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A 15-minute community life circle analysis of Shanghai based on non-work travel behaviour

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Declaration

Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of the MSc Sustainable Urbanism and Planning at University College London:

I declare that this dissertation is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

Signature. _____

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Abstract

Purpose

With the development of economy and promotion of cities' level of transformation, non-work trips by urban residents have significantly increased in recent years. It is even exceeding the number of commute trips. Therefore, understanding the factors that may affect residents' non-work travel behaviour, especially self-selection factors based on different socio-economic conditions is crucial. As a relatively new policy, the construction of the 15-minute community life circle has been promoted in many Chinese cities. This policy is expected to effectively change residents' non-work travel behaviour and reduce their dependence on car travel by intervening built environment. This paper chooses Shanghai as an example. It aims to explore whether the 15-minute community living cycle typology can effectively transform residents' non-work travel behaviour.

Methodology

This study was based on two primary data collection sources. The first was a critical review of the literature on the relationship between compact urban forms and travel behaviour. The second primary data collection included an online questionnaire survey of Shanghai's residents.

Findings

This study found that some social and economic factors, including age, occupation status and car ownership, significantly influenced non-work travel behaviour. Moreover, the 15-minute community life cycle typology in Shanghai has demonstrated helping reduce residents' dependence on automobile travel. However, a different residential location may result in the differentiation of policy benefits. Considering the needs of different socio-economic groups can help bring sustainable development benefits to the broader community.

Significance

This study makes up for the lack of research on government intervention in residents' non-work travel. Further, a theoretical framework for the intervention of residents' non-work travel behaviour is proposed, which can aid in the consideration of relevant self-selection factors in future policymaking.

Chapter 1 Introduction

1.1 Background of the study

Since the reform policy, China's urbanisation rate has been developing rapidly with an average growth rate of 1% during the last 30 years (Zhang, Deng and Jiang, 2017). With the rapid increase on city extensions, the travel distance and travel time of urban residents continue to increase, and the types of residents' trips are increasingly diversified. In terms of travel needs and purposes, corresponding to the development of large communities is the increasing travel needs of urban residents, especially for non-work travel purposes, such as leisure, personal affairs and shopping. According to Lu and Gu (2011), the number of daily non-work trips by Shanghai residents will gradually exceed the number of commuting trips within a few years.

However, rapid urbanisation and modernisation processes are accompanied by many new problems. Especially in some large cities, there is inevitable not only rapid expansion on a large scale but also internal reconstruction (Ma and Wu, 2005). Besides, the provision of housing based on market principles leads to social segregation and further injustices of spatial imbalances in terms of accessibility to public services and resources (Huang and Jiang, 2009). The result is an increased demand for transport and high levels of carbon emissions (Liu and Chai, 2015). According to statistics released by the Shanghai government in 2015, mobile pollution sources such as motor vehicles accounted for 29.2% of PM2.5 (Shanghai government, 2018).

In order to cope with these problems, in the new round of the overall planning of Shanghai in 2014, it was proposed to build a 15-minute community life circle (Shanghai 2040). It shows a shift from expansionary planning to optimised space utilisation. In the future, the coverage of community public service facilities within 15 minutes of walking distance could reach approximately 99%, which is thought to be effective in changing the choice of the residents' travel behaviour (Zhu and Xie, 2018). However, the residents' travel behaviour is the result of comprehensive factors, not just intervention in the built environment.

Based on the structural equations modelling framework (as shown in chapter 2), the personal and household characteristics of residents can affect travel behaviour and activity participation patterns directly (Kuppam and Pendyala, 2001). Furthermore, community characteristics, such as community location and accessibility are concerned as well. For non-work travel purposes, the spatial distribution characteristics of community public facilities are particularity important. Therefore, this study explores the significance of a 15-minute community typology through non-work travel behaviour.

1.2 Research Aim and Questions

1.2.1 Aims and questions

This dissertation aims to explore whether the 15-minute life circle community typology in Shanghai can effectively transform residents' travel choice and reduce the carbon emission caused by increasing travel demand. Although some scholars believe that the relationship between urban form and residents' travel choice is significant, it may be influenced by other self-choice factors, especially in non-work travel. This dissertation hypothesizes that 15-minute life circle typology does have an impact on residents' non-work trips, and it will explore other relevant factors as well. In order to achieve the objectives, this study collected data through online questionnaires and used quantitative analysis.

The study aims to answer the following questions.

1) How are Shanghai residents travelling for non-work-related trips?

2) What factors contribute to and influence this choice of travel behaviour?

3) How will residents change their non-work travel behaviours under conditions of the 15-minute community life circle?

4) What implications does this have for future design and policy of the 15-minute community life circle typology?

1.2.2 Research Objectives

In order to test the hypothesis, these objectives are required to be met:

RO1-To critically review the existing literature on the main divers of changing the residents' non-work travel behaviour.

RO2-To explore whether there are other socio-economic factors influencing residents' non-work travel choice from 15-minute community life circle.

RO3-To develop a framework of main drivers of residents' non-work travel behaviour change.

RO4-To provide practical suggestions for the improvement of the 15-minute community life circle.

1.3 Structure of this dissertation

After this introduction, Chapter 2 consists of a review of the literature on the relationship between urban form and travel behaviour, as well as the case study of Shanghai 15-minute life circle community typology. Research strategy and objectives are presented in chapter 3. Specifically, study areas will be defined, and data sources involve an online questionnaire on non-work travel behaviour. The key findings and analyse of the primary data collected from the questionnaires and secondary data integrated from the literature review will be presented in chapter 4. Chapter 5 will discuss the key findings, which could give some implication to the Shanghai 15 minutes community life circle. The conclusion and highlights areas for further investigation will then be presented.

Chapter 2 Literature review

The literature review starts by examining how compact urban forms contribute to sustainable development. 'The Chinese national new town planning 2014-2020' was proposed to deal with problems such as the vacancy of new town housing and the decline of the central city, which also represents the end of traditional urban growthism. With the transformation of the urban space development mode to intensive utilisation, urban planning strategies need to be adjusted. This will lead to the Shanghai 15-minute community life circle case study, based on the compact city concept. Finally, a selection of literature will be summarised on the relationship between urban form, other related factors and travel behaviour.

2.1 Compact sustainable community typologies

2.1.1 The definition of the compact city model

With the development of high density, the 'compact city' concept is being promoted by global urban development decision-makers (De Roo and Miller, 2000). The compact city represents a kind of urban form with high density and compactness (Burton, 2002), including diverse and mixed land-use, revitalisation of urban centres (Chao, Chen, and Zou, 2013), and efficient transportation systems (Jabareen, 2006). The core function of the compact city is to arrange a high-density population and industries within limited urban space (Gu and Chen, 2013). It is considered to be a response to the problems of urban sprawl such as social cohesion, environmental issues, and economic development challenges (Lim and Kain, 2016). The transformation of urban space is reflected in the community typology. As Kersey (2006) states, the small community should be a mixed-use development connected by public transportation, with well-designed, high-density medium and high-rise housing and a range of social and economic amenities within walking distance of residents.

2.1.2 How can the compact city model achieve sustainable goals

The compact city model embodies the concept of sustainable development, which is supported by several pieces of evidence. Firstly, the compactness of the built environment is considered to be the basic typology to achieve sustainability. Dumreicher et al. (2000) argue that a sustainable city should be diverse and highly integrated. Compactness is the result of an intensive strategy to make urban land more efficient by increasing density and activity (Jabareen, 2006). It provides opportunities to reduce greenhouse gas emissions and improve the most disappointing aspects of urban living today (Hillman, 1996; Sherlock, 1990). Also, Newman and Kenworthy (1989) put forward an inverse relationship between urban density and transportation energy consumption. The dominant mode of transportation is generally regarded as the reflection of urban form (Jenks, Burton and Williams, 1996). Compact, public transit-oriented development can shorten the travel time and encourage the habit of non-motorised travel (Robert, 1998).

An important factor related to energy use and emissions from everyday mobility and housing is the increase in density. Based on 'urban economies of scale', community infrastructure could be used more efficiently (Wiedenhofer et al., 2018). Compared with those in low-density areas, residents living in areas with high population density are more likely to travel by public transport, non-motorised travel or a combination of the two, which could reduce the use of private vehicles effectively (Transportation Research Board of the National Academy, 1996). Moreover, the mixed use of land is a crucial factor in the sustainable urban form. For example, residential land could be integrated with commercial, industrial, institutional and transportation functions. It ensures that many public services are within a reasonable distance (Ritchie and Thomas, 2013). Unlike previous planning experience, compact cities discourage zoning (Breheny, 1992). To some extent, this can not only improve the diversity of the community effectively but also enhance the vitality of the district's streets (Roseland, 1997). In short, the high density, sustainable transportation, mixed

land use, and diversity that compact cities advocate are consistent with the design concept of sustainable urban form.

2.1.3 Urban Sprawl Issues and Countermeasures under the background of China

In the context of high-speed urbanisation and housing commercialisation in China, the sprawling of urban built-up areas is becoming increasingly severe (Liu, Wang, and Tang, 2015). As Schneider and Woodcock state (2008), the pattern of urban sprawl in Chinese cities appears the result of 'frantic growth'. It features incredibly rapid land-conversion rates, which leads to the urban land growth rate being far greater than the urban population growth rate (Schneider and Mertes, 2014; Ding and Lichtenberg, 2010; Fang and Pal, 2016). The uncontrolled expansion of urban land also brings tremendous pressure. A lag in urban construction means that it is challenging to realise the full economic value of the land. The environmental effects of land and energy waste are severe and include loss of farmland and degradation of wetlands (Y. Chen et al. 2013; Jiang et al. 2014; Deng et al. 2015). In urban development areas, the low efficiency of public transportation not only reduces the quality of daily life of citizens, but also prevents the city from employing low-carbon, energy-saving and environmental protection measures. (Liu, Wang, and Tang, 2015). Dutton (2000) argued that the lack of planning is an essential cause of excessive spatial capitalisation. Large government-led construction projects have exacerbated urban sprawl. At the same time, some scholars indicate that the expansion of residential areas is the root cause of urban sprawl. Taking Nanjing city as an example, Liu found that the relationship between urban built-up areas and residential areas is increasingly close (2015). Moreover, the ageing population is also troubling urban development. The ageing rate is increasing by 1.4% per year, but the spatial clustering and marginalisation of the elderly are becoming increasingly severe (Chai, Ta and Mao, 2011).

In order to cope with these problems, the concept of urban planning in China has been changed significantly. According to the 'national new urbanisation plan 2014-2020', urbanisation needs to enter a new stage of quality improvement. This means that growth-controlled development based on the concept of a compact city becomes the main form of urban space development (Du and Li, 2017). The innovation of urban community public service becomes the critical target in the transition period. Therefore, the proposal of the 15-minute living circle typology might be an effective management scheme to coordinate city development.

2.2 From 'Danwei' Communities to Shanghai's 15-minute Living Circle policy

In order to cope with the urban sprawl issues within the context of China's rapid urbanisation, such as high dependence on automobiles and low utilisation of resources, the compact city theory has been popularised. The 15-minute life circle is a kind of community typology based on this theory.

2.2.1 Origins of urban communities in China

The development of urban community typologies in China originated from the period of 'planned economy' (1949-1978) before the market-oriented reform. There was a form of state control of society/allocation of resources/assistance in social integration, named 'Danwei'. At that time, 'Danwei', as the basic building block, played a crucial role in Chinese society, economy and daily life (Chai and Zhang, 2009). On the background of production-oriented and highly concentrated of power. 'Danwei' assumed the function of production and life organisation. Moreover, it presented a closed feature in the spatial form (Bjorklund, 1986). At that time, the degree of urban living differentiation in China was relatively low, and residents did not have the freedom to choose residence and community. Thus, the residential space dominated by 'Danwei' was formed (Li, Wu and Lu, 2004). The 'Danwei' community has been criticised for a lack of planning concept, which resulted in the lack of urban infrastructure, the

deterioration of the living environment and other consequences (Fung, 1981). In addition, each community has distinct boundaries, which reflects the division of urban space caused by the different administrative structures. It also leaves the city in tatters (Deng, 2002).

Although scholars generally hold a critical attitude towards the planning model with 'Danwei' as the basic unit, 'Danwei' as a unique community played a specific role in urban space. According to Chai (1996), the 'Danwei' community was organised by one or more units and provide public living services. The principal members were 'Danwei' workers and their families. The interpersonal relationships in the community were linked to production relations (Li and Li, 2000; Tang, 2007). As shown in figure 2–1, the traditional 'Danwei' community was usually centred on the administrative office building, which symbolised the authority of the political party. The living service facilities such as canteen, bathroom, school, hospital and activity centre surrounded the building, and together they formed the community centre. Surrounding this was a neat arrangement of factories, and then outside this was uniform neat and undifferentiated housing (Bray, 2005). To some extent, the traditional 'Danwei' community avoids the rapid expansion of urban space.
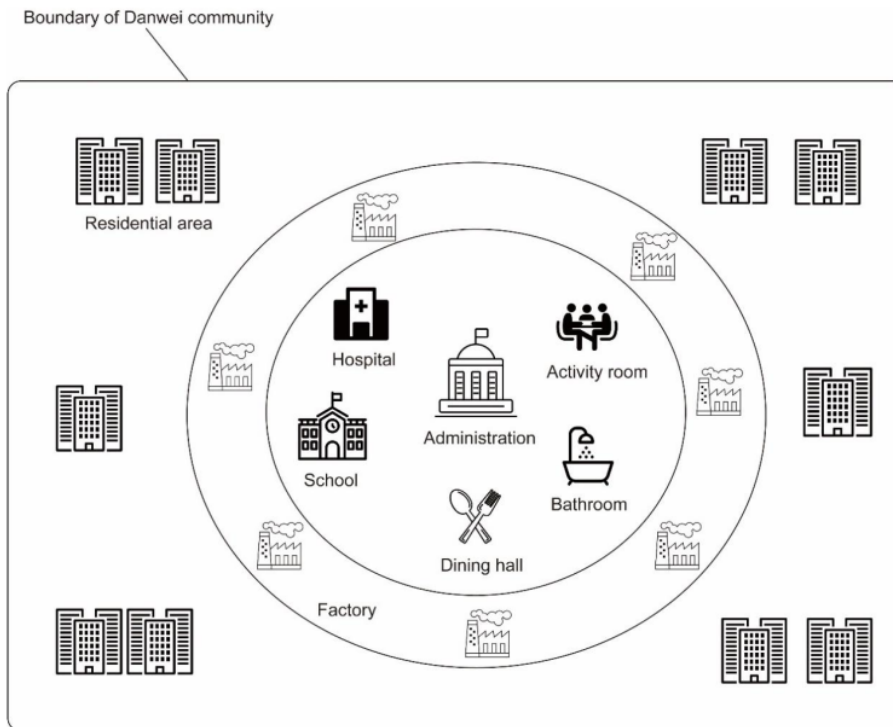
Figure 2-1 The layout of the "Danwei" community

2.2.2 Community typology in transition

The transformation of property ownership has changed the land-use of urban space since the reform of the economic system in 1978 (Li, 2008). The previously closed and independent 'Danwei' space was gradually opened to the city and integrated into the surrounding urban space. At the same time, land use was gradually diversified (Chai and Zhang, 2009). The evolution from Danwei community to citizen community can be followed through a case study of the Tongrentang factory in Beijing. This was a typical Danwei community with factories as the core and surrounding residential areas. Since the reform, the layout of community service facilities has changed from self-sufficiency to social sharing. First, the residents' activity room replaced the administrative building as the new community centre. In addition, advanced service facilities such as

restaurants have appeared. From the perspective of spatial form, the layout of the street became more suitable for independent operation. This accelerated the progression of the community from closed to open. While the external service facilities attracted the residents, thus they looked for better services on a larger scale (Zhang, Chai and Chen, 2009).

2.2.3 Shanghai 15-minute Community life circle Policy

With the increasing demand from residents for the construction of compact, complete and convenient living spaces, it is challenging for the original production-oriented urban development strategy to solve the issues, especially in Chinese megacities such as Shanghai (Zhao, Zhang, and Zhou, 2018). The Shanghai government launched a new urban masterplan in 2014 (Hou and Liu, 2017). As the basic unit of urban life, the community became the focus. Thus, the 15-minute community living circle plan is now being promoted across the country, as a new approach to urban renewal, as well as a method to improve the level of community services and stimulate vitality (Hou and Liu, 2017).

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will be able to provide more public services with the increasingly mixed land-use. Learning from the experience of Singapore's community centre, the complex set of childcare facilities, medical, commercial, public space, and other facilities promote the sharing of public service facilities (Xi et al. 2017). Accessibility will be another feature, and the emphasis on the scale of the 15-minute walk could help organise activities efficiently and easily.
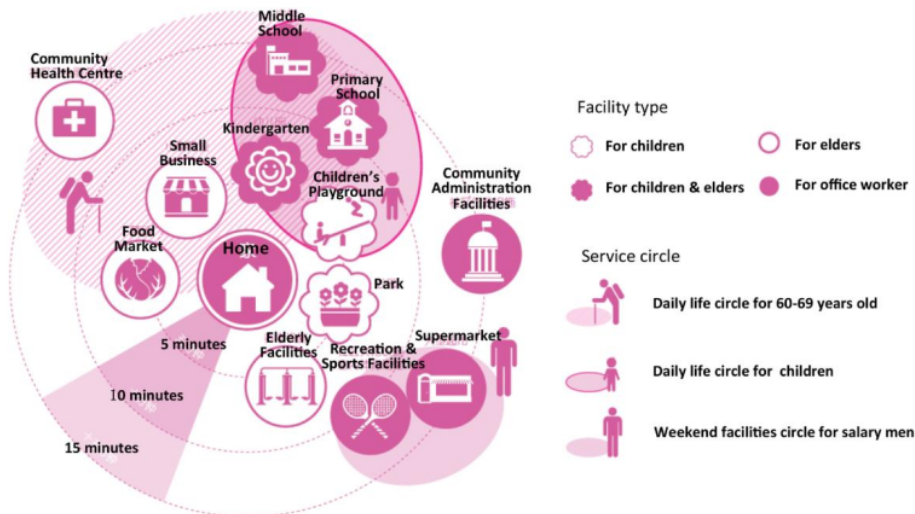
Figure 2-2. Facilities' distribution of 15-minute community life circle

(Source: Shanghai Urban Planning and Land Resources Administration Bureau, 2016.)

2.3 The relationship between urban form and travel behaviour from opposite perspectives

2.3.1 From the perspective of supporters

With the improvement in living standards, the increase in demand for travel promotes a rapid growth of private vehicle ownership. That aggravates urban traffic congestion and environmental pollution, which has become a common issue hindering the achievement of the goal of sustainable development in China's megacities (Yang et al., 2016). As a strategy for reducing car travel, changing land use seems reasonable. Many scholars have studied the

relationship between urban form and travel behaviour. Density is one of the factors of the built environment that influence travel behaviour (Cervero and Kockelman,1997). According to Hickman et al. (2009), density is inversely correlated with travel, showing that increased density may be associated with reduced travel distance, especially by car. Higher building and population densities could bring non-motorised and shared modes of transportation into competition with driving (Cao and Fan, 2012). Newman and Kenworthy (1989) conclude that the increase in urban density could provide residents with transport options and effectively restrain the proliferation of automobile infrastructure. The strategic transportation network is another factor. Hickman et al. (2009) indicate that an effective mass transport system could enhance the sustainability of residents' travel between distant destinations. Ewing and Cervero (2010) conclude that closer proximity to transit stations, increased intersection density, and mixed land use enhance the efficiency of transit. Neighbourhood design and street layout will be another important factor. Liu, Ma and Chai (2017) take Beijing as an example for exploration of the significant potential of neighbourhood-scale urban forms to reduce the carbon emissions generated by residents' travel under the context of rapid urbanisation and spatial transformation. They show that the integration of land use, improved public transport access and increased density of community streets could effectively improve service density and accessibility. This might increase the number of short trips, but it could reduce the overall distance of residents' travel per day and encourage low-carbon transportation.

2.3.2 From the perspective of opponents

However, some studies indicate that the relationship between urban form and travel demand is insignificant. One important factor is the under-emphasis of a geographic scale. Boarnet and Sarmiento (1998) argue that new design by urbanists are often implemented on the scale of a few blocks, which emphasises the proximity of land-use planning. Many non-work trips cover

larger areas. Baglex and Mokhtarian (2002) point out that mode of transport is more likely influenced by self-selection factors, which are easily ignored by the new urbanism supporters. For example, mixed land-use and the accessibility of public transportation could effectively reduce the travel time and shift mode choice towards non-motorised and public transport. However, such assumptions ignore other aspects of travel demand. The saved time could be the reason why residents travel longer distances (Maat, van Wee and Stead, 2005). Furthermore, Dieleman et al. (2002) argue that personal attributes and capabilities, such as the financial capability of owning a car, are also determinants. Car ownership is the most important variable in choice of travel mode and tends to encourage residents to increase their willingness to use cars. In terms of household type, families with children are more likely to use cars than other families (Dieleman, Dijst and Burghouwt, 2002). Kuppam and Pendyala (2001) developed a model that helps explain the relationships between socio-demographics, activity participation and travel behaviour. As shown in Figure 2-3, traveller characteristics can affect travel behaviour not only directly but also indirectly, through activity participation patterns. Although self-selection and other factors weaken the impact of urban form on travel behaviour, the latter still plays a dominant role (Liu, 2017). For example, Cao and Fan (2012) applied the propensity score matching approach. They found that self-

selection effects account for 28% of possibility, while density effects account for 72%.
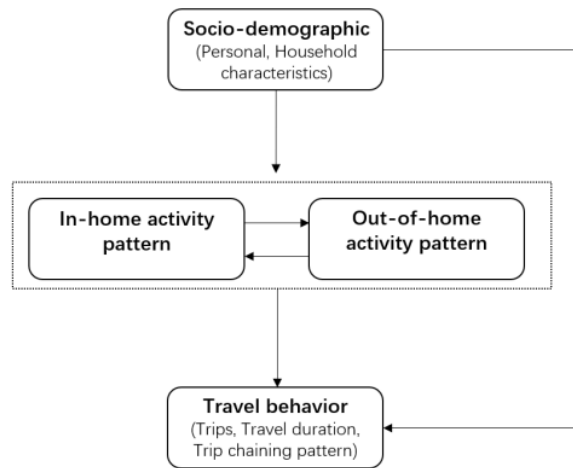
Figure 2-3 Structural equations modelling framework.

(Source: Kuppam and Pendyala, 2001)

2.4 Theoretical framework

According to existing literature, it is not enough to plan effective travel behaviour changes, but more important to consider residents' subjective factors. This study will collate the factors related to the influence of non-work travel. This will help in the analysis of how the traveller's subjective factors (personal characteristics and household characteristics) and community characteristics affect residents' participation in non-work activities and travel behaviours in the context of 15-minute living circle community typology.

2.4.1 Endogenous variables and exogenous variables

Figure 2-4 provides a possible theoretical framework for relevant factors that interfere with residents' travel behaviours. The factors could be grouped into

endogenous and exogenous variables. The endogenous variables in this analysis are descriptors of non-work travel behaviour, and the exogenous variables are related to socio-economic factors. Lu and Pas (1997) divided residents' travel activities into three categories: working activities, household-sustaining activities and recreational activities. In this paper, non-work trips include household activities (including shopping, dining out, seeing a doctor and picking up people) and recreational activities (including entertainment and going on sightseeing tours). By describing the characteristics of non-work travel behaviour, such as the number of trips, time and transportation choice, the non-work travel pattern of residents is revealed. First, individual socioeconomic factors such as gender, age, and occupational status may interfere with non-work travel behaviour. Second, family characteristics may also have some influence on non-work activities and travel behaviours. For example, the size of the family, whether there are old people and children in the family, and the number of cars. Thirdly, community features, including community location, distribution of surrounding public transportation stations, and coverage of public facilities, may have a significant impact on non-work travel activities. To be more specific, the daily travel decisions of residents, especially regarding non-work activities starting from home, are significantly affected by the community environment of the place where they live. The high-density coverage of essential public facilities and leisure facilities and excellent public transport conditions may reduce the use of cars.

Endogenous variable
➤ Non-work travel behavior characteristics (number of day trips, short trips, trip mode)
➤ Recreational activities (frequency, travel time, travel distance)
➤ Household sustaining activities (frequency, travel time, travel distance)

➕

Exogenous variable
➤ Household characteristics (family size, with children and elders, travel mode selection)
➤ Personal characteristics (sex, age, employment, driver license)
➤ Community characteristics (location of community, public transport stations, coverage of basic public facilities, leisure public facilities)

⟹ Non-work Travel

Figure 2-4 Theoretical framework of non-work travel behaviour intervention

2.4.2 Hypothesis

Based on the above the above model of factors influencing non-work travel, this dissertation will test the following hypotheses:

Hypothesis 1: Personal characteristics such as gender, employment status, driver's license and age will have an impact on residents' non-work travel behaviours.

Hypothesis 2: Family characteristics such as the possession of transportation and whether there are children under 12 years old or people over 60 years old in the home, will have an impact on residents' non-work travel behaviour. Hypothesis 3: Community features, such as residential location, whether there are public transport stations nearby, and the coverage of public service facilities, will affect residents' non-work travel behaviours.

Hypothesis 4: In the imagined 15-minute community life circle, socio-economic factors difference will affect people's willingness to change non-work travel behaviour.

Chapter 3 Methodology

In this chapter, the research methodology and rationale for the choice of research technique will be outlined. The researcher will explain how the relevant data and information are to be collected, analysed and presented. Reasons and justifications for selecting research designs, data sources, data collection, presentation, and analysis techniques will be given. This dissertation will use quantitative research methods to discuss these questions. The data on non-work trips of residents in the community living circle will be collected through a questionnaire survey. It is expected that the analysis will identify which factors influence residents' selection of travel mode.

3.1 Research Design

As shown in figure 3-1 above, the study will start by putting forward research objectives and questions. Then it will adopt positivism and the qualitative research hypothesis through the quantitative method of questionnaire data collection and analysis. Endogenous and exogenous variables related to residents' non-work travel choices will be discussed. Next, data statistics and analysis will be carried out. This will help to assess whether the 15-minute community living circle typology in Shanghai is likely to be effective in changing travel behaviour, and to identify other potential socio-economic factors. Finally, it is expected to provide practical suggestions for the development of the community living circle typology.
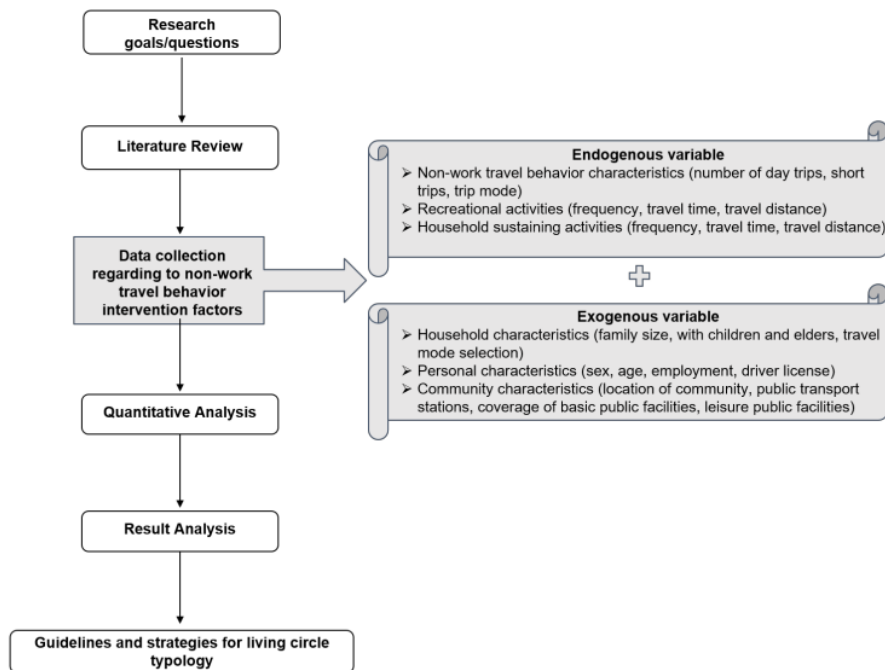
Figure 3-1 The structure of research process

3.2 Research Method

3.2.1 Quantitative Approach

This study will adopt a simple quantitative approach. In the positivist view, this is considered to explain phenomena by collecting and analysing data (Daniel, 2016). Bryman (2001) argue that the quantitative method emphasises numbers and numerical studies in collecting and analysing data. It can help reduce the time expended in describing the results. Denscombe (1998) defines quantitative research as 'researcher detachment'. That means the researchers had no direct contact with the participants and conducted questionnaires through the internet, telephone, and mail. The problem of researcher bias will be effectively eliminated.

3.2.2 Rationale for choice of the data collection instrument

It is crucial to choose the appropriate method because it will affect the data collection and analysis. A questionnaire survey is considered to be the most appropriate method of obtaining the data needed in this study. Reviewing the traditional data collection methods, such as interviews or telephone surveys, may be expensive and time-consuming. Creswell (2009) indicates that a questionnaire strategy is a quantitative method, which can numerically describe the attitudes and views of a group. There are several forms of questionnaire survey. Regmi et al. (2017) point out that an online questionnaire survey is considered relatively economical and practical (using methods such as social software sharing and email distribution). This new data collection strategy could collect large amounts of data from participants in a relatively short period. The advantages and disadvantages of the online questionnaire are summarised in table 3-1. Considering factors such as time, cost and available resources, this study will use the online questionnaire survey method.

Table 3-1: Benefits and drawbacks of the online questionnaire approach

Benefits	Drawbacks
1. Efficiency, ease of delivery.	1. Lack of control over samples.
2. Ease of reaching some potential responders.	2. Potential for limited access with some target populations (e.g. the elderly, children).

3. Flexible, multiple question formats can be used.	3. Potential for internet technique problems during the period of collecting feedback.
4. Ensures the confidentiality of respondents.	4. Time-consuming, requires much time to develop it.
5. Ease of data collection.	5. Questions asked cannot be complicated.

(Source: Balch, 2010; Reynolds, Woods and Baker, n.d.)

3.3 Data Collection and Analysis

3.3.1 Triangulation of Data collection

The triangulation method will be used, which means that multiple sources of data or approaches will be combined to enhance the credibility of the study (Salkind, 2010). In this study, two data collection methods will be adopted. Fieldwork through online questionnaire surveys and secondary data collection through previous studies. The secondary data collection will be based on a literature review and will provide a theoretical framework for the design of the questionnaire survey.

3.3.2 Online Questionnaire Survey

Primary data will be collected through self-completed questionnaires. The design of the questionnaire will be based on vital information from the literature review. The questions will involve exploring the socio-economic factors identified in the framework (as shown in chapter 2.4). The information collected is recorded in table 3-2, which looks at the non-work trips and activity participation of residents in the living circle community typology. More social-economic attributes of residents, community characteristics and other

information will be collected. The purpose is to understand the driving factors influencing travel behaviour and to provide some inspiration for the future development of living circle typology. In order to make the questions more accessible and more precisely answered, the design of the questionnaire will be based on ground theory strategy and provide 'closed' questions.

The questionnaire was divided into three parts: the socio-economic characteristics of the respondents, the characteristics of the current non-work travel behaviour of residents, and the residents' imagination of the 15-minute community living circle in the future.

Table 3-2: The information collected in the questionnaire survey

Category	Detailed information
Socio-economic information (household level)	- Home location - Vehicle ownership - Presence of children and elderly people
Socio-economic information (individual level)	- Gender - Age - Occupation - Driver licence
Community characteristics	- Public transport station - Household-sustaining facilities - Recreation facilities
Non-work travel dairy	- Number of trips - Time of trips

	- Frequency of using public services
	- Choice of transportation mode
	- Time of arrival

3.3.3 The study area

As mentioned in the introduction, this dissertation chooses Shanghai as the study area. Shanghai covers an area of 5,800 square kilometres and has a population of more than 24 million. As one of the most developed global cities in China, Shanghai is representative of the high-density, rapidly developing megacities in China. However, there are also problems caused by its large population, including issues related to the ecological environment, infrastructure and public services.

3.3.4 Survey samplings

The questionnaire will be posted on social networks for Shanghai urban residents to fill out. The random distribution of participants is a crucial method of reducing survey bias in quantitative research (Smith and Noble, 2017). In terms of the sample size, this study welcomes more participants to respond to the questionnaire to enhance the data credibility.

3.3.5 Profiles of the respondents

In this study, 81 effective responses were collected by issuing online questionnaires. A summary of the respondents' age groups is presented in table 3-3 below. The collected samples mainly show the following characteristics: the male and female respondents were 39 and 42, respectively. The age group of the respondents could effectively influence the change in travel patterns. Thus, this survey ensured that the number of children (under 18 years old) and the elderly (over 60 years old) accounted for about 28% of the total. In terms of residential location, 61% of respondents lived in the downtown area, and 28%

lived in areas outside the downtown area. In terms of survey groups, students accounted for 47%, commuters accounted for 33%, and retirees accounted for 15%. 68% of the respondents have driver licences, and more than 80% of the residents' households had one or more cars, which shows that car-dependence is currently heavy.

Table3-3: Summary of questionnaire respondents

Research participants	Number of respondents
Under 18 years old	12
19-29	32
30-49	13
50-59	13
Over 60 years old	11
Total	81

3.3.6 Data analysis

In order to determine the results of the questionnaire survey, this study will use descriptive statistics by utilising Microsoft Excel software. The application of descriptive statistics in data analysis enables the researcher to summarise and organise data efficiently. Finally, the quantitative data obtained will be analysed and presented graphically.

3.4 Limitation of the Methodology

It should be noted that the method used in this study has some limitations. Although the questionnaire focuses on non-work travel behaviour and purposes of residents, it fails to identify the difference in intensity of the factors influencing

non-work trips of residents. In order to clarify this, a mixed-methods approach, supplementing the questionnaire with interviews, should be employed. However, this does not seem possible because of time constraints and the unwillingness of participants. Furthermore, participants' age, occupation, and other attributes may not be balanced due to the sample size. For example, the survey may ignore the proportion of children and the elderly, thus affecting the research results.

3.5 Ethical Issues

During the study, the researcher will follow the highest ethical standards. Before responding to the questionnaire survey, participants will be informed that the results will only be used for the academic purpose of this study and will be treated with strict confidentiality. In order to ensure the anonymity of the respondents, the questionnaire will not require participants to reveal their real names. In addition, participants have the right to withdraw or omit the information they have shared, and this will also be stated at the beginning of the questionnaire.

Chapter 4 Analysis of Findings

The purpose of this chapter is to integrate, analyse and present the primary data collected. This chapter consists of two main parts. The first part analyses the current non-work travel behaviour patterns of Shanghai residents according to the use of public service facilities for travel purposes. Factors that might affect travel behaviour are also presented and discussed based on statistical methods. The second part analyses whether social-economic factors have a specific effect on the results of residents' willingness to change travel behaviour based on the imagination of a 15-minute community living circle.

4.1 Current non-work travel behaviour patterns

4.1.1 Research question #1: How are Shanghai residents travelling for non-work-related trips?

This section analyses the non-work travel patterns of Shanghai residents. In this context, the following aspects were explored: the frequency of taking non-work trips, the purpose of non-work travel, the typical mode of transportation used, and the factors influencing the choice of destination.

1) The frequency of taking non-work trips

On average, respondents had undertaken one to two non-work trips per day, and the total travel time was less than one hour. The statistical results of the number and duration of non-work trips are presented in figures 4-1 and 4-2 below. Compared with the survey results of Shanghai residents' travel in 2014, the average number of non-work trips increased from 1.14 to 1.48, while the average number of commutes fell from 1.1 to 1.04. This indicates that with the improvement of residents' living standards, the proportion of non-work trips in residents' travel structure are rising. Meanwhile, the increase in the number of freelancers had also contributed to a decline in residents' commutes, with most of their daily time allocated to non-work trips.
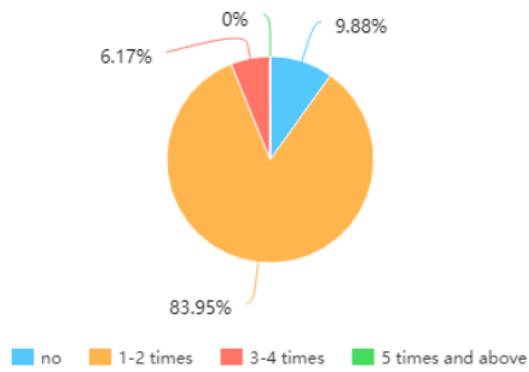
Figure 4-1 Average number of non-work trips
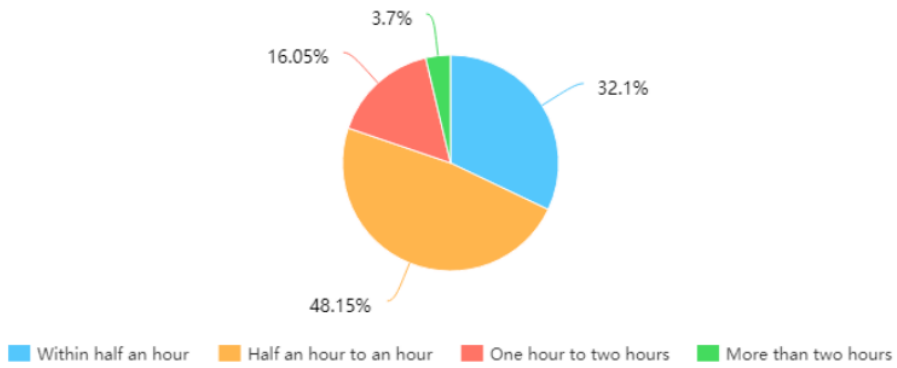
Figure 4-2 General non-work travel time each day

2) The purpose of non-work travel

With regard to non-work trips, the travel purpose of residents can be defined as household-sustaining activities or recreational activities. The frequency analysis showed that the main reasons stated for residents' non-work travel

were culture, sports, leisure, health care, education, daily shopping and social welfare. Use more than once per week is defined as a high frequency of use. As shown in figure 4-3, more than half of the respondents visited green spaces and city parks around the community, shopping facilities and educational institutions. There seemed to be no significant difference between the number of destinations frequently visited by residents in travel for household-sustaining activities and recreational activities. However, there was a difference between weekdays and weekends. In general, it was found that the daily travel chain of residents was relatively regular and straightforward. In addition to commuting on weekdays, residents mainly went out to pick up children, do the daily shopping or take a walk. On weekends, with the increase of non-work travel time, residents often chose facilities located far away from the community. However, in terms of the travel routes, markets and shopping malls were still the leading travel destinations. Moreover, the travel chain was supplemented by leisure activities such as going to parks and walking along streets and greenbelts (see figure 4-4).
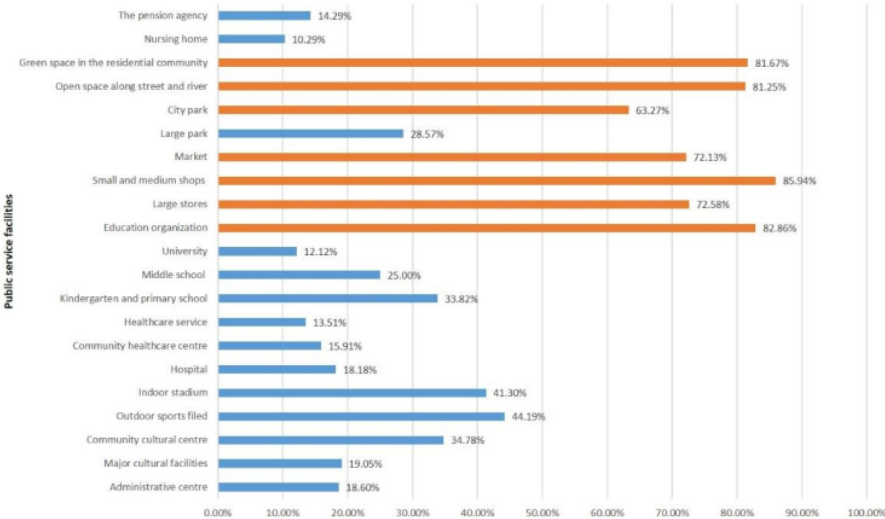
Figure 4-3 Percentage of Shanghai residents who use the public service facilities frequently

Non-work travel chain on weekdays   Non-work travel chain on weekends
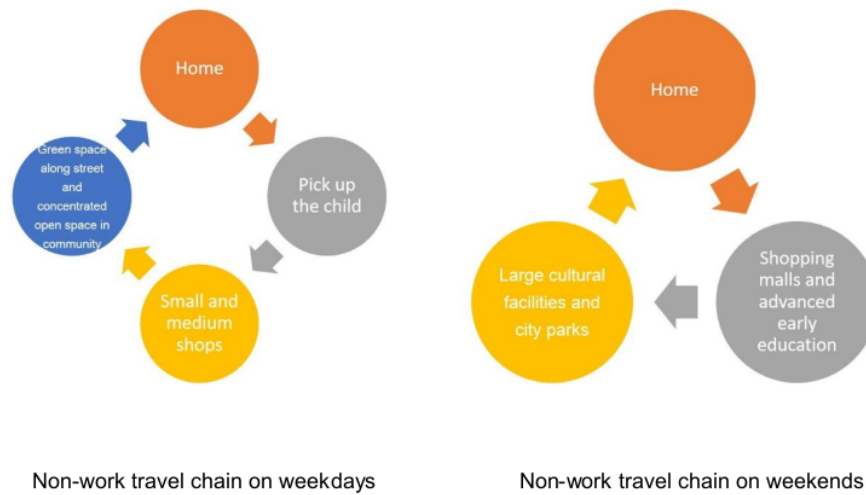
Figure 4-4 Comparison of the non-work travel chain

3) Modes of transport

The choice of transport mode determines the structure and efficiency of urban transportation to a large extent. Non-work travel behaviour plays an increasingly important role. This survey found that there is a relatively high rate of household car ownership in Shanghai (82.72%), which could be considered as a significant cause of traffic congestion on the road.

As the Shanghai government increased investment in public transport infrastructure, residents' willingness to use cars to travel decreased significantly. The survey found that most residents travel to non-work destinations on foot. Taking the very frequent use of public service facilities as an example, most Shanghai residents choose to walk to the facilities distributed around the residential community, including small and medium-sized shops, markets, open spaces along the streets and rivers, and concentrated green spaces within the residential community (see figure 4-5). According to Azmi, Karim and Ahmad

(2013), the number and frequency of visits to community public service facilities reflect the degree of local provision and good walking accessibility of community facilities. The walking time to such facilities reflects the spatial distribution of these public service facilities and residential communities. The analysis of the high-frequency facilities that residents prefer to go to on foot showed that all the facilities could be reached within 15 minutes of walking (about one kilometre), and the green space in the residential community accounts for the highest proportion (78%) (See figure 4-6). Most Shanghai residential communities have formed built environments with high spatial correlation with small and medium-sized shops and community-type open spaces. However, with the diversified development of residents' daily living needs, the number of very frequently-used facilities could continue to increase. At the same time, the characteristics of the community life of residents of different groups have become broader, especially regarding the aspect of age.
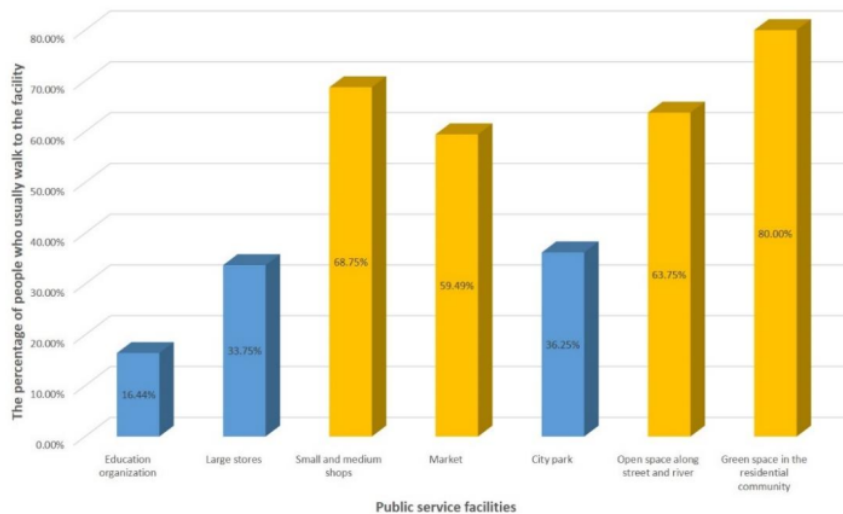
Figure 4-5 Percentage of residents walking to high-frequency use facilities
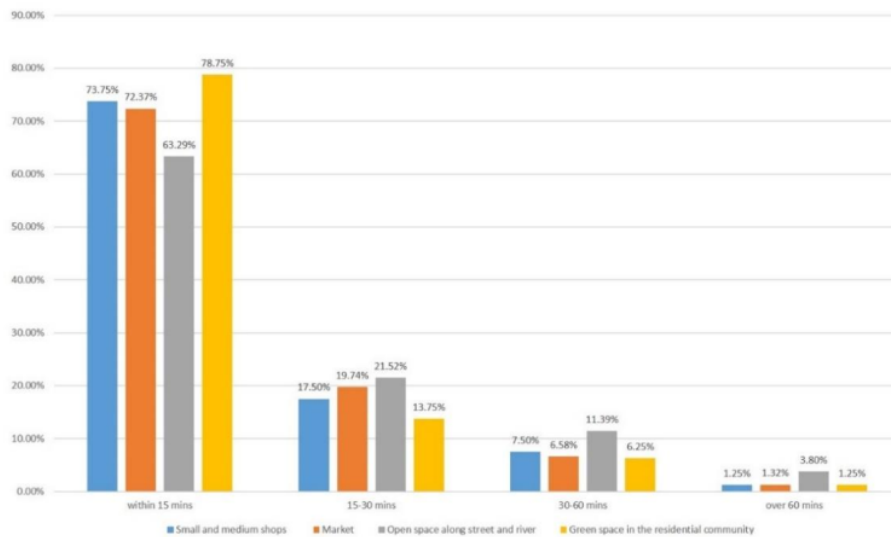
Figure 4-6 Comparison of residents' walking time to high-frequency facilities

4) Factors influencing travel behaviour choice

According to the responses received, the distance became the dominant factor influencing residents' choice of non-work travel behaviour (87%). This is consistent with the findings of Liu (2017), who showed that the distance between the trips' origins and destinations had a significant impact on mode choice. Personal and family needs were also important factors affecting residents' non-work travel, with 79% and 63% respectively. Cars are usually considered as a safe and convenient mode of transport when there are children, the elderly or other disabled household members involved (McCarthy et al., 2017). For families who do not own a car, walking and public transportation are the main modes of travel. Also, some respondents believe that the increasing number of public transportation options and the increasing difficulty of parking have prompted them to reduce their degree of car-dependence.

4.1.2 Research question #2: What factors contribute to and influence this choice of travel behaviour?

To continue with the assumptions made in the literature review, residents' non-work travel behaviours are affected by various factors. The factors could be divided into three categories: individual, family and community characteristics. The questions and results are presented in Appendices B and C.

A paired sample t-test and ANOVA test were performed to help determine the relative importance of each relevant socio-economic factor. These two methods are used to compare the mean values between two or more related sample groups. In the test design process, the null hypothesis states that this factor is not crucial in the process of influencing non-work travel behaviour, while the alternative hypothesis states that this factor has a significant impact on non-work travel behaviour. The following formula can show the relationship between the two hypotheses:

1) **H_0 (null hypothesis): Personal characteristics do not affect Shanghai residents' non-work travel behaviour.**

H_1 (alternative hypothesis): Personal characteristics do affect Shanghai residents' non-work travel behaviour.

Hypothesis testing: To ensure that the sample results are not affected by sampling error, the significance of the sample mean is tested, and 95% confidence is used. This means that the null hypothesis content can only be rejected when the significance level is less than 0.05. At the same time, different degrees were distinguished by 0.01 and 0.001 according to the significance level. The following three hypothesis test results are shown in Table 4-1.

Table 4-1: Results of the effects of social-economic factors on non-work travel behaviour (p-value)

X ╲ Y	The number of non-work trips	Duration of non-work trips
Gender	0.8059	0.0739
Driver license	0.0633	0.5061
Age	0.0809	0.0038**
Occupation	0.0446*	0.0030**
Children under 12 live together	0.8287	0.9069
People over 60 live together	0.6401	0.4188
Private cars	0.4095	0.0046**
Residential location	0.4244	0.0354*
Public transport station	0.6062	0.9181

If P-value>0.05, do not reject the null. (Red)

If P-value<0.05, reject the null. (Green) Degree of significance. *

If P-value<0.01, degree of significance. ** If P-value<0.001, degree of significance. ***

One-way analysis-of-variance (ANOVA) showed that there was a significant difference between occupation groups (F= 2.651, p= 0.446). This finding is consistent with that of Zhang, Deng and Jiang (2017). As daily commuting

groups, commuting workers and students have slightly lower average non-work travel time than freelancers (x= 2.25) and retirees (x= 2.08). This might be because commuters make more arrangements for non-worker trips during the commute, which means commuters tend to have more complex travel chains (refer to the classification of non-work travel purposes). This dissertation found that occupation status has a more significant impact on household- sustaining travel than on recreational activities travel (see tables 4-2 and 4-3). For commuting workers, the travel structure of working days will be manifested as one-way travel between home or workplace and basic shopping facilities. This is different from the unemployed and retirees. It can be seen that occupation status has a significant positive effect on household-sustaining activities.

In addition, age had a significant influence on non-work travel time. Elderly residents in Shanghai prefer to travel short distances within the community and prefer non-motorised transportation modes such as walking and cycling. This result is different from the findings of scholars in western countries. Paez et al. (2007) analysed the mobility of the elderly population in Canada, which is considered to be undergoing a crisis of population ageing. He believed that young people travel more frequently than older people, and older people rely on cars to travel. Some reasons can be outlined. The first is the impact of the built environment of Shanghai. Mixed land-use has improved the accessibility of shopping, recreation, education and other facilities around the community. Cultural differences also play a role. The elderly tend to live with their children and take on some non-work family responsibilities, such as picking up the children from school and carrying out daily shopping. Meanwhile, elderly people in the same community often like to get together for entertainment, which could increase the number and time of non-work trips.

Surprisingly, t-test statistical analysis indicated that there were no significant differences between males and females (t= 1.99, p= 0.806) in terms of the number and the total time of the non-work trips. This may reflect men and

women are equally committed to taking care of their families and doing some household-sustaining activities in their spare time.

2) H_0 (null hypothesis): Household characteristics do not affect Shanghai residents' non-work travel behaviour.

H_1 (alternative hypothesis): Household characteristics do affect Shanghai residents' non-work travel behaviour.

Regarding family characteristics, the number of private cars had a significant impact on non-work travel time. This is in line with the findings of Van Acker and Witlox (2009) that high car availability is positively correlated with car use and negatively correlated with other travel patterns. Owning a car helps residents choose non-work travel destinations without considering distance. As with the description of residents' travel modes in the previous section, Shanghai residents are more inclined to choose cars for increased mobility for both household-sustaining travel and recreational travel. This has led to an increase in non-work travel distances, road congestion and urban carbon emissions.

However, whether there are children under 12 years old and people over 60 years old in the family is considered to have no significant influence on non-work travel. This may be because, in families, older people take on more family responsibilities, such as looking after children, while office workers are more work-oriented than others, and so they have less impact on non-work travel. Further, it may be due to the small sample size that results differ.

3) H_0 (null hypothesis): Community characteristics do not affect Shanghai residents' non-work travel behaviour.

H_1 (alternative hypothesis): Community characteristics do affect Shanghai residents' non-work travel behaviour.

In terms of community characteristics, the residential location had a significant impact on non-work travel time. People living in suburbs travel for significantly longer than those living in the city centre. The insufficient coverage of public transportation and the dependence on mobility may affect the non-work travel behaviour of suburban residents. This also encourages them to complete multiple activities and form a complex travel chain. The findings of Mao, Ettema and Dijst (2016) support the conclusion that mixed-use built environments could effectively reduce travel time for activities such as shopping. The existence of public transportation stations within a specific range around the community had no significant impact on residents' non-work travel. However, Qin et al. (2017) argue that urban hotspot area reflected by high coverage of public transport facilities are the reflection of people's frequent travel activities. Feng and Yang (2015) found that the number of bus stops within 1,000 metres of the community has a significant impact on the elderly's non-work travel. A convenient public transport system could expand the travel range of the elderly. The findings of this study may be the result of an unbalanced sample in the survey. The proportion of young people (19-29 years old) in this survey is relatively large, and they tend to travel by car.
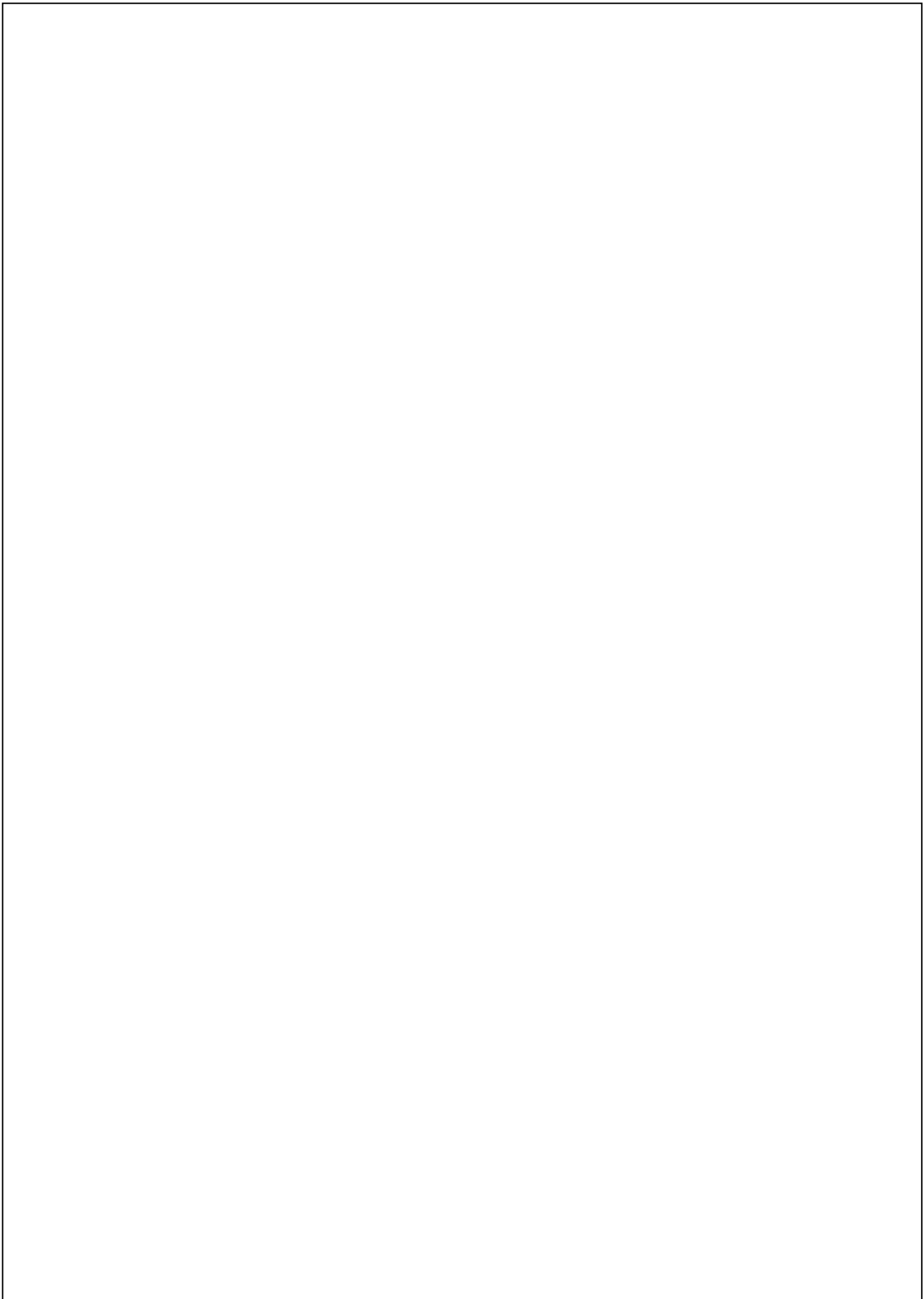
Table 4-3: A summary of ANOVA analyses results (Recreation activities)

Y / X	The destination for Recreation activities							
	Major cultural facilities	Community cultural centre	Outdoor sports filed	Indoor stadium	Large park	City park	Open space along street and river	Green space in the residential community
Occupation (category: student, office worker, freelance, retiree)	0.04900*	0.0688	0.0036**	0.0014**	0.9882	0.4381	0.1832	0.2547

If P-value>0.05, do not reject the null. (Red)

If P-value<0.05, reject the null. (Green) Degree of significance. *

If P-value<0.01, degree of significance. ** If P-value<0.001, degree of significance. ***

4.2 The imagination of 15 minutes community life circle

4.2.1 Overview of Shanghai 15-minute community life circle

The survey of residents' preferred non-work travel modes for the future showed that the non-motorised mode (dominated by walking and cycling) and public transportation have become the choices of most people (as shown in figure 4-7). This is in alignment with the goal of the Shanghai 15-minute community living cycle typology, which is to provide, through urban renewal projects, a variety of public services and to achieve community sharing of public service resources. Residents' travel habits could be changed by providing such a 'slow-moving' environment.
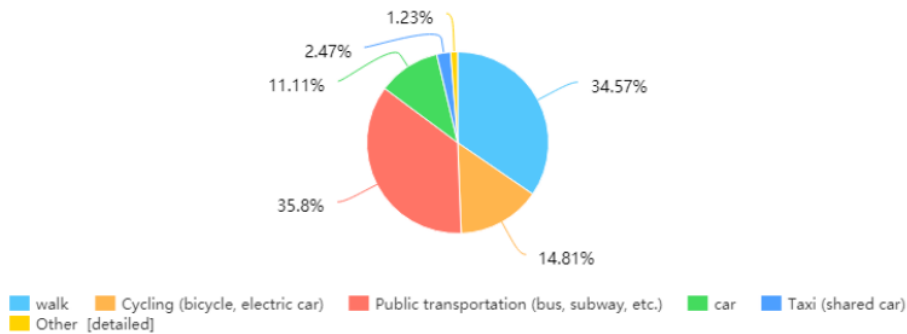
Figure 4-7 Survey results of residents' preferred travel choice in future

The survey also included non-work travel imagined in the 15-minute community living circle. Nearly 80% of respondents said they would travel a combination of long and short distances, and the proportion of non-work purpose short-distance travel would increase. In terms of travel mode choice, nearly half of respondents expect to travel without cars entirely. This means that residents intend to shift from car dependence to dependence on non-motor travel (including walking and cycling) and public transportation. Furthermore, according to the respondents' feedback, the types of high-demand facilities in

the 15-minute community living circle typology were listed. Overall, the results were in line with expectations, and there was little difference in residents' needs for the surrounding facilities. The three kinds of facilities with the highest demand are closely related to residents' daily life, namely daily shopping facilities (74%), convenience service facilities (72%) and dedicated green spaces or squares within the community (70%). However, some issues deserve attention. Residents with different socio-economic factors might have different viewpoints on the 15-minute community living circle typology. This will be analysed and discussed in the next section.

4.2.2 Socio-economic factors that affect the 15-minute community life circle

In order to examine whether socio-economic factors have an impact on the effect of 15-minute community living circle typology, this section will continue with the one-way analysis-of-variance (ANOVA) method to produce the following hypothesis:

H_0 (null hypothesis): Under the conditions of the 15-minute community life circle, socio-economic factors will not have an impact on Shanghai residents' willingness to change their non-work travel behaviour.

H_1 (alternative hypothesis): Under the conditions of the 15-minute community life circle, socio-economic factors will have an impact on Shanghai residents' willingness to change their non-work travel behaviour.

Table 4-4: Results of socio-economic factors affecting the willingness to change travel behaviour (p-value)

X \ Y	Non-work travel distance	Future travel patterns	The community-based alternative to regional public service facilities
Gender	0.3830	0.3425	0.0673
Driver license	0.5615	0.9888	0.0759
Age	0.1037	0.1344	0.0862
Occupation	0.9409	0.5499	0.1738
Children under 12 live together	0.4796	0.1164	4.9369
People over 60 live together	0.8810	0.7056	0.4285
Private cars	0.8143	0.1234	0.7386
Residential location	0.0365*	0.0479*	0.1597
Public transport station	0.3819	0.4482	0.2657

If P-value>0.05, do not reject the null. (Red)

If P-value<0.05, reject the null. (Green) Degree of significance. *

The results showed that the location of the residential community had a significant impact on residents' willingness to change non-work travel (see table 4-4). Compared with urban centres, residents of suburban communities in Shanghai tend to maintain medium and long-distance non-work travel. In terms of travel mode choice, residents living in suburban communities also tend to use a combination of automobile and non-automobile travel, and their dependence on car use is still higher than that of residents living in downtown communities. This echoes the findings of Clark et al. (2014), who argued that residential relocations are found to be triggers for changes in the level of car ownership and for switches in travel mode. Næss's (2009) study used Hangzhou metropolitan area as an example, and found that residents living near the city centre consumed less energy on average to travel. Overall, they travelled less and walked and cycled more. As the distance between the residential location and the city centre increases, the benefits of policy interventions such as the 15-minute community living circle for residents' non-work travel behaviours decreases.

In the period of urban transformation and development, the 15-minute community living circle typology was proposed to deal with the initially low standard of public service facilities. This was to improve the space supply to meet the travel needs of residents. This did have some effect, residents preferred short distance non-work travel, and most choose public transport and non-motor travel. However, due to the difference of community size, location distribution and other factors. The problem of diverse community demand and community supply remains.

Chapter 5 Discussion and Conclusions

This chapter states the conclusion of the previous findings. It will assess the success with which research objectives have been achieved and questions have been answered. In addition, the limitations of this study and recommendations for further investigation will also be mentioned.

5.1 Discussion

There were few studies on government intervention in residents' non-work trips, especially with regard to policy. As a relatively new policy, the construction of the 15-minute living circle has been promoted in many Chinese cities. However, whether there are other factors affecting people's non-work travel behaviour besides the change of built environment. Although it has been mentioned in the literature, few studies have been carried out in a similar context of rapid urbanisation. Therefore, to fill in these gaps, this dissertation generates not only valuable knowledge on policy intervention and residents' non-work trips but also analyses other influencing factors to illustrate the development of future living circle typology. In order to achieve the objectives, this study collected data through online questionnaires and used quantitative analysis.

5.1.1 Shanghai residents non-work travel patterns

The study found that in recent years, the non-work travel frequency of Shanghai residents increased, and the daily travel time decreased. High-frequency use facilities included shops, markets, educational organisations, green spaces in the community and open spaces along streets and rivers. In terms of transportation mode, most residents preferred non-car travel. Moreover, the study found that the main influence factor was distance. Currently, the study of travel behaviour mainly focuses on commuting activities. However, the analysis of residents' non-work travel characteristics is becoming more and more critical. This will provide a research basis for improving residents' life and travel quality.

5.1.2 Influence factors of non-work travel behaviour

This study summarised the previous literature and then established the theoretical framework of factors influencing non-work travel behaviour (chapter 2.4). In line with the hypothesis, the questionnaire analysis confirmed some socio-economic factors that had a significant influence on non-work travel, including age, occupation, car ownership and residential location.

Retired people over 60 years old in Shanghai have become the leading group of non-working travellers. However, their physical condition, travel purpose and walking mode may be the main reasons for their high dependence on household-sustaining facilities around the community. This inspires policy-makers to focus on the activities of the elderly and consider further needs of medical care, daily care and other service facilities. In terms of family characteristics, car ownership helps residents increase non-work travel distance. Under the current built environment, Shanghai residents are more inclined to choose cars because of their active mobility.

In terms of community characteristics, compared with the city centre, suburban residents tend to choose long-distance travel. The main reason is the poor accessibility of community public facilities and the high dependence on cars. With the construction of large suburban communities in Shanghai, the difference in activity and travel characteristics between suburban residents and the city centre residents and the influencing factors will be an essential basis for the planning of the community living circle in the future.

5.1.3 Shanghai residents' feedback on the 15-minute community life circle typology

The study found that the 15-minute community living circle typology in Shanghai did have a positive impact on residents' willingness to change their travel behaviours. Most residents are willing to take short-distance trips and travel by

non-car modes. At the same time, this study used socio-economic factors to examine the feedback of different groups of residents on community living cycle typology, which has not been mentioned in previous literature. The results showed that residents living further away from the city centre do not seem to accept the benefits of the policy. This finding is consistent with those recorded in previous literature, that the benefit differs in different locales. It inspires policy-makers to adapt their policies to local conditions.

5.1.4 Implications for the Shanghai 15-minute community life circle

Residents' non-work travel behaviour has been proved to be the result of multiple factors, especially the variable socio-economic factors of residents. Therefore, the design and implementation of the 15-minute community living circle in Shanghai should take into consideration research into residents' behaviour, transportation policy and land-use policy, and consider the travel needs of different groups. Our findings may also have broad implications for policy-making in other Chinese cities and even in other countries with similar high-density developments. The formulation of a community living circle policy should involve taking a long-term view and combining expert-driven and community-driven approaches.

5.2 Limitations of the study

Admittedly, there are limitations to this study. Firstly, in addition to the socio-economic factors that have been outlined and analysed, there may still be other influencing factors. Secondly, due to the time constraints, there are some problems in the collection of responses, such as the small sample size and unbalanced proportion of respondents from different socio-economic backgrounds. This may be the reason why some of the results are different from those of previous studies. Thirdly, some subjective assumptions about possible causes inevitably emerge in the analysis of the findings. This study could have

been integrated with interviews in order to understand the views of residents with different socio-economic backgrounds and provide empirical evidence.

5.3 Recommendations for further research

In terms of academic research, there were enough existing studies on the relationship between urban form and travel behaviour. However, some socio-economic factors have been shown to have significant effects on travel behaviour, as found in this paper. Other relevant factors, such as residents' travel intentions and preference characteristics, can be further studied in the future. With the implementation of the 15 -minute community living circle plan in Shanghai, further investigation on residents' travel choices could be carried out.

5.4 Conclusion

This study explored the current non-work travel patterns of Shanghai residents. The frequency of non-work trips has increased significantly in recent years, and most residents travel to their destinations on foot. Meanwhile, the theoretical framework of factors influencing non-work travel was proposed. Socio-economic factors of some residents, including age, occupation status and car ownership, have been shown to have significant effects. As an intervention policy focused on changing the built environment, the 15-minute community living circle typology is effective in reducing residents' non-work long-distance travel, as well as promoting the reduction of dependence on automobile travel. However, different community locations may affect the effectiveness of the policy. It may be mainly direction of policy improvement to Consider the needs of different groups, the corresponding public service facilities should be allocated, and classify the community living circle at various levels according to the specific residential location.

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(C) written in Chinese

(CE) written in Chinese with English abstract

Appendix A: Fieldwork risk form

EQUIPMENT	Is equipment used?	**No**	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangement for equipment is followed
☐	participants have been provided with any necessary equipment appropriate for the work
☐	all equipment has been inspected, before issue, by a competent person
☐	all users have been advised of correct use
☐	special equipment is only issued to persons trained in its use by a competent person
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	Is lone working a possibility?	**Yes**	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. alone or in isolation lone interviews.	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

The distribution of online questionnaire and data statistics will be completed by individuals alone. I will reduce the risk of data collection by reducing sensitive questions and complying with online questionnaire sharing regulations.

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☒	the departmental written Arrangement for lone/out of hours working for field work is followed
☐	lone or isolated working is not allowed
☐	location, route and expected time of return of lone workers is logged daily before work commences
☐	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
☐	all workers are fully familiar with emergency procedures
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

ILL HEALTH	The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? low risk. The respondent will be confirmed to be in good health to ensure the accuracy of the survey results.

| CONTROL MEASURES | Indicate which procedures are in place to control the identified risk |

- ☐ an appropriate number of trained first-aiders and first aid kits are present on the field trip
- ☐ all participants have had the necessary inoculations/ carry appropriate prophylactics
- ☒ participants have been advised of the physical demands of the trip and are deemed to be physically suited
- ☐ participants have been adequate advice on harmful plants, animals and substances they may encounter
- ☐ participants who require medication have advised the leader of this and carry sufficient medication for their needs
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	Will transport be required	NO	Move to next hazard
		YES	Use space below to identify and assess any risks
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low? No transport be required.		

| CONTROL MEASURES | Indicate which procedures are in place to control the identified risk |

- ☐ only public transport will be used
- ☐ the vehicle will be hired from a reputable supplier
- ☐ transport must be properly maintained in compliance with relevant national regulations
- ☐ drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
- ☐ drivers have been trained and hold the appropriate licence
- ☐ there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
- ☐ sufficient spare parts carried to meet foreseeable emergencies
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	Will people be dealing with public	Yes	If 'No' move to next hazard
			If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low? There is a risk of being misunderstood.		

| CONTROL MEASURES | Indicate which procedures are in place to control the identified risk |

- ☒ all participants are trained in interviewing techniques
- ☐ interviews are contracted out to a third party
- ☒ advice and support from local groups has been sought
- ☒ participants do not wear clothes that might cause offence or attract unwanted attention
- ☒ interviews are conducted at neutral locations or where neither party could be at risk
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

FIELDWORK   3   May 2010

WORKING ON OR NEAR WATER	Will people work on or near water?	No	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks

e.g. rivers, marshland, sea.

Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- ☐ lone working on or near water will not be allowed
- ☐ coastguard information is understood; all work takes place outside those times when tides could prove a threat
- ☐ all participants are competent swimmers
- ☐ participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
- ☐ boat is operated by a competent person
- ☐ all boats are equipped with an alternative means of propulsion e.g. oars
- ☐ participants have received any appropriate inoculations
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	Do MH activities take place?	No	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks

e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.

Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangement for MH is followed
- ☐ the supervisor has attended a MH risk assessment course
- ☐ all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
- ☐ all persons performing MH tasks are adequately trained
- ☐ equipment components will be assembled on site
- ☐ any MH task outside the competence of staff will be done by contractors
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

FIELDWORK   4   May 2010

SUBSTANCES	Will participants work with substances	No	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangements for dealing with hazardous substances and waste are followed

Appendix B: Questionnaire Sample

15-minute community life circle planning - questionnaire on non-commuting habits of residents

Hello to the participants of this online questionnaire survey! The questionnaire will not be very long and will only take you 3-5 minutes.

I am a graduate student majoring in sustainable urbanism at university college London (UCL). I sincerely invite you to participate in the survey of non-commuting behaviors of community residents. This research is based on the planning policy of building a 15-minute community life circle proposed by major cities. The urban community life circle is configured with necessary daily supporting public service facilities and public activity places according to the space range within a 15-minute walk, to improve the convenience and safety of community services. I expect to know the current situation of residents' non-commuting travel through my investigation, and what factors are influencing residents' choice of travel mode. I believe this will have absolute enlightenment for the design and policy implementation of the future life circle.

Statement on academic ethics :(1) this survey has been approved by UCL, and we promise that we will abide by the UCL code of academic ethics and ensure the confidentiality of information. Meanwhile, respondents will not be required to provide their real names.(2) The data collected in this questionnaire are only used for this study, and we promise that we will not share them with other studies.(3) this questionnaire is voluntary participation. If you have any questions or wish to delete the data, please contact me via email. Thank you very much for your participation, which will provide great help to my research!

住宅社区

Q: What is the 15-minute community life circle typology?

As the "Shanghai community planning guidance" (2016) defined, the life circle will be an elementary unit with a range of 3-5 km^2, and it could contain 50-100 thousand people. The spatial distribution will be community-based, with structuring pattern of residents' essential service functions and public activity space needed for life, to form a safe, friendly and comfortable living platform.

Part 1: Socio-economic characteristics

Q1: Gender_____

Fill in the number: 1. Male 2. Female

Q2: Age group_____

Fill in the number: 1. under 18 years old 2.19-29 3.30-49 4.50-59 5. Over 60 years old.

Q3: Occupation_____

Fill in the number: 1. Student 2. Employment 3. Education, research and health professional 4. Worker 5. Freelance 6. Civil servant 7. Retiree 8. other_____.

Q4: How many children under 12 live with you? _____

Fill in the number: 1. None 2. One 3. Two 4. Three 5. Over than four

Q5: How many people over 60 years old live with you? _____

Fill in the number: 1. None 2. One 3. Two 4. Three 5. Over than four

Q6: Do you have a driver license? _____

Fill in the number: 1. Yes 2. No

Part2: Non-work travel status survey

Q7: How many kinds of transportation do you have at home?_____ (multiple choice)

Fill in the number: 1. None 2. Car 3. Bike 4. Electric bike 5. Motorbike 6. other_____

Q8: Please tell me the location of your community in the city_____

Fill in the number: 1. City Centre 2. Outside the city Centre 3. Suburbs 4. Other_____

Q9: How far is the nearest public transport station? _____

Fill in the number: 1. within 300m 2. Between 300-600m 3. Between 600-1000m 4. More than 1000m.

Q10: What are the essential services within a 15-minute walk of your current community? _____ (multiple choice)

Fill in the number: 1. None 2. Medical and health services 3. Daily shopping 4. Education 5. Social welfare 6. Convenient service facilities 7. Public utility 8. other_____

Q11: What leisure services are available within a 15-minute walk of your current community? _____ (multiple choice)

Fill in the number: 1. Sports and fitness facilities 2. Cultural and leisure facilities 3. other_____

Q12: Average number of non-work trips? _____

Fill in the number: 1. None 2. 1-2 times 3. 3-4 times 4. Above 5 times

Q13: General non-work travel time each day? _____

Fill in the number: 1. within half an hour 2. Half an hour to one hour 3. One hour to two hours 4. Above two hours.

Q14: Frequency of use of public facilities.

Fill in the number: 1. Several times a day 2. once a day 3. Once a week 4. Once a month 5. Once half a year 6. Once a year 7. Irregular 8. Never go to

Options:

Convenience Facilities

Administrative facilities (e.g. local police station etc.)…………………….____

Cultural Facilities

Major cultural facilities (e.g. museum, library, gallery etc.) …………..….____

Community cultural Centre (e.g. youth Centre etc.) …………..…____

Fitness and Leisure Facilities

Outdoor sports filed (e.g. football field, basketball court etc.) …………..…____

Indoor stadium (e.g. gym, swimming pool etc.) …………..…____

Health care Facilities

Hospital (e.g. large hospital, community hospital etc.) …………..…____

Community healthcare Centre…………..…____

Health care (e.g. massage shop, medicine shop etc.) …………..…____

Educational Facilities

Kindergarten and primary school (including picking up the kids) ....____

Middle school...............____

University................____

Education and training organization (including picking up the kids) ....____

Daily Shopping facilities

Large stores (e.g. supermarket, plaza etc.) ....____

Small and medium stores (e.g. small shops, fruit shops, restaurant etc.)..____

Market...............____

Open space and Park

Large Park..............____

General City Park..............____

Open space along street and river...............____

Concentrated green space in the residential community...............____

Community Welfare Facilities

Nursing home (including visitation, pickup, daycare, catering and other services) ....

....____

The pension agency.......... ____

Other____...............____

Q15: The choice of transportation mode used to reach the facilities.

Fill in the number: 1. walk 2. Bus 3. Metro 4. Bicycle and electric-bike (including shared bike) 5. Car (including the shared car) 6. Other

Options:

Convenience Facilities

Administrative facilities (e.g. local police station etc.)…………….…….____

Cultural Facilities

Major cultural facilities (e.g. museum, library, gallery etc.) …………...….____

Community cultural Centre (e.g. youth Centre etc.) …………...….____

Fitness and Leisure Facilities

Outdoor sports filed (e.g. football field, basketball court etc.) …………...….____

Indoor stadium (e.g. gym, swimming pool etc.) …………...….____

Health care Facilities

Hospital (e.g. large hospital, community hospital etc.) …………...….____

Community healthcare Centre…………...….____

Health care (e.g. massage shop, medicine shop etc.) …………...….____

Educational Facilities

Kindergarten and primary school (including picking up the kids) ………….____

Middle school…………...….____

University…………...….____

Education and training organization (including picking up the kids) ……….____

Daily Shopping facilities

Large stores (e.g. supermarket, plaza etc.) …………...….____

Small and medium stores (e.g. small shops, fruit shops, restaurant etc.)..____

Market…………...….____

Open space and Park

Large Park…………..…____

General City Park…………..…____

Open space along street and river…………..…____

Concentrated green space in the residential community…………..…____

Community Welfare Facilities

Nursing home (including visitation, pickup, daycare, catering and other services) …………..…____

The pension agency………. ____

Other____…………..…____

Q16: How long can you arrive at the facilities of the usual mode of transport?

Fill in the number: 1. In 15 minutes 2. 15-30 minutes 3. 30-60 minutes 4.more than one hour

Options:

Convenience Facilities

Administrative facilities (e.g. local police station etc.)…………………..____

Cultural Facilities

Major cultural facilities (e.g. museum, library, gallery etc.) …………..…____

Community cultural Centre (e.g. youth Centre etc.) …………..…____

Fitness and Leisure Facilities

Outdoor sports filed (e.g. football field, basketball court etc.) …………..…____

Indoor stadium (e.g. gym, swimming pool etc.) …………..…____

Health care Facilities

Hospital (e.g. large hospital, community hospital etc.) ……………..____

Community healthcare Centre…………..….____

Health care (e.g. massage shop, medicine shop etc.) ……………..____

Educational Facilities

Kindergarten and primary school (including picking up the kids) …………..____

Middle school……………..____

University……………..____

Education and training organization (including picking up the kids) ……….____

Daily Shopping facilities

Large stores (e.g. supermarket, plaza etc.) ……………..____

Small and medium stores (e.g. small shops, fruit shops, restaurant etc.)..____

Market……………..____

Open space and Park

Large Park……………..____

General City Park……………..____

Open space along street and river……………..____

Concentrated green space in the residential community……………..____

Community Welfare Facilities

Nursing home (including visitation, pickup, daycare, catering and other services) ……………..____

The pension agency………. ____

Other_____……….……_____

Q17: What factors are influencing your travel behaviour choice? (Multiple choices)

_____.

Fill in the number: 1. Distance 2. Personal reasons (e.g. preference, physical condition, etc.) 3. Family factors (e.g. car ownership, travel needs for children or elderly) 4. Facilities are scattered 5. Alternative public transport options 6. Difficult parking around facilities 7. Other_____.

Part3: The imagination of the planning of the 15-min community life circle in future.

Q18: As for non-work travel, your preferred travel mode is expected in the future

_____.

Fill in the number: 1. Walk 2. Cycling (bike, E-bike) 3. Public transport (bus, metro etc.) 4. Car 5. Taxi (car-sharing) 6. Other_____.

Q19: Assuming that public service facilities are improved within a 15-minute walk of your community in the future, will this affect your non-work travel distance? (Usually, travel within a short distance of 3km) _____.

Fill in the number:

1. No, I will keep travelling medium to long distances.

2. Not so much, I will try to travel short distances, but mainly medium and long distances.

3. Maybe. I will increase short trips and focus on short trips.

4. Yes, I will travel completely on short distances.

Q20: Do you think this will affect the way of transportation in the future? _____.

Fill in the number:

1. Yes, I will probably travel by walking, cycling or public transportation in the future.

2. Maybe, I may combine low-carbon travel with cars in the future, and the proportion of car use will be reduced.

3. Not so much, I may combine low-carbon travel with cars in the future, but the proportion of car use is relatively high.

4. No, I'm still going to rely on cars in the future.

Q21: In your opinion, which kind of the following community public service facilities have higher accessibility requirements within 15 minutes of walking? (Multiple choices) _____.

1. Convenient service facilities (community Centre, post office, bank)

2. Community cultural facilities (library, youth Centre)

3. Community fitness facilities (fitness club)

4. Community health service Centre

5. Large hospital

6. School and institution for early education

7. Daily shopping facilities (market, general store)

8. Concentrated green space in the residential area (children's play facilities)

9. Parks

10. Large shops

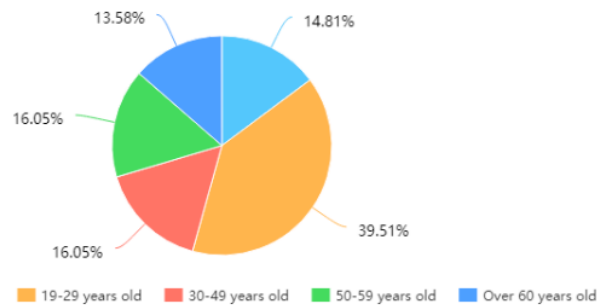11. Social welfare facilities (community care centres)

12. Other_____.

Q22: In your opinion, can community-based public service facilities replace distant regional public service facilities in the future as a destination for non-work needs? If you disagree with this point of view, what is the main reason?

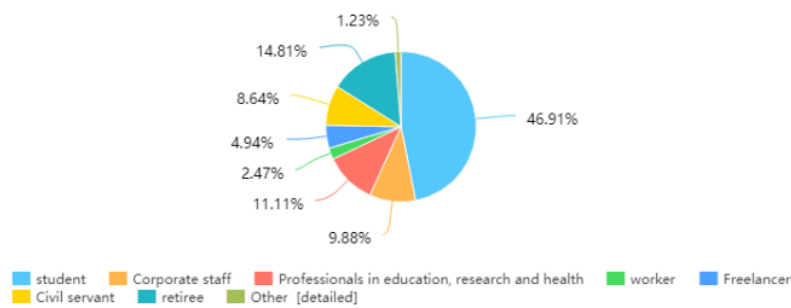## Appendix C: Questionnaire Result Statistics

Q1：Gender

Option ⇕	Subtotal⇕	proportion	
male	39		48.15%
Female	42		51.85%
This question is valid for the number of times	81		

Q2：Age groups

Under 18 years old 19-29 years old 30-49 years old 50-59 years old Over 60 years old

Q3：Occupation

student Corporate staff Professionals in education, research and health worker Freelancer
Civil servant retiree Other [detailed]

Q4：Children under 12 live with you

7.41% 0%
0%
28.4%
64.2%

■ no ■ 1 ■ 2 ■ 3 ■ 4 and above
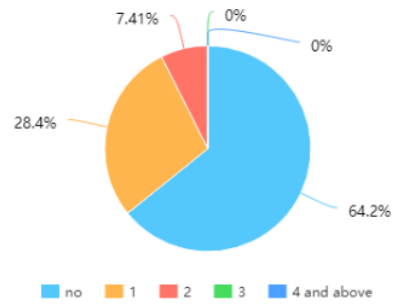
Q5：People over 60 live with you

6.17%
4.94%
27.16%
43.21%
18.52%

■ no ■ 1 ■ 2 ■ 3 ■ 4 and above

Q6: Driver license

no: 32.1%

Yes: 67.9%
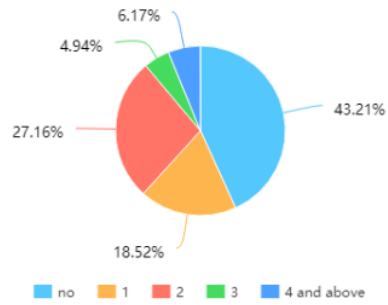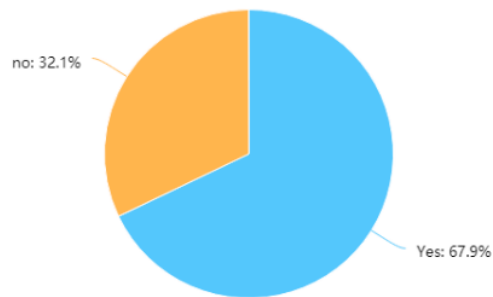
Q7: Transportation modes at home

Category	Percentage
No own transportation	3.7%
car	82.72%
bicycle	59.26%
electric bicycle	28.4%
motorcycle	3.7%
Other [detailed]	1.23%

Q8: Location of your community

- city center — 60.49%
- Downtown periphery — 28.4%
- Suburbs of the city — 11.11%
- Other [detailed] — 0%

Q9: The nearest public transport station

- Within 300 meters — 65.43%
- Between 300-600 meters — 28.4%
- Between 600-1000 meters — 6.17%
- More than 1000 meters — 0%
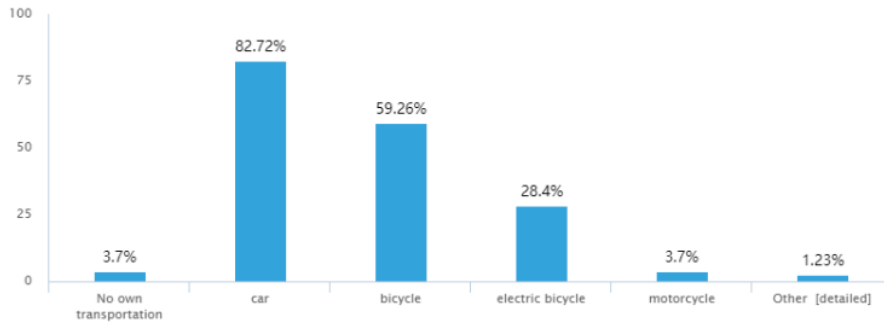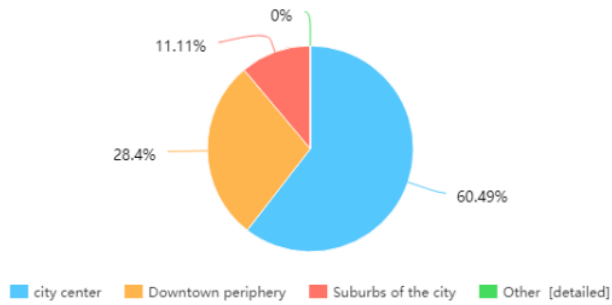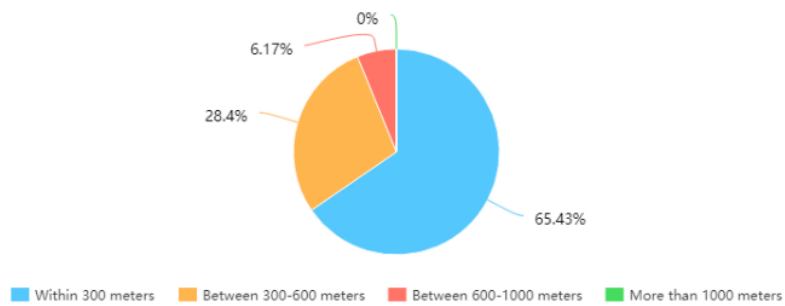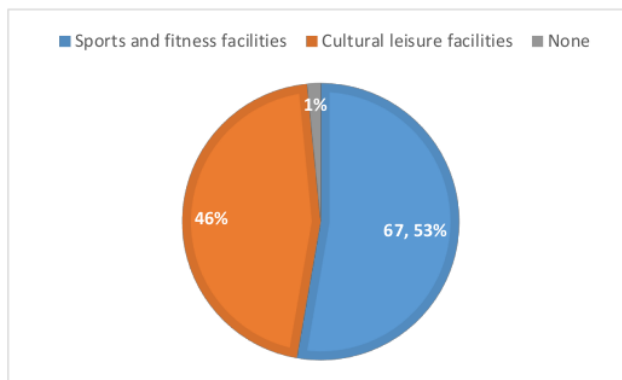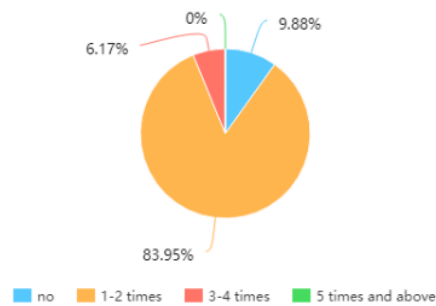
Q10: The essential services within 15 minutes' walk of the community
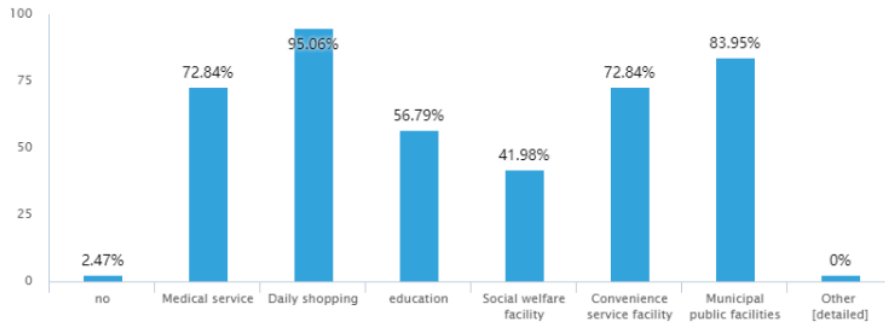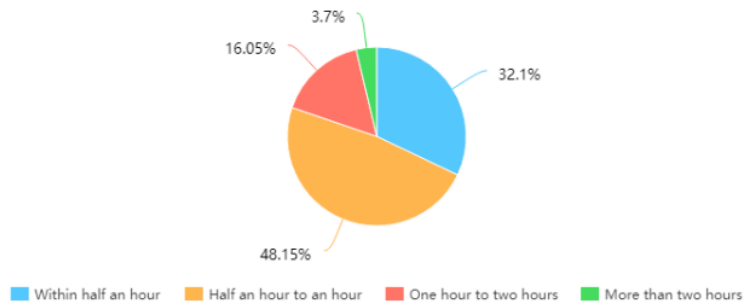

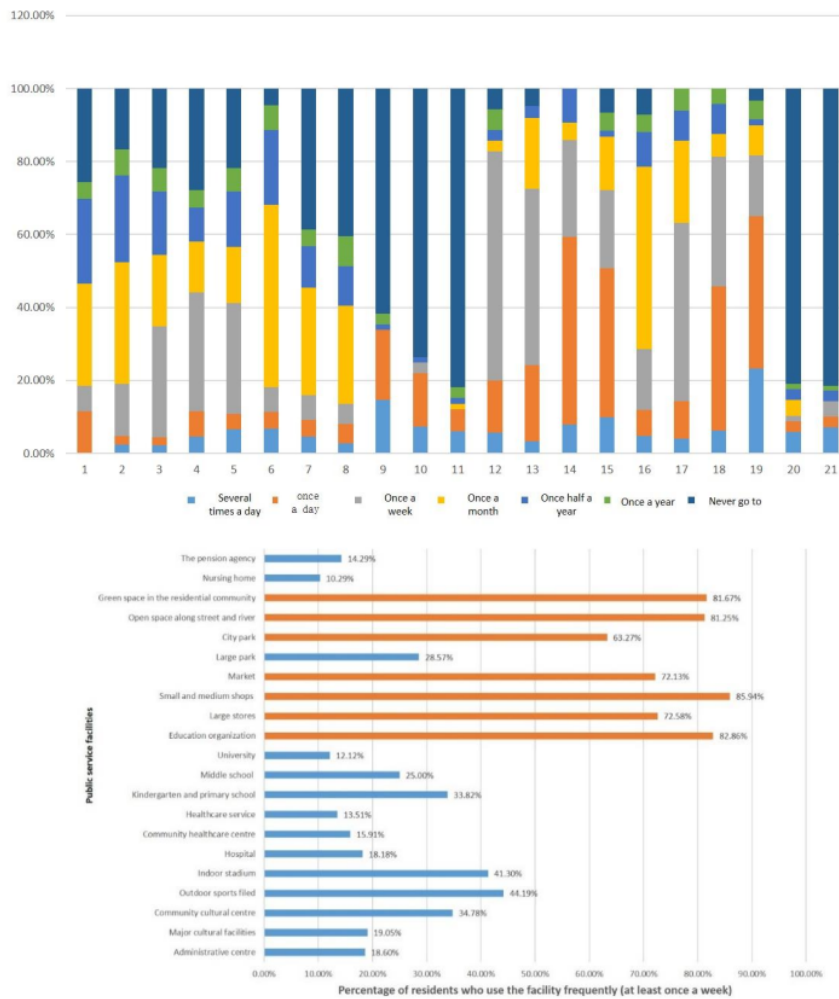## Q11: leisure services within a 15 minutes' walk of the community
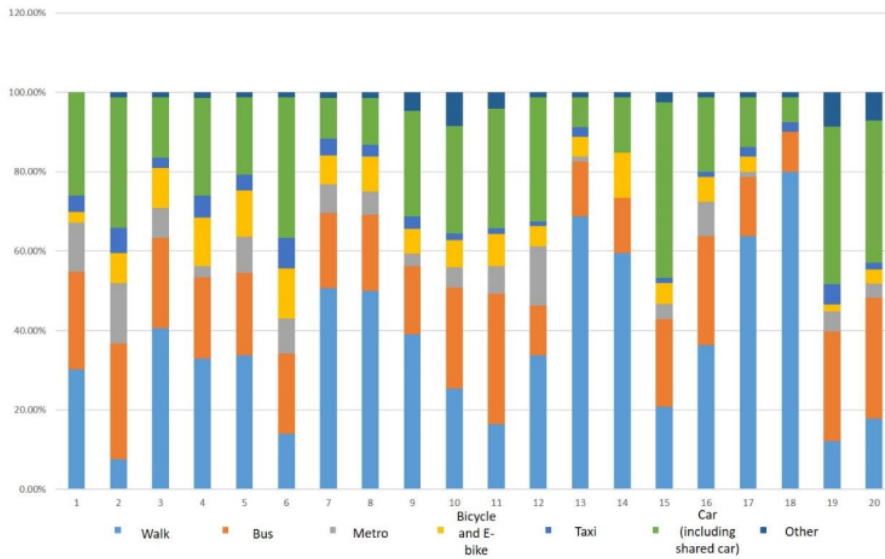

Q12: number of non-work trips

Q13: non-work travel time

- Within half an hour: 32.1%
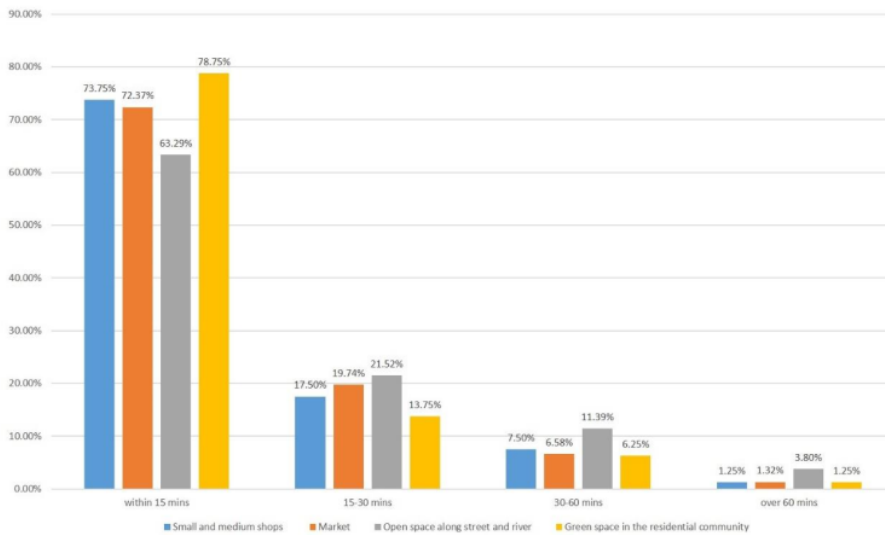- Half an hour to an hour: 48.15%
- One hour to two hours: 16.05%
- More than two hours: 3.7%

Within half an hour   Half an hour to an hour   One hour to two hours   More than two hours

Q14: frequency of the use of public facilities

Several times a day   once a day   Once a week   Once a month   Once half a year   Once a year   Never go to

Public service facilities	Percentage
The pension agency	14.29%
Nursing home	10.29%
Green space in the residential community	81.67%
Open space along street and river	81.25%
City park	63.27%
Large park	28.57%
Market	72.13%
Small and medium shops	85.94%
Large stores	72.58%
Education organization	82.86%
University	12.12%
Middle school	25.00%
Kindergarten and primary school	33.82%
Healthcare service	13.51%
Community healthcare centre	15.91%
Hospital	18.18%
Indoor stadium	41.30%
Outdoor sports filed	44.19%
Community cultural centre	34.78%
Major cultural facilities	19.05%
Administrative centre	18.60%

Percentage of residents who use the facility frequently (at least once a week)

Q15: the choice of transportation mode

Legend: Walk, Bus, Metro, Bicycle and E-bike, Taxi, Car (including shared car), Other

Q16: Time of arriving at the facilities

|	within 15 mins	15-30 mins	30-60 mins	over 60 mins
Small and medium shops	73.75%	17.50%	7.50%	1.25%
Market	72.37%	19.74%	6.58%	1.32%
Open space along street and river	63.29%	21.52%	11.39%	3.80%
Green space in the residential community	78.75%	13.75%	6.25%	1.25%

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Q17: Factors influencing travel behaviour choice
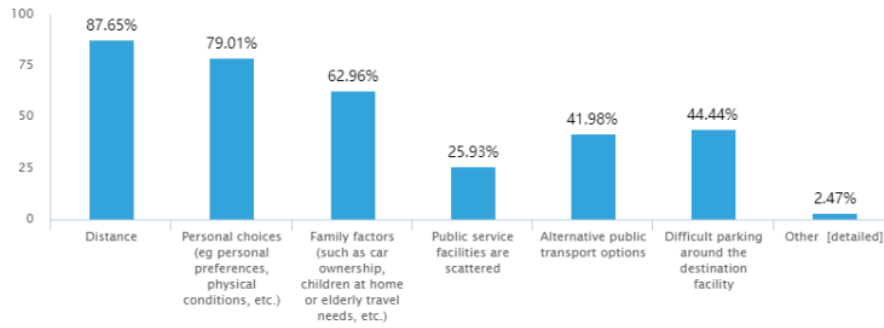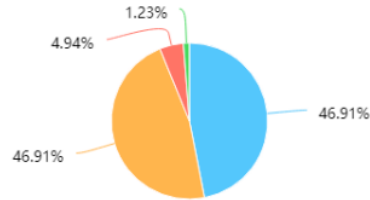

Q18: Residents' preferred travel modes choice in future
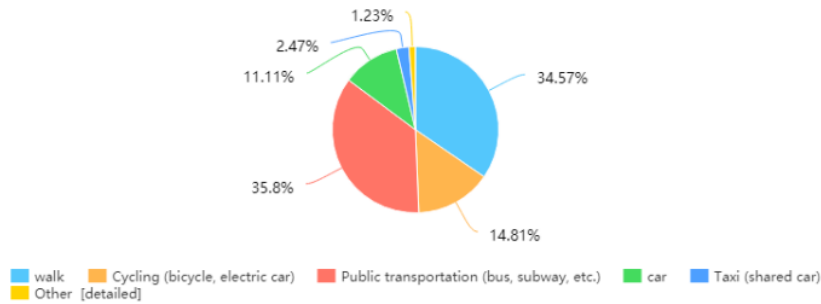
Q19: Residents' non-work travel distances in 15 minutes community life circle typology
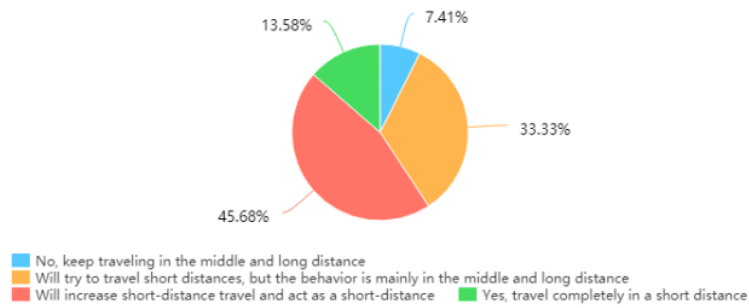
Q20: Residents' non-work travel modes choice in 15 minutes community life circle typology

- Yes, there will be low-carbon travel modes based on walking or public transportation in the future.
- Maybe, in the future, the combination of low-carbon travel and cars will be adopted, and the proportion of cars used will be reduced.
- Not very likely, in the future will adopt a combination of low-carbon travel and car, but the proportion of cars used is higher.
- No, I will still rely on car travel in the future.

Q21: Residents' purposed public services facilities within a 15 minutes' walk of the community
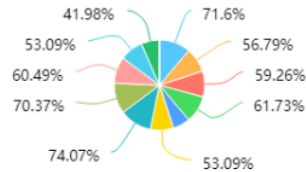
- Convenience service facilities (community service center, post office, bank, telecommunications)
- Community cultural facilities (library, youth activity center) ■ Community sports facilities (gym, etc.)
- Community Health Center ■ Large hospitals (top three hospitals, community hospitals, etc.)
- School and early education institutions (including pick-up and drop-off)
- Daily shopping facilities (vegetable market, grocery store)
- Centralized green space in the small area (including children's play facilities) ■ park
- Large stores (chain supermarkets, etc.) ■ Social welfare facilities (age activity room, community care center, etc.)
- Other [detailed]

Q22: Can community-based public service facilities replace distant regional public service facilities in the future as a destination for non-work needs?

- agree ■ Disagree [detailed]