lived and worked
	The services are frequent
	The service hours run from early morning till late at night
	Changing services on my travel route is convenient
Travel time and reliability	The services are fast The services are on time
Travel cost	The fares are good value The ticketing arrangements are simple
Comfort and amenity levels	The services are clean The services are comfortable There is protection against the weather while I wait
Safety	The services are safe The kinds of people who travel on public transport are well behaved Changing services en route is safe
Information	Finding out about routes and times of services is easy

Importance rankings were based on the performance rating and used the same items as for performance statements (Table 6.6). Ranking techniques were adopted in this part of the survey. Respondents were asked to give importance ranking from highest to lowest for the six service elements: availability, travel time and reliability, travel cost, comfort and amenity levels, safety, and information. This section was designed to ascertain the quality gaps in services and how well they meet customer wants and expectations; that is, how many aspects of services are not performing as well as they should from the customers' perspectives.

6.4.1.3 Questionnaire design for Issue III: The factors that would encourage use of alternatives

This section was designed to address Issue III, which aims at monitoring the trends of mobility changes. Participants were asked two open questions: "what would encourage you to use public transport more often in the future?" and "what would cause you to use your car more often in the future?" The aim was to pinpoint reasons which may not have

been included in the survey, and give people a chance to express their motivation in their own words. This also balances the limitation of the questionnaire survey where closed responses are offered.

6.4.2 Sample population and selection procedures

The questionnaire was administered by approaching people with an intercept survey at the two case studies locations, Bull Creek and Kangjian. Participants were from the residential areas where the two extant secondary surveys of travel behaviour were conducted (details in Chapter 5). In order to get results that reflect the target population as precisely as needed, it was necessary to determine the sample size. However, the two case study areas are quite different in population size: Bull Creek's population is around 7,000, which is only 1/10 of Kangjian's population (70,000). The population boundaries follow the two existing secondary survey boundaries (see Chapter 4). After considering Confidence Level (CL) and Confidence Interval (CI), CL=95% and CI=8.8 were chosen for this research. At a CL of 95% and a CI of 8.8, a population of 7,000 (Bull Creek) requires a sample size of 122 people. Using the same CL and CI for a population of 70,000 (Kangjian) requires a sample size of 124. Rounded for ease, a number of 120 was set for each of the research areas, with 240 people in total. Balancing the sample size in the two case studies will assist the comparative study.

People were randomly selected to participate in the intercept survey in the streets, shopping centres, local railway stations, bus stops, and also at home. Streets and shops were located where several public services are grouped and which have a broad influx of people from the whole residential area. The railway stations and bus stops were chosen because of their exemplary transport links. Questions were asked first to make sure the participants were from the local community before the survey was conducted. The street and shop survey were taken both on weekdays and weekends. Home intercepts were conducted at the weekend in an attempt to increase the response rate. The houses were selected within the two residential areas by randomly selecting from a computer generated random number list based on street number. All the participants were approached by the researcher and the purpose of the research explained. Respondents were asked to sign a consent form before participating in the study (Ethic approval number HR64/2009 by Curtin University).

6.4.3 Research methodology

To identify the characteristics of varied mobility groups, this part of the research employed a quantitative research method for the analysis of responses to the survey. Once the mobility type was defined, the travellers were profiled with respect to their preferences and attitudes and then compared for their differences in socio-economical characteristics, evaluation of public transport and future travel intentions. As mentioned above, both survey samples were selected randomly. In order to make up for deficiencies in data sampling, the intercept survey selected places which could capture an adequate number in each mobility group to give a good diversity of attitudes and behaviours. For example, to attract a proper number of bus users, there was a need to survey people from bus stops or railway stations, even though they may be over represented with respect to the actual percentage of bus users in the population.

6.5 Survey process

The survey was an attitudinal questionnaire with two open questions at the end. In total there were four sections (Table 6.7) in the survey and it took 15-20 minutes on average to complete.

Table 6.7: Four sections of the survey process

Section 1: Socio-economic and demographic characteristics
Section 2: Classifying six mobility types
Section 3: Performance rating/importance ranking of 6 attributes of PT services
Section 4: The encouragement factors for using alternative services

At the beginning of this survey, people were also asked some questions about themselves. This included their age, gender, occupation and family structure, with the aim of finding out the socio-economic characteristics of each mobility type. The aim was to find out how the socio-economic factors varied in the two case study areas when travel attitude factors were relatively controlled. Next, the participants were asked about the process of travel mode choice for their most regular journeys and about the influences affecting that choice. The attitudes towards transport were explored to classify people into different mobility types with attitude factors. Before this section three general questions about participants'

travel habits were asked, including the frequency of using a car/public transport in the past six months, car sharing (as a passenger or a driver), and travel purpose. These questions were designed to group people into three basic mobility types: car users (who always use private cars for all the journeys), public transport users (who use public transport for most of their journeys) and both (who use both for their journeys). Only those who used both car and public transport were asked to answer all of the survey questions related to their feelings about using public transport as well as a car. All the participants were asked to do the performance/importance survey about public transport services. As for those who seldom or never used public transport services, the questions were designed to detect their perceived attitudes toward the services. Finally, all the respondents were asked about their intentions regarding future travel mode choices.

6.6 Survey findings

6.6.1 The division of six mobility types

As discussed above, classifying participants into six predefined mobility types was the core part of this questionnaire survey. The answers come from participants' scores for the 28 attitude statements: the higher the score the stronger degree of agreement with that factor (5 is the highest and 1 is the lowest score). The mean value method was used to measure which group of attitude statements had the highest value. Classification of the participants into groups was based on the mean value of each group. If two or more groups shares the same value, extra questions were asked to obtain more information. By this method, the six mobility groups included 120 respondents for each study case. Table 6.8 shows the population composition of the six mobility types in the two case studies.

Table 6.8: Composition of the 6 mobility types in two case studies

		Bull Creek /Perth (n = 120)	Kangjian/Shanghai (n = 120)
Car users	Type 1: Car lover	16	26
	Type 2: Habitual car user	58	19
	Type 3: Car user by necessity	3	11
	Total	77	56
Public transport users	Type 4: PT Lover	14	30
	Type 5: Habitual PT user	25	32
	Type 6: PT user by necessity	4	2
	Total	43	64
Total		120	120

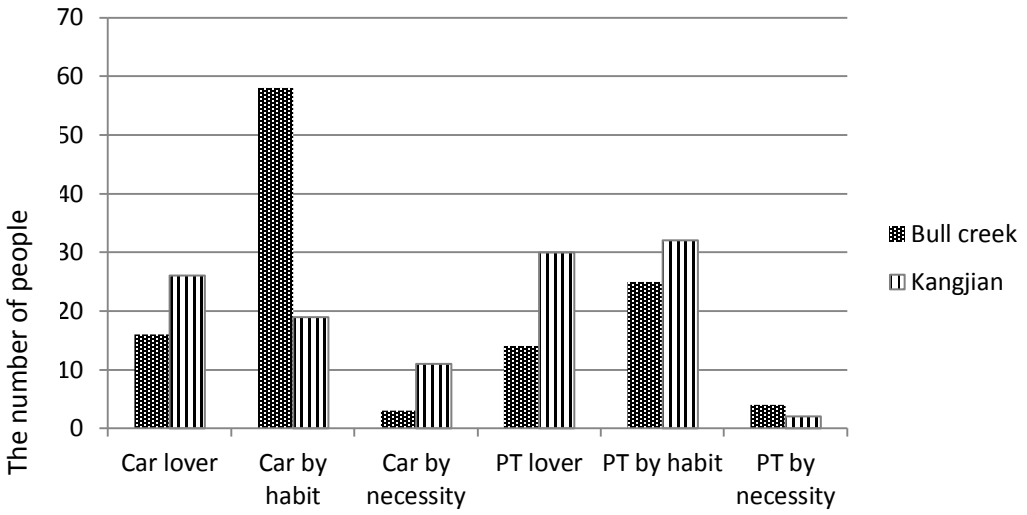


Figure 6.1 : Comparison of Bull Creek and Kangjian by the number of people in each mobility type (n=120)

Figure 6.1 has shown that compared with Kangjian, Bull Creek's car user group is larger than the PT user group. The largest mobility type in Bull Creek is car user by habit; the PT user by habit group is second in size; the car lover and PT lover groups are third and fourth in size. The number of car users by necessity and PT users by necessity is quite small in each case. This indicates that people in Bull Creek who use cars or public transport mostly do so by habit, which suggests that they get used to a certain type of travelling method and do not pay much attention to the alternatives. The Kangjian results tell a different story. There is not much difference between the sizes of "lover" groups and "habit" groups in both travel modes. It should be noted that the size of "lover" groups for car and PT in Kangjian are higher than in Bull Creek, which suggests changes in external conditions will not make much difference to the mode choices of people in Kangjian compared with Bull Creek.

As discussed earlier (see Table 6.3, 'indicators of mode change') when looking at the possibilities for mode change from high to low for the six groups, the "necessary" group will be the most likely to change and the "lover" group will be the least likely to do so. Further discussion of the findings will be based on the division of the 240 participants from Bull Creek and Kangjian into six mobility types.

6.6.2 Socio-economic and demographic characters

Having sorted participants into mobility types, the study focused on whether there are particular socio-economic attributes associated with a certain mobility type by relating findings to the secondary socio-economic and demographic data (see Chapter 5). The data quantifies the characteristics of age and occupation.

6.6.2.1 Age

The age percentage of each mobility type (Table 6.9) shows the distribution of different age groups within each mobility type. People aged under 35 as are defined as young age group, between 36 to 59 as middle age group, and 60 and above as older age group in both suburbs. Car lovers and car by necessity groups are mostly young people; car by habit and public transport lovers are mostly middle aged people. In the older age group, in Bull Creek they mostly use cars by habit, and in Kangjian, the low number of respondents in this group is statistically insignificant. Table 6.10 and Figure 6.2 show the average age of each mobility type in Bull Creek and Kangjian. Generally, the age difference by mobility type in Bull Creek is much more obvious than in Kangjian. The youngest average age group uses cars by necessity in both suburbs; the oldest average age group in Bull Creek use cars by habit, and in Kangjian they use cars by necessity. A clear picture of the age features of each mobility type will be helpful for future strategies to change mobility patterns in a targeted population.

Table 6.9: Number & percentage of people in each age group with same mobility type in Bull Creek

	Car Lover	Car by habit	Car by necessity	PT Lover	PT by habit	PT by necessity	Total
Bull Creek, Perth							
	n=16	n=58	n=3	n=14	n=25	n=4	n=120
Yr 18-35	8 (50%)	15 (26%)	2 (67%)	4 (29%)	13 (52%)	2 (50%)	44 (37%)
Yr 36-59	7 (44%)	31 (53%)	1 (33%)	9 (64%)	9 (36%)	2 (50%)	59 (49%)
Yr 60+	1 (6%)	12 (21%)	0 (0%)	1 (7%)	3 (12%)	0 (0%)	17 (14%)
Total	16 (100%)	58 (100%)	3 (100%)	14 (100%)	25 (100%)	4 (100%)	120 (100%)
Kangjian, Shanghai							
	n=26	n=19	n=11	n=30	n=32	n=2	n=120
Yr 18-35	13 (50%)	7 (37%)	6 (55%)	13 (43%)	15 (47%)	1 (50%)	55 (46%)

	Car Lover	Car by habit	Car by necessity	PT Lover	PT by habit	PT by necessity	Total
Yr 36-59	12 (46%)	11 (58%)	5 (45%)	17 (57%)	16 (50%)	1 (50%)	62 (51%)
Yr 60+	1 (4%)	1 (5%)	0 (0%)	0 (0%)	1 (3%)	0 (0%)	3 (3%)
Total	26 (100%)	19 (100%)	11 (100%)	30 (100%)	32 (100%)	2 (100%)	120 (100%)

Table 6.10 : Average age of each mobility type in Bull Creek and Kangjian (n=120)

	Car users			PT users		
	Car lovers	Car by habit	Car by necessity	PT lovers	PT by habit	PT by necessity
Bull Creek	37.81	45.54	33.66	42.70	38.63	36.36
Average	39.00			39.23		
Kangjian	37.76	39.90	37.00	38.42	38.43	41.70
Average	38.22			39.53		

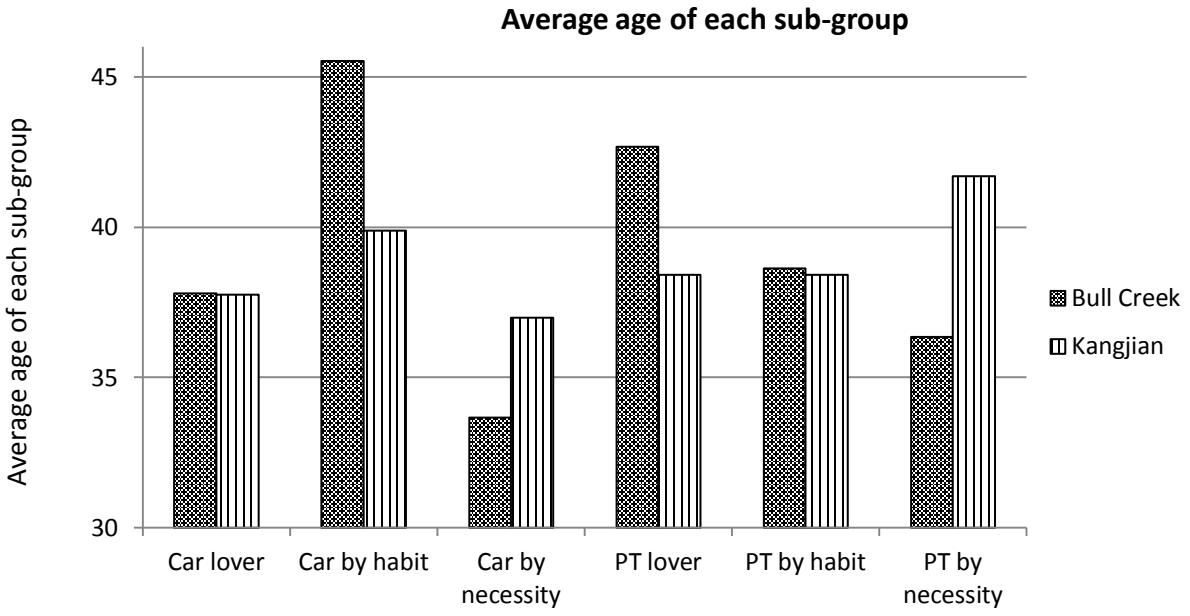


Figure 6.2 : Average age of each mobility type (n=120)

6.6.2.2 Occupation

Table 6.11 : Number & percentage of people in each occupation within same mobility type in Bull Creek and Kangjian

	Car lover	Car by habit	Car by necessity	PT lover	PT by habit	PT by necessity	Total
Bull Creek, Perth							
	n=16	n=58	n=3	n=14	n=25	n=4	n=120
Full time	9 (55%)	34 (58%)	0 (0%)	6 (44%)	12 (48%)	1 (25%)	62 (51%)
Part time	2 (14%)	7 (13%)	0 (0%)	3 (21%)	2 (8%)	0 (0%)	14 (12%)
Student	3 (17%)	7 (13%)	2 (67%)	4 (28%)	8 (32%)	2 (50%)	26 (21%)
Retired	0 (0%)	5 (8%)	1 (33%)	0 (0%)	2 (8%)	1 (25%)	9 (8%)
House duties	2 (14%)	5 (8%)	0 (0%)	1 (7%)	1 (4%)	0 (0%)	9 (8%)
Total	16 (100%)	58 (100%)	3 (100%)	14 (100%)	25 (100%)	4 (100%)	120 (100%)
Kangjian, Shanghai							
	n=26	n=19	n=11	n=30	n=32	n=2	n=120
Full time	24 (92%)	16 (85%)	10 (89%)	27 (88%)	29 (94%)	2 (100%)	108 (89%)
Part time	1 (4%)	1 (5%)	0 (0%)	1 (4%)	1 (3%)	0 (0%)	4 (4%)
Student	1 (4%)	1 (5%)	0 (0%)	1 (4%)	1 (3%)	0 (0%)	4 (4%)
Retired	0 (0%)	0 (0%)	1 (11%)	1 (4%)	0 (0%)	0 (0%)	2 (2%)
House duties	0 (0%)	1 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Total	26 (100%)	19 (100%)	11 (100%)	30 (100%)	32 (100%)	2 (100%)	120 (100%)

Note: "Student" here means TAFE or university student

Following the same method of analysis as for age, Table 6.11 shows the distribution of occupation within different mobility types. From this it can be seen that most car users by habit and PT users by habit are working full time. Part time workers mostly belong to "lover" groups. Students in Bull Creek and Kangjian show quite different characteristics. They both mostly belong to "necessity" group: students in Bull Creek tend to use cars by necessity, but Kangjian's students tend to use public transport by necessity. The data shows that most participants in Kangjian were fulltime workers.

6.6.3 Performance ratings of 6 attributes of public transport services

All the participants were given a choice of agreement ("agree"," neutral" or "disagree") in response to the list of statements about the 15 PT service attributes. The results are shown in Table 6.12 and Table 6.13.

For better comparison, the results show the number of choices as well as the percentage. When comparing the two sets of data (Figure 6.3), it can be seen that Kangjian respondents have given a much larger number of neutral answers regarding each service. There are two reasons that may explain this. One is that compared to respondents in Bull Creek, Kangjian people were not so concerned about PT services in their area; this can be aligned with the the earlier suggestion that that compared with Kangjian, Bull Creek respondents seem to be more sensitive to the external factors in regard to mode change (see 6.4.1). Another explanation may be to do with cultural differences; compared with western people, Chinese people may be more conservative in their expression. Researchers have established that evaluation, as a process of information exchange, is influenced by the cultural backgrounds of subjects (Kien 2007). Because of this, cross-cultural information exchange is a consideration in a culturally diverse research survey. Culturally appropriate sampling and measurement methods need to be used when collecting and analysing the data. This research is limited in this respect, and it is necessary to find a more objective way to compare the data.

Table 6.12 : Numbers and percentages for Bull Creek's PT performance ratings

15 Attributes of services	Agree (n=120)	Neutral (n=120)	Disagree (n=120)	Total (n=120)
Near	84(70%)	13(10.8%)	23(19.2%)	120(100%)
Frequent	67(55.8%)	22(18.3%)	31(25.9%)	120(100%)
Service hour	64(53.3%)	18(15%)	38(31.7%)	120(100%)
Changing service	44(36.7%)	35(29.1%)	41(34.2%)	120(100%)
Speed	46(38.3%)	25(20.9%)	49(30.8%)	120(100%)
On time	55(45.8%)	42(35%)	23(19.2%)	120(100%)
Fares	49(40.8%)	36(30%)	35(29.2%)	120(100%)
Ticketing	76(63.3%)	26(21.7%)	18(15%)	120(100%)
Clean	77(64.2%)	27(22.5%)	16(13.3%)	120(100%)

15 Attributes of services	Agree (n=120)	Neutral (n=120)	Disagree (n=120)	Total (n=120)
Comfortable	65(54.2%)	37(30.8%)	18(15%)	120(100%)
Protection	32(26.7%)	37(30.8%)	51(42.5%)	120(100%)
Safe	53(44.2%)	43(35.8%)	24(20%)	120(100%)
People behaviour	37(30.8%)	50(41.7%)	33(27.5%)	120(100%)
Changing safe	48(40%)	49(40.8%)	23(19.2%)	120(100%)
Easy info	63(52.5%)	33(27.5%)	24(20%)	120(100%)
Total	860(47.8%)	493(27.4%)	447(24.8%))	1800(100%)

Table 6.13 : Numbers and percentages for Kangjian's PT performance ratings

15 Attributes of services	Agree (Percentage out of 120)	Neutral (Percentage out of 120)	Disagree (Percentage out of 120)	Total (Percentage out of 120)
Near	52(43.3%)	46(38.3%)	22(18.4%)	120(100%)
Frequent	27(22.5%)	64(53.3%)	29(24.2%)	120(100%)
Service hour	30(25.0%)	57(47.5%)	33(27.5%)	120(100%)
Changing service	55(45.8%)	44(36.7%)	21(17.5%)	120(100%)
Speed	34(28.3%)	60(50.0%)	26(21.7%)	120(100%)
On time	23(19.2%)	54(45.0%)	43(35.8%)	120(100%)
Fares	29(24.2%)	55(45.8%)	36(30.0%)	120(100%)
Ticketing	19(15.8%)	93(77.5%)	8(6.7%)	120(100%)
Clean	27(22.5%)	70(58.3%)	23(19.2%)	120(100%)
Comfortable	17(14.2%)	76(63.3%)	27(22.5%)	120(100%)
Protection	18(15.0%)	75(62.5%)	27(22.5%)	120(100%)
Safe	39(32.5%)	71(59.2%)	10(8.3%)	120(100%)
People behaviour	16(13.3%)	85(70.8%)	19(15.9%)	120(100%)
Changing safe	10(8.3%)	102(85.0%)	8(6.7%)	120(100%)
Easy info	28(23.3%)	82(68.3%)	10(8.4%)	120(100%)
Total	424(23.5%)	1034(57.4%)	342(19.1%)	1800(100%)

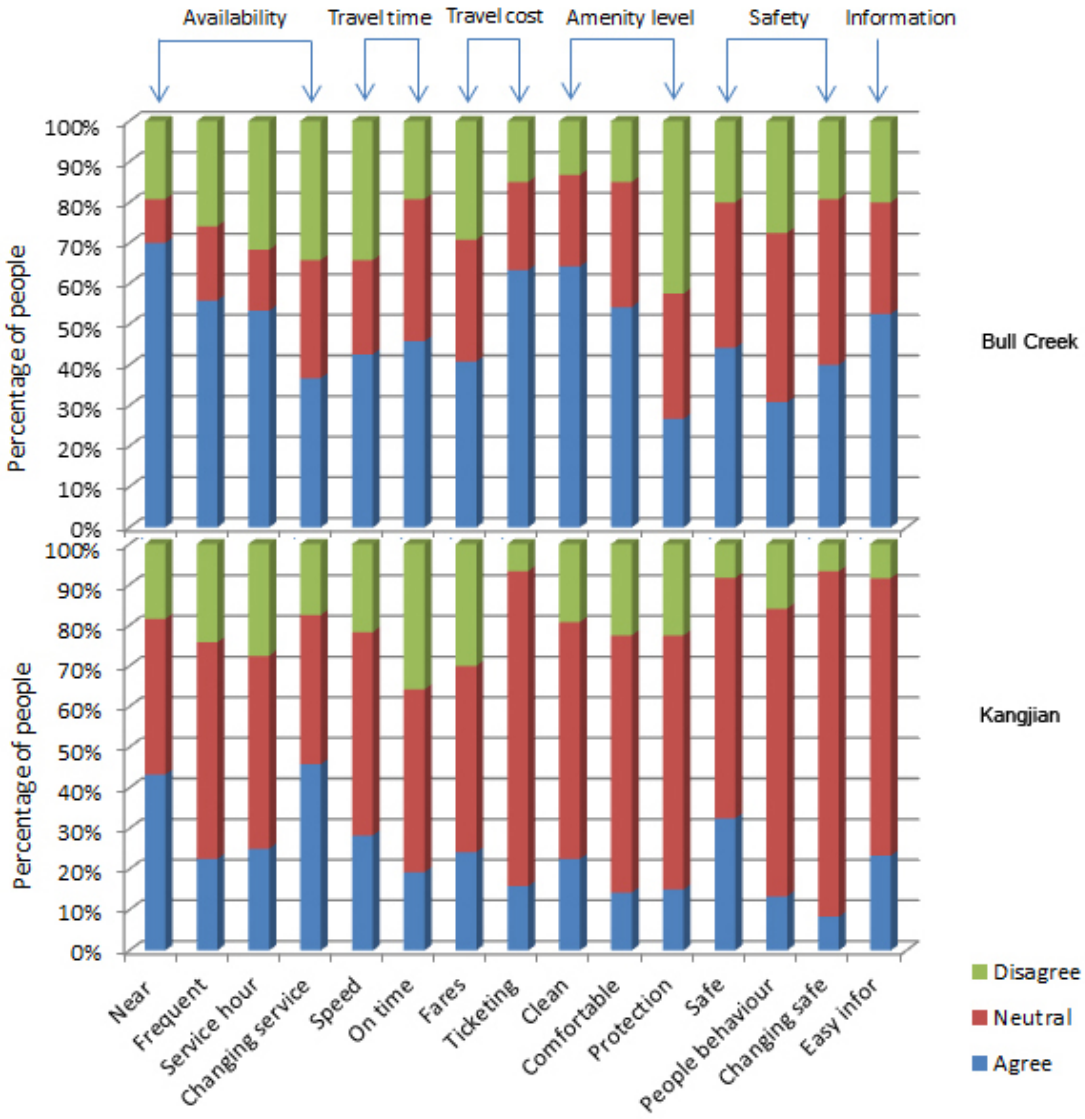


Figure 6.3 : Data comparison of Bull Creek's and Kangjian's perceptions based on PT performance rating

To strengthen the data analysis, Net Agreement Rates have been created in order to compare the evaluation results of the two case studies in a more precise way by subtracting the percentage of disagreement from the percentage of agreement, as below:.
Net Agreement Rates = percentage agree — percentage disagree.

If the value is larger than 0, it means the feedback to this part of service is positive; the higher the value the stronger the positive feedback. On the other hand, if the value is lower than 0, the feedback is negative; the lower the number the more negative.

Table 6.14 lists the respondents in Kangjian and Bull Creek; it can be seen that Bull Creek people gave relatively positive feedback to their public transport service. The exception was “there is protection against the weather while I wait”; all the other feedback was positive. The strongest agreements were for “the ticketing arrangements are simple” and “the service is clean”. However, in Kangjian, 7 out of 15 services attracted negative feedback: frequency, service hours, service on time, fares, comfort, protection while waiting, and people’s behaviour on services. There was relative satisfaction with the service attributes of “finding out about routes and times of services is easy”, “the service is near where I live and work” and “finding out about routes and times of services is easy”. Agreement percentages are shown in Figure 6.4.

Table 6.14 : Net Agreement Rates for 15 service attributes in Bull Creek and Kangjian

6 Aspects of service	15 Attributes of service	Bull Creek Agree percentage — disagree percentage	Kangjian Agree percentage — disagree percentage
Availability	Near	50.8%	24.9%
	Frequent	29.9%	-1.7%
	Service hours	21.6%	-2.5%
	Changing services	2.5%	28.3%
	Average	26.2%	12.3%
Travel time and reliability	Speed	7.5%	6.6%
	On time	26.6%	-16.6%
	Average	17.1%	-5.0%
Travel cost	Fares	11.6%	-5.8%
	Ticketing	48.3%	9.1%
	Average	30.0%	1.7%
Comfort and amenity levels	Clean	50.9%	3.3%
	Comfortable	39.2%	-8.3%
	Protection	-15.8%	-7.5%
	Average	37.2%	-6.3%
Safety	Safe	24.2%	2.4%

6 Aspects of service	15 Attributes of service	Bull Creek Agree percentage — disagree percentage	Kangjian Agree percentage — disagree percentage
	People behaviour	3.3%	-2.6%
	Changing safe	20.8%	1.6%
	Average	16.1%	0.5%
Information	Easy info	32.5%	14.9%
	Average	32.5%	14.9%
Average		23.6%	3.1%

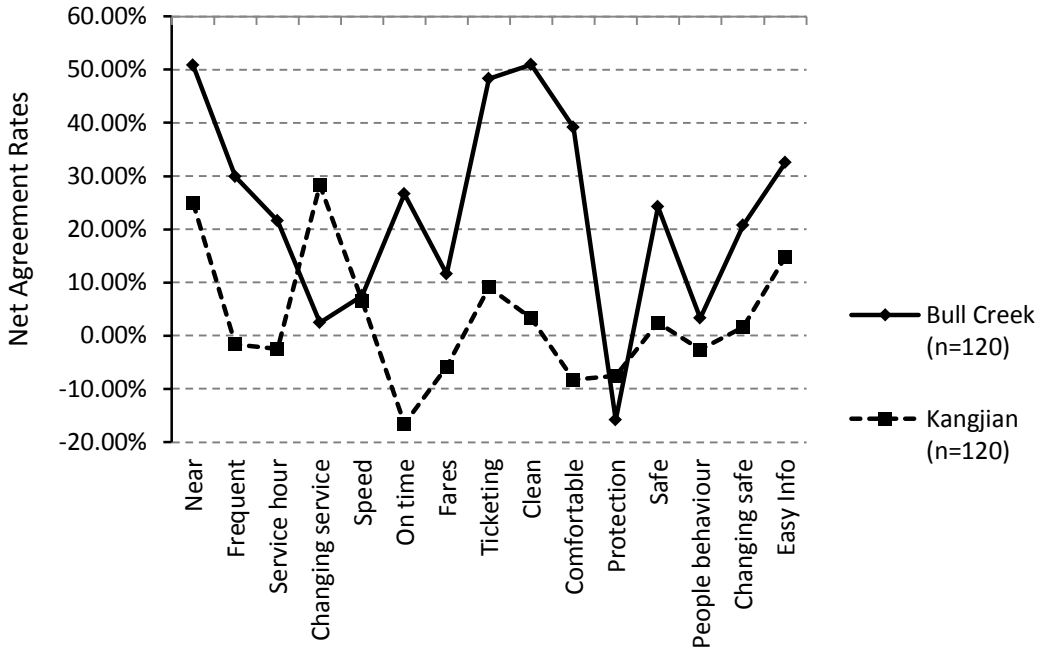


Figure 6.4 : Comparison of Net Agreement Rates for 15 service attributes in Bull Creek and Kangjian

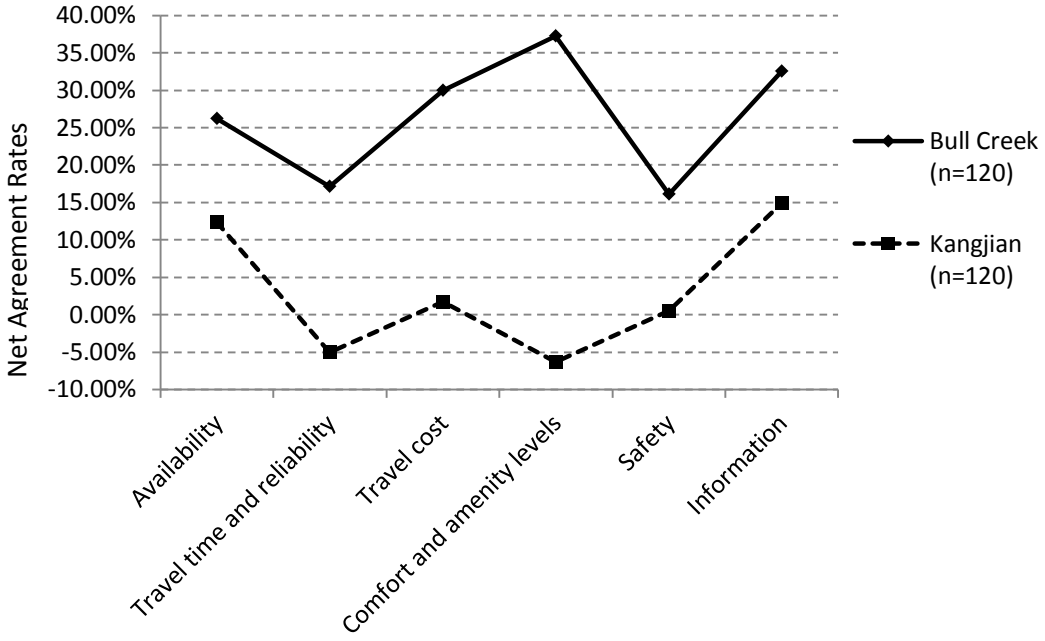


Figure 6.5 : Comparison of Net Agreement Rates for six aspects of PT services between Bull Creek and Kangjian

Using the same method for measuring Net Agreement Rates when summarising the 15 attributes into six aspects of PT service (Figure 6.5), it can be seen that for all the six aspects of service, Bull Creek respondents gave much more positive feedback than those in Kangjian, especially for comfort and amenity levels and travel cost. Travel cost can be compared with the data on family income and PT ticket prices. Comparing average disposable household incomes for 2013 (the survey year), Perth was about AU$52,000 per year (www.abs.gov.au) and Shanghai was about AU$18,000 per year (Shanghai's statistics year book 2010-2014); so Perth's average family income was nearly three times that of Shanghai. Perth has an integrated public transport ticket system, with buses, trains and ferries, which is calculated by a combination of zones and time limits (one fare lets you travel anywhere within a certain distance of your starting point until the time limit expires). There are three types of fares rates: standard by cash, standard by SmartRider and concession. The concession rate is about 40 per cent of the standard fare, and SmartRider is discounted by 15 per cent. During the survey year, the most common fare for two zones was $4.40 cash, or $3.70 with the SmartRider discount. The longest zones (9 zones) cost about $11.80 cash or $10.00 by SmartRider (Table 6.15). Calculating by income, Shanghai's metro fares were quite similar to those of Perth, but outside the time limits it would cost

more. Compared with Perth, Shanghai's bus fares were cheaper, with a unique ticket system (Table 6.16). Kangjian people gave travel cost a relatively low rating compared with other service items. This shows that the evaluation of travel cost is not only decided by the real cost of travel but is also impacted by concepts of consumption or consumption culture.

Table 6.15 : Perth's public transport fares in 2013

Fare type (Zones are circular bands, each between 8 to 10 kilometres wide with Central City)	Standard (AU$)		Concession (AU$)
	Cash	SmartRider	
1 Zone (within 10 kms)	$2.00	15% Discount	About 40% Discount
2 Zones (about 20 kms)	$4.40		
9 Zones (about 70kms)	$11.80		
School Student	50c		

Source: Transperth website: www.transperth.wa.gov.au

Table 6.16 : Shanghai's public transport fares in 2014

Fare type		Cash AU$(￥Chinese Yuan)	SmartRider
Metro	0-6 Kilometres	$0.6 (￥3)	10% Discount
	6-16 Kilometres	$0.8 (￥4)	
	Above 16 Kilometres	$0.20 (￥1) for each extra six kilometres	
	One-Day Pass	$3.6 (￥18)	
	Three-day Pass	$9 (￥45)	
Bus	Per journey	$0.2-0.4 (￥1-2)	
Concession	Aged over 70	Free	
	School Student	No discount	

Source: http://www.piaojia.cn/shanghai/. *Note: Currency exchange: 1AU$= ￥5 Chinese Yuan.*

The above discussion has compared the evaluation of services for the two cities. When comparing perceptions of six mobility groups within the same city about the same PT service, the results will be diverse. For better comparison, the concept of "agreement weights" has been used to compare the groups. It is defined as:

Agreement weights = Percentage of Agreement/Percentage of Disagreement

Table 6.17, and Figures 6.6 and 6.7 show that in Bull Creek, different mobility types have given different evaluations of the same public transport service. The most positive feedback came from the public transport users by habit group, whereas relatively negative

feedback came from car lovers and car users by habit groups. Comparing car users and public transport users groups, public transport users in Bull Creek recorded a much higher evaluation of every aspect of public transport service. The weighted averages of different population percentages of each mobility group were applied to calculate the mean rates.

Table 6.17 : Comparison of agreement weights for six aspects of PT services by mobility types in Bull Creek

		Population percentage	Availability	Travel time and reliability	Travel cost	Comfort and amenity levels	Safety	Information	Average Rates
Car users	CL	13.3%	1.21	1.50	2.75	1.69	1.7	2.25	1.85
	CH	48.3%	1.57	1.40	2.10	2.03	1.61	2.17	1.81
	CN	2.5%	1.61	1.42	2.18	2.13	1.71	2.29	1.89
	Weighted Average	64.1%	1.50	1.44	2.25	1.96	1.64	2.20	1.83
PT users	PL	11.7%	2.90	1.33	2.27	2.00	2.00	5.50	2.67
	PH	20.8%	5.92	3.56	3.44	1.95	3.50	9.00	4.56
	PN	3.4%	3.40	1.25	2.09	2.00	1.05	5.50	2.55
	Weighted Average	35.9%	4.70	2.63	2.96	1.97	2.77	7.51	3.75

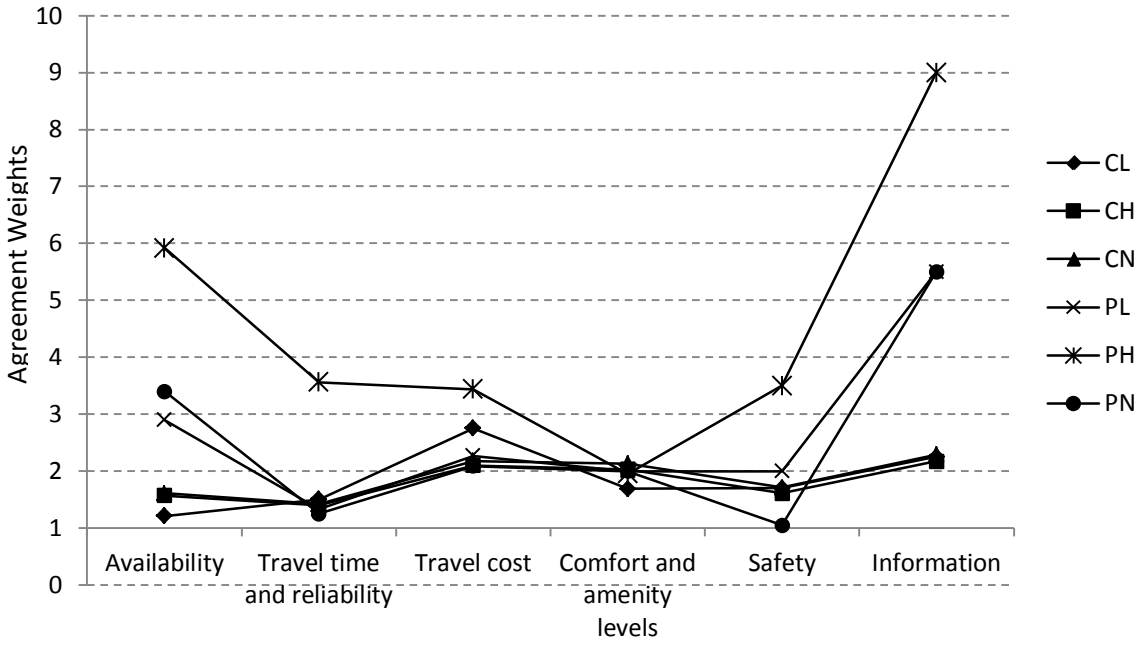


Figure 6.6 ： Comparison of agreement weights for six aspects of PT services by mobility types in Bull Creek

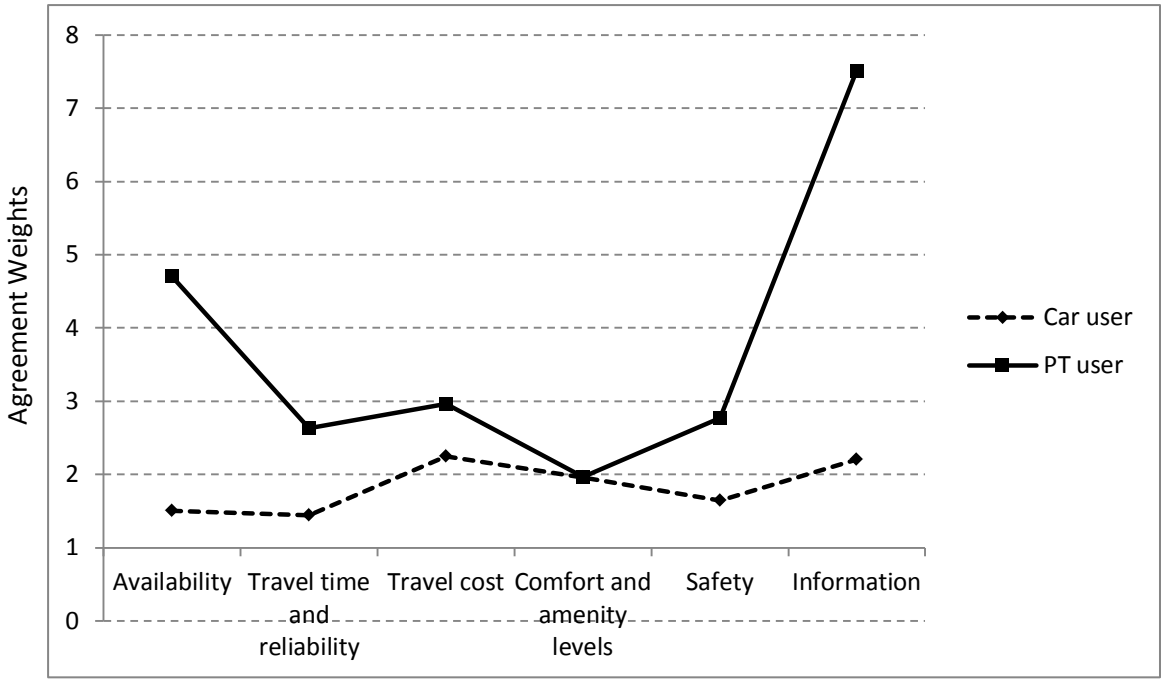


Figure 6.7 ： Comparison of average agreement between car users and public transport users in Bull Creek

Using the same method to analyse Kangjian's data (Table 6.18, Figures 6.8 and 6.9), it can be seen there is not an obvious trend in the evaluation of those six mobility types. The car lover group gave relatively positive feedback for several aspects of services such as availability and travel cost. Another interesting finding is that the PT use by necessity group gave the lowest evaluation of most aspects of public transport service. People who do not have a valid driver's licence, like students or people with disabilities, mostly belong to this group. However, when looking at the difference between car and public transport users, the same trend appears as with Bull Creek, in that public transport users have given a more positive or similar evaluation to transit services than car users have, except for one aspect of service — travel cost (Figure 6.10). But this trend is not as obvious as for Bull Creek.

Table 6.18 : Comparison of agreement weights for six aspects of PT services by mobility types in Kangjian

		Population percentage	Availability	Travel time and reliability	Travel cost	Comfort and amenity levels	Safety	Information	Average rates
Car users	CL	21.7%	2.10	1.06	1.88	0.87	2.00	2.50	1.735
	CH	15.8%	0.87	0.92	1.80	0.63	2.29	1.20	1.29
	CN	9.2%	1.22	0.70	1.07	0.95	1.56	2.00	1.75
	Weighted Average	46.7%	1.51	0.94	1.69	0.80	2.01	1.96	1.59
Public transport users	PL	25.0%	2.32	1.00	1.50	1.06	1.71	4.00	1.93
	PH	26.7%	1.59	0.79	1.10	1.06	2.65	1.80	1.50
	PN	1.6%	2.00	1.00	0.35	0.38	1.82	0.83	1.06
	Weighted Average	53.3%	1.94	0.89	1.27	1.04	2.18	2.80	1.69

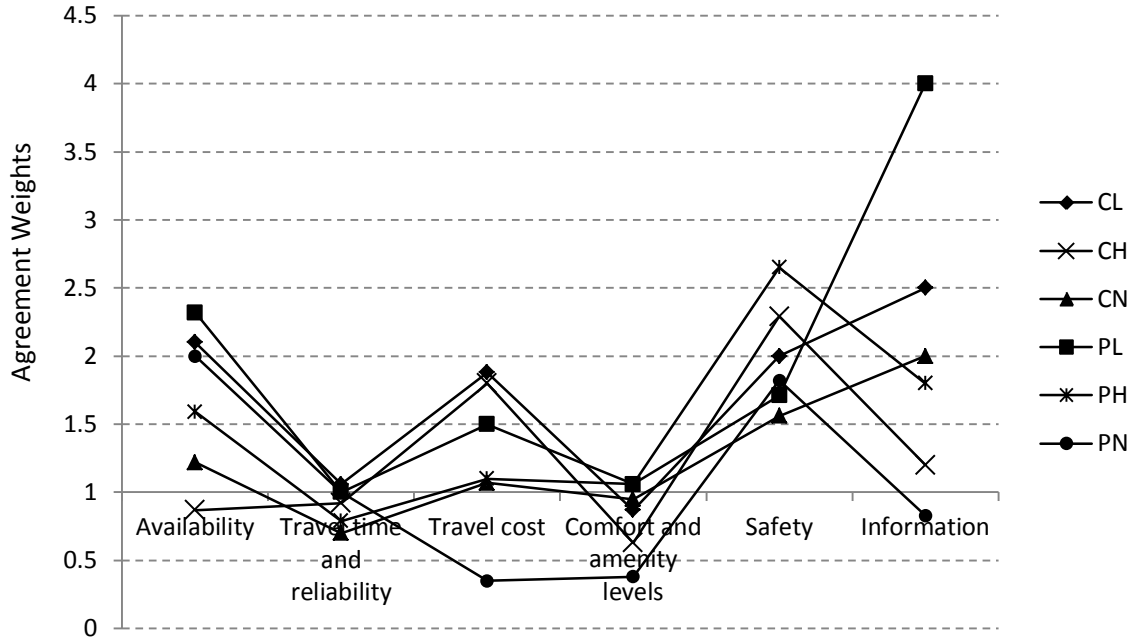


Figure 6.8 : Comparison of agreement weights on six aspects of PT services by mobility types in Kangjian

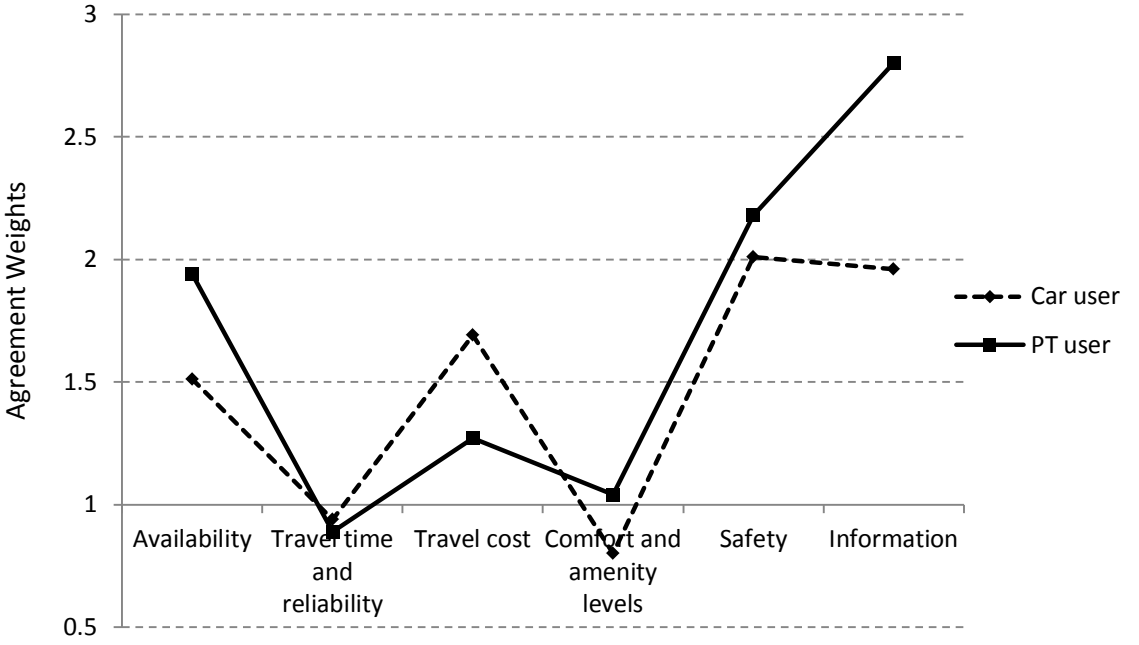


Figure 6.9 : Comparison of average agreement between car users and public transport users in Kangjian

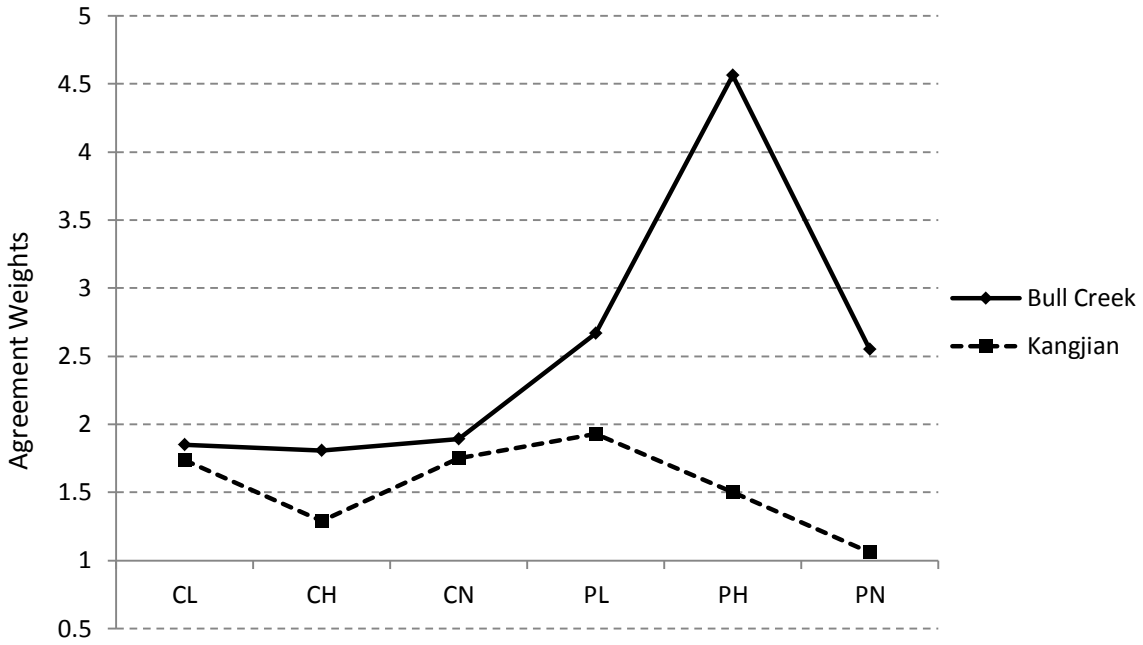


Figure 6.10 : Comparison of average agreement weights between Bull Creek and Kangjian by mobility type

6.6.4 Importance ranking of the six PT service factors

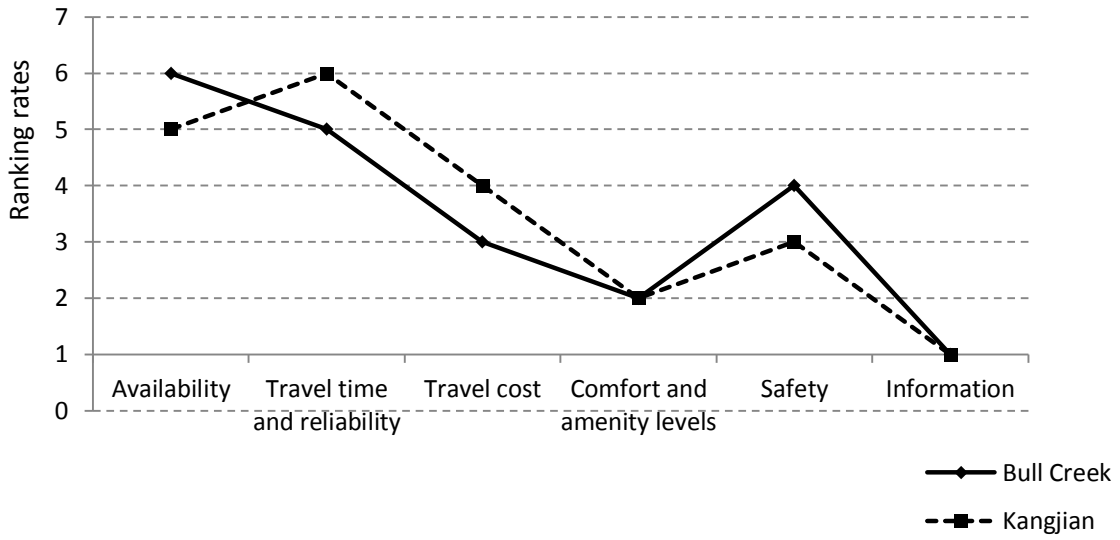


Figure 6.11 : Importance ranking of six attributes of PT services in Bull Creek and Kangjian

Researchers have suggested that customer satisfaction with a service is related to the perceived difference between actual and ideal levels of service delivery (Stradling, Anable and Carreno 2007). After performance ranking the local public transport services, Stradling et al. designed a question for people to rank the importance of six attributes of public transport service. This was to find out what they perceived public transport services should deliver, from the most important to the least important elements. This method found discrepancies by weighting performance ratings against importance ratings, with the objective of improving users' satisfaction with services in a more effective way (Stradling, Anable and Carreno 2007). The disgruntlement measure was derived by cross-tabulating performance against importance ratings for each element. Figure 6.11 shows the importance ranking results for the two research areas in this study. The ranking rates are from 1-6. The bigger the number, the better the ranking. The figure shows that the two case studies shared similar ranking results for the importance of each public transport service.

Using importance ranking, when the Net Agreement Rates shown in Figure 6.5 are compared with performance ratings, differences can be seen between actual and ideal levels. The numbers 1-6 were used to measure performance. The lowest value of Net Agreement Rates is 1 and the highest value is 6. The ranking order obtained in Figure 6.11 (importance ranking) differs from that obtained in Figure 6.12 (performance ranking).

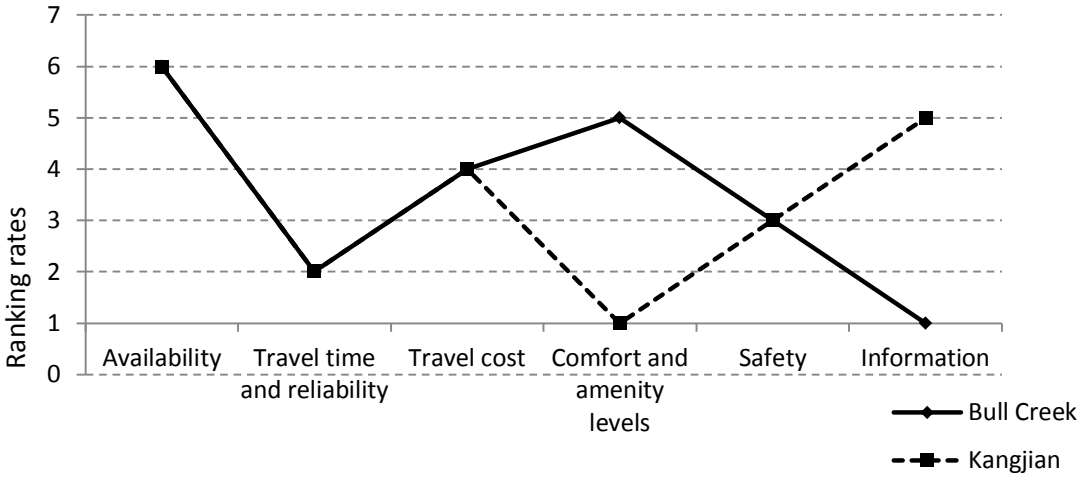


Figure 6.12 : Performance ranking of six attributes of PT services in Bull Creek and Kangjian

When cross-tabulating importance and performance ranking of PT services within the two case studies, it will be of particular interest to see the gap between the residents' expectations and the realities. Rather than dealing in aggregate mean scores, this method identifies which aspects of a service need to be improved and to what extent. Figure 6.13 and Figure 6.14 show the results: it indicates the distance between the expectation and the reality from the users' perspectives. The results show that in Bull Creek people were particularly concerned about travel time and the attributes of safety. Travel time was also a major concern for Kangjian people, whereas the comfort of current services was considered satisfactory. Both groups believed that travel time was the most important item, and currently performed below their expectation, and should therefore be a focus for service improvement in the future. Comfort in Bull Creek and information in Kangjian were regarded as the most satisfactory aspect of service in the local areas.

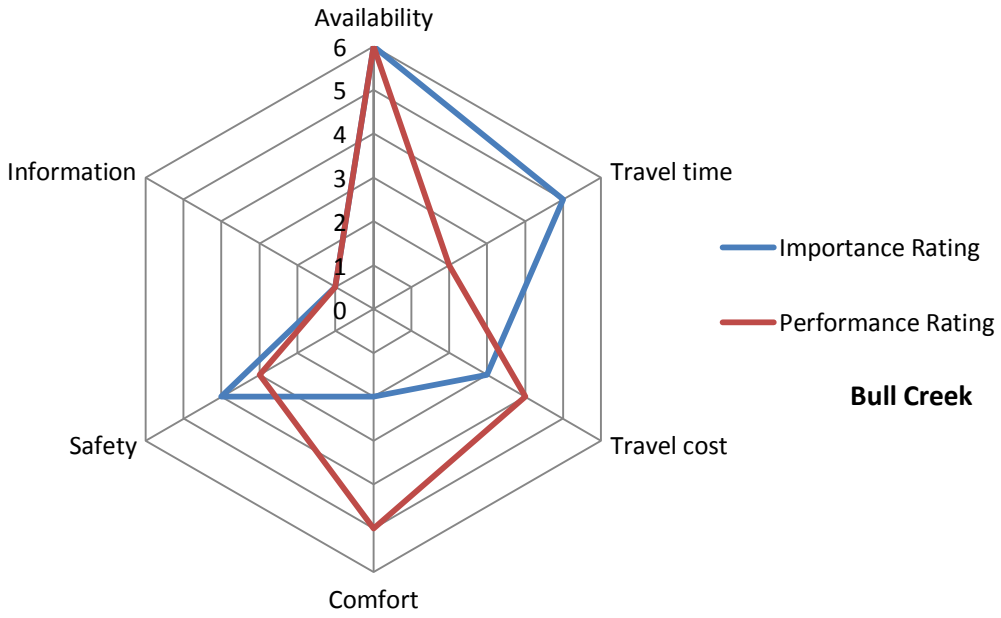


Figure 6.13 : Cross-tabulating importance and performance ranking for Bull Creek sample

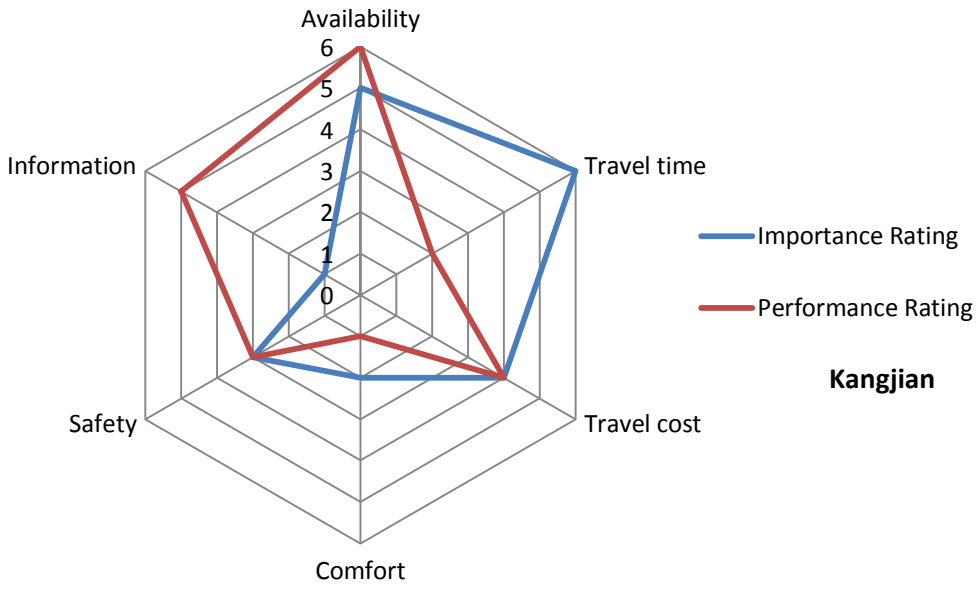


Figure 6.14 : Cross-tabulating importance and performance ranking for Kangjian sample

6.6.5 The encouraging factors of using alternatives

In Bull Creek, the factor most cited as a reason for not using public transport was service availability, especially frequency of service. Also, cheaper tickets and traffic jams on the freeway were mentioned as reasons for using public transport more. Respondents were also considered that PT services could be easier for big families with three or more children on board. Some mentioned special services such as "being able to take bikes onto the train at peak hour" and "more comfortable seats". Among the reasons for people to use their cars more, most of them said that they would "if parking becomes easier". They were concerned about space for parking more than cost. Another aspect of car use that was mentioned as a concern was "safety at car parks especially at night time". "More lanes on the freeway" and "reduced congestion" could also influence them to use their cars more. People who were concerned about pollution would use their cars more when "more fuel efficient engines with low carbon emissions" become possible. Of interest was that there were quite a few people who had no thoughts about this factor, because "they use their cars every day, anyway".

In Kangjian, the most significant reasons for people to use PT were the availability of transport, travel time and travel cost. As well as these general reasons, people also mentioned more availability of metros and Bus Only lanes. Protection of the environment was mentioned as another reason for using PT more. Surprisingly, not many people were

concerned about safety aspects of PT in Kangjian, and only a small number of people chose amenity as a reason for use. On the other hand, the highest incentive for people to use a car more was identified as reduction in the cost of using a car, such as petrol prices, parking fees, insurance fees and the cost of registration. The second reason cited for using a car was an improvement in traffic conditions. Some people mentioned that if "their income increased" and if they thought they needed a car to carry shopping items, they would prefer that for greater convenience. Lower emissions from improved automobile design were cited as another potential reason for people in Kangjian to use cars more, but only by a small number of respondents.

The above analysis shows that the main reasons for people to use alternative modes of transport can be grouped as "push" and "pull". A push factor is a behavioural incentive: attractive features of a mode or a way of travel such as speed, convenience, low cost and so on. A pull factor is a restriction on behaviour or a "stick", such as unreliability because of congestion, negative perceptions of safety, the lack or high cost of parking.

In conclusion, the two case studies have shown that pull factors work very well for people to use public transport more in Bull Creek, whereas "push" factors are significant in the use of public transport in Kangjian. Kangjian people are more sensitive to economic factors such as ticket price, parking fees and fuel costs. Policies that take travellers' different characteristics into account and are targeted at changing individual travel behaviour are therefore likely to be effective.

6.7 Discussion and Conclusion

6.7.1 The limitations

Conclusions drawn from the survey findings are summarised in this section. As a research method, a questionnaire survey has advantages over many types of surveys; for instance, it can be targeted at research interests. However, a limitation is the framework of the survey instruments, which depends largely on a clear definition of the issues and anticipated participant responses. In this research, it was a big challenge to target all the participants' thinking about different travel modes in the way questions were phrased; it was also a challenge to frame the questions to be appropriate to different mobility groups. Moreover, culturally diverse research needs to draw on cross-cultural information exchange, but there has not been much in-depth research which has focused on cultural differences in these

two countries. Therefore, comparing evaluative responses of these two very different populations, a Western one and an Eastern one, was another challenge for this research. The relatively positive evaluation of the PT service in a suburb of the relatively small and remote city of Perth was influenced by Western Australian culture, which made it difficult to compare findings with those from Kangjian of Shanghai, a suburb of the huge city of Shanghai, under a unified standard. As the main interesting of this research is to find out travellers' travel attitude characters behind travel mode choices, even though the two case studies have many differences in their background characteristics, it will be interesting if similar attitude characters can be found within the same travel mode group. This will help to expand travel attitude study world widely.

6.7.2 The research findings

The following research findings are drawn from the survey.

Firstly, although there are significant alignments between socioeconomic and demographic variables and travel attitude factors, the socioeconomic and demographic variables do not explain much of the variation in the attitude factors. Travel attitude factors such as attitude and perceptions are characteristics of individuals that are distinct from the socioeconomic and demographic variables and which need separate measures.

Secondly, the study found that there are more car users than public transport users in Bull Creek, and mostly these are car users by habit. In Kangjian, there are more public transport users than car users and mostly they are also users by habit. Both areas have a larger percentage of habitual users, whether car or PT, which supports the hypothesis that perceived attitudes play an important role in mode choice. This is because habitual users normally have control of their behaviour, and persuasion or better alternative experiences can influence them to change.

Third, Bull Creek's public transport users gave more positive feedback overall about their PT service than did the Kangjian people. This is where the hidden factors of cultural differences play a part, as discussed before. It is interesting that Bull Creek's car User groups have given a relatively higher evaluation of their local public transport services than have Bull Creek PT users, even though they were reluctant to use it. This is contrary to the general conviction that higher satisfaction is associated with more usage. It also noteworthy that compared with Bull Creek respondents, Kangjian people seemed to be

more sensitive to the outside environment in decisions about mode change, especially with respect to economic reasons. Bull Creek people cared more about amenity factors.

The findings show that pulls (constraining) reasons can influence Bull Creek people to use public transport more, such as less amount of parking space in city centre or congestion. Push (encouraging) reasons can influence Kangjian people to use public transport more such as better service or cheaper ticket price. Better services are not enough to encourage people to change their travel habits in Bull Creek. Overall, Bull Creek and Kangjian people have different satisfaction levels regarding the quality of public transport services. The extent to which improvements in service quality can be used to increase acceptance of public transport depends on the users' perceptions of the quality of services. Bull Creek and Kangjian people are different in their perceptions of convenience, comfort and affordability, due to their different socio-economic and cultural background. Planning strategies to change travel behaviour need to be based on evidence of the population's perceptions of travel services and needs.

Fourthly, even though Bull Creek and Kangjian belong to two different societies and cultures, they share some transport characteristics. As discussed before, the largest percentage of users of cars and public transport in both case studies were motivated by habit, which shows that perceived attitude affects mode change worldwide. On the other hand, in both cases, the evaluation results for local public transport services were different among the six mobility groups. Car users' evaluations of public transport services mostly were determined by their perceived attitudes drawn from past experience or imagination. These perceptions do not directly reflect the quality of local services, and need to be further explained by the motivation for mode choice. There was evidence of prejudice in the responses in both case studies. The big gap which exists in real life between users' or non-users' perceptions of service quality and providers' perceptions of their delivery of services has resulted in a low level of public transport usage. This bias should motivate planners to make an effort to create a positive image of public transport.

On the other hand, when comparing the importance ranking of the defined service items, the two case studies attracted quite similar responses (Figure 6.12). This shows that people from different worlds share certain expectations of public transport service performance. Improvement of service standards to attract more users always works; the question is which services to focus on, in which way, and to what extent, in a limited time and with limited resources.

6.7.3 The contribution to research methods

The comparative study on two cities with different economic and cultural backgrounds contributes to knowledge in the following ways.

A. Aspects of travel behaviour are identified using attitude theory. The theory mainly applied here is TPB (theory of planned behaviour) (Ajzen 1991), from the discipline of psychology. Using an expanded version of this theory with multi-dimensional attitude statements, this study has divided participants into six distinct travel groups. Each group shows a different degree of capability for mode change.
B. An indicator of performance rating and importance ranking is created for six aspects of public transport services to measure customer dissatisfaction. Using travel behaviour statements and performance/importance rating to measure customers' dissatisfaction is not really new. The contribution of this research, however, is in the extension of the work by distinguishing the dissatisfactions into six travel mode sub-groups. This dissatisfaction measure provides a graphic analysis that compares different aspects of a particular service, with the aim of comparing travel mode sub-groups and case study findings, to show which aspects of service are in most urgent need of improvement. This also extends the focus on the connection between travel attitude and dissatisfaction on transport services.

In conclusion, the findings from this primary questionnaire survey data show that travel behaviour is impacted by internal attitude factors, including people's perceptions and attitudes toward different transport modes. The empirical evidence from both the secondary travel data analysis and the primary survey provide support for the understanding that individual factors, especially travel attitude factors, are an important dimension which should not be excluded. The next research question will be: to what extent in practice are the current transport policies designed taking account of this dimension? Do they consider different mobility types in terms of attitude factors in order to design more targeted transport policies? If not, what are the main barriers? The following chapter will discuss those issues.

Chapter 7: Public transport planning in practice – the what extent are individual needs taken account of

7.1 Introduction

A reliable, time efficient, uncrowded, safe and comfortable public transport service is a pleasure for everyone who engages in this urban activity, both users and policy makers. Public transport systems are significantly influenced by the economic, environmental and social fabric of urban life. There are many considerations during the planning process, including investment or profit, economic benefits or social equality, economic savings and environmental protection. What are the focuses of current public transport planning practices? Are there any differences in these practices between developed and fast developing cities in the world? The previous chapters have examined the individual attitudes/preferences to public transport relative to other transport modes from the passenger's perspective. The aim of this chapter is to examine what urban public transport planning goals are from the provider's perspective. This approach allows a comparison of the policy aspirations of government with the attitudes of residents, to answer the research question: do policy aspirations align with the attitudes and needs of residents?

This chapter assesses selected policy documents against a set of public transport planning principles, as discussed in Chapter 2. The overarching objective is to examine to what extent public transport policy takes account of individual needs. A comparison is made between the two case study cities. The analysis is based on people-oriented planning objectives (as identified in previous chapters), focussing on how the policies consider the possibility and ease of using public transport facilities and the ease of reaching activity centres by public transport. This preliminary analysis is then supplemented by in-depth interviews with policy shapers to consider how policy has been delivered and how different participants were involved in the planning process. In addition, the organisational structures of agencies involved in public transport in the two case studies are examined, with the aim of identifying potential barriers associated with coordination or the lack of it in the delivery of sustainable public transport policy.

7.2 Current planning and individual needs: content analysis

To understand the policy capacity of the planning systems, content analyses of relevant policy documents in the two case study areas were undertaken. The definition of content analysis and the normal process of undertaking it have been discussed in the research method chapter (chapter 4). Decisions were made regarding selection of the documents for content analysis and the critical attributes of specific categories for analysis.

7.2.1 The selection of the documents for content analysis

To meet the research aim, it was important to choose the most suitable policies for comparison. In this respect the documents selected share a similar time period which align with the time when the questionnaire survey were conducted, also are public transport specific. That is, they comprehend a complete framework for urban public transport policies, covering matters such as the challenges of infrastructure expansion, design of public transport network, integration with land use planning, environmental protection, institutional framework, and the funding system. “Public transport for Perth in 2031” (2011-2031) (Department of Transport 2011) and “Shanghai’s Public Transport Twelfth Five plan” (2011-2015) (Shanghai Municipal People's Government 2012) are the two documents that match these selection criteria. Perth’s plan is a long term vison from 2011-2031, whereas Shanghai’s plan is for a short five year-term from 2011-2015. This creates some obstacles for a comparative study. In order to reduce this difference, analysis of Perth’s plan will focus on the Stage One or short term (before 2020) plan. Another obstacle is that there exists a timeline mismatch between the survey (Chapter 6) and the content analysis (Chapter 7). The two attitudinal questionnaire surveys were conducted respectively in 2013 at Perth and early 2014 at Shanghai. The two planning policies - “Public transport planning for Perth in 2031”was published in 2011 and its planning period is from 2011 to 2031; “Shanghai’s Public Transport Twelfth Five Plan” was published in 2012 and its planning period is from 2011 to 2015. This means rather than above two planning policies the survey results reported in Chapter 6 may also be impacted by the two cities’ previous planning. Further research on the previous planning documents will also be necessary at the end. The following studies start from the content analysis of the selected two planning policies.

7.2.1.1 Perth: "Public transport for Perth in 2031" (Department of Transport 2011)

The Public Transport for Perth in 2031 document is the state government's vision for improved and expanded public transport in Perth. It was released on 2011 as a draft document, but so far nothing has replaced it which makes it the latest policy document. This policy document is a long term public transport network plan which was designed to cope with the projection that Perth's public transport system will be carrying more than twice the current population — 3.5 million — by 2050. It is also a support document for "Directions 2031 and Beyond" (Western Australian Planning Commission 2010) and "Perth and Peel@3.5million" (Western Australian Planning Commission 2015). The metropolitan strategic land use plan "Directions 2031 and Beyond" looks at the future 20 years, when people's activities and associated transport needs will range across the city.

> "To create a dynamic, vibrant and liveable city into the 21st century, the Western Australian Planning Commission (WAPC) has developed the draft "Perth and Peel@3.5 million" suite of documents that clearly spell out what will Perth and Peel will look like by 2050 and how we accommodate a substantial population increase." (Western Australian Planning Commission 2015, 1)

As traffic congestion, environmental issues and shortage of energy become more acute, in order to successfully move the growing population in a sustainable way, high capacity and high quality public transport services will be required. "Public transport for Perth in 2031" is one of the key enablers for successfully implementing "Directions 2031 and Beyond" and the latest planning strategy, "Perth and Peel@3.5 million". Its main task is to provide a mass transit network for the future and proposed projects of new public transport infrastructure such as railways, transit ways and bus lanes.

The Department of Transport (DOT) set up an independent panel which comprised a number of experts from the private sector with strategic policy and transport planning expertise, and chief executive and senior executive staff from a number of government agencies to oversee the process of producing this planning document (Table 7.1). The task of the panel was to identify a primary public transport network for the city, to recommend capital investment, and also consider how to best achieve land use and transport integration. The panel consults closely with government departments such as the Public Transport Authority, Main Roads, the Department of Planning, local Government, and the transport industries. This involvement of different stakeholders and various government departments is not a normal in policy productions. The aim is to align the objectives

between transport agencies and local government, also to allow the collaboration across three tiers of departments: land use, transport and treasury. However, the representatives of the community and the private sector were not in the panel. Active engagement and collaboration of government, business and the community should form the foundation of successful implementation of this public transport plan. This project planning should involve all these stakeholders especially the residents (users/non-users) who are closely related to the public services. To get a chance to hear and speak to prominent players in public transport it is necessary for the public to find a way to speak their voices. In Australia, Melbourne has Public Transport Users Association and it is an active group conveying issues to government about network design, frequency of service, ticketing issues and so on which helps the fight for better public transport. Perth does not have one. Instead an independent market research firm commissioned by Transperth carries out the annual Passenger Satisfaction Monitor (PSM) to determine passenger sentiment about various aspects of Perth's public transport services. This survey has been running since 1991 and it conducts detailed face-to-face interviews. For some reason the survey results are always good enough which shows a quite weak power of public voice (details refer to http://www.pta.wa.gov.au/portals/0/annualreports/2013/community/customer-satisfaction.asp). It can be noticed that the respondents of Transperth survey are those who use Transperth services. Melbourne's PTUA is also for PT users. There is still a big market of non-users of public transport being ignored here. Some European city governments, like Freiburg, German, used citizen forums where people were selected randomly to attend. Over time, public opinion in Freiburg has become increasingly supportive of sustainable policies. In Portland, United States, public involvement has been institutionalized into Portland's transport planning process through a city funded network. The insurance of citizen participation at every stage of transport project was realized by public meetings, citizen advisory boards, focus groups, surveys, and public hearings (Kelemen 2014). Those also show the ways of involving non-users of public transport.

Table7.1: The independent panel of "Public transport for Perth in 2031"

	Position/Profession	Organisation
Chair	Transport policy and strategy expert	the commissioner of the WA Planning Commission and chairman of the National Transport Commission
Members	Director General	Transport
	Director General	Department of Planning
	Managing Director	Public Transport Authority
	Managing Director	Main Roads WA
	Executive Director (Infrastructure and Finance)	Department of Treasury and Finance
	Bus industry expert	
	Rail industry expert	
	Transport Industry	

Adapted from Department of Transport (2011)

7.2.1.2 Shanghai – "Shanghai's Public transport Twelfth Five plan"

Shanghai's comprehensive urban transportation planning started from Shanghai's first comprehensive traffic survey in 1979 (Figure 7.1). In 1984, Shanghai has completed its first urban comprehensive master planning and at that time the urban traffic problems become more and more serious. One year later the first round urban comprehensive transportation planning was drawn up, which focused on specific transportation such as elevated ring expressways, trunk network planning, and bus and bicycle network planning. In 1990s, Shanghai entered into a high speed development period, in order to adapt this development at the end of year 2000 the second round of comprehensive urban transportation planning (2000 -2020) was worked out in Shanghai. As the city continued to expand, in 2002 Shanghai government completed the "Shanghai Municipal Urban Transportation White Paper" which is the first time a combination of planning and policy. Shanghai's urban transportation timeline has shown a character of turning from "lagging behind" to "synchronizing with" urban comprehensive master planning. The first round of Urban Comprehensive Transportation Planning (1985) was behind the Urban Comprehensive Master Planning (1984). The second round of Urban Comprehensive Transportation Planning (2000) and urban master planning carried out simultaneously, thus transportation planning and land use planning can programme closely. However, unlike Perth, Shanghai did not have an independent urban public transport planning in the history.

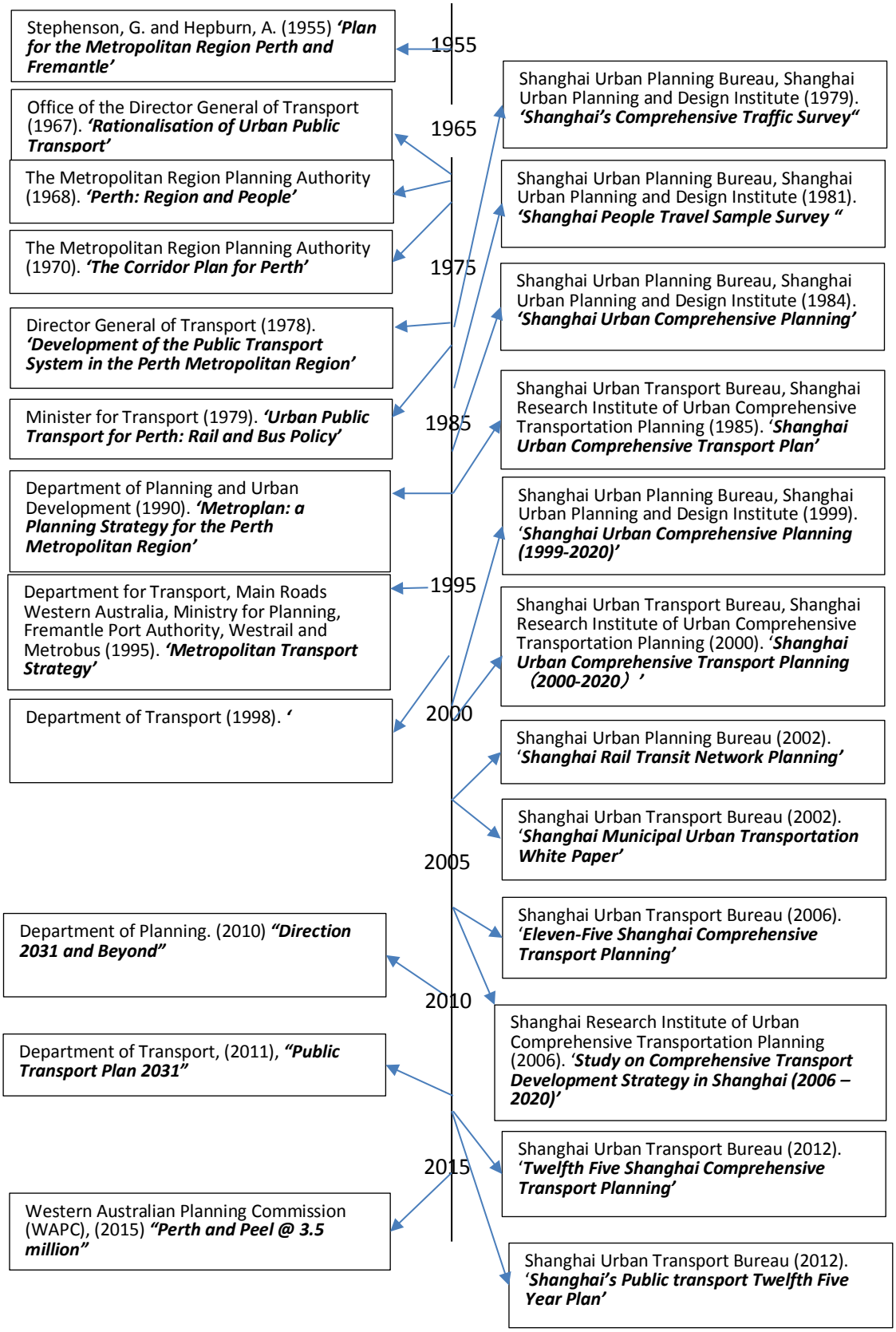


Figure 7.1: Timelines of key transport plans and land use plans for metropolitan Perth (left column) and Shanghai (right column). Source: Author

“Eleventh Five Shanghai Comprehensive Transport Planning” was developed to promote the city's comprehensive transportation development during “Eleventh Five" (see below) according to the "Shanghai Economic and Social Development Eleven Five Year Plan ", as was the “Twelfth Five” plan. Since 1953, China has carried out medium-term planning for each five year time period. The first “five year plan” was called “First Five” and so on. “Twelfth Five” refers to the period of 2011-2015. “Shanghai’s Public Transport Twelfth Five Year Plan” was public transport-specific.

7.2.1.3 Overall current public transport situation and future vision

As discussed earlier, the two case study cities are in different transport situations. In Perth, the car is still the primary mode of transport, accounting for most of the trips taken. In Shanghai, public transport plays a significant role and the rate of public transport use is quite high (details in Chapter 5). Those differences will greatly affect the two cities’ future planning tasks for public transport.

Perth: “Public Transport for Perth in 2031” indicates that Perth’s public transport system has met growing demands better than in the past. The overall vision of this plan is “Public transport will be the preferred choice of travel to Perth’s strategic centres and through growth corridors” (Department of Transport 2011, 20).

Shanghai: “Shanghai’s Public transport Twelfth Five Year Plan” shows that Shanghai has an extensive public transport system and a rapidly expanding metro system. Shanghai’s government has invested heavily in public transportation in recent years, especially before and after the 2010 World Expo. Overall, public satisfaction rates with public transport in Shanghai remain at over 80%. The vision is “to enhance the attractiveness and competitiveness of public transport in a comprehensive way, forming a cohesive and reliable network service” (Shanghai Municipal People's Government 2012, 7).

The above discussion has shown that both cities have placed public transport in a priority position for development. The differences in the investment in various public transport modes are based on the respective social, economic and political climates of the two cities. In Perth:

> "After years of neglect, Perth's railway system was completely rebuilt, commencing with the re-opening of the formerly closed Fremantle line in late 1983, then in the early 1990s the entire network was electrified and an entirely new fleet of trains built. Two totally new lines have been constructed — to Clarkson in the late 1990s, Southwards to Rockingham and Mandurah in 2007, and in September 2014 further north to Butler. The current six rail lines are radiating from the downtown Perth station. In the next 21 years the mass transit railway network will extend from 173kms to 220kms [Table 7.2] and Bus Rapid Transit network will extend to 413kms." (Department of Transport 2011, 21)

In Shanghai, the importance of rail continues to grow, and it is regarded as the most efficient and environmentally friendly transport method. Shanghai is implementing a very ambitious rail expansion programme: in the year 2009, Shanghai has 323kms of track length and 275 stations, and aims to increase this to 804kms of track length and 506 stations by the end of 2020 (Table 7.2). It will become one of the longest metro networks in the word (Shanghai Municipal People's Government 2012, 5).

Table 7.2: Comparison of current and future vision of train systems of Perth and Shanghai

Major characteristics of train systems	Perth		Shanghai	
Year	2009	2010-2030	2009	2010-2020
Length of network	173km	220km	323kms	804km
Number of lines	5		12	
Number of stations	70		275	506
Frequency of trains	10-20 min/ peak times 30-60 min/ off peak		2-5 min/ peak times 6-12 min/ off peak	

Adapted from Department of Transport (2011) and Shanghai Municipal People's Government (2012)

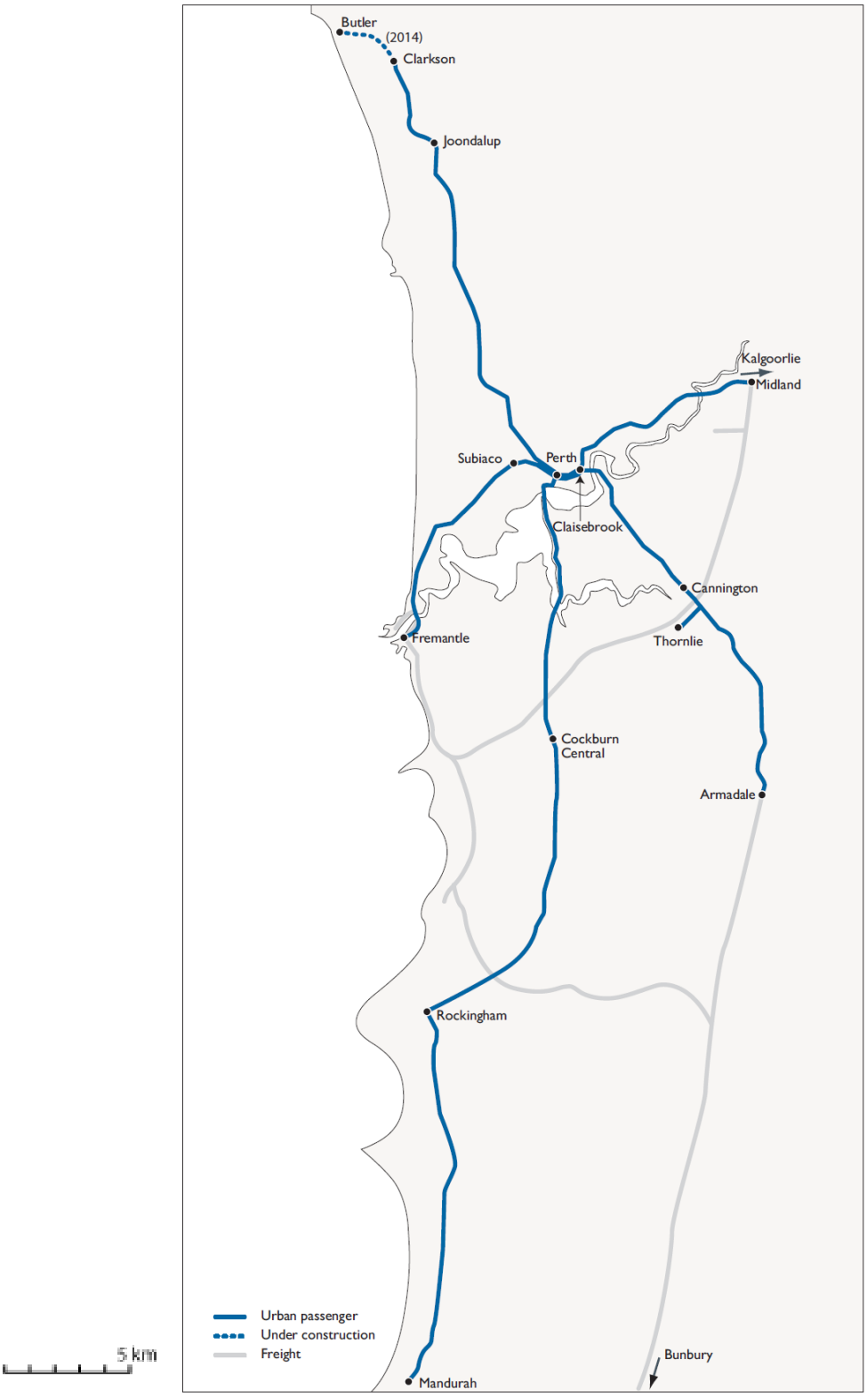


Figure 7.2: Perth's passenger rail network map. Source: (Dornan and Kain 2012, 4)

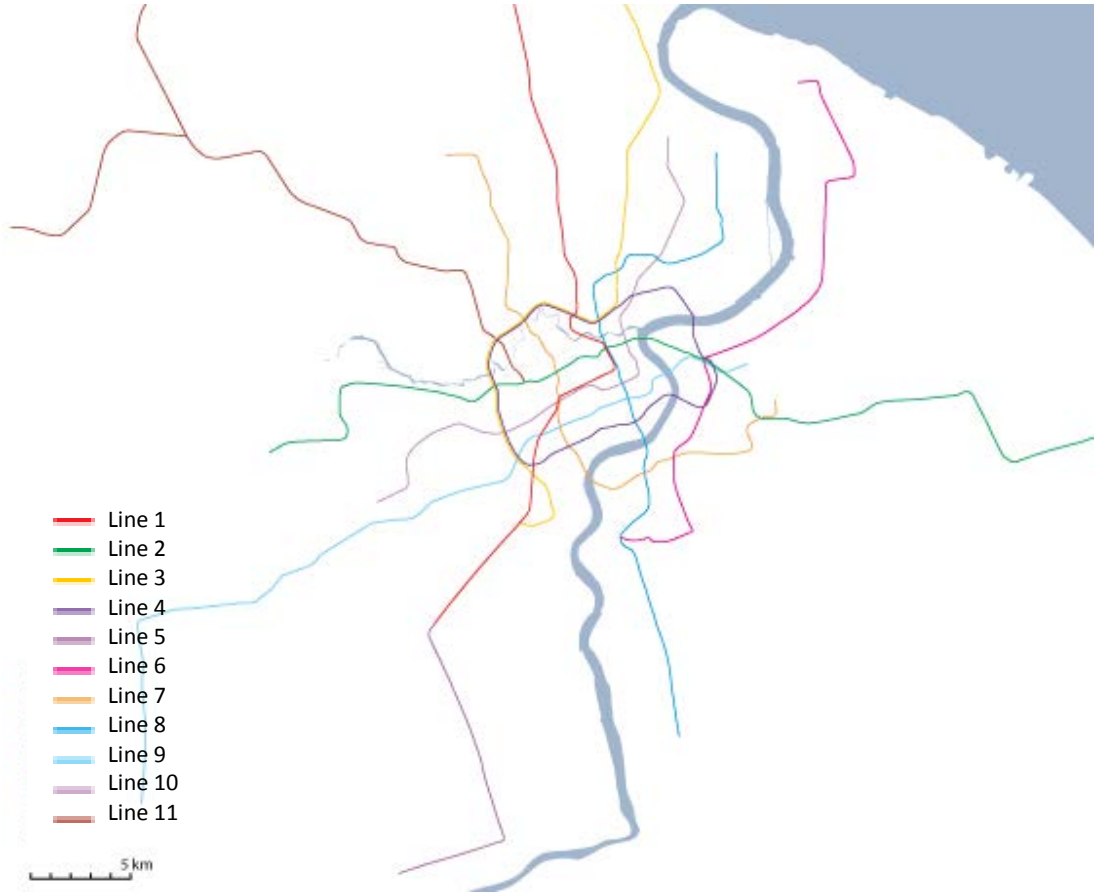


Figure 7.3: Shanghai Metro map, July 2010. Source: Bricole (2010, 3)

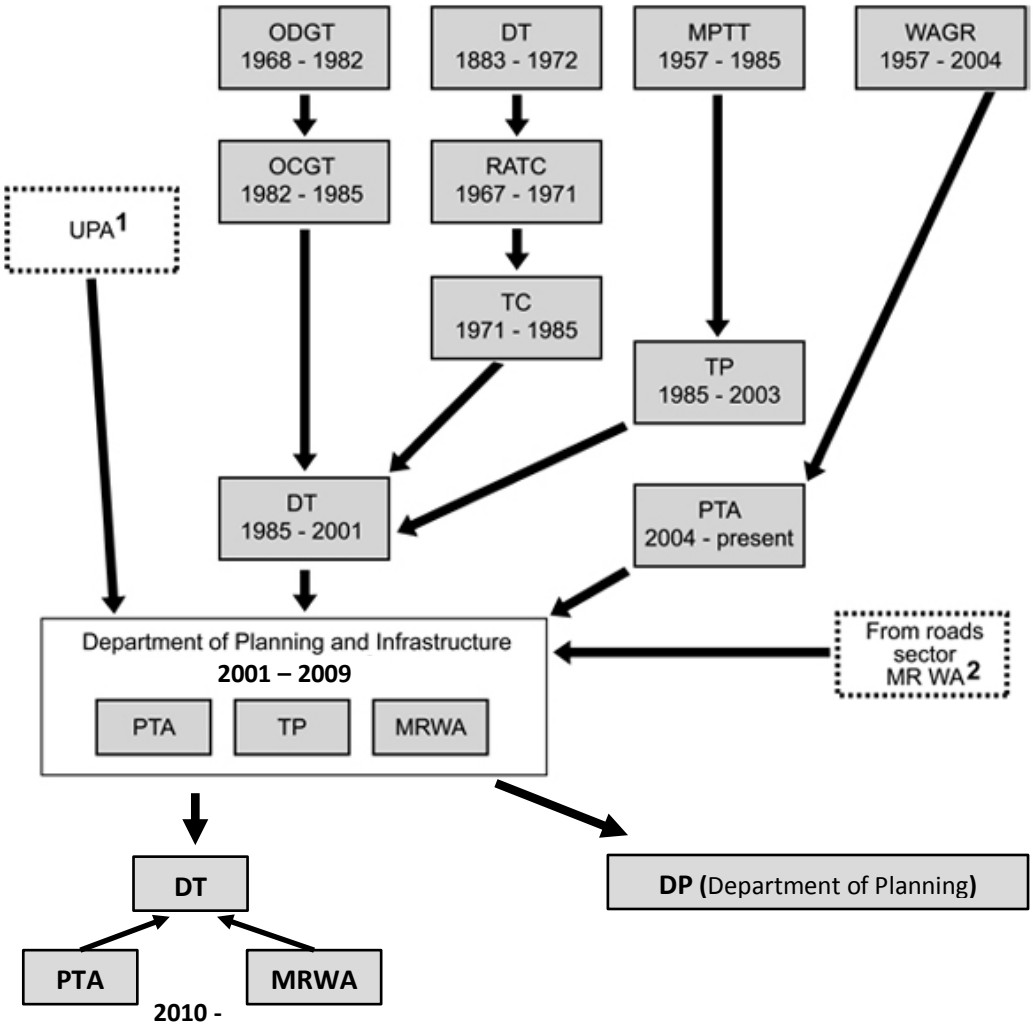
Perth and Shanghai have different future visions. Perth is moving from public transport being a "neglected choice" to it being a "preferred choice" (Department of Transport 2011, 1). In a low density, dispersed city, the current mode share of public transport is still quite low. Compared with cars, public transport is still not the preferred transport mode for Perth people. The future vision aims to make public transport play a very significant role in meeting Perth's travel needs by the time the city's population reaches 3.5 million people. Shanghai is making public transport a "very competitive choice" (Shanghai Municipal People's Government 2012, 7). Even though the rate of public transport use is quite high in Shanghai, rising car ownership has gradually shifted people's attention to cars. How to maintain public transport use and increase its competitiveness is a great challenge to Shanghai. In conclusion, the overarching goals of those two public transport planning policies are to keep investing in public transport and improving the network service to gain more passengers, no matter what transit service stages they are currently in.

7.2.2 Organisational structure of transport institutions in the two case study cities

During the whole process of public transport planning, the institutional and regulatory structures are important. Institutions create the framework of rules for public policy making (Curtis 2012). The two case study cities, Perth and Shanghai, have quite different institutional structures and management functions for urban transport. In-depth knowledge of the institutional characteristics of transport in these two cities provides background information for comparative content analysis.

7.2.2.1 Perth

In Perth, as government policies frequently change between electoral cycles, the names of departments and their accountability also changes over time (Curtis 2012). Figure 7.4 shows the structural change of institutions over the years in the transport sector; from this, we can see a movement to integrate the planning of all transport agencies, including roads and public transport. This has resulted in a reduction of the number of single purpose institutions. To achieve sustainable travel behaviour the integration of land use planning and transport planning (LUTI) has been espoused as a desirable outcome for many years. To deliver LUTI one core issue concerns the challenge of policy integration within and between organisations (Curtis 2012). In this case the integration of different trasnport agencies especially across transport and planning organisations is important for sustainable transport development.



Key: DT = Department of Transport; DPI = Department of Planning and Infrastructure; MPTT = Metropolitan Passenger Transport Trust; MRWA = Main Roads Western Australia; OCGT = Office of Coordinator General of Transport; ODGT= Office of the Director General of Transport; PTA = Public Transport Authority; RATC = Road and Rail Transport Commission; TC = Transport Commission; TP = TransPerth; UPA = Urban Planning Administration; WAGR = Western Australian Government Railways.

Figure 7.4: Institutional structure change in the public transport sector in Perth. Adapted and updated from Curtis (2012)

Figure 7.4 shows in Perth, a consolidated Department of Planning and Infrastructure (2001-2009) created in 2001 has significantly affected the institutional structure of transport agencies. The aim was to bring together not only public transport and roads, but also town planning, in one portfolio. The PTA takes on the operational functions of public transport services and infrastructure development, and is responsible for financial and service

planning and marketing. These systems include bus, train and ferry services. Transperth (TP) is a division of the PTA of Western Australia, which plans and manages the routes and timetables for the metropolitan system, but is separate from the sections that run school and rural services. One interesting thing is that PTA operates train services directly via TransPerth Train Operations Division of the PTA, but tenders bus and ferry services to private contractors (Curtis 2012). The state agency in Perth, however, retains strong contractual control over service delivery. The PTA, operating as a separate agency, is now able to carry out a powerful planning function for public transport, with its own CEO, annual report and published accounts (Mees and Dodson 2011). The Department of Main Roads is a well-integrated and continuous entity with responsibility for road planning, management and construction. Sitting under the DPI and within the same portfolio, road operations - MRWA and public transport operations - Transperth reported to one minister who had control over the land use planning and transport portfolio. It turned out that such integration has improved the coordination of land use and transport infrastructure planning and also service delivery which was a better integration institutional structure than had previously been experienced in WA (Legacy, Curtis and Sturup 2012).

In 2008 the state government proposed a change to the agency structure (finally enacted in July 2009), with the policy making functions of DPI split into two departments – Planning and Transport – each with its own minister. This move would break apart the organisational integration of transport and land use. To make up this disadvantage, in May 2010, the State Government established the WA “Transport Portfolio” which integrated Western Australia's three key transport agencies: Public Transport Authority, Department of Transport, and Main Roads. The aim was to enhance the co-ordination of operations, regulatory functions and policy development. To deliver a more balanced approach to the whole of network transport planning is not easy, the 2001 integrated structure was supposed to do all of this. However, “evidence later emerged concerning the extensive distribution of resources across the single department and departmental fragmentation suggesting that such a structure was not achieving its goal” (Curtis and James, 2004, 289). This has shown that the Perth’s coordination and integration in reality still has a long way to go. Recent years have seen an ongoing improvement in cross-agency collaboration, particularly between the Department of Planning and Transport, including regular inter-agency meetings on key projects such as Directions 2031 and Public Transport for Perth in 2031.

In contrast to China, Australia has three levels of government: federal, state and local. Each level of government has particular responsibilities in the transport sector (Table 7.3). To support sustainable transport, it is necessary to have an appropriate governance model for the delivery of transport policy and practice (Curtis and Sturup 2012).

Table 7.3: Transport governance in metropolitan Perth

Level of government	Transport Institution	Management function
Commonwealth Government	The Department of Infrastructure and Transport	The Department of Infrastructure and Transport is responsible for infrastructure planning and coordination; transport safety; land transport; civil aviation and airports; transport security; maritime transport including shipping; and major project facilitation. The portfolio includes Infrastructure Australia. The Commonwealth provides significant funding for strategic investments and funding to metropolitan local governments.
State Government	• Department of Transport • Main Roads WA • Public Transport Authority (including Transperth and Transwa)	The Government has three key transport agencies to enhance the co-ordination of the State's transport operations. The Department of Transport's focus is on operational transport functions and strategic transport planning and policy across the range of public and commercial transport systems that service Western Australia. Main Roads WA is responsible for highways and main roads. The Public Transport Authority operates four major passenger transport service systems in Western Australia, including Transperth, and Transwa which links Perth to regional areas.
Local government		Local government provides the large majority of the metropolitan area's road network, provides street lighting and regulates parking. Provision of parking facilities is a role of local governments.

Source: Metropolitan Local Government Review. http://metroreview.dlg.wa.gov.au/

7.2.2.2 Shanghai

In China, the central power has devolved to the provincial level since the economic reforms (Cherry 2005). Shanghai is one of the four municipalities which are directly under the central government. To avoid conflicts between government departments, the transport management model of Shanghai is a metropolitan tier of government that administers all

functions. It has only one department, named the Shanghai Urban-Rural Construction and Transport Committee, which is responsible for general regulation of transportation. This committee comprises two organisations, Shanghai Urban Transport Bureau, and Shanghai Municipal Engineering Bureau (Figure 7.5). The Urban Transport Bureau is responsible for regulation and administration of the transport system, and the Municipal Engineering Bureau is in charge of road and bridge construction. Usually an Urban Planning Bureau will prepare a master plan, comprehensive urban transport planning, and urban transport strategies which are responsible for coordinating various specialised planning (Table 7.4). Traffic Police Headquarters of Police Security is responsible for managing road traffic, promoting streets public security and so on. The management of public transport and the transport industry have been merged in one department named Shanghai Urban-Rural Construction and Transport Committee which can provide the opportunity for a stronger public transport voice. Shanghai's mode has shown a separated planning and operation system. All the planning including land use planning and transport planning are under one department called Shanghai Urban Planning Bureau which is good for LUTI. However transport agencies do not have the authority to do transport planning and this often leads to transport planning having to give way to urban land use planning. This limitation is not good for sustainable transport development. This is different from Perth: the WA Department of Transport is formally responsible for strategic transport planning, but that Public Transport Authority which responsible for operations also informally gets involved in strategy planning to speak for public transport.

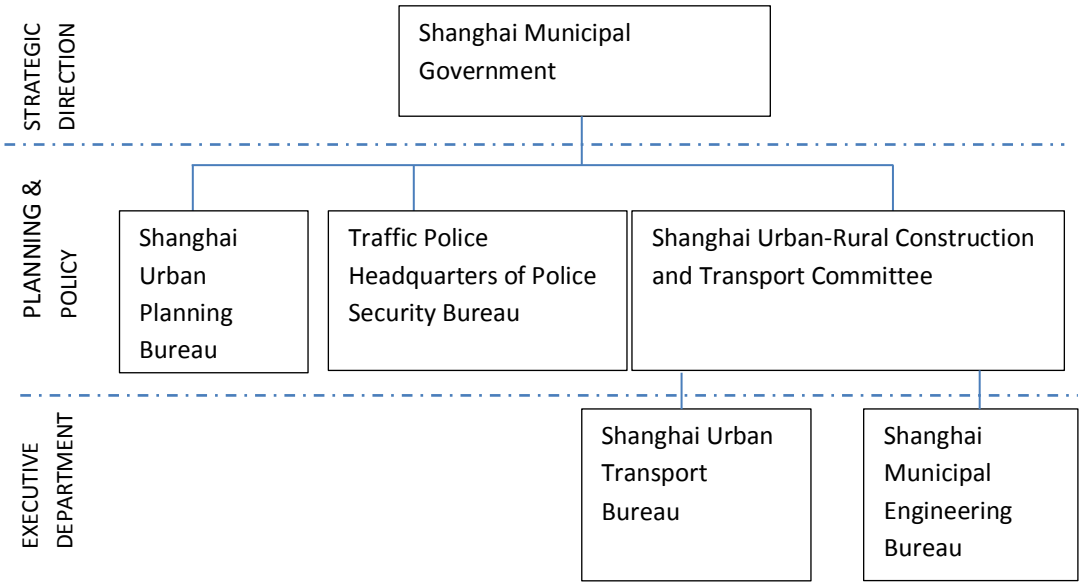


Figure 7.5: The organization structure of transport instituions in Shanghai. Author

Table 7.4: The management function of transport institutions in Shanghai

Institution		Management Function
Shanghai Urban Planning Bureau		• Coordinate various specialised planning including transport planning and urban transport strategy
Traffic Police Headquarters of Police Security		• Manages road traffic • Promotes order and security on public streets • Administers motor vehicles, non-motor vehicles and vehicle drivers • Prevents road traffic accidents
Shanghai Urban–Rural Construction and Transport Committee	Shanghai Urban Transport Bureau	• Formulates policy guidelines and industry criteria • Formulates public transportation service standards • Nurtures the transportation market
	Shanghai Municipal Engineering Bureau	• Constructs, maintains and administers urban roads and bridges

Adapted from Meakin (2004)

In summary, a single, multi-function institution that merges administration of both land use planning and transport planning, merges roads and public transport planning can foster a more sustainable transport development especially public transport development. Both cities have realised the importance of this integration and tried to minimise the levels of organisations to avoid conflicts between government departments. In Perth between years 2001 and 2009, the integration of roads, public transport and town planning functions in one institution had the aim of treating public transport and commercial road transport fairly and of aligning with the policy of integrating land use and transportation. However, this did not last long and also it turned out that the structure did not really achieve its goal; in 2009, the Department of Planning and Infrastructure was reformed into the new Department of Transport and Department of Planning for political reasons, which has brought more difficulties for such integration. In Shanghai, the management of public transport and the transport industry have been merged in only one department named Shanghai Urban-Rural Construction and Transport Committee. Land use planning, however, is still controlled by a separate Urban Planning Bureau. This planning bureau is responsible for coordinating various specialised planning, although differences may arise during internal negotiation between various sections of the planning commission. LUTI principles exist in both cities, however, to fully implement this policy there appear to be challenges. To enable more sustainable communities, integration requires that land uses are more

accessible by public transport mode which needs more supporting from governance arrangements in both case study cities.

7.2.3 Research approach

To examine to what extent the two planning policies were designed from the perspective of the passengers, a content analysis of recent urban public transport planning policies of relevance in the two research case studies was undertaken. As discussed in the methodology chapter (Chapter 4), content analysis is a quantitative method of textual analysis — the documents are coded according to their match with a list of categories. In this research, the categories developed for content analysis are design principles from the passenger's perspectives. Chapter 2's literature review lists the first order principles of public transport planning. Chapter 6 examines the passengers' requirements for using a public transport service through a questionnaire survey which embodies the detailed principles. The framework of content analysis has effectively merged the understandings from these two literature reviews. Five categories of public transport planning principles are established: network planning, social equity, environmental protection, people-friendly, and travel attitudes/preferences. The choice of each sub-category was determined by people's requirements in the areas of availability, travel time and reliability, travel cost, comfort and amenity levels, safety and information. The details are listed in Table 7.5.

Table 7.5: Public transport planning principles regarding users' requirements

Network planning	A1. Rail dominated simple network structure
	A2. High degree of hierarchy of lines into a network
	A3. Wide coverage to suburban areas
	A4. Fast, consistent and reliable service
	A5. Convenient transfer
	A6. Integrated ticket system
Social equity	B1. Fair distribution of activities and transport facilities
	B2. Accessible to people with disabilities, seniors, children etc.
	B3. Affordability
Environmental protection	C1. Greenhouse emissions
	C2. Renewable energy

People-friendly	D1. Safe, secure, convenient and comfortable stations/stops — on board and at interchanges
	D2. Ease of use: clear and readable
	D3. High amenity precincts for walking, cycling and use of public transport
Travel attitudes/preferences	E1. Accommodating and shaping travel attitudes/preferences

Each policy document was reviewed to examine the extent to which any of the above principles were present. Individual statements within each policy text that captured those principles were coded to a simple 5 point scale, where +2 (strongly satisfied with the principle) to -2 (strongly works against the principle) and 0 in the middle (ambiguous policy statement). The higher the score the greater the satisfaction with that criterion, and this aids measurement of the level of support for users in the policies. It also makes it possible for a comparison of individual criteria in the two case studies. The challenge for the discourse analysis comes from the translation of cultural aspects: "Shanghai's Public transport Twelfth Five plan" is in Chinese version which needs to be translated into English. For this comparative study of different cultures, discursive explanation is important for the content analysis. As an author with Chinese background, translation of the Shanghai policy into English is an important step in the research process, and cultural differences should be considered in advance.

7.2.4 Findings: content analysis of public transport policy

Table 7.6 shows the two cities' rating results on each planning principle, based on the two policy documents. The table of detailed content analysis is shown Appendix 1. Of interest is that the two planning documents reveal commitments to most of the planning principles, but the scales are quite different. Detailed discussion continues below.

Table 7.6: Rating results of the two policy documents

		Perth	Shanghai
A1	Rail dominated simple network structure	1	2
A2	High degree of hierarchy of lines into a network	2	2
A3	Wide coverage to suburb areas	1	2
A4	Fast, consistent and reliable service	1	2

		Perth	Shanghai
A5	Convenient transfer	2	2
A6	Integrated ticket system	2	1
B1	Fair distribution of activities and transport facilities	2	1
B2	Accessible by people with disabilities, seniors, children etc.	2	1
B3	Affordability	2	2
C1	Greenhouse emissions	2	2
C2	Renewable energy	0	2
D1	Safe, secure, convenient and comfortable stations/stops on board and at interchanges	1	1
D2	Ease of use: clear and readable	2	1
D3	High amenity precincts for walking, cycling and use of public transport	2	0
E1	Accommodating and shaping travel attitudes/preferences	0	0

A1. Rail dominated simple network structure

Perth: as mentioned in the planning document "there are limited options to further develop the rail system in a cost effective way", and most of the new growth corridors will "be served by road-based services" (Department of Transport 2011, 6) (Figure 7.6). Thus Perth's future network expansion will focus on road-based transit services; further development of the rail system will be enhanced by increasing capacity on the existing network. From the government's point of view the construction is "very expensive and not feasible for extending service to new areas" (Department of Transport 2011, 6). As this is against the design principle from the perspective of passengers — "rail-dominated simple network structure", the Perth government does not have a long-term vision of a reliable, highly efficient transit system. Budget limitations have raised the need for another tier of service — an on-road Rapid Transit System at this stage to Perth. However, road-based service development will largely depend on strategic decisions such as priority policies for general traffic. This is because the roads are shared with many other vehicles such as private cars, and without priority for public transport on roads, the quality and level of service will be hard to achieve. This will lead to increasing congestion and pressure for wider roads.

Figure 7.6: The future vision transit network map for Perth 2031. Source: (Department of Transport 2011, 7)

Shanghai's future transit development will maintain focus on its rail (metro) system. The aim is to further an "enhanced rail network with expanded range and radiation" and "further improve Suburban Rail transportation accessibility" (Shanghai Municipal People's Government 2012, 8). Except for radial railways, the city ring system is developed to form a "ring + star-shaped radiation" pattern of rail transit network (Figure 7.7). This is to develop

a strong rail network covering the whole urban region. A full area coverage rail service — a simple, fast system, will be accessible and attractive for all potential users. This is following the design principle from the perspective of passengers — “rail dominated simple network structure”.

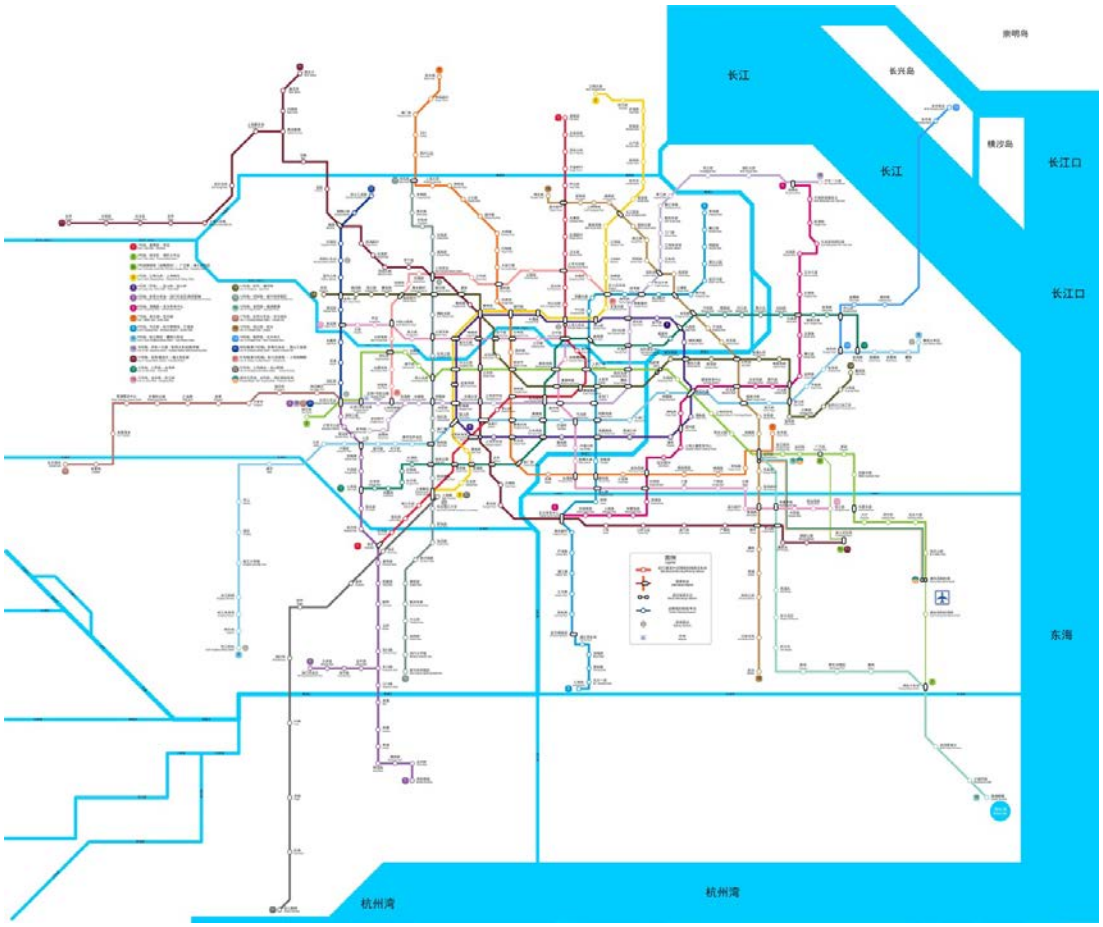


Figure 7.7: The future vision of Shanghai metro network in 2020. Source: http://shanghaiist.com/2013/08/26/what_the_shanghai_metro_will_look_like_in_2014_and_2020.php

A2. High degree of hierarchy of lines into a network

A high degree of hierarchy of lines requires combinations of bus and rail lines. Both cities in their planning documents have pointed out the need for high interconnection between road systems and train systems. Perth’s public transport system intends to be fully integrated, which means people can move easily between trains, buses and ferries. “The future transit system will need to have three integrated types of service – train services, road-based rapid transit services and buses” (Department of Transport 2011, 6). Road-based rapid services can be either light rail or bus rapid transit. Apart from rail and bus systems, the road-based rapid services are still at an early stage in Perth. The city has

reached a development stage where on road rapid transit is needed, which will probably depend on dedicated priority within existing streets. Transfers will become normal between different services when a city grows. Except for feeder buses, “park and ride” facilities at stations on the rail lines provide “effective access” (Department of Transport 2011, 7) to the train system and are popular for current car users, but supply and allocation of space for them has been restricted to discourage car use.

To optimise the network structure, Shanghai is creating a clear “Metro — Light rail — BRT—Feeder buses” hierarchical network system; this is the same for the Perth policy. The aim is “building up an integrated public transportation system which makes rail transportation the backbone, on-road transportation the basis, supplemented by taxis and ferries for assistance, with information systems as a means of transportation and transfer hubs as the anchoring points” (Shanghai Municipal People's Government 2012, 6). The plan highlights the link between rail and road passenger transport, with the building of transfer hubs and planning of surrounding land use. This is to achieve “multi-mode, multi-directional and multi-level transport interchange functions” (Shanghai Municipal People's Government 2012, 8) and cover the whole city. The road transit system has three levels of lines according to their functions: backbone lines, regional lines and feeder lines. The backbone lines set up bus priority lanes to ease the pressure and burden of rail transportation. Regional line services are in urban secondary passenger corridors to encapsulate the public transportation network, and expand the scope of services of bus lines. Feeder lines focus on residential areas, connecting rail stations, bus terminals and surrounding schools, community service centres, hospitals, shopping malls and other activities, to fill empty areas of the services and to meet the residents’ travel demand. Limited car parking spaces only exist in the outside city. Except for non-motor vehicle parking facilities, taxi stops are offered, and taxi as a feeder service are quite popular in Shanghai.

A3.Wide coverage to suburb areas

In Perth, the current public transport network and services “support and reinforce the concentration of employment, jobs and commuter activity in the central area” (Department of Transport 2011, 39). This can be further confirmed with the poor SNAMUTS score for network coverage in Perth (46% in 2014); (refer to http://www.snamuts.com/).The future plan considers the connection with suburban centres with large workforces or education and/or health facilities, to improve the

opportunity to connect between centres at suburban nodes. “Future rail expansion will build on the existing network to meet demand in growth corridors” (Department of Transport 2011, 21).

Shanghai’s plan strongly supports suburban construction by further improving the suburban rail transportation accessibility rate. It also dramatically improves the bus network and bus stop coverage in its suburbs and new town centre areas; the capacity and service level standards follow those of the central city. Both cities’ plans recognise the importance of public transport coverage to suburban areas. Perth’s extension starts with corridors and important activity centres; Shanghai’s plan has a much wider coverage and applies the transit service standards of the central city. This difference largely comes from the different population densities and different stages of public transport development. It is very costly for Perth to provide services at high frequencies.

A4. Fast, consistent and reliable service

Perth has realised the need for there to “be real improvements in reliability, speed of travel, service frequency” (Department of Transport 2011, 6) for a quality public transport service. Currently the train system provides a fast, reliable service “with service frequencies greater than many other Australian cities” (Department of Transport 2011, 15). The bus service, however, is “less legible than rail services with frequencies generally lower than trains in Perth and bus systems in other Australian cities” (Department of Transport 2011, 15). Current low frequency of services and less legible local bus timetables have formed a big obstacle to connection with rail services. In consequence, Perth’s plan points to “upgrading major bus interchanges and providing faster bus services to transfer passengers to rail services” (Department of Transport 2011, 7), but unfortunately, there is not an in-depth discussion of this issue in this planning document.

In Shanghai, on the other hand, public transport development has reached a relatively mature stage; the city's investment in its metro and BRT systems will continue to increase, trying to serve more and more passengers in urban areas with a fast and reliable service. The aim is to “reach punctuality rate for rail of over 99% and of commuter buses of 80%” (Shanghai Municipal People's Government 2012, 7); also, “ultimate objective of 80% of public transport trips in the city centre completed within one hour during peak hours” and “80% of public transport interchanges completed within 10 minutes” (Shanghai Municipal

People's Government 2012, 7). However, regarding network extension (A3) and fast/efficient service (A4), it should have a balance. Making more efficient use of the existing network to meet the travel demands is also necessary. In particular, it can be seen that 'travel time' has the biggest gap between "importance ranking" and "performance ranking" in Kangjian as revealed in the earlier chapter (Figure 6.14). The efficiency of current lines still has much space for improvement. The plan also emphasises the importance of timetabled co-ordination of aviation, water, road and rail traffic and other passenger transportation.

A5. Convenient transfer

As a city develops, passenger travel will be more dependent on transfers. This has already happened in Shanghai, and Perth is beginning to realise the importance of convenient transfers. For instance, in Perth's plan, major stops and stations are designed to support fast and efficient transfers; in Perth CBD, "superstops" have no-step entry and off-vehicle ticketing, and no transfer fee within the same zone. Shanghai's plan strengthens the link between rail transit and road passenger transport by optimising the orbit, reducing walking distance from the railway station and bus station to no more than 50 meters, and trying to achieve 80% of transfers within 10 minutes. The plan also largely reduces transfer fees to improve convenient transfer between rail and road bus systems. "Promoting the construction of an integrated passenger transfer hub" (Shanghai Municipal People's Government 2012, 6) has also been put in a high position in the planning.

A6. Integrated ticket system

Both Perth and Shanghai's public transport ticket systems are using a universal payment option. In Perth, "the SmartRider electronic ticketing system operates for all travel" (Department of Transport 2011, 14). Transperth provides the Perth metropolitan region with public transport services by bus, train and ferry; it operates the only fully-integrated public transport system in Australia. This means that with just one electronic card, you can tag on and off across modes in the Perth metropolitan area and transfer between services within a given period. Shanghai's ticket sale also applies joint inspection "using electronic chips and electronic monthly bus cards to improve the operational efficiency of management" (Shanghai Municipal People's Government 2012, 3). However, each mode and operator still charges their own fare in Shanghai, which is not fully integrated ticketing.

B1. Fair distribution of activities and transport facilities

As discussed in Chapter 1, one important function of public transport is to enable social equity in transport access. It's an important reference point for transport users, especially those with unequal access to transport services. These inequities come from users' physical, economic and social differences. To enable social equity, there is a need to provide fairly distributed public transport facilities and affordable and physically accessible transport services.

In Perth, the master plan – "The Directions 2031 and Beyond" (Western Australian Planning Commission 2010) emphasises two strategies for public transport: one is improving the integration of public transport and land use planning; the other is "ensuring ongoing access to public transport" (Department of Transport 2011, 16). The Public Transport Network Plan "supports the medium and long term planning direction for the City, particularly the need for consolidation and higher levels of activity in the Central Area" (Department of Transport 2011, 16). Consolidation and more intensive activity of services is planned largely "within 15km of the CBD" (Department of Transport 2011, 20) which does not match the design principle of "fair distribution of activities" at this stage. However, "The Directions 2031 and Beyond" has a planned activity centres hierarchy: capital city – primary centres – strategic metropolitan centres – secondary centres – district centres – neighbourhood centres – local centres. The adding of primary centres is to achieve long-term sub-regional high order public and employment objectives, with the aim of gradually forming a polycentric urban form. No centres currently perform a primary centre function, and this classification works as an aspirational target for the future of a city of 3.5 million. In Perth, urban planning has shown an intention for polycentric development which requires the urban public transport planning to also strongly support this direction. Comparing the "future vision transit map" (Figure 7.6) with the map of "strategic centres" (Figure 7.9), the city's mass rail transit system is integrated with its land use planning, which has the foundation for building "primary centres" and further developing a polycentric city structure.

Shanghai is pushing forward a comprehensive suburban metro construction, promoting the construction of new towns and the integration of urban and rural development. Shanghai's urban space aims to "achieve strategic development building a polycentric spatial pattern with international influence and competitiveness" (Shanghai Municipal People's Government 2012, 5). Shanghai's master plan 1999–2020 (Shanghai Municipal Government,

1998) aims to build one city centre with four sub-centres, a polycentric spatial structure. However, this city land use plan did not integrate the planning of the city's mass rail transit well (Pan et al. 2013). The activity centres do not quite match the transport centres. As a result, some city centres originally planned along Metro Line 2 were not developed (Figure 7.8). Instead, centres like Daning Commercial Centre on the north part of metro line 1 was previously not included in the master plan (Figure 7.8); however it has attracted more and more passenger flows to the north section of metro line 1 under the influence of the mass rail transit system (Pan et al. 2013).

Figure 7.8: Shanghai's activity centres and metro line 1, 2. Source: (Pan et al. 2013, 3)

In conclusion, both cities' master plans have a long term vision of building polycentric city structures which are shown in the cities' master plans of hierarchically ordered centres. However, the level of integration of their land use planning and public transport facilities is not the same. Perth is developing its concentrated centres along major public transport corridors within urban areas which have seen a good integration of urban land use and public transport planning in a future vision. On the other hand, Shanghai's urban activity centre development does not quite match its mass rail transit nodes; the consequence will be that some activity centres will not have good public transport accessibility.

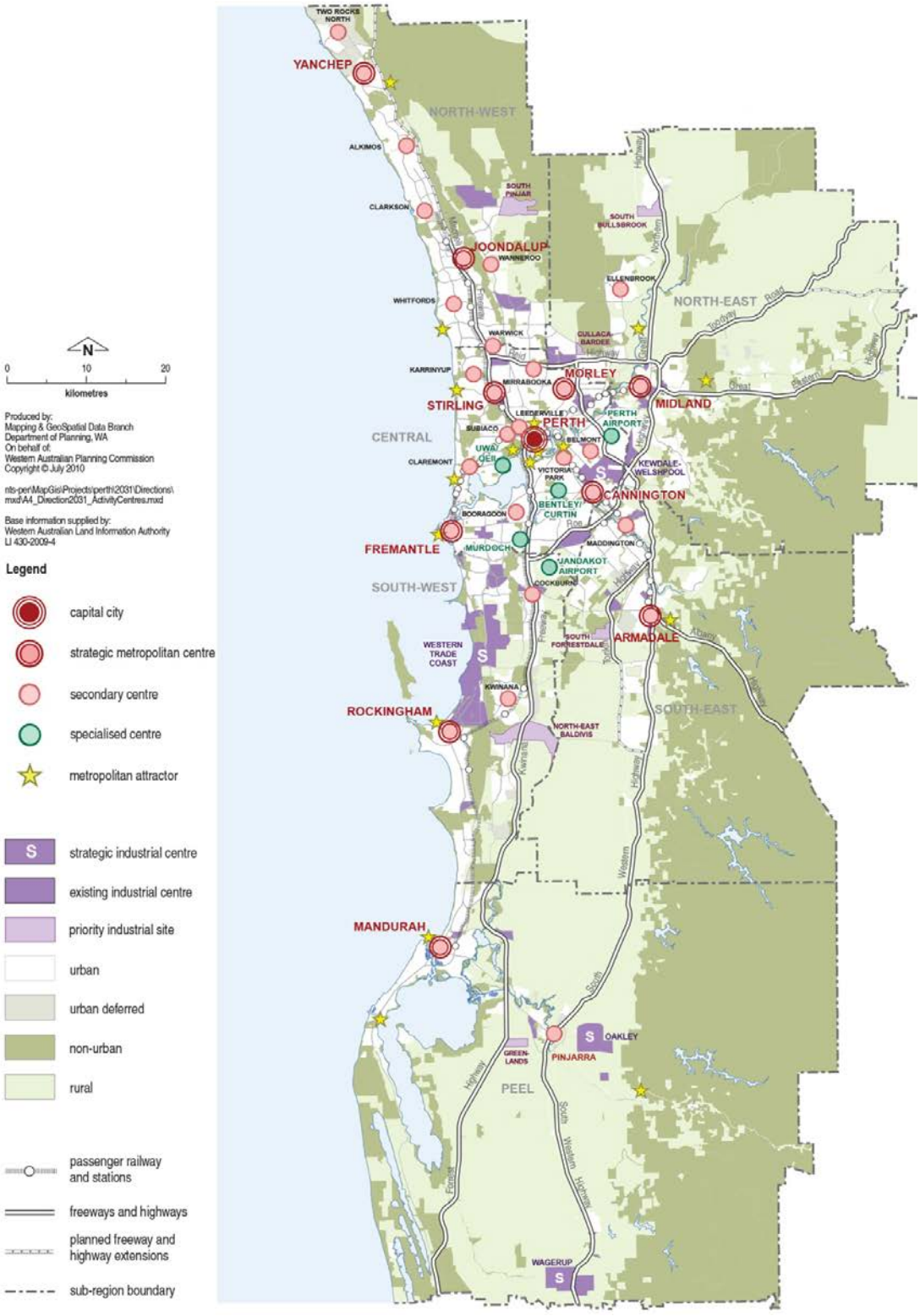


Figure 7.9: Direction 2031 and beyond - strategic centres and areas of future urban development. Source: (Department of Planning 2010, 34)

B2. Accessible by people with disabilities, seniors, children etc.

A major barrier, particularly to the disadvantaged groups, is “last-mile connectivity” — ensuring physical convenience in accessing public transport (Shaheen and Finson 2003). Perth has always attached great importance to improving accessibility. In terms of barrier-free transport, like other Western countries, Perth has made great progress. The plan expresses the intent to: “provide walkable environments and give priority to pedestrians including people with disabilities. Ensure that pedestrian access to public transport is direct and pleasant with good lighting and natural surveillance from adjacent uses” (Department of Transport 2011, 37).

As an international metropolis, Shanghai has gradually improved its attention to barrier-free facilities in the last few years. Like many other Chinese cities, even with barrier-free transport facilities, the disabled still find it hard to use. The “on-board” as well as “access/egress” facilities such as disabled walking trails have always been occupied by non-disabled people for a variety of reasons due to the city’s high density conditions. Shanghai is striving to change this situation, by “adding another 110 barrier-free buses” (Shanghai Municipal People's Government 2012, 3) at the end of 2009, and “basically achieving barrier-free transit” (Shanghai Municipal People's Government 2012, 7) around the city. The World Expo in 2010 saw some improvement in its barrier free transport services, but there are still problems in the low efficiency of barrier-free facilities (Pan et al. 2013). Adding barrier-free transport facilities alone cannot solve the problem of low efficiency; an appropriate connection to the transport facilities and good management of disabled facilities are also very important. Shanghai’s plan is lacking in this direction.

B3. Affordability

Another barrier is the affordability of transit tickets, especially for the urban poor. Social exclusion occurs in developed countries as well as in developing countries. The reasons for this not only arise from fiscal or technical aspects, but also from social, political and institutional factors (Un-Habitat 2013). In Perth, “the level of cost recovery, being the ratio of fares to the total cost of the Transperth system, is low at 22.5%. This compares with a ratio of 28.5% in Sydney” (Department of Transport 2011, 41). Perth’s planning document provides for reduced fares for concession users, which are supported by government subsidy. As discussed in Chapter 6, compared with Perth, Shanghai residents are more sensitive to ticket pricing. Since the ticket price in Shanghai is artificially low, no revenue is made, no matter what kind of reforms are made to the transit system. To effectively

improve the attractiveness of public transportation, the Shanghai government provides subsidies to operators. They plan to do “further research into the transit fare incentives, make a variety of fare concessions and reduce the proportion of transit costs to disposable income” (Shanghai Municipal People's Government 2012, 15).

C1. Greenhouse emission; C2. Renewable energy

Perth’s plan seeks a way to calculate and balance the value of benefits with the cost of public transport. Regarding the benefit of the increased use of public transport, “90% of the net benefits are derived from lower congestion costs (49%), improved travel time for users (18%), reduced road trauma costs (14%) and savings in car parking costs (9%)” and “the value of carbon does not critically impact the evaluation” (Department of Transport 2011, 33). Accordingly, Perth’s plan does not have much to say about emissions and does not mention renewable energy.

As a city with a high population density, Shanghai has paid much attention to vehicle pollution. Their plan aims to completely improve vehicle emission standards all over the city. It also aims to introduce new alternative energy use vehicles widely by “building and improving the charging station, charging pile, charging rack, rectifier stations and other new power supply facilities to support buses that use alternative energy sources” and “call for policy support to encourage the use of technologically innovative, secure, reliable, economical, energy saving and environmentally friendly vehicles” (Shanghai Municipal People's Government 2012, 12).

D1. Safe, secure, convenient and comfortable stations/stops on board and at interchanges

Perth’s transport plan emphasises the need to see real improvements in safety and security, but does not go into details. It also requires that the on-board experience is comfortable for riders. Shanghai’s plan aims at bringing the overall quality of service, including security, to “Asian advanced levels”; it does not detail the standards. It also does not mention comfort and convenience. Both of plans mention the importance of safety and intend to bring the safety qualities to advanced levels. However the information of current safety situations is insufficient, and there is no clear details about safety of on board or interchanges.

D2. Ease of use: clear and readable

In Perth, all the stops will have good levels of information including destinations, timetables and local maps, and "enhanced passenger information could be available through real time information on individual services" for ease of use (Department of Transport 2011, 27). Shanghai's plan also mentions "construction of a public transport information platform" and "the establishment of public transport information release system" (Shanghai Municipal People's Government 2012, 14).

D3. High amenity precincts for walking, cycling and use of public transport

Regarding the requirement of providing high amenity precincts for walking, cycling and use of public transport, Perth has made one of the key design principles for strategic centres to "provide a walkable environment" and "ensure that pedestrian access to public transport is direct and pleasant with good lighting and natural surveillance from adjacent uses" (Department of Transport 2011, 37). Shanghai's plan does not consider this requirement for amenity planning.

E1. Accommodating and shaping travel attitudes/preferences

The attitudinal survey (Chapter 6) reveals that travel attitudes/preferences affect travellers' choices of transport mode. The relevant literature reviewed in earlier chapters has found that transport planners seldom account for these factors in their planning process. Content analysis of our two planning documents provides additional evidence for this argument. Neither of these two planning policies discusses the necessity of understanding users' travel attitudes/preferences and considering them in the transport planning and design process. Their efforts and investments focus on improving the quality of physical services in public transport, rather than understanding, accommodating and/or shaping people's preferences. This will result in a mismatch between demand and supply, especially within a limited time and with limited resources.

In conclusion, except for attitude/preference factors, both of the two cities' transport plans have a broad coverage of design principles from the perspective of passengers; the differences are in the scale of each. In Shanghai, a criterion that is not covered is high amenity level. Perth does not include a policy on renewable energy. Also gaps can be seen in Perth's plan in the coverage of services, especially to suburban areas, as well as provision of a "fast, consistent and reliable service". The continued expansion of an on-road bus system teamed with the consolidation of the current rail system, with limited options for

further developing the rail system, will be an obstacle for effective delivery of public transport in the long term. However, compared with Shanghai, the intensive integration of Perth's land use system and public transport planning has created favourable conditions for multi-centre urban development and will effectively relieve the traffic pressure on the central city district. On the whole, as discussed earlier, Perth and Shanghai are in different stages of public transport development. Perth's plan shows an early stage of the public transport network, as well as low density of population and dispersed city structure. Its current rail-dominated public transport system is a radial system that primarily focuses development on the CBD. Shanghai, on the other hand, has a more connected rail system, and thus has more and larger sub-centres, but a focus on the CBD is also quite obvious. The mismatching of newly developed activity centres with main transport nodes will, to some extent, slow down the pace of Shanghai's multi-central development. The limitation of the content analysis is that the design principles of each plan don't distinguish the stage of public transport development in each city, and also don't identify the city land use patterns. As Perth is a dispersed, medium sized city with low density, its passenger transport is currently car dominated, with public transport development in an early stage. In contrast, Shanghai is a large, centralized city with high density, and the development of urban public transport has reached a more mature stage. All these factors will directly affect the level of compliance with the design principles.

Neither of these two planning documents has paid any attention to how attitude factors shape behaviour. This suggests that the planners' focus in both cases is on improving the quality of the physical services of public transport, and less on considering users and non-users travel mode preferences. According to previous studies, the core finding of own conducted questionnaire survey (Chapter 6) is that from individual perspective both modalities, physical services and attitudes, influence travel behaviour; therefore to achieve long term social goals, it is important to base the planning practices on both. For example, some suburbs in Perth such as Subiaco have really good public transport accessibility (refer to the SNAMUTS score, details in http://www.snamuts.com/); the train and bus services have good frequency, but residents still seldom use public transport. This contrary behaviour suggests that many attitude factors may be as important as the observed variables such as the transport system in explaining travel outcomes. Ignoring them in the planning process could result in mistakes in demand forecasting.

Current planning policies have ignored attitude factors, then how about the previous ones? As mentioned earlier there is a mismatching timeline of the researcher's conducted questionnaire survey and policy content analysis, on this basis it is important to also examine the content of the earlier planning documents of both cases. Figure 7.1 shows that the earlier policy for Perth is "Better Public Transport: Ten-Year Plan for Transperth 1998-2007" (Department of Transport 1998) and for Shanghai is "Eleven-Five Shanghai Comprehensive Transport Planning" (Shanghai Urban Transport Bureau 2006). The focus here is to find out if the attitude factors which are ignored by current planning practice have been paid any attention in previous planning.

"Better Public Transport: Ten-Year Plan for Transperth 1998-2007" advocated a more "user-oriented" service. It put forward that "An effective and attractive public transport system may not be financially profitable, but the social and environmental well-being that is enables is priceless" (Department of Transport 1998, 2). The plan emphasized about community participant mainly from five sources: The annual Passenger Satisfaction Monitor, Customer Service Committees, The Consumer Advisory Committee of people with disabilities, Ministerial or direct correspondence with individuals or specific interest groups and the Transperth website (Department of Transport 1998, 32). Those five sources involve in both planning and implementation stages. It should be highlighted that the plan also takes notice of the problems addressed by perceived attitude of local government and non-users. It advocated that "it is also imperative that Transport increases its understanding of the attitudes and perceptions of people who never or rarely use public transport" (Department of Transport 1998, 33). TravelSmart project was strongly recommended in this plan. TravelSmart program in Perth promotes alternative transport options by correcting information failures at an individual and household level. It works by directly contacting individuals and contributes to the establishment of new attitudes to public transport and new social norms that include travel alternatives to the car. A detailed evaluation of eight TravelSmart projects shows an average 10 percent reduction in car trips and 13 per cent reduction in car kilometres across the suburbs in which the programme was delivered (see http://www.transport.wa.gov.au/activetransport/24605.asp).

"Better Public Transport: Ten-Year Plan for Transperth 1998-2007" shows a more people-oriented planning approach to address travel behaviour change. It pays attention to the perceived attitude factors. The later plan "Public transport for Perth in 2031", however, rarely discusses the attitude dimension. Given the influence of attitude factors on

behaviour, it is important to understand why the policy has changed and what the main obstacles are. Further investigation of public transport practice in future research will extend this analysis.

“Eleven-Five Shanghai Comprehensive Transport Planning” is not a public transport particular planning. The plan reinforces the priority of public transport development, but mainly focuses on infrastructure and high technology on both vehicle and management. The community participation remains in passenger satisfaction survey level and the attitude factors are rarely mentioned at the planning. The pity of it is that the later Twelfth Five plan has not enhanced much at this dimension.

Besides the principles discussed above, another important criterion — the linkage between urban form and public transport planning —plays an important role in the success of provisions for sustainable public transport (Curtis 2005). The two case study policy documents show differences in the integration policies in the two cities. Perth’s “Public Transport for Perth in 2031” highlights the opportunities for land use and transport integration through aligning with its master plan – “Directions 2031 and Beyond”, especially regarding the connection of public transport with identified strategic centres and future growth areas. This plan also includes a special section that discusses the rationale for and operability of the integration. The Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) developed by Curtis and Scheurer (2010) is used in this study to assess the new plan’s functions, particularly in regard to accessibility and connectivity to/between strategic centres. The plan recognises that this integration is a two-way interaction: the land use policies need to support the maximum use of key transport nodes and routes to ensure success. In this case, new residential development should also be assessed for its influence on the existing transit network.

“Shanghai’s Public Transport Twelfth Five Year Plan” makes only limited mention of the integration of public transport with land use development. It puts forward the idea that Shanghai’s public transport development should follow the significant re-structure of Shanghai’s urban spatial layout, focusing on the integration of public transit hubs with public activity spaces such as schools, community centres, hospitals, shopping centres and so forth. It also proposes the reservation of land for public transport facilities and prioritising the building of bus transit lanes. However, it does not reinforce other possible ways of integrating public transport with development, such as taking existing or planned

transit networks into account to coordinate strategic planning with land use. This can refer back to earlier discussion in section 7.2.2.2, the institutional organisation which lacks of integration of land use with public transport planning has largely contributed to this problem.

Following the discussion about whether or how well all given principles/criteria were covered in the two planning documents of the case study cities, two questions emerge: why are some principles missing? And as for the principles that are covered, to what extent can they be put into practice? The capacity of institutions and government to implement policy varies with each particular policy document and from country to country. To what extent are the current key design principles of public transport understood by the different planning participants? How were they involved in the planning process? What were the major difficulties? Following detailed analysis of the planning documents, a further investigation into the planning process is necessary. The following discussion addresses this dimension.

7.3 Understanding the planning role of different participants: in-depth interviews

The interviews are an integral part of the research. They are designed to enrich the research findings from the practitioners' perspective. The interview questions are all developed from my earlier work in this thesis (details in Appendix 1). Three representatives in each case study area were selected for a semi-structured in-depth interview. They represent government transport officers, transit agents and academics. Respondents are anonymised, so that no name or individual information appears in the final analysis, in order to comply with ethics standards. Where an individual represents an organisation, the name of the organisation is used. The interview started with the roles and positions of the participants from different transport agencies in terms of their responsibilities, such as route and lines selection, day to day operations like frequency, also the relationships between frequency and technological solutions such as signals, station spacing and platform organisation.

7.3.1 The design of interview questions

Table 7.7: Summary of key interview questions adapted from the research questions and findings

Research question	Research findings from content analysis of policy documents	Interview questions
What are current public transport planning objectives?	Physical service quality of public transport in the area of • Network planning • Social equality • Environmental protection • People friendly	1) In day-to-day practice what do you see are the key objectives of public transport planning in Perth/Shanghai? 2) Of those objectives you mentioned above which do you think are the most critical?
	Psychology factors such as attitudes, preferences also affect travellers' decision making on transport mode	3a) How do you take account of passengers' aspects such as travel attitudes and preferences (particularly in relation to encouraging increased public transport mode share) in your public transport planning practice?
How can the existing public transport system be reoriented to take account of the individual?	Barriers from: institutional structure/cooperation between departments, funding (investment) mechanisms in implementing planning objectives, and methods of capturing travellers' attitudes/preferences	3b) If yes, in what ways, could you give me an example? 3c) If not, what do you think are the major barriers/difficulties/concerns? And how do you think those difficulties can be overcome?

7.3.2 Findings: Interview analysis

The response against each interview question from the transport agencies' perspective of Perth and Shanghai is summarised below (Table 7.8) (for details see Appendix 2)

Table 7.8: Major answers against each interview question from the transport agencies of Perth and Shanghai

Research question	Interview questions	Findings	
		Perth	Shanghai
What are current public transport planning objectives ?	1) In day-to-day practice what do you see are the key objectives of public transport planning in Perth/Shanghai?	1) Improve service quality, such as frequency, the coordinated timetables of trains and feeder buses, also service times 2) Integrate public transport facilities with supportive urban development 3) Consolidate the existing rail lines and look at the gaps between places to develop light rail 4) Cooperate with other transport agencies or different departments	1) Shanghai's urban public transport planning is focused on urban metro system 2) High design standards in frequency and speed have been applied through the whole metro system. 3) High technical standards have been largely introduced into the planning process.
	2) Of those objectives you mentioned above which do you think are the most critical?	1) Frequency 2) Technical constraints to the system such as: the signals affect the frequency, and also the arrangements on the platforms affect access/egress speed	1) Frequency 2) The building of multi-model transport system (not too much reliance on rail system).
	3a) How do you take account of passengers' aspects such as travel attitudes and preferences (particularly in relation to encouraging increased public transport mode share) in your public transport planning practice?	What the people want is point-to-point (without stop or directly) trips and in this case public transport largely fails at the 'going anywhere, anytime' principle that would compete with the car	1) To Shanghai people, the car is sometimes not only a means of transport; it's also a status symbol. 2) Of public transport users, Shanghai people are too much reliant on the city's metro system which has put big pressure on its rail system and does not help the development of city bus services.

Research question	Interview questions	Findings	
		Perth	Shanghai
How can the existing public transport system be reoriented to take account of the individual?	3b) If yes, in what ways, could you give me an example?	1) A very comprehensive passenger satisfaction survey is run every year 2) Behaviour change through education, like "travel smart" program 3) Education awareness for younger generations in school 4) Smart techniques like Transperth journey planner are getting more people to use public transport	1) City-wide transport demand survey and travellers' satisfaction survey runs to monitor the users' travel requirements. 2) The people's congress which stands for the people also have the right to be involved in public transport planning to a certain degree. 3) It will be pretty hard to apply individualised marketing programs such as travel behaviour change programs in Shanghai due to the large population size
	3c) What do you think are the major barriers/difficulties/concerns? And how do you think those difficulties can be overcome?	1) Funding: It's hard to convince the government to provide the funding to expand public transport networks especially railways. 2) Difficult to get government to focus on soft measures like behaviour change. 3) Difficulties of collaboration of different agencies in public transport planning; the governmental arrangements change frequently between electoral cycles	1) The Chinese centralised political model is advantageous to investment in the construction of urban infrastructure. For public transport in particular, the policy direction of its urban transport development is decisive. In recent years Shanghai's government has shown a great interest in expanding and increasing the capacity of its rail network. This is not beneficial to the development of a multi-mode public transport system. 2) The government likes doing planning and changing often. This has weakened the authority of planning.

7.3.2.1 Perth

From the transport agencies' perspective, the current public transport system of Perth is competitive in Australia. Great achievements have been made in the area of increasing the

frequency and coverage of service, the integration of transport planning and land use planning, maintaining a cheaper ticket price, introducing new technology like smart phones to do journey planning, and so on. The current low patronage rate is driven by technical constraints rather than individual travellers' perspectives. The agents believe that if they increase the frequency, that will be received favourably. However, they did not talk about the perspective of individuals. For instance, there were no statements such as "we surveyed people who are not using public transport and if we do x, y, z then we will catch that market". None of the language was in that vein, which shows that the knowledge base for planning was not sourced from individual users. This shows a gap between planners and users in the public transport planning process. Meanwhile, the relatively high satisfaction score in annual passengers surveys in Perth has given public transport planners confidence. However that score is only from the users' perspective, and the planners haven't gone to the bigger potential market to establish why those non-users are not using public transport. They don't appear to have thought about what strategy can be used to encourage non-users to change their travel habits.

On the other hand, even when they begin to think about the big market of non-users, there are so many governmental issues requiring a high degree of cross-agency cooperation if they are to be addressed. For example: the network design relies on urban land use design, which is the domain of the Department of Planning; travel behaviour change programs like "travel smart" are with the Department of Transport; education awareness programs for the younger generation need the help of the Department of Education; the price of tickets are determined by the Department of Treasury; the technological solutions to high frequency services needs the support of other government agencies. All these issues underline the importance of structuring transport institutions as a whole. The current institutional structure as discussed in section 7.2.2 has not led by this direction and this creates a big obstacle to thinking in terms of the individual.

The interview shows that during Perth's public transport planning process, there already can be seen some community participation in both the design and operation stages. When referring back to Vuchic's planning theory in Chapter 2 (Figure 2.2), this participation can be shown as below highlighted in red (Figure 7.10). The Perth case has already seen the start of attention to individuals' requirement. At this stage, however, It is not systematic and also hasn't seen its necessarity during the planning process in general.

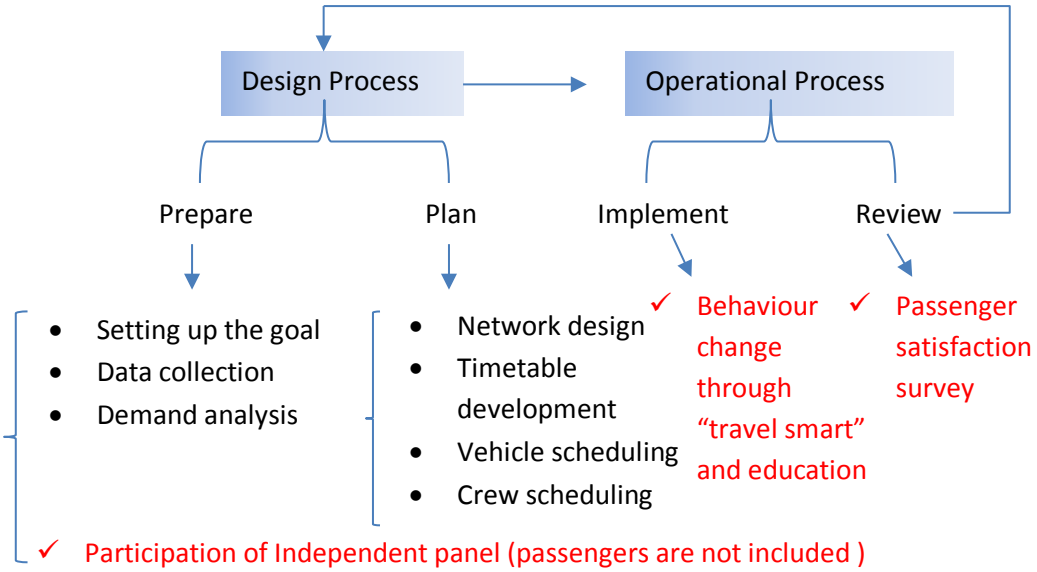


Figure 7.10: Public participation in public transport planning process in Perth .

7.3.2.2 Shanghai

Shanghai's urban public transport system, especially its urban rail (metro) system, has entered a unprecedented rapid development stage which is world leading. However, its transit planning still is ruled by a government guided "top-down" mode. As in Perth, there is not much indication of understanding passengers' individual needs during the planning process. A unified operating standard referred to as world-class has been adopted throughout the metro system. This planning model is led from the supply side. As discussed in ealier chapters, "performance based measurements rather than passenger-oriented services have been criticised for their insufficient consideration of the users and the community's benefit" (Chapter 2, section 2.7). An inefficient metro system will inevitably have huge socio-economic and environmental impacts on society. Unlike Perth, Shanghai has gone beyond the technical aspects of constraints in service provision, due to the government's strong concern and investment priorities for public transport, mainly through its metro system.

Shanghai's public participation in public transport planning process occurs predominantly at the 'Prepare and Review' stage. The city wide demand survey uses high technology to monitor the users' and forcast the potential users' travel demand. The passengers' satisfaction survey is used to reflect the users' requirements. The relatively large numbers of travellers makes it hard to reach the individuals and it can be seen the participation of individuals in the design and operation stage is rarely occurs in Shanghai (Figure 7.11).

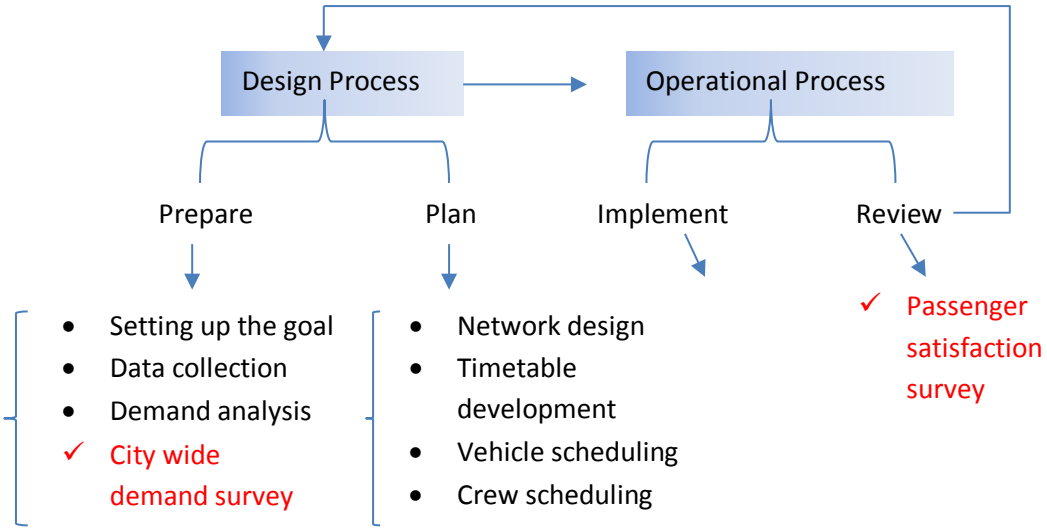


Figure 7.11: Public participation in public transport planning process in Shanghai.

From the above discussion, we can see that both Perth and Shanghai are keen to improve the quality of their public transport services in the areas of freqency, speed, transfer and so on. Perth's system is constrained in making technicual improvements, whereas Shanghai has overcome these problems. Both service providers believe that when good service is provided, there will be users. They have limited access to knowledge of users and non-users' requirements, and neither of them believe that attitude factors are decisive for public transport planning. They believe that people's requirements of public transport are beyond their function as planners. Meanwhile, the major challenges in understanding people's needs are: firstly, the methods of and approaches to reaching people; secondly, the government's complex interests in the planning process and the coordination of different departments.

7.4 Discussion and conclusion

This chapter consists of three separate parts of research: content analysis of policy objectives, analysis of organisational structure evolution, and in-depth interview of planning practitioners. This provides the bridge back to all the previous chapters which together enable the answer to the research questions: whether the attitudes and preferences were taken account in planning objectives, also whether those factors were incorporated in public transport planning process. The first discussion is based on content analysis of planning policies as well as in-depth interview on practitioners. The criteria for content analysis are from the theory of public transport planning objectives (Chapter 2)

combined with the researcher's questionnaire survey on people's requirement (Chapter 6). The first discussion is to answer the question how much the current planning objectives have reflected the travellers' needs. The second discussion is based on in-depth interview of planning practitioners. It was designed to find out if there involved community participation in the public transport planning process (including design and implementation process) to understand people's requirement. The theoretical basis is Vuchic's theory on public transport planning process which was discussed in Chapter 2.

In general, the content analysis and intensive interviews have shown that Perth and Shanghai are in different "life stages" of urban transport development. Shanghai's public transport, especially its rail system, is much more advanced than Perth's. However, there are many common aspects of public transport planning policies between the two cities. In the matter of considering users/non-users' requirements, they also share some same views and desires from the planning sectors. The findings respectively from planning objectives and planning process can be summarized as follows:

- **Planning objectives**

1. The desire to continually increase service quality in terms of reliable service, coordinated networks, efficient schedules and minimal cost through technical methods. Both cities' planners express a strong desire for fast, reliable transit services, no matter what directions their current transport policies have.

2. An awareness of the importance of coordinating multi-sectoral planning, linking land use and urban transport planning. Both cities' plans have paid attention to the integration of transport planning and land use planning and express the desire to integrate public transport facilities with supportive urban development.

3. An awareness of the institutional factors that play strong roles in the operation of such systems. Generally, a single integrated multi-modal network is more efficient than separate institutions managing different parts of the work. Separation of urban sector functions into different organisations will lead to uncoordinated and poorly integrated services.

4. In both cities' planning, concerns about passengers' travel attitudes/preferences are missing. The interests of the transport planners and the decision-makers in urban mobility planning are from the transport bias, such as improving service quality in technical aspects, rather than from the user bias, such as understanding people's attitudes and respecting users' requirements.

- **Planning process**

Chapter 2 has reviewed the main planning process in theory. It turned out that Vuchic's very influential transit planning approach (Figure 2.2) did not refer to any stakeholders' requirement/preference especially the users'. This chapter comes to examine whether actual public transport planning practices have incorporated the attitudes/preferences. The content analysis on the policy documents in both case studies revealed that the planners' focuses were on improving the quality of the physical services of public transport, and had hardly paid any attention to how attitude factors shape behaviour. The in-depth interviews in both case studies have showed that the community participations in planning process have happened and the major challenges in understanding people's needs are: firstly, the methods of and approaches to reaching people; secondly, the government's complex interests in the planning process and the coordination of different departments. In Perth, the independent panel of "Public transport for Perth in 2031" (Table 7.1) has shown an involvement of different stakeholders in the design stage of public transport planning. However the residents (users/non-users of public transport) who are most related to the public services are not listed in the panel. In operation stage, "users' satisfaction survey" was used to provide feedbacks to public transport services in both cities. As discussed earlier, however, the power of this survey method is always quite limited to speak for the users.

The previous chapters of this thesis have established that people's attitude/preference factors play an important role in use/non-use of public transport. This chapter has shown that public transport planners are keen to improve public transport service quality in terms of technicalities. This transport bias rather than user bias in the planning process occurs not only in cities advanced in public transport like Shanghai, but also in cities that are in the early stages of public transport like Perth. The allocation of limited resources to public transport largely depends on policy direction. As a public

service, the effects of the investment in public transport should finally be judged by the users. In this case, the extent to which public transport is able to meet its social and economic objectives depends on how widely the public transport service can meet the people's needs, as much as on how good the services are. Public transport planning plays an important role in achieving this objective. A study of the perspectives of the users in this part of the research has shown that the two case study planning bodies have missed this important part of the public transport planning process.

Chapter 8: Summary and Conclusions

The results of the 2015 Perth Perceptions Survey "Get a move on!" (Committee for Perth and RAC 2015) revealed that "there's a huge divide between the number of people who want Perth to have an efficient public transport system in the future and those that believe that anything is currently being done about it to make it a reality" (1). The public is eager for an efficient public transport system; however, according to this investigation, "only 17 per cent were convinced anything was being done about it" (1). On the contrary, the official government document "Public Transport for Perth in 2031" (Department of Transport 2011) has shown that "the train network has been expanded from 66 kms in the early 1990s to 173 kms in 2010 (14); also, during the same period, "the bus fleet grew by 27% from 889 to 1134 buses" (14). Meanwhile, the quality of transit services such as frequency, coverage and transfer speed has been largely improved, and the overall transit patronage has been largely increased (Department of Transport 2011). The inconsistency between the provider's statistics and public perceptions further confirms the argument of this study, that there is a big gap in perspective of what constitutes good quality of public transport service when comparing the view of the public transport provider and public transport users in the case study area of Perth. A likely consequence is that despite the efforts of the transport provider, users and potential users may be slow in taking up public transport as a preferred transport option.

To address this problem, this study has examined both "provider" and "passenger" viewpoints regarding public transport, and has found that passengers' needs and attitudes have been neglected during the public transport planning process in both case studies. The author asserts that people's requirements need to be considered as well as the spatial environment and the technicalities of public transport systems for better results. The following discussion has drawn together the key findings of previous chapters to answer the research questions which have been introduced in Chapter 1. It concludes with some theoretical considerations for public transport policy and suggestions for future research.

8.1 The importance of representative case selection

One big difference of this comparative research with other comparative urban studies is that it crosses the boundary of different regional grouping of cities (Figure 1.4). Perth and Shanghai are diversely from developed and developing countries. This has provided a more global perspective but also brought a big challenge. While identifying Perth and Shanghai's differences, this research looks at their future trends. It can be seen that during the process of developing and promoting public transport as the residents' preferred mode of motorised transport, both cities have encountered difficulties. A common problem which has been found in the public transport planning process is that both cities downplay the importance of a user focus in public transport planning. In spite of the different situations, finding out the similar problems and providing suggestions in a general perspective, this research contributes knowledge on public transport study by choosing cases with large differences, which has seldom been examined by other researchers. This expands the scope of comparative study and also contributes to the research methods.

8.2 The importance of considering public transport from both provider and passenger points of view

In public transport services, a gap between the providers' and the passengers' views can be the source of conflict and inefficiency. Many previous researches have noticed this gap and efforts always target at improving the service quality and rarely go into an investigation of the users' needs and attitudes. The research contribution to this has addressed this gap and found significant limitations in the perceived outcomes of public transport system design from the perspective of the individual needs of potential users. To ascertain the factors contributing to these limitations, it is necessary to study the services from both directions: how the provider plans public transport; and the passengers' individual attitudes to and requirements of public transport relative to other transport modes. An understanding of these two dimensions and the relationship between them answers the main research question: "to what extent can individual transport preferences be met by public transport?"

8.3 Individual transport preferences

The individual passenger factors which affect their travel behaviour, such as travel mode choice, have been separated into socio-economic factors and travel attitude factors in this research. A household travel survey (secondary data) and attitudinal questionnaire survey (primary data) is carried out for this part of the research. The research findings answer Research Question 1: "what are the key socio-economic variables that affect individual travel mode choices?" and Question 2: "To what extent do the travel attitude factors of the individual affect travel choice?" Findings are summarised below.

Question 1 - "what are the key socio-economic variables that affect individual travel mode choices?" Compared with external built environment and transport system factors, Individual factors such as socio-economic characteristics, travel preferences and attitude factors are seldom included in travel demand analysis. Analysis of the two sets of secondary travel data has shown that the mode shares in the two cases are different. Perth shows a much greater reliance on the car. Regardless of mobility stages of cities, car ownership increases as income grows, and so does car use, and trip distance increases with motorisation for both work and non-work trip purposes. Due to limitations of the secondary data, this study does not cross-compare the socio-economic characteristics of the two cases based on travel mode choice, except for income. The research found that, compared with Bull Creek, Kangjian's car ownership was sensitive to income. As Shanghai's economic growth speed is much faster than Perth's, the economic gap between these cities will narrow, resulting in less difference in household income, car ownership and use of a car. The effect of some socio-economic factors such as income and car ownership on travel behaviour will become less pronounced over time. Therefore travel attitude factors must be paid greater attention if sustainable travel outcomes are to be achieved. The extent to which travel behaviour is affected by this dimension remains difficult to measure and will benefit from further research.

Question 2 - "to what extent do the travel attitude factors of the individual affect travel choice?" Analysis of the secondary travel data in the two cases has enabled a detailed understanding of the travel patterns and the related socio-economic background (in this case income and car ownership). From analysis of the primary data collected of multi-dimensional attitude statements in the two cases, participants were grouped into six distinct travel groups based on their travel attitudes. The results show that in both cases,

the largest number of participants makes their travel mode choices by habit, but the mode differs between the cases: the largest habit group of Bull Creek is car users; in Kangjian, the largest habit group is public transport users. Habitual choice is open to the possibility of mode change with better alternative experiences or persuasion to change. Turning car users by habit to use public transport will benefit Bull Creek's sustainable transport development. However, the reverse trend of turning from PT by habit to car use by habit must be discouraged in Kangjian. The questions to be addressed in further research are: how can transport use habits be changed or maintained, and how can the "good habits" of using public transport (in Kangjian) be maintained while preventing "bad" habits; further, what is the trigger for changing from "bad" habits of car use in city areas such as Bull Creek to "good" ones of public transport use.

The analysis of both performance and importance ratings of public transport has shown that travellers' consideration of alternative modes is closely related to subjective perceptions of viability and desirability. The findings show that evaluation of public transport service varies in mobility types within same case study. Further, the evaluation of public transport services is affected by cultural differences; however, higher satisfaction does not necessarily result in more usage. Another observation is that for people to change their travel behaviours, "pull" factors (behavioural incentives) work very well for people to use public transport in Bull Creek; whereas "push" factors (behavioural restriction) are influential in the use of public transport in Kangjian. To align with travellers' different characteristics, policy needs to be appropriately targeted to interfere with travel behaviour choices, as well as to create incentives.

In conclusion, this part of the research contributes to the knowledge of travel behaviour, specifically that individual factors especially the travel attitude factor play very important roles in travel mode choice. This research also contributes to research methods on travel attitude analysis in the following two ways: first, using attitude theory to identify aspects of travel behaviour and dividing participants into several distinct travel groups which stands for different degree of capability for mode change for better analysis; second, using performance rating and importance ranking methods to measure customer dissatisfaction which provides a graphic analysis that compares different aspects of a particular service within different travel mode sub-groups.

8.4 How public transport is planned

This research project has separated the investigation of providers in each case study into two parts. One looks at public transport planning objectives and the planning process in general through a literature review. The other looks at the relevant transport policies in the two cases via content analysis and in-depth interviews. The research findings are used to answer Research Question 3: "What are key objectives and design principles of public transport planning? Are they designed to take account of the needs of individuals?" They are summarised below.

8.4.1 The literature review

The most frequently discussed topics in the literature on current public transport planning objectives are: planning a fast efficient network; specifying all service characteristics for operators and managing subsidies; designing fare structures to support the network; undertaking marketing of the overall system; and managing the network financing. As to who is doing the planning, the main agents in public transport planning include: the government (policy maker), the transport planner (planner) and the transit operator (policy deliverer); each takes different responsibilities in the planning process. The three main interests groups in public transport planning include: the passengers, the transit agency and the community; they have multiple perspectives and requirements of the planning. The passengers are mostly concerned about service quality, such as availability and accessibility. The transit agency's requirements are mainly based on cost-efficiency, or minimising the operating costs. The community requires public transport to provide mobility to people without cars or not intending to use cars, and to be compatible with environmental variables such as air quality, energy consumption, noise pollution and sustainability. To allow for the different interest groups' different requirements, public transport services cannot adopt a unilateral standard of evaluation.

8.4.2 The content analysis

Content analysis of the most recent public transport planning documents in the two case study cities helps to understand what the public transport planning objectives are in practice. Both cities have shown a broad coverage of the design principles from the perspective of passengers, according to previous studies (Chapter 7). The differences come from the stage of public transport development city wide. Perth's plan shows an early stage

of public transport development in the context of low density and a dispersed city structure. Rail development is still very limited. Shanghai has a more connected rail system, and the coverage and frequency of rail services is more advanced than Perth. No matter what mobility life stage they are at, neither of the planning documents pay attention to shaping passengers' attitude factors in behavioural choices. The providers' focus in both cases is still on improving the physical quality of service rather than on the passengers. As previous studies have shown that both factors influence travel behaviour in certain ways (Chapter 5 and Chapter 6), to achieve long-term social goals it is important to see greater efforts in both directions in planning practice.

8.4.3 The in-depth interview

The in-depth interview is a central tool of the content analysis. The aim is to further investigate the reasons for inattention to passengers' attitude factors during the public transport planning process. The intensive interviews with the transit planning practitioners from both case study cities have shown that they have the same strong desire for fast, reliable transit services, no matter what their policy directions are. The physical environment and technical improvements have been given more attention than passengers' requirements. The major reasons for this fall into three areas. First is a misunderstanding of passengers' requirements. They believe that passengers' requirements of public transport are equal to their requirements of cars, which is beyond public transport's function. Second, they have difficulty understanding passengers' attitudes, and consider it difficult to approach people for this purpose. Third, governments' major interests in planning outcomes are in physical facilities which are more observable.

8.5 Summary of findings

In summary, this thesis presents the research into individual factors, especially travel attitudes, in choice of transport mode, and analyses the extent to which planning instruments are aimed at catering for passenger needs. The first part of the study has demonstrated the importance of travel attitude factors, and advocates that individual travel preferences should be considered in public transport planning. The second part of the study examines whether this factor has been translated into practical action, in terms of success factors such as network coverage, service frequencies, free/easy transfer, and the integration of public transport facilities with supportive urban development. It also

investigates whether an integrated institutional framework is well understood by public transport providers in both case study areas. The study has found that the dimension of addressing individual attitudes and preferences is missing during the planning process. The consequences for the passenger will be a lack of awareness ("can I go there by bus?") or misperceptions ("the bus is too slow") which prevent them from taking up the available alternatives. The consequences for the provider will experience below-potential rates of passenger growth, no matter how hard they work on improving the services. There is a need to establish a dialogue between the two sides, passengers and providers which is the main contribution of this PhD research. The TravelSmart program, as mentioned in earlier studies (Chapter 7), is a successful project in Perth which is driven by this dimension. It is specially designed for low-density, high car dependent suburban areas with residents who have strong habitual responses to car use and a low level of awareness of alternatives. This project has been co-ordinated and supported by the Commonwealth Government in Western Australia, but still has not been addressed in a transport policy framework. On the other hand, in high density areas dominated by public transport like Shanghai, people are familiar with and accustomed to using public transport services on a daily basis. Since the infrastructure and information barriers have been overcome there, a TravelSmart program would not be so suitable for Shanghai. To prevent the community from using more cars it is most relevant to address emerging forces such as carbon pricing, traffic jams and social/environmental problems like climate change and pollution. Rather than awareness of car alternatives, the focus of the individual program should be on the negative aspects of using a car like environmental impacts and emerging obstacles which prevent from easy-using.

In either situation, the missing part of current transport planning policies is a "bridge" to connect the provider and the passenger. A systematic effort is needed in transport planning to understand the role of travellers' preferences in travel choices, to monitor their changes in relation to policy interventions, and to forecast their evolution in future planning. The in-depth interviews reported in Chapter 7 inform us about the political challenges to practitioners if they are to deliver these objectives. The following discussion will give the policy implications suggestions and discuss about the major barriers during the process.

8.6 Policy implications

8.6.1 Step 1: Understanding travellers' preferences in travel choices

Since the attitude factors can be as important as the observed variables such as land use and transport systems in explaining travel behaviour, I assert that there is a need in transportation planning to understand travellers' preferences through customer research. This is a preference accommodating process which finds out the distance between what has been assumed about how people behave and how they actually behave, and respecting people's preferences in the planning activities. Analysis of the in-depth interviews (details in Chapter 7) has shown that the most common way to understand travellers in both cases is by an annual customer satisfaction survey to assess the views of passengers on the quality of public transport services. The results have been quite even over the years in both cases, which make the monitoring function quite limited. A major reason is that this kind of survey pays little attention to the reasons behind each attitude/preference, such as motivation. Therefore, the planning activities need to include a more diverse set of factors in assessment of travellers' decision making processes, to better understand their choices.

Designing surveys to measure travel preferences is not easy. Questionnaires about attitude factors do not include standards such as age, income in socio-economic variables. Specific wording about the indicators may vary greatly across surveys. This can be seen in the results of the attitudinal surveys (details in Chapter 6) of the two case study areas in Perth and Shanghai. The difficulty of measuring attitude factors limits the range and depth of research which can be readily conducted. Moreover, statistical capacity to analyse the survey results is also limited.

Besides these barriers in survey instruments, there is an important attitudinal barrier on the part of transport planners (both the agency and the government). The in-depth interviews have shown that transport planners from both case studies regarded attitude factors as "too soft" and not being relevant to behaviour change. In Shanghai, respondents particularly mentioned that it is too hard to incorporate travellers' preferences due to the large population. This has led to an imbalance between research focus on transportation systems and the focus on travellers' preferences.

8.6.2 Step 2: Changing travel behaviour via preference shaping

Following analysis of the difficulties in understanding and measuring travellers' travel preferences, this section discusses the advantages of shaping travel preferences. There is still a debate about employing policy interventions such as congestion charges or increasing parking costs to "interfere" with travel behaviour. These types of interventions often receive serious resistance from the public. It is a trade-off between short term individual profit and long term benefit to society. Travellers feel deprived and unhappy because they feel they have to sacrifice their own wellbeing for the social good. But once they have been introduced to and encouraged to try more environmentally-friendly travel behaviour such as train and bus, they may be happy to change and there will be efficiency gains. This travel preference shaping process is as an alternative to relying on infrastructure investment or service improvement to influence behaviour.

Given the advantages of preference shaping, why is it still rarely discussed in transportation policies? The in-depth interviews with public transport practitioners reveal two challenges: one is methodological convenience; the other is the legitimate concerns about barriers to investment in physical outcomes or broadening the domain of knowledge to include behavioural psychology. Due to the complexity of travel behaviour, travel preferences usually do not change rapidly, and travel preference shaping is a matter of long term education, advertising and changing cultural norms. This requires careful thinking about the specific contexts of space and time. For example, in the two case studies of this study, Perth and Shanghai cannot apply the same methods to influence consumer preferences, as the survey findings (details in Chapter 6) have shown that behaviour change may require different degrees and types of intervention. Perth's efforts should focus on bringing customers' interests back to public transport by advocating the advantages of public transport service. Shanghai's effort should be to draw customers' attention away from cars to public transport, considering the harmful effects of greater car use such as pollution and congestion. Therefore, to influence travellers' preferences will be culturally adaptive.

8.6.3 Step 3: Forecasting the evolution in future planning

The outcomes of behaviour shaping are not as obvious as infrastructure investment or policy intervention, therefore forecasting the evolution in future planning in terms of this dimension cannot follow the traditional way of demand analysis. Change will involve lots of informing, awakening, education and inspiring activities, and the outcomes will vary among

individuals. Participants will experience four stages in the behaviour shaping process: awareness, experience, acceptance and transformation. The forecasting of behaviour change normally only calculates the outcomes of the last stage, but in reality the impacts on awareness, experience and acceptance levels are more significant than those on transformation. External social and cultural agendas such as global warming can transform travellers' habits at any of the first three stages and achieve the ultimate goal. For this reason, the extent of potential future change is hard to forecast.

8.7 Re-examining the theory of public transport planning process

Given the importance and policy implications of incorporating travellers' preference/attitude factors into transport planning, we can go back to the literature on the public transport planning process (Chapter 2) to see if it is possible to address this important element in a transport policy framework. The suggestion is to integrate three steps of the preference accommodating, shaping and forecasting process into four stages of public transport planning: Prepare, Plan, Implement and Review (Figure 2.2). The suggested planning process is summarised in Figure 8.2 and includes travel preference/attitude factors.

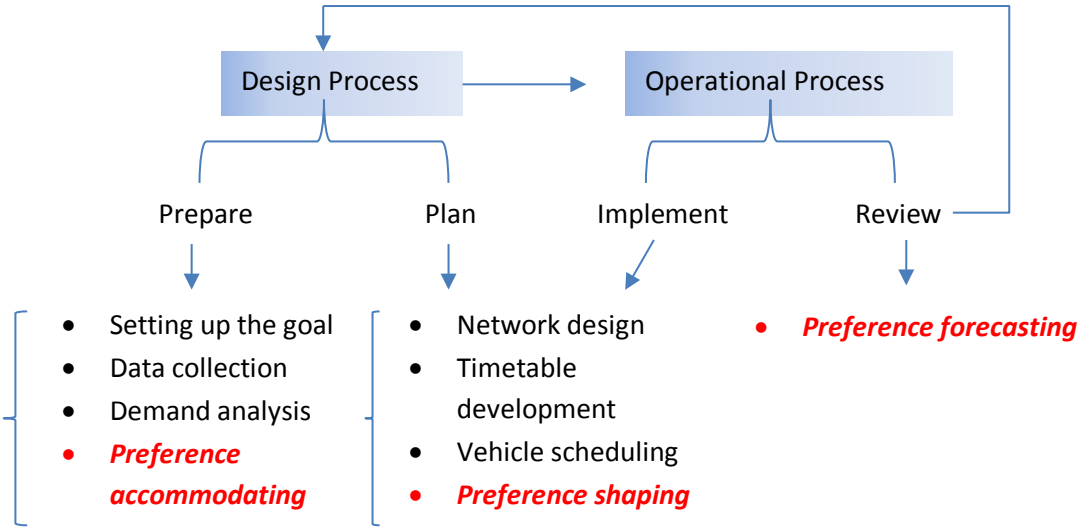


Figure 8.2: Public transport planning process when considering travel preference/attitude factors (Author).

In this new policy structure, at the Prepare stage there is a need to examine the present/potential customers' travel attitudes and their future travel preferences. This preference accommodating process is also one part of the demand analysis. Given awareness of the important travel attitude factors, in the Plan stage there is a need to set

up a preference shaping plan based on this understanding. At the implement stage, following the plan, a series of informing, persuading, awaking, educating or inspiring activities will be undertaken with the local people, together with infrastructure investment and policy interventions to achieve the best results. Also at the Review stage, there is need to distinguish people's different types of travel behaviour, monitor the changes and forecast the potential users. On the other hand, during the whole planning process to incorporate travellers' preferences into public transport planning to a greater extent requires a systematic effort throughout the functional departments of transportation agencies, such as the customer research team, the project evaluation team, the policy development team, and the modelling and forecasting team. There is no unique standard to follow to complete this preference shaping work, because the target is the individual users; all the related jobs must be locally and culturally sensitive and appropriate, which is a big challenge and needs teamwork, informed input and cooperation.

8.8 Thesis contribution

This thesis contributes to the public transport planning field in three respects:

a). Travel behaviour analysis from the impacts of travel attitude factors. This research presents a set of travel behaviour findings with respect to travel attitude factors. 6 mobility groups were established based on their travel attitude indicators. Integrating these mobility types into travel behaviour analysis significantly increase the explanatory power of the travel mode choice as well as the future trends when the external situation changes.

b). Methods for analysing travel attitude/preference. This research uses attitude theory to identify aspects of travel behaviour and divides passengers into several distinct travel groups; and it uses performance rating and importance ranking methods to measure customer dissatisfaction in order to understand public transport services in a more comprehensive way.

c). Critical review of current public transport planning practice and recommendations on the possibility of combining the policy aspirations of government with the attitudes of residents. The indications of integrating preference accommodating, preference shaping and preference forecasting activities into public transport planning process add new knowledge to public transport planning.

8.9 Conclusion and future research

The core idea of this research is to consider the possibility of combining the policy aspirations of government with the attitudes of residents. I have argued that by ignoring the importance of travellers' attitudes/preferences, not only may transport planners miss opportunities to solve transport problems by accommodating and shaping people's preferences, but also they may make serious mistakes in the planning process by misunderstanding the people. To give this research a world context, two distinguished case studies of Perth and Shanghai, from the developed and the developing world, are used to explain the importance of attitude/preference factors in transport planning. Even though Perth and Shanghai are at different mobility stages, the research has found that from both sets of planners' perspectives, to compete with the car they need a high frequency and large coverage network which will favour every passenger's needs, which means that continued investment in the infrastructure should be the first priority. This may be true for high public transport usage places like Chinese cities. However, for car-dominated places like Australian cities which have a relatively weak role for public transport, as the current demand for public transport is still quite limited, a high investment and complete public transport network is not high up on the agenda for the provider at this stage. There is a need to more clearly understand the individual travellers' needs and add this step into the planning process in more goal-directed steps.

The extent to which public transport policy aspirations can align with the attitudes and needs of residents in practice is still a question. It will be decided by many factors such as policy directions, economic development, transport situations, institutional structures, the global energy crisis, and so on. This thesis has given some policy suggestions for integrating a preference shaping process into public transport planning, and discusses the possible difficulties of each stage. Indeed, to incorporate travellers' preferences into transport planning demands a complex synthesis of different objectives and careful trade-offs. Considering the diverse and dynamic situations they face, transport agencies and academic researchers should work together. There are still many unclear issues in the psychology and cultural dimensions which need further study. It is important to establish standards for identifying and measuring the core attitude/preference factors in shaping travel behaviour. Other questions like how to do the customer surveys and other customer-based programs,

what methodology can be used to analyse the survey data, what kind of organisational team is best suited for this activity and in which way, and more, require further research.

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Appendix 1: Content analysis

		Perth	Page	RT	Shanghai	Page	RT
A1	Rail dominated simple network structure	"There are limited options to further develop the rail system in a cost effective way" "Most of the new growth corridors can be served by road-based services"	P6 P6	1	"Continue to strengthen rail transit construction and renovation, upgrade rail transport capacity." "Further improve the central city rail transit service coverage and network level ";"Further improve the Suburban Rail transportation accessibility" "Enhanced rail network expanded range and radiation"	P6 P8 P8	2
A2	High degree of hierarchy of lines into a network	"The future transit system will need to have three integrated types of service – train services, road-based rapid transit services and buses". "A road based rapid transit service could be either light rail or bus rapid transit".	P6	2	"Building up an integrated public transportation system which makes rail transportation as the backbone, ground transportation as the basis, supplemented by taxi, public water ferry for assistance, information systems as a means of transportation and transfer hub as the anchoring points".	P6	2
A3	Wide coverage to suburb areas	"Future rail expansion will build on the existing network to meet demand in growth corridors and to provide efficient access to, and connectivity between, strategic centres and central Perth". "Northern Suburbs Railway (NSR) extension". "As the public transport network develops, the opportunity to connect between centres at suburban nodes improves. These improved	P21 P30	1	"Internal suburbs and new towns public transport service radius are of 500 meters wide coverage; suburb villages' bus accessible rate is of 100%". "Strongly support suburbs construction; further improve the Suburban Rail transportation accessibility rate". "A substantial increase of public transportation site coverage in suburbs and new town centre	P7 P8 P10	2

		Perth	Page	RT	Shanghai	Page	RT
		connections contribute to greater coverage, more direct and shorter journeys and a more efficient public transport system".			area; the capacity and service level standards follow by central city"		
A4	Fast, consistent and reliable service	"For the level and quality of public transport services to continue to improve, there will need to be real improvements in reliability, speed of travel, service frequency". "Over time the routes will be developed to provide a network with priority for transit services over other traffic. Journey times will be faster with fewer, more widely spaced stops up to 800m apart." "Upgrading major bus interchanges and providing faster bus services to transfer passengers to rail services".	P6 P21 P7	1	"By 2015, to match international metropolis status keep enhancing the attractiveness and competitiveness of public transport and operational reliability; the overall level of service has basically reached the advanced level in Asia". "To reach punctuality rate of rail to be over 99% and of commuter bus to be 80%" "gradually realize that during peak hours 80% public transport travel in the city centre can be completed within one hour" and "80% of public transport interchanges can be completed within 10 minutes" "And aviation, rail, water, road and rail traffic and other passenger transportation's service time can be synchronized cohesion".	P7 P7 P7 P7	2
A5	Convenient transfer	High frequency services during peak periods and timetabled co-ordination of services at other times, in conjunction with high quality interchanges, will ensure that transfers are considered by passengers to be a normal part of their trip. Major stops and stations will be designed to support fast and efficient transfers to train and transitway services.	P20 P21	2	"promote the construction of integrated passenger transfer hub" "optimize rail transportation and ground transportation link orbit, reduce walking distance from the rail way station to bus station, in principle, no more than 50 meters from the entrance" "80% of public transport interchanges can be completed within 10 minutes"	P6 P8 P7	2

		Perth	Page	RT	Shanghai	Page	RT
		Passengers could catch buses at “superstops”, which would include no-step entry and off-vehicle ticket validation to improve vehicle loading speeds.	P27				
A6	Integrated ticket system	“The system is fully integrated between train, bus and ferry services and the SmartRider electronic ticketing system operates for all travel”	P14	2	“Using electronic chips and electronic monthly bus card to improve the operational efficiency of management”	P3	1
B1	Fair distribution of activities and transport facilities	“Directions 2031 and Beyond identifies the need for two key strategies for public transport. These are improving the relationship between public transport and land use planning and ensuring ongoing access to public transport”. “The Public Transport Network Plan supports the medium and long term planning direction for the City, particularly the need for consolidation and higher levels of activity in the Central Area”. “many of the strategic centres in the Central Sector (largely within 15km of the CB D) where consolidation and higher intensity of activity is planned”.	P16 P16 P20	2	Shanghai’s urban space will achieve strategic development building a polycentric spatial pattern with international influence and competitiveness. “promote the comprehensive construction of suburbs; hierarchically, orderly develop new town construction - to guide an urban-rural integration of urban space body covering the whole city region”	P5 P5	1
B2	Accessible by people with disabilities, seniors, children etc.	“Provide walkable environments and give priority to pedestrians including people with disabilities. Ensure that pedestrian access to public transport is direct and pleasant with good lighting and natural surveillance from adjacent uses.”	P37	2	“add another 110 barrier-free Buses” “basically achieve barrier-free transit”	P3 P7	1
B3	Affordability	The level of cost recovery, being the ratio of	P41	2	“Further research on the ground transit fare	P15	2

		Perth	Page	RT	Shanghai	Page	RT
		fares to the total cost of the Transperth system, is low in Perth at 22.5%. This compares with a ratio of 28.5% in Sydney. "provide reduced fares for concession users" This would establish an agreed and consistent basis to assess the value of benefits to nonusers (externalities) and users; to assess the cost of the system (including operating costs, capital costs and a return on capital); to provide a clear basis for comparison with other jurisdictions and to provide a long term strategy for fares.	P31 P41		incentives, take a variety of fare concessions, lower actual travel costs residents to effectively improve the attractiveness of ground transportation"		
C1	Greenhouse emission	"90% of the net benefits are derived from lower congestion costs (49%), improved travel time for users (18%), reduced road trauma costs (14%) and savings in car parking costs (9%). Reduced carbon emissions is a relevantly small benefit (3% at $75 per tonne of carbon dioxide) so the value of carbon does not critically impact the evaluation".	P33	2	"Improve overall vehicle environmental standards. Increase vehicle scrapped efforts to phase out low standard, high fuel consumption vehicles, basically eliminate the black smoke emission buses. Encourage enterprises to purchase more environmental protection and higher emission standards vehicles."	P11	2
C2	Renewable energy	None		0	"Expand clean energy bus test operations. Promote new energy bus use; build and improve the charging station, charging pile, charging rack, rectifier stations and other new energy bus supporting power supply facilities; ask for policy support to encourage the use of technological, secure, reliable, economical, energy saving and environmental protection vehicles".	P12	2
D1	Safe, secure, convenient and comfortable	For the level and quality of public transport services to continue to improve, there will need to be real improvements in reliability,	P6	1	Strive for the general public to provide fast, safe, convenient and comfortable public transport services; the overall level of service has basically	P7	1

		Perth	Page	RT	Shanghai	Page	RT
	stations/stops - on board and at interchanges	speed of travel, service frequency, safety and security, and ease of use.			reached the advanced level in Asia.		
D2	Ease of use - legible design	Bus stops will have good levels of information including destinations, timetables and local maps. Major stops and stations will be designed to support fast and efficient transfers to train and transitway services. Overall, the bus network will benefit from improved legibility and frequency.	P21	2	"enabled passenger ferry ship Automatic Identification System (AIS)" "Construction of public transportation information platform; the establishment of public transportation information release system"	P3 P14	1
D3	High amenity precincts for walking, cycling and use of public transport	Provide walkable environments and give priority to pedestrians including people with disabilities. Ensure that pedestrian access to public transport is direct and pleasant with good lighting and natural surveillance from adjacent uses. Bus routes will be designed to maximise accessibility, whilst maintaining travel speed and ride comfort.	P37 P21	2	None		0
E1	Accommodating and shaping travel attitudes/preferences			0			0

Appendix 2: Main content of in-depth interview

Research question	Interview questions	Main ideas of the answers from the participants	
		Perth	Shanghai
What are current public transport planning objectives?	1) In day-to-day practice what do you see are the key objectives of public transport planning in Perth/Shanghai?	1) Perth has a competitive public transport system compared with other cities in Australia in terms of network coverage and service frequency. Frequency of the network is based on the strategy level of demand modelling. 2) Perth has integrated public transport facilities with supportive urban development. 3) The government makes reasonable decision on tickets price which is recommended by transport agencies. 4) Transport agencies have cooperation with other sectors like bus/train operators and land use planners to get as much as information they can get from all. 5) Current planning focus is consolidating the existing rail lines and looking at the gaps between to develop light rail	1) Shanghai's urban public transport planning is developed by the Shanghai Urban Planning Bureau which is one of the urban subject planning. In order to best support urban master planning (or strategy planning), Shanghai's government has set the stage of the subject planning. Shanghai Urban Transport Bureau is mainly an executive department which turns the transport planning into reality also gives feedbacks to the planning. Centralizing the power of urban land use planning and transport planning in one institution is beneficial to the integration of land use and transport planning. However this has turned out to be a relatively weak power of urban transport planning compared with urban land use planning. 2) Shanghai's urban public transport planning is focused on urban metro system. In Shanghai, the city metro and bus system are under the charge of different transport operation companies; the enforcement of

Research question	Interview questions	Main ideas of the answers from the participants	
		Perth	Shanghai
			Shanghai metro agency is far higher than that of city bus. This priority has greatly shown in the planning of lines and stops around the overall public transport network. The function of bus system has become more and more weak and consequently less reliable to the users. 3) Uni-standard design principles have been applied through the whole metro system in Shanghai. The overall planning of metro system is less of details which is based on the demand analysis of a particular area. This can easily lead to some sections of the metro is very crowded and some sections are quite empty.
	2) Of those objectives you mentioned above which do you think are the most critical?	1) Service frequency, the coordinated timetable of train and its feeder bus, also service time are the most important things to attract more users. 2) Technique constraints to the system such as the signals affect the frequency and also the arrangements on the platforms affect access/egress speed.	1)Frequency 2) The building of multi-model transport system (not too much relying on rail system).
	3a) How do you take account of other passengers' aspects - such as travel attitudes and	For the non-users, they realize that sometimes the use or not-use is not driven by how good or bad the public transport service is. They believe what	1) The car to Shanghai people sometimes is not only a transport; it's also a status "symbol".

Research question	Interview questions	Main ideas of the answers from the participants	
		Perth	Shanghai
	perceptions (particularly in relation to encouraging increased public transport mode share) in your public transport planning practice?	the people want is point to point trip and in this case public transport largely fails at 'going anywhere, anytime' principle that would compete with the car.	2) Of public transport users, Shanghai people are too much rely on the city's metro system which has brought a big pressure to its rail system and is not beneficial to help the development of city bus.
How can the existing public transport system be reoriented to take account of the individual?	3b) If yes, in what ways, could you give me an example?	1) The very comprehensive passenger satisfaction survey runs every year and can monitor the current users' need in details and. In general the results turn out to be very high. 2) Educational behaviour change like "travel smart" programme works with lots of evidence. It does critically going forward let people know what choices are and how to access them. The challenge is to what we can do it in a more cost effective way, instead of sitting there talking through, smart phone technology probably goes to help that a lot. Also education awareness to younger generation in school to sell the benefit of public transport and other broadly education to the public also works. 3) They believe the trend of usage is increasing in Perth and when the "good" service is there, people eventually will come to use it. The current low usage was largely contributed by historic land use development and government policy priorities.	1) In every 10 years, Shanghai's transport agency will apply a city-wide transport demand survey which refers to the traditional way of household travel survey. This is a good way to contact with people within the scope of transport choices and future requirements. 2) Nowadays in the area of demand analysis high-tech has been largely introduced into the planning process. The technique of positioning mobile communications and transit IC card as well as GPS has greatly improved the accuracy of the demand modelling. 3) The people's congress which stands for the people also have the rights involved in public transport planning in a certain degree. 4) Travellers' satisfaction survey also runs regularly by the transit operation company to monitor the users' travel requirement.

Research question	Interview questions	Main ideas of the answers from the participants	
		Perth	Shanghai
			5) It will be pretty hard to apply individualised marketing programme such as travel behaviour changing programme in Shanghai due to the large population size. The effect won't be very obvious. 6) Shanghai people are too much relying on the city's metro system which has brought a big pressure to its rail system and is not beneficial to help the development of city bus.
	3c) What do you think are the major barriers/difficulties/concern? And how do you think those difficulties can be overcome?	1) The federal government is still not so coping with public transport investment especially railways at this moment. Because affordability will be the massive issue for the state at least at the next 5-10 years. The public transport infrastructure, the railway particular is not cheap. It's hard to convince the government to provide the funding to expand public transport network. 2) The behaviour change is soft measure which is difficult to get government to really focus because the government is interested in things that can be really seen by public such as that experience of high frequencies. The government is also not interested in those supporting techniques like signal and communication system also it costs lots of money.	1) Chinese centralized political model is advantageous to the investment on the construction of urban infrastructure. For public transport particular, in this case, the policy direction of its urban transport development is decisive. In recent years Shanghai's government has shown a great interest in the expansion and increasing the capacity of its rail network. This is not beneficial to the benign development of multi-modelling public transport system. 2) The government likes doing planning. Often do and often change. This has weakened the authority of planning.

Research question	Interview questions	Main ideas of the answers from the participants	
		Perth	Shanghai
		3) Planning is sometimes a more cartable of getting documents formally published by government showing future transport might be there. And the plan has always been shelved and then been replaced by another one. 4) As the governmental arrangements change frequently between electoral cycles, the names of departments also their accountability also changes over time. This affects the collaboration of different agency on public transport planning.	