The Role of Age-friendly Environments

in Promoting Ageing-in-place in Urban China

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ABSTRACT

Globally, the population is ageing owing to falling fertility rates and growing life expectancy. Another mega-trend that characterises the global population of today is urbanisation. China is also experiencing an ageing population and urbanisation in line with global demographic trends. On a global scale, almost one in four people who are 60 years or over were living in China by 2017. Research from architecture, urban studies, geography, epidemiology, and public health demonstrates that the place where a person lives significantly influences his/her health performance. Some physical or cognitive loss of capacity relating to ageing can be avoided by an adaptive environment, such as avoiding the environment's negative effects on older people and improving it according to the older person's needs. The change to an individual's ageing process may necessitate alterations in their living environments, by modifying current residences or moving to a more supportive place. When considering where to live, older individuals would wish to live in a community which allows them to maintain social connections, security and familiarity, and to provide a sense of independence, autonomy and identity. Moreover, allowing the older individuals to stay in private housing and within the community as long as possible could be an effective solution in avoiding a move to a nursing home and increased healthcare expenditure. Thus, ageing-in-place is advocated by policymakers, healthcare providers, and most of the older persons themselves. Design plays a crucial role in providing an age-friendly environment that enables individuals to achieve ageing-in-place and promote their health and well-being.

This research aims to discover the age-friendly living environment requirements of older population in urban China. It seeks to develop a holistic framework to guide retrofitting of housing environments and the design of new mainstream housings which overcomes the social and physical changes associated with ageing, allowing older individuals to live independently for longer, age well and avoid or delay the move into residential care. The research strategy used in this study is based on qualitative case studies. Three mainstream residential communities in Nanjing were selected to represent different types of mainstream housing in urban China. Semi-structured interviews and observations were the primary data source. Firstly, 13 expert interviews, including architects, property managers, care providers, and policymakers, were conducted to identify the challenges of establishing age-friendly environments and supporting ageing-in-place from a professional perspective. Then, observations were conducted which evaluated the age-friendliness of the community based on the existing design guidelines. Additionally, 37 interviews with the older residents living in the selected communities were conducted to understand their attitudes towards ageing-in-place. The main findings were divided into four parts:

- the age-friendliness of the mainstream residential communities in urban China
- the meaning of ageing-in-place in urban China
- the role of the age-friendly built environment
- the role of the age-friendly social environment in promoting ageing-in-place

A holistic framework was developed by integrating the living environment, older residents met and unmet needs, and the strategies and challenges adopted by experts in supporting ageing-in-place. The framework gives an overview of the key themes of ageing-in-place, contributing to new knowledge that can be used to better understand the person and environment fit. The findings may be beneficial for policymakers, researchers, designers, communities, care and service providers, to increase understanding relating to the adaptability and practises of the ageing-in-place concept, contributing to older people's quality of life. The framework and recommendations could provide practical help for governments and professionals when developing fit policies on ageing-in-place. Additionally, a list of design guidelines could be applied in the existing housing retrofitting and new housing design to provide older individuals with a more supportive living environment.

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DECLARATION

I, the author, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not been previously presented for an award at this, or any other university.

CHAPTER 1.   INTRODUCTION

1.1   Background to the Study

Globally, the population is ageing. The World Health Organization (WHO) (WHO, 2015a, p. 230) defines population ageing as "a shift in the population structure whereby the proportion of people in older age groups increases", as the result of two vital demographic determinants of ageing: falling fertility rates and growing life expectancy (United Nations, 2017a).

China is also experiencing an ageing population in line with global demographic trends. Almost one fourth older population worldwide were living in China by 2017. It is predicted that, between 2017 and 2050, the share of people aged 60 years and over will grow from 16% to 35% of the total population in China (United Nations, 2017b).

Older individuals are much more variable in their overall health than younger persons, including declining physical and mental capacities and geriatric syndromes (WHO, 2017a). However, these changes are only loosely associated with increasing age, being strongly influenced genetic and environmental factors (WHO, 2017a). Research from urban studies, geography, epidemiology, and public health demonstrates that the place where a person lives significantly influences their health performance (Tunstall, Shaw, & Dorling, 2004; Beard & Petitot, 2010). Some physical or cognitive capacity losses related to ageing can be avoided by an adaptive environment, such as, older people avoiding the negative effects of the physical environment and improving it according to their requirements.

The change in an individual's ageing process necessitates a transition in their living space, for example, by modifying current homes or by relocating to a more supportive setting (Perry, Andersen, & Kaplan, 2014). When considering where to live, older persons often think about their home or community in terms of the benefits of enabling them to maintain a sense of security and familiarity with their neighbourhoods, connection to social networks, , as well as the sense of independence, identity and autonomy (Lawler, 2001; Wiles et al., 2012). Chinese older people also prefer to age-in-place in familiar environments supported by a lifelong social network, preferring not to be moved to a nursing home due to the associated risks (High, Juthani-Mehta, & Quagliarello, 2010). Moreover, there is a preference for older persons to remain in private housing and community if possible, which could be an effective approach to avoid increased healthcare expenditure. Therefore, ageing-in-place is preferred by policymakers, care providers, and older persons themselves (WHO, 2007; Kim, Gollamudi, & Steinhubl, 2017).

Ageing-in-place has become a common policy response to population ageing. WHO (2004, p.9) defines the concept of ageing-in-place as:

> "Meeting the desire and ability of people, through the provision of appropriate services and assistance, to remain living relatively independently in the community in his or her current home or an appropriate level of housing.".

Ageing-in-place is stated by Davey et al. (2004, p.133) as the ability to "remain living in the community, with some level of independence, rather than in residential care". It is also explained as "the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level" by the Centres for Disease Control and Prevention in the U.S.A. (2009).

Governments and international organisations increasingly concur that it makes economic and social sense to help older persons in staying in the community as long as possible. However, enabling older population achieve age-in-place is a multipart task, which requires the necessary resources to allow this demographic to stay in their own homes and communities (Kim et al., 2017). It also needs comprehensive planning, provision of a wide range of community support services and the removal of barriers which limit older persons in doing activities (Lui et al., 2009).

As the theoretical basis underpinning ageing and environment, Lawton and Nahemow (1973) introduced their Press-Competence Model, which is seen as a landmark in environmental gerontology, highlighting the meaning of balancing individual competences with environmental press. Lawton (1977a) stated, in the ecology theory of ageing, that the environment includes housing, neighbourhoods, and out-of-home areas. Afterward, his supplementary work (Lawton, 1998) strongly supports the role that technology has to play in the environment and subsequently and crucially to ageing as well. In the spirit of Lawton's seminal work, an integrative model on ageing well is developed based on the Person-Environment (P-E) fit theory by Wahl and Oswald (2010). From the perspective of environmental gerontology, they agree that older people's lifespan and ageing is influenced by their interaction with the physical-spatial-technical environment. An overarching conceptual framework of how older people interact with the surrounding environment is established based on the traditional ecology of ageing theories (Wahl & Oswald, 2010). Additionally, Sallis, Bauman and Pratt (1998) stated that environmental and policy interventions which promote physical activity contribute to improving public health, underscoring the need for increased emphasis on research into environmental and policy interventions. Later, Sallis et al. (2006) built a holistic framework that applies ecological models to the study of active

living for environmental and policy research. The theories of environmental and ageing field, especially P-E fit theory and active living ecological model, are key in understanding the significance of an age-friendly environment in supporting older persons' ability to maintain independent living and achieve active and healthy ageing.

From the perspective of architecture, inclusive design is crucial in achieving an age-friendly environment. Inclusive design is defined by the British Standards Institute (Keates, 2005) as "The design of mainstream products and/or services that are accessible to, and useable by, as many people as reasonably necessary ... without the need for special adaptation or specialised design". Inclusive design emerges as a desire to bring disabled people into mainstream society, and is also a response to demographic trends of population ageing (Burton & Mitchell, 2006; Handler, 2014). With the trend of population ageing, older individuals need to live in an environment which is age-friendly, both indoor and outdoor, to balance for the physical and social changes connected with ageing (Hadjri, Afacan, & Gadakari, 2016). Thus, Inclusive design and an enabling built environment are in accord with the age-friendly community concepts and initiatives.

Evidence suggests that ageing-in-place is also favoured by older people in the Chinese urban context (Gadakari et al., 2017). Zhou and Walker (2021) noted that ageing-in-place respects older people's wishes and psychological needs and meets the majority of the older people's requirements, based on local conditions and the traditional filial piety culture to address the population ageing challenges.

The home environment becomes more significant to people later in life, becoming increasing related to personal health, as older people spend most of their time at home, far more than in other settings (Danziger & Chaudhury, 2009). Zhou and Qin (2016) pointed out that most older people's economic conditions do not allow for them to buy better housing, and many prefer to continue living in a familiar environment with a sense of belonging. Therefore, home modification could be an essential solution for the older people living in outdated urban housing in China (Sang & Ying, 2015). Additionally, Lin (2015) pointed out that Chinese mandatory residential building standards do not fully consider the requirements of older residents, which should be updated in response to ageing population.

This study aims to explore the age-friendly living environment requirements of older people in urban China. It seeks to develop a holistic framework to guide retrofitting of housing environments and the design of new mainstream accommodation to overcome the changes associated with ageing allowing older people to continue living independently, ageing well and therefore avoiding or delaying the move into residential care.

1.2   Research Gaps

Several research gaps have been identified from reviewing the literature about age-friendly environments worldwide. First, in developed countries and regions with a high degree of population ageing, a relatively complete body of research and an action framework have gradually been conducted (Cairncross, 2016; Dalzied, 2001; Rosenwohl-Mack, et al., 2020). Few studies focused on age-friendly initiatives in developing nations even though low and middle-income regions will face a more dramatic and rapid demographic changes (Kinsella & Phillips, 2005). Therefore, the age-friendly interventions in the Chinese context are worthy of research and exploration. The contexts and methods in the research on age-friendly environments from developed countries have highlighted the significance of this topic. The connections between older persons and the environment need to be further understood and explored in the developing regions to provide a scientific basis and direction for the construction of an age-friendly environment. Establishing a forward-looking holistic framework in specific context would contribute to the resolution of the current dilemma.

Secondly, although the policies advocate ageing-in-place, there is a lack of understanding of the meaning of ageing-in-place for the older populations in urban China. A research in China uncovered that family-oriented care is no longer sustainable given that social changes for example the one-child policy, rural to urban migration and the growth in the number of females worker have reduced the availability of traditional family caregivers (Glass, Gao, & Luo, 2013). The above cultural factors and developmental changes could affect the living patterns and needs of the older people in urban China. For example, what are their motivations to opt for ageing-in-place? How is ageing-in-place conceptualised in urban China, and do older people prefer to age-in-place and why? What are the challenges they face in the process, and are there any potential concerns about the future?

Thirdly, the research results of Chinese scholars mostly focus on care facilities for older people, though not mainstream residential environment, and lack of exploration into the relationship and influence mechanisms between environment and the older individuals. While age-friendly programmes focusing on technical or architectural guidelines have appeared in China, the recent discourse on age-friendly environment in west countries emphasises the value of the integrated social and built environment in enhancing the quality of life of older people. For example, (1) to further explore the connections between the built environment and older people's quality of life; (2) study the environmental factors and mechanisms that have an impact on the health and social adaptability of older persons; and (3) provide theoretical support to increase age-friendliness of living environment.

Finally, a model of collaborative governance is required. Multi-stakeholder collaborations are important in contributing to the building of a mutually improving environment for older individuals. Policymakers and planners should be encouraged to take a proactive solution and engage with older persons to build a supportive environment. As the reviewed model by Rosenwohl-Mack et al. (2020) suggests, cross-sectoral involvement with both top-down and bottom-up input is vital to develop an age-friendly environment.

In summary, there is limited evidence from older persons' perspective concerning ageing-in-place and the role of the built environment and social environment in the urban China context. In-depth research with cross-sectoral involvement is necessary to realise older people's genuine requirements and reasons and to propose effective suggestions accordingly.

1.3 Research Questions and Objectives

Based on the research gaps, this PhD study purposes to develop a framework to better understand ageing-in-place and to support the construction of age-friendly environments for older people in urban China context. The framework seeks to fill the gap on age-friendly initiatives in the developing regions, including the provision of an integrated social and physical tool following a multi-stakeholder participatory and collaborative process. It can also be used as a reference for solving other developing countries' population ageing issues. Additionally, the framework will provide a holistic tool that will be developed into policy recommendations and practical guidelines to benefit the older population and communities in urban settings.

The main research question centres on how to support older people to achieve ageing-in-place in urban China by providing an age-friendly living environment? Five sub-questions (Q1-Q5) are developed as follows:

- How age-friendly are the housing, facilities, and community environments in Chinese urban mainstream residential communities?
- How is ageing-in-place conceptualised in urban China, and do older people prefer to age-in-place?
- How does the built environment (including housing, community, and technology) influence older people's ability to age-in-place?
- How does the social environment (including social networks, care and service, and technology) influence older people's ability to age-in-place?
- How to support older population in urban China to achieve ageing-in-place by

providing an age-friendly environment? How is the age-friendly environment supported by design, planning and community services?

What follows are five corresponding objectives set to answer the research questions and accomplish the purpose of the study. Those questions and objectives will drive the subsequent research design.

- To evaluate the age-friendliness of the physical environment in contemporary mainstream residential communities in urban China.
- To conceptualise ageing-in-place in urban China and to establish whether older people prefer to age-in-place.
- To establish the relationship between the built environment and older people's ability to achieve ageing-in-place.
- To understand the relationship between the social environment and older people's motivation and ability to achieve ageing-in-place.
- To develop a design and retrofitting framework to improve the age-friendly living environment and help older people achieve ageing-in-place.

1.4   The Significance of the Study

As discussed above, population ageing cannot be reversed in almost all countries. China is facing a particularly challenging ageing problem not merely because China is home to the world's largest elderly population, but also due to longevity growth and reductions in fertility. As the foundation of receiving care (Feng et al., 2017) and the well-being of the elderly (Ren & Treiman, 2015), the living arrangements in later life are a critical determinant of their health and even mortality. The preference of most older people is to live at home for as long as possible with benefits for individuals, such as maintaining independence, familiar setting and routines, a healthier and safer living environment, ease of access to family and friends, and cost-savings. The main contributions of this PhD will be:

1. **A new conceptualisation of ageing-in-place**.
   The study will help better understand the phenomena affecting the ageing population in urban China living in private mainstream housing and how this influences the housing design and community cohesion. Ageing-in-place as a conceptual term is explored with new meanings and concepts to respond to the population ageing in the contemporary urban China context, including the resource challenges and limitations, the familistic history and policy background. This will provide a practical conceptualisation to inform the housing design and policy framework, and future

research direction.

2. **An age-friendly environment framework to support ageing-in-place**.
   The framework is a practical guide to support the creation of age-friendly environments for older population and to achieve ageing-in-place. The framework seeks to fill the gap on age-friendly initiatives in the developing regions, integrating physical and social aspects and following a participatory and collaborative process with multiple stakeholders. It can be used as a reference in solving other developing countries' population ageing issues. Additionally, the framework will provide a holistic tool which will be developed into policy recommendations and practical guidelines to benefit the older population, their families, communities, and society.

By achieving the above goals, the needs and challenges of the urban older generation living in private homes can be better understood. On this basis, this study will put forward corresponding policy suggestions and design guidance to improve the age-friendliness of mainstream residential communities and ultimately support ageing-in-place in urban China.

1.5 Methodological Approach

As Robson and McCartan (2016, p.3) have stated, methodology refers to "the fundamental principles on which the methods of social research are based". Based on the research questions and objectives presented above, the researcher's position in this study resides within the being ontology, constructivism epistemology and interpretivism theoretical perspective. Saunders, Lewis and Thornhill (2019) claim that "Interpretivism is a subjectivist philosophy". Interpretivism assumes that people seek an understanding of the world where they live in (Blaikie, 2007). Saunders et al. (2019) highlighted that because people with different cultural backgrounds, at different times or under different conditions, create different meanings, and experience different social realities, interpretivism is critical of the positivist attempts to find definite, universal "laws" which apply to everyone. Denzin and Lincoln (2011) stated that qualitative research is often connected to an interpretive philosophy. The qualitative approach helps to understand people's lives, behaviours, experiences, feelings, emotions, cultural phenomena, social movements , and interactions between nations (Strauss & Corbin, 1990). Qualitative approach provides more chances to find out the similarities and differences of people's lives and to explore the thoughts and actions of persons (Strauss & Corbin, 1990). Qualitative approach is suitable for this research which aims to understand the experiences and feelings of individuals in the real world.

As this research focuses on real-life contexts, trying to explain connections between the older population in urban China and their residential choice, a case study methodology has

been selected as the most suitable research strategy. Considering the scope of the research, the nature of the research questions, and the role of replication in confirming the study's outcomes, a multiple-case design is appropriate for investigating this topic in different types of residential communities.

The fieldwork involved three residential communities as typical cases of housing built at different times. The main sources of evidence collected during fieldwork consisted of direct observations, interviews with older residents, and interviews with experts. The selection criteria for multiple cases were determined by community type, data availability and access, locations, and the extent of stakeholder engagement. Data collection is divided into three main parts in this research: semi-structured interviews with 13 experts, in-depth interviews with 37 older residents, and direct site observation in three residential communities. The observation was conducted using a structured approach and analysed based on the living environment checklists from previous studies. Interview data were explored by the qualitative content analysis method to deliver knowledge and understanding of the phenomenon (Downe-Wamboldt, 1992). A holistic framework to support ageing-in-place is the ultimate goal of this research, guided by the preceding data and objectives mentioned above. The findings from each objective were subsequently synthesised and triangulated.

In a qualitative study, validity involves determining the degree to which researchers' claims about knowledge corresponded to the reality (Eisner & Peshkin, 1990, cited in Cho & Trent, 2006). Within this research, two strategies were used: triangulation and audit trail. The results triangulation of the interviews with different groups and observation was used to construct the final framework. The next section introduces how the objectives have been achieved and integrated by briefly presenting each thesis chapter.

Data collection and analysis in this research followed the ethics procedure of The University of Sheffield and was approved by The University's Ethics Committee.

1.6 Thesis Structure

This thesis consists of 10 chapters. Figure 1.1 presents an overview of the thesis structure and the contents of each chapter. Generally, the thesis consists of five parts namely the introduction, literature review, methodology, findings, discussion, and conclusion. Among those, the literature review and findings consist of multiple chapters.

Introduction	**Chapter 1**	• Overview of the research topic • Research objectives • Importance of the research • Forthcoming chapter overview
Literature Review	**Chapter 2**	• Global demographic data & trends • Ageing and built environment • The theoretical basis on ageing and environment • Ageing-in-place • Conceptual framework
	Chapter 3	• Chinese demographic data & trends • Living arrangements of the Chinese older people • Ageing-in-place in China • Living conditions of the Chinese urban older people • Research gaps • Research questions and objectives
Methodology	**Chapter 4**	• Research philosophy • Research design • Case selection • Data collection • Data analysis • Ethical considerations
Findings	**Chapter 5**	• Multiple-case study • Site observation data
	Chapter 6	• A new conceptualisation of ageing-in-place • Interviews with older people and experts
	Chapter 7	• The role of built environment • Interviews with older people and experts
	Chapter 8	• The role of social environment • Interviews with older people and experts
	Chapter 9	• An age-friendly living environment framework • Date integration
Discussion & Conclusion	**Chapter 10**	• Summary of key findings • Practical implications • Limitations and basis for further study • Contribution to knowledge

Figure 1.1 Thesis structure

Chapter 1 is an introduction to the background context of the research topic with a list of the research questions and objectives, and a brief explanation of the study methodology and expected outcomes.

Chapter 2 is the literature review which establish the existing knowledge about the research topic. Firstly, global demographic data and trends are introduced, highlighting the importance and urgency of the population ageing issue. Secondly, the close connection between the environment and ageing is highlighted. The environment holds tremendous potential for addressing public health concerns. The chapter then goes on to present the theoretical foundation underpinning ageing and the environment with a review of the developments of Environmental Gerontology, Person-Environment Fit Theory and Ecological Model of Active Living to guide the fundamental research. Chapter 2 also discusses the concept of ageing-in-place worldwide and builds a conceptual framework as a roadmap to further guide the literature review and field investigation.

Chapter 3 continues by outlining the research background in China. It starts by discussing the Chinese context in population ageing and the living arrangements of Chinese older people. Ageing-in-place is identified as respecting older people's wishes and psychological needs and meeting the majority of the older people's requirements, based on the local conditions and the traditional filial piety culture to respond to the population ageing challenges. It also presents an outline of the residential environment of older people living in urban areas, mainly focusing on the studies of the age-friendly environment in supporting ageing-in-place. Based on the literature in the Chinese context and the conceptual framework, the final research gaps are identified to inform this PhD study's research aim.

Chapter 4 shows the research design and the key considerations in conducting this study. It starts with the researcher's philosophy of knowledge and the selection of an appropriate approach to theory development in order to provide a philosophical foundation to the study. Based on the research questions and objectives presented in Chapter 3, qualitative case study research is chosen as the research strategy to reply to the research questions and fill the research gaps. A description of the case study design, case selection criteria and process are followed by explanations of data collection and data analysis. The ethical considerations, credibility and validity in this study is given at the end of this chapter.

Chapter 5 presents an assessment by case study of the age-friendly environment condition in three different types of mainstream residential communities in urban China. Three communities were selected to exemplify typical residential communities according to the date of construction in Xuanwu District, Nanjing. This chapter seeks to achieve research Objective 1, which reveals the Chinese urban mainstream communities and private

dwellings environment from an age-friendly environment perspective and identifies environmental barriers to achieving ageing-in-place in different urban residential community settings. Chapter 5 presents data collected via a desktop study, architectural observation conducted via note taking and photographs taken during fieldwork.

Chapter 6 builds a conceptualisation of ageing-in-place in an urban Chinese background to achieve the second objective of the PhD study. To meet this objective, this chapter seeks to answer the following questions: 1) How do Chinese urban older people understand the meaning of ageing-in-place? 2) What are the challenges facing older people achieving ageing-in-place in urban China? And 3) What are the differences between ageing-in-place and ageing in a care facility? Chapter 6 presents the attitudes, experiences, challenges, and visions from the perspective of both the older people group and the expert group. Data were collected from in-depth interviews with 50 participants (37 older people and 13 experts). Understanding the ageing-in-place in a current Chinese urban setting is necessary to develop a holistic framework for promoting ageing-in-place.

Chapter 7 is designed to fulfil Objective 3 of the research. This chapter explores the role and components of an age-friendly built environment in relation to community and housing and establishes the links between the built environment and older people's capacity to achieve ageing-in-place. It examines the challenges and opportunities for built environment improvements by conducting semi-structured interviews with 37 older dwellers living in the case study communities and 13 experts. Results from the expert and older people groups are analysed separately via qualitative content analysis before being compared. The main findings include the design features of an age-friendly environment in housing to guide the framework for the mainstream residential community to support older people to ageing-in-place.

Chapter 8 presents the emotional and experience-based aspects of the place, including the role of social networks, service and support, and technologies, which represents Objective 4 of the study. This is to advance the investigation of ageing-in-place by exploring how the social environment influences successful ageing-in-place. This is crucial to produce a holistic framework for a supportive living environment for the older population. Chapter 8 explores the components of the social environment for older people and establishes the relationship between the social environment and their ability to achieve ageing-in-place. It also describes the role of social networks and support needed as reported by those older people living in mainstream housing in urban China. A list of recommendations for the social requirements of older individuals who prefer ageing-in-place will be presented to support an age-friendly living environment in the mainstream communities in urban China.

Chapter 9 outlines the development of the framework to support ageing-in-place in the mainstream residential community in the urban China context, which meets Objective 5 of the research. The framework combines the conceptual framework and related theories from the literature review and research findings from the case study. Four main domains (motivations, built environment, social environment, and technology) are established in the framework, supported by the preceding data and objectives mentioned in the above chapters. The framework targets supporting the older population to achieve ageing-in-place by improving their living environment to be more age-friendly. This chapter also presents key stakeholders in the framework, applications and recommendations for policy and practice. To increase the applicability and usability of the framework for end-users, a simplified version of the framework is presented in two languages (English and Chinese) to benefit non-expert stakeholder groups also in China.

Chapter 10 concludes the study by summarising the key research findings. This chapter first presents an overview of the thesis, reviewing the chapters to show how the research aims and objectives have been met. The key findings are then discussed to reflect the significance and implications thereof. This chapter also discusses the contribution to knowledge, followed by a review of the limitations of the study and proposal for future research.

1.7 Summary

This chapter introduced this PhD study by giving the research background. This research is motivated by population ageing and the close connection between the living environment and ageing well. Ageing-in-place as an advocated living pattern requires necessary resources and support. Based on previous international studies and the Chinese context, the research gaps were identified as a framework for age-friendly initiatives in the developing world, including an integrated physical and social aspect and following a multi-stakeholder participatory and collaborative process. The aims and objectives were generated to fill the research gaps. Chapter 1 also highlighted the significance of the study in that a new conceptualisation of ageing-in-place and an age-friendly environment framework to support ageing-in-place will be achieved by conducting this study. It was followed by a brief discussion of the methodological considerations and the presentation of a qualitative case study approach. This chapter closed by outlining the thesis structure and summary of each chapter. The next chapter present the background and previous studies related to the research topic.

CHAPTER 2.   LITERATURE REVIEW: Population ageing and ageing-in-place

2.1 Introduction

This chapter aims to establish the foundation for this PhD research and identify the attitudes and concepts towards ageing-in-place. By examining the background and related studies, a conceptual framework will be formed as the basis to guide further investigations.

Firstly, the global demographic trends are presented by reviewing the WHO and United Nations reports on population ageing and prospects. Increasing life expectancy and falling fertility rates are two key demographic determinants of ageing. Next, the definition and changes of ageing are discussed by highlighting the significance of health and the relationship between life-course and the environment. An age-friendly environment contributes to promoting behaviours and removing barriers for older individuals. Furthermore, the ageing-in-place concept is reviewed. The change in individuals' ageing process may require transitions in living environments. Considering where to live, older persons often think their home or community enables them to maintain a sense of connection to society, security and familiarity, alongside providing a sense of independence, identity, and autonomy. Ageing-in-place is supported by academic theories on person-environment interactions, including environmental psychology, environmental gerontology (ecology of ageing), and Person-Environment Fit theory. Finally, a conceptual framework is established as the product from the literature review.

2.2 Global Population Ageing

Ageing is an emergent key global issue with population ageing and urbanisation influencing the patterns and trends in the living arrangements of older people. Firstly, this section presents the two mega-trends that characterise today's global population as the background to this study, namely the recent past and future trends in global population data relating to the elderly and trends in urbanisation. The interconnections between older people's living arrangements and their health and well-being are highlighted at the end of this section.

2.2.1 Global population trends

Globally, the population is ageing with virtually all the world undergoing a major demographic transition. The WHO (2015a, p.230) defines *population ageing* as "a shift in the population

structure whereby the proportion of people in older age groups increases". According to the latest data reported by the Population Division of the United Nations Department of Economic and Social Affairs (UNDESA) (2020a, 2020b), the world has experienced continuous growth in the amount and the share of older people in recent years, and this increase is poised to accelerate in the coming decades. By 2020, the number of the world's population aged 65 years or over was 727 million. By 2050, the global older population aged 65 or over is estimated to reach nearly 1.5 billion, which is more than double compared with the number in 2020. The proportion of the population aged 65 years or over increased from 6% in 1990 to 9.3% in 2020. That proportion is expected to increase from 9.3% in 2020 to 16.0% by 2050 when it is projected that one in six people globally will be aged 65 years or over (United Nations, 2020a, 2020b). Moreover, population statistics for those aged 80 years or over are experiencing a faster rise than those over 65 overall. Population projections indicate that, globally, the number of people aged 80 or over will grow significantly from 143 million to nearly 426 million between 2019 and 2050 (United Nations, 2020a).

It is worth noting that the UNDESA mainly used 60 years as the demarcation boundary to define the term "older people" in the series of reports of *world population ageing* from 2002 to 2017 (United Nations, 2002, 2007, 2009, 2013, 2015, 2017a). Since *world population ageing 2019* (United Nations, 2020a, 2020b), the data analysis and discussion define persons 65 years or over as the older population. The Centre for Health Development of WHO (2004, p.42) describes an "older person" as "a person who has reached a certain age that varies among countries but is often associated with the age of normal retirement".

According to the data published in 2017, two-thirds of the total older population aged 60 or over lived in developing regions (United Nations, 2017a, p.11) (Figure 2.1). Moreover, the growth in the older population in developing regions is occurring faster than in developed countries at present. It is projected that almost 80% of the global older people will be living in developing regions in 2050, compared with 60% in 2005 (United Nations, 2009). Thus, developing regions are required to adapt more rapidly to ageing populations at lower levels of national income. There are two key demographic determinants of ageing: falling fertility rates and increasing life expectancy (WHO, 2015a; United Nations, 2017c). Falling fertility rates are likely to have resulted from parents realising their children have a higher possibility to survive than was the case before, as a result of falls in child mortality (WHO, 2015a). The data on population trends from the *2017 Revision of the World Population Prospects* (United Nations, 2017b) confirms that life expectancy has increased noticeably in recent years with social and economic development and improvements in living conditions, public health, and medical technologies. Average life expectancy worldwide is projected to rise from 71 years

during 2010-2015 to 77 years during 2045-2050 (United Nations, 2017b) with global life expectancy at birth reaching 72.3 years in 2019 (United Nations, 2020a). In most of the world, survival after age 65 is more likely. These changes are also accompanied by a reduction in the birth rate, which represents the second reason for population ageing (WHO, 2015a). The pace of population ageing accelerated when the low adult mortality and low fertility occurred together.
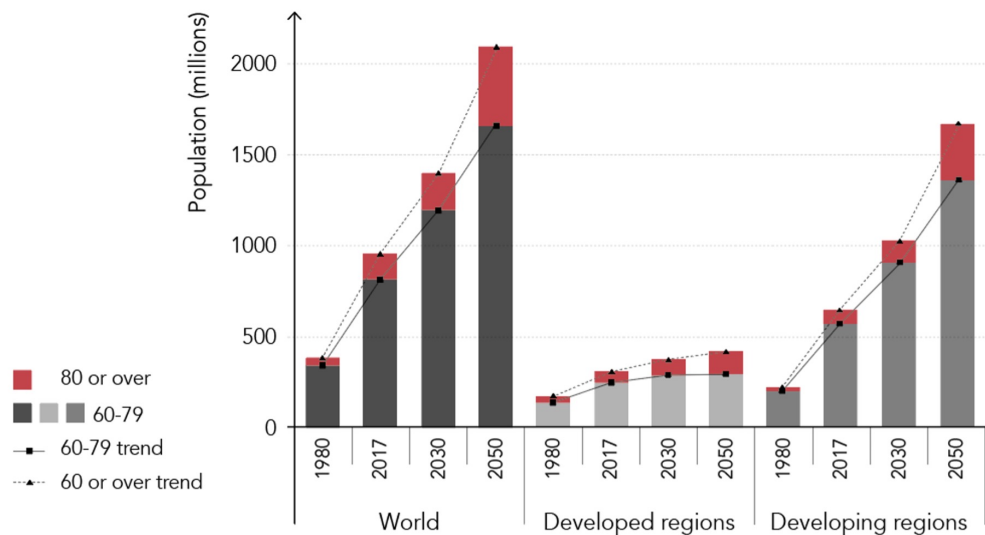
Figure 2.1 Older population by development group, 1980, 2017, 2030, 2050

Adapted from: United Nations, (2017a, p.11).

2.2.2 Global ageing and urbanisation

Another mega-trend that characterises the global population of today is urbanisation (United Nations, 2020a). In 2018, 55 percent of total population in the world were living in urban, and this is projected to growth to 68% by 2050 (United Nations, 2018). The number of older people is increasing quicker in cities than in rural areas (United Nations, 2017a). Globally, between 2000 and 2015, cities experienced an increase of 68% in the number of older persons aged 60 years or over, compared with a 25% growth in the countryside. Consequently, older populations are progressively more concentrated in cities, and trends suggest that this rise in the older population of city dwellers will continue (Montgomery & Ezeh, 2005).

Population ageing and urbanisation are the results of successful human development in the twentieth century (WHO, 2015a). The increasing amount and proportion of the world's older people have become an important social transformations of the 21st century and brings implications for almost all sectors of society. Older people's requirements of things and

services, for example housing and social support should be understood and answered in addressing the opportunities and the challenges that population ageing presents.

2.2.3 Living arrangements of older people

Population ageing and urbanisation have also influenced the patterns and trends in older people's living arrangements (United Nations, 2020b). Internationally, the percentage of people aged 60 years or over living with children decreased from 65% to 50% between 1990 and 2010, while the share of older people with a spouse only or living alone increased from 24% to 37%. Circa 2010, just 20% of older people lived with their children in the more developed countries, compared with 62% in the less developed areas (United Nations, 2017a). These demographic trends are related to shifts in the family structure. For example, in United States, the traditional extended-family households and intergenerational co-residence have become comparatively infrequent, while the nuclear-family households has become more typical (Ruggles, 2007).

Such changes are also impacted by social conditions, income levels, cultural norms and preferences (United Nations, 2020b). Despite the persistence of cultural norms and traditional family structures favouring multi-generational households, there is a slow shift in family size and household composition moving towards smaller in many countries (Ruggles, 2007). There are four main categories that form a living arrangement typology`: living independently, living with children, living with extended family households, and non-relative households (United Nations, 2020b).

Older persons' individual preferences and constraints determine their living arrangements (Reher & Requena, 2018). For most older adults, their preferred living arrangements may differ from their actual situation due to health constraints and limited functional ability, housing costs and location (rural or urban), kin availability, and financial affordability. There are obvious differences between countries characterized by individualistic societies with sufficient material resources to realise preferences and countries characterised by familistic societies with few resources to implement alternative solutions (Reher & Requena, 2018). Cultural norms and traditions also impact older people's preferences for living arrangements. Furthermore, the provision of social welfare, like health care, public pensions, social care services and public housing programmes, also influences older individuals' decision of their living arrangements, particularly in later stages of their lives (United Nations, 2020b).

The perceptions about the most appropriate living environment in old age vary according to the circumstances older people face (Fernández-Carro, 2016). The most of older individuals prefer to age in their own homes for a sufficient level of autonomy (Davey, 2006; Olsberg &

Winters, 2005). However, when older people suffer from physical or cognitive limitations, some older individuals identified co-residence with a relative as an ideal living arrangement (Fernández-Carro, 2016). Relatives are viewed as the most secure source of support in the familistic conceptualisation of care responsibilities. Ageing in institutions is also a living option for older persons but is not included in this study.

The living arrangements of older people directly affect their care arrangements and living environment, which are important determinants of their well-being, physical and mental health, and life satisfaction (Ong, Uchino, & Wethington, 2016). Feng et al. (2017) identified an association between an individual's living arrangements and mortality risks at older ages. For example, older people living in institutions or alone face higher overall mortality risks than older people living with others.

Since early 2020, all countries have been affected by the rapid spread of the coronavirus (COVID-19). Older persons generally are more vulnerable to the virus and be affected by higher mortality rates compared with younger people (Williamson et al., 2020). Since the living arrangements of older individuals affect their chance of catching the virus, living arrangements partially account for the disparities in age patterns of COVID-19 mortality (United Nations, 2020b). Residents at nursing homes tend to be more likely to develop infectious illnesses because they live in a community environment where they might be exposed to the virus through contact with other residents and care staff (Ladhani et al., 2020).

For policymakers, older people's living situations and family support systems are becoming more crucial. Given that governments committed to ensuring that no one is left behind in the 2030 Agenda for Sustainable Development, it is crucial to understand the linkages between older people's living arrangements and their health and well-being (United Nations, 2020b).

2.3 Ageing and the Built Environment

This section aims to understand ageing and the relationships between ageing and the built environment. Diversity in older age is heavily determined by a key characteristic: health. Given that the design of the built environment holds tremendous potential to solve issues of public health, the significance of an age-friendly environment has been highlighted in recent years.

2.3.1 What is ageing?

Ageing is the process of becoming older. In humans, it is deemed as a highly complex

biological problem caused by the gradual, lifelong accumulation of a wide variety of forms of molecular and cellular damage, resulting in progressive, generalised impairments in bodily functions, a growing risk of disease and death and an increased vulnerability to environmental challenges (Kirkwood, 2008). The organ function of older persons is much more variable than younger people, including declining physical and mental capacities and geriatric syndromes, as shown in Table 2.1 (WHO, 2017a).

Table 2.1 Decline in the capacity of older people

Declining physical and mental capacities	Mobility loss
	Malnutrition
	Visual impairment
	Hearing loss
	Cognitive impairment
	Depressive symptoms
Geriatric syndromes	Urinary incontinence
	Risk of falls

Source: WHO (2017a)

Nevertheless, the above changes are neither linear nor consistent with age in years, only loosely associated with increasing age, influenced by individual factors: genetic or environmental. Researchers who study lifespan or longevity have attempted to find age-related traits that will predict lifespan but have failed to reach a clear consensus (Steves, Spector, & Jackson, 2012). Some 70-year-olds may need help to meet their basic requirements, while others of the same age still maintain and benefit from great physical and mental functions. To some extent, the mechanisms of ageing are random. The decrease in organ function that accompanies ageing is only loosely related to an individual's chronological age (Steves et al., 2012).

However, the resulting diversity of abilities and health needs of older persons is not completely random but has its roots in events in the life course, which can often be changed (WHO, 2015a). The environment strongly influences health changes related to ageing (WHO, 2001; Lee et al., 2005). Research from urban studies, geography, epidemiology, and public health demonstrates that a person's place of residence significantly influences their health performance (Tunstall et al., 2004; Beard & Petitot, 2010). Many older persons will face losses in their cognitive or physical capacities. Some of these losses related to the environment can be avoided, and individuals and society should strive to prevent them, for example by avoiding a negative environment for older people and trying to improve it according to the needs of older people.

2.3.2 Ageing and health

Nowadays, most people can expect to live to an age of over 60 years with the reduced mortality of younger ages (WHO, 2015a). This dramatic demographic shift has profound implications for everybody and for the people live in (Beard et al., 2012). The implications of the increasing older population reflect a broader public discourse between two perspectives on ageing. One side, it is emphasised that older persons contribute to society playing an important and irreplaceable role within their family to the local community as well as engagement with society. Thus, ageing populations might be considered societal resources (Walker, 2002; Beard & Petitot, 2010). On the other side, old age is identified as a period of vulnerability and disengagement with decline and increasing irrelevance, related to pensions, burdensome dependence or supportive care needs (Cumming & Henry, 1961; Cook, 2011).

This diversity in older age is heavily dependent on one key characteristic: health (Walker, 2002; Cook, 2011; Beard & Petitot, 2010; WHO, 2015a). Specifically, if older people can experience extra years in good health, they will face few limitations to do what they value. However, if the added years are marked by a decline in physical and mental abilities, the consequences could be more negative for older persons themselves and for society. Therefore, adding health to years demands a series of comprehensive responses and actions as increasing numbers of people live longer.

Three main reasons for allocating public resources to improving older people's health are demonstrated by WHO (2015). Firstly, basic human rights are enshrined in international law, which states that older persons should have the highest attainable standard of health (Baer et al., 2016). According to the Economic and Social Council, United Nations (2000, p.2), a human rights-based approach to health acknowledges the right to health,

> "embraces a wide range of socio-economic factors that promote conditions in which people can lead a healthy life, and extends to the underlying determinants of health, such as… housing, …and a healthy environment".

Secondly, the Sustainable Development Goals (SDGs) is closely linked to population ageing (United Nations, 2020a). SDG 3 states that enabling healthy lives and supporting the well-being for all people at all ages is vital to sustainable development (United Nations, 2015). Promoting lifelong health and preventive care to maintain the maximum functional ability of people can benefit health and well-being, as suggested in SDG 3 (United Nations, 2020a). Most people will live into older age, accounting for a growing proportion of the whole population. An unhealthy older person not only endangers the individual self but also

requires someone else to look after them, resulting in other family members needing to provide support or pay for care services. Moreover, older persons in good health can contribute to development in various ways, such as taking care of their daily family diet or the raising of grandchildren (Aboderin & Beard, 2015). Maintaining the health and functioning of older people is a crucial issue for the sustainable development of cohesive, peaceful, secure and equitable societies (Rantanen et al., 2012).

Thirdly, economics is also an important reason to highlight healthy ageing. The aim is to point out that "economic imperative to adapt to shifts in the age structure in ways that minimise the expenditures associated with population ageing while maximising the many contributions that older people make" (WHO, 2015a, p.16).

The ageing demographic trends and the modifiability of health have forced countries to consider policy decisions as part of their social and health agenda that can extend quality and length of life, such as National Strategy for an Ageing Australia (Andrews, 2001), WHO Active Ageing framework (WHO, 2002), World Report on Ageing and Health (WHO, 2015a). The terms successful ageing, active ageing and healthy ageing have been widely used in academic circles and policy documents.

According to the WHO constitution (2006, p.1), health is defined as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity". Equally, healthy ageing cannot just be deliberated as the opposite of becoming old with functional impairment or disease. Within the category of the non-disabled, normal population, a difference can be made between 'usual' and 'successful' ageing (Rowe & Kahn, 1987). *Successful ageing* is defined as "multidimensional, encompassing the avoidance of disease and disability, the maintenance of high physical and cognitive function, and sustained engagement in social and productive activities" (Rowe & Kahn,1997, p.433).

Active ageing emerges as an attempt to combine compartmentalised policy domains with an integrated approach (Walker, 2002). WHO (2002, p.5) produced "Active ageing: a policy framework", in which active ageing is defined as "the process of optimising opportunities for health, participation and security to enhance quality of life as people age". It emphasises the requirements for action crossing many disciplines domains and social sectors with the goal of enabling that older people remain a resource to their communities, families, and economies.

Healthy ageing is defined as "a lifelong process of optimising opportunities for improving and preserving health and physical, social and mental wellness, independence, quality of life and enhancing successful life-course transitions" (Health Canada, 2002). Subsequently, healthy

ageing is defined by WHO (2015a, p.28) as "the process of developing and maintaining the functional ability that enables well-being in older age", as the focus of WHO's work on ageing from 2015 to 2030. As Figure 2.2 presents, WHO (2015a, p.28) provides a holistic model to
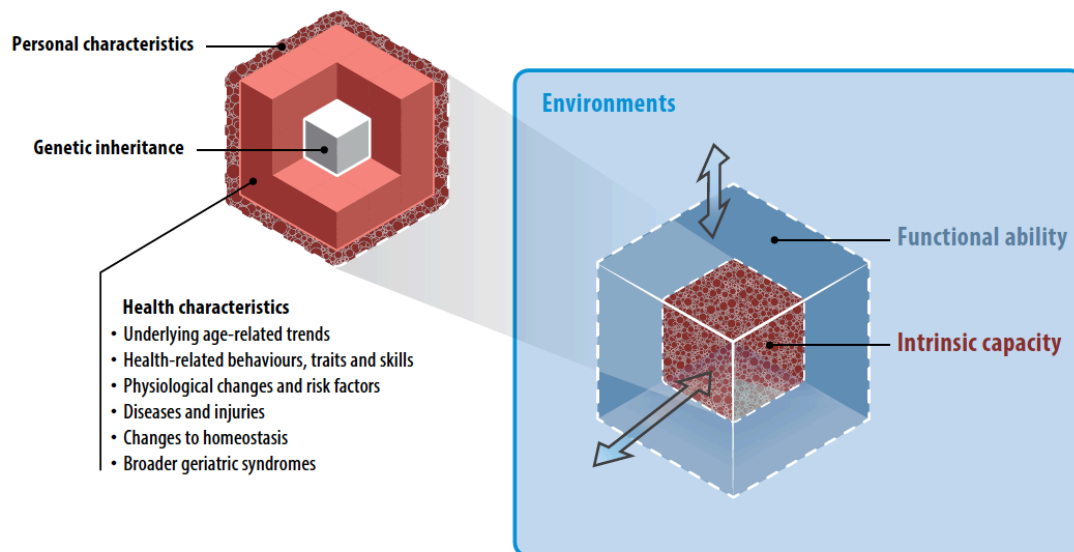
Figure 2.2 WHO Healthy Ageing Model

Source: WHO, (2015, p.28).

explain the interaction between the intrinsic capacity and the environments, with the core purpose of promoting older people's functional ability. Environments contain a variety of elements, including the built environment, people and their relationships, health and social policies, the services, attitudes and values, and the systems which support them.

2.3.3 Life-course and the built environment

Health provision has experienced a shift from a medical model to health promotion. The role of the built environment, especially in residential areas, has drawn attention (Srinivasan, O'fallon, & Dearry, 2003; Stewart, 2005). Jackson (2003) noted that the design of the built environment can offer enormous potential for addressing many of a nation's greatest health problems.

WHO (2015a, p.227) has pointed out that the consistent goal of actions to promote healthy ageing is to foster functional ability. Whether older individuals can do things they value will be determined by the personal health characteristic (intrinsic capacity) and by the interactions with the environment at a specific time. The built environment is emphasised as an important environmental characteristic that influences older people's functional ability, including their health, disability, life-space mobility and quality of life (Rantanen et al., 2012).

For instance, if a person with limited mobility has a supportive device such as a wheelchair and is in a barrier-free place that provides access for people with disabilities, they will still have mobility. However, another person with the same physical problem in less enabling surroundings might find it more difficult.

It is illustrated by WHO (2015a) how functional ability and intrinsic capacity change across the latter half of the life-course (Figure 2.3). The process is divided into three periods: relatively high and stable capacity, declining capacity, and significant loss of capacity. Moreover, it is pointed out that these three periods are not determined by chronological age, not unavoidably continually falling, and paths will differ significantly among individuals (WHO, 2015a).
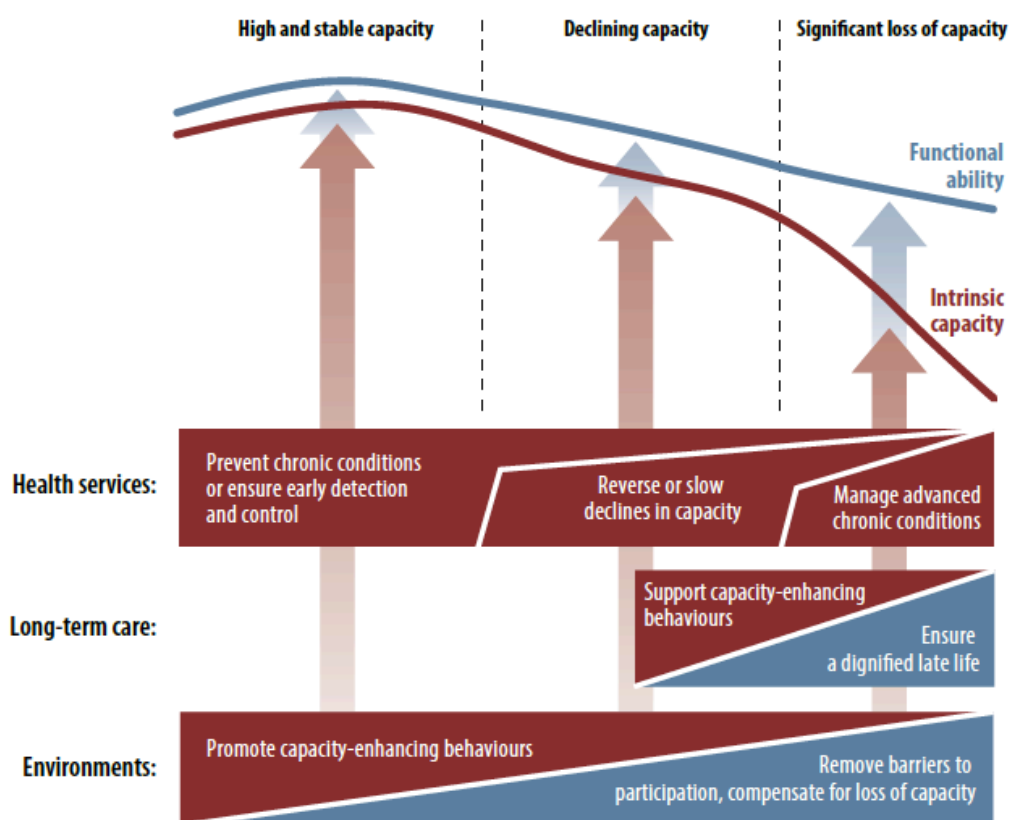
Figure 2.3 WHO public-health framework for Healthy Ageing

Source: WHO, (2015a, p.33).

The importance of the built environment is emphasised throughout the whole process and duration with specific emphasis, although the requirements of the people in the upper three different phases change (WHO, 2015a). For older people in a high and stable capacity period, the aim is to maintain this condition for as long as possible, such as providing a safe and pleasant place for physical activity. For persons in a declining capacity period, the

objectives are to promote functional capacity and help them overcome their limitations. For example, public seating could enable older people to rest in public spaces, and better street lighting might encourage visually impaired older people to walk outside at night. For older persons in the significant loss of capacity period, the built environment still plays a vital role in helping them to keep their basic rights, a level of functional ability, fundamental freedoms, and as much dignity as possible, such as the wheelchair-free housing and communities. Built environment interventions must meet the requirements of older persons in these phases and should also be seamless to remain relevant for older persons as they transition between each period.

In contrast, environmental barriers may hinder older individuals' daily activities, especially when their functional capacity is compromised (Portegijs et al., 2017). Environmental hazards are one of the main determinants that increase the risk of falls and injuries in older persons (Kannus et al., 2005). Furthermore, environmental barriers may increase loneliness through association and restricted autonomy in involvement outdoors (Rantakokko et al., 2014). Therefore, the built environment is closely related to people's whole life-course and especially critical for older people.

2.3.4 Age-friendly environment

The term 'age-friendly' arises from an ecological view of ageing and emphasises the connection between a person's social and physical surroundings (Steels, 2015). The definition of age-friendly environments is interpreted by WHO (2018, p.1) as:

> "Age-friendly environments (such as in the home and community) foster healthy and active ageing by building and maintaining intrinsic capacity across the life-course and enabling greater functional ability in someone with a given level of capacity."

WHO has made a leading contribution to promoting age-friendly environments from a global perspective with their review of the short history of WHO Age-friendly Cities Framework. In 1991, United Nations Member States adopted *The United Nations Principles for Older Persons*, based on the *International Plan of Action on Ageing*. They encourage governments to absorb the principles of Independence, Participation, Care, Self-fulfilment and Dignity into policy initiatives. The Age-friendly Cities are built on these principles.

In 2002, *Active Ageing: A Policy Framework* was established by the WHO's Ageing and Life Course Programme, published in the Second United Nations World Assembly on Ageing in

Madrid. The framework was designed to provide guidance for the formulation and discussion of action plans that support active and healthy ageing. It continues to define three pillars of active ageing, health, participation and security and is based on The United Nation's principles for older people. It makes a compelling case that policy choices ought to be grounded in determinants of active ageing to enhance the quality of life as people age.

WHO (2007) detailed a number of checklists of the essential elements to develop age-friendly cities, including outdoor spaces and buildings; housing; transportation; social participation; respect and social inclusion; civic participation and employment; community support and health services; and communication and information. Notably, the significance of age-friendly home design is emphasised, and several factors of housing design—including characteristics of the housing structure, design, location, and choice—are taken into account to impact older people's capacity to live peacefully, safe and well. Appropriate accommodation and access to community and social services have an impact on older people's independence and quality of life.

In 2015, *World report on ageing and health* (WHO, 2015a) offers a new conceptual framework for comprehending and promoting healthy ageing based on the idea of functional ability. The Active Ageing Framework from WHO has been replaced with the Healthy Ageing Framework. Chapter 6 describes how this new strategy builds on and completes the efforts made in previous decades to create age-friendly cities and communities. It emphasised the necessity for cities and communities to provide older individuals with better results, such as through assisting in the development of older people's capacities to: meet their basic needs; learn, grow and make decisions; be mobile; build and maintain relationships; and ability to contribute. In addition, WHO (2015b) published *Measuring the Age-friendliness of Cities: a guide to using core indicators,* offers detailed technical advice on choosing and utilising core indicators to create baselines, set targets, monitor, and evaluate Age-Friendly City activities. In the same year, an integrated, indivisible set of global goals for sustainable development, the 17 SDGs were approved with ageing issue relevant to 15 goals (WHO, 2017c).

In line with the SDGs, the *Global strategy and action plan on ageing and health* (WHO, 2017b) provides a policy framework listing five key strategic objectives which need to be met to enhance the ability of older individuals to be and do what they have good reason to appreciate. Therefore, the second objective is developing age-friendly environments to promote older persons' autonomy, enable their engagement, and promote multisectoral action involving in different sectors (WHO, 2017b).

In 2018, the WHO published *The Global Network for Age-friendly Cities and Communities.* This provides a global picture of the development of age-friendly cities and communities

during the past 10 years. It is believed that building age-friendly communities and cities could contribute to recognising the wide range of capacities and resources among older people; anticipate and respond flexibly to ageing-related needs and preferences; respect older people's decisions and lifestyle choices; reduce inequities; protect the most vulnerable; and promote older people's inclusion in and contribution to all areas of community life. As a result, such an inclusive and equitable place leaves no one behind, especially the most vulnerable older people (WHO, 2018).

Additionally, various frameworks including an age-friendly community and its qualities have been established in recent years by academics, governments, and other organisations, such as the AdvantAge framework (The AdvantAge Initiative, n.d.) and the Conceptual Process framework (Greenfield et al., 2012) in America; the Canadian Social Connectivity framework (Menec et al., 2011) and Healthy Ageing framework (Health Canada, 2006); New Zealand Positive Ageing Strategy (Ministry of Social Development, New Zealand Government, 2008); and the Age-Friendly Manchester in the UK (Manchester City Council, 2017).

To recognise the link between ageing and built environment, the literature concerned with 'what is ageing?', the connection between ageing and health, the life-course and the built environment, and existing age-friendly environment frameworks have been reviewed in this section. It explored how the built environment influences the ageing process and health, and what are the features of an age-friendly environment and related frameworks.

2.4 Theoretical Bases on Ageing and Environment

This section aims to review key theories related to age-friendly environments. In terms of the research topic, environmental gerontology, as the pertinent theoretical underpinning, is essential in understanding the relation between older individuals and their environment in supporting older people's ability to maintain independent living. On this basis, Person-Environment Fit theory is applied to clarify the interactions between older persons and their socio-spatial surroundings. The development of Environmental Gerontology, Lawton's Press-competence Model, Person-Environment Fit theory, and Ecological Model of Active Living are also reviewed and discussed in this section to understand the theoretical background and guide the whole research.

2.4.1 Environmental Gerontology and Lawton's Press-competence Model

According to Wahl and Weisman (2003), environmental gerontology (used interchangeably here with ecology of ageing) focuses on the description, explanation, and modification or

optimisation of the relationship between older people and their socio-spatial surroundings. According to the ecology of ageing perspective, old age is an important stage in the life course and is extremely impacted by the physical environment (Wahl & Oswald, 2010; Wahl, Iwarsson, & Oswald, 2012).

Kleemeier's (1956) work is seen as the "birth" of a rigorous environmental gerontology. Lawton, as a central and globally acknowledged leader in environmental gerontology, with Nahemow made an outstanding contribution with the introduction of the Press-Competence Model in 1973 (see Figure 2.4). This can be seen as a landmark in the field of environmental gerontology, highlighting the significance of balancing individual competences with environmental press. It conceptualised ageing well by connecting with the person and environment interchange dynamic.
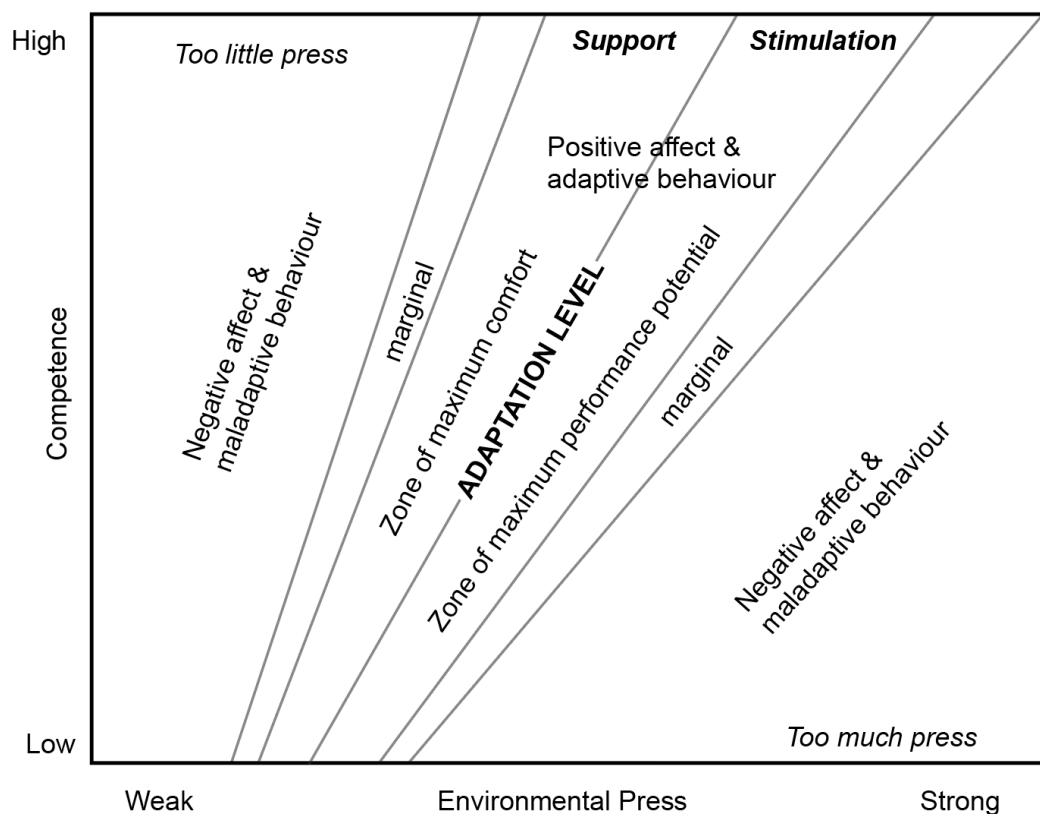
Figure 2.4 Lawton's press-competence model

Adapted from: Lawton & Nahemow, (1973).

They stated that the ageing process can be seen as a constant adjustment to changes in both the external and internal capabilities and functioning taking place during the life course. The balance of environmental press is required to enhance an adaptive level. The wide-ranging framework illustrated the different types and levels of individual capability (mobility

loss, sensory injury, and cognitive decline) and the features of the objective environment (housing standards, neighbourhood conditions, and public transport) to better harmonise the older persons and their environment in ageing research and practice.

The ecology model led to the development of P-E Fit theory as a major finding for planning and design application (Lawton, 1980). Later, Lawton (1983) concluded with a description of four sectors comprising "the good life" (Figure 2.5): objective environment, behavioural competence, psychological well-being, and perceived quality of life, of which both physical environment and social environment have been underlined. Moreover, Lawton (1989) distinguished between three fundamental residential environment functions: maintenance, stimulation, and support.
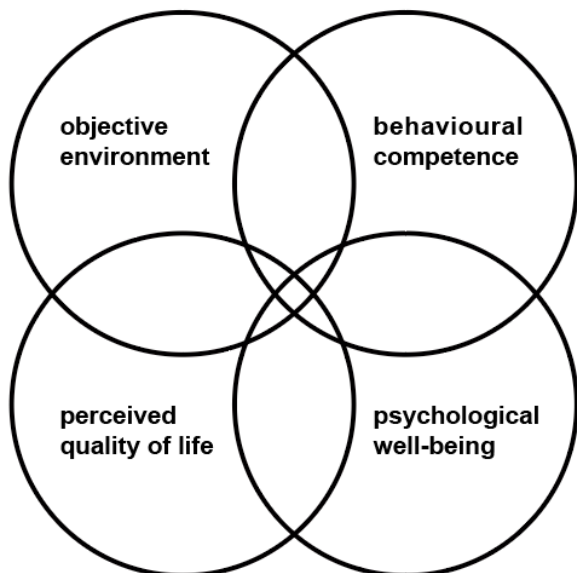
Figure 2.5 Four sectors of the good life

Adapted from: Lawton, (1983, p.355).

In terms of the scope, Lawton (1977a) stated that environment in the ecology theory of ageing involves housing, neighbourhoods, out-of-home areas, and transport issues. Later, the supplementary work of Lawton (1998) argued strongly that technology is also involved in the environment and plays an vital role for ageing well. It is affirmed that the theories and findings of environmental gerontology have been used at many scales, from housing design to institutional living, from home retrofitting to suggestions for ''age-friendly'' cities or communities.

2.4.2 Person-Environment Fit theory

In the spirit of Lawton's seminal work, an integrative model on ageing well has been developed based on the P-E fit theory by Wahl and Oswald (2010). From the perspectives of environmental gerontology, they agree that older people interact with the physical-spatial-technical environment, influencing their lifespan and ageing. An overarching conceptual framework of how older people interact with the surrounding environment is established based on the traditional ecology of ageing theories (Figure 2.6) (Wahl & Oswald, 2010).
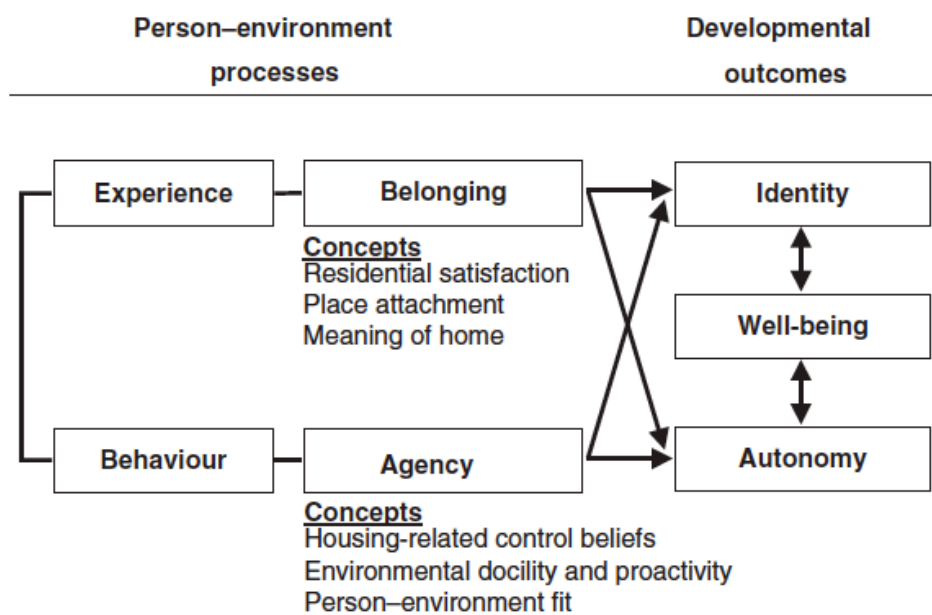
Figure 2.6 Conceptual framework on P-E relationships in later life

Source: Wahl & Oswald (2010, p.114).

According to Wahl and Oswald (2010), experience-driven belonging and behaviour-driven agency are two core processes of P-E interchange in later life. The concepts of belonging are explained as meaning of home, place attachment, and residential satisfaction, whereas concepts of agency represent housing-related control beliefs, environmental docility and proactivity, and P-E fit, which are considered to be particularly significant due to the decline in functional capacity and behavioural flexibility during ageing. In summary, belonging refers to a sense of relationship with people and a positive connection with the environment (Baumeister & Leary, 1995) while agency refers to the procedure of individuals to transcend the dictates of their immediate environment and to shape their life circumstances and life course (Bandura, 2006). These two P-E interchange processes are fundamental developmental tasks for older individuals to keep independence and autonomy, and to retain

their integrity and identity for as long as possible, ultimately, to promote older people's well-being (Wahl & Oswald, 2010).

Wahl and Oswald (2010) state that the P-E interchange processes in ageing involve several disciplines involving psychology, sociology, architecture, social geography, and urban planning. The interventional applications of environmental gerontology include home modification, reshaping of neighbourhoods, creative and innovative housing solutions, and technological potential. The role of technology has been particularly highlighted in recent years. Wahl, Iwarsson and Oswald (2012) emphasised the role of physical-spatial-technical environment on ageing well.

2.4.3 Ecological Model of Active Living

In the 1990s, Sallis, Bauman and Pratt (1998) believed environmental and policy interventions to enhance physical activity contribute to the improvement of public health and underscored the need for increased emphasis on research on environmental and policy interventions. Later, Sallis et al. (2006) built a holistic framework which applied ecological models to the study of active living for active living policy and environmental research. As presented in Figure 2.7, it is an ecological model targeting individuals, social environments, and physical environments. The perceived environment is summarised into five aspects: accessibility, convenience, comfort, attractiveness, and safety. The model systematically described the environmental factors related to behaviour, linked individual behaviour with activity space in the built environment, and refined the types and levels of functional space, providing a structured framework for the systematic understanding of the impact of environmental factors on health, providing a basis for policy and environmental intervention.

In summary, the theories and findings of the environmental and ageing field, especially P-E fit theory and the active living ecological model, are fruitful in understanding the importance of an age-friendly environment in supporting older persons' ability to maintain independent living and achieve active and healthy ageing.
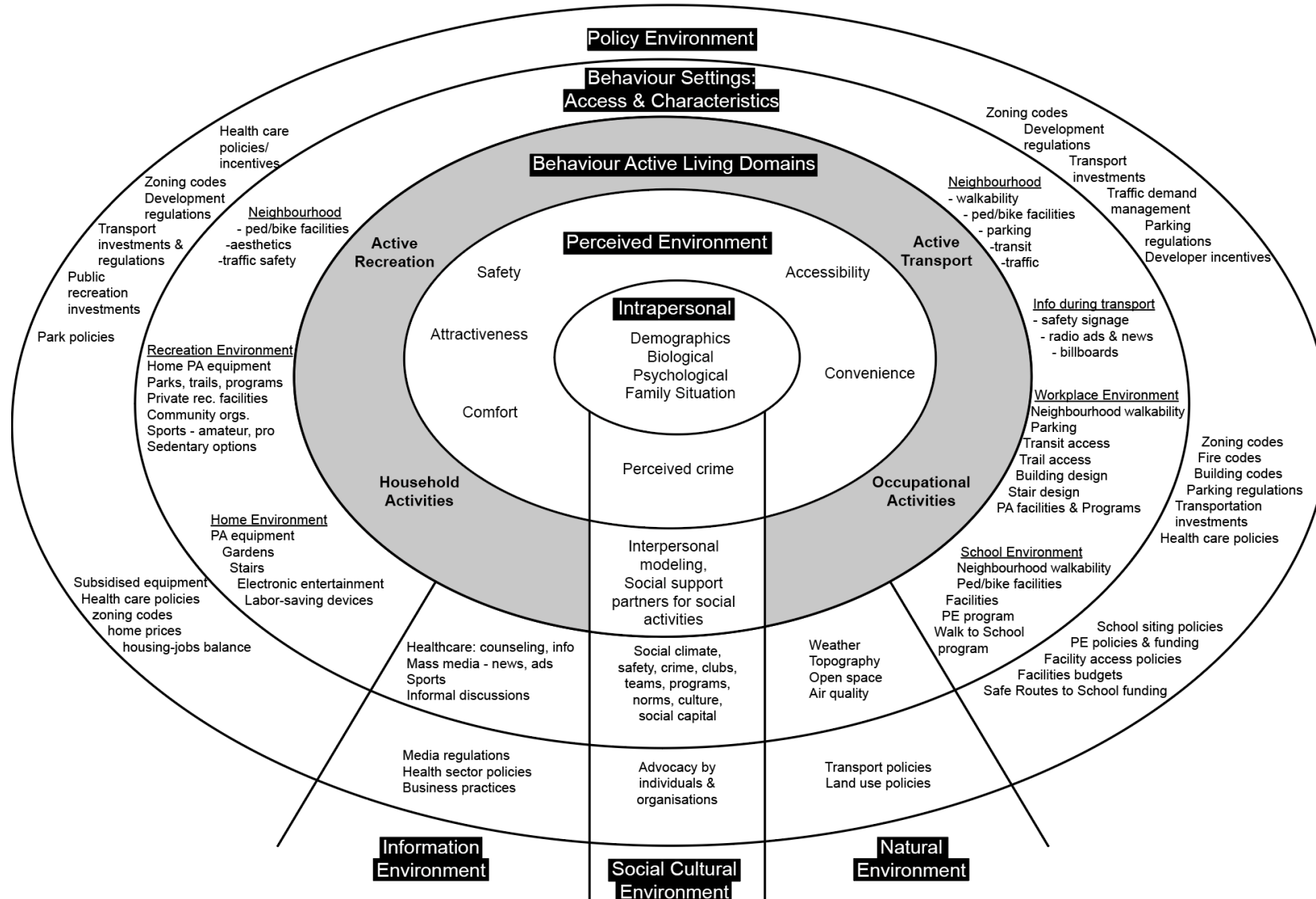
Figure 2.7 Ecological model of active living

Source：Sallis et al., (2006, p.301).

2.5 Ageing-in-place

Based on the environmental perspectives on ageing, this section focuses on the ageing-in-place concept, starting with the definitions and significance of this ageing option and global trend. This is followed by a review of the key themes of supporting ageing-in-place and a discussion of the role of housing and community design in achieving this.

2.5.1 Conceptualising Ageing-in-place

The change of an individual's ageing process necessitates transitions in their living environments by modifying current homes or by moving to a more supportive setting (Perry et al., 2014). When considering where to live, most older people associate home with the advantages of enabling them to maintain a sense of connection to society, security and familiarity, and as well as a sense of independence, identity, and autonomy (Lawler, 2001; Wiles et al., 2012). Moreover, remaining in private housing and communities as long as possible could be an effective solution to avoid increased health-care expenditure. Thus, ageing-in-place is favoured by policymakers, healthcare providers, and by older persons themselves (WHO, 2007; Kim et al., 2017).

Ageing-in-place has become a common policy response to population ageing. WHO (2004, p.9) defines the concept of ageing-in-place as:

> "meeting the desire and ability of people, through the provision of appropriate services and assistance, to remain living relatively independently in the community in his or her current home or an appropriate level of housing.".

New Zealand's Positive Ageing Strategy (Dalziel, 2001, p.10) defines age-in-place as "to be able to make choices in later life about where to live, and receive the support needed to do so". According to Davey et al. (2004, p.133), ageing-in-place is defined as the ability to "remain living in the community, with some level of independence, rather than in residential care".

Additionally, some scholars developed their own definition of ageing-in-place. Horner and Boldy (2008, p.356) defined ageing-in-place as a "positive approach to meeting the needs of the older person, supporting them to live independently, or with some assistance, for as long as possible". Kim et al. (2017, p.25) defined it as "the ability to safely and comfortably maintain an independent and high quality of life in one's own home and community", whereas Wiles et al. (2012, p.357) described it as "an individual's functional, symbolic, and emotional attachments and meanings to homes, neighbourhoods and communities".

There is a broad consensus among researchers that ageing-in-place appears to be the preferred option for older individuals compared to moving to institutions (Berg-Warman & Brodsky, 2006), especially when older people do not anticipate any care-related demands (Fernández-Carro, 2016). Higgins (1989) listed key characteristics comparing institutions and homes for older people and states that ordinary homes tends to be desirable to institutions for older people as accommodation mainly because it could offer more informality, privacy , familiarity and freedom.

Moreover, community-based care is supported by clinical outcomes. In a study by Marek et al. (2005) that older persons participating in a community-based ageing-in-place programme were matched to nursing home residents. The older persons who received community-based care experienced better cognition, less depression, decreased activities of daily living assistance, and less incontinence.

More recently, Pani-Harreman et al. (2020) presented a comprehensive and systematic overview of the existing definitions of ageing-in-place by conducting a scoping review. The following five main themes about ageing-in-place have been identified: ageing-in-place in relation to place, social networks, support, technology and personal characteristics. Rosenwohl-Mack et al. (2020) established a new conceptual model of age-in-place experiences in the U.S.A. by conducting a systematic review , emphasising the dynamic tensions involved in balancing threats and agency, among which identity as an older adult, connectedness, and place have been highlighted as three interconnected core experiences of ageing-in-place (see Figure 2.8).

Governments, international organisations, and scholars have come to the opinion that encouraging older people to stay in their communities for as long as possible is reasonable from an economic and social standpoint. However, enabling older people to age in place is a challenging task that necessitates providing the tools they need to stay in their own homes and communities (Kim et al., 2017), the provision of a variety of community support services, and the removal of obstacles that isolate older persons and restrict their activities (Lui et al., 2009).
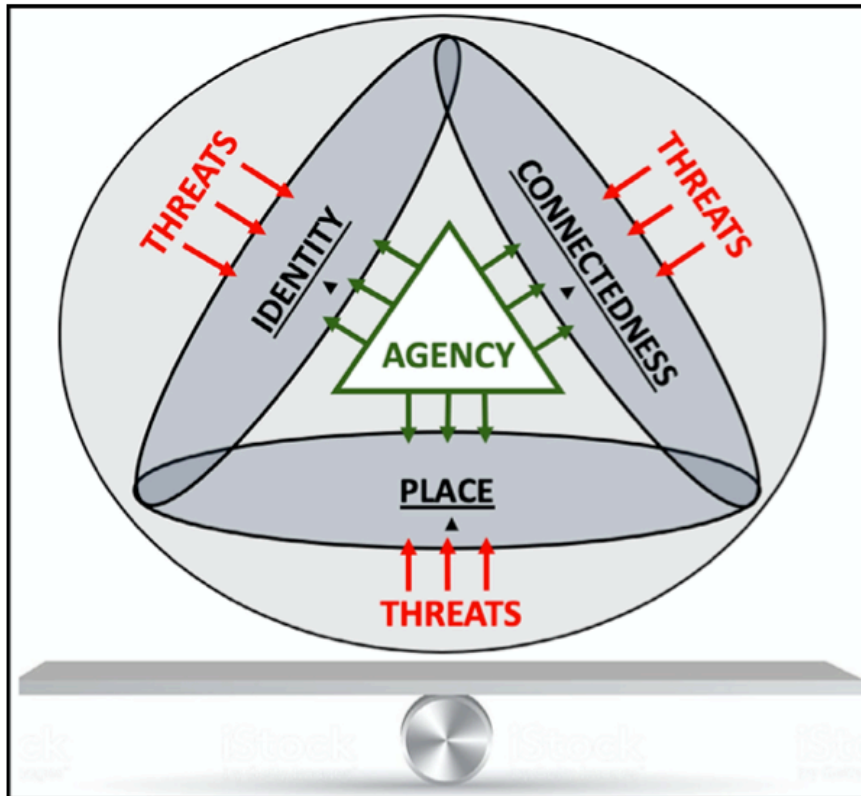
Figure 2.8 Rosenwohl-Mack et al.'s conceptual model: Dynamic tension model of ageing-in-place

Source: Rosenwohl-Mack et al. (2020, p.16).

Furthermore, ageing in place is unlikely a 'one size fits all' approach to yield the personal and social benefits that supporters of such a programme anticipate due to the diversity of requirements, wants, and preferences among older people. There is still much to learn about how older people live in their communities and at home, as well as how to best support them in achieving good mental and physical health, as well as how to combat social exclusion and loneliness (Sixsmith & Sixsmith, 2008). Without considering individual, social, and cultural differences or improving housing, just assisting older people to stay in their homes if possible is likely to leave them in subpar, harmful living conditions. Golant (2015) has advocated for "ageing in the right place" in response to these issues, and this concept has been discussed by more researchers in recent years (Sixsmith et al., 2017; Granbom et al., 2020). The stakeholders, including city planners and developers, housing authorities, architects, builders, health and social care experts, volunteers, and others are relevant stakeholders in building homes and communities for individuals to age in the right place.

2.5.2 Age-friendly living environment to promote ageing-in-place

As noted above, older persons can be faced with a variety of challenges linked with increasing age. The age-friendly environment aims to overcome these difficulties caused by those changes, ranging from the dwelling to the community. Fausset et al. (2011) argued that the capacity of older people to maintain their houses may be threatened by age-related decreases in capacities. They contend that in order to effectively support older people's intention to age-in-place, redesign initiatives and interventions must take into account the particular challenges that older people experience.

Based on the existing models/frameworks and previous studies, built environment (housing and community), social environment (support and social networks), and technology are defined as three interactive key aspects of the age-friendly living environment from an architectural perspective to support ageing-in-place in this study.

2.5.3.1   Age-friendly built environment (housing and community)

The concept of 'home' as a physical location is one that is always being negotiated (Wiles, 2003, 2005), incorporating a physical place and its surroundings, ranging from housing to community (Peace, Holland, & Kellaher, 2006). Andrews et al. (2007) stated that older people are constantly reintegrating with places and renegotiating meanings and identity in the dynamic environment including political, cultural, social, and personal change.

The ageing-in-place literature places a strong focus on housing (Bayer & Harper, 2000; Judd et al., 2010). The home environment is significant in people's later life, becoming gradually relevant to personal health, as older people spend most of their time at home, far more than other settings (Danziger & Chaudhury, 2009). From the perspective of environmental gerontology, Lawton (1982) highlighted the interaction between older people's competence and the physical home environment, exploring how modifications at home (for example, removing obstacles or adding mobility aids) could enhance older adults' independence and promote their well-being. Danziger and Chaudhury (2009) suggested that when environmental factors were designed to cater to the person's capabilities, frailty could be delayed, independence could be improved, while vulnerability and risk of injuries could be reduced. Moreover, researchers devote more attention to the quality and appropriateness of housing for ageing-in-place, such as design, housing size, heating/cooling, and insulation (Howden-Chapman, Signal, & Crane, 1999; Means, 2007). For the older generation, the home environment is an important determinant and consideration for participation and daily activities (Gadakari et al., 2017). Independent living might be supported by the physical

settings of housing, which is a crucial indication for older people to live a normal life at home (Iwarsson & Wilson, 2006).

Although most considerations on ageing-in-place focus on housing, there is increasing recognition that communities and neighbourhoods are also key aspects influencing older people's ability to achieve ageing-in-place (Oswald et al., 2011). Older people may have a greater sensitivity to the neighbourhood environment due to longevity of residence and changing levels of functioning, which may affect their health and emotional state (Glass & Balfour, 2003). For example, in John and Gunter's (2016) study in the U.S.A., the community characteristics of the built environment involve: walkable maintained sidewalks/paths; accessible public buildings; adequately marked roads with visible signs; adequate public transportation features; adequate special needs transportation features; driver network; housing options; and varied long-term care options available in the community. There has been criticism concerning the limitations of ageing-in-place particularly in relation to accessibility issues within the home and community environment (Means, 2007; Smith, 2009).

Ageing-in-place is a complex and long-term process, which includes more than just an attachment to a particular housing. Studies focused on the physical home concern the choice between relocating and making modifications to make it easier for older persons to keep living in their home (Boldy et al., 2011). Han and Kim's (2017) study indicated that older people in Australia preferred to remain in their current neighbourhood to keep their social ties. If the built environment inside the home cannot meet the requirements of the older residents, the older people can choose to redesign the existing housing with retrofitting or move to a more supportive home within the community as an alternative option of ageing-in-place.

2.5.3.2   Age-friendly social environment (social networks and support)

Ageing-in-place is inextricably linked with an age-friendly social environment, one that allows older persons to maintain social networks and receive support and services in the community. Wiles et al. (2012) stated that home is a place which brings certain social connections, familiarity, security, and a sense of identity. Butcher and Breheny (2016) argued that an attachment to place combines environmental, social, functional, psychological, and emotional meanings of place, particularly if they have lived there for many years.

Homes are not merely a physical space, but also operate on social and symbolic levels in interconnected ways (Wiles et al., 2012). The ageing-in-place concept includes physical aspects of the place as well as remaining in a known and stable setting where individuals feel a sense of belonging, and is closely concerned with emotions, memories, experiences, and people (Van Hees et al., 2017). Rowles (1993) explored how older persons' sense of attachment to a place produce security and meaning. Another study (Taylor, 2001) showed that long-term emotional attachments of the surrounding environment contribute to older people's well-being. Living at home enables existing links with friends and family to continue, empowering older persons to stay socially active. Phillipson et al. (2001) linked social networks with living arrangements and household structure. Ageing-in-place also enables individuals to keep regular family contact with their children and other relatives.

The community environment is the primary aspect for older residents (Versey, 2018). They showed preferences for remaining in familiar setting, being a community member, relying on their neighbours and friends, and joining daily activities. According to Roberts et al. (2017), older people prefer to live in a setting with others they feel connected to base on their memories and experiences. The environment should be familiar in fostering a sense of safety and security for the residents (Dobner, Musterd, & Fortuijn, 2016). The social network and the social environment are intimately tied to this familiar environment. Most older people want to be active in their social network. (John & Gunter, 2016). They hope to be integrated into the community and carry on with a self-determined life. Joining in on the community's regular activities maximises older people's sense of fulfilment and helps them to maintain their current standard of living. (Boldy et al., 2011). It also enables them to use their abilities to support their community. In addition, engagement in the community is vital for older individuals' mental health. Older individuals can also avoid loneliness by being a part of a community (Sixsmith & Sixsmith, 2008).

Additionally, receiving support from the home and community is another benefit of ageing-in-place. Support is a key factor in achieving successful ageing-in-place. Support can be divided into formal and informal support involving personal assistance, the living environment, daily needs, and facilities (Pani-Harreman et al., 2020). The providers of formal support are service providers and professionals, and mainly involves the infrastructure, facilities, and services, for example pharmacies, grocery stores, public transportation, personal care and meal services (Dobner et al., 2016). Paid help typically assists with hard housework and provides personal care (Wilkinson-Meyers et al., 2014). A lack of amenities and few public transport options present crucial obstacles to ageing-in-place. Informal support is provided by family members, friends, neighbours, and the community, consisting

of light housework, shopping, meal preparation, transportation, and finances (Wilkinson-Meyers et al., 2014).

Summarising these studies, the social environment is undoubtedly acknowledged as playing a key role in terms of ageing-in-place. Maintaining existing social networks and gaining support from the family and community is closely linked with ageing-in-place and could bring benefits for both physical and mental health and the overall well-being of the older people in an ideal setting.

2.5.3.3   Technology

In recent decades, technology has been closely linked with ageing-in-place. Using technology may empower older individuals to live independently in private homes and enhance their feeling of safety and security (Pani-Harreman et al., 2020). Compared with institutionalised care, ageing-in-place may lighten older people's financial pressures while optimising health outcomes and prolonging independence. To enhance the possibility of accomplishing ageing-in-place, substantial innovation in incorporating advanced technologies will be required (Kim et al. 2017).

Smart homes are designed to provide continuous and remote monitoring of older people's health and well-being. These houses include communication and information technology, actuators, and environmental and wearable medical sensors (Majumder et al., 2017). Smart homes may allow older people to stay at home instead of moving to expensive and limited healthcare facilities or institutions. They also provide improved safety monitoring and care of older persons (Prescher et al., 2012). Smart homes have the ability to record patterns that represent older people's physical and cognitive health states and identify aberrant departures from typical patterns that likely point to issues that need to be addressed (Skubic et al., 2009). Accordingly, incorporating smart home technology into the care of older individuals with diminished capacities is becoming more common (Ding et al., 2011).

Different kinds of technology related to older individuals were identified in the literature: mobility technology, ambient intelligence, Information and Communication Technology (ICT), and biotechnology. According to Loe (2010), the term "mobility technology" encompasses much more than crutches, walkers, wheelchairs, and elevators and may refer to everything from cars to public transportation, security systems, specific shoes, clothes, and heaters, which enable older people to be more mobile. The ambient intelligence technologies have been used as strategies already adopted by older people by using various assistive devices in home modifications to support ageing-in-place (Van Hoof et al., 2011). Biotechnology,

such as medications, are generally associated with health and well-being. Recent innovations in digital health technologies hold considerable promise for transforming social isolation, autonomy loss and cognitive disorders to diagnose, prevent, monitor, and treat a wide range of conditions of older people (Piau et al., 2014). Building a system of care around digital technologies can improve convenience (Steinhubl & Topol, 2015). For example, tracking technologies can possibly monitor important physiological and environmental changes, seamlessly deliver preventative treatments, identify the early indications of chronic illnesses getting worse, and allow for early management or the identification and response to emergencies like falls or cardiac arrest. Moreover, a variety of ICTs, such as phones, computers, TVs, and radios, are incorporated by older people into their self-care routines and important activities. These technologies help them maintain or increase connection with others in their social worlds (Ghorayeb, Comber, & Gooberman-Hill, 2021) and control and help foster intellectual growth (Loe, 2010).

2.5.3 The role of inclusive design

Inclusive design is defined by the British Standards Institute (Keates, 2005) as "the design of mainstream products and/or services that are accessible to, and useable by, as many people as reasonably necessary ... without the need for special adaptation or specialised design". According to Park and Porteus (2018, p.19), the concept of inclusive design is "creating an environment that works for everyone". It is often used interchangeably with terms such as 'Design for All' and 'Universal Design' (Burton & Mitchell, 2006). It aims to remove barriers from the built environment to provide easy mobility to most users, which has a positive effect on users' well-being. Inclusive design emerges as a desire to bring disabled people into mainstream society, and as a response to demographic trends of population ageing (Burton & Mitchell, 2006; Handler, 2014).

According to Hadjri et al. (2016), inclusive design developed from universal design which prioritises the user needs, requirements and expectations in the building design process. The importance of user needs and the process of selecting the right set of user requirements is emphasised when considering inclusive design. User-centred design is a discipline for understanding user needs (Jordan, 1998), while user involvement (informative, consultative, and participative) methods play a vital role in the inclusive design process (Damodaran, 1996).

Resulting from the trend of population ageing, older people will increasingly need to live in an age-friendly or barrier-free and comfortable environment, both indoor and outdoor, to compensate for any physical and social change related with grow older (Hadjri et al., 2016).

At the same time, the inclusive design and enabling built environment are in accord with the age-friendly city and community concept and initiatives, as well as enabling ageing-in-place.

Many nations have created design guidelines to increase inclusion and equality (Hadjri et al., 2016). One example is the Lifetime Homes Standards in the UK, developed by the Helen Hamlyn Foundation and Habinteg (Foster, 1997). The Lifetime Homes Standards aim to enable "general needs" housing to design solutions that satisfy the current and evolving needs of many households, either from the beginning or through easy and affordable adaptation. The revised Lifetime Homes Standards by Habinteg (2010) provides a 16-point criteria checklist. Another insightful study into healthy ageing called Housing our Ageing Population Panel for Innovation (HAPPI) also highlights the role of inclusive design, which is based on 10 key design criteria (Barac & Park, 2009). Similarly, Design Council Commission for Architecture and the Built Environment (CABE) (2006) describes five principles of inclusive design. Hadjri et al. (2019) noted that inclusive design standards and guidelines should form the basis of supporting age-friendly environments that address disability and mobility as well as the visual and cognitive impairments associated with age related conditions. The mobility, sensory, and cognitive domains are key design areas that merit further study.

An inclusive outdoor environment has also drawn more attention in recent years. Burton and Mitchell (2006) pointed out that population ageing is increasing the need to design inclusively and encouraging product manufacturers and designers to take seriously the requirements of older people, including an inclusive outdoor environment to enable independence. They support the idea that ageing-in-place is usually what people want, and what is best for them. The role of inclusive outdoor environments for older people is as important as home in meeting their needs. Being able to go out is vital for older people, of which key benefits are summarised as follow: freedom of autonomy; dignity and sense of worth; fresh air and exercise (physical health); psychological well-being and enjoyment (mental health); and social interaction (Burton & Mitchell, 2006).

Summarising this section, definitions of ageing-in-place were reviewed at the beginning. Built environment (housing and community), social environment (support and social networks), and technology were reviewed as the three interactive key aspects of the age-friendly living environment which support ageing-in-place. From an architectural perspective, the role of inclusive design and design guidelines were also highlighted.

2.6 Conceptual Framework

At this stage, it is essential to build a conceptual framework as a roadmap to guide the field investigation of the research project. Figure 2.9 presents a conceptual framework which is built based on the existing knowledge from the literature review presented in the earlier sections of this chapter.

As the research aims to understand the role of an age-friendly environment in supporting ageing-in-place in urban mainstream community settings, understanding the critical aspects of the living environment and older people's requirements is necessary. Another significant task is concerning the meaning of the ageing-in-place concept and person-environment interaction. As a result, the environmental gerontology and P-E fit theory are enlightening in forming the conceptual framework for this research.
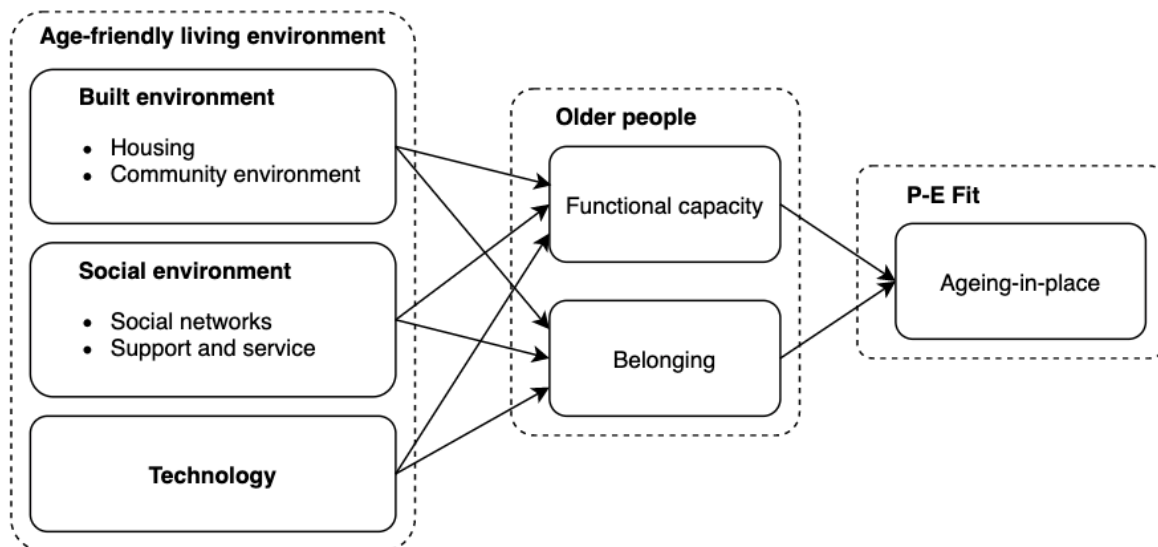
Figure 2.9 Research conceptual framework

The conceptual framework for this study consists of three main components, namely an age-friendly living environment, older people's demands, and P-E Fit scenario of ageing-in-place. The age-friendly living environment includes: the built environment, social environment, and technological application, targeted at supporting older individuals to maintain their functional capacity and a sense of belonging. It is presumed that the harmonisation of the environment and older people would fit well together and contribute to achieve ageing-in-place and ageing-well.

In this community-level study, an age-friendly built environment mainly involves housing conditions and community environment. As mentioned above, the home environment is

significant in people's later life, becoming increasingly relevant to personal health, as older people spend more time at home than in other settings. The quality and appropriateness of housing, such as insulation, heating/cooling, housing size, and design, are important environmental factors that influence older people's capabilities. Modifications at home (for example, removing obstacles or adding mobility aids) could enhance older adults' independence, reduce the risk of injuries, and promoting their well-being. The characteristics of the community environment, especially the accessibility and safety aspects, are also vital features influencing older people's ability to achieve ageing-in-place. This study will underline the characteristics of the age-friendly built environment and determine what are the harmful environmental factors for the older residents living in mainstream housing.

The social environment also plays a critical role in developing an age-friendly community as many older people prefer ageing-in-place because of the existing social networks, sense of belonging, support and service from family and community. Understanding the value of the social environment in mainstream communities and promoting the realisation of successful ageing-in-place by supporting social interaction is one of the focuses of this study.

The built environment and social environment are two aspects that influence each other. The built environment provides a place for a social environment, and social needs, in turn, affect the shaping of the built environment. The older people who choose to age-in-place usually face a contradiction. Their current living environment may present certain adverse factors with regards to growing old, but dependence on the environment will increase over one's lifetime. In this regard, the researcher poses the question: when the built environment of the mainstream community exposes some unsupportive problems for the older residents, how will the older people make the decision and balance the relationship between the two to maintain their existing social environment?

Additionally, the development of advanced technology and technological products plays a vital role in improving the age-friendly built environment, creating an online social environment and providing care and services. As a result, technology has been closely linked with ageing-in-place in recent decades. However, older individuals tend to be less accepting, or even resistant to new technological products. This study will explore the attitudes of older people towards technology and its relationships to ageing-in-place.

The conceptual framework aims to frame the knowledge basis of the research scope and thereby guide the research design approach. Another aim of the conceptual framework is to guide how further literature is sourced. The next chapter will focus on the Chinese context, followed by the framework presented above. In addition, the conceptual framework provides a lens through which data is themed and analysed. In Chapter 9, a detailed explanation is

given of how each conceptual framework component supported the development of the final framework.

2.7 Summary

This chapter presented a literature review establishing a global background to the research and developed a conceptual framework based on this existing knowledge. The literature began by covering global demography trends, including population ageing and urbanisation, to highlight the challenges posed by the shift in population structure. Then, the relationship between ageing and the built environment was explored by examining ageing, ageing and health, life-course and the built environment, leading to the concept of an age-friendly environment. From a theoretical perspective, environmental gerontology shed light on the role of the physical-spatial-technical environment on ageing. The chapter established the theoretical underpinning of this research to be the P-E Fit theory, which is an effective method in understanding the importance of an age-friendly environment in supporting older persons' ability to maintain independent living and achieve a health fulfilled life. The chapter further conceptualised ageing-in-place and unfolded three essential aspects to support this concept: built environment (housing and community), social environment (social networks and support), and technology. The literature review indicated the importance of inclusive design in developing a supportive living environment for people in later life. Based on the above, a conceptual framework was established to frame the knowledge basis of the research scope, guide the research design approach, and guide further literature review about the Chinese context in what follows.

CHAPTER 3.   THE RESIDENTIAL ENVIRONMENT OF OLDER PEOPLE IN URBAN CHINA

3.1   Introduction

China is undoubtedly the most crucial developing country regarding issues relating to population ageing. China is home to the world's largest population of older residents due to increasing life expectancy and reduction in fertility. Because of this combination of factors, China is facing rapid population ageing. Moreover, as a developing country, China has also been ageing at a lower level of national income than many developed countries. With this ongoing shift in demographic, China is facing unique problems and challenges in supporting its older population. This chapter starts with the Chinese context in population ageing and the living arrangements of older people therein. It also describes the residential environment of older people living in urban areas, focusing mainly on the age-friendly environment in supporting ageing-in-place. Based on the literature around the Chinese condition and the conceptual framework developed in Chapter 2, the research gaps will be explicitly defined to inform this PhD study's research aim and significance.

3.2   Population Ageing in China

In line with global demographic trends, China's population is ageing. According to official data from the Sixth National Population Census of the People's Republic of China, also referred to as the 2010 Chinese Census, which was conducted by the National Bureau of Statistics of China (NBSC, 2010, 2011), over 177.5 million older persons aged 60 years or over lived in China in 2010, accounting for 13.26% of the national population. Compared with the number in 2000, China experienced a growth in its elderly population of about 48 million within a decade (NBSC, 2002). Up to 2020, there were 264.02 million people aged 60 and above was, accounting for 18.70% of total population (of which 190.64 million people were 65 years of age or older, accounting for 13.50%). The percentage of adults aged 60 and older grew by 5.44% from 2010 to 2020 (NBSC, 2021).

On a global scale, almost one in four people worldwide who are 60 years or over were living in China in 2017 (see Figure 3.1). It is predicted that, between 2017 and 2050, the proportion of people aged 60 years or over will grow from 16 to 35% of the total population in China
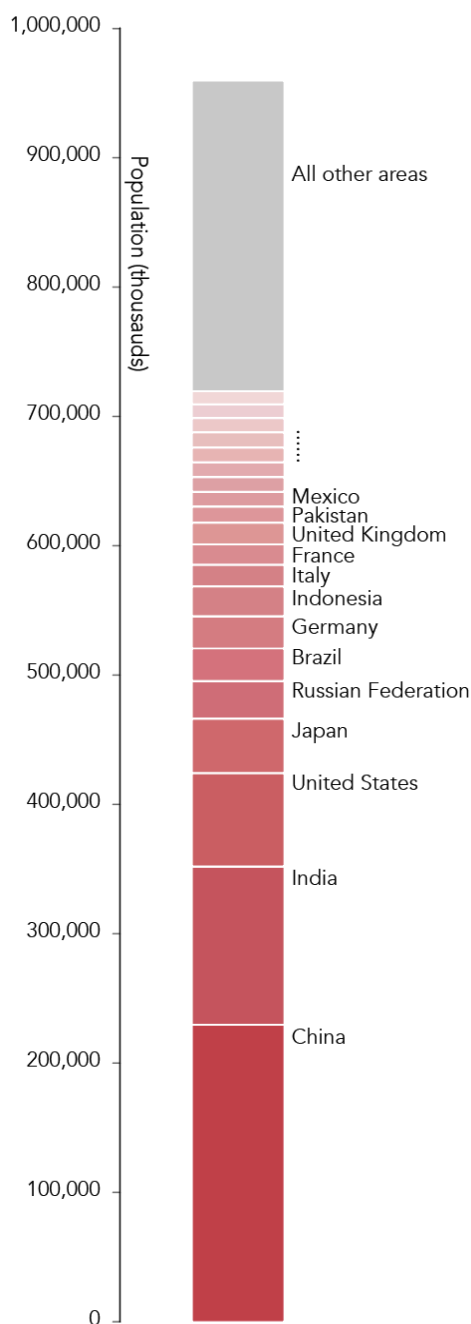
Figure 3.1 Population aged 60 years or over by country, 2017

Adapted from: United Nations (2017b, p.17)

(United Nations, 2017b). By the year 2050, China will have a population of people who are 65 years and over of 348.8 million, which will be greater than the combined total populations of Japan, Egypt, Germany, and Australia at 345.6 million (Wan et al., 2016).

Population ageing is happening considerably more quickly in China than it did in the earlier-developing nations. In particular, it took France 115 years, Sweden 85 years, Australia 73 years, the USA 69 years, the United Kingdom of Great Britain and Spain 45 years apiece for the proportion of persons over 65 to increase from 7 to 14% of the overall population. In comparison, the same change in the proportion of the older population is projected to take China around only 26 years from 2000 to 2026 (Kinsella & Gist, 1995; Kinsella & Phillips, 2005). Thus, China must adapt much more quickly to population ageing at a relatively lower income level than highly developed countries.

Generally, there are several demographic drivers of Chinese population ageing: increasing life expectancy, trends in fertility and declining mortality (Smith, Strauss, & Zhao, 2014). Between 1950 and 1955, the average life expectancy at birth was 43.8 years in China, but over the subsequent decades, life expectancy improved dramatically to 76.5 years between 2015 and 2020. Furthermore, it is projected that Chinese life expectancy will continue to grow to about 87 years at the end of the twenty-first century, almost double the level seen in the middle of the last century (United Nations, 2017d) (Figure 3.2).

Declining fertility is the second and arguably the most important driver of Chinese population ageing. In 1950, total fertility in China was 6.03 live births per woman (United Nations,

2017d). Better healthcare decreased infant mortality, the personal philosophy of Chairman Mao, and longer life expectancy fuelled the population explosion after the victory of the Chinese Communist Revolution in 1949 (Lewis, 1987). Following this, Chinese fertility rates saw a decrease from over 6 to 1.9 in the 1990s, due to the implementation of the later-longer-fewer policy (later marriage, longer spacing between subsequent births and fewer children), followed by strict one-child policy rules (Greenhalgh, 1990). The subsequent decline to lower levels continued to around 1.5 children per woman between 1995 and 2000. It is projected that Chinese total fertility trends will stabilise at around 1.6 by 2030 and will experience a slight growth to 1.8 by the end of the twenty-first century (United Nations, 2017a) (Figure 3.2).
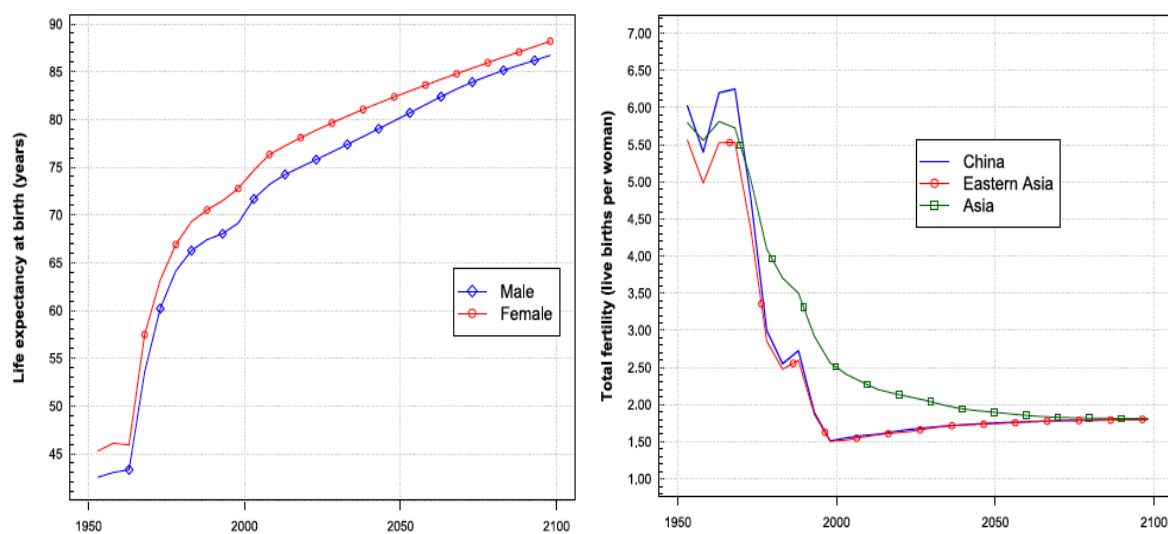
Figure 3.2 Total fertility and life expectancy at birth by sex in China

Source ： United Nations, (2017a, p.190)

Declining child mortality rate is another factor which contributes to population ageing by letting populations on average "older". According to the data from United Nations Inter-agency Group for Child Mortality Estimation (2021), the under-five mortality rate is 7.34 deaths per 1,000 live births, which was 62.62 deaths in 1980.

However, despite the increasing average life expectancy of the population, the quality of life of older people in China is not positive. Data from the sixth population census in 2010 showed that the prevalence rate of chronic diseases among older people in China is very high. Less than one-third of the older population is self-rated as healthy. The proportion of disabled older people increases with age, with nearly half of those aged 85 and older unable to take care of themselves. In terms of mental health, the situation of the older people in China is not optimistic. According to a 2010 sampling survey of the older population in China, more than half reported loneliness, among which 57% of the older people aged

between 75 and 79 feel they have become a burden to their families (Wu & Guo, 2014).

These demographic shifts can have significant implications for healthcare, pension funds, social services, and government revenue. Therefore, it is essential that these challenges are taken into account when making decisions and preparing for the future of cities. Cities throughout the region are starting to support active ageing by developing transportation, buildings, and public spaces that are accessible for those with mobility challenges as part of planning for a growing older population (United Nations, 2022).

This section presents demographic data and trends of the older population, its characteristics, and determinants globally and in China. The background indicates the significance and timeliness of ageing-related research.

3.3   Living Arrangements of the Chinese Older People

Due to substantial fertility declines since the 1970s as well as rural-urban migration in recent decades, the traditional Chinese family system of co-residence with adult children is under pressure (Zhao & Guo, 2010). As a result, a growing number of older people are living apart from their offspring. (He & Ye, 2014).

According to Zhang and Goza (2006), the one child per couple policy established in 1979 resulted in a reduction in fertility rates. Consequently, the country has been experiencing shifts in family structures, challenging the traditional family-based caregiving patterns for older people. Especially, the one-child policy resulted in an increased ratio between older parents, adult children, and the next generation. This problem has been named as "4:2:1" phenomenon, which means that middle-aged couples will be solely responsible for the care of one child and four older people (parents of the couple) (Hesketh, Lu, & Xing, 2005; Feng, 2014). As a proactive measure to address the ageing population, China announced in October 2015 that one-child policy has finally been replaced by a universal two-child policy (Zeng & Hesketh, 2016). However, demographers have projected that the two-child limit will not result in a baby boom (Zeng & Hesketh, 2016). More recently, in 2021, the Chinese government has implemented a three-child policy, which allows up to three children per couple (Tatum, 2021).

With the shifts in family structure, substantial changes in the older person's living arrangement were observed in China. Like other Asian countries, Chinese traditional culture emphasises filial piety, which contains the responsibility of children to respect and care for their parents. Chan and Tan (2004) emphasised that *xiao* '孝', commonly rendered as 'filial piety' or 'filiality', occupies a significant position in Chinese ethos to define the ideal

relationship between parent and child; "Among the various forms of virtuous conduct, xiao comes first" is a well-known Chinese proverb (Chan & Tan, 2004, p.1). In both past and present, the Chinese ethical worldview has been impacted profoundly by filial piety and Confucianism. Co-residence with the next generation is the traditional and most common living arrangement seen amongst previous generations of Chinese older people. Most contemporary older Chinese people still wish to live in familiar communities and enjoy life with their families. According to Guan et al.'s (2015) secondary analysis of the 2005 dataset of the Chinese Longitudinal Healthy Longevity Survey (CLHLS), 59.8% of the people in older age preferred to co-reside with their next generation, whereas 36.7% preferred to live alone or with a spouse, with only 3.5% preferring to live in a nursing home. However, with the rapid population ageing and family structure changes, increasingly fewer family members are taking care of older people by co-residency, especially after 1990 (Guan et al., 2015). The proportion of older people co-residing with their next generation decreased from 70% in 1990 to 57% in 2000. Consequently, an increasing number of older people have found themselves living alone or with their spouses (Feng et al., 2017).

Meng and Luo (2008) pointed out that a contributary reason for this decline seemed to be the growth in available accommodation as a result of the housing reform, allowing older people to choose preferred living arrangements. In the 1980s, when the housing situation was a constraint on elderly people's living choices, the level of co-residency revealed from the data might not reflect their real preferences. For instance, some older individuals may not want to live with their adult children because they prefer independence and want to avoid conflict with their children (Logan & Bian, 1999). A growing gap in attitudes and behaviours between the generations has appeared in Asian families (Croll, 2006). Conflicts between the two generations are common and not easy to resolve. Therefore, some older people may not want to co-reside with their adult children due to strained relationships, however, they may have to live with their children due to practical constraints, such as their next generation not having their own house (Guan et al., 2015).

The number of empty-nest older people, who live alone or with only a spouse and without children, has seen a steady growth in recent years (China State Council, 2017). According to the Data Analysis of the Sampling Survey of the Aged Population China 2010 (Wu & Guo, 2014), empty-nest older people accounted for 49.3% of the whole older population. Even though older people may show a preference to living alone or with a spouse, living as empty nesters has a negative impact on their life satisfaction (Guan et al., 2015). Gao et al. (2017) believes that if the empty-nest trend continues, the traditional family relations of older people supported by their children will certainly be challenged. Both home and community facilities and services will be needed to support an increasing number of empty-nests.

Living arrangements in later life are a critical determinant of older peoples' health and even mortality, and the foundation of receiving care (Feng et al., 2017) and ensuring well-being of people in older age (Ren & Treiman, 2015). This is supported by Waite and Hughes (1999, p.136) from a global perspective: ''various household structures make very different demands on the adults in them and offer very different levels and types of resources''. It has also been shown from empirical evidence that living arrangements are closely related to the life satisfaction of older people in China (Li, Chen, & Wu, 2008).

Yang and Fang (2018) summarised that the determinants of living arrangements include personal characteristics (demographic characteristics, educational background, health condition), family features (number of children, housing size and facilities), wealth issues, and policy legislation. The constraints of living arrangements of older people in China include income and health issues (care-delivery), while poor housing conditions, lack of support facilities and age-friendly rooms are important factors that impede older people from achieving ageing-in-place.

3.4   Ageing-in-place in China

As mentioned in the previous chapter, ageing-in-place is defined as "remaining living in the community, with some level of independence, rather than in residential care" (Davey et al., 2004, p.133), which involves providing services and creating an age-friendly built environment to support older people (WHO, 2015a, 2015b). This idea has attracted much attention globally and is often touted as a better option for supporting older people than admission to an institution (Cao et al., 2014). According to the data analysis of the sampling survey of the aged population in urban/rural China 2010 (Wu & Guo, 2014), 87.94% of the Chinese urban older people expressed an unwillingness to live in an institution.

In 2006, the Chinese Government (The State Council, 2006) officially proposed the initial concept of providing an ageing service system; to gradually establish and improve older peoples' service system, taking home care as the foundation, community-based service as the support, and institutions as the supplement. Since 2008, China has provided comprehensive support to implementing the ageing-in-place care model by encouraging and supporting older people in choosing to remain in their private homes and communities (The State Council, 2008). In Shanghai, the government took the lead in proposing the "9073" pattern, which encourages: 90% of the older people to take care of themselves or have families care, 7% of the older population to be provided with home care, day-care, assisted meals and other community care services, the oldest 3% or those with disabilities to live in institutions (Shanghai Municipal People's Government, 2007). Similarly, the Beijing

government (Zhu, 2015) follow the "9064" pattern to support their older population. As the care service structure, these patterns were put forward comprehensively on the basis of the investigation of the population scale and the ratio of care and service resources for older population. According to the age structure and spatial distribution characteristics of the older population within the planning scope, the facilities gap and structural adjustment direction are clarified on the basis of comprehensive analysis of the current stock of service facilities, and the total amount control could be proposed combined with the development prediction of population ageing (Yu & Tian, 2019).

By conducting focus groups with Chinese urban older people and experts, Gadakari et al. (2017) summarised a series of reasons to explain older individuals' preference of ageing-in-place in the Chinese urban context, involving save money; live with family and get care; help raise grandchildren; stay in familiar settings; keep a sense of independence, freedom and belonging; care homes cannot meet the required standard; and societal pressure and embarrassment associated with moving to a care facility.

Zhou and Walker (2021) noted that ageing-in-place respects older people's wishes and psychological needs and meet the majority of the older people's requirements, based on the national conditions and the traditional filial piety culture to reply to the population ageing challenges. However, Lu, Zhang and Zhang (2021) pointed out that the attitude of traditional filial piety has changed. Older people are more independent and express a reluctance to support from their children, especially when they need long-term care. It is unrealistic to take care of one's family entirely in modern China since the family structure has changed. Care of older people cannot depend solely on the care provided by their children, like the traditional care model of the large family, nor rely solely on institutions. Instead, the two complement each other, and are indispensable in the sense that jointly, they meet older people's care needs. Designing policy frameworks that create community support and service structures must take older people's needs into consideration; as a result, it is necessary to collect data that will define the extent of older people's care and support needs and to comprehend their perceptions of what they need to age safely in place (Cao et al., 2014).

As discussed in the previous chapter, the age-friendliness of the built environment, both indoor and in physical community environment, is another significant factor for older people in achieving successful ageing-in-place. Different communities provide diverse living conditions for the older residents, which will be presented in the next section.

3.5 Living Conditions of the Chinese Urban Older People

According to Chen, Yang, & Wang (2014), up to the end of 2010, the rate of homeownership for Chinese people in urban areas was 89.3%. Housing in urban China is supplied in a diversified multilevel provision system which includes four major components: market housing (new build commercial housing), privatised pre-reform public housing (also called staff accommodation or unit compound), old private or self-built housing, and post-reform public housing (Chen et al., 2014).

The data from China Longitudinal Ageing Social Survey (CLASS, 2016) shows that the homeownership rate of Chinese older people in urban areas is 87.75%. The urban China older people's housing is dominated by the privatised public housing built in the 1990s (welfare housing provision) (Chen et al., 2014). From the data analysis of the Sampling Survey of the Aged Population in Urban/Rural China 2010, Wang (2015) found that out of 9,653 older people in urban China, 83.88% of their housing was built before 2000, while only 16.12% was built after 2000 (see Table 3.1 for more details). Meanwhile, Wang (2015) pointed out that the aim of housing built between 1949 and 2000 was mainly to meet the general public's basic needs. Due to social and economic conditions and demographic changes that had not yet appeared during this period in China, these housing structures and supporting facilities were relatively underdeveloped.

Table 3.1 Year of build of older people's housing in urban China in 2010

Year of built	Number	Proportion (%)
Before 1995	6490	67.23
1995 - 2000	1607	16.65
2000 - 2005	983	10.18
2005 -	573	5.94

Source：Wang (2015, p.53)

Zhang, Zhang and Hudson (2018) suggest that housing conditions are more critical for older people than for younger people. However, younger people (26.52%) own more commodity houses than older people (21.47%) in China. Because the younger generation in China in general acquired their house more recently than previous generations, they are more likely to have bought private houses than that seen with older people (Zhang et al., 2018).

Two main types of Chinese urban housing will be introduced in the following subsections, privatised public housing and new market housing. Then, the Chinese mainstream housing design standards will be reviewed.

3.5.1 Privatised public housing and older residents

The earlier housing in urban China was mostly welfare housing allocated to employees. The socialist system in China has supplied urban housing since 1949. The government invested a significant amount of money in home building through economic planning (Wang & Murie, 1996). Public housing was a component of the socialist welfare system according to the socialist ideology. Employers were responsible for providing housing, especially for individuals who were directly employed by the state (Wang, 1995). In the early days of the new China, industrial construction started in the urban areas. Many workers and technicians joined the development and construction of cities. To meet their residential needs, a host of welfare housing (also called privatised pre-reform public housing, staff accommodation or unit compound) were built and allocated. Most of the owners of these welfare houses have since retired and are now into their old age. Thus, these old urban housing homes generally accommodate older people (Zhou & Qin, 2016).

This older urban housing presents many inconveniences to the older people who are current living there. According to the China Health and Retirement Longitudinal Study (CHARLS, 2013), just 22% of buildings have disabled-accessible features like ramps and 12.9% of buildings have more than 25 steps to get to the main door, 45.7% of older people live in walk-up multi-storey (often six storeys) structures (Gadakari et al., 2017).

Zhou and Qin (2016) pointed out that most older people's economic conditions do not allow them to buy better housing, and many prefer to continue living in a familiar environment with a sense of belonging. Therefore, home modification could be an essential solution for older people living in old housing in urban China (Sang & Ying, 2015).

In last century, the residential buildings in urban China were designed and built at a relatively basic level due to economic constraints, technology, labour, and insufficient design standards. Most of the old multi-storey housing is made of brick-concrete structures without a lift installed. With the population ageing seen in recent years and a lack of facilities and maintenance, the problems between the living environment and older people are becoming increasingly prominent. Zhou and Qin (2016) summarised the most severe issues found in old urban housing in Beijing into the following points:

- Most of the old urban residential buildings are not equipped with a lift. Before 1999, there were no clear standards about the lift in buildings below six floors. Older residents find it challenging to use the stairs to access their homes.
- The brick-concrete structure is difficult to reconstruct. The load-bearing walls restrict indoor spatial patterns; that is the room area is small, and the width of the access is

insufficient for the older people with a wheelchair. The indoor level difference is also high, especially in the main entrance, balcony, and toilet.

- The community infrastructure lacks public service facilities. Pavements, lighting systems and other infrastructure are old and lack barrier-free design consideration.

Based on the main problems stated above, retrofit suggestions and objectives as listed by Zhou and Qin (2016) are:

- To add lifts to the old residential buildings and improve barrier-free facilities.
- To improve the service facilities and infrastructures in the communities.
- To assist residents in carrying out home modifications according to their needs.

Similarly, Yu and colleagues (Yu & Chen, 2014; Yu et al., 2017) carried out a series of surveys into the living conditions of older people and related facilities in Shanghai. Their findings indicate that indoor and outdoor living environments, especially in the early built residential communities, disadvantage older residents. Yu and Jia (2015) suggest that the indoor living space should ensure older people's safety, health and comfort during their daily activities and provide necessary assistance facilities and equipment. Additionally, the outdoor living space directly affects the daily behaviour and older residents' motivation to go out, whereas it should be based on the basic principles of safety, accessibility, convenience, and comfort. The development of an age-friendly living environment, including home modification of the old residential buildings and communities, is considered a necessary guarantee to support ageing-in-place.

To summarise, the phenomenon and issues of population ageing is apparent in old residential buildings, which should therefore be retrofitted to meet older people's needs in living, care, and nursing. As mentioned above, most older people in urban China spend their later years at home. It is important to adapt the old residential buildings and surrounding settings according to their needs and requirements to support ageing-in-place. From an architectural perspective, inclusive design and an age-friendly environment could provide strong support for older people to extend their capacity and independence for as long as possible.

3.5.2 Market housing and older residents

According to the National Bureau of Statistics of China (NBSC, 2017), in 2017, more than 6.5 billion square meters of new private housing was being constructed. Although the lifetime of a new house can be over a hundred years, its design does not take account changes in

life-course, including the physical and function decline of residents and changes in family structure. For example, the adjustment of the birth policy increased the possibility of multi-generational living. According to Wu and Guo (2014), the proportion of older people who help their children care for their grandchildren was 38.38% in urban China in 2010. Three generations of the same family usually live together, especially when children are under three years old. The housing not only should meet the domestic needs of young couples and children but also the temporary living space for older people at home. In addition, for the increasing number of empty-nest older people who live in new private housing, the age-friendly environment and inclusive design are also very important.

In China, some housing on the market was designed to meet the living requirements of a family at a particular stage of life, for example, the rigid demand (gang xu 刚需) housing targets young couple's basic living needs, where attention is paid to the living area and cost-saving. At the same time, possible changes that may occur in the future were ignored during the design process, resulting in a lack of flexibility in response to changing demands of the occupants (Wang, 2018). Although the residents in the new market housing are mainly young and middle-aged, they will inevitably face various changes in the future such as multi-generational living with their parents. The consideration of their life-course needs should be considered during the initial design stage to avoid potential difficulties in the future.

Compared with the older residential building mentioned above, new housing functions are much improved and sanitation conditions have been significantly improved, but there is a general lack of refined design for the older residents, such as small bedroom space, narrow kitchen and bathroom, lack of handrails, indoor height difference, the hidden danger of the corridor and the lack of barrier-free design of the walking path in the outdoor environment (Yu & Jia, 2015). The following sub-section analyses the major factors shaping this phenomenon from the perspective of relevant legal policies and design standards.

3.5.3 Related laws, regulations, standards, and design guidelines in China

In terms of legislation, the age-friendly living environment first appeared in Chapter 6 "liveable environment" in the Law of the People's Republic of China on the Protection of the Rights and Interests of the Elderly revised and promulgated in 2012 (National People's

Congress (NPC) Standing Committee, 2012). For the first time, this piece of national legislation pushed for the construction of age-friendly environments and put forward construction principles, including four aspects: the urban public service facilities, engineering construction standard system, barrier-free construction, and age-friendly community construction. The 2015 revision continued to emphasise the importance of an age-friendly environment for the older population (NPC Standing Committee, 2015).

Table 3.2 lists the age-friendly environment related regulations and design standards. The specific measures concerning older people began in the 1980s with the construction of barrier-free urban roads and major public buildings in urban China by Ministry of Housing and Urban-Rural Development (MOHURD, MCA, & CDPF, 1989). With the increasing attention given to population ageing, several regulations and standards on the design of residential buildings for older people and care institutions have been issued since 1999 (MOHURD & MCA, 1999), and the construction level of institutional facilities has been gradually improved (MOHURD, 2003, 2008a, 2008b, 2013, 2016, 2018a; MOHURD & NDRC, 2011). However, besides the technical specifications for barrier-free design and day care centres for older people, there are few national standards for the construction of mainstream residential buildings suitable for older residents.

Currently, Codes for accessibility design (GB50763-2012) (MOHURD, 2012), is significant for older people as it ensures a barrier-free environment in the residential buildings. The codes stipulate: "Residential buildings with lifts should have at least one barrier-free entrance and exit, which can reach the lift hall through a barrier-free passage; For low-rise and multi-storey residential buildings without a lift, barrier-free access should be provided when planning barrier-free houses" and "Residential buildings should have at least two barrier-free houses for every 100 houses". Furthermore, the design of mainstream housing in urban China should follow the Standards for Urban Residential Area Planning and Design (GB50180-2018) (MOHURD, 2018b), Residential Building Code (GB50368-25) (MOHURD, 2005) and Design Code for Residential Buildings (GB 50096-2011) (MOHURD, 2011). There is a serious lack of age-friendly consideration in guiding the development and construction of mainstream housing. Table 3.3 summarises the age-friendly environment related contents in the above design standards.

Only six points are mentioned, and only briefly, concerning older people's needs in the Standards for Urban Residential Area Planning and Design (GB50180-2018) (MOHURD, 2018b). These involved activity areas, sunshine requirement, disabled parking, and location of day care centres. Similarly, another two codes (GB50368-25 and GB 50096-2011) also do not cover specific technical requirements to meet the needs of the older residents. As a result, it is difficult to provide necessary technical support for the development and construction of age-friendly housing and challenging to provide effective guidance for new building and retrofitting to achieve an age-friendly living environment.

Table 3.2 Related law, codes, and standards for the age-friendly environment in China

Name (Serial number)	Year	Approvers	Implement object
Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly	Promulgated in 1996 2012 First revision 2015 Second revision	NPC Standing Committee	The urban public service facilities, Engineering construction standard system, Barrier-free construction, Age-friendly community construction
Code for the design of urban roads and buildings for persons with disabilities (JGJ 50-88)	Promulgated in 1989 Replaced by JGJ50-2001	MOHURD MCA CDPF	Accessibility design of the city road and buildings
Code for design of buildings for elderly persons (JGT 122-99)	Promulgated in 1999 Replaced by GB 50340-2016	MOHURD MCA	Targeted at the residential buildings and public buildings for older person, such as older people's home and nursing for older people.
Codes for Design on Accessibility of Urban Roads and Buildings (JGJ50-2001)	Promulgated in 2001 Replaced by GB50763-2012	MOHURD	Accessibility design of the city road and buildings
Code for design of residential building for the aged (GBT50340-2003)	Promulgated in 2003 Replaced by GB 50340-2016	MOHURD	Targeted at the residential buildings for older person, such as older people's home and nursing home.
Code for planning of city and town facilities for the aged (GB 50437-2007)	Promulgated in 2008 2018 Revision	MOHURD	Targeted at the residential buildings and public buildings for older person.
Code for urban public facilities planning (GB 50442-2008)	2008	MOHURD	Urban public facilities, facilities for older people as a social welfare facility to participate in the provision of land.
Code for the construction of community day care centres for the older people (建标 143-2010)	2011	MOHURD NDRC	Home-based care service facilities for the aged
Codes for accessibility design (GB50763-2012)	2012	MOHURD	Accessibility design of the city road and buildings
Design code for buildings of elderly facilities (GB50867-2013)	Promulgated in 2013 Replaced by JGJ 450-2018	MOHURD	Targeted at the residential buildings for older person, such as older people's home, nursing home, and day care centre.
Code for design of residential building for the aged (GB 50340-2016)	Promulgated in 2016 Replaced by JGJ 450-2018	MOHURD	Applicable to the residential buildings for older people.
Standard for design of care facilities for the aged (JGJ 450-2018)	2018	MOHURD	Applicable to the design of new, reconstruction and expansion of the total number of beds or the total number of the older people not less than 20 beds (persons) care facilities.

Table 3.3 Age-friendly environment related contents in design standards of mainstream housing

Name (Serial number)	Age-friendly environment related contents
Residential Building Code (GB50368-25)	• Mainstream residential buildings can be equipped with several households for older people. • The sunshine standard for residential buildings for the older people should not be less than two hours on the winter solstice.
Design Code for Residential buildings (GB 50096-2011)	• Residential buildings design should be people oriented. In addition to meeting the requirements of general residential use, the needs of the older people, the disabled, and other special groups should be considered. • The steps of public entrances and exits are places where older people frequently fall. This article stipulates the width and height of steps to ensure the safety of older people walking in public entrances and exits.
Standards for Urban Residential Area Planning and Design (GB50180-2018)	• Conditions and places should be provided to facilitate the living and social activities of older persons and persons with disabilities. • Centralised green space should be set up for the older people's daily outdoor activities. • The sunshine standard for residential buildings for the older people should not be less than two hours on the winter solstice. • Day care centres for the older people should be included in the supporting facilities of the five-minute living circle, which can be centralised with community health service stations for the convenience of the older people. • Barrier-free parking spaces should be set up in the parking area. • The older people should be equipped with night lighting; Lighting design should not create light pollution for residents.

Compared with national policies, local policies provide more detailed guidance. For example, local standards in Jiangsu province (Design Standard for Residential Buildings DB32/3920-2020, which has been implemented since 1st July 2021) (Jiangsu Provincial Department of Housing and Urban-Rural Development, 2020, p.19) suggest that residential areas should be allocated space for home care services according to population size. The space for home care services should be set up in accordance with the scale of residential areas and should be at least 20 square meters per 100 households. Jiangsu province is gradually raising its awareness of and attention to the construction of material space foundations for home care for the older population. Since 2010, Beijing, Shanghai, Nanjing, Hangzhou, and other cities have started to promote the linkage mechanism based on: civil affairs, medical and health care, and planning management departments, paying attention to the effective integration and spatial implementation of older people's care services on community platforms, making positive exploration to improve the level of home care services and support ageing-in-place.

In Blue Book of Ageing - China Report of the Development on Liveable Environment for the

Elderly 2015, Lin (2015) examined the age-friendly environment related standards (up to March 2015) and policies and pointed out problems in several aspects, including the management system, making principles and methods, and specific contents, as presented in Table 3.4. Although the Standards for Urban Residential Area Planning and Design (GB50180-2018) (MOHURD, 2018b) has replaced GB50180-93 (2002 vision) (MOHURD, 2002), no significant change appeared in the age-friendly environment related contents.

Table 3.4 The problems of current Chinese standards for the design of older people's living environments

A. Standards with the management system	• The standards cannot match related policy. • Terminology difference in related fields and departments, such as care service, architecture, and urban planning. • Current standards cannot catch the rapid growth of market demands. • The development process is dominated by the government and lacks the participation of non-governmental organisations.
B. Making principles and methods	• Overemphasising the indicators. • Focused on concluding design requirements or implementation, but lack of principles from the essential or universal meaning of requirements.
C. Specific contents	• Lack of urban planning and public facilities standards. • Lack of urban public environment and community environment standards. • Lack of guidance for retrofitting projects. • Some standards are outmoded, such as the body dimension of the older people, new facilities, and assistive technologies.

Adapted from: Lin (2015)

In recent years, the consideration for older residents in mainstream residential design has gradually attracted more attention from academics. Yu (2017) summarised the key points of the planning and design of the age-friendly indoor and outdoor living area (see Table 3.5). Yu and Jia (2015) point out the lack of appropriate policies and technical guidance for the age-friendly environment in new housing in urban China. It is urgent to improve the age-friendliness in mainstream residential areas by sharpening laws and regulations, promoting basic research and implementing forward-looking practice.

Table 3.5 The key points of the planning and design of the age-friendly indoor and outdoor living areas

Outdoor environment	Planning	The overall shape External connectivity Density and volume ratio
	Residential buildings	Height Orientation and spacing

		Entrance and exit
		Vertical transport
		Corridor
		Doors and windows
		Balcony
	Public service facilities	Facilities configuration
		Construction indicators and setting requirements
		Layout and location
	Greenspace	Layout
		Scale
		Space control
		Plant configuration
		Waterbody
		Landscape sketch
	Road	Road network organisation
		Walking system
		Parking design
	Vertical design	Site height difference
		Slope requirement
	Space environment	Public activity space layout and scale
		Recreational facilities
		Identification system
		Floor paving
		Lighting facilities
		Other facilities
Indoor environment	Public part of the building	Entrance and exit
		Hall
		Vertical transport
		Corridor
		Exterior walls, doors, and windows
		Roof
	Residential space	Living room
		Bedroom
		Kitchen
		Bathroom
		Porch
		Doors and windows
		Balcony
	Facilities and equipment	Water supply and drainage system
		Gas and hot water supply system
		Heating and ventilation
		Fire and First Aid
		Lighting and electrical
		Intelligent system
		Lift

Adapted from: Yu (2017, p.28)

Similarly, Zhou and colleagues (Zhou & Li, 2018; Zhou & Qin, 2018) deliver designed guidelines in two books, one focusing on the community environment and the second focusing on the indoor environment, which interpret the design principles and main points in terms of the development of an age-friendly living environment. In the introduction, it is clearly pointed out that there is no systematic and clear requirement for an age-friendly environment in Chinese current residential planning and design standards, and most of the

residential community environments lack design consideration for older residents. In view of the construction requirements of the age-friendly living environment, Zhou and colleagues (Zhou & Li, 2018; Zhou & Qin, 2018) put forward a series of design principles and key design points (see Appendix 3.1 and 3.2), which have instructive significance for the data collection of this study as suggested by the analytical framework. With this argument in view, this doctoral research will further explore the impact of the lack of consideration of older residents in the design standards of mainstream housing in urban China.

3.6 Research Gaps

It is worthwhile to summarise the main findings of the literature review thus far. Ageing-in-place is advocated by governments, older people, and many stakeholders globally and China. However enabling older people to age-in-place is a challenging task that necessitates the resources required for them to stay in their own homes and communities (Kim et al., 2017). It necessitates thorough planning, the availability of a variety of community support services, and the removal of barriers that keep older people segregated and restrict their activities (Lui et al., 2009). In other words, the provision of an age-friendly living environment. From the theoretical perspective, the significant importance of a supportive environment has been highlighted by multiple disciplines, including psychology, ecology, environmental gerontology, preventive medicine, architecture, and urban planning.

From reviewing the literature on age-friendly environments worldwide and in a Chinese context, several research gaps have been identified. Firstly, from a global perspective in Chapter 2, developed countries and regions with a high degree of ageing have gradually formed a relatively complete research and action framework. Age-friendly programmes in developing nations received less attention in research. In reality, low- and middle-income nations will face the greatest rate of demographic change; it is predicted that by the year 2050, more than 80% of the world's older population would reside in developing nations, up from 60% in 2005 (United Nations, 2013). The age-friendly interventions for Chinese context are worthy of research and exploration. The relationship between older people and the environment needs to be further understood and explored to provide a scientific basis and action direction for the construction of age-friendly environments. Establishing a forward-looking holistic framework would be helpful in resolving the current dilemma.

Secondly, despite the policies that advocate and encourage ageing-in-place, we lack an understanding of the meaning of ageing-in-place for the older people in urban China. For example, what are the motivations for the older people in Urban China to prefer ageing-in-

place? What are the advantages of staying at home? What are the challenges they face in the process of ageing-in-place? Whether there are potential concerns about the future? According to a research conducted by Glass et al. (2013), family-centred care is no longer viable in China. The availability of traditional family caregivers has decreased as a result of changes in Chinese culture like the one-child policy, rural-to-urban migration, and the rise of female working professionals. The above cultural factors and developmental changes will affect the living patterns and requirements of the older population in China.

Thirdly, the research results of Chinese scholars mostly focus on residential community specialised for older people (not mainstream community), care facilities, development planning, and lack exploration into the relationships and influence mechanisms between the environment and older individuals. While age-friendly programmes which focus on technical or architectural guidelines appear in China, the recent discourse on age-friendly communities at a global level has emphasised the role of integrated social and built environment in enhancing older people's quality of life.

Finally, a model of collaborative governance is required. Multi-stakeholder collaborations are an important factor in helping to build a mutually enhancing environment for older individuals. Particularly, policymakers and city planners should be encouraged to take a proactive method and engage with older persons themselves in creating an age-friendly environment. As the reviewed model (Rosenwohl-Mack et al., 2020) suggests, cross-sectoral involvement with both top-down and bottom-up input is necessary to develop an age-friendly environment.

In summary, there is limited evidence from the perspective of older people themselves concerning ageing-in-place and the role of the built and social environment in an urban Chinese context. In-depth research, combining top-down and bottom-up approaches is necessary to understand older people's real requirements and reasons and propose effective suggestions accordingly.

3.7 Research Questions and Objectives

Based on the research gaps discussed above, this PhD study aims to develop a design and retrofitting framework to better understand ageing-in-place and to support the development of age-friendly environments for older people in urban China. The framework will fill the gap on age-friendly initiatives in the developing world, including an integrated physical and social aspect and following a multi-stakeholder participatory and collaborative process. It can also be used as a reference for solving other developing countries' ageing population issues.

Additionally, the framework will provide a holistic tool that will be developed into policy recommendations and practice guidelines to benefit the older population and communities in urban settings.

The main research question was defined as how to support older people in urban China and achieve ageing-in-place by building an age-friendly living environment? Table 3.6 presents sub-questions (Q1-Q5) and corresponding objectives (O1-O5) in this study. There are five objectives set to answer the research questions and accomplish the purpose of the research step by step. Those questions and objectives will drive the subsequent development of the research design.

Table 3.6 Research questions and objectives

Research questions	Research objectives
Q1: How age-friendly are the housing, facilities and community environment in Chinese urban mainstream residential communities?	O1: To evaluate the age-friendliness of the physical environment in contemporary mainstream residential communities urban China.
Q2: How is ageing-in-place conceptualised in urban China, and do older people prefer to age-in-place?	O2: To conceptualise ageing-in-place in the case of urban China and establish whether older people prefer to age-in-place.
Q3: How does the built environment (including housing, community and technology) influence older people's ability to age-in-place?	O3: To establish the relationship between the built environment and older people's ability to achieve ageing-in-place.
Q4: How does the social environment (including social networks, care and service, and technology) influence older people's ability to age-in-place?	O4: To understand the relationship between the social environment and older people's motivation and ability to achieve ageing-in-place.
Q5: How to support older people in urban China to achieve ageing-in-place by building an age-friendly environment? How is the age-friendly environment supported by design, planning and community services?	O5: To develop a design and retrofitting framework to improve age-friendly living environment and help older people achieve ageing-in-place.

Current models and theories underpin the ageing-in-place, P-E fit, and inclusive design as outlined in Chapter 2 and Chapter 3 which provided the theoretical framework for this investigation and were the guiding themes for this study. The detail case study design will be presented in Chapter 4.

3.8 Summary

Firstly, the demographic background and concept of ageing-in-place were reviewed based on the Chinese perspective. China is experiencing an ageing population with global ageing trends. Population ageing is taking place much more quickly in China than was experienced

in countries which developed earlier. There is an urgent need for conducting ageing-related research to support the older population. Based on the cultural and historical background of Chinese, the living arrangements of older people have experienced a shift in recent years. Ageing-in-place has been identified as respecting older people's wishes and psychological needs and meeting the majority of the older people's requirements, based on the national conditions and the traditional filial piety culture to reply to the population ageing challenges. To achieve ageing-in-place, an age-friendly living environment is necessary. The living conditions of the Chinese urban older people were created by the housing types: privatised public housing and new market housing. Additionally, related laws, policies, and design standards from the national and local level have been reviewed.

According to the literature review in Chapter 2 and Chapter 3, four main research gaps have been outlined: 1) age-friendly interventions in developing country, 2) a new conceptualisation of ageing-in-place in the case of urban China, 3) exploration of the relationship and influence mechanisms between an integrated physical and social environment and the older individuals, and 4) a model of collaborative governance. To fill the research gaps, the research questions and objectives of this study are clearly defined. Based on these research gaps, this doctoral research will explore the impact of the lack of consideration of older residents in the design standards of mainstream housing in urban China. The study aims to develop an age-friendly design and policy framework to support the development of an age-friendly living environment for older people and promote ageing-in-place in urban China. The next chapter will present the research design and explain the plan of whole study.

CHAPTER 4.   METHODOLOGY AND RESEARCH DESIGN

4.1   Introduction

This PhD study is interdisciplinary real-world research carried out across several disciplines in the social sciences, including architecture, sociology, and environmental gerontology (ecology of ageing). This chapter focuses on the methodological path and the considerations that underpinned this PhD research. It explains what the researcher's approach is to ensure the reliability and validity of the research. As Robson and McCartan (2016, p.3) state, methodology is "the fundamental principles on which the methods of social research are based".

This chapter begins with the researcher's philosophy of knowledge and selects an appropriate approach to theory development to provide a philosophical foundation. Based on the research questions and objectives presented in Chapter 3, qualitative case study research was decided as the research strategy to answer the research questions and address the research gaps. This chapter then goes on to discuss the case study research design and explain data collection and analysis. The ethical considerations, credibility and validity in this research are presented at the end of this chapter.

4.2 Understanding Research Philosophy and Approaches to Theory Development

The term "Methodology" refers to "the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes" (Crotty, 1998, p.3). The following sections present the methodological considerations and research design based on the "research onion" (Figure 4.1) proposed by Saunders et al. (2019, p.130). The research onion presents a systematic guideline for decision-making during the research design process. In keeping with the research onion, as shown in Figure 4.1, the data collection and analysis belong in the centre of the "onion". Before this central core, considerations on several layers must be taken into account to explain the decision-making process regarding the research. The outer layers of the "research onion" include philosophies, approaches to theory development, methodological choices, strategies, and time horizons. Several layers are vital and must be consistently employed when conducting research "rather than just peel and throw away" (Crotty, 1998;

Saunders et al., 2019, p.128). This section is concerned with the outer two layers of the onion: research philosophy and approach to theory development in this study.
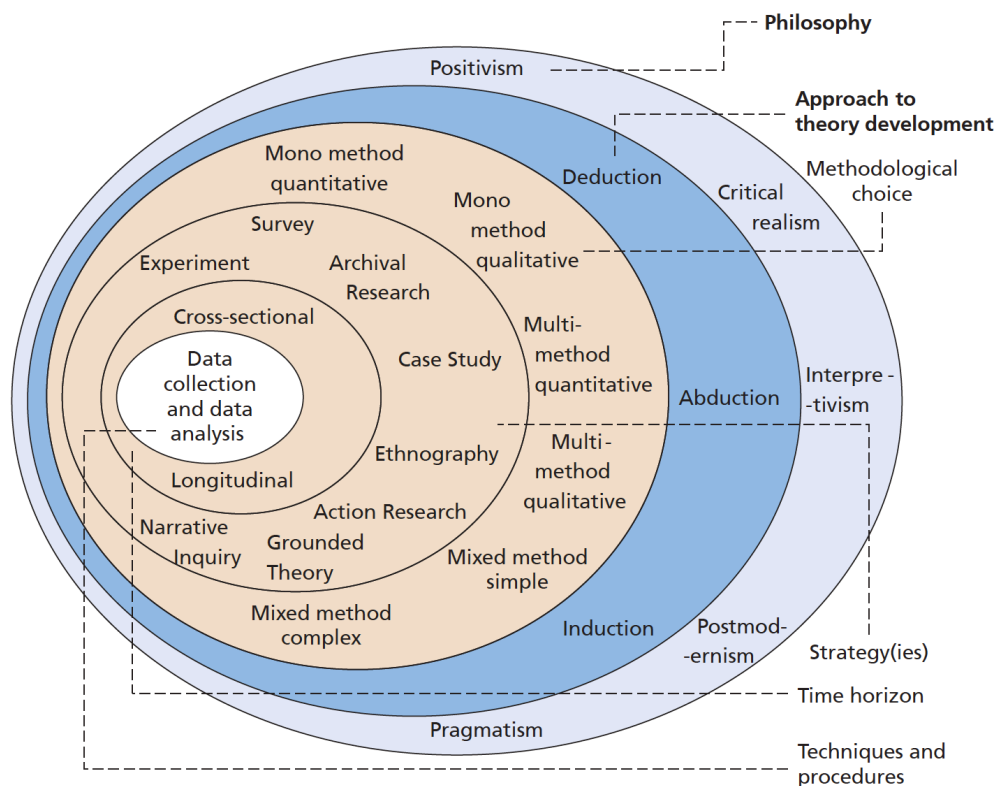
Figure 4.1 The "research onion"

Source: Saunders et al., (2019, p.130)

4.2.1 Research philosophy

According to Saunders et al. (2019, p.130), the term research philosophy means "a system of beliefs and assumptions about the development of knowledge", including but not limited to ontological assumptions (about the realities encountered in research), epistemological assumptions (about human knowledge), and axiological assumptions (about the extent and ways one's values influence one's research process).

Those assumptions inevitably shape how a researcher understands research questions, selects methodology and methods, and interprets findings. Trigg (2001, p.255) claims that "the philosophy of the social research cannot be an optional activity... It is the indispensable starting point for all the social sciences". Groat and Wang (2002) also note that, as an architectural researcher, one's choice of a particular research design is necessarily framed by the researcher's assumptions.

Ontology, epistemology, and axiology

Ontology, epistemology and axiology are the three main types of research assumptions that should be considered when deciding on research philosophies and before making the decision for individual research. The explanations of those terms are given as follows:

Ontology refers to assumptions about the nature of reality (Saunders et al., 2019). Burrell and Morgan (2016) point out the ontological assumptions is the essence of the phenomena under investigation. It is divided into being ontology and becoming orientation (Chia, 2002).

Epistemology refers to "assumptions about the grounds of knowledge – about how one might begin to understand the world and communicate this as knowledge to fellow human beings" (Burrell & Morgan, 2016). Epistemology focuses on the knowledge discovery process. It pays attention to the method(s) selection and the strengths and limitations of research findings (Saunders et al., 2019).

Axiology refers to the role of values and ethics within the research process (Saunders et al., 2019). The researcher needs to decide how to deal with both their own values and participants values. As Heron (1996) argues, it is essential that the researcher clearly recognises and reflects on these during the research phases.

Research philosophy in this research

Gray (2018) states that the researcher's epistemological stance influences their theoretical perspective, and their theoretical perspective influences their chosen methodology, which in turn will influence their decision on data gathering methods. A relationship between the research philosophy components and theoretical perspectives is presented in Figure 4.2. Different philosophical positions are also called theoretical perspectives (Gray, 2018) or research paradigms (Petty, Thomson, & Stew, 2012a) and are available in social science research. The most commonly referred to in the literature are positivism and interpretivism.

The researcher's position in this study resides within the being ontology, constructivism epistemology and interpretivism theoretical perspective, highlighted by the bold line in Figure 4.2. Bristow and Saunders (2014) designed a reflexive tool called Heightening your Awareness of your Research Philosophy (HARP) to help the researcher explore their own research philosophy (Saunders et al., 2019, p.161-164). The HARP lists 30 questions to test researcher's agreement with the ontological, epistemological, axiological, purpose of research, the meaning of data and structure and agency aspects of research philosophy. Following this tool, the interpretivism philosophy of the researcher in this research is reconfirmed.

Research Philosophy means 'a system of beliefs and assumptions about the development of knowledge', including but not limited to ontological assumptions, epistemological assumptions, and axiological assumptions (Saunders et al., 2019, p. 130).	Ontology refers to assumptions about the nature of reality (Saunders et al., 2019, p. 133).	Being ontology	Becoming ontology
	Epistemology refers to 'assumptions about the grounds of knowledge – about how one might begin to understand the world and communicate this as knowledge to fellow human beings' (Burrell & Morgan, 2016).	Objectivism incorporates the assumptions of the natural sciences, arguing that the social reality that we research is external to us and others (Saunders et al., 2019, p. 135).	Constructivism Truth and meanings do not exist in some external world, but are created by the subject's interactions with the world (Gray, 2018, p. 22).	Subjectivism incorporates assumptions of the arts and humanities, asserting that social reality is made from the perceptions and consequent actions of social actors (people).
	Axiology refers to the role of values and ethics (Saunders et al., 2019, p. 134).			
	Theoretical perspective	Positivism	Interpretivism	Postmodernism

Figure 4.2 The relationship between the research philosophy components and theoretical perspectives

Source: Author adapted from: Burrell & Morgan, (2016); Gray, (2018); Saunders et al., (2019)

Interpretivism

This research resides within the interpretivism research theoretical perspective (research philosophy/paradigm). Saunders et al. (2019) claim that "Interpretivism is a subjectivist philosophy". Interpretivist assumes that people seek understanding of the world in which they live (Blaikie, 2007). Interpretivism underlines that people are different from physical phenomena as they create meanings, without direct, one-to-one relationships between the subjects (ourselves) and object (the world) (Gray, 2018; Saunders et al., 2019). Interpretivism aims to create new, richer understandings of organisational realities.

In terms of epistemology, interpretivism is linked to constructivism, which argues that "truth and meaning do not exist in the same external world but are created by the subject's interactions with the world" (Gray, 2018, p.22). The interpretive epistemology believes that knowledge acquired is socially constructed, understanding the multiple views of people in a particular situation (Petty et al., 2012a). Interpretivism is based upon the being ontology (Chia, 2002).

Interpretivism claims that human beings and social worlds are different and therefore need to be studied by taking a different approach to physical phenomena (Gray, 2018). Saunders et al. (2019) explain that because persons with different cultural backgrounds, at different times and under different conditions, make different meanings, and so create and experience

different social realities, interpretivism is critical of the positivist attempts to find definite, universal "laws" that apply to everyone. If such complexity is reduced entirely to a series of law-like generalisations, rich insights into humanity will be lost. The intention of interpretivist study is to find new, richer understandings and interpretations of social worlds and contexts.

4.2.2 Approaches to theory development

In terms of the logical relationships between a research project and theory development (also called the place of theory), deduction and induction are the two main approaches (Gray, 2018). Different philosophies tend to lead researchers to different approaches, with interpretivists leaning towards induction, due to its relationship with humanities and its accent on the significance of subjective interpretations (Saunders et al., 2019). Generally, researchers use an inductive approach, starting by collecting data to explore a phenomenon and generating or building a theory or a conceptual framework. Researchers in the inductive approach are more likely to work with qualitative data and use various methods to collect these data to establish different views. Therefore, the inductive approach plays a vital role in this research, mainly dealing with interview data. On the contrary, the deductive approach involves propositions or hypotheses related to an existing theory, while the research strategy is designed for theory falsification or verification (Saunders et al., 2019).

Note the procedure of this research is partly deductive (based on the statements or propositions at the outset of the site evaluation from the multiple-case study) and partly inductive (based on the interview data). For evaluating the age-friendliness of the residential community environment, it follows a deductive approach by referring to the analytical framework, which was introduced in Chapter 3 based on the literature review. Regarding the interview data, which aims 1) to explain why older people choose ageing-in-place; 2) to explain the relationship between the age-friendly environment and older people's ability to achieve ageing-in-place; inductive reasoning was conducted.

4.3 Formulating the Research Design

Following the research philosophy choice and decision of the approach to theory development in the above section, this section presents the methodological choice and research strategy, which focuses on research design and answering the research questions (Saunders, Lewis, & Thornhill, 2015).

4.3.1 Methodological choice: qualitative research

The justification for the methodological choice should be based on the nature of the research questions and objectives and be informed by researcher's philosophical assumptions (Saunders et al., 2015). Denzin and Lincoln (2011) state that qualitative research is often connected to an interpretive philosophy. The qualitative method helps to comprehend social movements, cultural phenomena, and cross-national exchanges as well as people's lives, behaviours, lived experiences, emotions, and opinions (Strauss & Corbin, 1990). This approach provides more chances to discover the similarities and differences between people's lives and to interpret their thoughts and actions (Strauss & Corbin, 1990).

Groat and Wang (2013) list the major strengths of the qualitative approach in architectural research: (a) capacity to take in the rich and holistic qualities of real-life circumstances; (b) flexibility in design and procedures allowing adjustments in the process; and (c) sensitivity to the meanings and processes of artefacts and people's activities. These significant advantages also come with some weaknesses, including the challenge of dealing with vast quantities of data.

The qualitative approach is appropriate for this study which aims to understand the experiences and feelings of the older people living in urban China, combined with multiple experts' opinions, to develop a richer theoretical perspective than what already exists in the literature (Saunders et al., 2019).

4.3.2 Research strategy: case study

Research strategy is defined as "a plan of how a researcher will go about answering her or his research question" (Saunders et al., 2015, p.177). The research strategy is a methodological link between researchers' philosophy and their choice of data collection and analytical methods (Denzin & Lincoln, 2011). Saunders et al. (2015, p.178) points out that the decision also needs "pragmatic concerns including the extent of existing knowledge, the amount of time and other resources you have available and access to potential participants and to other sources of data". The choice of research strategy should be guided by the research questions and objectives. Considering the above elements and comparing a series of qualitative research strategies (case study, grounded theory, action research, narrative inquiry, and ethnography), the case study strategy was selected for conducting this study as the most suitable one to answer the research questions.

Yin (2018, p.15) defines a case study as an empirical inquiry that "investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context may not be clearly evident". In other words, it is suitable for answering 'how' or 'why' questions which are being asked about a contemporary set of events and over which a researcher has little or no control, and also questions which require an extensive and 'in-depth' description of some social phenomenon.

As noted by Stake (1995, p.xi), "Case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances". Groat and Wang (2002, p.346) amend this definition to architectural research stating, "an empirical inquiry that investigates a phenomenon or setting". Simons (2009, p.10) points out that the case study "is research-based, inclusive of different methods and is evidence-led. The primary purpose is to generate an in-depth understanding of a specific topic, programme, policy, institution or system to generate knowledge and/or inform policy development, professional practice and civil or community action".

As this research focuses on real-life contexts, trying to explain connections between the older population in urban China and their residential choice, the case study has been selected as the appropriate research strategy. Considering the nature of the research questions, the scope of the research and the role of replication in confirming the study's outcomes, the multiple-case design is deemed appropriate for this study which aims to investigate this topic in different settings. The case study will be done at the community level to understand older people's choices, met and unmet needs, and the challenges of an inadequate environment.

4.4   Research Design

This section presents the research design, which aims to fill the research gaps and achieve the research objectives presented in Chapter 3. Yin (2018) defines research design as a logical plan for moving from research questions to conclusions. Nachmias and Nachmias (2014) cited in Yin (2018) state a research design as a logical model of proof. Research design is an overarching plan, including describing research purpose, research questions, data collection techniques, sample selection, and data analytical methods (Gray, 2018).

The main research question of the study is how to support older people in urban China to achieve ageing-in-place by building age-friendly living environment? This question is based on the proposition that the living environment highly influences older people's ability to live independently, based on existing knowledge such as the Press-competence Model (Lawton

& Nahemow, 1973), P-E Fit theory (Wahl & Oswald, 2010) and Ecological Model of Active Living (Sallis et al., 2006). The next components of designing case studies are identifying case(s) and establishing the logic of the case study. In this research, according to the nature of study questions and the urban Chinese context reviewed in Chapter 3, residential communities were identified as cases to be studied. After reviewing the Chinese urban housing development in Chapter 3, residential communities were classified into three main types in this study: privatised public housing (housing built before 1998), market housing following old design standards (housing built between 1998 and 2012), and new market housing built after 2012. This research plans to select three cases according to build year as typical examples of each type of different residential community to conduct fieldwork.

The development of the research design for this study was driven by the research questions and objectives of the project. Table 4.1 is a reminder of the research questions and research objectives of this study.

Table 4.1 Research questions and objectives

Research questions	Research objectives
Q1: How age-friendly are the housing, facilities and community environment in Chinese urban mainstream residential communities?	O1: To evaluate the age-friendliness of physical environment in contemporary mainstream residential communities urban China.
Q2: How is ageing-in-place conceptualised in urban China, and do older people prefer to age-in-place?	O2: To conceptualise ageing-in-place in the case of urban China and establish whether older people prefer to age-in-place.
Q3: How does the built environment (including housing, community and technology) influence older people's ability to age-in-place?	O3: To establish the relationship between the built environment and older people's ability to achieve ageing-in-place.
Q4: How does the social environment (including social networks, care and service, and technology) influence older people's ability to age-in-place?	O4: To understand the relationship between the social environment and older people's motivation and ability to achieve ageing-in-place.
Q5: How to support older people in urban China to achieve ageing-in-place by building an age-friendly environment? How is the age-friendly environment supported by design, planning and community services?	O5: To develop a design and retrofitting framework to improve age-friendly living environment and help older people achieve ageing-in-place.

Because of the nature of the research questions, and control of project time and travel costs, this study was set as a cross-sectional study in the design stage, as shown in Figure 4.3. Three case studies were conducted during the same period using the same data collection and analytical methods. The following sections describes the research objectives and explains how these objectives contribute to the research project and provides a descriptive explanation of how each objective is be achieved.
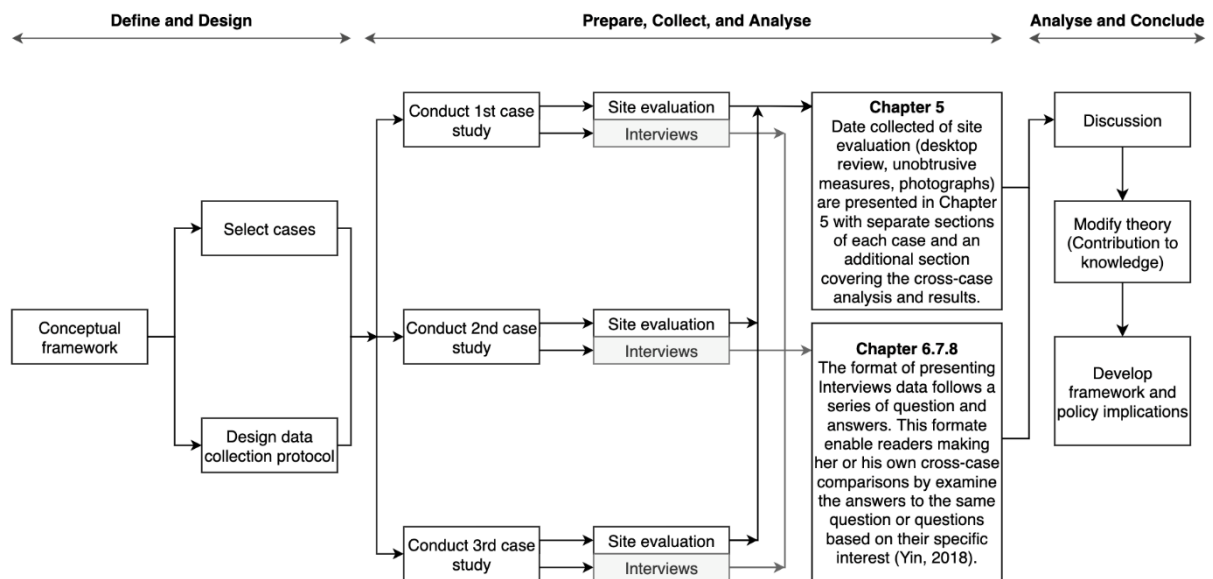
Figure 4.3 Multiple-case study procedure

Source: Adapted from Yin (2018, p.58)

4.4.1 Objective 1: Housing conditions assessment in urban China

The first objective was to assess the housing conditions in urban China. The aim was to reveal the urban mainstream communities and private dwelling environments from an age-friendly environment perspective and identify environmental barriers to achieving ageing-in-place in the different urban residential community settings. This objective is essential for forming the research settings and providing the necessary evidence for understanding the data and informing the formation of the framework afterwards. Direct site observation was combined with a desktop review and researcher-created photographs to achieve the research Objective 1. The desktop review collected general information about the site, including population data, site plan, and surrounding infrastructure, to acquire basic information before starting the fieldwork. During the fieldwork, the direct site observation was conducted according to the analytical framework. In addition, images are helpful as a mode

of interpretation and representation. The researcher took photographs of space and constructions to provide visual evidence to the fieldnotes (Chapter 5).

4.4.2 Objective 2: A new conceptualisation of ageing-in-place in urban China

According to the literature review, ageing-in-place is advocated by academia and practice both at the global level and in the Chinese context. Therefore, Objective 2 was to interpret and understand the ageing-in-place concept in contemporary urban China and identify the challenges multi-stakeholders face during ageing-in-place. This objective seeks to answer the following questions: 1) What is the Chinese urban peoples' understanding of the meaning of ageing-in-place? 2) What are the challenges facing older people in achieving ageing-in-place in urban China? and 3) What are the differences between ageing-in-place and ageing in a care facility? The data was collected through semi-structured interviews with older residents and experts to shed light on their motivation, attitudes, experiences, and tasks throughout the ageing-in-place process. Motivation represents reasons used to explain behaviour, and in this research, it can be understood to be the positive side of ageing-in-place. Conversely, the challenges here represent the difficulties and negative aspects of realising ageing-in-place. Arguably, understanding the motivations why most older people prefer ageing-in-place in current Chinese urban settings and challenges during this process will inform the development of a holistic framework for promoting ageing-in-place (Chapter 6).

4.4.3 Objective 3: The role of built environment in promoting ageing-in-place

Based on the conceptual framework formed by the literature review in Chapter 2, it is shown that older people's functional capacity and health benefits can be enhanced by living in an age-friendly environment. The built environment has a significant influence on supporting older people's independent living. Therefore, Objective 3 established the role of an age-friendly built environment in promoting ageing-in-place by exploring the characteristics of an age-friendly built environment in mainstreaming housing and establishing the relationship between the built environment and older people's willingness to continue living at home. The empirical data was collected by semi-structured interviews with older people and experts. It provided evidence to develop a design and retrofitting framework to facilitate a more age-friendly living environment and help older people achieve ageing-in-place (Chapter 7).

4.4.4 Objective 4: The role of social environment in promoting ageing-in-place

The social environment also plays a critical role in developing an age-friendly community. Older people who prefer ageing-in-place might attribute this to their existing social networks, sense of belonging, support and services from family and community. This is the goal of Objective 4, which aims to describe these emotional and experience-based aspects of the place, including the role of social networks, social support, and technologies, and to advance the investigation of ageing-in-place by exploring how the social environment influences successful ageing-in-place. This is indispensable in a holistic framework for a supportive living environment for the older population. Objective 4 focuses on the components of the social environment for older people and establishes the relationship between the social environment and their ability to achieve ageing-in-place. Similar to the Objective 3, the data for this objective was also carried out by conducting semi-structured interviews with older dwellers and experts (Chapter 8).

4.4.5 Objective 5: Framework development

Objective 5 is the ultimate goal of this research project, supported by the preceding data and objectives mentioned above, to build an age-friendly design and policy framework. The framework targets supporting the older population to achieve ageing-in-place by improving their living environment. The conceptual framework provides main themes for the holistic age-friendly living environment framework: built environment, social environment, and technology. The findings from each objective were synthesised in this step. The output of this study combined the conceptual framework and related theories from the literature review and research findings from the case study. This framework targets support to able the older population to achieve ageing-in-place by improving their living environment by making it more age-friendly. Chapter 9 also presents framework for stakeholders to help in applications and put forward recommendations for policy and practice.

In summary, this study uses multiple-case study research. The study aims to build a holistic design and policy framework to guide the improvement of the living environment in urban Chinese mainstream residential communities to be more age-friendly and enable the older residents to live at home for as long as possible. As presented in Figure 4.4, the whole study was broken down into five sub-research questions and five corresponding objectives. The fieldwork involved collecting data from three distinct residential communities which represented typical examples of the types of housing built during different time periods. The main sources of evidence collected during fieldwork consist of direct observations, interviews with older residents, and interviews with experts.

Literature review

Research Questions

How age-friendly are the housing, facilities and community environment in Chinese urban mainstream residential communities?

How is "ageing-in-place" conceptualised in urban China, and do older people prefer to "age-in-place"?

How does the built environment (including housing, community and technology) influence older people's ability to age-in-place?

How does the social environment (including social networks, care and service, and technology) influence older people's ability to age-in-place?

How to support older people in urban China to achieve ageing-in-place by building an age-friendly environment? How is the age-friendly environment supported by design, planning and community services?

Research Objectives

Objective 1: To evaluate the age-friendliness of physical environment in contemporary mainstream residential communities urban China.

Objective 2: To conceptualise ageing-in-place in the case of urban China and establish whether older people prefer to "age-in-place".

Objective 3: To establish the relationship between the built environment and older people's ability to achieve ageing-in-place.

Objective 4: To understand the relationship between the social environment and older people's motivation and ability to achieve ageing-in-place.

Objective 5: To develop a design and retrofitting framework to improve age-friendly living environment and help older people achieve ageing-in-place.

Collecting Case Study Evidence

Case Study Research

Case 1 - Old public housing (built before 1998)
Case 2 - Market housing (built between 1998 and 2012)
Case 3 - Market housing (built after 2012)

Source of Evidence 1:
Structured site observation
Desktop review
Fieldwork
Photograph
(Under the guidance of the analytical framework)

Source of Evidence 2:
Interviews with older residents (37 participants)
Case 1 (12) Case 2 (13) Caes 3 (12)

Source of Evidence 3:
Interviews with Experts (13 participants)
Architects (4) Policymakers (3) Care providers (3)   Property managers (3)

Framework development

Development of a design and policy framework by data synthesis.

Findings

Housing conditions evaluation in urban China

A new conceptualisation of ageing-in-place in urban China

Understanding the role of age-friendly built environment in promoting ageing-in-place in urban China

Understanding the role of age-friendly social environment in promoting ageing-in-place in urban China

An age-friendly design and policy framework

Chapter 5

Chapter 6

Chapter 7

Chapter 8

Chapter 9

Figure 4.4 Research design

4.5   Case Study Selection

This section presents the case study selection criteria and process. As introduced in Chapter 3, two main milestones occurred in Chinese housing history during recent decades: housing reform in 1998 (Chen et al., 2014) and new design standard in 2012 (MOHURD & AQSIQ, 2012). Therefore, in this research, the three main community types were classified based on the year built. Type A refers to privatised pre-reform public housing, also known as staff accommodation or unit compound and was built before 1998. Type B describes private market housing built between 1998 and 2012. Type C represents market residential buildings built after 2012. Two housing standards, GB 50096-2011, Design Code of Residential Buildings (MOHURD & AQSIQ, 2011) and GB 50763-2012, Codes for Accessibility Design (MOHURD & AQSIQ, 2012), influenced the design of the housing and the communities significantly. Accordingly, three communities were selected to represent the three main types of residential types.

4.5.1   Case study selection criteria

Based on the demographic data of China, the share of the older population in Jiangsu province is the highest compared with other provinces. Nanjing, as the capital city of Jiangsu, is a representative city for this study. The selection criteria (see Table 4.2) for the different community types, were data availability and access, location, and the extent of stakeholder engagement. The research criteria were considered from the following aspects:

Table 4.2 Case study selection criteria

	Case 1	Case 2	Case 3
Community Type	Privatised pre-reform public housing (staff accommodation or unit compound)	Private market housing	Private market housing, which follows the current accessibility design standards
Built Date	Before 1998	1998-2012	2012-2018
Location	The case study location is in the urban area in Nanjing.		
Data Access	Valuable existing data (information) is accessible. For example, the information can be found in books, journals or reliable websites; various experts (such as architects, householders, older residents, community managers) are accessible.		

4.5.2 The selection process of case study sites

The selection of the case study areas involved three main steps: 1) determine a research region (Xuanwu District), 2) select several communities which meet the selection criteria within that area based on the desktop review (a list of target communities), 3) make a final decision (three residential communities as study cases) according to the data access during fieldwork.

Case Selection Step 1

The study used purposive and convenience sampling methods (Petty et al., 2012b) to select the study area, which was Xuanwu District in Nanjing, Jiangsu Province. In 2009, Xuanwu District was selected by the China National Committee on Ageing (Jiangsu Ageing Network, 2012) as one of the first three pilot age-friendly districts around the country, which is the main reason for this location selection, owing to its representativeness and relevance to study. Additionally, the locations were selected according to convenience and the researcher's ability to obtain easy access to those communities during the fieldwork.

Case Selection Step 2

To better understand the research context, it is necessary to explain the urban administrative level in Nanjing. Nanjing consists of eight districts in the urban area and three counties in the rural area, with 11 districts in total (Figure 4.5). Every district is divided into several streets (also called sub-districts), and every street administers several community committees (also called neighbourhood committees, residents committees or community office). Specifically, the Xuanwu district includes seven streets, as shown in Figure 4.6, called Street A – G in this research. Street A manages six community committees, named Community Committee A1 – A7. Xuanwu District consists of 59 community committees, which represent the primary level management organisations. Each community committee manages one or more communities. A community, also referred to as residential community or neighbourhood or a residential unit, is an urban residential area, which is identified as the "case" to be studied in this research. One community consists of several residential buildings where the residents live. Most of the urban residential communities are gated with a name and a geographical boundary marked by walls and gates that control access into and out of the residential area. To summarise, the Chinese administrative management levels are country, province, city, district, street and community committee (Figure 4.7).
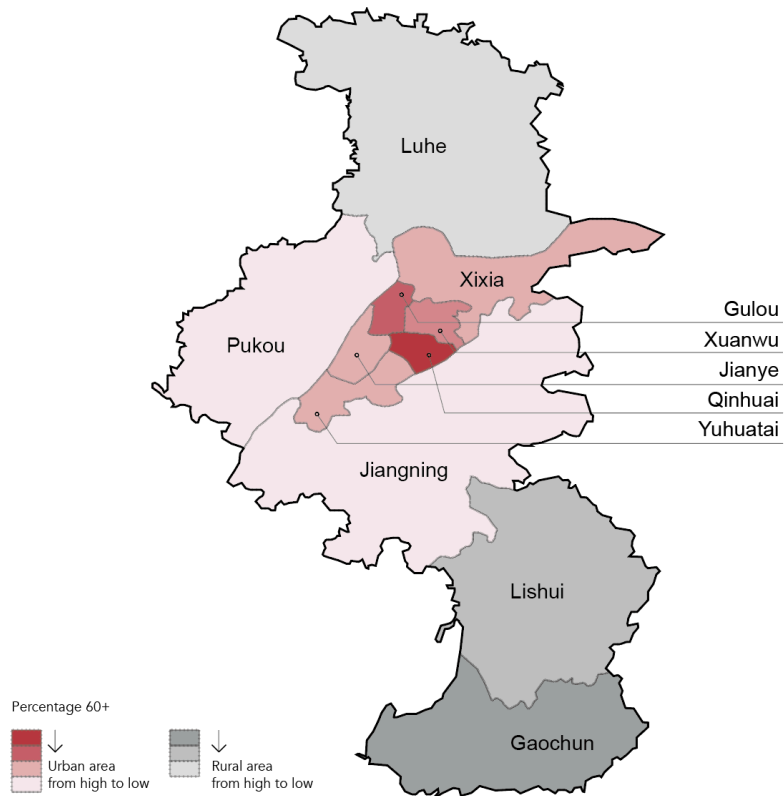
Figure 4.5 Map of percentage of the older population in 2017 by district, Nanjing
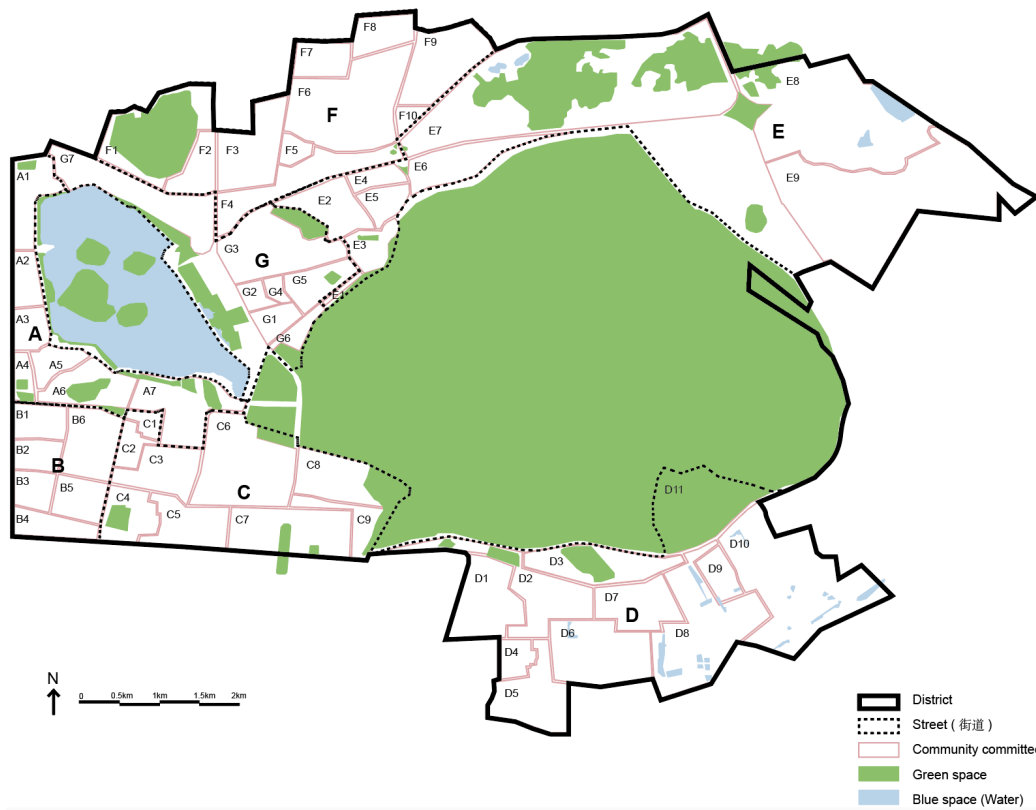
Figure 4.6 Map of administrative management levels in Xuanwu district, Nanjing
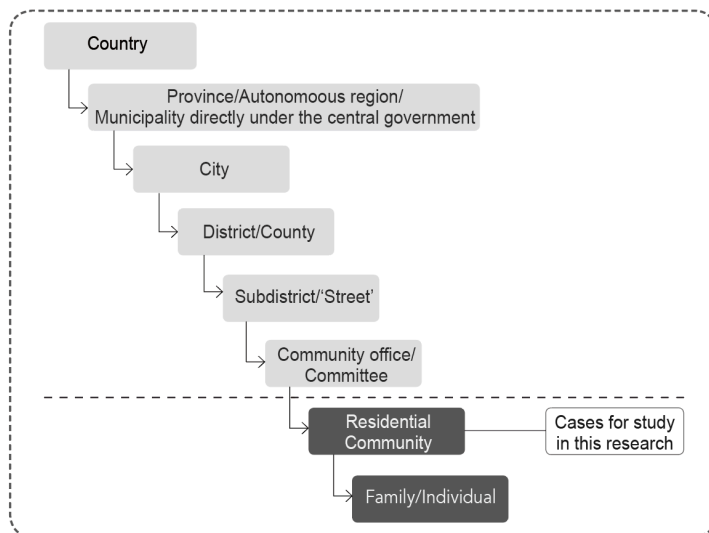
Figure 4.7 Chinese administrative management levels and identified "cases" to be studied

Before the fieldwork, the case selection was conducted by via a desktop study, mainly based on the population data and built year of the residential community, to narrow the range of communities. The population data can only be accessed at the community committee level. Figure 4.8 shows the percentage of the population aged 60 years or over in 2017 by the community committee in Xuanwu District, drawing on data listed in Appendix 4.1. In several community committees, more than 30% of people who lived there were older people aged 60 and over including A1, B1, B5, G5 and D6.
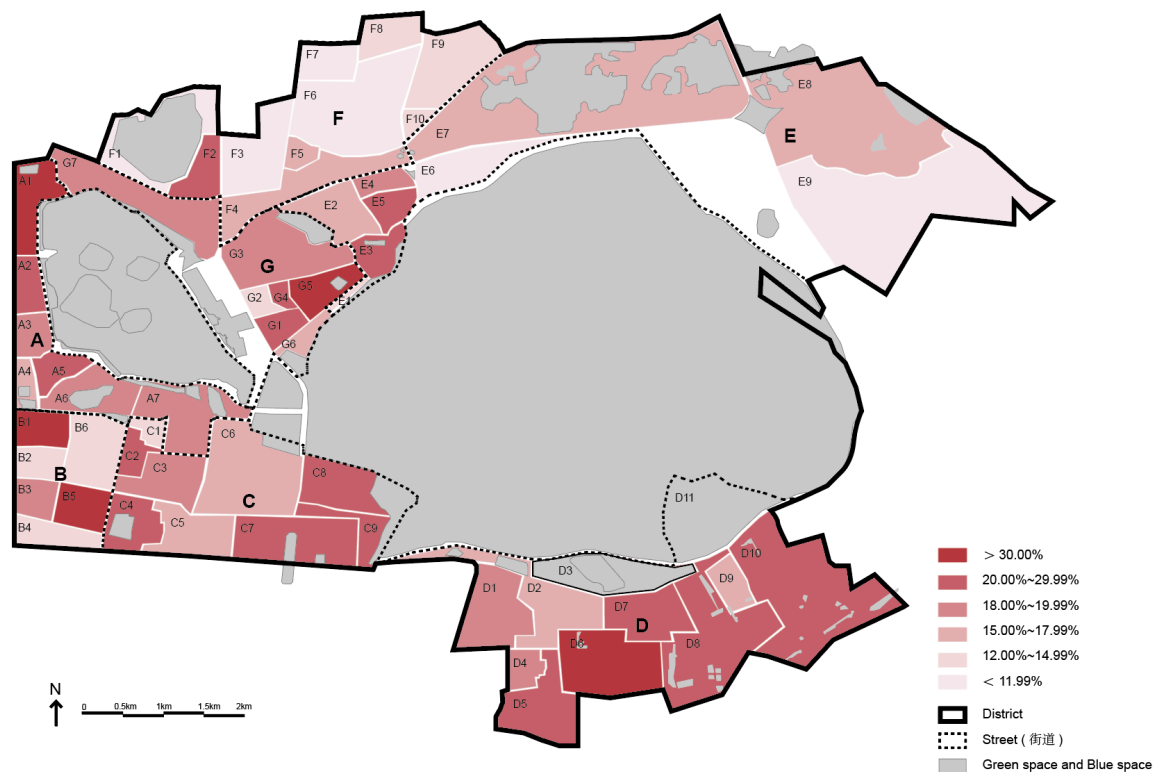
Figure 4.8 Map of the percentage of the older population in 2017 by community committee, in Xuanwu District, Nanjing

The population aged 60 and over and the corresponding proportion in the above five community committees are listed from high to low in Table 4.3. All of the communities in those five community committees are listed with community type, built year and households in Appendix 4.2.

Table 4.3 Community committees with more than 30% of the population aged 60 and over in Xuanwu district

District	Street	Community committee	Resident population	Population aged 60 and over	Proportion of population aged 60 and over
Xuanwu	B Xinjiekou (新街口街道)	B1 Dashiqiao (大石桥社区)	11169	4180	37.43%
	D Xiaolingwei (孝陵卫街道)	D6 Nanjing University of science & technology staff accommodation (南京理工大学社区)	10882	3980	36.57%
	G Suojincun (锁金村街道)	G5 Suowu (锁五社区)	4340	1500	34.56%
	B Xinjiekou (新街口街道)	B5 Xiangpuying (香铺营社区)	21080	6800	32.26%
	A Xuanwumen (玄武门街道)	A1 Liaojiaxiang (廖家巷社区)	6220	1900	30.55%

A shortlist was achieved according to the selection criteria based on the information shown in Appendix 4.2. There are three main community types in contemporary Chinese cities based on the built year and housing type. The first is privatised pre-reform public housing built before 1998. The second is private market housing built between 1998 and 2012 and the third is commercial housing built after 2012. The first two types of community have been targeted after this step, as shown in Table 4.4.

Table 4.4 A shortlist of target communities (Type A and Type B communities)

Community type	Community committee	Community	Year built	Building	Floor	Households
Type A	D6	Ziyuan (紫园小区)	1990	64	6	2230
		Keyuan (科园小区)				
		Zhongshan (中山小区)				
		Zhuyuan (竹园小区)				
		Xiyuan (西园小区)				
Type B	A1	Guozhan (国展中央花园)	2008	4	7~12	154
	B1	Hengji (恒基国际公寓)	2004	4	18-22	629
	G5	Cuiling (翠岭居)	2006	6	9~19	339

However, none of the communities in the five community committees was built after 2012 for the third case selection. All the communities built after 2012 in Xuanwu District are listed in Table 4.5. Considering the first four communities were built in 2013, the design of those buildings may not follow GB 50096-2011, Design Code of Residential Buildings (MOHURD& AQSIQ, 2011) and GB 50763-2012, Codes for Accessibility Design (MOHURD& AQSIQ, 2012). As the last four communities were completed in the two years before the data collection in May 2019, the occupancy rates might be meagre. Moreover, the community built in 2015 only consists of one building and 340 households. As a result, the remaining two communities have been selected as alternatives.

Table 4.5 A list of target Type C communities

Community type	Community committee	Community	Year built	Building	Floor	Households
Type C		Zijin(紫金东郡)	2013			
		Cuiping(翠屏紫气钟山)	2013			
		Deji(德基紫金南苑)	2013			
		Suojin68(锁金村 68 号)	2013			
	E5	Yangguan (阳光聚宝山庄臻园)	2014	37	12	1368
		101zuo(壹零壹座)	2015	1		340
	F6	Hengda(恒大翡翠华庭)	2016	12	29	1251
		Zijin(紫金华府)	2017			
		Dafa(大发融悦)	2017			
		Wukuang(五矿晏山居)	2017			
		Zhouhai(中海玄武公馆)	2018			

Before the fieldwork, there were five Type A communities, three Type B communities, and two Type C communities in the shortlist of potential cases (Table 4.6). All those communities meet the case selection criteria listed in Table 4.2.

Table 4.6 A shortlist of target communities

Community type	Community committee	Community	Year built	Building	Floor	Households
Type A	D6	Ziyuan (紫园小区)	1990s	64	6	2230
		Keyuan (科园小区)				
		Zhongshan (中山小区)				
		Zhuyuan (竹园小区) *				
		Xiyuan (西园小区) *				
Type B	A1	Guozhan (国展中央花园)	2008	4	7-12	154
	B1	Hengji (恒基国际公寓) *	2004	4	18-22	629
	G5	Cuiling (翠岭居)	2006	6	9-19	339
Type C	E5	Zhenyuan (阳光聚宝山庄臻园)	2014	37	5-12	1368
	F6	Hengdafeicui (恒大翡翠华庭) *	2016	12	29	1251

Case Selection Step 3

The last step of case selection involves a final decision during the fieldwork based on the data access and degree of participation. Three communities were selected as research cases for the fieldwork. Zhuyuan community is Case 1, Hengji community is Case 2, and Hengdafeicui is Case 3. The locations are presented in Figure 4.9**.** Further details of the selected sites are illustrated and analysed in Chapter 5.
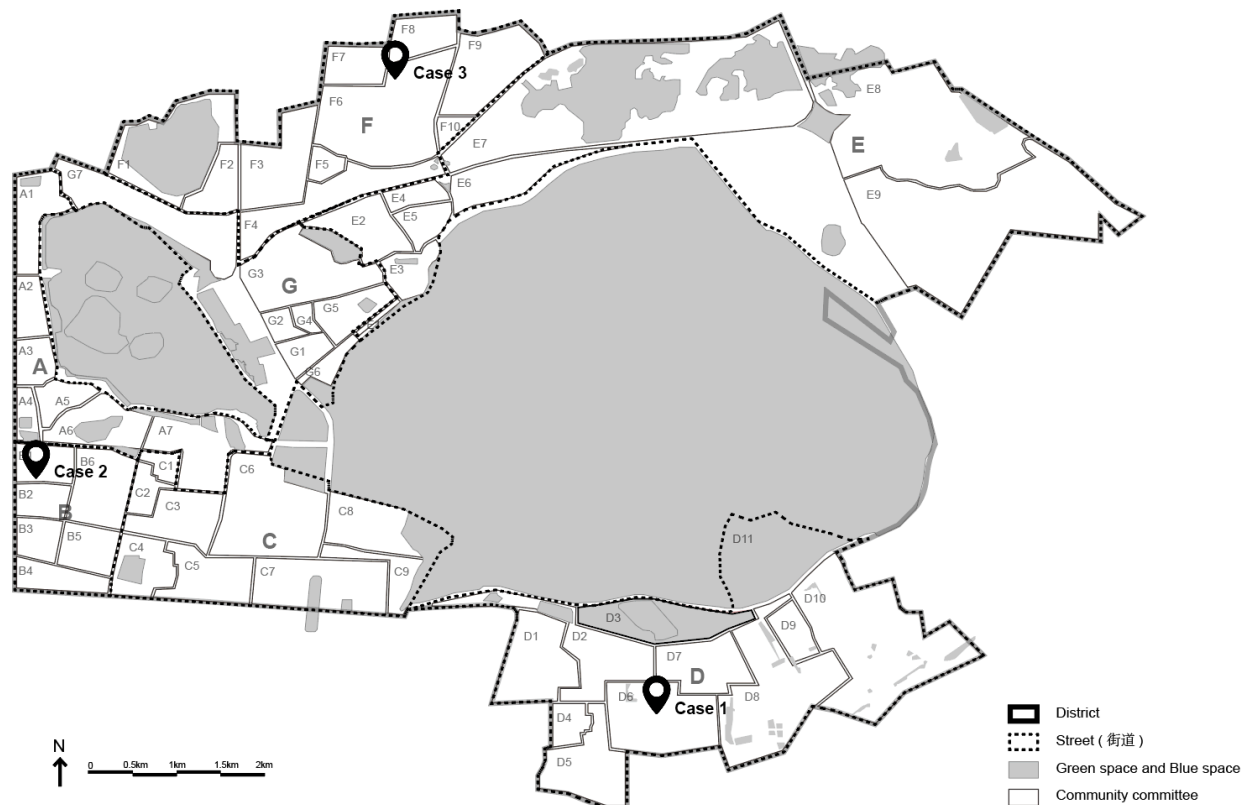
Figure 4.9 Case locations

4.6 Data Collection

From April to May 2019, the researcher conducted fieldwork in Xuanwu District, Nanjing and the three residential communities to collect case study evidence. Data collection was divided into three main parts for this research: semi-structured interviews with experts, in-depth interviews with older residents, and direct site observation. This section explains why these data collection methods were used, how evidence was collected from these sources and the data collection process. A schedule of data collection during the fieldwork is presented in Appendix 4.3.

4.6.1 Semi-structured interviews with experts

Interviews are used widely in social science research as a method of qualitative data collection. Robson and McCartan (2016) describe interviewing as typically involving the researcher asking questions and hopefully receiving answers from the participants. Individual interviews are useful when the researcher wants to explore the experiences or views of individuals in-depth (Petty, Thomson, & Stew, 2012b). In this research, experts are defined as those who occupy positions closely related to the age-friendly environment development or service provision, including policymakers, architects, property managers, and service providers. This group of people has a rich experience of promoting age-friendly environment or providing services for older people who chose ageing-in-place in different place of work. This enables them to provide an in-depth understanding and share valuable opinions with the researcher.

Interviews may be fully structured, semi-structured or unstructured (Robson & McCartan, 2016). In the initial phase of this study, the semi-structured interview with experts was selected as a data collection method, and involved several predetermined areas of interest with possible prompts to help guide the conversation with the interviewees. All the interviews followed a list of questions (see Appendix 4.4), which served as a checklist of topics to be covered and a default wording and order for the questions. As Robson and McCartan (2016) mention, the order and wording of the questions could often be substantially adapted depending on the flow of the interview, and the responses of the interviewee which may lead to additional unplanned questions.

After receiving ethical approval (Section 4.9), the researcher contacted different groups of experts directly by email or phone to explain the research aims and request interview permission before the fieldwork to save time. However, in Chinese society, it is very challenging to get a reply or agreement without a middleman. Gold et al. (2002) highlight the importance of 'Guanxi' (similar to social networks) in China, which can reduce uncertainty, provide usable resources, and increase interpersonal communication and a sense of connectedness. Chen and Chen (2004) describe 'Guanxi' as a personal connection at different levels, determined by the perceived level of trust, loyalty and obligation between persons. During the initial recruitment process, the researcher realised the significance of data access and the difficulties with recruiting participants. As a result, the researcher started to connect with family ties, former classmates, colleagues and friends and provided them with general information on the research, trying to create a connection with people who were working in related positions or had experience in building age-friendly environments. Through the middleman and their 'Guanxi' in Nanjing, the researcher obtained access to

several policymakers and property managers working in the target case before conducting the fieldwork. In this research, this was a crucial contribution to the success of recruiting participants. During the fieldwork, more suitable participants were recommended by the initial interviewees. To summarise, the recruitment of interviewees used the purposive and snowball method to reach more participants.

Semi-structured interviews were carried out with 13 experts who have worked in age-friendly environment-related positions, including four architects, three property managers, three care providers, and three policymakers. Twenty-two experts were initially contacted and eventually 13 were included in the study. All of the participants had worked in related work for more than three years, and more than half of them had a close relationship with the case communities. Although the researcher planned to conduct interviews with architects who designed the case communities, the actual data collection process was not realised because it was not possible to contact with them. Nonetheless, the architects interviewed were involved in the design of mainstream housing in Nanjing. Eleven interviews were conducted face-to-face, while two interviews with architects were conducted by telephone due to limited time for travel. The length of each expert interview session was between thirty to ninety minutes and the average duration was 53 minutes. The basic information of experts involved in the interviews is shown in Table 4.7. All the interviews followed the questions outlined in Appendix 4.4.

Table 4.7 Basic information of the experts

Number	Position	Years of working	Connection with case
E_1	Property manager	9	Case 2
E_2	Care provider	3	N/A
E_3	Property manager	10	Case 2
E_4	Property manager	12	Case 3
E_5	Policymaker	10	Case 1
E_6	Policymaker	4	Case 1，Case 2，Case 3
E_7	Care provider	5	Case 2
E_8	Care provider	17	N/A
E_9	Policymaker	13	Case 1，Case 2，Case 3
E_10	Architect	14	N/A
E_11	Architect	7	N/A
E_12	Architect	3	N/A
E_13	Architect	5	N/A

As an interviewer, the researcher conducted the interviews following Robson and McCartan's (2016) advice: a) listen more than speak, b) ask questions in a straightforward,

clear and non-threatening way, c) eliminate cues that lead interviewees to respond in a particular way, and d) enjoy it.

4.6.2 In-depth interviews with older residents

As Yin (2018) suggests Interview is one of the most important sources of case study evidence. Interviews with older people is another major data source in this research. Semi-structured interviews were conducted with older people living in the case communities. Many ageing studies (Borglin, Edberg, & Hallberg, 2005; Cloutier-Fisher, Kobayashi, & Smith, 2011) employed in-depth interviews to understand older people's subjective experiences and opinions.

The researcher planned to conduct at least 12 interviews in each case to provide substantial evidence for the case studies. The property managers and policymakers involved in the interviews played an essential role in the process of recruiting older participants. They helped the researcher contact the older residents after introducing the research aims and older participants' recruitment criteria. As mentioned above, 'Guanxi' (social network or personal connection) was also crucial in the recruitment process of older participants. Participants' basic selection criteria were provided to property managers in the target communities. There were three main criteria: people who 1) were aged 60 and older, 2) currently living in the case communities, and 3) had the cognitive ability to understand questions and communicate verbally. This process also made use of the snowball method to reach more participants. Some participants were willing to recommend their friends or spouse to the researcher. The researcher completed the interviews with older people in this way in Case 1 and Case 2 communities. However, as Case 3 is a very new residential community, even the property managers were not able to directly invite older people to take part in the research. They simply gave the researcher permission to enter the gated community public space to find potential participants by making a self-introduction of the research. In this case, the researcher spent more time on the recruitment of participants, and the average length of interviews was shorter than those in the other two cases.

More than 50 older people were initially contacted and eventually 37 were included in the study. Some of the older people expressed unwillingness to involve in the research after the researcher explained the aim of this study, while some of the initially contacted people could not meet the main criteria. Finally, the researcher recruited 37 older people in three case study communities to participate in interviews, ranging from 60 to 95 years with an average age of 73, 6 males and 6 females from each community in Case 1 and Case 3, and 6 males and 7 females in Case 2. The basic information of older residents is shown in Table 4.8 and

the interview questions are presented in Appendix 4.4. A face-to-face approach was employed to guarantee effective communication with older residents.

Table 4.8 Basic information of older interviewees

Case	Number	Age	Gender	Living arrangement
Case 1: Privatised pre-reform public housing (staff accommodation or unit compound)	C1_1	63	Male	Spouse, Children
	C1_2	72	Male	Spouse
	C1_3	65	Female	Spouse, Children, Grandchildren
	C1_4	74	Male	Alone
	C1_5	80	Female	Spouse
	C1_6	81	Male	Spouse, Children, Grandchildren
	C1_7	72	Male	Spouse, Children, Grandchildren
	C1_8	91	Male	Spouse
	C1_9	82	Male	Alone
	C1_10	95	Male	Children, Grandchildren
	C1_11	66	Female	Alone
	C1_12	62	Female	Children, Grandchildren
Case 2: Private market housing Built between 1998~2012	C2_1	70	Male	Spouse
	C2_2	73	Female	Alone
	C2_3	60	Male	Spouse, Children
	C2_4	67	Female	Alone
	C2_5	64	Male	Children, Grandchildren
	C2_6	62	Male	Spouse
	C2_7	80	Male	Spouse
	C2_8	75	Female	Spouse
	C2_9	67	Female	Spouse, Parents
	C2_10	69	Male	Spouse, Children, Grandchildren
	C2_11	72	Female	Spouse
	C2_12	73	Female	Spouse
	C2_13	82	Female	Spouse
Case 3: Private Market housing, which in compliance with the accessibility design standards After 2012	C3_1	66	Female	Children, Grandchildren
	C3_2	67	Female	Children, Grandchildren
	C3_3	65	Male	Children, Grandchildren
	C3_4	81	Male	Children, Grandchildren
	C3_5	68	Female	Grandchildren
	C3_6	78	Male	Spouse, Children, Grandchildren
	C3_7	79	Female	Spouse, Children, Grandchildren
	C3_8	63	Female	Children
	C3_9	88	Male	Children, Grandchildren, housekeeper
	C3_10	69	Male	Children, Grandchildren
	C3_11	67	Male	Children, Grandchildren
	C3_12	73	Female	Children, Grandchildren

In this study, the sample size was determined by various constraints, including resources available, the time constraints, and the work capacity of the researcher. It also depended on the purpose of the inquiry.

4.6.3 Direct observations

As this research is a multiple-case study that took place in real-world settings, the relevant social and environmental conditions of the phenomena were available for observation. Observations can serve as a further source of evidence (Yin, 2018). In this study, direct observations were used to evaluate the age-friendliness of three residential communities.

The observations include formal and casual data collection activities (Yin, 2018). In this study, two kinds of data were used during fieldwork. According to Sarantakos (2012), fieldwork is a form of social inquiry into an existing situation in the field in a natural setting. It is a suitable approach to achieve the research objectives in this study.

In designing the study, under the theory of P-E fit, observation of the behaviour of older people in residential setting has been considered. However, considering time constraints and logistics required, it was decided that only the built environment, with an irreplaceable necessity, would be assessed in the observation section of the selected cases. Two observational checklists developed by Zhou and colleagues (Zhou & Li, 2018; Zhou & Qin, 2018) (Full list see Appendix 3.1 and Appendix 3.2; Observation checklist see Table 5.1 and Table 5.2) were used to assess the living environment as part of the case study protocol.

The researcher conducted direct site observations and used two checklists to compare the benchmarks with the reality of the community's physical environment and buildings by filling in the checklist and taking fieldnotes. As mentioned in Chapter 3, the checklists are based on the Chinese urban context, one for the outdoor environment (Zhou & Qin, 2018) and another for the private indoor environment (Zhou & Li, 2018). For example, the outdoor environment checklist includes 12 domains (residential community entrances, residential community roads, motor vehicle parking areas, non-motor vehicle parking areas, pedestrian roads, walking paths, residential building entrances, activity spaces, rest spaces, landscapes, signage systems, lighting systems) (Zhou & Qin, 2018). Each domain consists of several points. In accordance with the scope of this research, 44 points were selected from the checklist as key criteria to evaluate the cases. For each point, literal interpretations combined with graphics or photos are provided to explain the meaning in a visual way. For example, Figure 4.10 shows images illustrating the positive and negative examples with

checkmarks or crosses. During the field trip, the researcher walked around the site to assess each point in the checklists according to the site situation and took notes.

Fragmented, uneven ground surfaces are not suitable for pavements.

Older people may be trip up due to gap protrusions in a pavement junction with different materials.

The gap between brick is large, not suitable for pavements.

Smooth and uniform cement is suitable for pavement surfaces.

Figure 4.10 Positive and negative examples of the pavement surface material

Adapted from: Zhou & Qin (2018, p.33)

In addition, the researcher took a series of photographs at the fieldwork site to provide visual evidence to convey important case characteristics to outside observers (Yin, 2018). Visual images can play a valuable role in the study process in a range of ways (Robson & McCartan, 2016; Weber, 2008). During the site visit and evaluation, the researcher took photographs to represent the community's physical environment as evidence of unobtrusive measures relating to the buildings, roads, green spaces, infrastructure, and layout of the neighbourhoods, helping to present the data in an approach that text descriptions could not realise. All the photos were taken without any image editing using a smartphone which could record the location and time, which was very helpful for the researcher to find the corresponding points in the checklist.

Observational evidence helps provide additional information about the topic being studied. Direct observations were incorporated alongside researcher-created photographs, the data from expert interviews and interviews with older people to provide a comprehensive answer to the research questions.

4.7 Data Analysis

This section focuses on the analytical stage of the project. In this research, two main types of data have been collected: interview data and observation data. This section explains how the data collected from the fieldwork was analysed, and the cross-case synthesis in this study.

4.7.1 Interview data analysis

The interviews were fully audio recorded then transcribed. A single interview was conducted with each of the participants, and every interview was analysed according to the content of research questions and answers to obtain the results presented in chapters 6, 7, and 8. The qualitative content analysis method was used to study the interview data. The transcriptions were analysed by using data analysis software, NVivo 12, which was used for managing, sorting, organising, and coding the qualitative data, as well as indexing and retrieving established themes and sub-themes. Another challenge in the analysis of the interview data was the language differences in the research, which are explained in this sub-section.

4.7.1.1 Qualitative Content Analysis

The interview data were explored by the content analysis method. The purpose of content analysis is "to provide knowledge and understanding of the phenomenon under study" (Downe-Wamboldt, 1992, p.314). The process of qualitative content analysis can be divided into three phases, as shown in Figure 4.11, and includes preparation, organising, and results (Elo & Kyngäs, 2008).
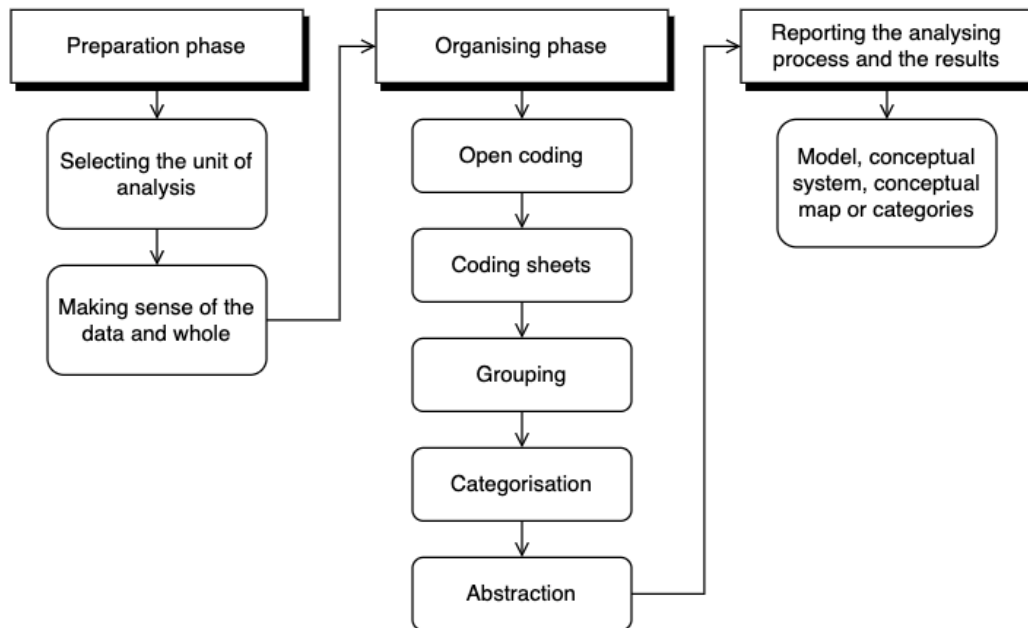
Figure 4.11 Preparation, organising and resulting phases in the content analysis

Adapted from: Elo & Kyngäs, (2008)

The preparation phase aims to immerse the researcher into the data (Elo & Kyngäs, 2008) and starts with selecting the unit of analysis (Guthrie et al., 2004). In this study, the unit of analysis was the utterance, which could be a letter, word, sentence, or a part of a sentence. After making sense of the interview data, the organising phase was conducted using an inductive approach, guided by the research aims and questions. In the first stage of organising phase, the data were reduced by open coding the utterances concerning the age-friendly environment and ageing-in-place, generating coding sheets and categories freely (Burnard, 1991). Next, the lists of categories were grouped under higher-order headings by combining statements that are classified as "belonging" to a particular group (Dey, 2003), resulting in sub-categories to give a way to describe the phenomena in order to foster knowledge and better understanding (Cavanagh, 1997). Then, the sub-categories are combined with similar content into generic categories. Abstraction refers to the formulation of a summary of the study topic through the creation of categories (Burnard, 1996; Polit & Beck, 2004). Each category is labelled using content-characteristic words. Sub-categories with similar incidents and events are grouped as categories, and categories are grouped as main categories (Robson, 1993).

The preparation and organising phases were conducted using the computer-assisted tool Nvivo12, which is helpful in coding and categorising a large amount of data. Reporting the analysis process and results is the final phase and is discussed in Section 4.8.

4.7.1.2   Language differences in the research

All of the interviews were done, recorded, and transcribed in their original Chinese language as Word documents. Some scholars (Van Nes et al., 2010) attach importance to language differences in qualitative research when the primary researcher and participants both speak a language other than English and the non-English data leads to English publications. Van Nes et al. (2010) suggest remaining in the original language as long and as much as possible to reduce the potential for the loss of meaning and to enhance the validity of cross-English qualitative research. One of the main reasons is that it is vital to check the interpretations via checking to the codes and preliminary findings in the source language during the analysis process. Such an issue was also encountered by another researcher (Orton, 2017) when conducting a study about Chinese older people. She also analysed interview data in Chinese to enhance the validity and ensure the distance between the meanings experienced by the participants and those interpreted in the findings is as close as possible, to preserve and highlight the cultural differences (Orton, 2017). In order to achieve the greatest degree of meaning similarity, only a specific portion of participant quotations and research findings were translated into English for this study. The translated quotes have been reviewed by Chinese colleagues to validate.

4.7.2 Observation data analysis

The observation data collection was mainly based on the checklists from Zhou and colleagues' work (Zhou & Li, 2018; Zhou & Qin, 2018) as shown in Appendix 3.1 and Appendix 3.2. The observable environmental features were recorded during the fieldwork by taking fieldnotes and photographs. The results are presented case by case in Chapter 5 following the same structure: general information of the surroundings and infrastructure, community public environment, and private housing environment. Notable issues were highlighted at the beginning of each section, and the cross-case analysis was conducted afterwards.

4.7.3 Cross-case Synthesis

In contrast to conventional research syntheses, which aggregate data from a number of separate studies to draw conclusions about the variables but not necessarily the cases, a desired cross-case synthesis should use a "case-based" approach (Byrne, 2009). Yin (2018, p.196) points out, "in a case-based approach, the goal is to retain the integrity of the entire case and then to compare or synthesise any within-case patterns across the cases". Case

study research highlights holistic features in the cases and helps people understand phenomena in real-world settings. The desired cross-case synthesis should attempt to maintain the holistic features rather than down into the domain of individual variables.

In this research, three cases were selected to represent different mainstream residential communities in urban China. Each of the cases was regarded as an entire case and would initially be identified as within-case patterns, as in determining how the environment influences older people's choice and their experience of ageing-in-place. In the unobtrusive measures phase of the case study, the multiple-case study began with a checklist from a deductive perspective. The cross-case synthesis was also conducted inductively when the goal of the data from interviews was to find new explanations and experiences of ageing-in-place. The researcher tended to work upwards conceptually to build a holistic framework to support ageing-in-place in different types of communities in urban China.

4.8 Reporting the Case Studies

The results of this project are divided into two main parts based on the data collection methods: observation results and interview results. The findings from the observations are presented in a separate chapter (Chapter 5) and outline the evaluation of the three cases and a description of the notable issues in each case. Through the observation results, the actual situation of cases included in this study is presented in detail.

The format of presenting the interview data follows a series of questions and answers. This format enables readers to make their own cross-case comparisons by examining the answers to the same question or questions based on their specific interests (Yin, 2018). Chapter 6 focuses on presenting the attitudes, experiences, challenges, and visions from older people and experts' perspectives regarding ageing-in-place to build a new conceptualisation of ageing-in-place in the urban China context. Chapter 7 explores the components of an age-friendly built environment in relation to community and housing and establishes the relationship between the built environment and older people's ability to achieve ageing-in-place. Chapter 8 focuses on the relationships between the social environment and ageing-in-place, reflecting on the role of social networks, support and service needed, and technologies.

Chapter 9 integrates results from the observations in three residential communities and interviews with different groups to achieve the objectives of an age-friendly design and policy framework, which represents the ultimate goal of this research. The conceptual framework provides the main domains for a holistic age-friendly living environment framework: built

environment, social environment, and technology. Based on the conceptual framework, all the findings are synthesised at this stage to complete each domain and develop a holistic framework to guide policymaking and implementation, such as community planning and design, service provision, and technology development.

4.9   Ethical Considerations

The interview with experts and older residents in this research was approved by The University of Sheffield Ethics Committee on the 12th of April 2019 (see Appendix 4.5). The data gathering procedure complied with the University's code of practice and ethical guidelines to recruit participants using the Participant Information Sheet (PIS) (Appendix 4.6) and Consent Form (CF) (Appendix 4.7).

The PIS consists of the research purpose, participant recruitment, researcher information, research funding, data protection, and complaint contact details. The CF was used to document agreement from the participants in their participation, and stated that the researcher will maintain their confidentiality and anonymity throughout the study, without including any personal information such as names, telephone numbers, and email addresses in any reports or thesis. All research data are used for research purposes only and may be quoted in publications, reports, web pages, and other research output. However, no identifiable data will be used in these outputs unless the participants specifically request this. If any information collected during the interview makes certain participants identifiable, the use of this type of information was also avoided in any research files. Additionally, the interview data and the audio recordings were stored securely and were not used in the research files or shared online.

Interviews in this research involved two groups of participants: experts and older people. As all interviews with older people were conducted face-to-face, the researcher explained the PIS and CF verbally when the older participants had vision problems or found it hard to understand the documents. As some of the interviews with experts were conducted by phone, the researcher sent the participants the PIS and CF beforehand, and before the interview began, individuals gave their written or verbal agreement to participate in the study.

Verbal and written information was given in Chinese. All the interviews were audio-recorded. Any academic terms and translations were explained consistently with each participant to ensure the participants fully understood the information and process.

4.10 Research Validity

In a qualitative study, validity involves determining the degree to which researchers' claims about knowledge corresponded to the reality being studied (Eisner & Peshkin 1990, cited in Cho & Trent, 2006). Some proponents of qualitative research prefer to use credibility, transferability, dependability, and confirmability instead of the term validity (Robson & McCartan, 2016). While it is difficult or sometimes impossible to be certain about the accuracy or truth of qualitative research, a number of strategies can be used to improve the likelihood of validity (Padgett, 2008; Robson & McCartan, 2016). Within this research, two strategies were used: triangulation and audit trail (Robson & McCartan, 2016).

4.10.1 Triangulation

Flick (2007) defined triangulation as researchers holding different perspectives on an issue being studied or more generally in answering research questions. In qualitative research, using triangulation appropriately might enhance the confirmation and completeness of the data in research findings (Thurmond, 2001). Yin (2018) recommends the use of multiple sources of evidence to strengthen the construct validity in case study research, in accordance with the basic motivation for selecting a case study: to do in-depth research of a phenomenon in its real-word context. Denzin (2017) sees triangulation as a strategy on the road to a deeper understanding of an issue under research, as a way to more knowledge and less toward validity and objectivity in interpretation. Patton (2014) distinguished four types of triangulations: theory triangulation, investigator triangulation, data triangulation, and triangulation of methods. In this research, triangulation of methods and data triangulation have been taken into used.

Methods triangulation

Triangulation of methods involves using more than one kind of method to study a phenomenon (Bekhet & Zauszniewski, 2012). In this study, two kinds of data collection methods were used: interview and direct observation to provide confirmation of findings and more comprehensive data, and to increase validity and enhance the understanding of the studied phenomena. For example, the assessment of the built environment of the cases were obtained by combining the subjective feelings described by the respondents (older residents) and fieldnotes made according to the results of environmental observation based on the checklist. Different research methods provide richer information and data types, verbal descriptions from interviews provided textual information, and a series of picture

information and fieldnotes were collected during observation. Diversified data provide abundant evidence for achieving research objectives.

Data triangulation

Data triangulation refers to the use of different sources of data as distinct from using different methods in the collection of data (Denzin, 1970, cited in Flick, 2007). Triangulation of data allows the researcher to use the same methods in different ways, including understanding the same phenomenon at different times, in various locations and with different people. In the current study, the researcher conducted a multiple case study involving the following data:

- Site evaluation (including checklists and photographs of three residential communities)
- Interviews with older people living in different residential communities
- Interviews with experts (architects, property managers, care providers, and policymakers)

In this study, the triangulation of various data can make the research results more comprehensive. For example, when analysing the social aspects of living environment, site evaluation provides information about the current situation of built environment as the "place" to promote or limit social interaction, interviews with the older residents provide subjective feelings as research objects, and interviews with experts provide different understandings and interventions of relevant staff. As a result, by integrating different data, comprehensive information can be obtained to answer relevant research questions and effectively achieve research objectives.

4.10.2 Audit trail

Robson and McCartan (2016) interpret an audit trail as a way of recording the full process of conducting a study, including raw data, such as transcripts of interviews, fieldnotes, and details of data analysis. For example, in this research, all interviews were transcribed in Chinese and content analysis was employed to analysis the transcriptions with the help of NVivo 12 software in Chinese. all the interview transcription and analysis processes were fully recorded, enabling the representative quotations to be found quickly to support the findings and increase the dependability of the research (Cho & Lee, 2014). The results and quotations were translated to English in the report stage in this thesis. The fieldnotes also provided evidence to achieve the research objectives.

During the transcription process, participants have been given a pseudonym to preserve anonymity, such as E_1 representing one interviewee from the expert group, and C1_1 which refers to one of the older residents living in Case 1. The participants' gender and the age of older people or position of experts are included in quotations. The information is presented after each quote, such as (C1_3, 65, Female) which means the information originates from a 65-year-old female participant living in the Case 1 community. In this way, it is straightforward for the researcher to return to the raw data afterwards.

4.11 Summary

This chapter has presented the researcher's methodological considerations. First, the position of the researcher in this study resides within the being ontology, constructivism epistemology and interpretivism theoretical perspective. The theoretical perspective influences the methodology chosen, which influences the decisions regarding the data gathering methods. Based on the theoretical perspective of the researcher and the research objectives of this project, a qualitative multiple-case study was employed to answer the research questions. The data collection methods were direct site observations and interviews with experts and older people. Furthermore, the case selection process, data collection, and data analytical methods have been explained, linking the research design to the desired outcomes. This chapter also addressed the ethical considerations and the credibility of the study.

The next chapters present and discuss the background information of the research area and the findings of direct site observations in the three selected residential communities, and is followed by an analysis and presentation of the data collected by interviews.

CHAPTER 5.   CASE STUDIES: Age-friendly environment evaluation of three residential communities in Nanjing, China

5.1   Introduction

This chapter presents an assessment of the age-friendly environment condition in three different types of mainstream residential community in urban China by case study. Three communities were selected to exemplify typical residential communities according to the built years in Xuanwu District, Nanjing. The case selection criteria and process are shown in detail in Section 4.5. This chapter seeks to achieve Objective 1, which is to show the environment of Chinese urban mainstream communities and private dwellings from an age-friendly environment perspective and to identify environmental barriers to achieving ageing-in-place in different urban residential community settings.

This chapter includes data collected by conducting a desktop study, architectural observation and taking notes and photographs during the fieldwork. The background information of Nanjing and Xuanwu District is introduced first, followed by the case study of the three communities and a discussion of a cross-case comparison. Chapter 5 is presented following the structure shown in Figure 5.1.
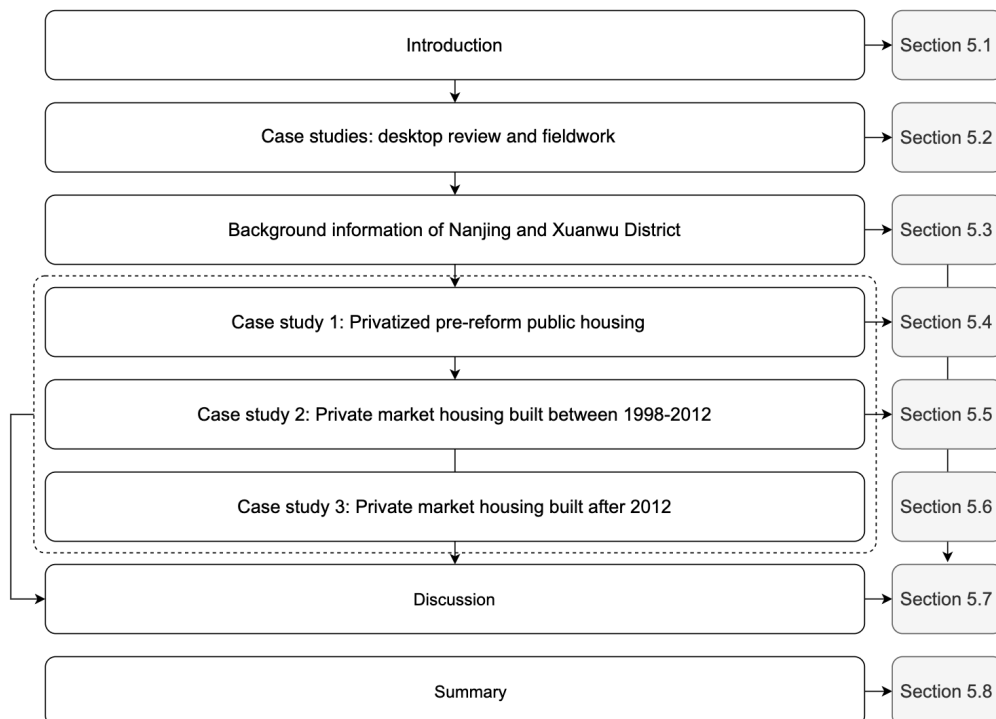
Figure 5.1 Structure of Chapter 5

5.2 Collecting Case Study Evidence: Desktop study and fieldwork

As explained in Chapter 4, this research takes case studies as the research methodology by examining three residential communities that represent the urban mainstream housing in cities in China. This chapter presents case study evidence by undertaking a desktop study and fieldwork under the guidance of the analytical framework (Figure 5.2).
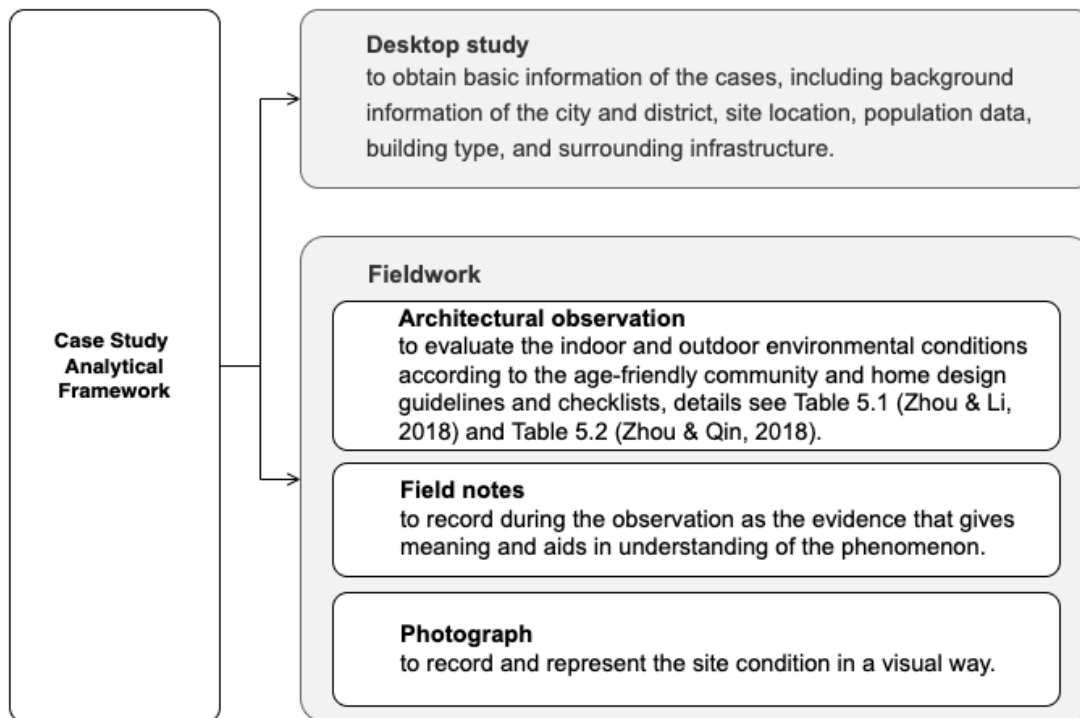
Figure 5.2 Case study analytical framework

Before the fieldwork, the desktop study gathered basic information of the cases, including background information of the city and district, site location, population data, building type, and surrounding infrastructure. Then, a structured site observation was conducted during the fieldwork using checklists to carry out architectural observations and take fieldnotes and photos. The fieldwork mainly investigated the age-friendliness of the living environment in three selected residential communities. The researcher conducted fieldwork on the three residential communities from April to May 2019.

Observations of each community was conducted based on two checklists to assess the extent to which a community is age-friendly. Two checklists were prepared for the observation. As shown in Table 5.1, the community environment checklist involves twelve areas, including residential community entrances, residential community roads, motor

vehicle parking areas, non-motor vehicle parking areas, pedestrian roads, walking paths, residential building entrances, activity spaces, rest spaces, landscapes, signage systems, and the lighting systems. Under the scope of this research, 44 key points were chosen by the researcher from the whole checklist as criteria to evaluate the case studies during the observation.

Table 5.1 The checklist of an age-friendly community

Area		The key points of an age-friendly community
Community entrance	1	Clearly dividing pedestrian lines and traffic lines
	2	Meet barrier-free access needs
Community road	3	Separate people and vehicles in the traffic organisation
	4	Design road section according to traffic organisation and functional requirements
	5	The road system should be clear and concise
	6	Meet the traffic needs of all types of vehicles
Motor vehicle parking area	7	Reasonable allocation of ground and underground parking spaces
	8	Temporary parking space at the entrance of the residential building
	9	Set up barrier-free parking space
Non-motor vehicle parking area	10	Non-motor vehicle parking space near the entrance of the residential building
	11	Meet the parking needs of all types of non-motor vehicles
Pedestrian road	12	Try to use the flat road and handle spatial height differences properly
	13	Use flat and homogeneous ground covering material
	14	Try to ensure the continuity of the pedestrian road
	15	Ensure adequate pedestrian road width
Walking path	16	Reasonable planning of the path streamline
	17	Set up rest facilities along the path for older people to rest
	18	Rational allocation of plants along the path
	19	Consider setting up shelter corridor
Residential building entrance	20	Obvious position and easy to identify
	21	Avoid crossing with external streamlines
	22	Handle the entrance height difference properly
	23	Provide a transitional space for older people to stay and interact
	24	The rain shed should cover the entrance platform and the steep ramp
Activity space	25	Arranged in place with a pleasant micro-climate
	26	Pay attention to the accessibility of path streamlines and visual lines
	27	Maintain a suitable distance from the residential building and the road
	28	Use plants or structures to define boundaries properly
	29	Provide a wide variety activity space
	30	Set up older people and parent-child activity space
	31	Use suitable ground covering material
	32	Set up necessary subsidiary equipment
Rest space	33	Set up rest seats for major pedestrians and activity space
	34	Set up rest space with shade shelter
	35	Choose a suitable seat type and arrangement

	36	Provide space for older people who use wheelchairs to rest and stay
Landscape	37	Enhance spatial identification through the collocation of plants and pieces
	38	Create a sensory stimulation of the landscape
	39	Set up the lawn reasonably
Signage system	40	Form a continuous, multi-level signage system
	41	Located in an apparent position that is easy to observe
	42	Express the signage content accurately
	43	Present graphic information clearly
Lighting system	44	Set up key lighting in key areas

Source: Zhou & Qin, 2018

As shown in Table 5.2, the age-friendly home checklist involves nine areas, including the hallway, living room, dining room, kitchen, toilet, bedroom, balcony, facilities, and Intelligent home. There are 60 key points in the checklist as criteria to evaluate the age-friendliness of the home environment.

Table 5.2 The checklist of age-friendly housing

Areas		The key points of an age-friendly housing
Hallway	1	To consider older people need to sit down to change their shoes
	2	To choose a suitable seat for older people to change their shoes
	3	Pay attention to the shoe storage relationship with the position of the door
	4	The height of the shoe storage should be easy to use by the older people
Living room	5	To leave a space for older people with a wheelchair
	6	The layout of the sofa and tea table should be accessible for older people to pass in and out
	7	To choose a suitable tea table for older people to use
	8	To choose a suitable sofa for older people to use
	9	To avoid air conditioning is directly blown sofa
	10	The ground material should no-slip and anti-glare
Dining room	11	To improve the visual connection between the dining room and kitchen
	12	To consider watching TV at meals
	13	To reserve a wheelchair position beside the dining table
	14	To avoid the wall cabinet bump against older people
Kitchen	15	To add a middle cabinet between the base cabinet and wall cabinet
	16	Worktop should be continuous
	17	Design worktop between and beside the sink and hob
	18	The microwave oven should be placed on the worktop, not too high or too low
	19	Small tables can be arranged in the kitchen when conditions permit
	20	Keep a worktop beside the fridge
Toilet	21	To separate wet and dry areas in the bathroom

	22	To choose a suitable bathroom sink for older people to use
	23	To add a towel rail near the bathroom sink
	24	To use an out-opening door or sliding door in the bathroom
	25	To use a mixer tap
	26	To use a handrail and shower curtain in the shower room
	27	To use an adjustable height shower head
	28	To use a shower seat
	29	To use a grab bar near the toilet
Bedroom	30	To consider the older couple who need sleep separately
	31	The bed size should be reasonable, not too large or too small
	32	Bed selection and layout should meet the needs of the older people
	33	Bed material should be comfortable for older people to touch
	34	Double-control switch should be set for main lamp
	35	The air supply direction of air conditioner should not be directly opposite the bed
	36	To choose a suitable bedside table
Balcony	37	Closed balcony should be equipped with a washing machine for centralised washing and drying
	38	To consider the possibility of a low position washing line
	39	Pay attention to the height difference of the balcony door
	40	The size of the balcony door should be suitable for older people
Facilities	41	Switch panels need to be easy for the older people to distinguish and operate
	42	Handles should be easy for older people to grasp
	43	The socket should be raised appropriately according to the position and function
	44	To choose suitable lamps for older people
	45	There should be two light sources in the main space
	46	Lighting should be enhanced in reading and fine operation areas
	47	The layout of sockets should consider various forms of furniture placement
	48	Seats need to be light and stable for the older people to move and sit up
	49	To guarantee the width of door
	50	To consider fixed window over the windowsill with items
	51	To consider floor heating
	52	To ensure the older people can use hot water conveniently
	53	To consider the drainage and ventilation in the toilet
Intelligent home	54	To reserve a socket beside toilets for setting up intelligent seats
	55	To consider older people's needs of video door phone system
	56	To install emergency alarms in bedrooms and bathrooms
	57	To install an integrated switch in the hallway
	58	Infrared detectors can be set to sense the action of the older people
	59	To use an adjustable light
	60	To consider using a remote control to operate curtains, kitchen ventilator

Source: Zhou & Li, 2018

In the next sections, the results from the desktop study are presented to introduce the background information of the Nanjing and Xuanwu District, followed by fieldwork findings in each residential community.

5.3 Background Information of Nanjing and Xuanwu District

This section aims to introduce the background information about Nanjing and Xuanwu District. Nanjing, also known as Nanking and Nankin, has served as the capital city of Jiangsu province since the establishment of the People's Republic of China. It is located in East China, with 11 districts (eight central districts and three rural districts), an administrative area of 6,600 km² and a total population of 8.5 million in 2019 (Nanjing Statistics, 2020).

Nanjing occupies a prominent position in Chinese culture and history, having served as the capital of several dynasties, kingdoms and governments from the third century AD to 1949 (Government of Nanjing, 2012). It is a centre of culture, education, research, politics, economy, transportation, and tourism in China (Zhang, 2012).

Xuanwu District, located in the middle part of Nanjing (

Figure 5.3), is one of the eight central districts of Nanjing, covering 75.46 square kilometres. The green coverage rate of the Xuanwu District is over 58% (Figure 5.4). The famous Zhongshan Scenic Area and Xuanwu Lake Scenic Area in Xuanwu District integrate mountains, water, city, and forest. The imperial palace of the Six Dynasties, the imperial palace of Ming Dynasty, the Xiaoling Tomb of Ming Dynasty, the heavenly palace of the Taiping Heavenly Kingdom, the presidential palace and the Zhongshan Mausoleum are all located in this region, which is one of the most concentrated tourist attractions in Nanjing.
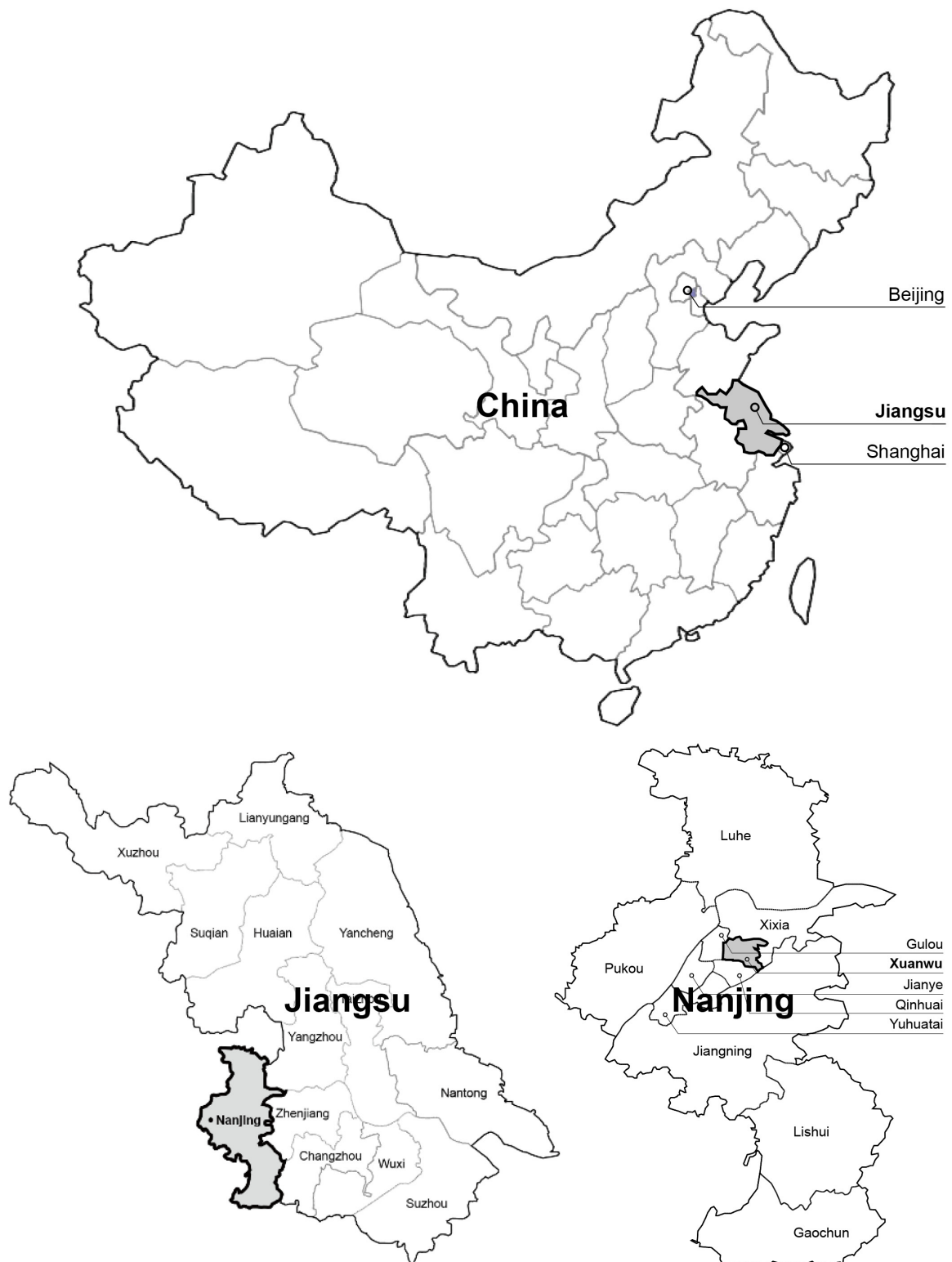
Figure 5.3 Map of China, Jiangsu Province and Nanjing
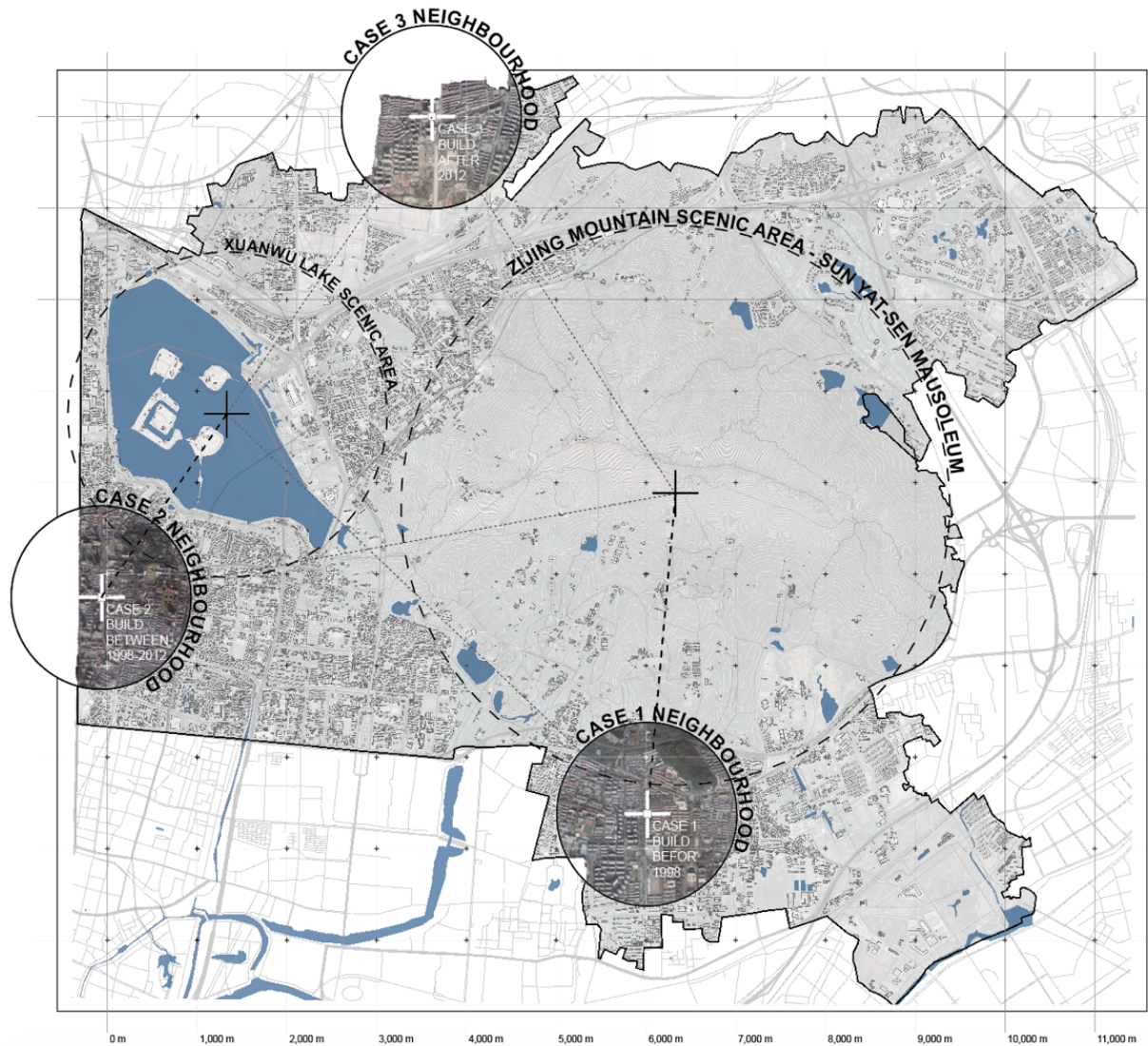
Figure 5.4 Case location and connection with the main landscape

Figure 5.5 shows the urban fabric, transportation network, river system, contour lines, and satellite imagery in different layers to present Xuanwu District. The constructions are distributed around the two scenic areas, while the building density in the west and south of Xuanwu District is higher than in the northeast region. The second layer shows the transportation network, including highways, urban express roads, roads, the underground, and trains, forming a well-developed transportation system. The river system and contour lines are displayed in the third and fourth layers to represent the terrain. Generally, Xuanwu District is a highly urbanised area with a beautiful natural environment.

URBAN FABRIC

TRANSPORTATION NETWORK

Highway
Urban Express Road
Road
Underground
Train

RIVER SYSTEM

CONTOUR LINE

SATELLITE IMAGERY
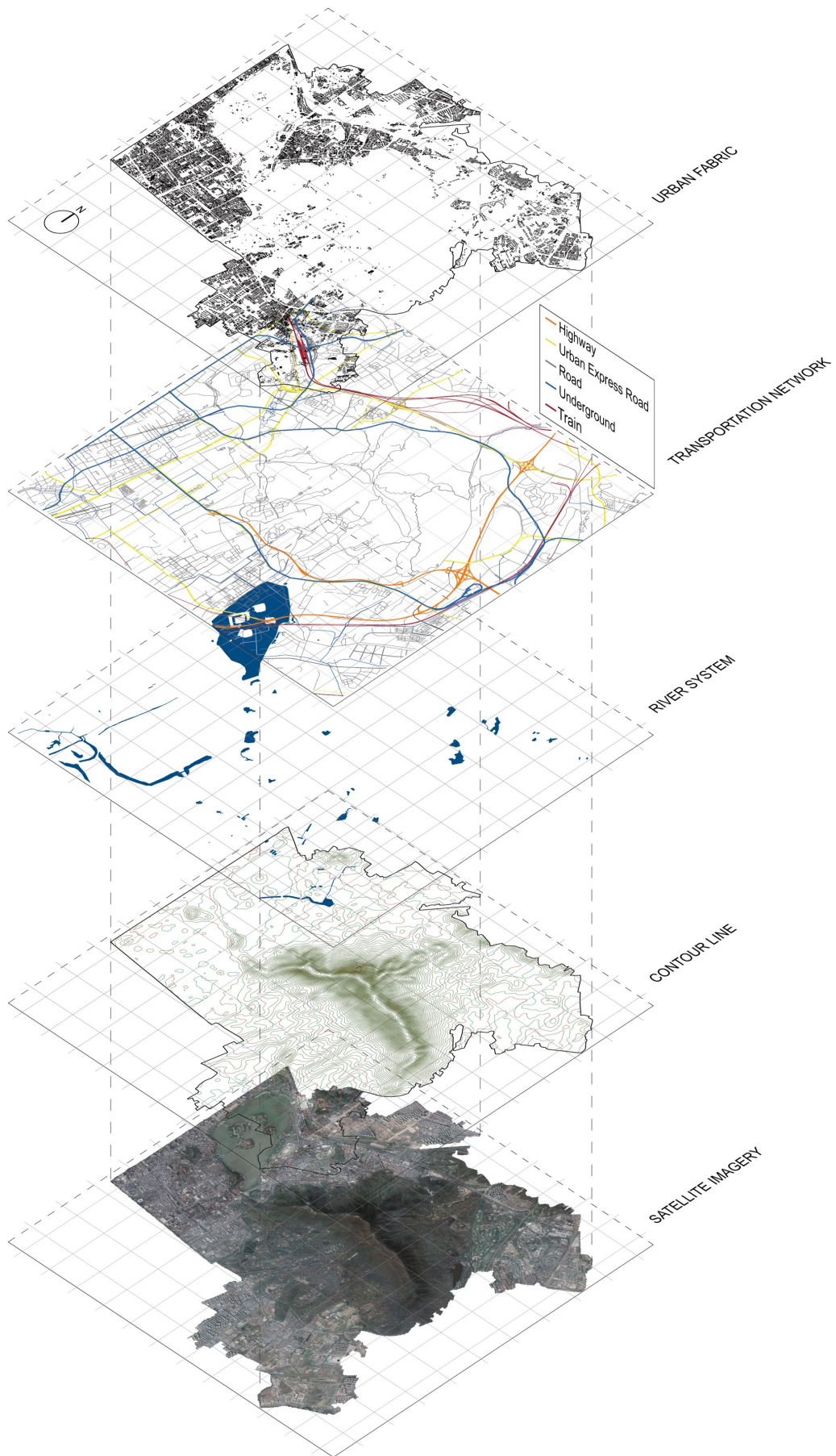
Figure 5.5 The exploded axonometric of Xuanwu District, Nanjing

Up to the end of 2017, the total population of Jiangsu province was over 78 million. The number of people aged 60 and over was about 17.5 million, accounting for 22.51%. In the same year, the proportion of older people aged 60 and over was 21.7% in Nanjing and 21.87% in Xuanwu District (Jiangsu Civil Affairs, 2018).

In 2005 and 2006, Xuanwu District was rated as one of the national advanced districts of ageing-related work (Nanjing Daily, 2006). In 2009, Xuanwu District was selected as one of the first three pilot districts to be named nationally as a liveable community for older people (Lei, Cao, & Li, 2013).

During the next decade, two major policy transformations took place. The first was to highlight the role of a liveable community. Community is the core of an age-friendly environment with care services representing the basis of the social system for older residents. In the practice of promoting care service, Xuanwu District Civil Affairs (2012) gradually realised that a sole reliance on a home-based or community-based care service was insufficient to meet the needs of older people. They also understood the need to explore building a liveable community suitable for older people in all aspects, in other words, building a holistic age-friendly environment.

The second transformation was not only to provide physical help for older people but also attention to their mental health. This included related research to understand older people, organising activities and education for the older residents, and providing emotional care for those who live alone (Xuanwu District Civil Affairs, 2012). Thus, Xuanwu District is an outstanding example of an age-friendly environment in urban China. Evaluating communities in the pilot district will be of guiding significance to further support ageing-in-place processes in urban China.

As the previous paragraph indicates, Xuanwu District is a suitable area to achieve the research objectives, which were to evaluate the implementation of development guidelines and their impacts in developing the age-friendliness of the built environment in contemporary mainstream residential communities in urban China.

5.4   Case Study 1: Privatised pre-reform public housing

Case 1 community is situated on Nanjing University of Science and Technology (NUST) campus, which is in the southern region of Xuanwu District, Nanjing. It is a typical staff accommodation community, in close proximity to the Purple Mountain in the north and the Ming Dynasty City Wall to the west. The campus has pleasant scenery, integrated with the Zhongshan Mausoleum Scenic Area. According to the local government population data, up

to the end of 2018, there were 3,281 households with a total of 10,882 residents, including 3,980 older people aged 60 and over of whom accounted for 36.57% of the total. There are around 1,000 people over 80 years old. It is a typical older people community and the community was awarded the "advanced older people association" by the Nanjing Aging Working Committee (NUST, n.d.).

The Community of NUST consists of eight residential communities, 114 residential buildings, which were built between 1990 and 1994. All the apartment buildings are 6-story and were initially constructed without lifts. Since early 2018, a project has been implemented to add lifts, a small part of the residential buildings had lifts installed when the researcher conducted the fieldwork.

The red line encloses the boundary of Case 1 as indicated in Figure 5.6. As shown, the residential zone is in the northern part, covering over one-third of the whole campus. There is a landscaped area with a between the residential zone and the teaching area, two playgrounds and several open green spaces are arranged in the university. Purple Mountain is situated close to the residential zone allowing residents quick access to the mountain walks.

Case 1 is an established community with supporting facilities, including kindergarten, primary and secondary schools, universities, several student canteens, two supermarkets, three hospitals, a post office, banks, fitness facilities, and an older people activity centre (Figure 5.6). The activity centre, also called the retiree activity centre, provides multi-functional spaces for older residents where they can exercise and participate in activities. Here there is a: billiard room, Chinese chess room, card room, mah-jong (a very popular traditional desk game in China) room, dancing room, table tennis room, calligraphy and painting room, reading room, and a multi-function room. Additionally, the public transportation network is well-developed in this area with every university gate allocated a bus stop, and the nearest underground station is in close proximity to the university's northern gate.

During the fieldwork in Case 1, the researcher conducted architectural observations as well as taking notes and photographs in respect to the community public space, one private apartment, and the older people's activity centre mentioned in the paragraph above. The following sections discusses the evaluation of the built environment according to the checklists, focusing mainly on presenting and analysing features which are not conducive to the independent living of the older residents.

RESIDENCE ZONE

DORMITORY

CAMPUS

CAMPUS

DORMITORY

OPEN SPACE

OPEN SPACE

PLAYGROUND

OPEN SPACE

PLAYGROUND

Older people activity centre

MARKET

HOSPITAL

OLDER PEOPLE ACTIVITY CENTRE

BARBER SHOP

CONVENIENCE STORE

BANK

CANTEEN

600 m

N

UNDERGROUND
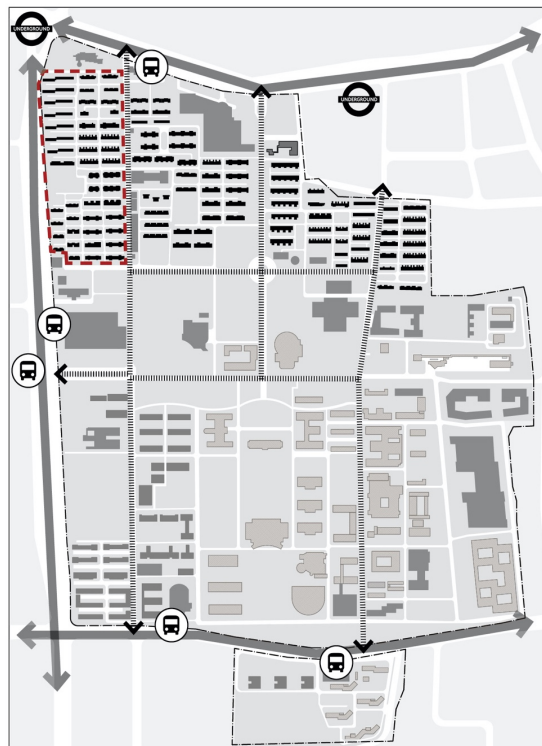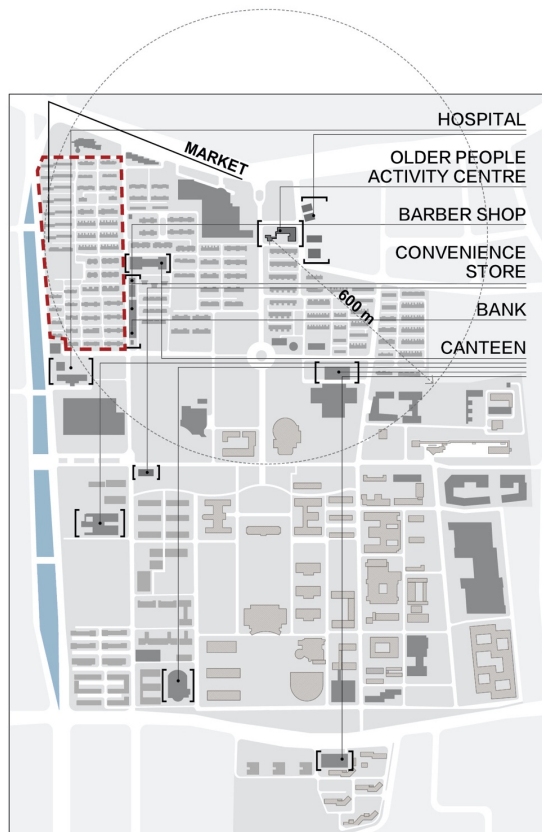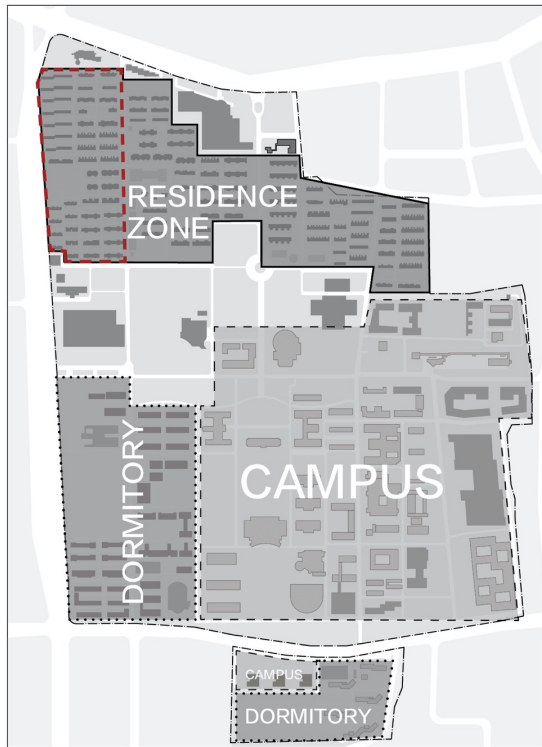
UNDERGROUND

Bus station

Underground station

Main road

Lane

Case scope

Figure 5.6 Mappings of Case 1

5.4.1 Community environment, Case 1

To gain a better understanding of the overall outdoor environmental condition of Case 1, Figure 5.7 shows photographs and an axonometric drawing of the community.

Figure 5.7 A 3D axonometric drawing of Case 1

The residential community environment is a complex system composed of a series of elements, such as buildings, roads and parking spaces, landscape, activity spaces, signage, and lighting. All these elements should be considered comprehensively when carrying out an age-friendly design or retrofitting work of the community environment. Due to technological and economic constraints at the time of construction, the overall age-friendly level of the old residential buildings built before 1998 are relatively low.

According to the architectural observation using the age-friendly community environment checklist (see Table 5.1), the following noticeable issues, which are not age-friendly, have been defined in the community outdoor space in Case 1:

- **Parking and community road system:** The mobility of the community road system is deficient, and the safety, convenience and identifiability of the walking system needs to be improved. The pavement is not connected, and the road present height differences. Electric bicycles and car parking occupy public spaces and green areas, because there is a lack of parking space and management.
- **Residential building entrance:** The residences' lack barrier-free considerations, and the entrances lack a ramp and handrails. Stairs are the only route from the entrances to the upper floors in most of the buildings. Only a small number of the buildings have installed lifts.
- **Activity space and rest space:** The function and comfort of outdoor activity space need to be improved. There is both a lack of activity space suitable for the older residents, a lack of multi-generational activity space, outdoor seating and supporting facilities.
- **Landscape:** The safety, aesthetics, and functionality of open green areas need to be improved. The path surfaces are not level and contain cracks and holes.
- **Signage and lighting system:** The design of signage and the lighting system lacks consideration for older residents.
- **Community sanitation:** The environmental sanitation condition is poor. Domestic waste and construction waste occupy the public space.
- **Staircases:** The condition of staircases in community 1 is poor, lacks maintenance, contains hidden hazards.

The top five issues are defined according to the checklist. The last two problems were found during the observation, and were not included in the checklist. The following section, examines the above issues to highlight the potential adverse conditions faced by older people when living independently, and to put forward targeted improvement suggestions.

Parking and community road system

In Case 1, all the vehicles, bicycles, electric bicycles, and pedestrians use the same entrance and road system with no distinction between pedestrian paths and vehicular traffic lanes. There is no gatekeeper or access control system to manage the access of vehicles and persons. There is limited car parking space inside the community, no underground parking is available, and accessible parking space has not been considered. Many cars occupied the green space near the buildings (Figure 5.8.a).

The community does not provide bicycles parking spaces within close proximity to the entrance of each residential building. Nevertheless, many bicycles were parked close to the entrances or on the grass (Figure 5.8.b). Four centralised bicycle parking areas are found in the middle part of the community. However, a part of the space was occupied by abandoned furniture and waste bins (Figure 5.8.c). Some residents left their bicycles beside the building entrances, even though the residential building is close to the bicycle parking area.

Limited parking areas and randomly parked bicycles and electric bicycles clutter public roads in the community. This phenomenon has a negative impact on the mobility of older people and other residents. Given this problem, proper planning and parking management action should be taken to improve the parking issue in the community.

Another problem is the condition of the roads. There is noticeable damage to the kerbs, as shown in Figure 5.8.d. The road surface is uneven which deters residents from using it, impacting on its usefulness and connectivity. Residents have placed several concrete slabs on the grass to create a shortcut for pedestrians between the main road and building entrance (Figure 5.8.e). The paths built by the residents themselves are not age-friendly, the stone slabs are not firm enough and contain dangerous gaps and height differences. This situation shows that the road design is not satisfactory, and there is a lack of suitable footpaths through green spaces. Repair of damaged roads and planning pedestrian routes needs to be improved to make the community more suitable for older residents in terms of their mobility and safety needs.

The issues of parking and the community road system are prominent in the Case 1 community and are detrimental to the safety and mobility of older residents. From this perspective, the old residential community represented by case 1 needs to take corresponding road systems and parking measures to enable the older people realise ageing-in-place.

Residential building entrance

As introduced in Chapter 3, the privatised pre-reform public housing (staff accommodation or unit compound) built before 1998 in China were not equipped with a lift and did not consider barrier-free design. Case 1 is a typical staff accommodation community, according to this feature. Initially, all the residential buildings in Case 1 were six-story and only used stairs for circulation. The entrances of the buildings exhibit two forms: several steps (Figure 5.8.f) or a gentle ramp (Figure 5.8.g). As a result, older residents need to overcome the height difference between the indoor and outdoor space, which might be a burden for people who have mobility problems.

During the fieldwork in Case 1, an age-friendly transformation project was underway. Lifts were being added to some of the residential buildings, as shown in Figure 5.8.h. The added lifts provide another level of access for the residents by helping them reach their homes and thereby improving their mobility. However, most lifts do not directly lead to the resident's door, just to the stair landing, and the residents still need to use several steps to get home. Moreover, the added lifts make the entrance space more cramped. More about the retrofitting of lifts, along with how it relates to age-friendly built environment will be discussed in more detail in Chapter 7.

Other problems relating to the building entrance are the narrow transitional space and the rain shed not covering the entrance platform, steps or ramp. These environmental features do not meet the requirements of a supportive space for older people during their daily use.

a. Random parking

b. Bicycles in the building entrance

c. Abandoned furniture in the bicycle parking area

d. A broken kerb

e. Shortcut built by residents

f. Steps into the building entrance

g. Ramp into the building entrance

h. New lift which was added

Figure 5.8 The community environmental condition in Case 1 (Parking and community road system and residential building entrance)

Activity space and rest space

The activity space and rest space in the Case 1 community is not small, but there are other problems. For example, there is an open activity space in the southern part of the residential community (Figure 5.9.a), but there is a lack of necessary public facilities, such as seats for resting and a pavilion for shade, and the provision of a diverse and multi-functional activity space to allow older residents to remain outside. Additionally, the open activity space lacks the barrier-free design consideration, the kerb without a ramp at the junction (Figure 5.9.b), presenting an increased falling risk for older adults.

Fitness equipment has been installed in the northern part of Case 1. Besides this equipment, some chairs have been brought from resident's homes and placed around this area (Figure 5.9.c). Some older people use the fitness equipment or chairs to sit on in the afternoon, conversing with each other or generally enjoying being outdoors, instead of doing exercise (Figure 5.9.d). Arguably, this is attributed to lacking rest facilities for people in the community's public space.

In Case 1, the mobility, functionality and comfortability of outdoor activity and rest spaces requires improvement. One of the main ways for older people to maintain physical and mental health is to spend time outdoors and be exposed to sunlight and fresh air, and carry out varied activities for their well-being.

Landscape

In Case 1, the open space for landscaping is adequate. Unfortunately, the green space has not been well designed. The greening between the residential buildings simply consists of grass and few trees without paths or shrubs (Figure 5.9.e). Another scene in Case 1 is a Chinese style yard. The entrance of the yard is a round door opening with a high threshold and no ramp (Figure 5.9.f). In the middle part of Case 1, there is also a large pond, though, there is a gap at the side of the pool which is a potential hazard (Figure 5.9.g). In addition, the pavement is made of large stones and the ground is overgrown with weeds (Figure 5.9.h). During the observation, no residents used this green space.

It is obvious that the landscape in the Case 1 community is lacking consideration for safety, mobility, aesthetics, functionality, and maintenance. Ideally, spatial identification could be enhanced through the collocation of various plants simultaneously enhancing the sensory function while improving safety aspects of the landscape. A properly designed and regularly maintained landscape is an important part of an age-friendly community. There is a great deal of room for improvement in the landscape aspect in Case 1.

a. Open activity space

b. Level difference

c. Chairs in the fitness area

d. Older people sit on the fitness equipment to chat

e. Landscape between the buildings

f. The entrance of the yard

g. A pool in the yard

h. The path in the yard

Figure 5.9 The community environmental condition in Case 1 (Activity space and rest space and Landscape)

Signage and lighting system

The signage system in Case 1 consists of building number signs and unit number plates (Figure 5.10.a, Figure 5.10.b). The house number of each unit is too small to be easily recognised by an observer, and so, very challenging for older people with visual impairment.

The fieldwork was conducted during the daytime hence the lighting system can only be evaluated by the number and arrangement of road lamps. The lampposts stand along the community road with security camera nearby. Night lighting plays an important role in ensuring the safety of older people and further improves the utilisation of the outdoor activity space.

Community sanitation

Generally, the sanitation condition in community public spaces needs to be improved. Construction materials and domestic waste are scattered around the green open space in more than one place (Figure 5.10.c, Figure 5.10.d). Basic sanitation of the community needs to be maintained through services such as garbage collection and construction waste management, which would benefit the older people's health and well-being, as it would for all residents living in the community.

Staircases

The public indoor areas are minimal within the Case 1 community of which staircases are the only examples. Those areas are not covered in the checklist (Zhou & Qin, 2018). The researcher recorded the apparent barriers and defects during the site visit. The stairs are dirty and badly maintained, which negatively impacts on residents' well-being. The window glass in the stair platform is broken (Figure 5.10.e), contrary to safety needs. The handrail on the staircase has rusted (Figure 5.10.f), affecting the functionality of the bars, especially for older people with mobility difficulties. Overall, the stairs need to be improved from an age-friendly perspective.

As mentioned above, numerous existing environmental problems in Case 1 do not meet the requirement of age-friendly environment features. According to the checklist, only four key points (out of 44) had been achieved in the Case 1 community environment. Future retrofitting projects should consider the following aforementioned aspects for improvement: parking and community road system, residential building entrance, activity space and rest space, landscape, signage and lighting system, and community sanitation.

a. Unit number plate

b. Building number sign

c. Construction materials on grass

d. Domestic garbage on grass

e. The broken glass on stair platform

f. The rusty handrail

Figure 5.10 The community environmental condition in Case 1 (Signage and lighting system, Community sanitation, and Staircases)

5.4.2 Home environment, Case 1

Regarding the above section, a checklist of age-friendly housing criteria was adopted to evaluate the indoor environment within the dwelling. This checklist includes nine areas: hallway, living room, dining room, kitchen, toilet, bedroom, balcony, facilities, and technology, and 60 key points (Table 5.2). Following the graphic examples and literal interpretation in the checklist, 26 key points met the criteria, while 34 key points fail to meet the recommendations.

The apartment that was visited in Case 1 is a two-person household. An older couple have been living in this apartment for more than 20 years. The host was 72 years old, and the hostess was 69 years old. Both were healthy without mobility problems as shown by their self-assessment. The total indoor area is around 50 square meters as shown in the floor plan in Figure 5.11, which is drawn according to the sketch and photographs taken during the observation. It is a two-bedroom apartment with traditional amenities, including kitchen, toilet, living room, dining area, which is part of the living room, balcony, two bedrooms and a study, which is part of the guest room.

A: Hallway
B: Living room
C: Dining room (area)
D: Kitchen
E: Toilet
F: Bedroom
G: Balcony
H: Study
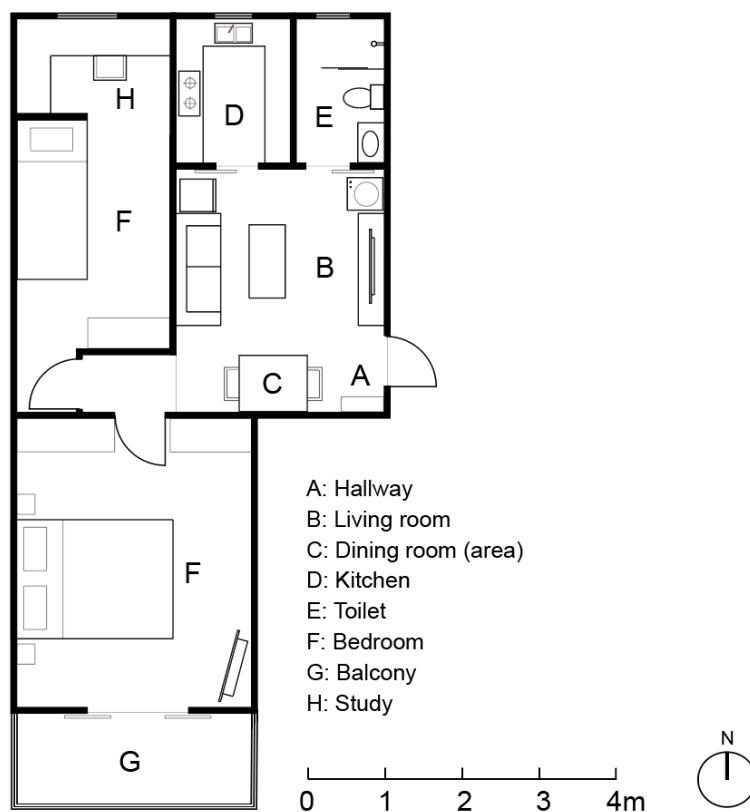
Figure 5.11 Layout of the Case 1apartment

In general, the following key issues were defined by observations made in the Case 1 apartment:

- Living space is relatively small (50 square meters).
- The living room has no windows and is not well ventilated.
- The indoor space has several height differences and thresholds.
- Wall-mounted cupboards and shelves in the kitchen and bedroom are placed extremely high.
- Slippery floor surfaces in the kitchen, toilet, and balcony.
- No place to sit in shower.
- The application of age-friendly facilities and technologies is insufficient.

In the following sections, the indoor issues highlighted above and associated potential hazards are discussed specifically to put forward targeted improvement suggestions.

Firstly, the living space in this apartment is small. There is a multi-functional living room directly connected to the apartment door with this room functioning as dining room, living room, and hallway. The hallway space is limited with a shoe storage cabinet beside the wall. The primary function of the hallway is changing shoes, which need a series of body movements, such as bending down, sitting down and standing up. This, therefore, could be difficult for older people may have weak legs and need to sit down to put on shoes. In this apartment, residents could only use the dining chair to change their shoes because of the limited space. Besides, the bathroom and kitchen are also very limited in size, a washing machine and refrigerator are also arranged in this living space, constituting a potential inconvenience to the daily life of the residents.

The living area is the main space where residents can watch TV, socialise, and enjoy entertainment. An age-friendly living room should pay attention to the selection and layout of the sofa and tea table based on older people's needs. According to the checklist, an age-friendly living room should be wheelchair accessible and provide adequate space for its storage. In this apartment, as shown in Figure 5.12.a, the cramped area leads to a very compact furniture arrangement, which makes wheelchair access impossible. It is likely be a serious limitation if the residents suffer from mobility issues and need a wheelchair in the future.

Another issue of the living room is the lack of natural light and ventilation. It is an enclosed space without a window. The sunlight must pass the toilet or kitchen into the living area, which increases the demand for artificial lighting.

There are several level differences and thresholds in this apartment (Figure 5.12.b), which would further hamper the movement of a wheelchair, and bring potential hazards for older people. The mobility aspect, therefore, is in need of improvement. An accessible environment would decrease falls, contributing to safety needs, and creating a barrier-free environment would help fulfil the potential challenges of future wheelchair use. Moreover, older people find it difficult to use wall cabinets that are very high, as is seen in this apartment's bedroom and kitchen (Figure 5.12.c). needing to step on a bench when reaching for items. This is inconvenient and poses a safety hazard for the older residents.

It is hard to see the application, in this apartment, of the age-friendly facilities and technologies mentioned in the checklist. For example, the toilet is a space with a high frequency of use both day and night. It is a space prone to accidents due to wet ground, the

height difference of the shower room, and a toilet without a handrail. These are issue which should have more attention paid to them in order to ensure the safety of the older people when washing, bathing, and toileting. As Figure 5.12.d shows, the toilet displays several potential risks for older people: floor tiles without non-slip treatment, lack of handrail in the shower room and beside the flush toilet, narrow space for storage, and no shower seat. These are all potentially hazardous to residents, especially for older people. When selecting home facilities, such as switches, sockets, lamps, heating equipment, hot water equipment, and exhaust equipment, the specific physical conditions, usage habits, and safety needs of older people should be considered. Seven technologies are mentioned in the checklist, including intelligent seats in the toilet, video door phone systems, emergency alarms, integrated switches, infrared detectors, adjustable lights, intelligent kitchen ventilator and curtains (Zhou & Li, 2018). The above age-friendly facilities and technologies should be taken into consideration during housing retrofitting.

a.   Living room

b.   Level difference between rooms

c.   Kitchen

d.   Toilet

Figure 5.12 The home environmental condition in Case 1

5.5   Case Study 2: Private market housing built between 1998-2012

Case 2 residential community is situated in the downtown area and the completion time was 2004. The residential community is divided into northern and southern sections, with an urban road in between. The first five floors are for commercial purposes, used as a supermarket and offices for rent. The residential part consists of five high-rise apartments, the tallest of which is 22 stories, with the other four being 17 stories and the apartment sizes range from 120 to 250 square meters. As a commercial and residential complex, Case 2 has a unique traffic pattern. Residents need to take the lift from the main entrance on the ground floor to the rooftop garden on the fifth floor and then transfer to the lifts of each building to reach the floor of their apartments. Case 2 is an established community with completed infrastructural facilities and support services, including underground, bus stations, supermarkets, hospitals, banks, schools, fitness facilities, parks, and an older person's activity and service centre (Figure 5.13).

Figure 5.13 Master plan of Case 2

It is worth mentioning that the older people's home care service centre adjacent to Case 2 is an excellent representative of this type of residential building in Nanjing. It aims to provide a comprehensive solution for older people to achieve ageing-in-place. The related services and support provided by this service centre are be discussed in Chapter 8.

This section focuses on evaluating the built environment of Case 2 according to the checklists (Table 5.1, Table 5.2), especially looking the features that are not conducive to the independent living of the older residents. The researcher observed the community public space and one private apartment in Case 2 during the fieldwork.

5.5.1 Community environment, Case 2

As mentioned above, Case 2 is a commercial complex combined with a supermarket and offices within the same buildings. The buildings are next to the city roads, as shown in Figure 5.14.

Figure 5.14 Site overview of Case 2

According to the fieldwork, the following problems emerged in terms of the age-friendliness of the community environment in Case 2:

- **Accessibility:** The buildings are equipped with lifts, but the barrier-free design is not coherent.
- **Parking:** Most of the ground parking spaces were occupied by non-motor vehicles,

and the underground parking is not considered accessible parking.

- **Activity space and rest space:** There is limited space for outdoor activities. The indoor rest space does not use non-slip flooring so is a potential safety hazard in rain or snow.
- **Landscape:** There is limited space for landscape. There is no special consideration for the requirements of older individuals in terms of mobility and safety.

Accessibility

According to the construction year, the design and building of Case 2 followed the residential building design code GB50096-1999, which stipulates that a lift must be installed in residential buildings with seven or more floors. During the fieldwork, it was found that although the residential buildings in Case 2 had at least one lift installed in each unit, some residents must go through several steps to enter the lift, as shown in Figure 5.15.a. In addition, the building also has problems in dealing with height differences. For example, the step between indoor and outdoor at the main entrance is made of concrete, which is steep and damaged (Figure 5.15.b).

In daily use, stairs can be inconvenient, especially for older, infirm residents, people with a wheelchair or baby carriage, and if carrying heavy objects. This was also verified from the interview, see Chapter 7. Lack of accessibility is the most serious built environment problem in Case 2, and common in other residential buildings from the same period in China.

Parking

Residents' mobility is also affected by parking issues (Figure 5.15.c). As a typical commercial complex beside city roads, the parking space of Case 2 is mainly an underground parking lot. The ground parking spaces are very limited and are mostly occupied by non-motor vehicles. In addition, office workers, customers of commercial spaces and residents share parking spaces making it difficult to find a parking space. Additionally, there is no barrier-free parking available.

Activity space and rest space

Based on building type and location, the building density of Case 2 is high, while the open space ratio is low. There is no open space available for outdoor activities, particularly for residents living on the southern side of the residential community. In the northern part of the residential community, the roof space of the fifth floor is designed as an activity space, as shown in Figure 5.15.d. The space and function of outdoor activities in Case 2 are limited, with no seating for residents to rest outside.

To cover the shortage of outdoor space, part of the interior space on the fifth floor is used as a place for activities and rest for residents to relax. The indoor activity space consists of two main functional areas: the rest area (Figure 5.15.e) and the table tennis area (Figure 5.15.f). In terms of functional considerations, this arrangement is positive. However, the floor tiles used here are smooth do not have good traction. Rain and snow or water may bring the risk of slipping and falling which is a serious hazard for older people.

a.   Steps in front of the lift

b.   The ramp in the main entrance

c.   Non-motor vehicles occupy ground parking space

d.   The roof garden

e.   Indoor rest area

f.   Table tennis area

Figure 5.15 The community environmental condition in Case 2 (Accessibility, Parking, Activity space and rest space)

Landscape

The landscape of Case 2 is also set in the roof space of the fifth floor on the northern side. Contained within a small space, the rooftop garden features a Chinese pavilion, a pond, rockeries and is planted with various types of plants, creating, as far as possible, a rich green space for community residents (see Figure 5.16.a, Figure 5.16.b).

However, there are two obvious downsides in terms of the age-friendliness in this roof garden. Firstly, the garden floor is partly paved with uneven pebbles and lacks maintenance. As shown in Figure 5.16.c the ground is full of potholes and pedestrians can easily trip over and so is hazardous for older residents. Secondly, the roof garden is not wheelchair accessible, as presented in Figure 5.16.d.

The roof garden

a. The roof garden

Uneven floor in roof garden

The entrance to the pavilion

Figure 5.16 The community environmental condition in Case 2 (Landscape)

5.5.2 Home environment, Case 2

The apartment visited in Case 2 is a two-person household. A couple had been living in this apartment since 2005, the host being 89 years old, and the hostess 83 years old. Both are able to live independently while experiencing some chronic diseases, such as hypertension and slipped discs.

The total indoor area of the apartment is around 120 square meters. The floor plan is shown in Figure 5.17. It is a two-bedroom apartment, comprising a living room, two bedrooms, a kitchen, two toilets, a dining room, three balconies and two study rooms. The couple enjoy calligraphy and Chinese painting and have a high degree of satisfaction with their living environment.
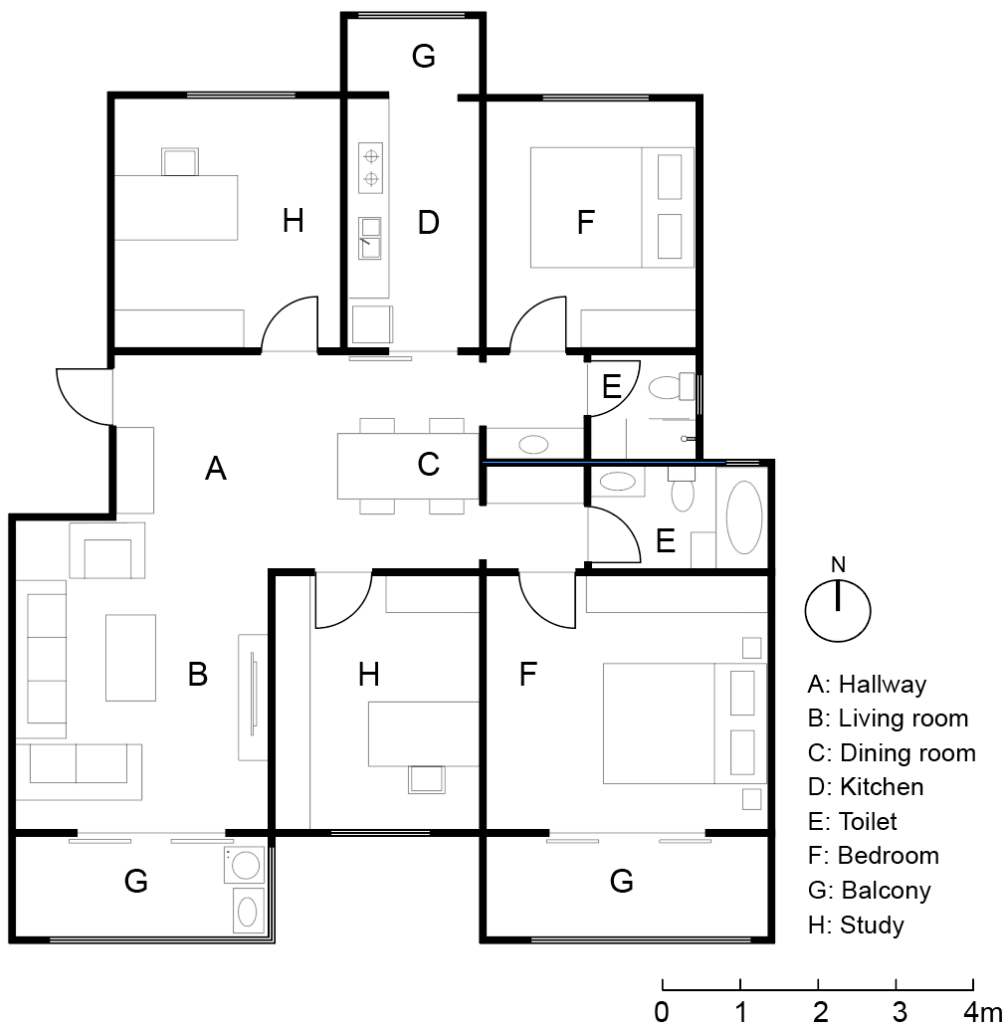
Figure 5.17 Layout of the apartment in Case 2

Following the age-friendly home checklist (Table 5.2), 44 key points met the criteria, while 16 key points failed to meet the recommendations. In general, the apartment in Case 2 showed a high level of age-friendliness, reflected in the following aspects (Figure 5.18):

- The apartment is spacious and bright with good ventilation and lighting.

- Non-slip materials have been used in the floor of kitchen and toilets.

- No high steps at the home.

- Functional layout is reasonable. Besides basic life demands, two study rooms are able to satisfy personal hobbies.

- Some modifications were made according to the needs of older people, such as handrails in the toilet.

According to the recommendations on the checklist, the following points can be used as a reference to further improve the apartment in terms of the age-friendliness of the home:

- Adjust the height of the kitchen worktop and cabinets to cater for older people.

- Add a grab bar near the toilet.

- Add a stable seat in shower/bath.

- Set a double-control switch for lighting in the bedroom.

- Consider technologies such as emergency alarms.

a. The living room

b. The study

c. The toilets 1

d. The toilets 2

Figure 5.18 The home environment condition in Case 2

5.6 Case Study 3: Private market housing built after 2012

Case 3 residential community is in the north of Xuanwu District. The project covers about 80,000 square meters, with a total construction area of about 330,000 square meters, accommodating a total number of 1,120 households. The market positioning of Case 3 is high-end improved housing. The developer aims to integrate shopping, life services, sports, leisure, entertainment, catering, schools, and a green space within the project. In addition to the residential buildings, the project lays out commercial streets along urban roads. As shown in Figure 5.19, the whole community is divided into three Zones: A, B and C. Zone B was completed at the end of 2018, therefore, the occupancy rate was low during the fieldwork. Zone C and the commercial street area was still under construction. Zone A was completed in 2016 and had a comparatively high occupancy rate when the research was conducted. As a result, Zone A was the main area observed during the fieldwork. Zone A consists of nine high-rise buildings with 32 floors, mainly 203 square meters for each apartment.
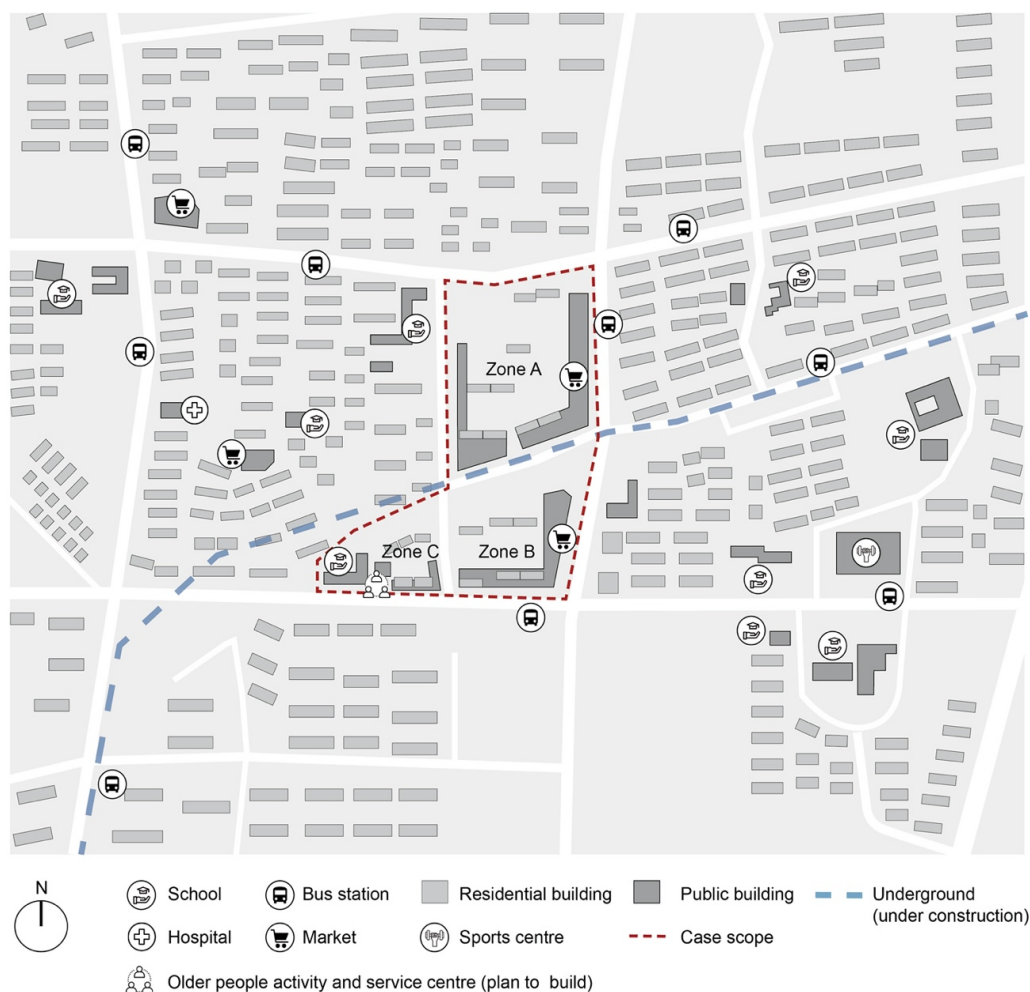
Figure 5.19 Master plan of Case 3

Case 3 is surrounded mainly by residential areas and living supporting facilities, and is in an accessible location. There are many buses stops around the community, and it is about 1.2 kilometres away from the nearest underground station. The proposed underground line, which will run through the community's main entrance, is scheduled to begin operation in 2024, making public transport more convenient for residents in the future. The community is within one kilometre of a market ,about one and a half kilometres to the nearest supermarket, and 1.2 kilometres away from the nearest general hospital. The community is adjacent to several primary school, secondary schools, and internal kindergarten. According to the blueprint of the Case 3 project, the property sales office will be transformed into an activity and service centre for the older residents in the future. In addition, the commercial building in the community is establishing a supermarket, which was still under construction during the fieldwork.

This section focuses on evaluating the built environment of Case 3 according to the community environment checklist achieved by visiting the outdoor community environment in Zone A. Due to the lack of accessibility to the private apartment in Case 3, the researcher did not have access to the home environment on-site which presents a limitation within this case study.

5.6.1   Community environment, Case 3

As mentioned above, Case 3 is a gated community consisting of high-rise residential buildings. The site overview of Case 3 residential community is presented in Figure 5.20.

Figure 5.20 Site overview of Case 3

The majority of residential community environment issues mentioned in the above cases are not present in Case 3, such as aspects relating to: parking, activities and rest areas, landscape and barrier-free design, found in both the outdoor environment and residential building entrance.

The parking space in Case 3 is underground (Figure 5.21.a), and the ratio of parking spaces is 1:1.4, including a portion of accessible parking spaces. The parking of non-motor vehicles is also arranged into the underground space. As a result, there is no problem with the disorderly parking of vehicles in the grounds of Case 3. The separation of people and cars in the community by using car stop stones, ensures pedestrians' safety on the community roads (Figure 5.21.b). In case of emergency, the car stop stones are movable, and there are temporary parking spaces for fire engines and ambulances at the entrance of each residential building.

The outdoor public spaces of the community have been carefully planned and designed to serve as activity areas and rest areas for residents (Figure 5.21.c), combined with a landscape decorated with decent ornaments (Figure 5.21.d). There is also consideration of the older people's safety with the choice of slip and fall prevention paving material used. The only shortfall identified in Case 3's outdoor space is that of inadequate shelter from bad weather.

The most noteworthy feature is that the accessibility design within the community is very consistent, with relatively shallow ramps are used to deal with the positions with height differences. For example, the height transition between the road and the pavement (Figure 5.21.e), the ramps near the steps in the landscape area (Figure 5.21.f), and the ramps and handrails at the entrance to each building (Figure 5.21.g).

In addition, all the apartments in Case 3 have a strict access control system, which prevents strangers from entering the building without residents' permission, conducive to ensuring residents' safety and security (Figure 5.21.h).

a. The entrance of underground parking

b. Car stop stones

c. Rest space

d. Landscape

e. The height transition between the road and the pavement

f. Ramp in the green space

g. The ramp and handrails at the entrance of the building

h. Access control system and post boxes in the residential building entrance

Figure 5.21 The community environmental condition in Case 3

5.7 Comparative Analysis of Three Cases

As presented in the above sections, the three cases present differing conditions regarding the age-friendliness of the physical environment. In terms of the community environment, 44 key points in the checklist of community environment were observed during fieldwork in the three cases. The overall results of the three cases are listed in Table 5.3. Only four key points met the guidelines in Case 1, while 19 key points were met in Case 2 and 39 in Case 3. Some points in the checklist were not applicable to Case 2. According to the observations based on the age-friendly community environment checklist, 19 key points met the checklist recommendation, while six key points were not applicable and 19 were unmet in Case 2. In Case 3, 39 key points met the checklist recommendations, while five key points did not. Seen in this light, older residential communities expose elderly residence to a greater number of unsuitable environmental features. The newly built community, however, provides a more age-friendly physical environment for the older population in terms of the built environment. The implementation of new building and design standards is the main reason for this phenomenon.

Table 5.3 The checklist of an age-friendly community, results of observation

The main points of an age-friendly community	Case 1	Case 2	Case 3
Category A. Residential community entrance			
1 Clearly dividing pedestrian lines and traffic lines	NO	N/A	YES
2 Meet barrier-free access needs	NO	NO	YES
Category B. Residential community road			
3 Separate people and vehicles in the traffic organisation	NO	N/A	YES
4 Design road section according to traffic organisation and functional requirements	NO	N/A	YES
5 The road system should be clear and concise	NO	N/A	YES
6 Meet the traffic needs of all types of vehicles	NO	N/A	YES
Category C. Motor vehicle parking area			
7 Reasonable allocation of ground and underground parking spaces	NO	NO	YES
8 Temporary parking space at the entrance of the residential building	YES	YES	YES
9 Set up barrier-free parking space	NO	NO	YES
Category D. Non-motor vehicle parking area			
10 Non-motor vehicle parking space near the entrance of the residential building	NO	YES	YES
11 Meet the parking needs of all types of non-motor vehicles	NO	YES	YES
Category E. Pedestrian road			
12 Try to use the flat road and handle spatial height differences properly	NO	NO	YES
13 Use flat and homogeneous ground covering material	NO	NO	YES

14	Try to ensure the continuity of the pedestrian road	NO	NO	YES
15	Ensure adequate pedestrian road width	YES	YES	YES
Category F. Walking path				
16	Reasonable planning of the path streamline	NO	YES	YES
17	Set up rest facilities along the path for older people to rest	NO	YES	YES
18	Rational allocation of plants along the path	NO	YES	YES
19	Consider setting up shelter corridor	NO	YES	NO
Category G. Residential building entrance				
20	Obvious position and easy to identify	NO	YES	YES
21	Avoid crossing with external streamlines	NO	YES	YES
22	Handle the entrance height difference properly	NO	YES	YES
23	Provide a transitional space for older people to stay and interact	NO	YES	YES
24	The rain shed should cover the entrance platform and the steep ramp as much as possible	NO	YES	YES
Category H. Activity space				
25	Arranged in place with pleasant micro-climate	NO	YES	YES
26	Pay attention to the accessibility of path streamlines and visual lines	YES	YES	YES
27	Maintain a suitable distance from the residential building and the road	YES	N/A	YES
28	Use plants or structures to define boundaries properly	NO	NO	YES
29	Provide a wide variety activity space	NO	NO	NO
30	Set up older people and parent-child activity space	NO	NO	NO
31	Use suitable ground covering material	NO	NO	YES
32	Set up necessary subsidiary equipment	NO	NO	NO
Category I. Rest space				
33	Set up rest seat for major pedestrians and activity space	NO	NO	YES
34	Set up rest space with shade shelter	NO	YES	NO
35	Choose suitable seat type and arrangement	NO	NO	YES
36	Provide space for older people who use wheelchairs to rest and stay	NO	NO	YES
Category J. Landscape				
37	Enhance spatial identification through the collocation of plants and pieces	NO	YES	YES
38	Create a sensory stimulation of the landscape	NO	NO	YES
39	Set up the lawn reasonably	NO	YES	YES
Category K. Signage system				
40	Form a continuous, multi-level signage system	NO	NO	YES
41	Located in an apparent position that is easy to observe	NO	NO	YES
42	Express the signage content accurately	NO	NO	YES
43	Present graphic information clearly	NO	NO	YES
Category L. Lighting system				
44	Set up key lighting in key areas	NO	YES	YES

Two apartments were visited during fieldwork, one in Case 1 and another one in Case 2. The private apartment in Case 3 could not be reached because access was not allowed, representing a limitation within this case study. In summary, Case 1 met 26 out of the 60 key points of the age-friendly guidelines in private housing, while Case 2 met 44. The overall results are presented in Table 5.4. In line with the trend of the community environment, the interior living space of the newer community is more suitable for older people.

Table 5.4 The checklist of age-friendly housing, results of observation

The main points of an age-friendly housing	Case 1	Case 2
A. Hallway		
1 To consider older people need to sit down to change their shoes	NO	YES
2 To choose a suitable seat for older people to change their shoes	NO	YES
3 Pay attention to the shoe storage relationship with the position of the door	NO	YES
4 The height of the shoe storage should be easy to use by older people	NO	YES
B. Living Room		
5 To leave a space for older people with wheelchair	NO	YES
6 The layout of the sofa and tea table should be more accessible for older people to pass in and out	NO	YES
7 To choose a suitable tea table for older people to use	NO	YES
8 To choose a suitable sofa for older people to use	NO	YES
9 To avoid air conditioning is directly blown sofa	NO	NO
10 The ground material should non-slip and anti-glance	YES	YES
C. Dining Room		
11 To improve the visual connection between the dining room and kitchen	NO	YES
12 To consider watching TV at meals	YES	YES
13 To reserve a wheelchair position beside the dining table.	NO	YES
D. Kitchen		
14 To avoid the wall cabinet bump against older people	YES	NO
15 To add a middle cabinet between the base cabinet and wall cabinet	NO	YES
16 Worktop should be continuous	YES	YES
17 Design worktop between and beside the sink and hob	YES	NO
18 The microwave oven should be placed on the worktop, not too high or too low	YES	YES
19 Small tables can be arranged in the kitchen when conditions permit	NO	YES
20 Keep a worktop beside the fridge	NO	NO
E. Toilet		
21 To separate wet and dry areas in the bathroom	YES	YES
22 To choose a suitable bathroom sink for older people to use	YES	YES
23 To add a towel rail near the bathroom sink	YES	YES
24 To use an out-opening door or sliding door in the bathroom	YES	YES
25 To use a mixer tap	YES	YES

26	To use a handrail and shower curtain in the shower room	NO	YES
27	To use an adjustable height shower head	YES	YES
28	To use a shower seat	NO	YES
29	To use a grab bar near the toilet	NO	NO
F. Bedroom			
30	To consider the older couple who need to sleep separately	YES	YES
31	The bed size should be well reasonable, not too large or too small	YES	YES
32	Bed selection and layout should meet the needs of the older people	YES	YES
33	Bed material should be comfortable for older people to touch	YES	YES
34	Double-control switch should be set for main lamp	YES	NO
35	The air supply direction of air conditioner should not be directly opposite the bed	NO	NO
36	To choose a suitable bedside table	YES	YES
G. Balcony			
37	Closed balconies should be equipped with washing machines for centralised washing and drying	NO	YES
38	To consider the possibility of low position washing line	YES	YES
39	Pay attention to the height difference of the balcony door	NO	YES
40	The size of the balcony door should be suitable for older people	YES	YES
H. Facilities			
41	Switch panels need to be easy for the older people to distinguish and operate	YES	YES
42	Handles should be easy for older people to grasp	NO	YES
43	The socket should be raised appropriately according to the position and function	NO	NO
44	To choose suitable lamps for older people	NO	YES
45	There should be two light sources in the main space	YES	YES
46	Lighting should be enhanced in reading and fine operation areas	YES	YES
47	The layout of sockets should take into account various forms of furniture placement	NO	YES
48	Seats need to be light and stable for the older people to move and sit up	NO	YES
49	To guarantee the width of door	YES	YES
50	To consider fixed window over the windowsill with items	NO	NO
51	To consider floor heating	NO	NO
52	To ensure the older people can use hot water conveniently	YES	YES
53	To consider the drainage and ventilation in the toilet	YES	YES
I. Technology			
54	To reserve a socket beside toilets for setting up intelligent seats	NO	YES
55	To consider older people's needs of video door phone system	NO	NO
56	To install emergency alarms in bedrooms and bathrooms	NO	NO
57	To install an integrated switch in the hallway	NO	NO
58	Infrared detectors can be set to sense the action of the older people	NO	NO

59	To use adjustable light	NO	NO
60	To consider using a remote control to operate curtains, kitchen ventilator	NO	NO

In general, the staff accommodation communities were mainly built from the 1950s to the 1990s. Due to a long-term housing shortage, a compact layout was adopted. The planning of the residential buildings followed the basic principles of providing sunshine and ventilation. Green space or activity areas were set up between the buildings. The building form is relatively simple, mostly a six-story block buildings without lifts. Case 1 is the typical staff accommodation community without basic age-friendly measures. The community outdoor environment and indoor apartment environment are at a low level of age-friendliness. The most prominent environmental barrier is the lack of lifts. Additionally, as the number of private cars in China has increased rapidly in recent decades, parking has become a significant problem in such residential communities. Community renovation projects have been put into practice in recent years.
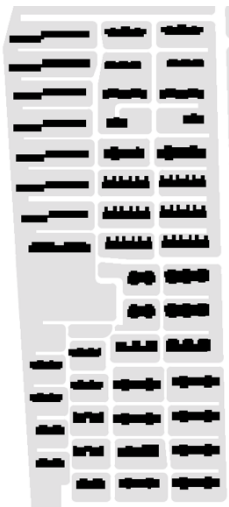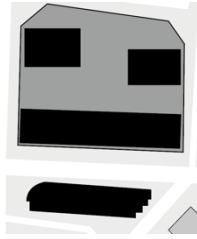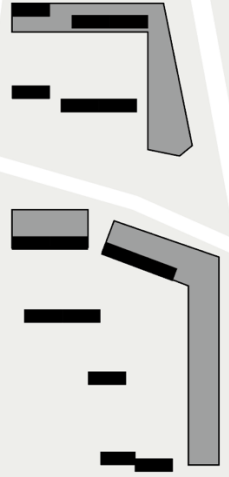
Following the housing reform, the first batch of commercial buildings was built in the late 1990s. The regulations and design standards of residential buildings had been greatly improved compared to those of public housing before in terms of spatial function and environmental performance. Due to the scarcity of land in the urban area, most residential buildings constructed in this period are high-rise, which increases residential density while freeing up public open space. Case 2, completed in 2004, represents an example of this type of residential community. Compared with Case 1, this kind of community has seen improvements in the community environment and apartment layout. The building is equipped with lifts to improve accessibility, but the accessibility design is inconsistent, and residents still need to use a small number of stairs.

In the early 2010s, the introduction of two new residential building design standards significantly influenced housing and residential community design. Since then, the new housing has consistently achieved improved accessibility and supporting facilities for the community. As Section 5.6 presents, Case 3 largely met the checklist recommendations of an age-friendly community, avoiding the environmental barriers defined in Case 1 and Case 2 and providing an age-friendly built environment for the older residents.

Table 5.5 presents an overview of the typical residential communities in Nanjing in regards community type, built data, built environment, location, and form, and ordered using the master plan of the three selected cases as examples.

In terms of the indoor living environment, the two visited apartments in Case 1 and Case 2 showed different characteristics reflected in the floor area, which influences the possibility and flexibility of the space and function. Compared with the apartment in Case 2, the apartment in Case 1 was exposed to more environmental barriers with significant room for improvement in terms of safety, comfort and mobility.

Table 5.5 Overview of three typical communities in urban China

Community type	Built Date	The features of the built environment	Form and order
Privatised pre-reform public housing (staff accommodation or unit compound)	Before 1998	Multi-storey, walk-up. High building density. Limited public activity area. The buildings are relatively old, mostly brick-concrete structures.	
Private market housing	1998-2012	Mainly on high floors, equipped with lifts. The barrier-free design is not coherent. Considered as public venues. Some communities combine commercial buildings.	
Private Market housing, which in compliance with the accessibility design standards	After 2012	The number of layers is higher than before. The building density is relatively low. The barrier-free facilities are consistent. Outdoor venues and green areas are adequate. Complete public services.	

5.8 Summary

This chapter focused on the case studies which explored the environmental conditions in three different types of mainstream residential communities in urban China. Three communities were selected to exemplify typical residential communities according to the year built in Xuanwu District, Nanjing. Two objectives were achieved: 1) the evaluation of the Chinese urban mainstream communities and private dwellings environment from an age-friendly environment perspective, 2) the identification of environmental barriers in achieving ageing-in-place within the three different urban communities.

This chapter used data collected via a desktop study and from fieldwork. The desktop study included site location, population data, building type, and surrounding infrastructure. Fieldwork was conducted by structured site observation using checklists, taking fieldnotes and photos for analysis.

It was found that the newly built community provides a more age-friendly physical environment for the older residents. According to the age-friendly community environment checklist, only four key points from the guidelines were met in Case 1, while Case 2 met 19 key points and 39 key points for Case 3, totalling 44 key points from the checklist. In other words, the older communities present more environmental barriers for older individuals in regard age-in-place.

The difference in build date between the three residential communities was reflected in the differences seen in the design standards, building techniques and community positioning, and the environmental barriers faced by older residents. The goals and recommendations for improvement are, however, are the same: to promote safety, mobility, convenience, and universality.

This chapter has identified the environmental features through conducting observations. In Chapter 7, the older residents and experts express their attitudes toward the built environment features which they feel are supportive, or potentially hazardous. Before this, the chapter 6 presents the meaning of ageing-in-place for older people in urban China.

CHAPTER 6.   CONCEPTUALISING "AGEING-IN-PLACE" IN URBAN CHINA

6.1   Introduction

This chapter aims to build a conceptualisation of ageing-in-place in an urban Chinese context. This is the second objective of the PhD study which aims to interpret and analyse ageing-in-place in contemporary urban China.

To meet the second objective, this chapter seeks to answer the following questions: 1) How do Chinese urban older people understand the meaning of ageing-in-place? 2) What are the challenges facing older people achieving ageing-in-place in urban China? And 3) What are the differences between ageing-in-place and ageing in a care facility?

This chapter presents the attitudes, experiences, challenges and visions from both the older people group and stakeholder group perspectives. Data were collected from in-depth face-to-face interviews with 50 participants (37 older people and 13 experts). Inductive qualitative content analysis was employed in this chapter to build the conceptual model. Understanding the ageing-in-place concept in current Chinese urban settings is necessary to develop a holistic framework for promoting ageing-in-place.

6.2   What is Already Known About Ageing-in-place?

Globally, ageing-in-place is an increasingly important concept with the ageing trend in the world population (WHO, 2007). The changes inherent in individuals' ageing process necessitates transitions in living environments, by adapting current homes or relocating to a more supportive environment (Perry et al., 2014). Considering where to live, older people often think their home or community as enabling them to maintain a sense of connection to society, security and familiarity, and as being related to the sense of independence, identity and autonomy (Lawler, 2001; Wiles et al., 2012). Moreover, older people 'staying put' in private housing and communities as long as possible could be an effective solution to avoid increased healthcare expenditure. Thus, ageing-in-place is favoured by policymakers, healthcare providers, and by the older people themselves (WHO, 2007; Kim et al., 2017).

'Ageing-in-place', then, has become a common policy response to population ageing. New Zealand's Positive Ageing Strategy (Dalziel, 2001, p.10) defines "age-in-place [as] to be able to make choices in later life about where to live, and receive the support needed to do so."

Higgins (1989) listed key characteristics derived from comparing institutions and homes for older people (错误!未找到引用源。), stating that ordinary housing (homes) tended to be the preferred accommodation than institutions for older people because it could offer more privacy, informality, freedom and familiarity. Community-based care ageing-in-place has also been supported by clinical outcomes from older people participating in community-based ageing-in-place programmes matched to nursing home residents. The older people who received community-based care experienced better cognition, less depression, decreased activities of daily living assistance, and less incontinence (Marek et al., 2005).

Governments and international organisations increasingly concur that it makes economic and social sense to help older people in staying in the community as long as possible (WHO, 2015a). However, it is a very complicated task to enable older people to age-in-place, needing the provision of necessary resources for older people to remain in their own homes and communities (Kim et al., 2017). Additionally, it necessitates comprehensive planning, the availability of a variety of community support services, and the removal of obstacles that isolate and restrict the activities of older people (Lui et al., 2009). Thus, understanding the connection between the environment and ageing well is necessary to provide a supportive environment for older people and thus to enable them to age-in-place.

6.3 Design of Interview

As discussed in the previous section, there are different definitions of ageing-in-place. The majority of the existing literature is focused on Europe and the US. Ageing-in-place is also a preferred option for older people in China (The State Council, 2008). Hence there was a need to explore the meaning, conceptualisation and manifestation of ageing-in-place in the Chinese context. To reiterate, the research objective of this chapter is to build a new conceptual model of the experience of ageing-in-place in the case of urban China, which is the fundamental aim of the study.

The semi-structured interview method was chosen as an ideally suited qualitative data collection method to learn the meaning and experiences of ageing-in-place of older people in urban China. The interview design was driven by the objective of the research project. The data involved in this chapter can be divided into two parts. Firstly, semi-structured interviews involved 13 experts, including policymakers, property managers, and care providers, to understand how to support older people to age well. Second, semi-structured interviews were conducted with 37 older residents to understand the meaning of ageing-in-place to them, and what the benefits and difficulties of doing so involved. The older participants were selected from among those aged 60 and over, who resided in the case communities and had

the cognitive ability to understand and answer the interview questions. Different participant groups answered questions around the topic of ageing-in-place during the interview. The interview questions are presented in Table 6.1.

Table 6.1 Interview question schedule of ageing-in-place

Older people group	1.	What do you think ageing-in-place means to you?
	2.	Do you prefer living in your private housing as long as possible? Why?
	3.	What are the challenges of achieving ageing-in-place in your experience?
Stakeholder group	1.	What is your understanding of ageing-in-place? In your opinion, do older people in urban China prefer to age-in-place or not? And why?
	2.	What are the challenges of older people achieving ageing-in-place in urban China in your opinion?

All older people interviewees lived at home. They decided to age-in-place as the result of the benefits and meanings of staying at home or in the community. They pointed out the challenges during the ageing-in-place process. Some of the participants also had considered care facilities and made a comparison between the two choices. Their attitudes toward the differences and decision-making processes were discussed. The results will be presented in the following three sections:

- The meaning of ageing-in-place;

- The challenges of older people achieving ageing-in-place in urban China; and

- Comparison between ageing-in-place and ageing in a care facility.

The categories and themes are derived from the data in inductive content analysis, see Figure 6.1.

Figure 6.1 The themes of ageing-in-place

6.4 The Motivations of Older People to Age-in-place in Urban China

The overarching understanding of ageing-in-place, and the one adopted as a working definition with participants in this research, is that of older people staying in their home or community as opposed to moving to a care facility. The direct translation of the term 'ageing-in-place' is '就地养老' ('jiù dì yǎng lǎo' in pinyin) in Chinese. However, another term '居家养老' ('jū jiā yǎng lǎo' in pinyin) is widely used in Chinese literature and policy, meaning ageing at home. The translation of the phrase '居家养老' is ageing at home or home-based care. The researcher found that older people participants would often ask for the phrase to be repeated when using the first translation '就地养老', while they used the second one '居家养老' to understand ageing-in-place and discussed this further. The experts also understood the two phrases equally, which are virtually interchangeable in Chinese. Notably, the direct

translation of the phrase 'ageing-in-place' was popular among policymakers, service providers, and architects, but was unfamiliar to some of the older participants in this research. It was useful to explore older participants' understanding of the phrase since it highlighted the importance of not assuming that the terms held fixed or shared meanings.

Inductive qualitative content analysis of the interview transcriptions revealed four main categories about the motivations of older people to age-in-place. Each main category contained several sub-categories and sub-sub-categories, as indicated in Table 6.2.

Table 6.2 The motivations of older people to age-in-place

Main category	Sub-category	Sub-sub-category
Identity	Physical identity	Freedom
		Independence
		Autonomy
	Psychological identity	Dignity
		Privacy
		Personal value
		Subjective well-being
Belonging	Place attachment	Familiarity
		Avoid change
		Resist the new environment
		Convenience
		Security
	Social connection	Neighbourhood
		Social networks
		Lifestyle
Culture	Family ties	Family support
		Take care of others
		Multigenerational living
	Filial piety	Personal experience
		Attitudes from others
Finance	Individual	Affordability
		Frugalness
	Family	Save for next generation

6.4.1 Ageing-in-place linked to the sense of identity

'Identity' within this conceptual model related to an older person's sense of self, which is divided into physical identity and psychological identity according to the interview results. Physical identity is understood in terms of older people's freedom, independence, and

autonomy, while psychological identity reflected in their dignity, privacy, personal value, and subjective well-being.

Older participants in each community expressed the significance of freedom when they stayed in a private home. They could maintain their own lifestyles and habits without control from others. They could arrange a time to eat and rest as they liked or decide which activities to attend. Many emphasised their right to go out freely, to do exercise, go shopping, chat with friends, enjoy the fresh air, travel, or walk around the neighbourhood. Some individuals highlighted that they enjoyed personal space at home. Several older people linked freedom with property ownership. One of the participants stated:

> I like to stay at my apartment, because of freedom. It is important to me. Although my son and his wife are living with me, I still feel free, because it is my property. (C1_3, 65, Female) (for details of the participants see Table 4.8)

The stakeholder group showed less attention to freedom than the older people. Only two property managers mentioned freedom as an advantage of ageing-in-place.

Some participants identified independence as one key factor which influenced their choice of where to live. The older people made it clear that they would stay at home as long as they could live independently, without help from others. Ageing-in-place was linked to maintaining a sense of independence. Some participants believed that home environment, family members and surroundings could contribute to their ability to live independently. Meanwhile, some older people stated that they would think about future choices once they lost independence:

> Currently, I can live independently. I prefer living at home. But one day when I have difficulty in mobility, and nobody can help me at home. I will consider moving to a care home for service and care. (C1_9, 82, Male)

> If I lost independence and need care and help in the future, I will try to heir a care provider to my own home. Home is the best place. (C2_13, 82, Female)

Independence also attracted the stakeholder's attention. Architects highlighted the importance of a supportive living environment, which could help older people to live without help and reduce the probability of falls. The care provider always distinguished older people according to their ability to live independently, suggesting that ageing-in-place was the first choice for people who were able to live independently.

Participants linked ageing-in-place with autonomy, as they could decide according to their desires rather than under the influence of others. They advocated staying at home as long as possible. However, some worried about losing their autonomy in the future. People connected autonomy with their mental health. Mental disorders would represent a potential risk that could impact their self-management ability. One of the interviewees mentioned that:

> I'm not even thinking about moving to a nursing home before, and I probably won't in the future. I certainly wouldn't want to go in my perspective, but by the time I'm 90 years old, I don't think I'll be able to decide by myself, maybe I have dementia. My family might send me (to a care facility). Now that I can make my own decision, I would not choose to go. (C1_3, 65, Female)

In another way, ageing-in-place could be achieved if older people's autonomy was maintained by living in a private home. Besides, participants also mentioned that financial autonomy might influence their choice. Participants said:

> Now my pension is not enough for the cost of a high-level nursing home. Staying at home will be more economical. (C2_3, 60, Male)

> I don't want to add to the burden of my child. Most of this generation is the only child. They are facing much pressure from work and their own family. Our pension is to feed ourselves. (C1_11, 66, Female)

The participants from the stakeholder group thought that the opinion of older people should be respected, and that they have the right to decide where to live and with whom to live. In terms of living arrangements, most contemporary Chinese older people prefer ageing-in-place. A care provider stated:

> The present older person may be influenced by traditional ideas and tend to stay with children. However, in the future, the next generation, when we get older, may have a more significant gap in ideas. (S_4, Property manager)

First, from the traditional Chinese culture perspective, a number of older people believed that receiving care from family members and enjoying the company of children and grandchildren could get admiration from relatives and friends. On the contrary, going to a care facility would make them feel 'humiliated', or in Chinese, to lose face, because the Confucius value advocates moral obligation to look after one's parents. Some older participants passed on this perspective:

I have kids. What would people say about me if I move to a nursing home? Chinese people believe that we should stay with children, and they take care of us to reflect filial duty. (C2_9, 67, Female)

In China, the tradition is to stay at home, with children around. There is an old saying in Chinese, '天伦之乐' (Happiness of a family), which refers to the scene of children and grandchildren circling when people grow old, which is the best happiness of the older people. That is what I want. (C3_10, 69, Male)

This kind of dignity informed by the cultural aspect was also highlighted by experts. They claimed that this traditional idea was impressive for most Chinese older people, which is one of the critical factors in determining their choice to age-in-place, rather than go to a care facility.

Secondly, with the ageing process, older people may lose self-care ability due to their health and functional decline. Several participants expressed their fear of not being able to take care of themselves as this would be seen by others; in consequence, they would feel as if they were losing their dignity. As interviewees said:

In a nursing home, if I become incontinent, I will lose my dignity and self-respect in front of others. (C2_10, 69, Male)

I will be terrified that when I am lying in a hospital, other people would pity me, sympathise with me. The extra money spent only extends the life span of two or three months with various oxygen tubes in my body. The quality of life will be inferior. When people become incapacitated, they have no dignity at all. (C2_1, 70, Male)

Thus, ageing-in-place is considered as essential to maintain the dignity of older people in later life. A care provider introduced a care model called 'nursing bed at home'. With the help of professional nursing workers and technologies, older people without self-care ability can keep living in their own home. The Chinese Government and non-profit organisations have been piloting and promoting this model to support older people to achieve ageing-in-place. The participant believed that:

Living with dignity and living without dignity is entirely different in the quality of life, and the former will result in an effective extension of older people's life course. We want to extend their life span and improve their quality of life as well. When the older person feels love, power, and care at his (or her) own home, he (or she) will have a will to live as long as possible. (S_7, Care provider)

Participants linked ageing-in-place with their privacy, mainly referring to personal space and the right to be immune from scrutiny or observation. Staying at home helps them to protect their privacy and reduce being influenced by others to some extent. Participants mentioned that they already slept alone, even if living with their spouse in the same apartment. Some interviewees expressed their requirement for an independent space at home, as highlighted in the following explanations by two participants:

> I need privacy. Because as older people, we often have some physical problems, such as insomnia, snoring at night, and the habit of watching TV or watching mobile phones to fall asleep. Then, these activities will affect the rest of the people if there are people nearby. (C2_10, 69, Male)

> I have different habits and schedule with my wife. I like investing in stocks in the daytime and reading quietly in the night. She likes watching TV day and night. Living in two rooms is good for both of us, reducing argument and complaint. (C2_11, 72, Male)

Personal value was mentioned when participants discussed the meaning of ageing-in-place. They believed that ageing-in-place could reflect their value to some extent, such as joining volunteer work, attending the University of the Third Age, being re-employed following retirement, and contributing to the community, all of which reflect personal identity. A participant talked about his volunteer work in a very proud tone:

> I used to be an accountant, and I believe I was an expert in this field. When my previous colleagues, classmates and friends have some financial problems, they do not know how to deal with these problems. Sometimes, they call me to have a look. I am willing to help them, and it is convenient to live in this house in the urban area. I don't take money from those work, but I feel like I can prove myself that I'm not old, that I'm valuable. (C2_11, 70, Male)

Many participants also linked personal value with looking after family members, including their children, grandchildren, spouses, and parents. A large proportion of participants, especially the older people living in Case 3, talked about looking after their grandchildren, which was the main reason for them to live with family members. This will be discussed in detail in the Section 6.4.3 of culture aspect.

Subjective well-being is a self-reported measure used to express their attitudes toward ageing-in-place. Some of the participants summarised the meaning of ageing-in-place using positive words linked with well-being, such as happiness, comfort, fun, joy, going well, and satisfaction, as the overall experience of ageing-in-place. Although they were facing some

challenges and threats during this process, participants always started discussing ageing-in-place by showing an active attitude, followed by stating difficulties or suggestions, and finishing with a positive conclusion. For example, a participant said:

> I would like to live at home for as long as possible. My home is a good place for me. Although we feel lonely sometimes without my children around, I still think home is better than a nursing home. (C2_8, 75, Female)

6.4.2 Ageing-in-place is linked to sense of belonging

Gilleard, Hyde, & Higgs (2007) stated that ageing-in-place is associated with increased feelings of attachment to one's area and contributes to people's sense of belonging. During the interview a sense of belonging was found to be linked to place attachment and social connection concerning the ageing-in-place. Place attachment is particularly in terms of familiarity. Older people expressed their thought about avoiding change and resisting a new environment. They believed that a familiar place means convenience and security. Social connection was reflected in keeping in touch with their existing social networks and neighbourhood and maintain their lifestyle.

Familiarity for older people concerned both social and physical dimensions. The social dimension involved the personal connection with relatives, neighbours, friends, property managers, and even a salesperson they often ran into and so on. Participants highlighted the social bond with people around them, which played a positive role in the meaning of ageing-in-place. Older people also mentioned their daily activities and lifestyles when they talked about familiarity at the social dimension. A participant explained her reason for preferring ageing-in-place:

> I want to be at home. I want to see people of different ages. There are old neighbours, we talked together almost every day and occasionally participated in some activities together, such as dancing and chorus. There are a lot of children and young people in the community. They are very energetic. I feel pleased to live with them. (C2_13, 82, Female)

Besides, familiar language and dialect have been mentioned by both older individuals and experts regarding the social dimension. A policymaker stated that many older people were worried about chatting with people who could not use their dialect. Some of the Chinese older people cannot speak and understand mandarin, which is a fundamental reason why some of them choose to stay in their hometown. Similarly, an older couple shared their experience regarding the language barrier. Their only daughter established her family in

America many years ago and suggested that the parents moved to live with her. The older couple had lived in the US for a short period, but subsequently decided to go back to China primarily because of the language barrier.

Regarding the physical place dimension, familiarity is comprised of home, the surrounding environment and the city. Participants highlighted the physical characteristics of a place as one that provided resources and amenities to support their daily routine and habits. The types of places that participants found meaningful involved a broad range of physical settings, from built environments such as apartment, roads, supermarket, older people activity centres and other certain buildings, to natural environments including lakes, parks, and mountains. For example, the individuals living in the Case 1 community expressed their appreciation of natural resources around their place:

> The location of my apartment is good. I walk to the Zijin Mountain every morning within 15 mins and take at least one hour's exercise with some other older people in a lovely natural environment. I enjoy the greens and fresh air. (C1_9, 82, Male)

The participants from Case 2 appreciated the convenience of the surroundings to meet their daily needs, including a supermarket, a hospital, and well-developed public transportation network, as few of the current Chinese older people can drive. The advantages of living in urban areas were some of the reasons why they choose to age-in-place.

Concerning the familiarity of the social and physical environment, participants expressed their sense of belonging with a variety of sources, such as place, people and cultures. Ageing-in-place keeps their feeling of being part of a strong and intergenerational community. Participants from different communities highlighted different aspects of belonging. Interviewees from Case 1 and Case 2 emphasised the place and people:

> East or west, home is the best. I've been at this campus for more than 50 years, so I'm familiar with the environment and people. I feel like this is my home. I belong here. I don't want to leave. (C1_10, 95, Male)

> I think the most important thing is the familiar living environment and familiar people. If you don't have friends around, you will lose the sense of belonging. Even if my younger daughter asked me to go to Shanghai and she said she would give me an apartment to live in, I wouldn't go. Because my old colleagues and friends surround me at home. (C1_13, 82, Female)

However, participants in Case 3 tended to link their sense of belonging with culture, especially the traditional idea of ageing with children and grandchildren. As Case 3 is a

relatively new residential community, residents had only moved to their respective apartments within a three-year period prior to when the researcher conducted the interviews. Only one participant mentioned belonging with place, due to his previous home having been located in the same area. Other interviewees linked belonging with their family members and traditional culture. The following represents the typical attitude from the participants in Case 3:

> Home is where I belong. At my age, home is the place where I have children and grandchildren. I am happy when them. I need company, and I can help them. (C3_2, 67, Female)

Older people believed that their home was a secure place, where they felt safe and protected. Participants in Case 2 linked security with good property management. An interviewee mentioned:

> My house needs to be looked after and secured. I think the property in our community is excellent. I don't care how much the property costs are, but the service must be good. (C2_11, 72, Male)

Besides, older participants linked security with the familiar surrounding built environment and their cognition. In other words, a familiar place contributed to their sense of security. In contrast, a new living environment might be unsettling for older people, even one that was modern and fully equipped. For example, a participant from Case 3 expressed her negative feeling of the new home:

> I lived a regular life at my house. I went grocery shopping, chatted with my friends and took a walk in the evening. When I move here, I am unfamiliar with the environment and do not want to go out, although the environment is pretty good. My own house is on the first floor and has a small yard, but my daughter's house is on the twentieth floor. I do not like the lift. I felt bored, cooped up at home like a pigeon, and didn't know my friends or neighbours. I can't use some facilities at home. I need my kids to help me. I'm afraid I'll break it or get lost if I go out on my own. I feel more comfortable and safer in my own home. (C3_7, 79, Female)

When the older people discussed place attachment and social connection, they typically expressed a desire to avoid change and resist the new environment. The experts also paid attention to this kind of attachment to familiar features:

> Old adults have formed a habit after living in the same place for many years. After a sudden change in his living habits, it will change all aspects of his physical

performance. Therefore, I believe older people should do their best to live in their own home. The society, government, family members should provide the corresponding support. If older people feel happy, keep regular life, they will rarely sick. The older people live in a familiar environment; the persons around him are also familiar. It's good for their mental health as well. (S_1, Property manager)

The older people who live in this community (talked about Case 1, which is a stuff accommodation) are old colleagues and old friends who have been together for decades. They are reluctant to leave the familiar environment and people. (S_5, Policymaker)

6.4.3 Ageing-in-place is strongly linked to culture

In this research, ageing-in-place is closely linked to filial piety by the individuals. Chan and Tan (2004) emphasised that *xiao* '孝', commonly rendered as 'filial piety' or 'filiality', occupies a significant position in Chinese ethos to define the ideal relationship between parent and child: "Among the various forms of virtuous conduct, xiao comes first" is a well-known Chinese proverb (Chan & Tan, 2004, p.1). Both past and present, the Chinese ethical worldview is impacted profoundly by filial piety and Confucianism. Besides, devotion to their offspring and spouses was repeated by the participants during the interviews. Beyond that, only children and the '4:2:1' family structure (Hesketh et al., 2005) was discussed, as a result of the Chinese birth-control policies.

The participants pointed out that the concept of filial piety was one of the reasons for their choice to age-in-place. The culture of filial piety in China includes respect and support for parents, which influences people's attitudes, as a Chinese proverb states: 'bring up children for the purpose of being looked after in old age.' Such views are widely shared in China, as a participant argued:

Home-based care has been the Chinese way for generations. It is a tradition that no older man has ever wished to spend his old age away from home. (C2_1, 70, Male)

Not only the older people agreed with this point of view; their children and relatives were also influenced by the traditional culture to support older people to achieve ageing-in-place as the ideal ageing and living arrangement. A participant stated:

My son said, "you have children, if you go to the nursing home, what people will talk about me". Chinese people still believe that older people should stay at home to reflect the traditional filial piety. (C3_12, 73, Female)

However, some participants pointed out that the influence of traditional culture on contemporary young people was gradually weakening. For example, an interviewee said:

> My children are not influenced enough by the concept of traditional Chinese culture. Because of the historical reasons of the Cultural Revolution, the Confucian idea of etiquette and filial piety was not inherited but criticised. Confucius became the greatest class enemy in that period. Therefore, this generation lacks the traditional culture of filial piety of ancient China. (C2_10, 69, Male)

Instead of receiving care from their children, many of the older participants were looking after their grandchildren, especially the residents living in Case 3. Daily tasks included taking the kids to school, doing some housework, buying and cooking food for the family. Most of them expressed their willingness to help the next generation to reduce stress. As a participant said:

> I want to help my son as much as I can while I'm well. This generation is not easy. They are all only children without sibling. The house is too expensive now. It has cost them much money. They need to pay the mortgage. I can help them a little. They are busy with work under great pressure. I feel uneasy about giving their children to others. I'm happy when they're happy. (C3_2, 67, Female)

However, some of the respondents mentioned that multi-generational living was due to a feeling of helplessness. Due to the family structure and social pressure, they currently had no choice, as described by an interviewee:

> Now we live together because my grandson is still young and needs our help to take care of the kid. When the kid goes to primary school, they (son, daughter-in-law, and grandson) will probably move out. It is crowded now, but there is no way. We do not have enough money for a bigger one. It is what it is. It's all for the kid. (C2_5, 64, Male)

Besides, some participants expressed the need to take care of their parents or spouse as their duty and responsibility. To carry on the Chinese virtue of filial piety, some of the participants lived with their parents, taking care of the oldest people at home. Another situation encountered was the partner with a poor health condition, needing help from the interviewee. This group of older people still upheld the responsibility and labour with the spirit of devotion as one of reasons to age-in-place.

The one-child policy was repeatedly mentioned when the older participants talked about culture and family ties. As parents of the first generation under the one-child policy and moving into old age, loners and empty nesters received less support from their families and

felt insecure about their old age. They wished to receive more support service and care from the community and society. This will be discussed in detail in the next section.

6.4.4 Ageing-in-place is linked to finance

Compared with institutionalised care settings, remaining at home in later life could bring financial benefits for older adults (Dobner et al., 2016). In this research, ageing-in-place was linked to affordability by both the older people group and other experts during the interviews.

Considering where to live, older people pointed out that, to some extent, their choices were based on current economic conditions. Ageing-in-place is seen as a way to save money while maintaining quality of life. Some of the participants had considered moving to another place, such as visiting some nursing homes. Affordable nursing homes exposed some obvious disadvantages, such as needing to share a bedroom with other older people or being in remote locations. However, a satisfying nursing home may be unaffordable. This group of older people preferred to stay at home in a comfortable and familiar environment within their financial ability. An interviewee stated:

> I would like to live in an upscale retirement home, but it's a question of whether I can afford it on my income. For example, my monthly retirement salary is 4000 yuan, while that of the high-end nursing home is 5000 yuan. If I want to live in it, the 1000 yuan will have to be paid by my children. However, they are under great pressure from life now and have to pay the car loan and mortgage and raise their children. I can't count on my only child. When I was young, the one-child policy was in place. I'm still living at home, and I don't go to a nursing home, because which I can afford, and I don't want to. (C1_11, 66, Female)

Respondents expressed reluctance to add burden on their children and tied their status to the one-child policy and pension system. This unique historical background also made this group of older people face particular pension problems. Similarly, a participant from Case 2 also discussed the policy and expectations of the government:

> Now my pension is not high, which cannot afford the cost of a good nursing home. Stay at home will be more economical. But I still hope that the country can attach importance to the older people, especially for families like ours with only one child. The state should take care of older people. When the one-child policy was promoted, it was said by the government that "one child is good, and the state will take care of the older people". This is just contrary to the saying "raising children for old age". Now that we are old, the state should have some policies to help us. Also, there should be some

commercial insurance for older people, because the medical treatment in China is not free medical treatment. (C2_3, 60, Male)

Some older people believed that money should not be spent on themselves. Instead, it should be spent on young people. Experts also clearly indicated that economic conditions and their consuming attitudes limited the choices for older people:

The reason why older people in China choose to age-in-place is because of the economic situation. Good nursing homes are expensive and far away from the city. The government is now also addressing the needs of the older people in the lower-income brackets. The high-income older people and the non-income older adults already have solutions. The middle group of older people faces some problems. Still, most of the older people belong to the middle group. (S_12, Architect)

There is a widespread and critical problem that many Chinese older people now may not be willing to spend money on themselves, preferring to pay for the next generation. (S_7, Care provider)

While some older people stated that they avoided nursing homes because it was cost-effective to stay at home, others said that their choice was unconnected to the economy. Even if they could afford a high-ranking nursing home, they did not want to leave their own home, due to the advantages of ageing-in-place; indeed, they looked at nursing homes with fear. Even if he/she needed someone else's help in the future, instead they would consider hiring a caregiver to come into their own home:

I don't want to go to a nursing home at all. I don't want to go to a nursing home do not because of financial problems. I know some people don't go because of financial problems. I prefer to stay at home anyway. (C2_2, 73, Female)

From the above, ageing-in-place is seen as a meaningful living pattern for Chinese urban older adults remaining at home in later life, and one with a series of advantages. These included retaining a sense of identity, maintaining sense of belonging, in accordance with traditional culture, and gaining financial benefits from ageing-in-place. It is these significances and meanings of ageing-in-place that were the reasons and starting points for older people to choose staying at home. Criticism and caution regarding limitations of ageing-in-place have been raised by participants, which will be listed in the following section.

6.5 The Challenges of Older People Wanting to Achieve Ageing-in-place in Urban China

There was agreement between older participants and other stakeholders that continuing to live in the community for as long as possible made both economic and social sense. However, it was a very complicated task with some difficulties faced by older adults to remain in their own homes and communities. Understanding their challenges to achieving ageing-in-place is necessary.

Inductive qualitative content analysis of the interview transcriptions revealed six main categories about the challenges of older people wanting to achieve ageing-in-place in urban China.

First, many older participants were thinking about their future choice, pointing out that having few options was a difficult problem. Besides, they were facing health and functional declines associated with getting old, resulting in needing help from others with, at the same time, a lack of availability and appropriateness of local service and resources to support them within their affordability. Last but not least, participants faced a number of problems regarding the home environment and community environment. A more supportive and age-friendly living environment was expected by the participants.

6.5.1 Thinking about future choice, having few options

When discussing ageing-in-place, some older adults considered their future choices. A common perspective was that their current status was suitable for staying at home but that it might not be ideal in the future. Considering where to live in the future, older adults presented their attitudes. For example, a man living in Case 2 supposed his requirements would be a dynamic process:

> Requirements (of the older people) vary from age to age and from condition to condition. At present, I think it is better to age-in-place because of freedom and I can visit my relatives and friends. I like the feeling of freedom. But when I can't take care of myself, I may change my mind. There's no one at home to take care of me. (C2_11, 72, Male)

Some older interviewees hypothesised their future options, but most of them thought that the alternatives did not satisfy their ideal state. More than half of the older participants expressed their fear and traps for the future, especially the older people who were living

alone. A 66-year-old lady living alone in the Case 1 community described her vision in great detail:

> Instead of hiring a caregiver, I'd rather go to a fancy nursing home and have other older people around. However, the nursing home must be of a higher-level one, not the kind of care home which put the older people in a small room, are unable to move. I think the country should provide different levels of nursing homes for the older people to choose, not just high and low, may be divided into more detailed, such as five levels, so that the kind of middle-upper one will be suitable for me. I wish I have more choices. Now many older people in nursing homes are not in good health. They need to be quiet, not noisy every day. I'm not 70 yet, so I definitely can't go to a nursing home like this. When I am over 70 years old, I may need a place for my later life. I hope it will be a place where I can live with higher educated older people, rather than a place where people smoke, drink and play cards every day. I hope to find such a targeted nursing home to meet my needs. (C1_11, 66, Female)

Similarly, another lady living alone in Case 2 described her ideal live environment as:

> My ideal is older people living on the first floor and the second floor. The older people usually play with older people. The young adults can live in upstairs, providing help when the older people need. Or the children and their parents live upstairs and downstairs. Just like the distance of a bowl of soup shown on TV, it can avoid daily living together with conflicts, but not too far-sighted. This scenario requires the housing developer to provide some apartments with smaller sizes on lower floors with age-friendly considerations. (C2_4, 67, Female)

In terms of future choices, the views of experts were consistent with those of the older people group. They agreed that older people should consider their actual situation because their physical conditions and living environments varied from person to person. If the older people were in good health, then ageing-in-place was the best option. They attempted to provide support from different aspects for older people living at home, such as care provision and environmental improvements. A new model called 'Family nursing beds' have been implemented as a trial in Xuanwu District to help older people to achieve ageing-in-place. Government-backed non-profit organisations operate the service centres to overcome the challenges of the care needs of older people at home. A care provider stakeholder introduced this model as:

> Many older people in China are reluctant to go to a nursing home because of the high cost and difficulty in finding a satisfactory one. Nursing homes in urban areas are often

hard to find. Suburban nursing homes are rejected because children are inconvenient to visit, and receiving timely medical treatment is also a problem.

Ageing-in-place is a perfect solution to China's current older population pressure. But many older people need to be cared for at home, and their families have to work. Therefore, we have launched such a service, which is to move the nursing bed to the older people's home and provide related services according to the individual's physical conditions and needs.

The concept of the family nursing bed for older people is relatively new, and many people do not understand it. It is a gradual process, and it also requires the social, the government, and institutions to carry out strong publicity. I believe that in three or five years, this concept will be deeply rooted in the hearts of the people. (S_7, care provider)

6.5.2 Health and functional challenges

Health and functional decline constituted critical threats to older people with health issues who had to give up valued activities or have lost independence in their daily routines. Functional capacity refers here to the ability to carry out daily activities in a normal or accepted way (Guo et al., 2020).

In current research, older participants took their physical condition and ability to live independently as the dividing line and considered it is an unquestionable choice to age-in-place while in good health. However, older people would face significant challenges in the process of ageing-in-place with a series of physical problems. They would be dependent on others for their daily life routines, meaning they might need frequent help and care from others. The degree of care dependence was negatively correlated with the overall level of functioning of older individuals. During the interviews, a series of health and safety challenges were mentioned by the older participants, including mobility problems and falls, chronic disease, and mental disorders.

Mobility problems and falls

A large proportion of participants mentioned the problem of mobility inconveniences such as muscle weakness, joint problems, pain, and neurological difficulties. As a result, older people had difficulty in using stairs and walking as before. A participant stated:

My legs aren't as good as they used to be. I've already bought a wheelchair, and I'll have to use it when I need it. (C2_13, 82, Female)

Older people require a supportive environment to avoid falls and injuries. Participants linked the physical environment with mobility issues, especially regarding stairs and lifts. During the field trip, the Case 1 residential community was being retrofitted. The government provided an opportunity for the residents to decide whether or not to install a lift. Alterations could only be carried out with the consent of every owner in the unit. The older people looked forward to adding a lift, but the process was more difficult than expected, as a participant noted:

The biggest challenge for me is no lift. Older people live high without a lift is very inconvenient. We have a chance to install it now, but my next door doesn't agree. If the neighbours don't agree, we can't install it, which is very annoying. I live on the fifth floor. My heart is not good, legs and feet are not convenient, go upstairs and downstairs are more difficult. I have difficulties in my current living environment. Stairs are a big problem, mainly affecting daily access. (C1_1, 63, Male)

Chronic disease

Chronic diseases increase the risks that older people face living at home, and this can severely impact their quality of life. The participants mentioned several chronic diseases during the interviews, including heart disease, stroke, diabetes, and hypertension. Their chronic illnesses affected their lives to varying degrees. For example, a female participant said:

I have chronic diseases, diabetes, high blood pressure and have to take medicine every day. I am afraid to go far away. (C2_12, 73, Female)

The older people believed that they relied more on hospitals than they did when they were younger, and that they wanted to be able to see a doctor more quickly. A participant stated:

It is easy to fall ill when one is old. I find it difficult to see a doctor. I need to queue up, register, wait for a long time and need someone to accompany me. I prefer to live near the hospital. (C2_7, 80, Male)

Mental disorder

With the ageing of physiological function, older adults also experience some mental disorders. Some respondents reported declines in their perception of the outside world and memory, which affected their willingness to travel, restricted their activities and social

interactions, and created a sense of social isolation. Some older people presented negative emotions, such as depression, anxiety, and loneliness. A few of the participants also mentioned dementia. An older person who lived alone expressed her concern:

> Very lonely. No one can help you in your daily life. For example, no one can pass you a glass if you want a drink of water. The most terrible is in case of Alzheimer's disease, people cannot take care of themselves, fell while defecating, died at home, maybe a few days no one found. Of course, it doesn't happen every day. (C1_11, 66, Female)

6.5.3 Needing help from others

As a result of physical and mental decline, older people gradually need support or assistance from others. However, older people in contemporary China are receiving less support from their children and family than the group who were not subject to the one-child policy during most of their childbearing years. Respondents attributed the phenomenon to two main reasons: changes in family structure caused by the one-child policy; and high housing prices and life pressures make children's lives more stressful. For example, young people might work in another place instead of staying with them. In other words, there were too few children to rely on. However, older people love their children dearly and are not willing to increase their burden. The older participants recognised the problem and expressed their helplessness:

> Now it is changing gradually, which is influenced by many factors. For example, under the one-child policy, I only have one child, but he and his wife will have four older people to take care of in the future. Therefore, it is impossible for us to live together. It's best that we could take care of ourselves and not burden them. (C2_3, 60, Male)

This challenge was also raised by the experts, such as the property manager, who had worked in the Case 2 community for more than eight years and had close contact with the older residents on a daily basis. As the property manager pointed out:

> Their difficulties are indeed the absence of their children. Parents had nurtured their children with all their heart when they were young, and they have gone abroad with great success. Many children refuse to come back. As a result of the one-child policy, many families have only one child, and a few have two. Older people are lonely, and when they get old. They can't follow the child to other cities or even abroad because they may not speak the same language. This problem is realistic and helpless. They don't want to burden their children. (S_1, Property manager)

6.5.4 Lack of availability and appropriateness of local service and resources

Most of the older participants believed that ageing-in-place was the desired approach in line with the traditional Chinese concept, but that they might have to seek help and support from others as their physical conditions changed. For example, when children and family members are unable to provide adequate support, community and local service become the source of support available to older people. During the interview, older people living in Case 2 repeatedly expressed their recognition and appreciation and improvement of relevant services in recent years. A participant said:

> This area is very convenient. The length of this street is about 1000 meters. There are already three home-based care service institutions and places for older people to eat at a very low price. Great progress has been made in the past two years. The government has begun to pay attention to older people. (C2_12, 73, Female)

Meanwhile, the older adults expressed their unmet requirements, which can be grouped into the following four aspects:

- Life service, such as personal care at home, housekeeping, dining, bathing, daily shopping services, exercise and physical activities.
- Mental health services, companions and activities, such as providing a chess and card room, library, table tennis room, internet information platform, IT training courses and marriage introduction.
- Transport service, such as taking older people to see a doctor.
- Medical services, such as installing emergency calls at home.

Participants expressed their demand for the services listed above. By meeting these needs, their challenges and difficulties could be alleviated during the ageing-in-place process.

6.5.5 Financial concerns

Ageing-in-place holds significant financial advantages in terms of health-care expenditure versus nursing home care (Marek et al., 2012). As discussed in Section 6.4.4, the older participants supported the point that ageing-in-place was closely linked with affordability to save money. However, the quality of life of the older adults remained influenced by their economic conditions.

From the older people's perspective, first, the price of housing with complete supporting facilities in a good location is very high in urban China, so few older people might consider

selling their current home and move to a new one even if the current living environment had exposed obvious flaws. Second, an excellent property service means more property management fees. Third, there will be a cost for any renovation of the physical environment, including the addition of lifts and age-friendly retrofitting of interior space. Last but not least, a professional caregiver always comes with an unexpected cost and can also be difficult to find.

However, the stakeholder group held different opinions. The care providers believed that the older people's sense of thrift made them reluctant to spend money on themselves, especially when it came to buying intangible services. A policymaker also mentioned that how to cultivate the service purchase awareness of older people was key to the problem of promoting care services for older people.

Besides, the policymaker indicated that the government could only do as much as it could within limited budgetary constraints to help the older people who needed it the most. Financial expenditure needs to be considered in policy formulation and popularisation when supporting ageing-in-place by the government. Social non-profit organisations could play an important role. The government could encourage social organisations to vigorously develop related services through a series of preferential policies, such as providing operation sites, reducing rent and taxation.

6.5.6 Problems with home environment and community environment

During the interview, the older participants closely linked ageing-in-place with the physical environment and raised a series of issues about the built environment. As shown in Chapter 5, the relevant contents of this study can be divided into two parts: community facilities; and housing problems. In general, later built communities are superior compared to the earlier housing in terms of basic living facilities. Two checklists were used to evaluate the physical environment of the three cases. Table 6.3 shows the results of the site visits. More criteria have been met in the checklist in the later built communities. Along with the corresponding findings, the older people living in Case 1 raised the most problems about the built environment, followed by Case 2.

Table 6.3 Results of the site visits of the three cases

	The checklist of age-friendly community	The checklist of age-friendly housing
Case 1	9/42	25/60
Case 2	23/42	43/60
Case 3	34/42	n/a

In terms of community environment, the older people generally put forward problems from the perspective of convenience, safety and mobility aspects. The specific elements those older participants talked about included road lighting, traffic conditions, exercise places, public toilets, green space, security, signage system, and accessible facilities. Mobility and barrier-free facilities were emphasised, see Figure 6.2, especially in Case 1 and Case 2, where there was a lack of coherent accessibility.

Figure 6.2 Building entrances in Case 1

Regarding the indoor living environment, the older people were more concerned about safety, convenience and comfort. Specific problems associated with housing included ground level differences (see Figure 6.3), lack of handrails, slippery floors, inappropriate use of toilets and bathrooms, lack of sound alarms, noise, and dimly lit rooms. Chapter 7 will mainly discuss the age-friendly home and community environment to support older resident in achieving ageing-in-place.

Figure 6.3 Indoor height difference in Case 1

As shown in this section, the challenges of older people achieving ageing-in-place can be summarised into six aspects, including: having few options; personal health and functional decline; refusing to be a burden on others; lacking appropriate services; financial concerns; and difficulties concerning the built environment.

6.6 Comparison Between Ageing-in-place and Ageing in a Care Facility

As stated in the above two sections, ageing-in-place has many advantages as an ideal way to live for most older people. Living at home was conducive to the continuation of their social relationships and satisfaction of their emotional needs. The majority of older people were willing to choose ageing-in-place when relatively healthy, combining home- and community-based services.

In contrast, institutional care provided more specialised care and medical care, with alternatives for older people unable to take care of themselves, lacked family care or lived in a poor environment.

Based on the content analysis of interview data of ageing-in-place versus nursing facilities, The 13 aspects emerged from the themes mentioned during the discussion of the meanings and challenges of ageing-in-place by the older participants. Although most of the older people preferred to live in their own homes as long as possible, some of the older respondents also pointed out a number of advantages of the nursing homes. Moving to a nursing home could avoid family conflicts such as the family relationship, reduce young people's pressure to avoid family members getting too tired, and to receive relatively professional care and services.

Table 6.4 show the key characteristics of the care facility and home from 13 aspects. The 13 aspects emerged from the themes mentioned during the discussion of the meanings and challenges of ageing-in-place by the older participants. Although most of the older people preferred to live in their own homes as long as possible, some of the older respondents also pointed out a number of advantages of the nursing homes. Moving to a nursing home could avoid family conflicts such as the family relationship, reduce young people's pressure to avoid family members getting too tired, and to receive relatively professional care and services.

Table 6.4 The key characteristics of the care facility and home

	Home	Care facility
Freedom	A considerable degree of freedom	Limitations on choice and personal freedom
Independence	Living independently, without help from others	Usually, depending on care providers
Autonomy	Communal living	Individual arrangements can vary according to time and place
Dignity	Keeping dignity in front of others	Limitations on keeping dignity
Privacy	Private space, but maybe some limitations on privacy	Public space, limitations on privacy
Personal value	Ability to participate in social work and contribute to the family	Limitations on realising personal value
Subjective well-being	Normally positive attitudes in subjective well-being	Normally take a sceptical attitude
Familiarity	Familiarity (of people and place.)	Strangeness (of people and place)
Sense of belonging	May live alone or with relatives or friends in a familiar environment	Living with strangers in a new environment
Cultural aspect	In line with the filial piety culture	Against traditional Confucianism culture
Affordability	Owned/rented by inhabitants, normally affordable	Owned/rented by other agencies
Care and service	Normally no staff living there but they may visit to provide services	Staffed by professionals or volunteers
Built environment	Commonly mainstream housing with a lack of age-friendly consideration	Normally designed for older people with good mobility

Experts also compared ageing-in-place and moving to a care facility. They analysed the reasons underlying older people's resistance to care homes. An architect involved in the design of several high-level nursing homes considered that many older people in China held prejudice against nursing homes. He stated:

Most people still have the same idea about the nursing home as the previous generation or the generations before them. They feel that a home is a terrifying place. After they go there, they feel that nurses will abuse them, and the nursing home is in

the dark. So, there is a kind of rejection of care home. Family members felt that way, too. Many nursing homes now have an excellent environment and services. (S_14, Architect)

Another interviewee believed that older people should choose the place according to their situation, such as the ability to live independently and the availability of support from family. He explained:

> The first category of the older people to live in nursing homes is the widowed, lost only-child, empty-nest older people. They need someone to take care of, suitable for nursing homes. The second category is disabled older people, who cannot take a shower at home, or in bed for a long time, or need to use catheters, need to turn over by the help from others. If this part of the older people keeps staying at home, they will be unable to receive service from people with professional skills and equipment. Depending on their physical condition, they should live in a care home. That is the difference between a home and a nursing home. (S_2, Care provider)

To sum up, families, communities and institutions have their advantages, which can only be realised when meeting the needs of older people. The choice of ageing mode is the process of individuals making voluntary decisions in order to meet specific needs.

6.7 Summary

This chapter presented evidence to understand the meaning of ageing-in-place to older people in urban China and listed the challenges faced by older people to achieve ageing-in-place. A conceptualisation of ageing-in-place in an urban China context has been built to interpret and analyse ageing-in-place in contemporary urban China. This goal was fulfilled by using an inductive content analysis of interview data with 37 older people and 13 experts. A brief comparison was also made between ageing-in-place and care facilities. Based on an understanding of the ageing-in-place concept in a current Chinese urban setting, Chapter 7 and Chapter 8 will develop a holistic framework of an age-friendly environment for promoting ageing-in-place.

CHAPTER 7.   THE ROLE OF AGE-FRIENDLY BUILT ENVIRONMENT IN PROMOTING AGEING-IN-PLACE

7.1   Introduction

Ageing cannot be prevented, but older people's quality of life and health benefits can be enhanced by improving their living environment and lifestyle. An age-friendly environment has a significant influence on improving the ability of older people to live independently. This chapter will present the role of an age-friendly built environment in promoting ageing-in-place in urban China. It will provide evidence to develop a design and retrofitting framework to facilitate a more age-friendly living environment and help older people achieve ageing-in-place.

This chapter explores the components of an age-friendly built environment in relation to community and housing and establishes the relationship between the built environment and older people's ability to achieve ageing-in-place. Further, it will examine the challenges and opportunities for improvements through case studies, by conducting semi-structured interviews with 37 older dwellers living in the case study communities and 13 key experts, including architects, property managers, policymaker and care providers.

By interviewing a number of key experts, their attitudes and practices on age-friendly built environments were identified. Moreover, older participants were interviewed to understand their experiences and attitudes of the living environment in the community and the private home. Inductive qualitative content analysis was employed to establish emerging themes from the interviews using NVivo 12 and Excel.

This chapter will start by introducing the fundamental knowledge of age-friendly built environment and data gathered for this purpose. The main findings include the challenges and opportunities of residential design for older people in urban China from the stakeholder's position and the difficulties faced by older residents who chose ageing-in-place. Results from the multi-stakeholder group and older people group will be analysed separately before being compared. A list of design features of an age-friendly residential community will be presented to guide the design and retrofitting framework for mainstream housing and to support older people during the process of ageing-in-place. The structure of Chapter 7 is set out in Figure 7.1.
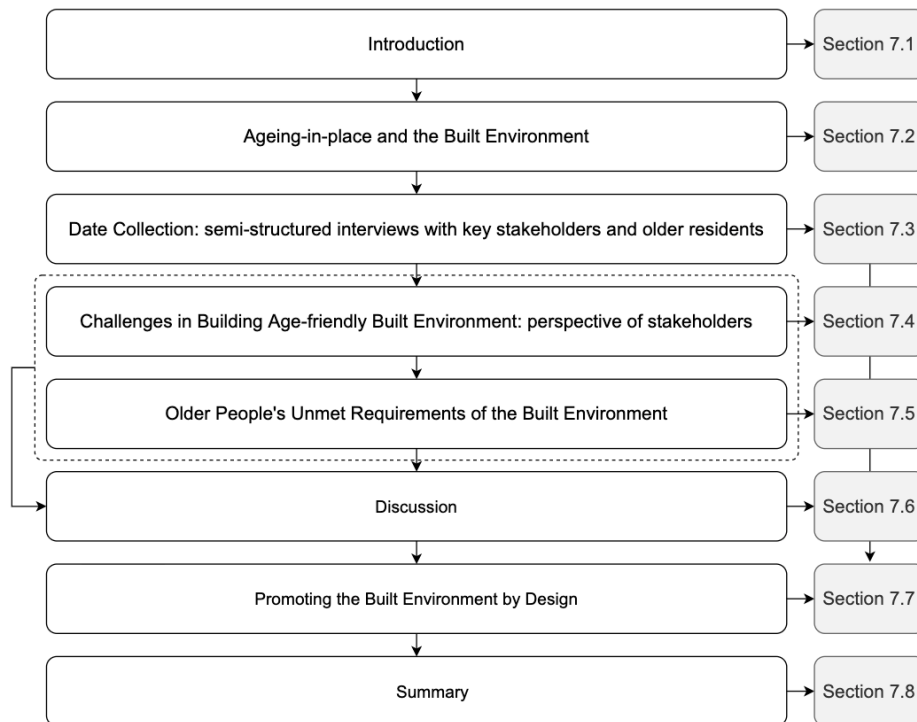
Figure 7.1 Structure of Chapter 7

7.2 Ageing-in-place and the Built Environment

Changes to an individual's health due to the ageing process necessitates transitions in living environments. This can be achieved by modifying current homes or relocating to a more supportive environment (Perry et al., 2014). Considering where to live, older people often think that their home or community offer advantages such as enabling them to maintain a sense of connection to social networks, security and familiarity, in addition to supporting a sense of independence, identity and autonomy (Lawler, 2001; Wiles et al., 2012), as discussed in Chapter 6. A supportive built environment could promote physical activity and preserve and maintain older people's health and well-being (Cairncross, 2016). The age-friendliness of built environments can cause a difference between dependence and independence for all people but are of specific significance for older individuals (WHO, 2002).

A series of theories clarify the relationship between people and the environment. The environment press model developed by Lawton and Nahemow (1973) provides a monumental theoretical framework which recognises that people have different levels of competencies. Optimal fit occurs when an individual's capacities are consistent with the demands and opportunities within the surrounding environment. This model has informed

the design of the physical environment to fit the needs of individuals. Another overarching conceptual framework of how older people interact with the surrounding environment was developed based on the traditional ecology of ageing theories, called Person-Environment Fit (P-E fit) (Wahl & Oswald, 2010). The P-E fit interchange processes are fundamental tasks for older persons to maintain autonomy and independence, and to retain their integrity and identity for as long as possible, ultimately to promote older people's well-being (Wahl & Oswald, 2010). This framework explains the significance of a supportive environment for older individuals.

Supportive environmental factors can enhance the long-term health and well-being of older users, reduce the risk of falling (Tinetti, Speechley, & Ginter, 1988), promote physical activity (Humpel, Owen, & Leslie, 2002) and reduce social isolation (Hemingway & Jack, 2013). In contrast, less age-friendly environments are perceived by older people as posing an increased risk of falling, particularly for individuals with mobility, vision and/or other impairments (Cairncross, 2016). Unsafe settings or areas with environmental hazards or barriers may deter or prevent older individuals from engaging actively at home or in their community, therefore leading to reduced fitness, increased mobility problems, isolation and depression (Cairncross, 2016; WHO, 2002).

The significance of an age-friendly environment is via making use of interventions through planning and design to create a supportive environment for older people. This is in order to compensate for the decline of physical and cognitive capacity, and thus enhance their living independence and promote physical activity as much as possible.

With a decline in physical function with ageing, older people spend most of their time at home, far more than in other settings (Danziger & Chaudhury, 2009). In other words, the living environment is a vital consideration for the health and well-being of older generations (Gadakari et al., 2017). The age-friendliness of community and housing environments affects older people's lifestyles and quality of life to a great extent. As discussed in Chapter 6, participants put forward a range of appreciations, challenges, and unmet requirements of the built environment during their ageing-in-place experience. This chapter will focus on demonstrating the relationship between the built environment and ageing-in-place through an analysis of the interviews and observations of the built environment.

7.3 Date Collection: semi-structured interviews with experts and older residents

The above section highlighted the close person-environment relationship (Lawton, 1977a, 1998) and the connection between age-friendly environment and ageing-in-place concept. It is an essential and complicated task to create an age-friendly built environment to support ageing-in-place, requiring the provision of necessary resources for older people to remain in their own homes and communities (Kim et al., 2017).

This chapter focuses on the above topic to explore the challenges and opportunities from the perspectives of experts working in key positions, combining older people's subjective opinions and unmet requirements of their current living environment.

The semi-structured interview was chosen as an ideally suited qualitative data collection method to understand the relationship between the built environment and older people's ability to achieve ageing-in-place. A total of 50 participants took part in this research through interviews leading to the main results. Thirteen of the participants were experts and 37 were older people, residents in the case studies.

The 13 experts worked in key positions, including policymaker, property managers, and care providers. Interviews with the experts were conducted to understand their experiences, challenges, and suggestions in building an age-friendly environment and supporting older people. The interview questions for this group are presented in Table 7.1.

Table 7.1 Interview question schedule for experts about the built environment

Generic questions	1.	Some older people are currently living with their children or grandchildren. In your opinion, how can we support multi-generational living through housing design?
	2.	In the housing projects, how can we future-proof housing needs as people get older and older?
	3.	What do you think about the home modification for older residents? Does financial affordability affect older people's decision to refurbish their homes?
	4.	While conducting refurbishment, which elements or conditions of the existing environment could potentially become barriers?
Architects only	5.	In what way can the design of a community affect older people's independent living ability?
	6.	Are you aware of any specific standards, or design guidelines for the age-friendly environment? How important do you think these standards or design guidelines are? Do you refer to these during the design process? What other standards are needed?

Older people were asked to comment on their living situation and ageing-in-place. Notably, it is recommended to empower older individuals to contribute to society and participate in decision-making processes. As such, the researcher developed interview questions for older people based on mobility, sensory, safety, cognitive, and home modification aspects. The interview questions for the older people group are presented in Table 7.2.

Table 7.2 Interview question schedule for older people about the built environment

Mobility	1.	What do you think about mobility in the public area of the community?
	2.	Is it convenient for you to get in/out your apartment by lift or stairs? Do you use the handrail while taking the stairs? (If no lift: Do you want to add a lift in the building if possible?)
	3.	How about the mobility and use of fixtures and fittings within your home? What are the challenges and what retrofitting would you like to do?
Sensory	4.	Do you experience any sensory impairment? If so, how is this affecting your daily life activities?
	5.	What adjustments do you think will be needed to improve your living environment?
Safety	6.	How about the safety aspect of your home and in the community? Do you have any suggestions for improving this aspect?
Cognitive	7.	Is your independence affected by the built environment? What are the main underlying reasons? Any example?
Home modification	8.	Have you made any modifications/adaptations to your current home due to above issues? Is the home modification helpful to daily life activities? Did you experience some difficulties during the home modification?
	9.	If not, do you want to conduct some home modification? Which aspect do you want to change? How much are you willing to spend on home modification?
	10.	Do you have any other suggestions about the living environment improvement?

Based on the participants' verbal descriptions about the built environment, the researcher also took photographs and fieldnotes to record the community's physical environment and provide evidence to support participants' comments. Photos taken during the fieldwork were used without any image-editing and combined with fieldnotes in the data analysis process. Fieldnotes were taken about the specific issues and areas mentioned by the participants during the interviews and as observed and recorded during the site visits.

7.3.1 Triangulation of results

Yin (2018) insisted that a case study should rely on multiple sources of evidence, with data needing to converge in a triangulation. Case studies using different sources of evidence presented a better quality than those which relied on only single sources of information (Yin, Bateman, & Moore, 1985), as the basic motive for doing case study is to undertake an in-

depth study of a phenomenon in its real-world setting. Being both in-depth and contextual means collecting a variety of relevant data and relying on multiple sources (Yin, 2018).

The findings in this chapter are drawn from the content analysis of the interview transcriptions with two different participant groups. This will be triangulated with the findings from the case study analysis (Figure 7.2).

Site visits of built environment in
three communities - Chapter 5

Data
triangulation

Interview with 13 key
stakeholders
(architects, property
managers, care providers, and
policymakers) - Chapter 7

Interview with
37 older people
- Chapter 7
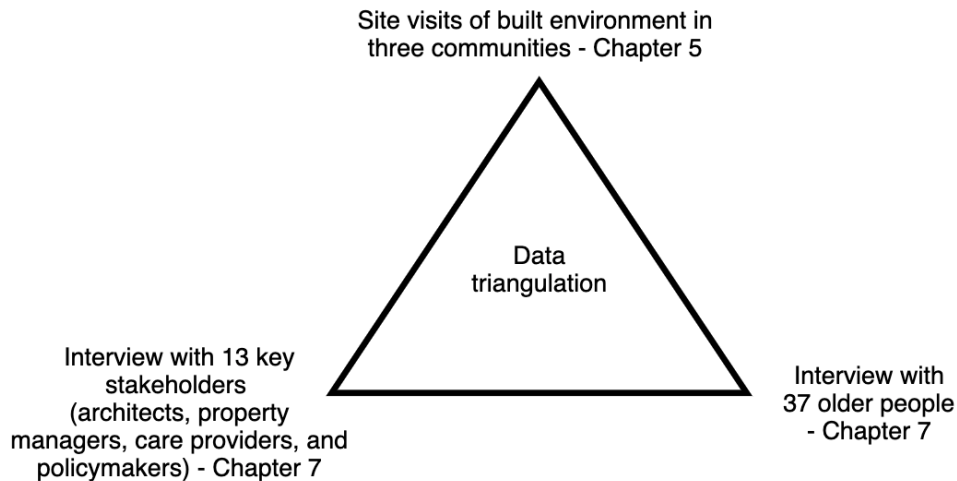
Figure 7.2 Data triangulation

In Chapter 5, the combination of fieldnotes, photographs, and checklists provided a holistic picture of the physical setting of each case. Differing from Chapter 5, this chapter mainly focused on the interview results. Themes and findings were extracted from interviews, while the case study findings (Chapter 5) were used to provide evidence to understand and visualise issues that emerged from the interview data.

7.4   Challenges in Creating an Age-friendly Built Environment: perspective of experts

This section presents the design challenges of living environments and the potential for retrofitting to support older people in achieving ageing-in-place in urban China through stakeholder interviews. The findings are divided into five interconnected aspects on the experts' understanding of the current situation of mainstream housing and the ageing population in urban China, and the approaches in place to support older residents in achieving ageing-in-place (Figure 7.3).
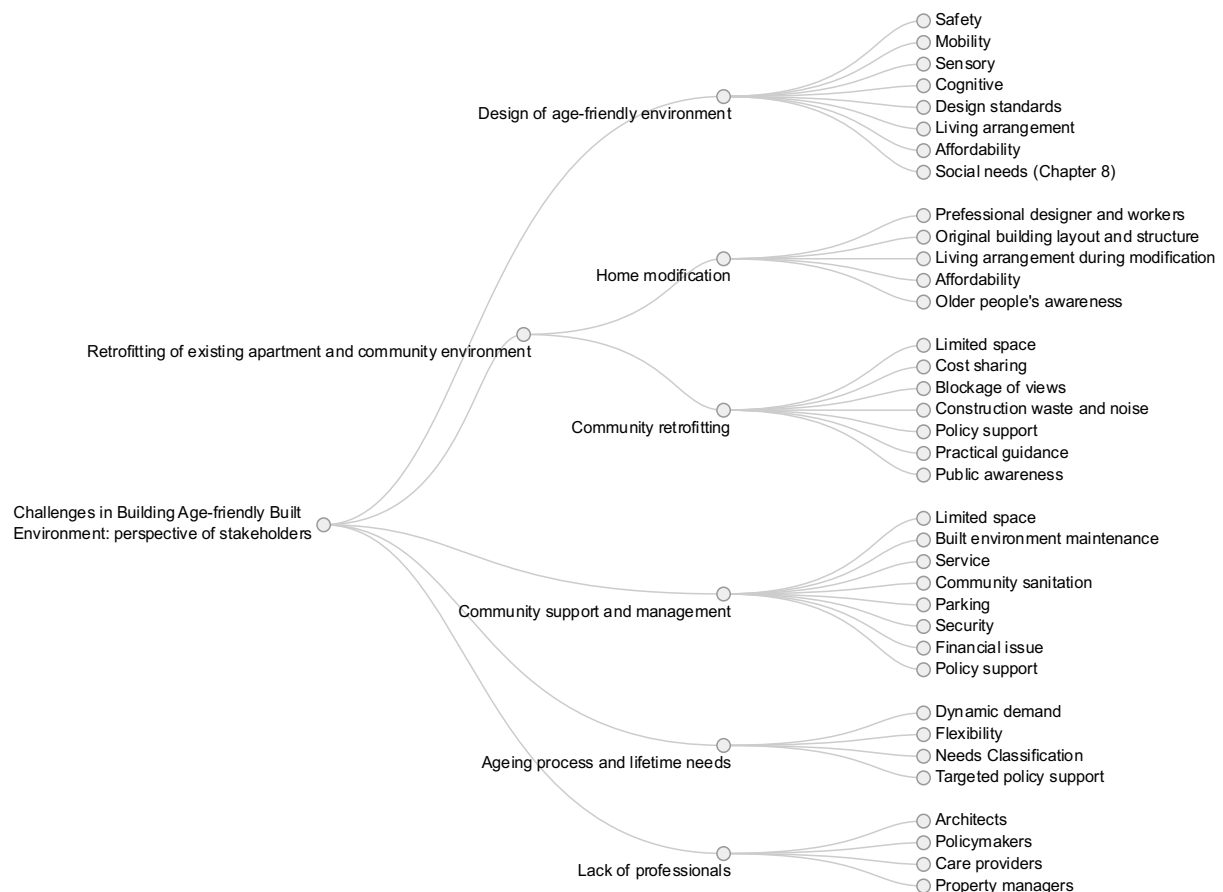
Figure 7.3 Overview of challenges in building age-friendly built environment: Perspective of experts

The main key categories include:

- **Design of age-friendly environment:** During the design process of the residential buildings and communities, consideration of the older residents' needs lays the foundation for the age-friendly degree of the living space, which is influenced by the design standards at that time.

- **Retrofitting of existing apartment and community environment:** The renovation of residential buildings and communities aims to improve the existing living environment, and to compensate for the unmet needs of older people, remove barriers and provide support regarding the existing situation.

- **Community support and management:** The property managers need to shoulder maintenance and service responsibility to ensure the built environment is age friendly all of the time.

- **Ageing process and lifetime needs:** The environment required by older people at different stages is constantly changing, and the built environment needs to be flexible to meet different needs.

- **Lack of professionals:** Experts who understand the needs of older people in relevant positions are urgently needed.

7.4.1 Design of age-friendly environment

The main aim of the design for older people is to enhance older people's ability to live independently. Safety and mobility aspects were prioritised as the key factors to consider while designing for older individuals, followed by sensory and cognitive considerations. All experts agreed that an age-friendly living environment was one of the determining factors in the success of ageing-in-place. An architect stated:

> The inappropriateness of the built environment is one of the challenges for older people who prefer ageing-in-place. For example, indoor accessibility, some apartments have stairs and height differences, which can be difficult for older residents, especially those in wheelchairs. The older people are afraid of falling and cannot walk easily. The bad roads and lack of lifts in old residential buildings are big problems for the older residents. I think the biggest challenge is about safety and mobility. (S_11, Architect)

Safety was highlighted to be an important factor. Because older people are relatively vulnerable, any falls may cause a series of serious consequences. The priority of the design is to ensure the health and safety of older people are protected. For example, accidents can be avoided by adding handrails in the kitchen and bathroom, using non-slip floor finishes, and adopting furniture with rounded corners.

Similarly, the mobility aspect was also emphasised repeatedly by the architects and care providers. Mobility problems in old buildings could reduce the frequency of older people going out and may even become the main reason the older person has to move out. The absence of lifts in an old residential building is a typical issue. At present, the older population accounts for a large proportion of the residents in the old communities in Chinese cities, especially the staff accommodation. A policymaker commented on Case 1 as an example:

> This (refers to Case 1) community has a total population of around 10,000. There are 1,000 people over the age of 80, and about 4,000 people over the age of 60, accounting for about 40%, which is a typical older people community. Because most of the staff did not buy a commercial house outside, did not move out after retirement, all live here, so the proportion of the older people is very high. Older people here are reluctant to leave familiar people and surroundings. Only a very small number of old people who can't take care of themselves have moved to nursing homes. There is no

lift, but the older people find ways to overcome difficulties, such as paying carers to look after them at home. (S_5, Policymaker)

Participants responded that with the improvement and implementation of relevant design standards, later-built residential accommodation had been greatly improved in terms of barrier-free design. However, architects agreed that the current design standards for mainstream housing in China were still at an early developmental stage and needed to be constantly perfected in terms of other design and construction aspects. The housing standards lacked a consideration of older people's requirements, such as the sensory and cognitive aspects. It was claimed that technology like voice-activated and motion-activated lighting, air conditioners, air purifiers, and humidifiers that enhanced interior environmental quality were as essential. ack of attention in those aspects could also affect the older people's quality of life. For example, the noise problem and lighting issue were mentioned by architects:

Indoor and outdoor noise can also be a big problem for older people. In some buildings close to the street, night noise can disturb older people as sleep problems are very common. In this case, noise proof windows are significant. We can improve their quality of sleep by design. (S_11, Architect)

The loss of vision in older people presents special needs. For example, it is necessary to avoid strong direct light during the daytime, and certain brightness is needed at night to ensure the safety of movement at night. (S_14, Architect)

A common problem that the architects raised was the absence of written codes and standards to guide the design process. Interviewees challenged that many practitioners lacked a systematic knowledge framework, and that their understanding of older people was mostly based on the accumulation of previous practical experience, which may be relatively one-sided. An architect shared his experience:

When we design the landscape, we may consider paying attention to the hearing and smell of the older people. The Sensory Garden, for example, may install speakers and provide healing and therapy to the senses of the older persons. However, I do not know exactly how loud it needs to be, the audio, smell, and air indicator. These are not clear norms. We only have design concepts, but the implementation is different for each design team and can only be adjusted by feeling rather than guided by specifications. (S_14, Architect)

Policymaker and architects highlighted another big problem for older people in urban China, that of overcrowding. They affirmed that better design and innovative solutions would significantly improve living conditions in crowded homes. This is vital for older people in multi-generational living arrangements. Due to the difference in living habits and daily schedules, multi-generational families usually faced some conflicts.

Design can also help family members achieve a better life experience. For example, the different sleep patterns of multi-generations living in the same house were considered as the most serious issue. Architects suggested that providing a better soundproof design could contribute to privacy needs without interfering with each other. An architect mentioned the concept of 'time-sharing' as a flexible design enabling multiple spaces in the home to be used by different family members for different functions at different times of the day, thereby promoting multi-generations to live in a tight space.

A property manager advised that the ideal way would be to have two apartments located closely together so that every small family could have its own independent space, reducing family conflict while maintaining privacy, providing care and emotional support.

In addition, providing community activity space is another solution for overcrowded homes so that older residents could have the space to do activities which cannot accommodate within their apartments. Experts also added familiar, convenient, comfortable and flexible community spaces to cater to social and psychological requirements should be taken into consideration in parallel to the above factors.

The social environment related aspects will be discussed in detail in Chapter 8 around the topic of the age-friendly social environment.

7.4.2 Retrofitting of existing apartment and community environment

The revised *Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly* (NPC Standing Committee, 2012) was implemented nationwide in China on 1st July 2013. For the first time, the new law added a section on liveable environment, laying out the principles for the state to promote age-friendly living environments for the older population, and helping to provide a safer, more convenient and comfortable living environment for the older people in their daily life and participation in society. More importantly, it has been shown in the form of law that having a suitable living and activity environment is the basic right of older people to live a healthy and active life. In recent years, a series of actions have been carried out to establish age-friendly cities and age-friendly

communities, such as community and home retrofitting projects, but the practice remains relatively slow.

Some of the architects shared their experiences of home retrofitting for older people by using well-designed storage and multifunctional furniture (like height adjustable kitchen worktops, cabinets), clearing out cluttered ways, improved natural light and acoustic design and technology equipment, to improve home accessibility and safety, and residents' experiences of the home. It was highlighted that modifications in the bathroom such as adding grab bars and replacing the bathtub to a walk-in shower were most required, as well as other equipment including gas alarms, smoke alarms, and emergency call buttons. A care provider noted that the retrofitting should take consideration of the warmth and familiarity of the home and avoid those design features which made residents 'feel old' or as if they were in a hospital.

Many difficulties were encountered in the renovation for ageing, such as the shortage of professional designers working on age-friendly interior renovations. It was hard for many older people to find practical support when they had reconstruction needs. An architect pointed out that the interior reconstruction of the old apartments was limited by the original building layout and structure. The narrow interior space limited the possibilities of renovation. In other words, it was not always easy to provide a good retrofit plan.

During the retrofitting process, the physical capabilities of older people may be challenged. Their living arrangement during retrofitting was also a problem. As a property manager said:

> Older people often think that renovation is troublesome and affects their normal life. For example, the toilet and kitchen cannot be used during renovation, and it is unrealistic for them to live in hotels. So, some older people make do. (S_1, property manager)

It was mentioned that health considerations could also affect older people's retrofitting decision. Some materials used in decoration may cause physical discomfort in older people. For example, new furniture and paint may release odorous gases that might make the older residents' respiratory system uncomfortable.

Besides, affordability played a part in the decision of whether or not older people retrofitted their existing home. Some experts believed that some older people may not be able to afford the renovation. However, the experts argued that affordability was not the decisive factor. A policymaker explained:

Some older people don't accept it in the concept of consumption. They believe that the older people should not spend money on themselves, and they are subjectively satisfied with the current state. Because many older people in China lived in a poor environment when they were young, and the living environment now has made great progress compared to when they were young. (S_6, Policymaker)

Policymaker supposed that this situation could be improved by the government raising awareness of age-friendly environments and providing funding via related policies and propaganda. At the same time, encouraging relevant professional training and technical support could also play a role in promoting home retrofitting. In recent years, community retrofitting for an age-friendly living environment has also been tried and encouraged in urban China. It is mainly aimed at the transformation of old residential communities, such as the Case 1 community in this research. Participants noted that a small part of old 6-7 storey buildings were being renewed by adding external lifts (Figure 7.5).

In addition, some communities had transformed public areas to support older people, such as renovating the landscape, adding exercise places (Figure 7.4), improving public security and traffic conditions, installing street lighting, adding ramps, handrails, chairs, public toilets, and signs.

At the same time, a lot of challenges were discussed by the architects, policymaker, and property managers about community retrofitting. Experts perceived many barriers to refurbishing buildings, including limited space, cost sharing, blockage of views, excessive noise and construction waste. A property manager proposed that improving accessibility by adding lifts in old buildings was both high cost and difficult to retrofit because of a lack of relevant experience and policy guidance. He explained:

Adding lifts is a good project, but the process is not easy, and we are facing a lot of difficulties. For example, the installation of a lift requires the consent of the owner of the entire unit, which is a very difficult step. Some people are too young to need a lift, some people don't want to spend money, for various reasons, only about a third of the units have been approved by all the residents. In the process of construction, there are also great resistance, such as the community belongs to the school, the school did not participate in nor supported the installation of the lift project. The lifts once damaged the campus road in the process of transportation and installation, nobody was willing to bear this part of maintenance. (S_4, Property manager)

Figure 7.5 The new added lift in Case 1

Figure 7.4 Outdoor activity space for older people

Similar difficulties facing retrofitting were also mentioned by the policymaker and architects. They agreed that China's retrofitting strategy for an ageing population remained in its infancy. The lack of successful experience, a mature framework guidance and the lack of public awareness resulted in great resistance in the implementation process.

In general, upgrading the existing environment is better than moving to a completely new one for the healthy older people, as their living habits, rules, familiar environment and people will make the older people more confident and comfortable to live independently and actively.

7.4.3 Community support and management

The experts concurred that community support and management were necessary to achieve an age-friendly environment based on design considerations for older residents, as mentioned above, to build an accessible, safe, comfortable and convenient community environment. In addition, property management needed to shoulder the maintenance and service responsibility to ensure the built environment remained age-friendly as designed.

It can be said that the three case communities differed significantly in terms of community support and management. In Case 1, there was virtually no involvement in property management in the community. This led to a series of problems in the community's public space, such as the random parking of vehicles and bicycles, arbitrary discarding of construction waste and household garbage, unattended green spaces, damage to roads and roadside stones, pet excrement, and so on (Figure 7.6). These issues are hidden inconveniences and dangers to older people's daily life.

Figure 7.6 Community public space in Case 1

The situation of Case 2 was better than that of Case 1. The community was equipped with property management personnel with different roles, such as a doorman and a maintenance team. They took care of community sanitation, built environment maintenance, parking, security and other aspects (Figure 7.7).

Figure 7.7 Community public space in Case 2

Case 3 was sophisticated in terms of property management, which was embodied in strict access control, a clean community environment, delivery service, and a well-planned and managed underground parking (Figure 7.8).
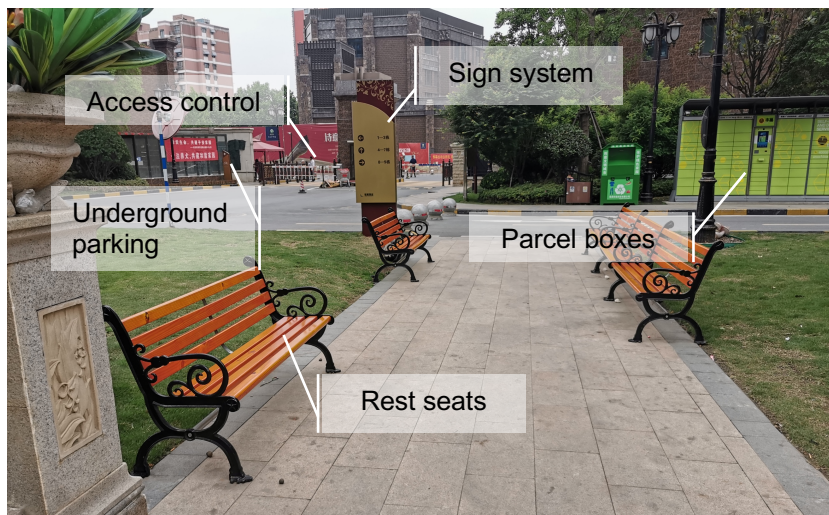
Figure 7.8 Community public space in Case 3

A government official in charge of Case 1 who participated in the interview highlighted the disadvantages of the lack of property management:

This community has an excellent environmental foundation, but some of the current disadvantages are caused by the lack of property management. Owners' needs cannot be met because there is a lack of managers to coordinate their needs and provide corresponding help. As a result, the environment and safety of the community are not guaranteed. This community is affiliated with the university, and the funding from the university employs several doormen. However, these doormen do nothing and are not supervised. The more serious consequence is that the government implement a policy for the age-friendly retrofitting project in the past two years. However, the retrofitting process is challenging due to the lack of relevant responsible person to coordinate the related work. Many older residents require a lift but cannot get it. (S_5, Government official)

Another challenge regarding community support and management, as noted by the interviewees, was the lack of space. A policymaker pointed out that space was needed to provide services and venues for the older residents in the existing communities:

Space is not enough. According to the policy of Nanjing City, 15 square meters per hundred households in the existing community are needed as community office space, and 20-30 square meters per hundred households in the new community are required. Since 2014, Nanjing has called for 40 per cent of community office space to be used free of charge to provide relevant services and places needed by older people. This document is not a mandatory requirement. Many downtown communities cannot meet that standard and don't have spare space. The government is now considering a policy to provide as much space as possible through leasing. However, then there is another question of rent. (S_6, Policymaker)

Architects pointed out a phenomenon where some new communities had provided underground spaces to set up services and support for older residents but did not make any benefit. Underground spaces were undesirable and unused by the residents due to bad lighting and ventilation. However, this only meets the policy requirements but not the really the real needs of the older residents.

Financial issues were another major factor affecting community support and property management. On the one hand, a comprehensive community property management equates to high property management costs. On the other hand, experts agreed that older people in China were currently less aware of the consumption of services. Policymaker analysed the reasons, including being influenced by educational background, personal experience when young, and the massive pressure on children in the current society. The reluctance of older

people to buy services therefore made it challenging to open the service market for this segment of the population.

The funds provided by government were limited in the ability to support organisations to provide services and space in the long term. A policymaker argued that if the organisations' survival could not be guaranteed, it would consequently be impossible to provide quality services for older people. He believed that such situations could be improved through more government funding, a new market model, strict policies and regulations. Other experts mentioned that the policies need to be detailed, implemented as soon as possible, and that the government should provide more community-level care services, care professionals training and infrastructure improvement.

7.4.4 Ageing process and lifetime needs

The experts were of the opinion that China's existing mainstream housing lacked consideration for the needs of older residents. The mainstream residential buildings only met adults' basic living needs but were not designed and built for the needs of different customer groups and vulnerable populations, such as children, older people, and disabled people. An architect analysed:

> After the housing reform in 1998, China's housing construction made significant progress, and the real estate market faced a peak of growth. The quantity and speed of residential development were rising. In this process, because the market was short of supply, most real estate developers pursued quantity to win. Not enough attention was paid to the quality of the residence. Consumers were also inexperienced and had not formed a sufficient understanding of what constitutes a good home. (S_13, Architect)

Moreover, experts advocated that ageing was a dynamic process as well as the demands on the built environment. The built environment should adapt to the individuals' whole ageing process to delay ageing or improve their quality of life. In other words, it is a challenge to be able to provide a built environment suitable for people in different physical conditions and living arrangement. A care provider pointed out that older people were often reluctant to change their familiar living environment, as the flexibility of the current living environment was particularly important:

> Some older people may think that having to move out of the original residence means a complete deterioration of physical function, which will bring a certain psychological

gap and cause negative effects. So, we are providing service at their current home within the community. (S_7, Care provider)

Some experts suggested that older people should be classified and provided with appropriate support. For example, older people could be classified according to their physical health and family conditions, such as the individuals who have lost the ability to live independently, the empty nesters, the older people living alone. Corresponding policy support should be provided according to an individual's condition. However, a policymaker predicted that it was hard to regularly evaluate every older person adopting a positive approach. He proposed:

Relevant policies and measures need to be put forward. Technology and big data may be the breakthrough to solve this difficulty. (S_6, Policymaker)

7.4.5 Lack of professionals and practical technologies

Another major difficulty mentioned by experts was the shortage of relevant professionals in key positions, including architects, policymaker, care providers, and property managers. The interviewees reflected that they lacked theoretical knowledge related to older people, and most of their cognition was gained from practical experience. An architect shared a problem encountered in providing a more supportive built environment for older people:

We are not old people yet, and there is still a certain gap between what we imagine and what older people really need. For example, we think fingerprint lock can solve the problem that the older people forget to take their key when going out, but in fact, many older people encounter a series of troubles in using fingerprint lock. For example, some older people's fingerprints are relatively shallow and cannot be identified. Some older people are relatively low in the acceptance of science and technology products, and they feel hard to learn how to use it. Some older people have no sense of security to fingerprint lock, always think that others can also open their door. These are questions that we didn't know of in advance. (S_12, Architect)

The care providers also added similar concerns regarding their work and built environment for older people. The care provider pointed out that, on the one hand, there was a shortage of practitioners to provide services related to older people, and most of the existing practitioners did not have a professional knowledge and rich practical experience. On the other hand, it was difficult to attract more practitioners due to the low salary of nursing workers.

Figure 7.9 presents an overview of the findings from the stakeholder group. The design and retrofitting of the living environment aimed to provide an age-friendly physical environment for the older residents. Seven aspects were highlighted: safety; mobility; sensory; cognitive; living arrangement; affordability; and social needs. These should be taken into consideration by the architects in the design process. At the same time, nine challenges were discussed in terms of community and home retrofitting. Design standards were considered to be an essential factor affecting the quality of the living environment. The existing communities were built in different times, meaning that they followed different design codes, resulting in different degrees of age-friendliness, especially in the mobility aspect. The experts believed that the overall quality of residential buildings could be improved by increasing the consideration of older people's requirements in design standards for mainstream housing, contributing to ageing-in-place.

Based on the built environment, an age-friendly setting cannot be achieved without community support and service. The maintenance of the built environment, security, sanitation, and parking management should be carried out continuously by the property managers. Experts pointed out that community support and management could be improved through policy support and operational guidance. In addition, older residents may need help from the care providers. This issue will be explored in Chapter 8.
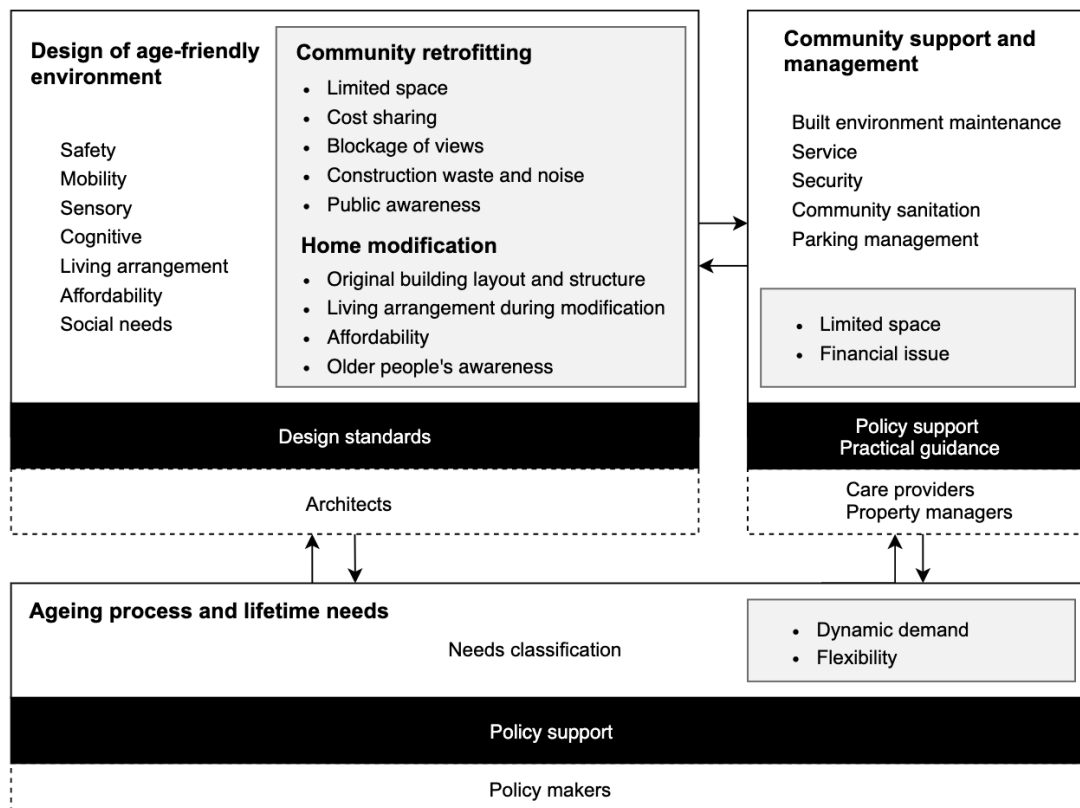
Figure 7.9 An overview providing an age-friendly built environment from the experts' perspective

Furthermore, consideration of the whole ageing process and lifetime needs was highlighted by policymakers as the current objective and problem. Older people faced different and changing demands, meaning that they might need a flexible environment and support during the ageing process. The classification of the older population and their needs was considered a key measure to provide practical help. Relevant policy support was therefore demanded by both older people and experts to achieve the above goal.

7.5 Older People's Unmet Requirements of the Built Environment

With the gradual decline in physical function, older people are more sensitive to environmental obstacles and have new demands on the living environment (Lawton, 1977b). In China, existing mainstream housing stock as occupied by many older people is not well suited for ageing-in-place. This section presents the results of the interviews with 37 older participants from the three case communities.

The categories and sub-categories were derived from the data using inductive content analysis. The process of inductive qualitative content analysis can be divided into three phases: preparation phase; organising phase; and resulting phase (Elo & Kyngäs, 2008). There are five main domains: mobility; safety; sensory; cognitive; and technology; there are 21 sub-categories as shown in Figure 7.10.

This study focuses on the deterioration of physical functions faced by the older people in the ageing process, as well as their dependence on the built environment and special needs that may arise in this process. The main categories include:

- **Mobility:** Individuals with mobility impairment may need to use a wheelchair, crutches, or a walker, correspondingly, they require a barrier-free environment.
- **Safety:** The environmental difficulties reflected in the obvious obstacles and safety hazards may result in older people falling and slipping, with slower response or visual loss, leading to more severe health problems.
- **Sensory:** The sensory change of older people includes the sense of hearing, smell, and visual decline, temperature changes, which require a more supportive physical environment to compensate.
- **Cognitive:** The cognitive changes make older people more dependent on the familiar environment and need a more supportive surrounding.
- **Technology:** Technologies could enable mobility, enhance safety or provide social interaction for older residents. However, the acceptance of technology is influenced

by many factors.

Some of these phenomena are common in the three cases, and some are unique to an individual case. Detailed elaboration and analysis will be carried out below for each theme.
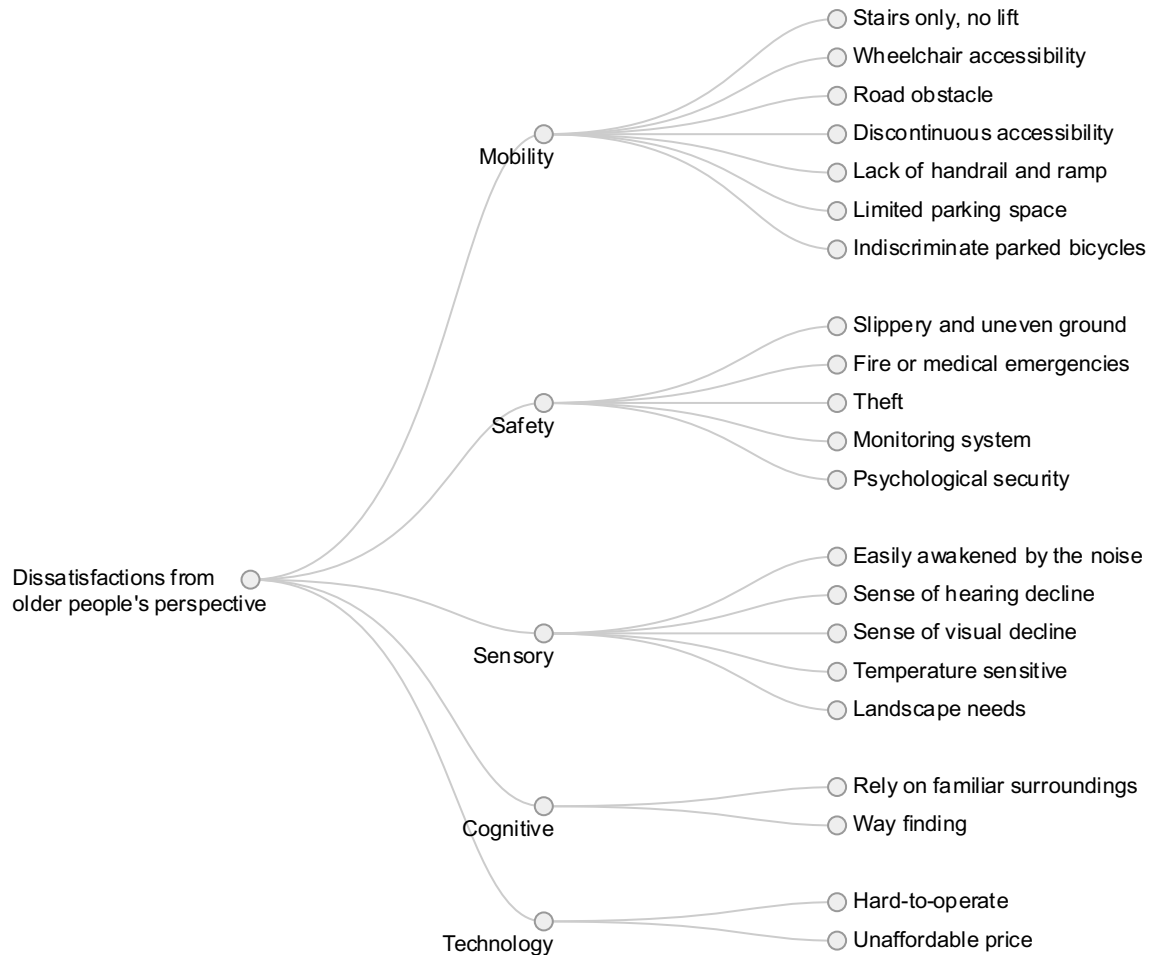
Figure 7.10 Overview of dissatisfaction from older people's perspective

7.5.1 Mobility

The older participants' most frequent complaint was mobility impairment, referring to the inability of a person to use one or more of their extremities, or a lack of strength to walk, grasp, or lift objects. Individuals with mobility issues may need to use a wheelchair, crutches, or a walker.

The participants' specific mobility impairments included slow movement, hard to bend down or squat, difficulty walking, joint pain, and quickly feeling tired. Respondents expressed that the degradation of their mobility made them reduce the frequency of going out or shorten the

walking distance. Mobility impairment may be caused by different factors such as physical decline, disease, an accident or a congenital disorder. For example, an interviewee said:

> I have heart problems for some congenital reasons. Now I'm older, I often feel chest tightness, and it's challenging for me to go upstairs or downstairs. There are difficulties in the current living environment, and no lift is the biggest problem. It disturbs daily access. (C1_1, 63, Male)

As this participant identified, the built environment is closely linked with mobility. Respondents identified stairs as the biggest obstacle to their mobility. Since the 2010s, accessibility has been used to address the minimum legal requirements of designed environments in China. However, many older individuals have to use stairs in their daily lives in the old existing residential buildings, such as the Case 1 community built two decades ago. A built environment without age-friendly features not only limited older individuals' behaviours but also contained hidden dangers. An interviewee described:

> There was a small hazard on the road in our community. That day, there was an old lady. She fell there and could not move for ten minutes. She shook her foot slowly after a while. Older people are terrified of such falls, sprains, and fractures, and our bones are brittle, unlike young people. The ground must be flat. (C1_12, 62, Female)

Although the residential buildings in the Case 2 community have been equipped with lifts, there remain several stairs in the building entrance and unit entrances. Thus, the accessibility in Case 2 is not coherent, which also becomes a challenge for older people who need wheelchairs:

> My neighbours are an older couple. I met him twice. He wanted to go to the hospital, but he had difficulty. He was in a wheelchair. The steps stopped him, unlike new buildings that are now required to be barrier-free. I helped him to stand up and put his hand on my shoulder. Help him get down…I was live on the fifth floor without a lift. My wife had a meniscus problem and couldn't go up and down the stairs, so we moved. Now there's a lift, but the steps are still a little difficult. It's better than the fifth floor. (C2_1, 70, Male)

Participants also highlighted parking issues when they talked about mobility. Especially in Case 1, as introduced in Chapter 5, there was no underground parking area. Parking space availability was limited, as more residents owned private cars and electric bicycles, occupying roads and green space (Figure 7.11). As an older participant complained:

I'm not satisfied with the accessibility in the community. The traffic is not very good. The road is narrow; especially now there are more cars, the parking space is not enough. Some people parking unruly, it is not convenient for us to walk. (C1_1, 63, Male)
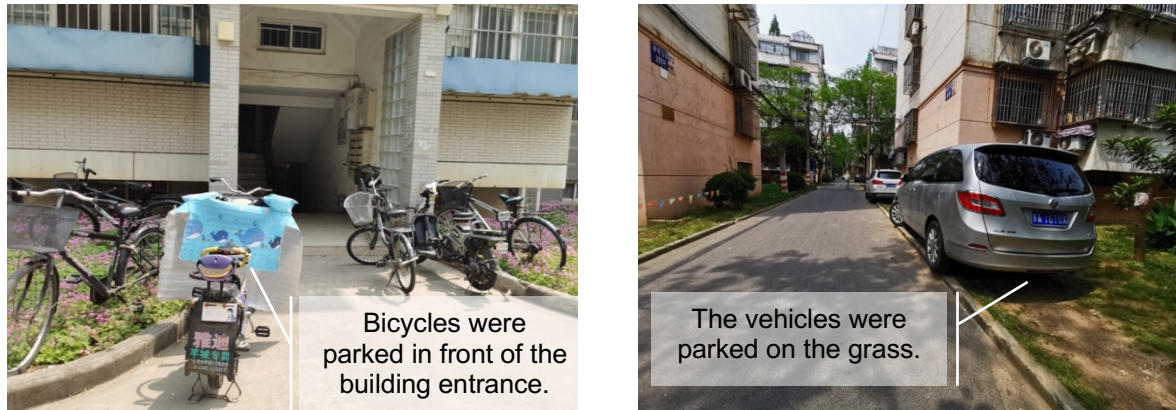
Figure 7.11 Indiscriminate parked vehicles and bicycles in Case 1 community

Participants living in Case 3 were relatively satisfied with the accessibility of the community and the residential buildings, but they also raised the issues of no ramps and handrails in the green space. Regarding the degradation of older people's mobility, those communities built early exposed the most severe problems, especially a lack of barrier-free consideration and limited parking. The newly built community's situation is better than that of the older communities, but there remained room for improvement in considering older people's needs, such as stairs without a wheelchair ramp and the absence of handrails in the green areas.

The mobility aspect of the built environment was identified by older people as a top-priority which can reflect the degree of age-friendliness. Seven sub-categories were generated from the mobility domain. The older participants pointed out that these deficiencies regarding the built environment had a negative impact on enabling ageing-in-place for them. As Table 7.3 presents, the early built residential buildings and communities revealed serious accessibly problems, especially a lack of lifts, a shortage of parking spaces, and inconsistent wheelchair accessibility. Participants from Case 3 only mentioned the problem of uneven accessibility in the landscape area in the community outdoor space.

Table 7.3 The mobility issues of the built environment and the situation in cases

Mobility aspect	Case 1	Case 2	Case 3
Stairs only, no lift	Yes	No	No
Lack of wheelchair access	Yes	Yes	No
Road obstacle	Yes	Yes	No
Discontinuous accessibility	Yes	Yes	Yes
Lack of handrail and ramp	Yes	Yes	No

Limited parking space	Yes	Yes	No
Indiscriminate parked bicycles	Yes	Yes	No

Older participants linked mobility with the safety and sensory domains during their interpretation. The connection between categories is illustrated in Figure 7.12 according to the coding results. Lack of wheelchair access was highlighted by showing the connection with other mobility issues and the safety aspect. It also displayed a close relationship between the mobility and safety domains, especially reflecting the consideration of fire or medical emergencies.

Figure 7.12 The connection between mobility and other domains

7.5.2 Safety

The age-friendliness of the built environment was reflected in the safety domain. Participants linked safety with the built environment in several aspects, including preventing slips and falls, fire and medical emergencies, and property management.

It was expected by older residents that anti-skid prevention and fall prevention are the primary issues that need to be resolved regarding the built environment's safety aspect. Older people are afraid of slippery and uneven roads, believing that such an environment will cause them to fall leading to more severe health problems. For example, in Case 1, there was a small courtyard for residents to do some outdoor activity in the community, but it was currently abandoned due to potential safety hazards (Figure 7.13). An interviewee mentioned:

> The community is not very good at preventing slip and fall. There is a small yard next to here that you can go and see. It is full of weeds. Several people have had accidents at night, because of the uneven ground and the water pool. People stopped going there, and there's no one to take care of it. Occasionally people walk their dogs inside. They said there's a lot of shit on the grass. I don't want to go there anyway, for fear of falling. (C1_10, 95, Female)

Figure 7.13 The abandoned yard in Case 1 community

The older people consciously avoided unsafe places to reduce the occurrence of accidents. However, the hidden safety problems in some public areas are hard to avoid. In Case 2, for example, the outside public ground was paved with uneven cobblestones (see Figure 7.14). A participant expressed dissatisfaction with the material of the ground:

> The designer should pay attention to anti-slip. One day, an old guy went out and slipped, got several stitches. Our roof garden's pavement is cobblestone, bumpy, easy to fall, and easy to break. The indoor public floor is tile. When it is rain or snow, a little water makes the floor very slippery. I dare not go out in bad weather. (C2_1, 70, Male)

Figure 7.14 The outdoor pavement and indoor tile in Case 2 community

In addition to the community public space, many older people discussed slip and fall prevention in their homes. Compared with the community, the anti-skid problem within a private apartment was better. Most older interviewees thought that they had already taken measures in their homes, including non-slip tiles and wood floors, non-slip mats, handrails and shower chairs. Some people over the age of 80 said that the community and the government had offered them free renovations to improve the safety of living alone. Likewise, some older people mentioned that they were considering doing something about it at home in the future.

Another safety concern for older people was being rescued in an emergency, such as during a fire or medical emergencies. For Case 1 and Case 2, the limited parking area, narrow road and lack of a residential stretcher lift were the three key features of the built environment in their list of trepidations. Older people pointed out their worries about the absence or lack of parking spaces and access for fire engines and ambulances. The older residents in the newly built Case 3 did not mention such concerns as the new residential building design codes included consideration for fire and emergency rescue.

The property management was also linked with safety in terms of anti-theft. Similar to the emergency issues, only older participants from Case 1 and Case 2 highlighted their safety concerns linked to the theft problem. The interviewee in Case 1 told his experience:

> There have been incidents of things being lost, such as the battery of my electric bicycles, parked downstairs. The battery was stolen. Someone chose to take it home, but it was too heavy for me to lift. Then I just stopped to use it, and it's safe not to ride an electric bike for me. (C1_2, 8, Female)

The participants in Case 2 were concerned by the safety issue and property management, including the laying of non-slip mats in the rain and snow, and the installation of a security and monitoring system. An older participant claimed:

> The security and safety problems are inseparable from the property management, the relationship between the owner and the property should be coordinated and win-win. Property services for the residents wholeheartedly, the residents cooperate with their work. If the property has perfect rules and regulations, strict implementation and the residents' safety will be guaranteed, for example, providing non-slip mat in rain and snow weather, monitoring by CCTV. (C2_4, 67, Female)

The older participants who lived in Case 3 presented a unique understanding of safety. More than one older person said they felt unsafe living on very high floors, mainly due to psychological and physical discomfort. Because she had never lived in a high-rise building before, one woman thought she might have acrophobia because she was afraid to stand close to a window. High floors made her feel dizzy and restless.

To sum up, the safety aspect of the built environment was another top priority for older people. Five main safety issues related with built environment were discussed by the older participants (Table 7.4). The design considerations of anti-slip and anti-fall could avoid safety risks, and at the same time, the maintenance and management of the built environment was also significant and necessary.

Table 7.4 The safety issues of the built environment and the situation in cases

Safety aspect	Case 1	Case 2	Case 3
Slippery and uneven ground	Yes	Yes	Yes
Fire or medical emergencies	Yes	Yes	No
Theft	Yes	No	No
Monitoring system	Yes	Yes	No
Psychological safety	No	No	Yes

By showing the connection between the safety domain and other domains, Figure 7.15 suggests that for the older people group, the safety of the built environment was closely related to many aspects, including mobility, sensory, cognitive, and technology. The most notably issue was the problem of emergency rescue, which was influenced by the mobility aspect to a great extent. Psychological safety was only described by participants from Case 3, and it is notable that the residents in Case 3 only moved to this new community less than two years ago. This could reflect the value of living in a familiar environment for older people, which is one of the meanings of ageing-in-place.
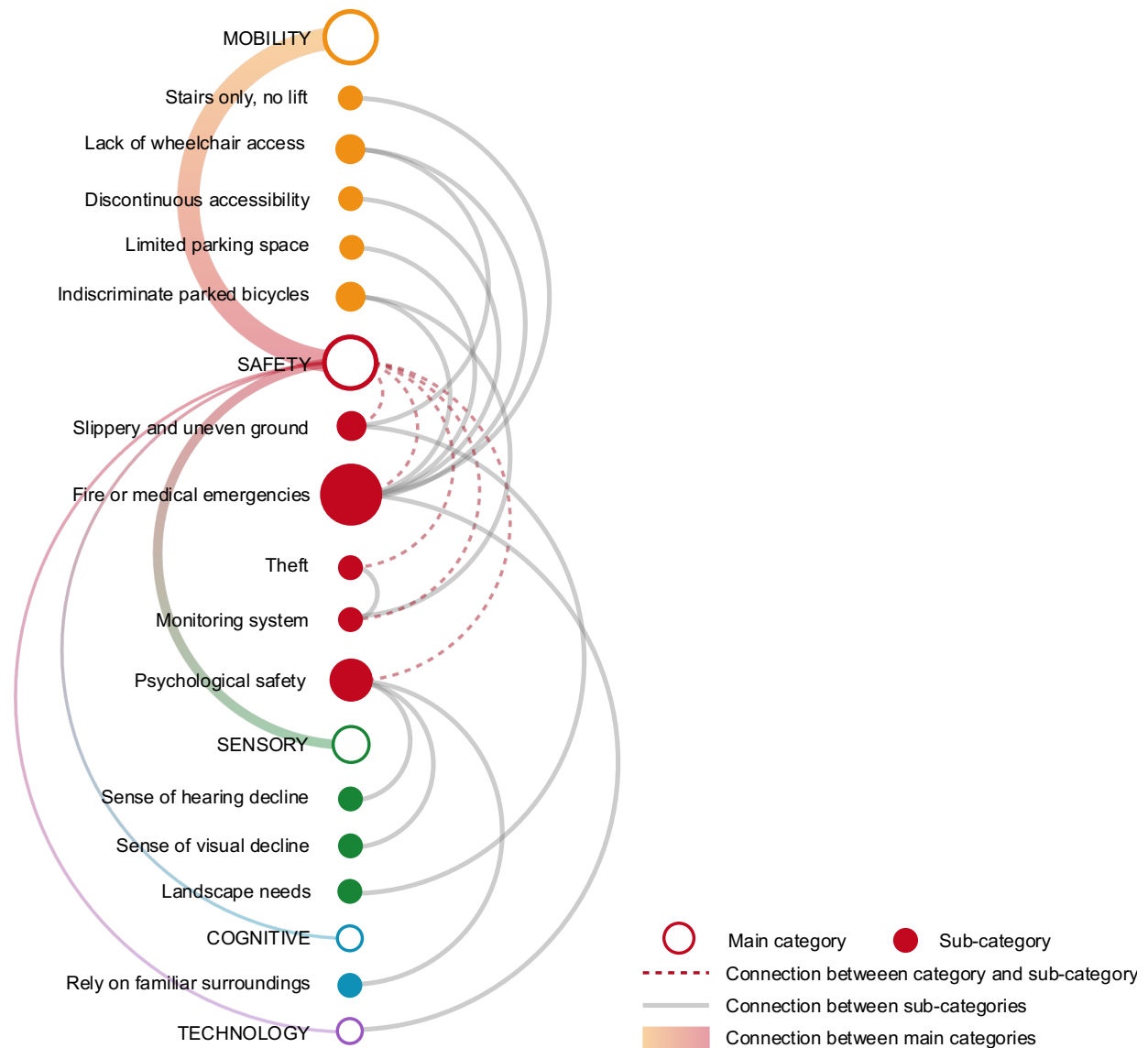
Figure 7.15 The connection between safety and other domains

7.5.3 Sensory

Older participants reported a range of sensory changes, including the sense of hearing, smell, and visual decline, temperature changes, easily awakened by noise, vision loss at night, sensitivity to intense light and avoiding bright and saturated colours. Some of the older interviewees believed that an improved built environment could help them solve the problem caused by their sensory decline to a certain extent. For example, a participant living in Case 2 described:

Our community is located in the centre of the city. Even at night, there are many cars on the road. The lights and noises made it difficult for me to sleep, and it was easy to

wake up even when I fall asleep. Later, my child installed noise-proof windows and blackout curtains for me, and I am much better now. (C2_7, 80, Male)

Additionally, the older participants associated technology with the change in the sensory aspect. Indoor environmental quality could be improved by technologies such as air purifiers, air conditioners, and voice-controlled/motion sensor activated lights. The technology could also benefit their sensory ability, such as wearing a hearing aid and glasses.

However, some older participants believed that the problems caused by sensory decline could not be improved; rather, they could only accept and adapt to the decline. Several older people expressed similar sentiments that their sight and hearing were not as good as before, but that it did not affect their life at the moment. As an interviewee stated:

I'm still young now, and I feel degenerating, but it hasn't affected my daily life for the time being. Maybe my older age will be affected. Of course, it's best to improve, but I find it difficult. Don't know how to start. (C1_12, 62, Female)

The age-friendly landscape environment could also play an important role in supporting older people to achieve ageing-in-place, including the natural landscape around the community, the designed landscape in the community, and plants in the home. Some older participants appreciated nature and greening in the living environment, including better views, indoor plants and outdoor landscape. The older people living in Case 1 and 3 provided positive comments on outdoor greening, while the older people in Case 2 thought their community lacked green space.

In terms of the sensory aspects, older participants in the three cases faced similar problems (see Table 7.5). Reply to the degradation of the older people's senses, such as the sense of hearing and visual decline and temperature sensitivity, the design of the physical environment should take acoustical, optical, and thermal considerations to compensate for sensory impairment of the older people.

Table 7.5 The sensory issues of the built environment and the situation in cases

Sensory aspect	Case 1	Case 2	Case 3
Easily awakened by the noise	Yes	Yes	Yes
Sense of hearing decline	Yes	Yes	Yes
Sense of visual decline	Yes	Yes	Yes
Temperature sensitive	Yes	Yes	Yes
Landscape needs	Yes (Positive)	Yes (Negative)	Yes (Positive)

The sensory aspect was linked with the mobility, safety, cognitive and technology aspects by the older people group (see Figure 7.16). One of the most prominent requirement was the visual decline of the older people, followed by the landscape needs. From the built environment, the sensory aspect change could be remedied by taking the design intervention and making use of technologies.

Figure 7.16 The connection between sensory and other domains

7.5.4 Cognitive

Participants identified that they felt they experienced a worsening cognitive competence, such as the ability of intuition, perception, problem-solving, and oral and written expression. They also mentioned their increasing sense of nostalgia and memory decline to some extent. These changes affected older peoples' feelings, even though that living environment does not meet the age-friendly design features according to the objective evaluation criteria (see Section 5.5).

This phenomenon was most evident in Case 1, where many older people said they have been living there for many years, so the familiar environment made them feel at ease. In other words, it was convenient and an ideal place to age-in-place. Using the stairs every day was considered by some older participants as a way to exercise, even though they also raised concerns about the future when they might have problems with mobility. In contrast, in Case 3, some interviewees thought that although the new built environment was good, they needed some time to adapt. Some older people thought that the newer and bigger apartments were not as good as their original homes. As an older participant claimed:

> I feel that every building here looks the same. Sometimes I dare not go out by myself because I am afraid that I can't find my way home. Although there are lifts in every building, I am not used to using it. Every time I go out, I have to wait for the lift for a long time, and sometimes I pressed the wrong number and go to the underground parking area. I chose not to go out when at the beginning, but I feel bored when I didn't get outside. (C3_12, 67, Female)

In the construction of the age-friendly environment, it is also imperative to meet older individuals' cognitive needs. Older people prefer to live in familiar surroundings. An older person living in Case 2 also emphasised the importance of this point during the interview. He had tried to move to a nursing home a few years ago, where the built environment was more in line with the design features of the age-friendly environment. However, he felt strange and cold, and the handrails and beds in the nursing home made him feel as if he was already ill and very aged. He decided to move out and bought the current apartment beside the community where he previously lived. The atmosphere of the city and familiar surroundings made him feel happier than when he was living in the nursing home.

Older people's cognitive decline makes them resist unfamiliar environments and rely on familiar surroundings. The familiar environment can help older people maintain their living habits and rhythms. On the contrary, a new environment may bring a series of problems, such as getting lost and anxiety. Some of the participants from Case 1 and Case 2 mentioned the importance of familiar surroundings and gave positive feedback in terms of their current residential community, while the participants living in the new community (Case 3) presented negative feedback on their surroundings. The same results were obtained for wayfinding (Table 7.6).

Table 7.6 The cognitive issues of the built environment and the situation in cases

Cognitive aspect	Case 1	Case 2	Case 3
Rely on familiar surroundings	Yes (Positive)	Yes (Positive)	Yes (Negative)
Wayfinding	Yes (Positive)	Yes (Positive)	Yes (Negative)

The cognitive domain was linked by the older participants to the safety and sensory aspects as presented in Figure 7.17. For example, the sense of visual decline might influence their wayfinding ability and result in older people relying more on familiar surroundings.
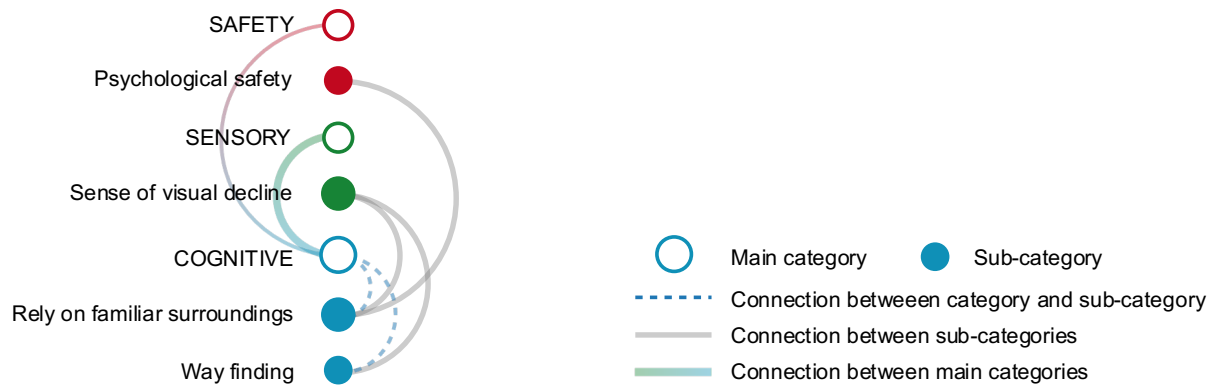
Figure 7.17 The connection between cognitive and other domains

7.5.5 Technology

Some older people believed that technology played an important role in their daily lives. Environment-related technological products cited included sweeping robots, automatic washing machines, voice-controlled lights, air conditioners, air purifiers, humidifiers and other household appliances. Older people were more receptive to this kind of easy-to-operate products, which could reduce physical labour and provide a more comfortable living environment. Some home medical technology devices were also approved, such as blood pressure monitors, blood glucose monitors and massage chairs.

Another widely mentioned technology was the smart phone. Older people considered that the popularity of smart phones enhanced their relationship with their relatives and friends and made it quicker and more convenient to receive information from the outside world, replacing traditional books, newspapers and broadcasts to a large extent. One older person who lived alone believed that the ubiquity of mobile phones also made her solitary life safer. When not feeling well or encountering some difficulties, the mobile phone can help her get in touch with her family or the hospital quickly.

Very few older people talked about wearable technology devices such as smart watches, which they said had been left unused because they often needed to be charged and that the text/buttons were too small to operate easily. However, many older people held the opinion that new technologies were difficult to master and very expensive, leading to their reluctance

to try them. Older people's acceptance of technology may depend on the help of their children. One older person shared her experience:

> I thought it was too much trouble to use. But after the child taught me little by little, I found it very helpful. Technology is very good, but hard to learn by myself. Children need to teach some simple functions, such as weather forecast, alarm, send WeChat messages, playing video. Learn to feel good. (C1_11, 66, Female)

The application of technologies reduces the physical labour of the older people and increases the comfort and convenience of life. Due to the inability of older people to accept new things, the ease of operation of the equipment needs to be considered. As shown in Table 7.7, hard-to-operate technologies were seen as a barrier by the older people from the three cases. In addition, most of the current Chinese older people are frugal; as a result, the affordability of technology equipment is another important factor for it to be widely accepted.

Table 7.7 The technology issues of the built environment and the situation in cases

Cognitive aspect	Case 1	Case 2	Case 3
Hard-to-operate	Yes	Yes	Yes
Unaffordable price	Yes	No	Yes

As shown in Figure 7.18, older people connected the technology aspect with safety and sensory aspects by improving the built environment to support ageing-in-place, such as the provision of fire alarm buttons and emergency call buttons for older people who lived alone. In addition, due to the sense of visual decline, older participants described their specific requirements, for instance, that the control interface needed to be simple, and the font large.

Figure 7.18 The connection between technology and other domains

7.5.6 Older residents' overall evaluation of the three case communities

To sum up, as the three types of communities showed apparent differences in the built environment, the older residents emphasised their living environment differently during the interviews. Participants from Case 1 agreed that the beautiful natural environment around the community, familiar neighbours, having friends helping each other and the retirement centre for veteran cadres were the main reasons they continued to live in there. Simultaneously, they faced some apparent issues with the built environment, such as the lack of a lift, crowded road, lack of an activity space by vehicles and bicycles, and a lack of seats in the public areas as the most significant barriers.

In Case 2, respondents identified the location of the community as the main reason for their choice of ageing-in-place, reflected in enjoying convenient living with access to products and services, easy and cheap public transportation, and timely medical treatment due to a general hospital nearby, as the key components of ageing in their communities. They perceived convenient connections to local amenities as the most favoured feature. They also mentioned dissatisfaction about the built environment, such as incoherent wheelchair accessibility, urban noise, slippery floor tiles, and lack of greenery and activity space around their community.

In Case 3, all older participants' living arrangements were multi-generational as they were living with their children and grandchildren (Chapter 8). Thus, they identified living with descendants and supporting each other as the most favoured feature to age-in-place. They showed appreciation for the spacious apartments and new equipment. However, the construction noise, high-rise residential buildings, living habits and schedule differences with the children had become troublesome. Several participants said they would like to return to their own home when their grandchildren grew up in the future, rather than continue to live there.

This section aimed to understand older people's unmet needs and attitudes toward the built environment for living. Five main aspects were discussed, and 21 sub-categories generated by doing a content analysis of the interview transcriptions. Figure 7.19 presents the overview of the findings and the connections between the main categories and sub-categories.

Mobility and safety aspects were agreed as the top priorities of an age-friendly built environment by the older participants. Older people's general appeal for mobility and safety aspects in the built environment was higher than that of younger people, which could be attributed to the deterioration of physical functions, especially mobility impairment. As the National Health Service (NHS) (2018) stated, anybody can have a fall, but older people are

more vulnerable and likely to fall, especially if they have long-term health condition. Falls are a common but often an overlooked cause of injury. There is a risk that a fall could lead to broken bones, causing the individual to lose confidence, become withdrawn, and feel as if they have lost their independence. For older people who prefer ageing-in-place, losing their independence could be a destructive factor as discussed in Chapter 5. As a result, mobility and safety aspects are essential and closely interrelated.

Figure 7.19 The relationship between older people's unmet requirements

In the ageing process, older people may also face sensory degradation (Cavazzana et al., 2018; Fozard, 1990), resulting in special needs for an age-friendly built environment. Age-related sensory loss may lead to increased isolation from the outside world and impact the quality of life of older individuals (Fischer et al., 2009), by affecting the way they experience the environment, respond to stimuli and limiting their social activities, all of which may result in isolation and depression (Chou, 2008). Sensory decline also has negative effects for physical health. For instance, vision loss may increase the risk of falls and injury, while olfactory loss makes it more difficult to identify environmental risks, such as smoke, gas, and spoiled food. During the interview, some of the older participants connected sensory with other aspects and affirmed that the environment and technology could contribute to the difficulties caused by their sensory loss, such as well-designed lighting and gas alarms. The risks mentioned above can be reduced and avoided to some extent.

Similarly, cognitive decline is another age-related change that affects older people (Reid & MacLullich, 2006). The previous study suggested that unfavourable environmental features might limit the daily activities of older people, thus increasing the risk of cognitive decline (Wu et al., 2015). In this research, older participants highlighted their preference for familiar surroundings and their concerns about wayfinding in a new environment.

Although researchers have emphasised the value and possibilities of technology for ageing-in-place in recent years (Kim et al., 2017; Steinhubl & Topol, 2015), the interviews here found that the older participants' acceptance of science and technology was not high, and two reasons were repeated: hard-to-operate; and unaffordable price.

7.6   Promoting the Built Environment by Design

This section presents the design features of an age-friendly built environment mentioned by the participants from both groups during the interviews, as well as the findings from the case studies by conducting the architectural observation (Chapter 5).

The integrated design features are listed in Table 7.8, which are thematically divided into mobility, safety, sensory, cognitive, and technology aspects, and spatially separated into the home environment and community environment. This aims to provide design recommendations for designers and encourage the planning, designing and building sectors to develop age-friendly homes and communities. The design features could be taken into consideration during new community design and existing community retrofitting projects to improve the future of age-friendly residential model in urban China to enable the older population to age-in-place.

It will also form the basis for the framework in Chapter 9. The age-friendly built environment is an important component of the ageing-in-place design framework with a focus on providing a supportive physical environment.

Table 7.8 Design features of the age-friendly built environment

	Home environment	Community environment
Mobility	• Indoor wheelchair accessibility (wheelchair ramp, turning area for wheelchair, wide corridors and doors to allow access to wheelchair) • Spacious rooms • Walk-in showers • Handrails and grab bars • No thresholds • No altitude differences • Reasonable furniture and layout	• Lifts • Wheelchair accessibility • Wheelchair ramp and handrail • Barrier-free parking • Enough ground and underground parking spaces for all types of motor and non-motor vehicles • Flat walking pathways with adequate width • Continuity of the pedestrian road
Safety	• Seat for older people to change shoes • Shower seat • Anti-slip flooring • Rounded furniture • Avoid the wall cabinet against older people • Dual opening doors • Storage space for medicines • Emergency callers in bedrooms and bathrooms	• Dividing pedestrian lines and traffic lines • Design to prevent falls • Lifts to accommodate stretchers and hospital beds • Flat and homogeneous ground covering material • Community health care facilities (consultation, rehabilitation, management) • Temporary parking space at the entrance of the residential building for fire or emergencies • Monitoring system
Sensory	• Natural light • Adjustable light • Sensor controlled lights • Close to floor lighting at night • Ventilation • Thermal comfort • Avoid air conditioning blowing on the sofa or bed • Mixer tap • Acoustic materials (soundproof doors and windows) • Indoor plants and greenery • Views	• Well-designed landscape • Set up lighting in key areas • Set up rest space with shade shelter • Public toilet
Cognitive	• Familiar environment • Design to create memory triggers • Photos of children, memories • User-friendly technologies	• Community library • Public spaces • Clear and concise road system • Continuous, multi-level signage system
Technology	• Sweeping robots • Automatic washing machine • Voice-controlled lights • Air conditioners • Air purifiers and humidifiers • Gas alarm • Smoke alarm • Emergency call button	

7.7 Discussion

Based on the findings generated from the interviews with the two groups, a comparison was made to inform the cross-case analysis in order to understand the role of age-friendly built environments in promoting ageing-in-place from different perspectives. This was also necessary to fill the gap of a "mismatch" between the design of communities and the needs of older people (Iecovich, 2014). Lui et al. (2009) suggested that, to meet the challenges of building an age-friendly community, policymaker and designers were encouraged to take a proactive approach and to engage with experts together with empowering the older people themselves to create the conditions for active ageing.

The research objective of this chapter was to understand the role of age-friendly environments in promoting ageing-in-place. Figure 7.20 presents an overview of the comparison between the two groups visually (The raw data of Figure 7.20 is listed in Appendix 7.1.). The diagram highlights links in the main category and sub-category in the same group and links in different groups, which have been further emphasised using colours and identifying significant connections.

The comparison started from the sub-category generated for the older people group to identify the interactions with the sub-categories of the stakeholder group. The order of sub-categories of the older people group depends on the number of links with the sub-categories of the stakeholder group. This shows that the mobility and safety aspects of the living environment occupy the top seven positions, meaning that the two groups agreed with the environmental needs on mobility and safety aspects. For example, wheelchair accessibility is a key factor influencing the age-friendliness of the living environment. Even though the older participants did not need a wheelchair when they joined the research, they appealed for a barrier-free environment for other older people or for themselves as they might need wheelchairs in the future. This proves that environmental factors can generate positive outcomes and achieve a person-environment fit by improving living conditions (Lawton, 1998).

Wheelchair accessibility is connected with 13 sub-categories mentioned by the experts, including design standards, original building layout and structure, limited space, policy support, public awareness, built environment maintenance, and parking management. It reflects that wheelchair accessibility is a very complex task requiring comprehensive planning, provision of policy support and design standards, and removing barriers. This can explain why the obvious requirements of some older people have not been met: a lack of many necessary objective conditions in the construction process of the age-friendly

environment. These conditions will become the focus in future work, and how to break through these challenges needs to be investigated.

The order of the sub-categories of the stakeholder group represents the main barriers and interventions to achieving an age-friendly built environment such as limited space, original building layout and structure which significantly hinders the retrofitting projects. While policy support and design standards should be paid more attention to provide a more supportive environment, some of the sub-categories highlight the essential aspects of building age-friendly environments including safety, mobility and sensory considerations. These environmental concerns are highly consistent with those presented by the older people group. Experts believed that the previous design standards implemented during the construction period of the residential community had affected the age-friendliness of the built environment. Consideration of the older people's needs in the latest design standards have improved the age-friendliness of new residential buildings.

Experts also highlighted the value of community support and management. Community support and management involves many aspects of the age-friendly environment including maintaining the community environment, parking management, service, security and community sanitation. These priorities are also in line with the needs of older people.

In addition, experts in different positions recognised that ageing is a dynamic process, and the needs of older people are constantly changing. Considering the age-friendly environment for older residents' needs should reflect flexibility and the dynamic demand to meet the changing requirements of their life cycle. Corresponding to the older people group, many older participants mentioned their worries about the future as they get older. To cope with the changing needs of older residents, the concept of 'Lifetime Neighbourhood' in the UK is worth learning from (Harding, 2007). Since the types of mainstream residential buildings and communities in the two countries are dissimilar, the details should be adjusted according to the specific situation of urban communities in China.

The themes which have not been connected between the two groups are the lack of professionals. Experts advocated the demand of training more professional practitioners who understand the needs of older people, including architects, policymaker, care providers, and property managers. As Black (2008) suggested, service providers should receive training to enhance interactions with older people and enhance their knowledge and skills in gerontological competencies to recognise the comprehensive needs of older individuals in terms of their living environment. Likewise, Lui et al. (2009) advocated stakeholders from various levels of government, the private sector and the community to to collaborate to address the true needs of older people for supportive environments.
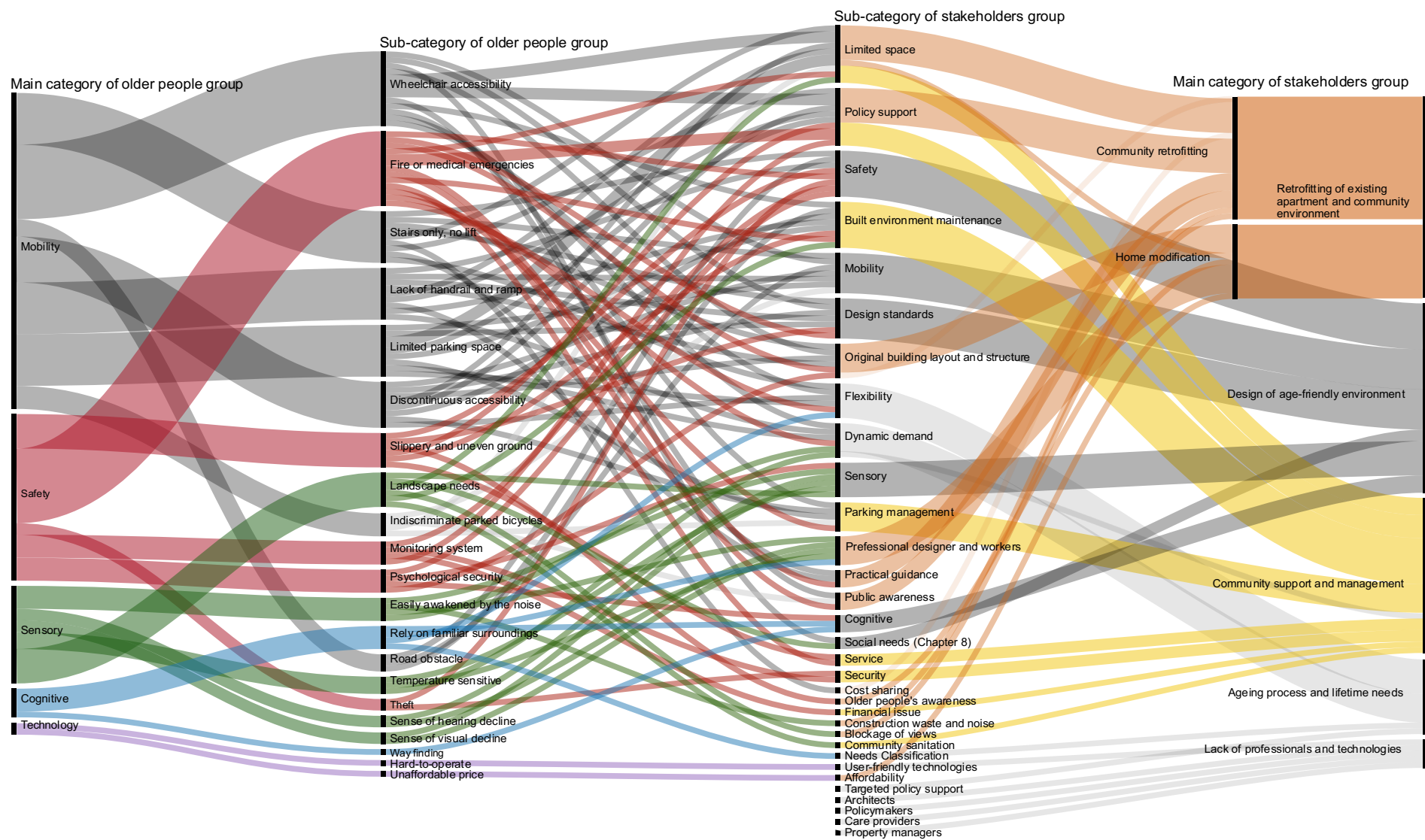
Figure 7.20 Overview of the comparison between the older people group and the experts group in the built environment

7.8 Summary

This chapter has confirmed the value of age-friendly built environment and examined challenges and potentials for improvements, establishing the relationship between the built environment and older people's ability to achieve ageing-in-place, by conducting semi-structured interviews with 37 older dwellers living in case communities and 13 experts, including architects, property managers, policymaker and care providers.

Participants from two groups agreed that an age-friendly living environment can benefit older individuals through increased independence, avoiding falls and accidents, improving health and overall well-being, and greater social interaction. Age-friendly built environments can also make communities more liveable for other vulnerable residents, such as disabled people and children, reduce costs related with health and care, producing a variety of social and economic benefits by expanding and extending older people's contribution to community life and achieve ageing-in-place as long as possible.

The experts discussed the weaknesses and challenges of the present situation of the age-friendly built environment in mainstream communities in urban China. Five main categories have been highlighted, including design of age-friendly environment, retrofitting of existing apartment and community, community support and management, ageing process and lifetime needs, and lack of professionals and technologies. In addition, older participants described their unmet requirements from mobility, safety, sensory, cognitive and technology aspects.

By comparing the findings from two participants groups, this research suggests public awareness of the age-friendly built environment is raising, while the existing mainstream residential communities in Chinese cities are facing improvement opportunities. The retrofitting of the existing environment has already started but is still in its infancy. Practitioners face a series of difficulties, among which the most prominent are limited areas, lack of corresponding policy support and practical experience. Furthermore, the design features of an age-friendly built environment have been listed in section 7.6 (Table 7.8).

This chapter has established the relationship between the built environment and older people's ability to achieve ageing-in-place, which is the third objective of the whole research project. On this basis, age-friendly social environment will be discussed in the next chapter.

CHAPTER 8. THE ROLE OF AGE-FRIENDLY SOCIAL ENVIRONMENT IN PROMOTING AGEING-IN-PLACE

8.1 Introduction

Two interpretations of place can be derived from the literature on ageing-in-place (Pani-Harreman et al., 2020). As discussed in the previous chapter, the first refers to the physical and functional aspects of an age-friendly built environment. While the second one refers to a less tangible environment. This chapter aims to describe the emotional, and experience-based aspects of the place, including the role of social networks, social support, and technologies. This is in order to advance the investigation of ageing-in-place by not only focusing on the physical environment but also by exploring how the social environment influences the success of ageing-in-place. This is crucial to produce a holistic framework for a supportive living environment for the older population.

This chapter explores the components of the social environment for older people and establishes the relationship between the social environment and their ability to achieve ageing-in-place. It also describes the role of social networks and the support needed as reported by older people living in mainstream housing in urban China. This was carried out by conducting semi-structured interviews with 37 older dwellers to understand their opinions of the social aspect of ageing-in-place. Additionally, by interviewing 13 experts, including architects, property managers, policymakers and care providers, it was possible to explore their experiences and attitudes on providing an age-friendly social environment. Inductive qualitative content analysis using NVivo 12 was employed to establish emerging themes from the interview transcriptions.

This chapter will start with a brief literature review to present the connections between the social environment and ageing-in-place. The findings comprise three main parts. Firstly, the existing ageing-in-place strategy is discussed, including goals and key actions highlighted by the expert group. Secondly, the role of the social network, social care and support, and ICTs in promoting ageing-in-place will be presented from the older people's perspective. Thirdly, a comparison between the two groups attempts to integrate the social and care aspects and define the gaps between the two participation groups. A list of recommendations on social needs of older people who prefer ageing-in-place is presented to support the development of a more age-friendly living environment in the mainstream communities in urban China. The structure of Chapter 8 is set out in Figure 8.1.
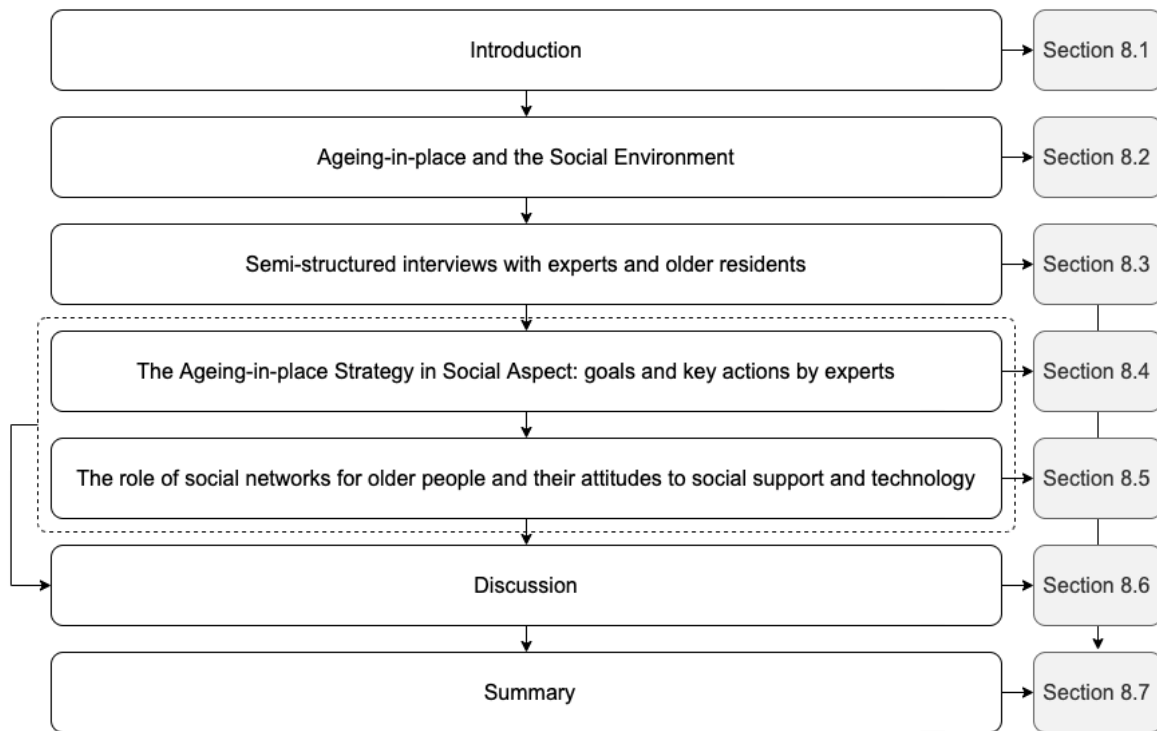
Figure 8.1 Structure of Chapter 8

8.2   Ageing-in-place and the Social Environment

As mentioned in Chapter 7, many studies focusing on the physical living environment concern the choice made between moving to new housing or undertaking retrofitting to make it easier for older residents to achieve ageing-in-place (Boldy et al., 2011). While the social environment is also discussed, including the sense of place attachment (Wiles et al., 2012), social networks (Roberts et al., 2017), support (Dobner et al., 2016; Wilkinson-Meyers et al., 2014), and technology (Loe, 2010; Van Hoof et al., 2011). It is concluded that the social environment has been recognised as a significant factor in the well-being of older people.

Older people typically wish to age-in-place as they are attached to their home environment. Wiles et al. (2012) states that home is a place which brings with it certain social connections, security, familiarity, and a sense of identity. Butcher and Breheny (2016) also argue that attachment to place incorporates the social, environmental, functional, emotional, and psychological aspects of a place, particularly if they have lived there for many years. The ageing-in-place concept includes not only physical aspects of the place but also the emotional qualities connected with remaining in a known and stable environment where individuals feel a sense of belonging, which is closely concerned with memories, experiences, and people (Van Hees et al., 2017).

Social networks also play a key part in enabling ageing-in-place were living at home enables existing links with friends and family to continue, in turn empowering older persons to stay socially active. Phillipson et al. (2001) link social networks with living arrangements and household structure. The relationship is face-to-face when family members live close, while when they live far apart, the relationship is conducted by telephone and in the form of occasional visits (Doblas, 2018, cited in Pani-Harreman et al., 2020). Ageing-in-place enables individuals to keep regular family contact with their sons, daughters and other relatives. The community can be seen as the primary aspect for the residents (Versey, 2018). They showed a preference for remaining in their known urban setting and neighbourhood, being a community member, relying on their neighbours and friends, and participating in daily activities. According to Roberts et al. (2017), active ageing, community involvement, and participation are important factors in motivating older individuals to stay in contact with their social network. Based on their memories and experiences, older people want to live in an atmosphere with others they feel connected to. The surroundings should be familiar and provide them with a sense of security and safety (Dobner et al., 2016). This familiar setting is closely linked to the social environment and social networks. Most older people want to be needed and active in their social network. (John & Gunter, 2016). They hope to be integrated into the community and carry on with a self-determined life. Joining the community's regular activities maximises older people's sense of fulfilment and helps them to maintain their current standard of living (Boldy et al., 2011). Joining day-to-day community life also involves using the people's abilities to mental health and being an active member of a community can also prevent loneliness (Sixsmith & Sixsmith, 2008).

Another important element in achieving successful ageing-in-place is support, which can be divided into formal support and informal support, including the living environment, daily requirements, and amenities (Pani-Harreman et al., 2020). The providers of formal support are service providers and professionals, and mainly involves the infrastructure, facilities, and services, for example pharmacies, grocery stores, public transportation, personal care and meal services (Dobner et al., 2016). Paid help typically assists with hard housework and provides personal care (Wilkinson-Meyers et al., 2014). Informal support is provided by family members, friends, neighbours, and the community in general, consisting of light housework, shopping, meal preparation, transportation, and finances (Wilkinson-Meyers et al., 2014). Support from informal networks may become more important for older people who live far away from their families (Dobner et al., 2016).

Technology has been closely linked with ageing-in-place in recent decades. Using technology may empower individuals to live independently in private homes and enhance their feeling of safety and security (Pani-Harreman et al., 2020). The issue of the different

kinds of technology relating to older individuals was raised in the literature: mobility technology, ambient intelligence, ICT, and biotechnology. According to Loe (2010), the term "mobility technology" encompasses much more than crutches, walkers, wheelchairs, and elevators and may refer to everything from cars to public transportation, security systems, specific shoes, clothes, and heaters, which enable older people with their mobility. Ambient intelligence technologies have already been adopted by older people to support ageing-in-place in the form of various assistive devices for home modifications (Van Hoof et al., 2011). The purpose of mobility technology and ambient intelligence is complementary to the age-friendly built environment discussed in Chapter 7. In addition, older people make use of various of ICTs into meaningful activities and self-care routines, including phones, computers, TVs, and radios. These technologies help in maintaining or increasing the connection with others in their social networks (Ghorayeb et al., 2021) and in controlling and helping to foster intellectual growth (Loe, 2010). ICTs are covered in more detain within this chapter.

8.3   Semi-structured Interviews with Experts and Older Residents

The above section highlighted the importance of social aspects in supporting ageing-in-place. This chapter now focuses on the data related to the above topic in order to explore the strategies taken by experts, in combination with older people's subjective opinions on social network, support, and technology.

In line with Chapter 7, this chapter focuses on the semi-structured interviews to understand the relationship between the social environment and older people's ability to achieve ageing-in-place. A total of 50 participants took part in these research interviews, thirteen of which were experts while 37 were older people.

The 13 experts work in key positions, including policymakers, property managers, and care providers. Interviews with these experts were conducted to gain an understanding of their goals and actions in creating an age-friendly social environment to support older people. The interview questions for this group are presented in Table 8.1.

Table 8.1 Interview question schedule for experts about the social environment

Support	1.	From your related work experience, what would be the major factors to consider that can support their ageing-in-place needs? Can you prioritise these factors according to your opinion?
	2.	Do you think community support is important for ageing-in-place?
Policy	3.	Are you aware of government policies regarding the ageing industry in China?
	4.	How do these policies influence or guide your work in any way?
Technology	5.	Are you aware of any technology which can provide or is providing support to older people to create a more independent, healthy, and safe living environment?
	6.	Do you think technology can support ageing-in-place?

The researcher developed interview questions so that the thoughts of older people could be explored relating to their social situation in particular, social/activity and technology aspects. The interview questions for older people group are presented in Table 8.2.

Table 8.2 Interview question schedule for older people about the social environment

Social/Activity	11.	Do you have enough living space to maintain your lifestyle, hobbies, and social contacts?
	12.	Do you often attend social activities?
	13.	Where do you engage in activities? Do you think that the older people in your community require more public activity areas?
Technology	14.	Do you use any kind of technology in your daily life?
	15.	How does technology support your daily life?
General	16.	Do you have any other suggestions about how the age-friendly living environment could be improved?

Along with the participants' verbal descriptions about social aspects, the researcher also conducted site visits to the community's older people's activity centre in Case 1 and a care support centre in Case 2, taking photographs and fieldnotes. The sites analysis is presented in Chapter 5. Fieldnotes were taken concerning the specific issues and areas mentioned by the participants during the interviews and as observed and recorded during the site visits. This chapter presents the evidence for the interview data.

8.4 The Ageing-in-place Strategy in Social Aspect: Goals and key actions by experts

This section presents the strategies aimed at improving the social aspect and support for ageing-in-place in urban China gained as a result of interviews with the experts. The findings are divided into three parts based on the experts' understanding of the goals and key actions in building an age-friendly social environment and the suggestions made about how to support older residents achieve ageing-in-place. Maintaining older people's existing social networks was agreed by experts as a prominent advantage of living at home. But with the series of physical and psychological changes that ageing brings, older people often require support and service from others, including families, neighbours, friends, community, and social organisations. In recent decades, the application and spread of technology has also playing an increasingly important role in supporting ageing-in-place. Experts believe technology will bring more benefit for older people in the future, but how this technology will be provided is in need of further exploration. The Figure 8.2 shows an overview of the themes generated from the interview data of this group.
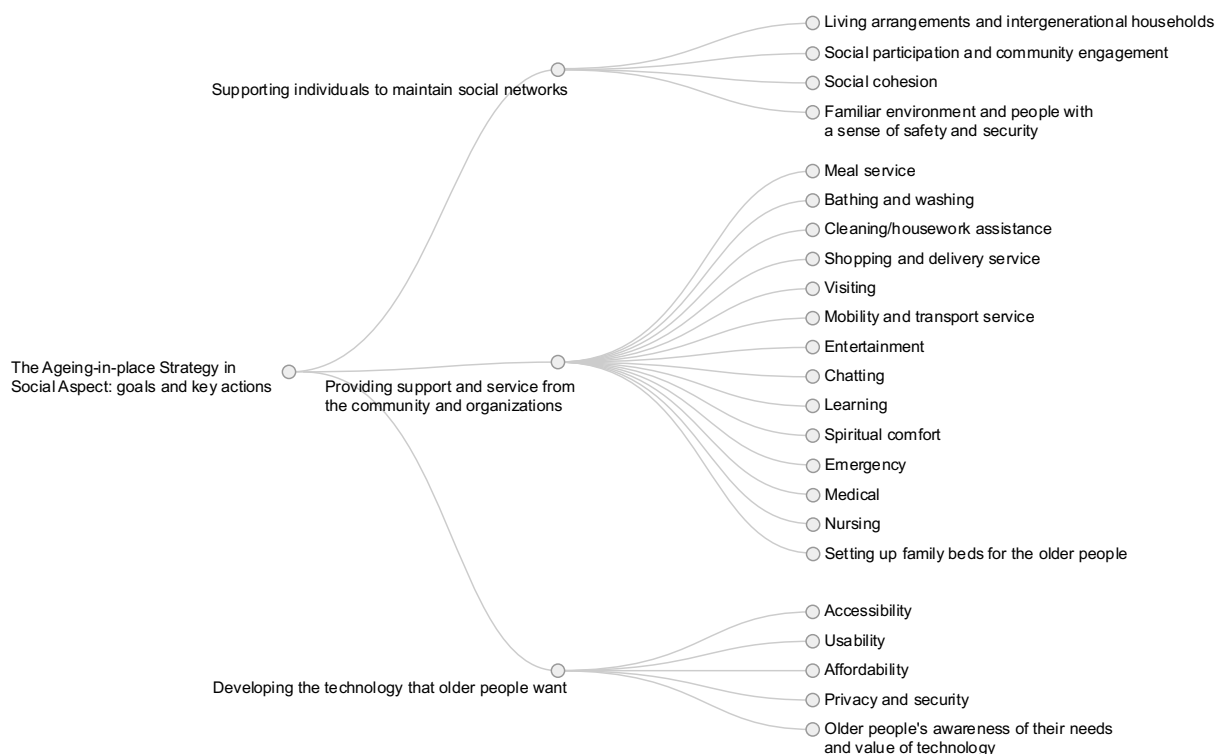
Figure 8.2 Overview of the ageing-in-place strategy in social aspects, perspective of experts

8.4.1 Supporting individuals in maintaining social networks

Experts agree that the capacity to maintain existing social networks is one of the main reasons for many older people to choose to stay at home, even though their current living space exposes them to certain features that do not meet their needs in terms of the built environment. According to discussions with the experts, two main aspects were highlighted which determine older people's social networks. The first is family structure, reflected in older people's living arrangements. Another is social contacts, involving community engagement and participation, social cohesion, the familiar environment and providing people with a sense of safety and security.

Living arrangements and intergenerational households

As mentioned in Chapter 6, ageing-in-place is linked to culture and family ties. Filial piety occupies a significant position in Chinese ethos, defining the ideal relationship between parents and children. In traditional Chinese culture, older people living with their offspring was the norm (Chan & Tan, 2004). However, the "4:2:1" family structure is more typical today because of Chinese birth-control policies (Hesketh et al., 2005). In this context, only a small portion of older Chinese people continue with the tradition of living with their children, while many live alone or only with a spouse.

Experts interviewed point out that for older people who live with their families, these ties play an important role in their daily lives and are central to their interactions with other people. Especially for the older people who are grandparents, their daily life commonly revolves around the needs of their grandchildren, and generally, this group of older individuals are in good physical condition, both physically and mentally. Older people in intergenerational households help with looking after the younger generation, for example, by picking them up from school, and doing light housework such as shopping and cooking. In turn, their offspring could provide company, undertake heavy housework, help with medical treatment, and provide care during illness. A property manager working in the Case 3 community believed that living with their children could be the main reason why older people moved to this new living environment:

> Our community was built only a few years ago, so the proportion of older residents living in it is not high. As far as I know, most of the older people live here with their children or come here occasionally, mostly to care for their grandchildren. (S_4, Property manager in Case 3)

Older people who live independently or with only a partner have weaker ties to family members compared to those who live in a multiple generation home. Children may come to visit or live occasionally, but most of the time, the older people live there on their own. This group of older people rely more on friends, neighbours, property managers, community staff and other non-family members. They tend to attend more social activities and show a more profound attachment to the existing social networks in their current surroundings.

Social cohesion

Social cohesion is explained as patterns of social interaction among neighbours and the associated process of building shared values (Van Dijk, Cramm, & Nieboer, 2013). Neighbourhood social cohesion and belonging may enhance older peoples' well-being through a greater degree of social organisation, including instrumental support of neighbours in the form of help with basic household tasks and transportation (Cramm & Nieboer, 2015). According to Shanghai Urban Neighbourhood Survey data, social cohesion is associated with a lower rate of depression among older persons (Miao, Wu, & Sun, 2019).

The participants stated that housing policy during the pre-reform period integrated housing and work. This led to the unique Chinese urban residential communities and the strong social ties people living in these communities keep. Familiarity and close neighbourhood relations deepens the social cohesion of older residents within a community, which in turn provides more opportunities for spontaneous community activities and volunteer participation:

> The older residents in this community (Case 1) have lived here for decades and are surrounded by old friends and familiar colleagues. It is home for them and there is a strong social cohesion among the whole community. (S_5, Policymaker)

Therefore, social participation and community engagement appears to be an important factor in enhancing social cohesion. According to Aroogh and Shahboulaghi (2020), older people's social participation emphasises community-based activities and interpersonal interactions based on active involvement, resource sharing, and individual satisfaction. Older persons seem to benefit the most from participation in social and productive activities, as it is associated with positive outcomes on health (Richard et al., 2009).

The interviewees agreed on the importance of social participation for the physical and mental well-being of older people. They adopted a series of actions to promote the active participation of older people in social activities, such as providing venues and organising

events. A community staff working in Case 1 described her efforts to promote social participation for the older residents:

> Our community is a typical staff accommodation. Most of the residents are/were university employees. The school has provided an activity centre for retired cadres to participate in activities, which is very good. However, some older residents are not employees of the school, and their activities and social engagement need to be taken care of by our community. After the approval, we built an activity room and encouraged the older people to participate in some indoor activities, such as health lectures, fire drills, and Party Constitution learning. In addition, we also took the older people on short trips, such as climbing mountains and appreciating flowers. Such activities can prevent them from becoming too lonely. (S_5, Policymaker)

Community engagement refers to encouraging communities to get involved in the decision-making process, including the planning, development and management of services and activities that aim to improve health and/or reduce health inequalities (Popay, 2006). Residents are encouraged to participate in community engagement as it enables a better understanding of older people's requirements and aspirations. Community engagement is a meaningful action which can be used to influence experts with governmental, political or funding power. This can then drive impactful social change and improvements via the implementation of public projects and policies, primarily benefitting individual communities and people's everyday lives. At the same time, interviewees remarked that there is still room for improvement in community engagement in China and agree that improving community engagement is considered a key point for future work.

One policymaker advocated that older persons stay in their homes if their health status allowed, and maintaining social cohesion was conducive to staying active. However, it emerged that the social cohesion of older people in newly built communities was relatively weak, attributed to the new environment and neighbourhood. Property managers and community staff have been trying to implement action within the newly built communities, such as providing activity opportunities and platforms to promote the neighbourhood's networks and improve social cohesion.

Familiar environment and people with a sense of safety and security

Safety is a multifaceted, and a basic need for older individuals who prefer ageing-in-place. There are four aspects of safety for older people at home: social, physical, emotional and mental, and cognitive (Kivimäki et al., 2020). Older people's sense of security can be

affected by their sense of control, support from family and friends, a safe environment, and current health status (Saunders House, 2019).

Experts agree that a regular daily routine improves older people's self-confidence and sense of security by providing stability and familiarity. Older people might feel uncomfortable with change, and a regular routine can reduce stress while improving their sleep. A designer shared her family story on this issue:

> My grandmother lives alone now. She does not agree to move and live with us. Her reason is that she has been accustomed to the current pace of life, going out to buy food at a familiar market at a fixed time every day, going dancing in the park with her friends, and she would even miss the noodle shop. These are her reasons for refusing to move. She once came to my house for a few days, she didn't know where to go or what to do every day, and she couldn't sleep well at night. She needed us to help her in life. She is more confident in her original environment. My family decided that her choice should be respected. We visit her regularly. (S_10, Architect)

Seeing family and friends regularly helps older people to feel safe. A care provider believed that maintaining a connection with others could combat older persons' feelings of loneliness and isolation and avoid psychological and physical problems. As mentioned in Chapter 7, familiar surroundings and home safety measures can also reduce danger, such as fall prevention.

8.4.2 Providing support and service from the community and organisations

The success of ageing-in-place depends largely on the availability of an appropriate home environment, a supportive social network and regular assessments to detect changes in the older individual's health status and their support needs (Wilkinson-Meyers et al., 2014).

The findings of this study suggest that due to the health status and the pursuit of a decent quality of life, the urban older people in China have an increasing need for personal assistance. The Government and service agencies are constantly exploring and trying to provide community-based support and services including: meal service, bathing and washing, cleaning/housework assistance, shopping and delivery service, home visits, mobility and transport service, entertainment, chatting, learning, spiritual comfort, emergency, medical, nursing, and setting up family beds. The above list incorporates all the actions mentioned by the experts during their interviews, but many of these projects were still in the experimental stage and on a small scale (for example the care centre discussed in Chapter 5).

The most frequently mentioned programme is meal service, which aims to solve the older people's daily problem in regards cooking and consumption, especially for the oldest and those living alone. The home care service centre aims to provide centralised dining and door-to-door meal delivery services for the older residents. This programme had been rolled out in the district where the fieldwork was carried out, and meal service was accessible for almost all older people in this district. A property manager praised this service:

> There is a couple in our community. Every day, they go to the canteen (for older people meal service) at 11 am and 5 pm. After the meal, they walk back and continue with their regular life. The community now provides dining services for older people, making their life easier as they do not need to buy food, do not need to cook, and the price is cost-effective. There is the corresponding subsidy policy given by the government. Community canteen for the older people is the first step to solve their needs. (S1_Property manager in Case 2)

The challenge for experts in providing services to the older people is that the willingness of Chinese older individuals to use these services is quite low, and most of them were unwilling to pay for services. They expect the cost of these services to be borne mainly by the government. The government's budget, on the other hand, is not enough to cover all the service expenses for the older population. Government agencies face the challenge of identifying the older people whose needs are unmet or cannot afford to pay for the service. How the limited budget is used to help the greatest number older people in need is a challenging task. On this issue, a policymaker provided two ideas. Firstly, the government should work in partnership with organisations to increase the older people's awareness of the value of using services, to help them realise the value of these services and encourage their use. Secondly, according to differences in health status, social/demographic status, and socioeconomic status of the older people, a practical classification and evaluation system for the older people should be established. Economic subsidies should be given to those who are most in need and are unable to pay for the service and support.

In addition, experts suggested that more attention should be paid to companionship and spiritual support services. But only a few professionals could address the mental needs of older people. A property manager explained:

> Some older people living alone in our community are well off financially. Some older people's children are very busy in other cities, even in foreign countries. They can afford domestic service. But for them, besides the help and service, what they need is companionship. (S3_Property manager in Case 2)

Arguably, the economic status of older individuals greatly influences their acceptance of services and support. In this sense, affordability and comprehensive needs of the service and support for older people need to be considered together.

8.4.3 Developing the technology that older people want

As discussed in Section 8.2, technology has been closely linked with ageing-in-place. Using technology may empower older individuals to live independently in private homes and enhance their feeling of security and safety (Pani-Harreman et al., 2020). This section mainly focuses on the major factors shaping older people's technology acceptance from the perspective of experts.

Acceptance of technology has been defined as "the approval, favourable reception and ongoing use of newly introduced devices and systems" (Arning & Ziefle, 2007, p.2905). Five aspects which promote the technology acceptance by older people have been discussed by experts: accessibility, usability, affordability, privacy and security, and older people's awareness of their vulnerability and need for help. The above five aspects have been identified as possible barriers to the adoption of technology for older users.

Accessibility

Experts pointed out that although many older people expressed a wish for ageing-in-place, this same group, however, have largely been unable to access the technologies that would assist them achieve in this. A care provider mentioned:

> I have been to several sliver industry exhibitions, and I saw many technology-related products there, but many of them are not available on the market. Institutions and care homes have adopted only a small part of the products, but older people living in their own homes have very limited access to related products. (S_2, care provider)

Architects hold a similar opinion that, while they expressed positive attitudes toward the role of technology in supporting ageing-in-place, fewer products that would aid older people were used in the design process of mainstream housing. Policymakers proposed full support in using big data and technology to support ageing-in-place in the future, however, it was still in the preliminary blueprint stage, and the specific implementation needs further exploration.

Usability

Another crucial factor in determining technology acceptance among older people is the usability of a product. As discussed in Section 6.4.2, older individuals feel safe and comfortable with familiar items, opposed to change and resist resist the unfamiliar things. Technology is undoubtedly unfamiliar to older people, who have no experience of using these new technologies. Experts agreed that one approach to get older people to embrace technology is to design products that are easy to use:

> The biggest challenge in getting older people to embrace technology is to make it easy to learn and use. (S_13, Architect)

The design of technological products should fully consider the characteristics of older people. The products controls should also be as convenient and straightforward as possible. For example, the guiding font of the product control interface should be simple and large enough to ensure older users can understand it easily. Another example would be voice-activated products which need to consider and accurately recognise dialect. Older people can develop their habits of technology use only if technology products are easily usable.

Affordability

Cost is one of the most critical factors in determining an older person's acceptance of technology (Mallenius, Rossi, & Tuunainen, 2007). Economic factors have appeared in all aspects of this study, including the built environment in Chapter 7, the purchase of services in Section 8.4.2, and the affordability of technology.

Experts pointed out that the unaffordable price is an important factor preventing older users from widely adopting technology. For older people in average economic conditions or who are poor, their limited disposable income will be prioritised towards basic living expenses and the expenses of their younger generation. A policymaker made three suggestions for this phenomenon:

> The premise of encouraging older people to use technology is that they should be able to afford it. First, the country should implement policy that support the research and development of related technologies to reduce the cost of products. Secondly, purchasing subsidies should be provided to the older individuals who really need them. In addition, leasing services can be provided instead of buying. (S_9, Policymaker)

The affordability of technology will have a direct impact on the technology acceptance under the premise that most of the older individuals are thrifty and frugal.

Privacy and security

Experts also considered older people's privacy and security in using technology. For instance, the smartphone is a highly popular technological product the use of which is convenient for older people in accessing information and entertainment, contact families and friends, and dealing with emergencies. However, smartphones may also bring with them possible security problems such as information leakage and telephone fraud. A community manager pointed out that cases of older people being scammed has increased in the past few years highlighting the hidden dangers brought about by the development of science and technology. Older people lack the sense of self-protection, and relevant personnel should take measures to provide help to counter these potential problems.

Another concern is the privacy aspects of older people. A care provider supplied their family care bed service, which include a camera to monitor the condition of older people. In response to the privacy issues posed by cameras, she explained:

> When the terminal is open to us, we can see the older people's homes directly through the camera. We cannot see it all the time because we respect people's privacy, and the camera is directly aimed at the older people only. When can we see it? First, we monitor the nursing assistants during the service. Second, we will send an alarm if the older people stay out of bed for a long time. Third, when the older people take the initiative to press the emergency call button, the camera will be opened. We can deal with the emergency at the first time, such as immediately inform the community or contact their family member. (S_7, Care provider)

Implications surrounding the issues of security and privacy emerged from the above discussion. Along with the benefits of technology, there may also be potential negative effects. How the development of technology can increase the positive effects whilst reducing negative impacts as much as possible is a further topic worthy of discussion.

Older people's awareness of their needs and value of technology

Experts pointed out that most older persons do not fully accept technology whilst harbouring ambivalent feelings of acceptance and detachment toward technology and a policymaker believed that older people would benefit from technology. However, older people lack awareness of their needs and are not aware of the value of technology. Although an

architect suggested that older people might not be sure that they can benefit from high-technology applications, because they do not consider themselves to have the requisite skills to use them. A care provider believed that it is her responsibility to introduce more technological products to the older users so that they can appreciate the value of technology through personal experience. To this end, the community care centre offers technology-related tutoring courses and experience programmes for older residents.

In summary, Figure 8.3 presents an overview of the findings from the experts' group to improve the living environment through social aspects, which is a significant facet of to achieving ageing-in-place for older people, while an age-friendly built environment is another characteristic (see Chapter 7).

Supporting individuals to maintain social networks	**Community support and management**
Living arrangements and intergenerational households	• Meal service
Social participation and community engagement	• Bathing and washing
Social cohesion	• Cleaning/housework assistance
Familiar environment and people with a sense of safety and sercurity	• Shopping and delivery service

Support older people stay in mainstream community

Developing the technology that older people want

Technology acceptance

• Accessibility   • Affordability
• Usability   • Privacy and security

Older people's awareness of their needs and value of technology

Policy support & Commercialization & Research and development

• Visiting
• Mobility and transport service
• Entertainment
• Chatting
• Learning
• Spiritual comfort
• Emergency
• Medical
• Nursing
• Setting up family beds

Informal support: families, friends, neighbours, community.
Formal support: infrastructure, facilities, services.

Policy support & Commercialization

Figure 8.3 An overview of providing an age-friendly social environment from the perspective of experts

Maintaining existing social networks is one of the critical reasons older people decide to live in a private home. Four dimensions determine the older people's social networks: living arrangements, community engagement and participation, social cohesion, familiar environment and people with a sense of safety and security. Encouraging older people to stay in a mainstream community caters to their social needs by maintaining their existing social networks.

The urban Chinese older people have an increasingly strong need for support and service due to their health status and the pursuit of a better quality of life. Besides informal support

from families, friends and neighbours, the importance of community-based formal support and services become more apparent, including meal service, bathing and washing, cleaning/housework assistance, shopping and delivery service, visiting, mobility and transport service, entertainment, chatting, learning, spiritual comfort, emergency, medical, nursing, and setting up family beds. The availability of such support and services enables older residents to stay at home as long as possible.

In addition, the application of technology could contribute to ageing-in-place by enhancing both the built environment and social aspects. However, technology which enhances older people's lives should only be promoted after considering accessibility, affordability, usability, privacy and security, and strengthening older people's awareness of their needs and value of technology.

8.5　The Role of Social Networks and Older People's Attitudes to Social Support and Technology

As discussed in Chapter 6, social aspects are decisive factors for the older people who prefer ageing-in-place. Older persons typically wish to age-in-place given that they are attached to their home environment. Home is a place which brings with it certain social connections, familiarity, security, and a sense of identity (Wiles et al., 2012), particularly if they have lived there for many years (Butcher & Breheny, 2016). The ageing-in-place concept includes remaining in a known and stable environment where individuals feel belonging, concerning emotions, memories, experiences, and people (Van Hees et al., 2017). This section focuses on the findings from the interview with older participants with a view to analyse the role of social networks for urban Chinese older people and their attitudes in supporting social needs related technologies. Figure 8.4 presents an overview of the findings in current section.

Figure 8.4 Overview of social networks for older people and their attitudes in support and technology

8.5.1 The value of social networks for older people

Although the living arrangements of the participants were different, virtually all older participants from the three case communities have linked ageing-in-place with social networks. It embodies maintaining their existing social contacts and personal lifestyle, providing a primary reason for them to stay in mainstream housing.

Social contacts

Older participants mentioned a series of social contacts in their daily life, which could be divided into four categories: family members, neighbours, friends (including former classmates and colleagues), and community workers (including government officers, property managers, care and service providers). According to the different forms, social contacts can be divided into face-to-face contact and online contacts based on the technology development, which is discussed in Section 8.5.2.

Some older people emphasised one kind of contact, while others maintained multiple social contacts simultaneously. Family ties were highlighted by the older people living with families who believed that ageing-in-place is a good way for them to keep in touch with their families. Living with children and grandchildren is in line with traditional Chinese philosophy, bringing

happiness, satisfaction, and mutual care. Most of the older people living in the Case 3 community emphasised this point because most of them were living with their children. Since the Case 1 community is a typical employee accommodation community, most of the older participants living there emphasised good neighbourhoods and close ties with their friends and old colleagues. Most of the older participants living in the Case 2 community talked about more than one kind of social connection, and they showed a positive attitude towards the rich social interactions they enjoyed. One of them shared his experience of moving:

> My wife and I moved to this apartment five years ago. Before that, we lived in the next residential community. Our previous apartment was on the fifth floor. It didn't have a lift and was small. My wife's bad knee makes it very inconvenient to go out and climb stairs every day. We wanted to change to a bigger apartment with a lift. This area is extremely familiar to us. We have an attachment to this place, want to choose a nearby one. In this way, I can often meet my friends and neighbours as before. (C2_1, 70, Male)

This participant stated that even though they needed to move because of the unsuitable physical living environment, they chose to move to a nearby place to maintain their existing social networks. Tight social connections can make them feel secure, not alone, and in good spirits. This approach does not only meet their social needs but also improves the living environment.

Participants from the Case 3 community agreed that high density high-rise residential areas have weaker neighbourhood relations than low density one. Older people yearn for a closer neighbourhood relationship as they enjoyed before, when they were young and living in traditional streets or courtyards, and hoped that the community would organise activities to enhance relationships between neighbours.

Diversified social relationships were also seen as a beneficial aspect of ageing-in-place by respondents. Another interviewee thought that compared with living in a nursing home, having access to people of different ages and diverse information in the mainstream housing helps her remain healthy and feel happy.

Personal lifestyle

Older participants consistently agreed that living in familiar surroundings helped them maintain their lifestyle, including participating in social activities, pursuing hobbies, engaging in physical activities, and the ability to go out independently. Maintaining a lifestyle gives

older people a sense of control and security in their lives and enhances their subjective well-being. The lifestyles mentioned by the older people can be divided into four main parts:

- Daily routines
- Personal hobbies and interests
- Participation in physical exercise
- The company of peers

Older people believed that their daily routines could be maintained by living in their own homes, which also benefits independent living. Older people feel reassured by a familiar built environment and infrastructure, as well as access to familiar persons. Living at home enables them to take part in personal and social activities. Participation in activities is beneficial to older individuals' physical and mental health. A participant emphasised the benefits of being involved in social activities and maintaining personal interests:

> Living in the city is easy to participate in activities. I have many interests, such as computers, finance, harmonica, and photography. I like to get involved in some related activities. I'm good at trading stocks, and sometimes I offer consulting advice for free. At this age, I hope I can communicate with others more. On the one hand, I can meet my spiritual need for communication, not alone, and on the other hand, I can share some of my experiences with others. (C2_11, 72, Male)

Other interviewees linked physical and mental health with personal and rich lifestyle full of many activities:

> I have taken part in many activities, mainly to exercise, weekdays in the Citizen Square in the morning from 8 to 10 o'clock to play soft power ball. Every weekend, five or six older people go to the nearby park, bring some snacks, start at 9 am and come back around 3 or 4 pm. Regular exercise is for good health. I also take part in some recreational activities. Every Monday, we sing at Yue Xin, organised by an 80-year-old professor from Southeast University. There were many people in that class. Several colleagues live close. We eat, chat, and play together. My daily life is colourful, and I enjoy it. (C2_12, 62, Female)

> Every afternoon, I go to the Southeast University playground with a few professors, one was a professor of sports department. I got a lot of information from talking to him. I've had diabetes for ten years and high blood pressure, so I go running and I am on a diet. and I've managed it well. I pay attention to the impact of daily habits on health.

> Doing exercise keeps me from going to the hospital, and the hospital keeps me from going to heaven. (C2_11, 72, Male)

In Case 1, many older people mentioned their activity centre. It provides a space for them to partake in a variety of activities, including billiards, Chinese chess, card, mah-jong, dancing, table tennis, calligraphy and painting, reading, and dancing (Figure 8.5).

Billiard room

Chinese chess room

Dancing room

Table tennis room

Figure 8.5 Activity rooms in the older people's activity centre, Case 1

In general, older people living in mainstream housing and familiar community tended to be more likely to participate in various personal and social activities, which is beneficial to achieving life satisfaction and reducing loneliness.

8.5.2 Older people's needs for support and service

Older people have highlighted the importance of support and service. Two kinds of support were mentioned: informal support from the family members, neighbours, friends, and community; and formal support from care providers, hourly workers, and other paid services. Their needs of daily support involve personal care, light and heavy housework, meal preparation, shopping, finances, and transportation. For individuals with health issues, medical care and rehabilitation services are necessary.

The findings suggest that the health status and living arrangements of older people were crucial factors influencing their formal support needs. In this study, most of the respondents lived independently with good health status; their current need for support was most commonly for heavy housework and emergency help. Family, neighbours, and property managers play an essential role in providing support in terms of safety and emergency. Such as an interviewee expressed:

> It's often easy to be careless when you get older. Property managers need to be on the lookout for emergencies and notice when someone's home is smoking. Because, when using the stove cooking something, older people may realise they lack something then go downstairs to the supermarket to buy it. This has happened several times. It is dangerous. (C2_12, 62, Female)

Most of the older participants living in Case 1 and Case 2 communities lived alone or with their spouses. They spoke much more often about support and service needs than the participants living in the Case 3 community where all the older residents lived with their children.

Older individuals expected they would require service and support needs if they were facing health issues. They expressed concern about their health deteriorating and being dependent on care by, and so wish to remain healthy and live independently as long as possible. An older man hoped that he could have the opportunity to participate in health lectures, learn more about the health relevant knowledge, and prevent diseases. He said:

> I hope there will be lectures on popular science on health because I found that many chronic diseases of older people are due to ignorance and bad living habits. For example, the first time I found out I was diabetic was because I was not used to the local food when I travelled to Egypt, and I ate 1kg of sweet snacks brought by myself within three days. There is a little blockage in my carotid artery from sitting too much, and low immunity caused by staying up late. Smoking leads to my bad lungs. I think many diseases are caused by ignorance. Older people should know more health. Prevention is better than cure. The popular science by a professional person is needed. I do not mean the kind lecture that aims to sell health care products. (C2_11, 72, Male)

As introduced in Chapter 5, there is a pilot service centre for older people near Case 2 community, called Yuexin. As a result, the older participants who live in Case 2 community were more aware of service and support than the older residents in the other two communities. When it comes to service, the participants from Case 2 expressed various

attitudes. They held different opinions regarding the service centre. Some older people presented a completely positive attitude:

> Yuexin is very good, with day care, bath help, massage, purchasing service, travel for the older people and so on. I think it's necessary for us to have a place to go. Older people play cards there every day. The restaurant is multi-functional, so you can play cards when it is not eating time. There are also several classrooms for singing and dancing. They hold some activities and lectures jointly with the community. (C2_4, 67, Female)

However, some individuals hold a different opinion. A participant suggested that:

> I think there's a lot of room for improvement in services for older people. Yuexin is an outstanding case of the Nanjing government, often appearing on TV. But there are many problems in real life. Take a simple example. I went to have a haircut here, they put it off, then postponed it again, then again until the day after tomorrow. Older people's legs and feet are not good and so it is not convenient for us to walk. I was so disappointed that I let my wife shave my hair now. (C2_7, 80, Male)

In addition to complaints and suggestions about older people's service centres, participants also felt that the care provided by government departments needed to be improved:

> I think the government does not care enough about older people. We need to be provided with GPS trackers and a perfect system to match it. Now only older people over 85 years and living alone can have it. This condition is very rigorous. I think the range should be a little bit larger. (C2_8, 75, Female)

> Now, government workers are too young to understand the requirements of older people. Community workers used to make home visits or phone calls, but not anymore recently. I think this needs policy guidance. (C2_12, 73, Female)

Most of the older people believed that informal support from the families is primary. A few respondents expressed a willingness to pay for services, instead of having to move into a care home, when their personal health no longer allows them to live independently and their families cannot provide enough support.

8.5.3 The role of technology in support and social aspect for older people

This section focuses on older people's attitudes toward using technology. The participants discussed three kinds of technology in regard to support and social aspects for which they

give positive feedback. These were: intelligent household electrical appliances, ICTs, and health and safety technologies.

Older people appreciate intelligent household electrical appliances, which contribute to reducing their physical exertion. Participants mentioned several widely used products, such as the sweeping robot, dishwasher, and automatic washing machine. An older person believed that smart home appliances could help older people share housework and are worth having:

> Because my wife is not in good health, the doctor suggested that she reduce housework and physical labour. I bought a dishwasher for her. (C2_10, 69, Male)

Another kind of widely used technology is ICT. It helps older people get in touch with families and friends and to develop an online social network. It also supports older people in obtaining information and gaining specific knowledge according to personal interests. Both online social media and access to information benefit older individuals' mental health and well-being and reduce loneliness. Some older people have come to rely on communications technology and the Internet:

> I can't leave my mobile phone. I use it to communicate with others and learn about state affairs and current news. (C3_6, 78, Male)

A respondent said she had benefited from a series of technologies and would recommend to other older people:

> I use the computer, mobile phone, PAD, Tmall smart speaker (intelligent voice assistant speaker, like Google Home, Apple HomePod). Tmall smart speaker is fun, can sing, accompanying older people, I like it and always sing with it. I also bought one for my sister. She usually stays at home alone. She can have a conversation with it and listen to the news when she is bored. I also use the smartwatch to tell me the time and answer my phone. It can also locate. (C1_12, 62, Female)

In addition, health and safety technology won the approval of some older individuals, such as, infrared therapy instruments, massage devices, and emergency alarms. This kind of technology is closely related to the health and safety aspect of the older people, monitoring their physical state, to relieve or treat physical discomfort.

Some of the participants had great user experiences, while some respondents thought they did not need these technological products, which were left lying idle at home:

> I do not know how to use those new things and I do not want to learn. I cannot see the small text in the screen. I don't use any of this stuff at home. (C3_7, 79, Female)

Seen in this light, the respondents who do not use technology did not show any interest in the products. They generally considered that the new technology is irrelevant to their daily lives and did not need it. On the contrary, other users believed the technologies could support activities, made life more convenient, and contained useful features.

A theme on the issue of technology acceptance emerged from the above discussion. Technology has the potential to support older persons by improving their quality of life, allowing them to live independently for longer, and counteracting the reduced capabilities caused by the ageing process. However, the popularisation of technology products among the older people needs to be explored. In other words, the older people's technology acceptance is worthy of discussed.

According to the interviews, older people's intention to use technology is highly influenced by its usefulness. Whether the technology is helpful to the older people and can meet their actual needs are important factors in increasing the acceptance of technology. A positive experience is the key to getting people to use it again and develop habits.

Ease of use of technology is another factor for older persons owing to a lack of confidence and belief that they will derive benefit from its use. Furthermore, older people often consider that they do not poses the skills to use it. Older individuals face more difficulty than younger persons in learning to use and operate technology. The design and usability of these devices and services are largely responsible for barriers to the use of technology. Older people are more likely to accept technologies which are easy to operate with a simple interface design.

Another concern of the older non-user is the privacy and personal economic security issue. Older people worry about the privacy of using technology and the risk of online payment. The worry of the older individuals in terms of privacy and security often comes from negative news stories and their insufficient understanding of and resistance to technology:

> I don't want to use a smart phone. There is always news on TV about older people being cheated, and all the money in the bank is transferred to the scammer in one phone call. I was afraid of such a thing. If I don't, it won't happen. (C1_9, 82, Male)

Referring to the aforementioned issue of technology among older participants who had already tried the technology, dependence and trust increased over time and with use. It is suggested that the technology would be more acceptable if it was possible to take usefulness, usability, security, and privacy into overall consideration.

8.6 Discussion

In order to gain a better understanding of the social environment's role in supporting ageing-in-place, this section explores the similarity and differences based on the interview findings with the two groups. This was done to fill the gap of a "mismatch" between the strategy taken by experts and the needs of older people. Figure 8.6 presents a visually overview of the comparison made between the two groups. The raw data of Figure 8.6 is listed in Appendix 8.1. The diagram highlights links in the main categories, sub-categories and themes within the same group and connections between two groups, which have been further emphasised using colours to identify significant connections.

Referring to the issue of social environment, three main categories of the two groups were very consistent with each other. Specifically, social networks, support and services, and technology were widely highlighted by both. The conceptual framework presented in section 8.2 is effective in helping to analyse the age-friendly social environment.

As aforementioned, social networks provide emotional and instrumental social support help engender a sense of social engagement and contribute positively to mental and physical health for older individuals (Stephens et al., 2011). Older participants and experts reached a consensus on the importance of social networks. They agreed that maintaining the older individual's existing social networks was a decisive factor in the choice of ageing-in-place having a significantly positive effect on their quality of life and happiness. The two groups of respondents interpreted the value of social networks from different perspectives. Older people emphasised different social contacts and believed that these diversified social relationships allow them to maintain their lifestyles and habits. As a result, older people stated that a nearby place would be considered first if they must relocate. Experts analysed the connections and advantages between maintaining social networks and ageing-in-place and pointed out that living arrangements and intergenerational living patterns are the key factors affecting the social networks of older people. Although the perspective of the two groups was different, they were closely connected in terms of content and maintained a high degree of overlap. Additionally, the findings of the above qualitative research are consistent with the results of qualitative study. According to the data from CHARLS, more social participation decreases frailty among older people living in Chinese community-dwellings, which is an important element of successful ageing (Feng et al., 2020; Zhao et al., 2014).

In terms of support and services, the experts group identified more types of support than older people mentioned. The overlapping content is mainly in the daily life support. The main reason for this result is that the older participants in this PhD study were relatively active and

healthy with the ability to live independently and were less dependent on external support and services. As the previous study on the support and service needs of older individuals identified, health status is a key factor (Wilkinson-Meyers et al., 2014). Seen in this sense, the understanding of the support and service needs of the older people in this study is limited.

Older individuals highlighted their future concerns about poorer health and support requirements. There are two different views on what should be the major sources of support provision. The older people living with adult children believed that family members are the main support providers. They expressed hope that they would receive care from family members rather than from strangers. As noted by Zhu and Walker (2018), in Chinese older individuals' own opinions, they prefer to receive daily living care from their families. However, living arrangements of Chinese older people are gradually becoming Westernised (Wang, Chen, & Han, 2014). Thus, another group realised that due to changes in family structure and other reasons, they will have to receive support from the community or institutions in the future, instead of relying entirely on their families. They showed concern regarding the coverage of social support and services provided by government and market. In other words, Chinese older people seek help from other agencies only if their family is unable to provide.
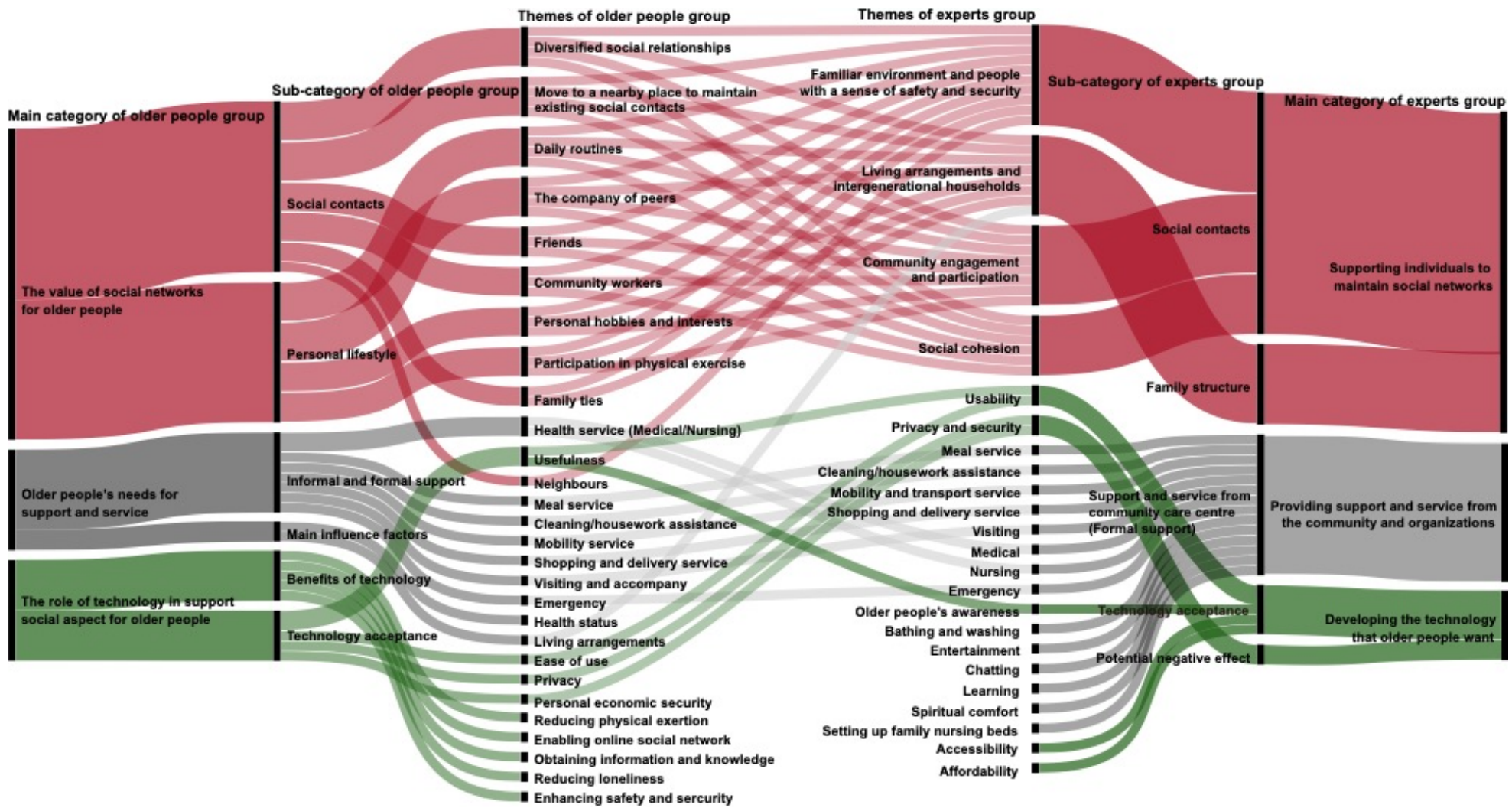
Figure 8.6 Overview of the comparison between the older people group and the experts group in the social aspect

From the perspective of the experts, in recent years, governments and private actors have attached great importance to providing support and services for older people who prefer ageing-in-place. A series of measures and attempts have been carried out at the community level and improvements made. Experts noted that even if governments and organisations tried to provide multiple services, older people are not willing to pay for it. As a result, the operation of service institutions faces problems. This is a result of the reliance of non-government organisations on government funding, as pointed out in a case study in Guangdong Province, China (Lin, 2015). The current challenge is to popularise the coverage of community services on the one hand and cultivate the awareness of acceptance and purchase of formal services among the older people on the other. Therefore, an understanding of the needs of older people is as important as an understanding of older people's attitudes towards purchasing services. For the low-income older people, the government agencies face the challenge of identifying the target individuals who should receive free support or subsidy.

Older people have been demonstrated to benefit from technology (Chen & Chan, 2011). More than half of the older participants in this research said they use mobile phones every day. The benefits of technology in the support and social aspects are highlighted by reducing physical exertion, enabling online social networks, obtaining information and knowledge, reducing loneliness, and enhancing safety and security. At the same time, older people also suggested that technology should be useful, easy to use, protect their privacy and personal economic security. The above were, along with accessibility and affordability, aspects also discussed by the experts as features to increase acceptance of technology. The results are consistent with the research of Ma, Chan and Chen (2016) in regards smartphone acceptance by Chinese older people. Generally, technology presents a great potential to provide multifaceted support to ageing-in-place. Increasing technology acceptance and popularity is a research focus for future study.

8.7 Summary

This chapter provides a social lens through which to consider the approach to support ageing-in-place, which is the fourth research objective of the whole thesis. As discussed in the previous section, this chapter has confirmed the value of the social environment by both experts and older individuals. It highlights, through semi-structured interviews with 37 older dwellers living in case communities and 13 experts, including architects, property managers,

policymaker and care providers, the inextricable link between ageing-in-place and maintaining social networks.

Participants from the two groups agreed that maintaining existing social networks in the community is an important factor for older people when deciding to age-in-place. This is because they are able to remain in a stable and known environment where they feel that they belong, have memories, experiences, and know people. Social networks involve connections with families, neighbours, friends, including former classmates and colleagues, and community workers, including government officers, property managers, care and service providers. The existing social networks bring a sense of familiarity, safety, belonging, and well-being and increase older individuals' independence and decrease loneliness.

The experts discussed the strategy and key actions in the social aspect to support ageing-in-place in Chinese urban communities. Three main categories were highlighted: supporting individuals to maintain social networks, providing support and service from community and organisations, and developing the technology that older people want. Older participants also described their understanding of social networks and attitudes towards social support and technology.

By comparing the findings from the two participants' groups, this research suggests ageing-in-place contributes to a supportive social environment for older people. For the older individuals with unmet needs, formal (paid) services will be the solution to provide support. However, how to provide viable services to support the older people in need is the next challenge for governments and institutions. Technology has also been adopted and used frequently by some older people with positive feedback though, more effective, user-friendly, and affordable technologies for older people needs to be developed.

This chapter has highlighted the connection between the social environment and older people's attitudes towards to ageing-in-place being the fourth objective of this research project. Combining the age-friendly built environment discussed in Chapter 7, and a holistic framework to support ageing-in-place is be presented in the next chapter.

CHAPTER 9.   FORMULATION OF AN AGE-FRIENDLY LIVING ENVIRONMENT FRAMEWORK TO SUPPORT AGEING-IN-PLACE

9.1   Introduction

This chapter presents the final output of this research, which is an age-friendly living environment framework to support ageing-in-place in the mainstream residential community within the context of urban China. The development of the framework is Objective 5 of this research. The output combines the conceptual framework and related theories from the literature review and research findings from the case study.

First, the conceptual framework which guided the research design is reviewed, followed by an overview of the ageing-in-place framework. Four main domains, motivations, built environment, social environment, and technology, are established in the framework, supported by the preceding data and objectives mentioned in the above chapters. The framework targets supporting the older population to achieve ageing-in-place by improving their living environment and making them more age-friendly. This chapter also presents framework stakeholders, applications and recommendations for policy and practice.

9.2   Overview of the Framework for Support Ageing-in-place in Urban China

Before presenting the final output of this research, it is worth reviewing the conceptual framework, which was discussed in detail in Chapter 2, and as seen in Figure 2.9. The conceptual framework is derived from the theoretical foundations of Lawton's press-competence model (Lawton & Nahemow, 1973), P-E Fit theory (Wahl & Oswald, 2010), and the ecological model of active living (Sallis et al., 2006). It consists of three main components, namely age-friendly living environment, older people's demands, and P-E Fit scenario of ageing-in-place. The age-friendly living environment includes the built environment, social environment, and technological application, which aim to support older individuals maintain their functional capacity and a sense of belonging. It is presumed that the harmonisation of the environment and older people would fit well together and contribute to achieving ageing-in-place and ageing-well. The conceptual framework aims to frame the

knowledge basis of the research scope and guide the research design approach. Another aim of the conceptual framework is to guide how further literature is sourced. Chapter 3 focused on the Chinese context under the guidance of the conceptual framework to establish a research background. In addition, the framework provides a lens through which data is themed and analysed, as described in Chapter 4. The whole study process was focused and guided by developing this conceptual framework (Figure 9.1).
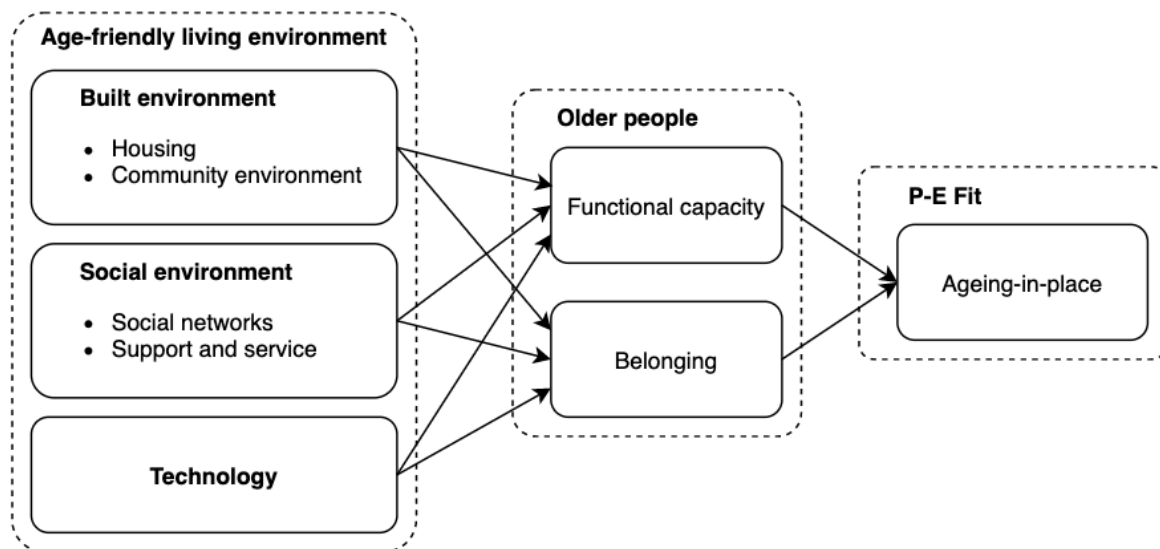
Figure 9.1 Components of the conceptual framework

Based on the conceptual framework, an age-friendly living environment framework to support ageing-in-place is constructed from field investigation results, in the case of this PhD study, observations and interviews, as shown in Figure 9.2. The wheel diagram presents the core ideas of the conceptual framework in a visual form.

The final ageing-in-place framework is visually presented in a wheel diagram format with four levels of information: domains, main categories, sub-categories, and sub-sub-categories. Each quarter of the circle represents a domain, with each domain distinguished by a colour code. The core themes are located centrally and summarised from the findings of the previous studies and first-hand data via case study interviews and observations. Findings at the subordinate level is arranged around the core themes. Each domain and its subordinate themes are in line with the structure of the corresponding thesis chapters. From the inside out, the core of the framework is the research's ultimate objective, which is to support ageing-in-place. The four key domains of the framework are: built environment, social environment, technology, and motivation. The first three domains correspond to the age-

friendly living environment, while the motivation reflects older people's needs. Within each domain, there are several main categories aimed at achieving the research goal. The sub-categories are manifestations of the main category with sub-sub-categories explain or clarify the sub-category.

The framework seeks to provide an effective support approach for the future design and retrofitting of mainstream residential communities. It is a set of guidelines to help the stakeholders understand older people's motivations of ageing-in-place and their
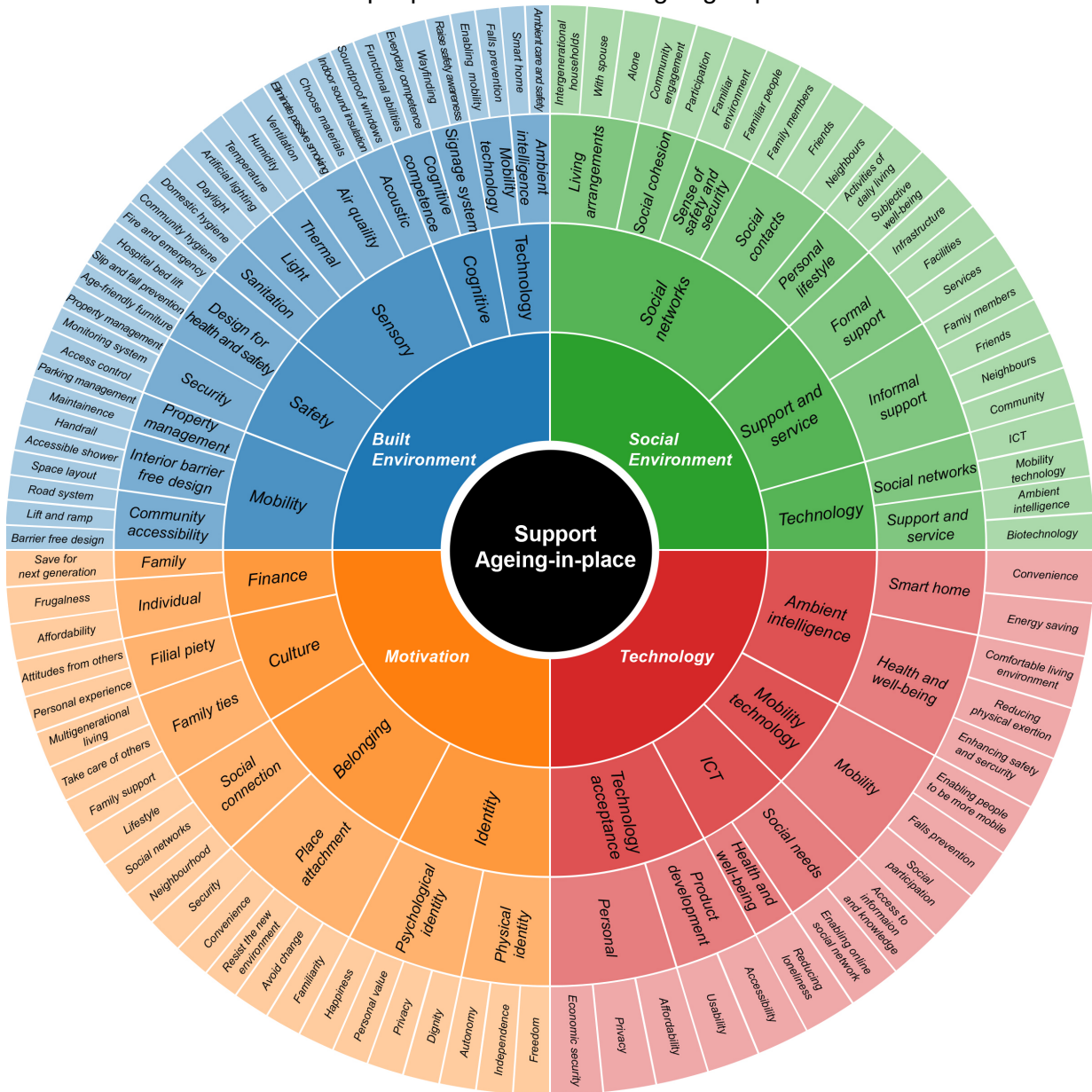
Figure 9.2 The age-friendly living environment framework to support ageing-in-place

requirements during this process, then to support the older individuals by improving their living environment.

The following sections introduces the aforementioned four key domains separately, and explain how each domain contributes to the ageing-in-place and the stakeholders within each domain.

9.3 Domain 1: The motivations of older people to age-in-place

The aim of this domain was to identify what motivates older people to remain in mainstream residential communities in urban China. Although both internationally and in China, government and academia have advocated ageing-in-place and remaining in mainstream housing is currently still the situation for most older people. It should be known that ageing-in-place is not a 'one size fits all' choice, and whether it is actually the real desire of older individuals or because they have no choice. Therefore, the motivation of older people to choose ageing-in-place is an indispensable part of this research topic. The findings and evidence of older people's motivations to age-in-place were elaborated in detail in Chapter 6, and the main findings are summarised and repeated in this section.

Based on the content analysis of the interviews, the research helps to reveal the motivations of Chinese urban older people to age-in-place by presenting comprehensive considerations. As shown in Figure 9.3, four aspects were identified as the main contributary factors for older individuals to reach a decision: identity, belonging, culture, and finance.
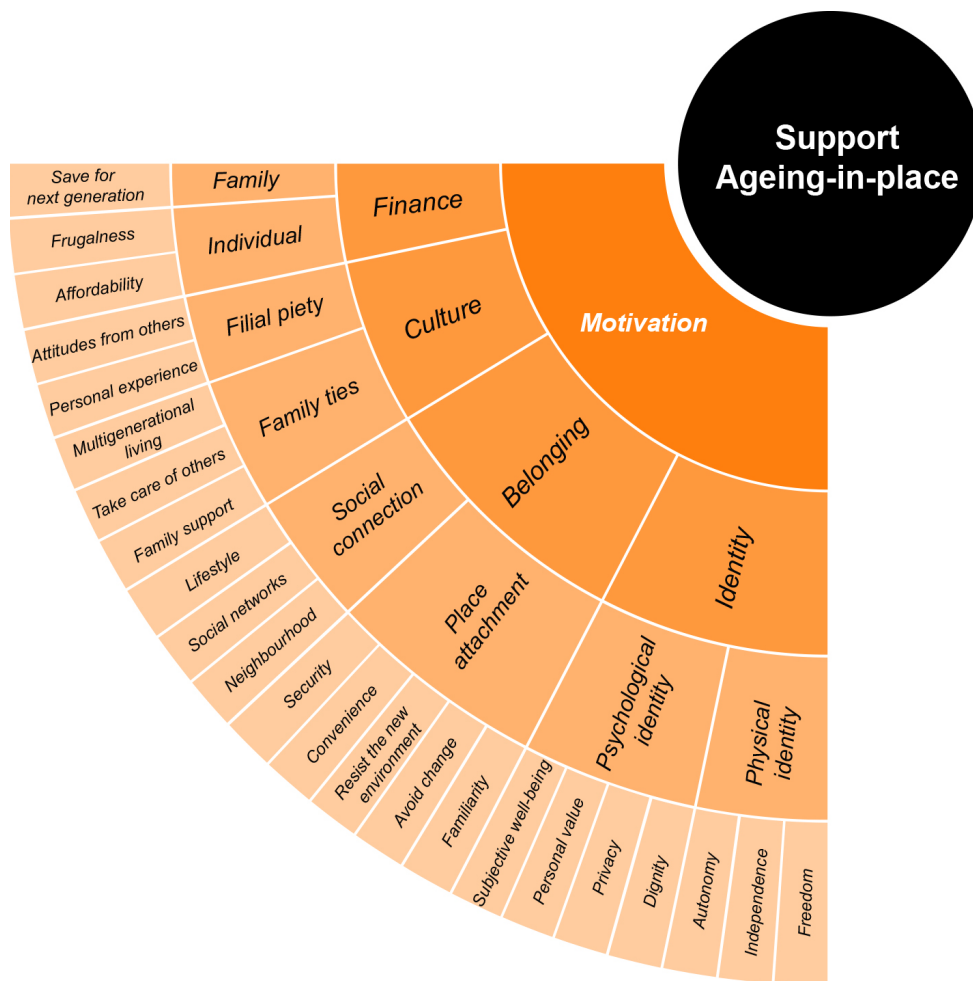
Figure 9.3 Framework Domain 1: The motivation of older people to age-in-place

First, older individuals and experts linked ageing-in-place to a sense of identity, which is related to one's sense of self. Identity was divided into physical identity and psychological identity according to the interview results. Physical identity is particularly important in terms of older people's freedom, independence, and autonomy, while psychological identity is reflected in their dignity, privacy, personal value, and subjective well-being. In the consideration of identity, it is worth mentioning that older people interviewees attach great importance to it and describe it from multiple dimensions, while most experts only mentioned the freedom. In addition, in this study, the older individuals living in the different communities attached similar importance to their sense of identity.

The participants also linked ageing-in-place to a sense of belonging. Gilleard et al. (2007) stated that ageing-in-place is associated with increased feelings of attachment to the area where someone is already living, contributing to a sense of belonging. During the interview, a sense of belonging was found to be linked to place attachment and social connection

concerning ageing-in-place, and place attachment was related to familiarity. Older people expressed a desire to avoid change and a tendency to resist new environments, associating a familiar place with convenience and security. Social connections were reflected by maintaining existing social networks with their neighbourhoods and their lifestyles. In terms of a sense of belonging, older people living in the old residential communities, as seen in Case's 1 and 2, placed more emphasis on this aspect.

Cultural factors were another important component in need of attention regards the motivations behind ageing-in-place. The influence of culture was divided into two parts: filial piety and family ties. Family ties were embodied in family support, taking care of other family member(s), and multigenerational living (Chan & Tan, 2004). This mutual support among family members was a dynamic process, possibly due to the younger generation taking care of the older people, or the younger generation's dependence on the older generation, which was visible in the newly built community. In Case 3, most of the older people were living in multi-generation households, usually there to take care of the grandchildren. Filial piety, given its strong cultural significance in China was a likely reason for this. Influenced by such traditional concepts, the more conventional Chinese older people attributed negative connotations to living in a nursing home, such as that their children were unwilling to take care of themselves, which was considered shameful by them. In regards the cultural aspect, the experts and older participants expressed a very similar ideas. However, experts also pointed out that the views older people may change significantly in the future.

Finally, financial consideration also played an important role in older people's decision-making. in China, the older generation is typically economically prudent due largely to having limited funds available, and some interviewees stated a preference for saving money for their offspring rather than to spend on themselves.

In conclusion, it can be argued that ageing-in-place is a meaningful living arrangement for Chinese urban older people allowing them to remain at home in later life. This carries with it a series of advantages including: retaining a sense of identity, maintaining a sense of belonging in accordance with traditional culture, and gaining financial benefits. It is these implications and meanings of ageing-in-place that were the reasons and starting point for older people to choose staying at home. However, ageing-in-place is not a fitting solution for all older people, as the challenges and needs of the older individuals are in a state of constant change as they age. When discussing the motivation of ageing-in-place, the older participants and experts discussed the challenges and potential demands faced by ageing-

in-place and compared it with the institutional care pattern. This was elaborated on more in Chapter 6.

9.4   Domain 2: Built environment

The living environment was divided into the built and social environment for exploration and presentation in this framework. This section focuses on the role of the built environment by integrating results via observations, as presented in Chapter 5, and the interviews presented in Chapter 7. According to the needs of the older people, the age-friendly features of the built environment can be strengthened by following five aspects: mobility, safety, sensory, cognitive, and technology (see Figure 9.4).

The mobility aspects of the living environment was given the most attention in this study. It included: community accessibility, interior barrier-free design, and property management. The importance of community accessibility was specifically highlighted in this research, and mainly includes barrier-free public areas, lifts and ramps of building entrances, and road systems, both roadways and sidewalks. The oldest residential communities studied in this thesis such as Case 1 are particularly problematic in terms of community accessibility due to the design codes and construction techniques used at the time. During the field investigation, it was found that this problem was of concern to government and relevant departments and attempts, such as adding lifts had been made to improve it. However, there is still room for improvement in the process and results of the retrofitting. However, the accessibility of public space in the relatively new residential communities has been improved. Some buildings have considered mobility but have not dealt adequately with accessibility problems, such as seen in Case 2. This aspect of the community should also receive corresponding attention to mobility and improve overall convenience for the older residents.
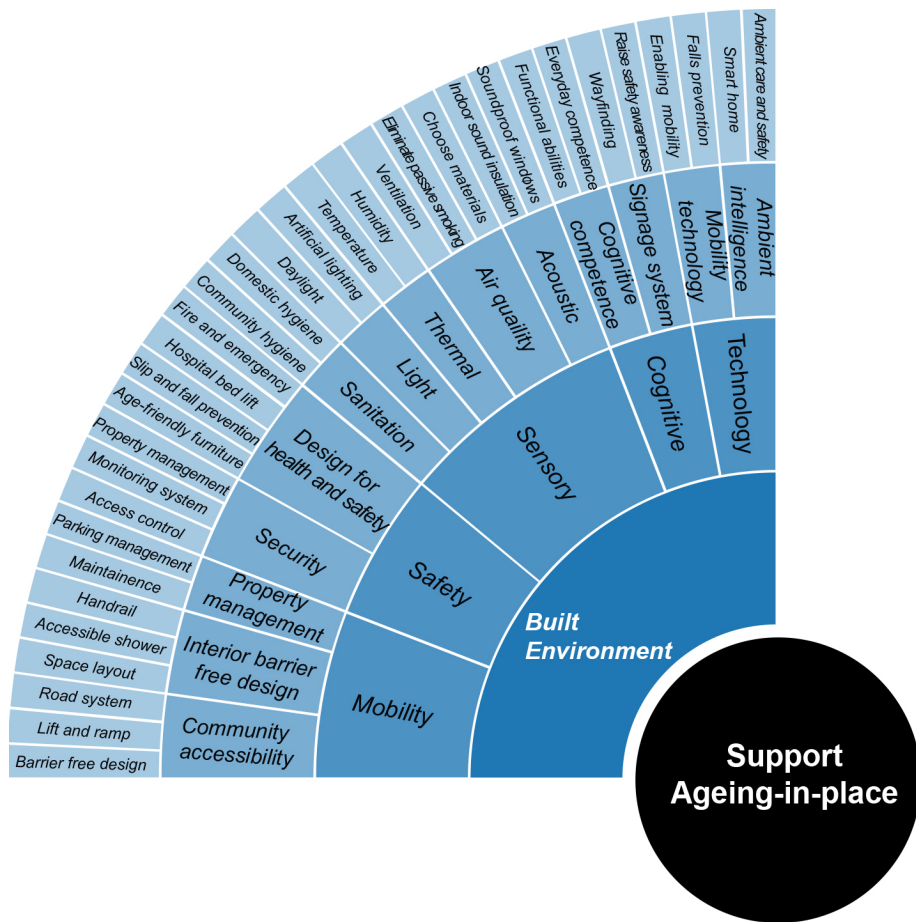
Figure 9.4 Framework Domain 2: The role of the built environment in supporting ageing-in-place

The barrier-free design is also very crucial for older people. Mobility within the interior can be supported through layout design of the indoor space, addition of handrails, walk-in bathrooms, and gentle gradients where there are height differences.

In addition, property management significantly affects mobility within the built environment, especially parking management and environment maintenance. The inconvenience caused by the parking of cars, bicycles, and electric bikes was mentioned numerous times in this study, particularly in Case 1 and 2. Serious parking problems cause traffic inconvenience and may bring hidden dangers to older people. For example, in Case 1, cars parked in the green space caused environmental damage. In this regard, property management should intervene in parking management and in repairing of damaged public facilities.

The participants repeatedly mentioned safety as a vital factor of the age-friendly features. The safety aspect of the living environment involves security and design for health and safety. In terms of security, access control of the residential buildings, monitoring systems,

and property management were identified as valuable solutions to improve security. Health and safety concerns should be emphasised in architectural design including consideration of fire and emergency, hospital bed lift, slip and fall prevention, and age-friendly furniture. According to the case study, safety considerations within the newly built mainstream housing had been significantly improved compared with that in the old community. Therefore, any future retrofitting projects should fully consider health and safety aspects.

Older participants described a range of sensory changes, including a reduction in hearing, smell, more sensitive to temperature changes, being easily awoken by noise, a loss in vision, sensitivity to intense light and avoiding bright and saturated colours. Some of the older interviewees believed that an improved built environment could help reduce the problems caused by their sensory decline to a certain extent. According to the observations and interview data, intervention could take the form of five aspects: sanitation, light, thermal, air quality, and acoustic.

In addition, some participants reported that they had been experiencing worsening cognitive competence, such as intuition, perception, problem-solving, and oral and written expression. They also mentioned an increasing sense of nostalgia and memory decline to some extent. A familiar environment and a well-designed signage system could support older people's ability to live independently and with dignity.

Finally, technology plays an essential role in constructing an age-friendly living environment. Technology could contribute to all the aspects mentioned above in this section regarding the built environment domain, especially in mobility technology, and ambient intelligence. Beyond that, technology presents a much greater possibility for supporting ageing-in-place. A separate quarter of the framework is dedicated to the role of technology in supporting older people living in a more age-friendly environment, which is introduced later.

9.5 Domain 3: Social environment

This section aims to present the role of the social environment in supporting ageing-in-place, including the role of social networks, type of support and service, and technology (see Figure 9.5). This is to advance the investigation of ageing-in-place by not only focusing on the physical environment mentioned above but also by exploring how the social environment influences a successful ageing-in-place. The social aspect is crucial in producing a holistic framework for a supportive living environment for the older population.
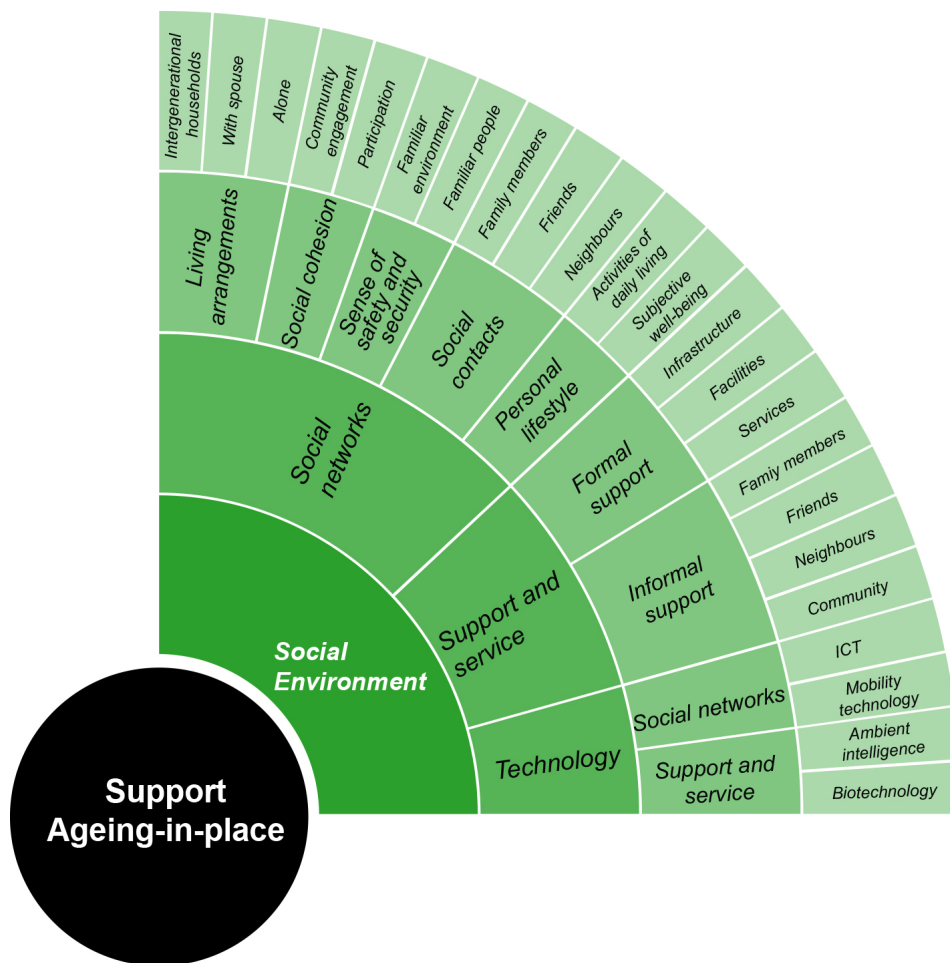
Figure 9.5 Framework Domain 3: The role of social environment in supporting ageing-in-place

Older people and experts agreed that the capacity to maintain existing social networks is one of the main reasons why many older people choose to stay at home. This is found to be the case even if their current living space does not contain features that meet their needs as an older person. Maintaining social networks is closely linked with older people's identity, belonging and cultural aspects, as mentioned earlier in the motivation of ageing-in-place. This contradiction is especially evident in the oldest of the residential communities investigated. For example, Case 1 exposed obvious environmental problems, such as no lift and disordered parking, however, the older residents expressed a sense of belonging because of very strong social networks within their community. According to the findings of this research, social networks can be divided into the following sub-categories: living arrangements, social cohesion, sense of safety and security, social contacts, and personal lifestyle.

From the perspective of the expert interviewees, family ties play an important role in the daily lives of older people who live in multi-generational home, and are central to their interactions with people. Older people who live independently or with only a partner have weaker ties to family members than those who live with multiple generations. This group of older people rely more on friends, neighbours, property managers, community staff and other non-family members. They tend to attend more social activities and present a more profound attachment to their existing social networks in their current surroundings. Furthermore, ageing-in-place enables more social participation and community engagement and enhances social cohesion, which is explained by Van Dijk et al. (2013) as patterns of social interaction among neighbours and the associated process of building shared values. The experts advocated that older people stay in their homes if their health status allow it, and maintaining social cohesion was conducive to staying active. However, a relatively weak state of social cohesion was seen for older people in the newly built communities, attributed to the new environment and neighbourhood. Property managers and community staff have been trying to take action to combat this in the newly built communities, such as providing activity opportunities and platforms to promote the neighbourhood's networks and social cohesion.

A sense of safety and security is a multifaceted basic need of older individuals who prefer ageing-in-place. The experts agreed that a regular daily routine could improve older people's self-confidence, sense of security and provide stability and familiarity. Older people might feel uncomfortable with change, and a regular routine can reduce stress while help them sleep better. Meanwhile, regularly seeing family and friends helps older people to feel safe. The experts who were interviewed believed that maintaining connections with others could combat the feelings of loneliness and isolation experienced by the older individuals and avoid psychological and physical problems.

From the opinions of the older people, it could be seen that social networks are mainly reflected in social contacts and personal lifestyle. On the one hand, ageing-in-place enables older people to easily maintain social contacts with family members, friends, and neighbours throughout their daily lives. Older participants consistently agreed that living in familiar surroundings helped them maintain their lifestyles and living habits, including participating in social activities, pursuing hobbies, engaging in physical activity, and the ability to go out independently. Maintaining a lifestyle enables older people to retain a sense of control and security in their lives and enhances their subjective well-being (Boldy et al., 2011).

Obtaining health and social support services is another critical component of an age-friendly social environment. The findings of this study suggest that due to their health status and pursuit of an improved quality of life, the urban older people in China have an increasing need for personal assistance. This can be differed into formal and informal support. Formal support mainly involves the infrastructure, facilities, and services for example, pharmacies, grocery stores, public transportation, meal services and personal care (Dobner et al., 2016). This study established that the Chinese Government and service agencies are constantly exploring and trying to provide community-based support and services. Informal support is provided by family members, friends, neighbours, and the community in general (Wilkinson-Meyers et al., 2014). Accessible and affordable support and service is another social factor important in achieving successful ageing-in-place.

Technology also plays an essential role in constructing an age-friendly social environment (Ghorayeb et al., 2021). The technology could contribute to the aspects mentioned above regarding the social environment domain, especially supporting social networks by ICT and mobility technology, and providing support and service by ambient intelligence and biotechnology. A separate quarter of the framework is dedicated for the role of technology in supporting older people living in a more age-friendly environment, which is presented in the following section.

9.6   Domain 4: Technology

Technology has been closely linked with ageing-in-place in recent decades. Using technology may empower older individuals to live independently in private homes and enhance their feeling of safety and security (Pani-Harreman et al., 2020). Technology and technical products have been described separately and appear in both built and social environments, playing an essential role in the above domains (Loe, 2010; Pani-Harreman et al., 2020; Van Hoof et al., 2011). This section focuses on classifying the technology related to ageing-in-place and highlights the importance of technology acceptance by older users (see Figure 9.6).

Ambient intelligence, mobility technology, and ICT are considered to be the top three most important types of technologies in supporting ageing-in-place. Ambient intelligence technologies have already been adopted as strategies by older people, shown by the use of various assistive devices in home modifications to support ageing-in-place (Van Hoof et al., 2011). For example, ambient intelligence can be used in the smart home to provide a more

supportive living environment, which is convenient and cost-saving. This technology is also helpful to older people's health and well-being by reducing their physical exertion via intelligent household electrical appliances and enhancing safety and security via monitoring and alarm systems (Pani-Harreman et al., 2020). Additionally, ambient intelligence can improve comfort in the living environment by adjusting indoor temperature, humidity, brightness, and other physical properties of the space (Van Hoof et al., 2011).

Mobility technology is also fundamental for older people in helping to reduce falls and encouraging social participation. Loe (2010) indicated that mobility technology is much broader than wheelchairs, walkers, walking sticks, and lifts, and can involve everything which enable older people to be more mobile.
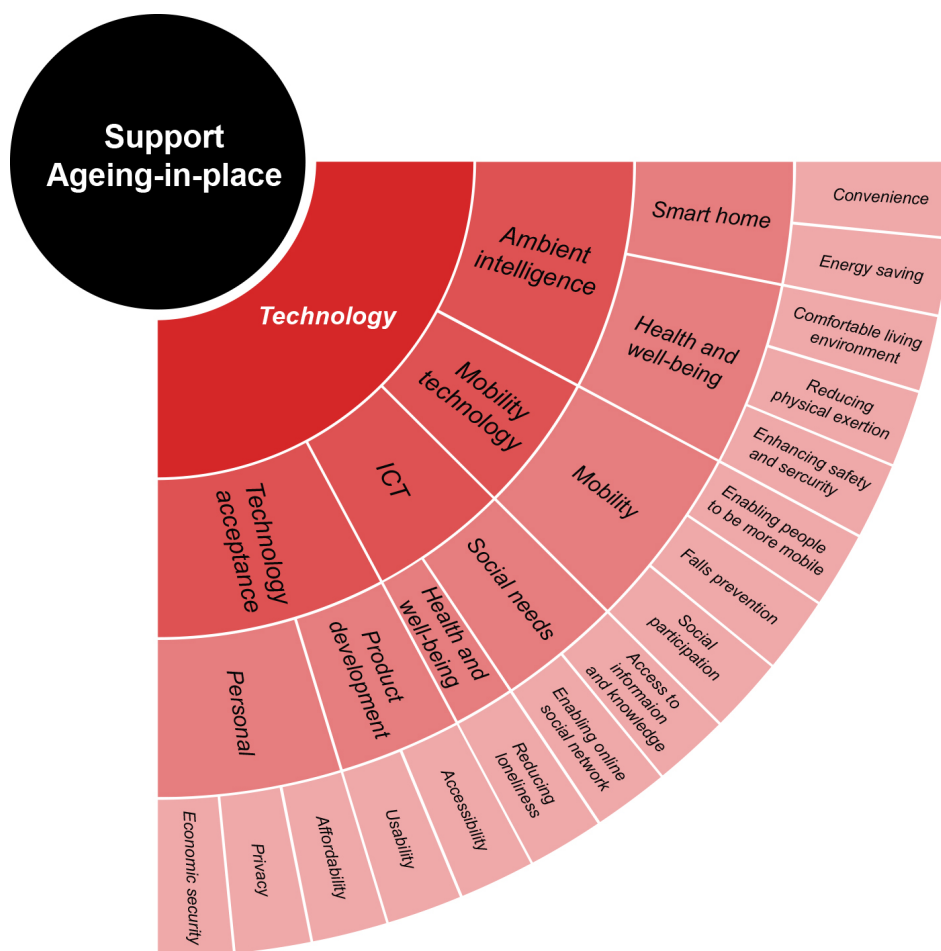

Figure 9.6 Framework Domain 4: The role of technology in supporting ageing-in-place

Nowadays, older adults make use of various of ICTs into their self-care routines and important activities, including phones, computers, TVs, and radios. These technologies help them maintain or increase connections with others in their social worlds (Ghorayeb et al.,

2021). ICT contributes to older people's social needs, providing access to information and knowledge and enabling online social networks, and benefiting older individuals' health and well-being, and as such reducing loneliness (Loe, 2010).

Although technology contributes positively to the promotion of ageing-in-place in multiple domains discussed above, some of the older participants in this study still hold a conservative attitude towards technology. For example, they believed that technology products are costly and challenging to operate. Additionally, experts pointed out that technology acceptance of older users is noteworthy. From the product development perspective, accessibility and usability could be notable. From the perspective of the older individuals, affordability, privacy, and economic security were highlighted as important factors that might encourage their use. In regards the aforementioned issue of technology use among older participants, it was seen that dependence and trust increased over time and with use. It is suggested that technology would be more acceptable if usefulness, usability, security, and privacy are prioritized.

9.7   Stakeholders of the Ageing-in-place Framework

So far, this chapter has presented the age-friendly living environment framework to support ageing-in-place in the mainstream residential communities in an urban Chinese context. The framework aims to fit the living environment into older people's requirements. This section focuses on clarifying who the potential stakeholders of the framework are. The relevance of the stakeholders to the ageing-in-place model, work requirements, or lifestyle needs is determined. The data collected helped to identify the stakeholder groups. Other stakeholder groups were identified by participants or the secondary data sources in addition to the specialists and older people who participated in the study. The stakeholder groups involve:

- Policy-related group: policymakers, standard makers, government staff, and researchers
- Practice-related group: architects, interior designers, housing developers, property managers, care and service providers, technical product developers
- Users: older residents, family members, and all community residents

From a top-down approach, policy-related group stakeholders play a key role in policy guidance and allocation of resources. This group involves policymakers, standard makers, government staff and researchers in this field. There is a direct mismatch between the age-

friendliness of the existing living environment and the actual needs of the older population, which is largely rooted in the lack of policies and design guidance and lack of knowledge and understanding of older people's diversity. The policy direction is unclear, or deviation leads to the lack of measures or inadequate measures in practice, which leads to the waste of human logistics and financial resources. Therefore, policy-related group stakeholders play the role of pioneer and guide in the process of realising ageing-in-place. Researchers need to fully understand the motivation and needs of the older population who prefer ageing-in-place and explore the key options in different living environments and provide corresponding policy recommendations and design guidelines. According to the above, policymakers and building and design standard developers should plan resources reasonably and optimise the technical system of an age-friendly environment. Government staff should carry out public policy interventions that can improve user satisfaction based on understanding the wishes and demands of older people.

Practice-related group stakeholders include architects, interior designers, housing developers, property managers, care and service providers, and technical product developers. The above personnel play a vital role in implementing policies and practices in building an age-friendly living environment or in providing support. Practice-related stakeholders need to thoroughly understand relevant policies and norms and implement them into concrete plans. The specific work involved may focus only on one domain, such as architects placing emphasis on the built environment, and the care providers focussing on social interventions and support. Furthermore, the implementation of the policy requires practitioners to understand the motivation and various needs of the older people who choose to age-in-place. Feedback from practitioners is also crucial for policy-related stakeholders to further revise and upgrade the relevant guidelines.

The stakeholders as users include older residents, their family members, and community residents. Older residents living in mainstream residential communities directly benefit from the age-friendly living environment framework from both a physical and social aspect. By analysing the motivations of the older individuals who choose ageing-in-place, the framework can help the older people to reach a decision in the process of deciding which type of living would best suit them. Moreover, older people could gain a better understanding and acceptance from others by explaining their motivations.

To increase the applicability and usability of the framework for end-users, a simplified version of the framework is presented in two languages (English and Chinese) to benefit

non-expert stakeholder groups in China and beyond, such as older people and their families could understand and use the framework to better their living conditions in urban settings.

Figure 9.7 The age-friendly living environment framework (simplified version)

As discussed in the literature review, the diversity in older age heavily depends on one key characteristic: health (WHO, 2015a). It is emphasised that older people contribute to society, their family, the local community, and social engagement, playing an essential and irreplaceable role. Therefore, ageing populations might be considered to be societal resources (Walker, 2002; Beard & Petitot, 2010). Conversely, old age is identified as a period of vulnerability and disengagement with a decline and feelings of increasing

irrelevance related to pension, burdensome dependence and need for supportive care needs (Cook, 2011). An age-friendly living environment enables older individuals to retain their independence and health through high levels of maintenance, stimulation and support. This is undoubtedly beneficial to the older people themselves and their families, and even to society. In addition, an age-friendly environment often means better mobility, safety, and inclusiveness, which are significant for people with disabilities, families with young children, and all residents who need accessible design.

9.8   Recommendations for Policy and Practice

Based on the age-friendly living environment framework, this section presents recommendations for future policymaking and community-related practices to support ageing-in-place in the mainstream residential communities. The recommendations follow this study's overall findings through interviewing multi-stakeholders and observations made during fieldwork. The framework aims to create a fit between older people's needs and their living environment by understanding their motivations, then using this knowledge to improve both built and social aspects to create a more age-friendly community, using the aforementioned technology to support this. The recommendations are presented in Table 9.1.

Table 9.1 Recommendations for policy and practice

Domains	Recommendations for policy and practice
Motivation	• Attach importance to the physiological and psychological needs of the older people, especially paying attention to their demands for identity, belonging and cultural identity, creating a respectful and inclusive social atmosphere.
	• Protect the rights of older people to choose where to live. Promote home-based and community-based ageing-in-place and highlight institutional living differences and suitable situations, therefore helping the older individuals to make decisions.
	• Understand older people's diverse demands and individual needs and respect their wishes and service needs at different times. To help older people adopt a positive attitude towards each stage of their life journey and enjoy a safe, healthy, and dignified ageing process.
	• Assess the older people according to their physical health, family status, economic strength, and provide corresponding support and subsidies for those who need special care, such as older persons who live alone, lose independence, and are in poverty, to promote the utilisation and equitable distribution of social resources.
	• Encourage active ageing, mobilising the initiative of older persons, promoting health, social participation and guaranteeing the full realisation of their rights.

	• Combine population ageing with industrialisation, urbanisation, technology development and other progressive features of the times, understand the current situation, grasp the development trend and characteristics, and timely adjustment of the response strategy according to the development at the time.
	• Pay attention to Chinese culture, family relations, and factors under socialism. The design of public policies should actively face the new conditions and opportunities in the process of demographic transition, explore a path suitable for Chinese national conditions, taking ageing-in-place as a long-term strategic task of the country.
Built environment	• Consider the decline in physical ability, mobility, sensory, and cognitive aspects of older people, using the planning and design intervention to provide a supportive environment to adapt to the changes in physical and mental features and extend the period of independent living as far as possible.
	• Build a safe and comfortable living environment, including community public space, indoor public space, and private space. Improve the convenience and accessibility of the living environment, promote universal design and barrier-free design, and improve the age-friendliness of the built environment in new communities.
	• Provide necessary supporting infrastructure around the residential community to meet the basic living needs of the older people, such as exercise, medical treatment, shopping, entertainment, and social contact.
	• Encourage older persons to play a role in the planning and design process and to participate in the age-friendly evaluation of their communities.
	• Improve the operability of old community retrofitting. Optimise retrofitting process and information transparency.
	• Promote and support the age-friendly renovation of homes for older people. For example, arrange experienced professional housing modification designers and builders; and subsidise home improvements for older people's homes.
	• Emphasise the role of public space in the daily use, sharing and social interaction, such as activity area, green space, and road system.
	• Provide intergenerational living space and communication spaces.
	• Improve policies and regulations, formulate design and engineering construction standards, guide and support the development of the age-friendly environment in the mainstream residential community.
Social environment	• Prize the contribution of older persons to families and society and their potential value. Integrate older persons as valuable resources into sustainable social development.
	• Pay attention to older persons' mental health. Encourage and support older people to actively participate in social activities and social interactions, reduce their loneliness, and help them avoid social isolation.
	• Encourage reciprocity and communication among older people, and value the practical help and emotional support provided by older people's existing social networks.
	• Pay attention to the changes in family structure and intergenerational relationships, and the weakening of family support. While advocating family to provide emotional support for older people, pay attention to the

		important impact of social support on their life quality and mental health.
		• Integrate the social needs of the older people with the elements of the built environment. Pay attention to the positive role that the built environment can play in promoting the healthy behaviour, psychological adjustment, and social adaptation of older people.
		• Support ageing-in-place through cross-sectoral coordination and cooperation. The realisation of ageing-in-place requires the pooling of resources from the government, market, social organisations, families, individuals and other aspects and levels.
		• Build a pattern of care services jointly composed of families, communities, and institutions. Strengthen the important role of community in care services and encourage the society to establish diversified modern care services.
		• Allocate public service resources to reflect the principle of fairness and a balanced distribution.
Technology		• Attach importance to the multi-dimensional impact of technological development on the living environment and social participation of older people.
		• Use technology to create a supportive living environment to enhance older people's independence and health and well-being.
		• Apply technology to protect older people from emergencies. Help the older individuals in emergencies to get timely assistance to reduce the risk of casualties.
		• Provide information that is easy for the older people to understand and create an information environment benefitting them.
		• Strengthen the older people contact with the outside world and their families.
		• Respect the psychological and physiological characteristics of older people. Develop technological products that are easy to operate, practical and affordable.
		• Integrate multiple resources to build an intelligent technology platform and form an industrial chain of intelligent care services. Combine technology with services, online with offline, daily services with emergency rescue and medical treatment to build an information-sharing platform and service team for the older people.
		• Promote the construction of standards and systems for intelligent care products.
		• Promote the positive role of technology in supporting older people. Expand the public influence of older people related technology.

These recommendations are proposed to guide policymakers, practitioners, housing and assistive technology providers targeted at older people in China with the aim to ensure ageing-in-place is achieved for all concerned. All recommendations are rooted in supporting ageing-in-place in the mainstream residential communities for the majority of the older populations in urban China by integrating age-friendly built environment, social environment and technology. Optimising allocation of scientific resources through public policies and

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spatial planning is the basic measure to deal with the ageing problem. The goals are, improving the happiness and prolonging the healthy life of the older population, and improving resources and services, and thus contributing to sustainable development.

The limitations of the above recommendations are mainly reflected in the fact that this study focuses on the living environment of urban mainstream communities and lacks an analysis into coping with ageing issues and measures from the urban level and a broader perspective. On the other hand, this study only focuses on ageing-in-place without discussing other possible ageing modes and applicable groups. Therefore, the framework and recommendations from this research exist within certain limitations.

9.9 Summary

This chapter summarised the overall research findings and produced an age-friendly living environment framework to support ageing-in-place in the mainstream residential community within the context of urban China. The development of the framework is Objective 5 of the research. The framework consisted of four core domains: motivation, built environment, social environment, and technology. Next, the potential stakeholders of the framework were identified based on their relevance to the ageing-in-place model, job specifications or living needs. The recommendations for policymaking and practice were then proposed based on the main findings of this research. The following chapter presents the final conclusion and highlights key findings, contribution to knowledge and future research.

CHAPTER 10. CONCLUSION

10.1 Introduction

This chapter concludes by summarising the key research findings and aligning them with the research aims and questions. It first presents an overview of the thesis, reviewing each chapter to highlight how the research aims and objectives have been addressed. Then, key findings are discussed to reflect the significance and implications thereof. It also discusses the contribution to knowledge of this study, followed by reviewing the limitations of the research and proposing directions for future study.

10.2 Overview of Key Research Findings

This PhD research derives its justification from population ageing and the advocacy of the ageing-in-place concept. Based on the research gaps identified in the literature review, the main research question was defined as how to support older people in urban China to achieve ageing-in-place by providing an age-friendly living environment? This research aims to develop a framework to better understand ageing-in-place and support the development of age-friendly environments for older people in urban China. The holistic framework was designed to guide retrofitting of housing environments and the design of new mainstream housings. This is with the aim to overcome the physical and social change associated with ageing so that older people can live independently for longer, age well and avoid or delay the move to residential care. The research aim was achieved through five research objectives. They are as follows:

Objective 1: To evaluate the age-friendliness of the physical environment in contemporary mainstream residential communities urban China.

Objective 2: To conceptualise ageing-in-place in the case of urban China and establish whether older people prefer to age-in-place.

Objective 3: To establish the relationship between the built environment and older people's ability to achieve ageing-in-place.

Objective 4: To understand the relationship between the social environment and older people's motivations and ability to achieve ageing-in-place.

Objective 5: To develop a design and retrofitting framework to improve the age-friendly living environment and help older people achieve ageing-in-place.

The whole research was designed to achieve the above research objectives and answer the research questions via conducting three case studies and interviews with multiple stakeholders: 37 older people and 13 experts. Accordingly, the thesis chapters were organised to respond to each objective and corresponding sub-question. Figure 10.1 elaborates the key research findings and how these research questions have been answered in this study.
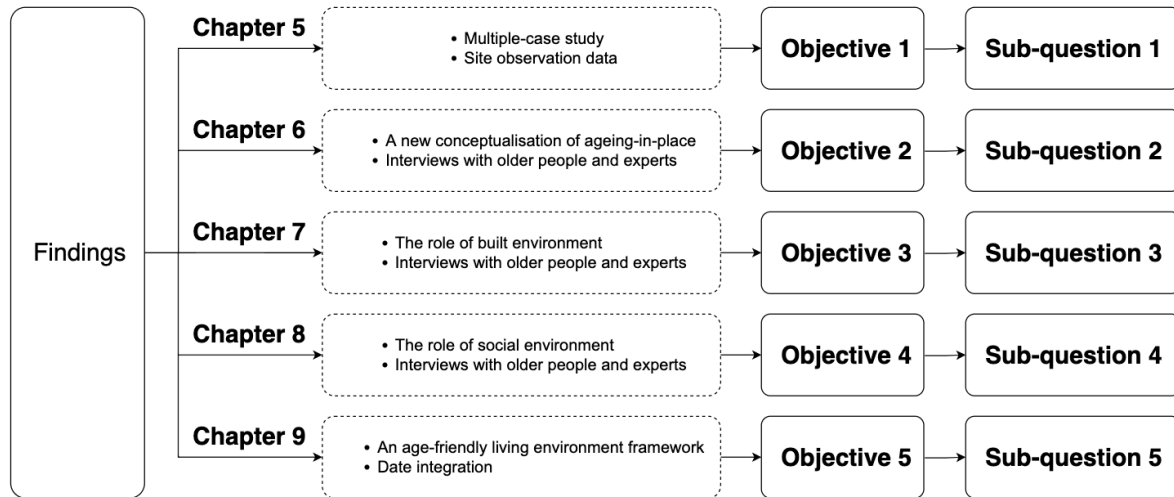
Figure 10.1 Key research findings

Objective 1 evaluated the age-friendliness of the physical environment in contemporary mainstream residential communities in urban China. To achieve this objective, three mainstream residential communities were selected according to the build year and community type to conduct multiple case studies via site observations and checklist evaluations based on previous environmental design recommendations from the literature review. The findings from the case studies were presented in **Chapter 5**. This was to investigate the Chinese urban mainstream communities and private dwelling environments from an age-friendly environment perspective and identify environmental barriers to achieving ageing-in-place in the different urban residential community settings. It was established that the newly built community provided a more age-friendly physical environment for the older residents, while the older communities were exposed to more environmental barriers for older individuals to age-in-place.

Chapter 6 presented the findings of **Objective 2**, which was to conceptualise ageing-in-place in the case of urban China and establish whether older people prefer to age-in-place. According to the interviews, the motivations of the older individuals and the challenges faced

by stakeholders during the ageing-in-place process were discussed. This objective was fundamental to understanding the ageing-in-place concept in a current Chinese urban setting, which is necessary to develop a holistic framework for promoting ageing-in-place. The findings provided evidence that ageing-in-place is advocated by older individuals when they have the ability to live independently. Meanwhile, the concept of ageing-in-place aligns with older people's traditional Chinese belief that home is the most comfortable place, closely related to freedom, dignity, privacy, and belonging. Experts from all walks of life believe that ageing-in-place is the choice of a large part of older people in urban China, because it can improve their happiness and reduce the resource and capital pressure brought by the institutional care model. The experts interviewed also stated there is still much room for progress in supporting older people to age-in-place, such as improving the built environment, providing a supportive social environment, and using technology.

Chapter 7 established the relationship between the built environment and older people's ability to achieve ageing-in-place, which addressed research **Objective 3**. The components of an age-friendly built environment concerning community and housing have been explored through interviewing older residents and experts, including architects, property managers, policymaker, and care providers. The main findings, from the position of the experts, uncovered the challenges and opportunities of residential design for older people in urban China and the difficulties faced by older residents who chose to age-in-place. A supportive built environment could promote physical activity and preserve and maintain older people's health and well-being. The age-friendliness of the built environment can lead to a difference between dependence and independence for all people, but is of specific significance for older individuals. In general, older people's unmet requirements of the built environment were reflected in their mobility, safety, sensory, cognitive, and technological aspects in this study. Based on the results, a list of design features of an age-friendly residential community was presented to guide the design and retrofitting framework for mainstream housing with the aim to support older people age-in-place.

In **Chapter 8**, the role of the social aspect of the living environment was discussed, which is emotional and experience-based characteristics of the place, including the role of social networks, social support, and technologies. This chapter aimed to achieve **Objective 4** of the study by exploring the components of the social environment for older people and establishing a relationship between the social environment and their ability to achieve ageing-in-place. It described the role of social networks and the support needed for older people living in mainstream housing in urban China. A list of recommendations on the social

needs of older people who prefer to age-in-place was presented to support the development of a more age-friendly living environment. Combining the age-friendly built environment discussed in Chapter 7, a holistic framework was created and acts as the solid foundation on which ageing-in-place can be built.

Chapter 9 presented the final output of this research, which is an age-friendly living environment framework to support ageing-in-place in a mainstream residential community within the context of urban China. The development of the framework was **Objective 5** of the research. The output combined the conceptual framework and related theories from the literature review and research findings from the case studies. Four main domains, being motivations, built environment, social environment, and technology, were established from the framework, supported by the preceding data and objectives mentioned in the above chapters. This frameworks aim was to support the older population achieve ageing-in-place by improving their living environment and in turn making them more age-friendly. To increase the applicability and usability of the framework for end-users, a simplified version framework is presented in two languages (English and Chinese) to benefit non-expert stakeholder groups in China and beyond.This chapter also presented framework stakeholders, applications and recommendations for policy and practice.

10.3 Significance and Implications of Key Findings

China is facing a particularly challenging ageing problem with the global ageing trend. In China, the traditional family structure of co-residence with offspring has come under pressure because of fast declines in fertility from the 1970s and rural-urban migration in recent decades, resulting in a growing number of older individuals living separately from their offspring. The country has been experiencing shifts in family structure, challenging the traditional family-based caregiving patterns for older individuals. Most older people wish to live at home for as long as possible with benefits for individuals, such as maintaining independence, familiar setting and routines, a healthier and safer living environment, better accessibility to family and friends, and cost-savings. Ageing-in-place considers older people's physical, social and psychological requirements and is based on the local conditions and the traditional filial piety culture to reply to the population ageing challenges.

Older people's requirements are essential for designing policy frameworks that build community support and service frameworks. Therefore, it is necessary to gather evidence that defines the extent of older people's care and support requirements and understand their

perceptions of what they need to age safely in their homes. Furthermore, responsive policy intervention is required to support those groups of older people. This study delivers a holistic framework that integrates social and physical aspects of the living environment in an urban mainstream residential community context with the aim of supporting the older population to achieve ageing-in-place. The implications of the framework could be helpful in related policymaking, design guidelines, or be a strategy for service providers.

It is certain that age-friendly living environment enables older individuals to maintain their independence and health. This is undoubtedly beneficial to the older people themselves, their families, and even society. In addition, an age-friendly environment often means better mobility, safety, and inclusiveness, which are significant for people with disabilities, families with young children, and all residents who need accessible design.

10.4 Contribution to Knowledge

Through conducting this PhD, new insights were made based on the available knowledge and by conducting research. This included producing a new conceptualisation of ageing-in-place and an age-friendly environment framework to support ageing-in-place.

A new conceptualisation of ageing-in-place. The interviews with multi-stakeholders enabled the researcher to gain an understanding of the ageing-in-place concept in China. Ageing-in-place as a conceptual vocabulary has been explored with new meanings to respond to population ageing in the contemporary urban China context, including the challenges and limitations of resources, the familistic history and policy background. The definition of ageing-in-place given by this study is:

> "Older persons can choose where to live and keep their connection to family or community and their ability to live independently as long as possible, maintaining a sense of belonging, dignity, familiarity and security".

Ageing-in-place does not necessarily mean staying in the original home. It could mean moving to a more supportive living environment nearby or moving in with a son or daughter's family rather than a nursing homes or care facility. Its focus is staying in mainstream communities that can satisfy the older individual's sense of attachment and security to familiar people or environments. This idea also provided a practical conceptualisation to inform the housing design and policy framework. Additionally, it provides the basis for future

research to support older individuals living in private mainstream housing in urban China and how this could influence housing design and community cohesion.

An age-friendly environment framework to support ageing-in-place. The age-friendly environment framework is a practical guide for creating a supportive living environment for older people and achieving ageing-in-place in mainstream residential communities. The framework produce through this study could help to fill the gap on age-friendly initiatives in the developing world, integrating the built environment and social aspects, and the application of assistive technologies. Furthermore, this study employed a participatory and collaborative research process with multi-stakeholders, including older people, architects, policymaker, property managers, and care providers. It could be used as a reference in solving other developing countries' population ageing issues. The framework provides a holistic tool that provides policy recommendations and practical guidelines to benefit the older population, their families, communities, and society. In addition to practitioners and researchers, the older individuals and their families could make decisions based on the above findings of this study when making choices of where to live or conducting home retrofitting.

10.5 Limitations of the Study

Due to the constraints on time, capacity and resources, this study has some limitations. The study limitations are reflected in two main aspects: methodological limitations and limitations of the researcher.

Methodological Limitations

- Sample size

Due to the transnational field investigation required in this study, the scope of sample size was set according to the research objectives prior to data collection in consideration of travel costs and the limited time frame for data collection. The main interviewees of this study were the older people group and the expert group. During data analysis, it was found that the information gathered from the older people group was relatively sufficient. However, since the expert group includes practitioners from multiple positions, the sample size of the respondents for each position was small but sufficient.

- The measure used to collect the data

The main data collection methods in this study were interview and site observation. In designing the study, under the theory of P-E fit, observation the behaviour of older people in residential setting has been considered. However, considering time constraints and the work capacity of the researcher in data collection and analysis, it was decided that only the built environment would be assessed in the observation section of the selected cases. The site observation focused on the condition of the built environment without observing and recording human behaviour.

- Self-reported data

This study was conducted as a qualitative research study and the data was gathered by the author via interviews. However, self-reported data by interviewees contain several potential sources of bias, which should be noted as limitations, including telescoping, selective memory, exaggeration, and attribution.

- Language difference in data collection and reporting

This study was designed in English while the data were collected and analysed in Chinese. Then, English was used as the reporting language to present the results and discussion. The process of translation may affect the accuracy of language expression. To address this potential limitation, the translated quotes have been reviewed by Chinese colleagues to validate.

Limitations of the Researcher

- Limited data access

This study was reliant on having access to the gated residential communities, older people, experts in related positions, policy documents, and private homes. Although most of the data identified in the research design were successfully obtained in the field research, full data access was denied. This was the case, for example, in Case 3 community where the researcher was not granted access to one private apartment to conduct an indoor space evaluation as no participant agreed.

- Cultural bias

Cultural bias is created by the assumptions about motivations and influences based on an individual's cultural lens. The author's upbringing and cultural background results in an emphasis on family ties and filial piety in traditional Chinese culture which is in accordance with maintaining a close connection with the family of ageing-in-place. To minimise the

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potential for cultural bias, neutral questions and wording were used as far as possible to seek interviewees' opinions.

- Language

In this study, as Chinese is the author's first language with English as a second language, the data were collected and transcribed in Chinese and in some cases using the dialect while English was used as the reporting language. Although the fluency in language and translation issues should be acknowledged as one limitation of the researcher, this was not significant.

10.6 Recommendations for Further Research

This study acknowledges that ageing-in-place fits the vision of the older individuals in the urban context of contemporary China and that providing an age-friendly living environment is a complex task that should integrate the built environment, social environment, and technology. This section aims to propose future research directions based on the research findings and the study limitations listed above. The study suggests three recommendations for further research:

- Address the limitations of this research

In combination with other methodologies and/or more data collection methods, for example, a mixed-research method such as questionnaires could be adopted to add quantitative data analysis, expand the number of samples, prolong the period of data collection, and intersperse the data analysis and data collection during the study.

- Conduct the same research in a new context, location and/or culture

One possibility would be to take the same research questions and conduct research in different cities, or rural areas in China to understand ageing-in-place in a different setting and conduct comparative studies where applicable.

- Re-assess and expand the framework addressed in this research

Future studies can re-assess and expand (scalability) the framework by taking the research findings back to the people involved in the data collection process, such as conducting a focus group to discuss the framework by stakeholders.

10.7 Summary

This chapter has summarised the whole research project as the last part of the thesis. Firstly, an overview of key research findings was reviewed in light of the research objectives. Then, the significance and implications of the key findings were reiterated to highlight the importance of the study, followed by the overall contribution to knowledge of the study. Furthermore, the limitations of the study and recommendations for further research were presented at the end of the chapter.

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APPENDICES

Appendix 3.1 Checklist of age-friendly housing (Full list)

适老家装图集	Checklist of Age-friendly Housing
A. 门厅适老家装要点	**A. Hallway**
1 需考虑老人坐姿换鞋需求	To consider older people need sit down to change their shoes
2 选择适合老人使用的换鞋凳	To choose a suitable seat for older people to change their shoes
3 注意鞋柜与门的位置关系	Pay attention to the shoe storage relationship with the position of the door
4 鞋柜高度需便于老人撑扶，底部可留空	The height of the shoe storage should be easy to support the older people, can be left a space at the bottom
B. 起居厅适老家装要点	**B. Living Room**
5 考虑乘坐轮椅老人的位置	To leave a space for older people with wheelchair
6 沙发、茶几的摆放需便于老人进出	The layout of sofa and tea table should be easier for older people to pass in and out
7 选择适合老人使用的茶几	To choose a suitable tea table for older people to use
8 沙发选型需注意适老	To choose a suitable sofa for older people to use
9 避免空调正吹沙发	To avoid air conditioning is directly blown sofa
10 地面材质应防滑、防反光	The ground material should non-slip and anti-glare
C. 餐厅适老家装要点	**C. Dining Room**
11 加强餐厅与厨房的视线联系	To improve the visual connection between dining room and kitchen
12 考虑就餐时也可以看到电视	To consider watching TV at meals
13 餐桌旁宜留出轮椅专用位置	To reserve a wheelchair position beside the dining table.
D. 厨房适老家装要点	**D. Kitchen**
14 吊柜需防止磕碰	To avoid the wall cabinet bump against older people
15 吊柜下方可加设中部柜	To add a middle cabinet between the base cabinet and wall cabinet
16 操作台面宜连续	Worktop should be continuous
17 炉灶、水池的两侧和之间均需留出台面	Design worktop between and beside the sink and hob
18 微波炉宜放在操作台面上，不宜过高或过低	Microwave oven should be placed on the worktop, not too high or too low
19 厨房内有条件时可布置小餐台	Small tables can be arranged in the kitchen when conditions permit
20 冰箱旁要留有接手台面	Keep a worktop beside the refrigerator
E. 卫生间适老家装要点	**E. Toilet**
21 需注意卫生间干湿分离	To separate wet and dry area in the bathroom

22	选择适合老人使用的盥洗台	To choose a suitable bathroom sink for older people to use
23	盥洗台旁侧墙上宜布置毛巾杆	To add a towel rail near the bathroom sink
24	卫生间门尽量采用推拉门或外开门	To use an out-opening door or sliding door in the bathroom
25	尽量采用冷热水混水龙头	To use a mixer tap
26	淋浴间需设置扶手，并用浴帘隔断	To use a handrail and shower curtain in the shower room
27	花洒高度宜可调节	To use an adjustable height shower head
28	淋浴间宜考虑摆放浴凳	To use a shower seat
29	坐便器旁宜设置扶手	To use a grab bar near the closestool
F. 卧室适老家装要点		**F. Bed Room**
30	卧室宜考虑老年夫妇分床休息的需求	To consider the older couple who need sleep separately
31	床的尺寸需适中，不宜过大或过小	The bed size should be reasonable, not too large or too small
32	床的选型与布置需满足老人使用需求	Bed selection and layout should meet the needs of the older people
33	床的材质需考虑老人接触时的舒适感	Bed material should be comfortable for older people to touch
34	主灯宜设双控开关	Double-control switch should be set for main lamp
35	空调送风方向不要正对床头	Air supply direction of air conditioner should not be directly opposite the bedside
36	床头柜要适合老人使用	To choose a suitable bedside table
G. 阳台适老家装要点		**G. Balcony**
37	封闭阳台上宜布置洗衣机，以便洗晾衣集中	Closed balconies should be equipped with washing machines for centralized washing and drying
38	晾衣杆需考虑低位操作的可能性	To consider the possibility of low position airer
39	注意阳台门的高差处理	Pay attention to the height difference of balcony door
40	阳台门的尺寸要利于通行	The size of balcony door should be suitable for older people
H. 设施设备适老家装要点		**H. Facilities**
41	开关面板需利于老人分辨和操作	Switch panels need to be easy for the older people to distinguish and operate
42	各类把手需便于老人抓握用力	Handles should be easy for the older people to grasp
43	插座宜根据使用部位适当抬高	The socket should be raised appropriately according to the position and function
44	灯具的选择宜适合老人使用	To choose suitable lamps for older people

45	主要空间宜有两处灯源	There should be two light sources in the main space
46	有阅读和精细操作的部位可加强局部照明	Lighting should be enhanced in reading and fine operation areas
47	插座布置需考虑家具的多种摆放形式	The layout of sockets should take into account various forms of furniture placement
48	座椅需轻便、稳定，便于老人移动、起坐	Seats need to be light and stable for the older people to move and sit up
49	需保证门的通行宽度	To guarantee the width of door
50	需置物的窗台上方可考虑设置一段固定扇	To consider install a fixed window over the windowsill with items
51	可考虑采用地板采暖	To consider floor heating
52	需保证老人方便的使用热水	To ensure the older people can use hot water conveniently
53	需注意卫生间排水、排风问题	To consider the drainge and ventilation in the toilet
I. 智能家居适老家装要点		**I. Smart Home (Technology)**
54	坐便器旁预留插座，以便设置智能便座	To reserve a socket beside toilets for setting up intelligent seats
55	可视对讲系统需考虑老人使用需求	To consider older people's needs of video doorphone system
56	宜在卧室和卫生间安装紧急呼叫器	To install emergency callers in bedrooms and bathrooms
57	可在门厅设置电源总控开关	To install a main switch in the hallway
58	可设置红外探测器感应老人行动	Infrared detectors can be set to sense the action of the older people
59	宜采用可调节式的光源	To use adjustable light
60	可考虑采用遥控器操作窗帘、油烟机等	To consider use a remote control to operate curtains, lampblack machines, etc

Source: Zhou & Li, 2018《适老家装图集——从 9 个原则到 60 条要点》

Appendix 3.2 Checklist of age-friendly community (Full list)

适老社区环境	Checklist of Age-friendly community
A. 社区出入口	A. Residential community entrance
1 明确划分人行和车行流线	Clearly dividing pedestrian lines and traffic lines
2 满足无障碍通行需求	Meet barrier-free access needs
3 设置休息等候空间	Set up rest and waiting space
B. 社区道路	B. Residential community road
4 采用人车分流的交通组织方式	Separate people and vehicles in the traffic organization
5 根据分流方式和功能需求合理设计道路断面	Design road section according to traffic organization and functional requirements
6 道路系统应清晰简洁	The road system should be clear and concise
7 满足各类车辆的通行需求	Meet the traffic needs of all types of vehicles
C. 机动车停车场地	C. Motor vehicle parking lot
8 合理配置地面和地下车位	Reasonable allocation of ground and underground parking spaces
9 在住宅楼栋出入口设置临时停车空间	Temporary parking space at the entrance of the residential building
10 设置无障碍停车位	Set up barrier-free parking space
D. 非机动车停车场地	D. Non-motor vehicle parking lot
11 临近楼栋出入口设置非机动车停放空间	Non-motor vehicle parking space near the entrance of the residential building
12 满足各类非机动车的停放需求	Meet the parking needs of all types of non-motor vehicles
E. 人行道路	E. Pedestrian Road
13 尽量采用平坦路面，妥善处理空间高差	Try to use the flat road and handle spatial height differences properly
14 采用平整均匀的地面铺装材料	Use flat and homogeneous ground covering material
15 尽量保证人行道路的连续性	Try to ensure the continuity of the pedestrian road
16 保证足够的通行宽度	Ensure adequate pedestrian road width
F. 散步道	F. Walking path
17 合理规划散步道流线	Reasonable planning of the path streamline
18 沿途设置休憩设施，方便老人停留休息	Set up rest facilities along the path for older people to rest
19 沿途合理配置植物	Rational allocation of plants along the path
20 可考虑设置风雨连廊	Consider setting up shelter corridor
G. 楼栋出入口	G. Residential building entrance

21	位置明显、易识别	Obvious position and easy to identify
22	避免与外部流线交叉	Avoid crossing with external streamlines
23	妥善处理出入口高差	Handle the entrance height difference properly
24	提供老人停留和交往的过渡空间	Provide a transitional space for older people to stay and interact
25	雨棚应尽可能覆盖入口平台和台阶坡道	The canopy should cover the entrance platform and the step ramp as much as possible
H. 活动场地		**H. Activity space**
26	布置在微气候宜人的位置	Arranged in place with pleasant micro-climate
27	注重流线和视线的可达性	Pay attention to the accessibility of path streamlines and visual lines
28	与楼栋和道路保持适宜的距离	Maintain a suitable distance from the residential building and the road
29	利用植物或构筑物进行适当界定	Use plants or structures to define boundaries properly
30	提供丰富多样的活动空间	Provide a wide variety activity space
31	设置老幼、亲子活动场地	Set up older people and parent-child activity space
32	选用适宜的地面铺装材料	Use suitable ground covering material
33	配置必要的辅助设施设备	Set up necessary subsidiary equipment
I. 休憩场地		**I. Rest space**
34	面向主要人流和活动场地设置休憩座椅	Set up rest seat for major pedestrians and activity space
35	设置遮阳避雨的休憩空间	Set up rest space with shade shelter
36	合理选择座椅的类型和布置形式	Choose suitable seat type and arrangement
37	为乘坐轮椅的老年人提供休息和停留的空间	Provide space for older people who use wheelchairs to rest and stay
J. 园林景观		**J. Landscape**
38	通过植物和小品的配置增强空间识别性	Enhance spatial identification through the configuration of plants and scenes
39	营造具有感官刺激作用的园林景观	Create a sensory stimulation of the landscape
40	合理设置草坪	Set up the lawn reasonably
K. 标识系统		**K. Signage system**
41	形成连续、多层次的标识系统体系	Form a continuous, multi-level signage system
42	设在易于观察到的显著位置	Located in a obvious position that is easy to observe
43	精准表达标识内容	Express the signage content accurately
44	清晰呈现图文信息	Present graphic information clearly
L. 照明系统		**L. Lighting system**
45	适度提高环境光照度	Moderately increase ambient illumination

46	关键区域布置重点照明	Set up key lighting in key areas
47	注意避免眩光	Avoid glare
48	保证照度均匀	Ensure uniform illumination
49	消除局部阴影	Elimination of local shadows
50	通过分级照明方便老人识别方位	Through grading lighting to facilitate older people to identify the location

Source: Zhou & Qin, 2018《适老社区环境营建图集——从 8 个原则到 50 条要点》

Appendix 4.1 Population data in Xuanwu District, Nanjing

城市 City	区县 District /County	街道 Subdistrict /Street	社区居民委员会名称 Community office /Committee	常住人口 Population	其中60岁及以上人口 Population over 60	60岁及以上人口占常住人口的比 Ratio
		新街口街道	大石桥社区居委会	11169	4180	37.43%
		孝陵卫街道	南京理工大学社区居委会	10882	3980	36.57%
		锁金村街道	锁五社区居委会	4340	1500	34.56%
		新街口街道	香铺营社区居委会	21080	6800	32.26%
		玄武门街道	廖家巷社区居委会	6220	1900	30.55%
		玄武湖街道	蒋王庙社区居委会	6183	1854	29.99%
		孝陵卫街道	盛和家园社区居委会	4414	1200	27.19%
		锁金村街道	锁四社区居委会	3800	966	25.42%
		玄武门街道	天山路社区居委会	9340	2300	24.63%
		锁金村街道	锁一社区居委会	7550	1800	23.84%
		梅园新村街道	富贵山社区居委会	11120	2600	23.38%
		玄武湖街道	樱驼花园社区居委会	10020	2300	22.95%
		孝陵卫街道	孝陵卫社区居委会	6780	1490	21.98%
南京市	玄武区	红山街道	曹后社区居委会	7523	1653	21.97%
		梅园新村街道	明故宫社区居委会	12880	2830	21.97%
		梅园新村街道	东南大学社区居委会	6061	1305	21.53%
		玄武门街道	大树根社区居委会	4670	1005	21.52%
		梅园新村街道	大行宫社区居委会	6680	1410	21.11%
		梅园新村街道	北安门社区居委会	15700	3200	20.38%
		孝陵卫街道	晏公庙社区居委会	8911	1800	20.20%
		孝陵卫街道	康定里社区居委会	6480	1300	20.06%
		梅园新村街道	大影壁社区居委会	9106	1820	19.99%
		玄武门街道	台城花园社区居委会	10820	2120	19.59%
		锁金村街道	锁三社区居委会	8360	1600	19.14%
		玄武湖街道	樱铁村社区居委会	5239	993	18.95%

		玄武门街道	公教一村社区居委会	7808	1455	18.63%
		锁金村街道	新庄社区居委会	9168	1700	18.54%
		孝陵卫街道	小卫街社区居委会	4590	850	18.52%
		孝陵卫街道	南京农业大学社区居委会	4325	800	18.50%
		玄武门街道	百子亭社区居委会	8233	1498	18.20%
		孝陵卫街道	银城东苑社区居委会	13200	2380	18.03%
		新街口街道	北门桥社区居委会	10500	1890	18.00%
		梅园新村街道	梅园新村社区居委会	10060	1797	17.86%
		梅园新村街道	太平门社区居委会	17456	3110	17.82%
		玄武湖街道	仙居雅苑社区居委会	9650	1700	17.62%
		孝陵卫街道	铁匠营社区居委会	12100	2100	17.36%
		红山街道	阳光嘉园社区居委会	4499	770	17.11%
		玄武湖街道	聚宝山社区居委会	8020	1343	16.75%
		红山街道	藤子社区居委会	2052	331	16.13%
南京市	玄武区	孝陵卫街道	农科院社区居委会	5520	882	15.98%
		玄武门街道	高楼门社区居委会	6747	1044	15.47%
		锁金村街道	紫鑫城社区居委会	7090	1086	15.32%
		玄武湖街道	花园路社区居委会	9980	1500	15.03%
		玄武湖街道	板仓社区居委会	8677	1300	14.98%
		锁金村街道	锁二社区居委会	6764	1010	14.93%
		梅园新村街道	兰园社区居委会	10890	1600	14.69%
		新街口街道	成贤街社区居委会	19356	2720	14.05%
		新街口街道	唱经楼社区居委会	21100	2944	13.95%
		红山街道	营苑社区居委会	9654	1314	13.61%
		新街口街道	长江路社区居委会	9120	1180	12.94%
		红山街道	紫金小营社区居委会	3120	400	12.82%
		红山街道	墨香山庄社区居委会	17110	2053	12.00%
		红山街道	红山公园社区居委会	9320	1100	11.80%
		红山街道	月苑社区居委会	12456	1419	11.39%
		玄武湖街道	仙鹤门社区居委会	7060	800	11.33%
		孝陵卫街道	钟灵街社区居委会	5488	580	10.57%

		玄武湖街道	东方城社区居委会	9800	890	9.08%
南京市	玄武区	红山街道	北苑社区居委会	11236	1014	9.02%
		红山街道	红山社区居委会	1230	85	6.91%

Appendix 4.2 Population data in the selected street

街道 Subdistrict /Street	社区居民委员会名称 Community office /Committee	常住人口 Population	60 岁及以 上人口 Population over 60	60 岁及以 上人口占常 住人口的比 率 Ratio
A 玄武门街道	A1 廖家巷社区居委会	6220	1900	30.55%
	A2 大树根社区居委会	4670	1005	21.52%
	A3 百子亭社区居委会	8233	1498	18.20%
	A4 高楼门社区居委会	6747	1044	15.47%
	A5 天山路社区居委会	9340	2300	24.63%
	A6 台城花园社区居委会	10820	2120	19.59%
	A7 公教一村社区居委会	7808	1455	18.63%
B 新街口街道	B1 大石桥社区居委会	11169	4180	37.43%
	B2 唱经楼社区居委会	21100	2944	13.95%
	B3 北门桥社区居委会	10500	1890	18.00%
	B4 长江路社区居委会	9120	1180	12.94%
	B5 香铺营社区居委会	21080	6800	32.26%
	B6 成贤街社区居委会	19356	2720	14.05%
C 梅园新村街道	C1 兰园社区居委会	10890	1600	14.69%
	C2 东南大学社区居委会	6061	1305	21.53%
	C3 大影壁社区居委会	9106	1820	19.99%
	C4 大行宫社区居委会	6680	1410	21.11%
	C5 梅园新村社区居委会	10060	1797	17.86%
	C6 太平门社区居委会	17456	3110	17.82%
	C7 明故宫社区居委会	12880	2830	21.97%
	C8 富贵山社区居委会	11120	2600	23.38%
	C9 北安门社区居委会	15700	3200	20.38%
D 孝陵卫街道	D1 南京农业大学社区居委会	4325	800	18.50%
	D2 铁匠营社区居委会	12100	2100	17.36%
	D3 小卫街社区居委会	4590	850	18.52%
	D4 银城东苑社区居委会	13200	2380	18.03%
	D5 康定里社区居委会	6480	1300	20.06%
	D6 南京理工大学社区居委会	10882	3980	36.57%
	D7 孝陵卫社区居委会	6780	1490	21.98%
	D8 晏公庙社区居委会	8911	1800	20.20%
	D9 农科院社区居委会	5520	882	15.98%
	D10 盛和家园社区居委会	4414	1200	27.19%
	D11 钟灵街社区居委会	5488	580	10.57%
E 玄武湖街道	E1 板仓社区居委会	8677	1300	14.98%

	E2 花园路社区居委会	9980	1500	15.03%
	E3 蒋王庙社区居委会	6183	1854	29.99%
	E4 樱铁村社区居委会	5239	993	18.95%
	E5 樱驼花园社区居委会	10020	2300	22.95%
	E6 东方城社区居委会	9800	890	9.08%
	E7 聚宝山社区居委会	8020	1343	16.75%
	E8 仙居雅苑社区居委会	9650	1700	17.62%
	E9 仙鹤门社区居委会	7060	800	11.33%
F 红山街道	F1 红山公园社区居委会	9320	1100	11.80%
	F2 曹后社区居委会	7523	1653	21.97%
	F3 红山社区居委会	1230	85	6.91%
	F4 藤子社区居委会	2052	331	16.13%
	F5 阳光嘉园社区居委会	4499	770	17.11%
	F6 月苑社区居委会	12456	1419	11.39%
	F7 北苑社区居委会	11236	1014	9.02%
	F8 营苑社区居委会	9654	1314	13.61%
	F9 墨香山庄社区居委会	17110	2053	12.00%
	F10 紫金小营社区居委会	3120	400	12.82%
G 锁金村街道	G1 锁一社区居委会	7550	1800	23.84%
	G2 锁二社区居委会	6764	1010	14.93%
	G3 锁三社区居委会	8360	1600	19.14%
	G4 锁四社区居委会	3800	966	25.42%
	G5 锁五社区居委会	4340	1500	34.56%
	G6 紫鑫城社区居委会	7090	1086	15.32%
	G7 新庄社区居委会	9168	1700	18.54%

Appendix 4.3 Data collection schedule in fieldwork

Date	Week 1						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	2019-4-29	2019-4-30	2019-5-1	2019-5-2	2019-5-3	2019-5-4	2019-5-5
Phase	Semi-structured interviews with experts						
Location	N/A		Depend on participates			If the data collection has not been completed, to continue the task. To edit and sort data preliminarily. To double check the access of three comunities. To prepare the map for Phase 2.	
Task	Preparation		Interviews				
Purpose	To get connection and make a appointment with the participants in Phase 1.		To explore the relationship between living environment and ageing-in-place from prespective of related prefessionals.				
Method	Email, Wechat.		Face-to-face Interview or online interview				
Participants	Architects, Housing providers, Care poviders, Policy makers, Community managers.						
Documentation	N/A		Audio recording, note taking				
Comments	This task could be started two weeks early.		3 participants each day. The policy makers will be interviewed during phase 2.				

Date	Week 2						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	2019-5-6	2019-5-7	2019-5-8	2019-5-9	2019-5-10	2019-5-11	2019-5-12
Phase	Phase 2 Case study						
Location	Case 1 (Community 1)				If the data collection has not been completed, to continue the task. To edit and sort data preliminarily.	Case 2 (Community 2)	
Task	In-depth interviews with older residents			Site visual surveys (Comunity public space)		In-depth interviews with older residents	
Purpose	To explore the relationship between living environment and ageing-in-place from prespective of older people. To identify the challenges facing the establishment of age-friendly environments and ageing-in-place in type 1 community.			To understand the current built environment in the community public area. To find evidence to support data from interview.		To explore the relationship between living environment and ageing-in-place from prespective of older people. To identify the challenges facing the establishment of age-friendly environments and ageing-in-place in type 2 community.	
Method	Interview, note taking, photography, mapping			Photography, mapping, note taking		Interview, note taking, photography, mapping	
Participants	Older residents who are living in the conmmunity 1			Researcher and assistant		Older residents who are living in the conmmunity 2	
Documentation	Audio recording, note taking, photos			Drawings, photos, note taking		Audio recording, note taking, photos	
Comments	4-5 participants each day, 12 in total. If the participant agree, researcher visited private home environment and take some photos. Based on the home environment checklist (Zhou & Li, 2018).			Based on the community environment checklist (Zhou & Qin, 2018).		4-5 participants each day, 13 in total. If the participant agree, researcher visited private home environment and take some photos. Based on the home environment checklist (Zhou & Li, 2018).	

Date	Week 3						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	2019-5-13	2019-5-14	2019-5-15	2019-5-16	2019-5-17	2019-5-18	2019-5-19
Phase	Phase 2 Case study						
Location	Case 2 (Community 2)		If the data collection has not been completed, to continue the task. To edit and sort data preliminarily.	Case 3 (Community 3)			
Task	In-depth interviews with older residents	Site visual surveys (Comunity public space)		In-depth interviews with older residents			Site visual surveys (Comunity public space)
Purpose	To explore the relationship between living environment and ageing-in-place from prespective of older people. To identify the challenges facing the establishment of age-friendly environments and ageing-in-place in type 2 community.	To understand the current built environment in the community public area. To find evidence to support data from interview.		To explore the relationship between living environment and ageing-in-place from prespective of older people. To identify the challenges facing the establishment of age-friendly environments and ageing-in-place in type 3 community.			To understand the current built environment in the community public area. To find evidence to support data from interview.
Method	Interview, note taking, photography, mapping	Photography, mapping, note taking		Interview, note taking, photography, mapping			Photography, mapping, note taking
Participants	Older residents who are living in the conmmunity 2	Researcher and assistant		Older residents who are living in the conmmunity 3			Researcher and assistant
Documentation	Audio recording, note taking, photos	Drawings, photos, note taking		Audio recording, note taking, photos			Drawings, photos, note taking
Comments	4-5 participants each day, 13 in total. If the participant agree, researcher visited private home environment and take some photos. Based on the home environment checklist (Zhou & Li, 2018).	Based on the community environment checklist (Zhou & Qin, 2018).		4 participants each day, 12 in total. No participant agreed home visit.			Based on the community environment checklist (Zhou & Qin, 2018).

Appendix 4.4 Interview questions

Interview questions with older people (Case Study):

Age	Gender	Living arrangement
		Spouse Children Grandchildren Alone Others_____

A: The conceptualisation of ageing-in-place

1. What do you think ageing-in-place means to you?
    您如何看待就地养老？

2. Do you prefer living in your private housing as long as possible? Why？
    您是否愿意尽可能长时间的居住在自己家中（而不是养老院）？为什么？

3. What are the challenges of achieving ageing-in-place in your experience？
    根据您的日常生活经验，您在就地养老的过程中面临着哪些挑战？

4. <u>For older people currently living with their children or grandchildren.</u> In your opinion, how can age-friendly housing support multi-generational living?
    <u>For older people who live alone or with spouse.</u> In your opinion, how can age-friendly housing support be living alone or with older spouse?
    <u>对于跟子女或孙辈居住在一起的老人。</u>您的居住环境是否能满足目前多代同堂的居住模式？

    <u>对于独自居住或与配偶居住在一起的老人。</u>您的居住环境是否能满足目前单独居住或与配偶居住的居住模式？

B: Mobility

5. What do you think about the mobility in the public area of the community?
    您认为您所居住的社区公共空间中的通行是否方便？

6. Is it convenient for you to get in/out your apartment, by lift or stairs? Do you use the handrail during taking the stairs? (If no lift: Do you want to add a lift in the building if possible?)
    请问您出入公寓时是否方便？是乘坐电梯还是走楼梯？您会使用楼梯扶手吗？（<u>对于没有配置电梯的社区</u>，您是否愿意在所居住的建筑中加装电梯？）

7. How about the mobility and use of fixtures and fittings within your home? What are the challenges and what retrofitting would you like to do?
    请问您在家中的通行是否方便？是否遇到什么不便？是否有安装一些辅助设施？

C: Sensory

8. Do you experience any sensory impairment? If so, how is this affecting your daily life activities?

您是否有经历什么感知方面的损伤（如听力、视力的老化）？如果有，是否影响您的日常活动？

9. What adjustments do you think will be needed to improve your living environment?
对于您所在的居住环境，在感知方面有什么改善建议？

D: Safety

10. How about the safety aspect in your home and in the community? Do you have any suggestions for improving this aspect? (such as the anti-slip and fall prevention facilities?)
您认为您所居住的住房和社区是否安全？您是否有什么改进的建议？（例如防滑防跌倒的设施方面）

E: Cognitive

11. Is your independence affected by the physical environment? what are the main underlying reasons? Any example?
您的生活独立性是否受到物理环境的影响？有哪些主要的潜在因素？可以举一些例子吗？

F: Social/Activity

12. Do you have enough living space to maintain your lifestyle, hobbies and social contacts? Do you often attend social activities? Where do you engage in activities? Do you think that the older people in your community require more public activity areas?
您有足够的生活空间来维持您的生活习惯、爱好和社交吗？您是否经常参加一些社会活动？一般在哪参加？您是否需要社区为老年人提供更多的公共活动空间？

G: Technology

13. Do you use any kind of technologies? (If yes: What Assistive Technologies can enhance your personal safety? What Assistive Technologies can enhance your health and well-being? What Assistive Technologies will support your daily activities?)
您是否有使用一些科技产品？（如果有，这些科技分别是什么？是否有助于您的安全、健康和日常活动？）

H: Home modification

14. Have you made any modifications/ adaptations to your current home due to above issues? Does the home modification helpful to daily life activities? Did you experience some difficulties during home modification?
您是否对您的家进行过适老化改造？这些改造是否有助于您的日常生活？改造过程中有什么困难？（如缺少专业的施工团队和设计人员

15. If not, do you want to conduct some home modification? Which aspect do you want to change? How much are you willing to spend for home modification?

如果未进行过适老化改造，您是否想对您的家进行改造呢？希望对哪个方面进行改造？愿意花多少钱改造？

16. Do you have any other suggestions about how the age-friendly living environment could be improved?

除了以上内容您是否还有其他的关于居住环境方面的建议或意见？

Interview questions with professionals:

Profession

Position

Experience related to age-friendly housing.

1. What is your understanding of ageing-in-place? In your opinion, do older people in urban China prefer to age-in-place or not, why?
    您如何理解就地养老？您认为中国城市中老年人愿意就地养老吗？

2. What are the challenges of older people achieving ageing-in-place in urban China in your opinion ?

    您认为目前中国城市中老年人实现就地养老的过程中面临着哪些挑战？

3. From your related work experience (of designing providing housing, policymaking) for older people, what would be the major factors to consider that can support their ageing-in-place needs? Can you prioritise these factors according to your opinion?
    根据您的相关从业经验（设计，政策制定，住宅开发），在满足中国城市老年人就地养老

    需要时，您认为有哪些主要的因素需要考虑？能否给出优先顺序？

4. In China, some <u>older people are currently living with their children or grandchildren.</u> In your opinion, how can we support multi-generational living by means of housing design (providing housing, housing with care)?
    对于中国城市中与子女或孙辈居住在一起的老年人，您认为在您的工作中（住宅设计，住

    宅开发，服务提供）可以如何促进多代同堂的居住模式？

5. In the housing projects, how can we future-proof housing needs as people get older?
    在住宅项目中，您如何看待住户未来老龄阶段的需求？（终生住宅）

6. What do you think about the home modification for the older residents? Does financial affordability affect older people's decision to refurbish and adapt their homes?
    您如何看待住房适老化改造？您认为经济承担能力是否影响老年人在住房改造方面的决

    定？

7. While conducting refurbishment, which elements or conditions of the existing environment could potentially become barriers?
    在进行住房改造时，现有环境的哪些因素可能成为潜在的障碍？

8. Do you think community care is important for ageing-in-place?
    您认为社区照料对就地养老是否重要？

9. Are you aware of government policies regarding the ageing industry in China? Do these policies influence or guide your work (design project, providing housing, policymaking) in any way?
    您是否有注意到中国有老年产业相关的政府政策出台？这些政策会影响或引导您的工作

    么？

10. Are you aware of any assistive technology which can provide or is providing support to older people so as to create a more independent, healthy, and safe living environment? Do you think assistive technology can support ageing-in-place?

您是否有注意到一些利于老年人独立生活、健康、安全的生活辅助科技？您认为这些科技是否有助于促进就地养老？

Architects only:

11. In what way can the design of community affect older people's independent living ability？

社区的设计如何影响老年人独立生活的能力？

12. Are you aware of any specific standards, or design guidelines for age-friendly environment? How important do you think these standards or design guidelines are? Do you refer to those during the design process? What other standards are needed?

您是否有注意到一些专门的与适老化环境相关的规范或设计指南？您认为这些规范或设计指南是否重要？您在设计过程中是否会参考？

Appendix 4.5 Ethics approval letter

Yiru Pan
Registration number: 170266453
School of Architecture
Programme: Architecture (PhD/Architecture FT) - ARCR131

Dear Yiru

PROJECT TITLE: The role of age-friendly environments in promoting ageing-in-place in urban China
APPLICATION: Reference Number 023382

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 12/04/2019 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 023382 (form submission date: 10/04/2019); (expected project end date: 01/12/2020).
- Participant information sheet 1056590 version 1 (22/02/2019).
- Participant consent form 1056591 version 1 (22/02/2019).

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Your responsibilities in delivering this research project are set out at the end of this letter.

Yours sincerely

Chengzhi Peng
Ethics Administrator
School of Architecture

Please note the following responsibilities of the researcher in delivering the research project:

- The project must abide by the University's Research Ethics Policy:
  https://www.sheffield.ac.uk/rs/ethicsandintegrity/ethicspolicy/approval-procedure
- The project must abide by the University's Good Research & Innovation Practices Policy:
  https://www.sheffield.ac.uk/polopoly_fs/1.671066!/file/GRIPPolicy.pdf
- The researcher must inform their supervisor (in the case of a student) or Ethics Administrator (in the case of a member of staff) of any significant changes to the project or the approved documentation.
- The researcher must comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data.
- The researcher is responsible for effectively managing the data collected both during and after the end of the project in line with best practice, and any relevant legislative, regulatory or contractual requirements.

Appendix 4.6 Participant Information Sheet

Study title: The role of age-friendly environment in promoting ageing-in-place in urban China

Invitation to take part in this study:
You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

1. **Purpose of the study:**
China is experiencing an ageing population in line with global demographic trends. This research aims to explore the age-friendly living environment requirements of older people in urban China. It seeks to develop a holistic framework to guide retrofitting of housing environments and design of new mainstream housings in order to overcome the physical and social change associated with ageing so that older people can live independently for longer and ageing well and avoid or delay the move to residential care.

2. **Why you have been invited to participate:**
As part of the research, we would like to interview older people (60 and above) who live in the mainstream housing communities in urban China, and also multi-stakeholders, such as architects, policymakers, housing providers, related researchers. I would like to gather information on participants' perspectives about the role of age-friendly built environment in promoting ageing-in-place, which aims to provide an age-friendly living environment for older people living in private housing.

3. **Do I have to take part?**
You do not have to take part. This is entirely voluntary. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form and you can still withdraw at any time without it affecting any benefits that you are entitled to in any way and do not have to give a reason.

4. **What will happen to me if I take part?**
You will be interviewed in Phase 1 and Phase 2 (or participant in a focus group in Phase 4). The interview should take approximately 30-40 minutes. The interview will be audio-recorded for transcription, and all information used will be anonymous. If audio recording is not acceptable, then hand-written notes will be undertaken. Interview questions will be based on your personal experiences to understand your attitudes about ageing-in-place and your requirements of the age-friendly living environment. There are no costs or risks associated with this activity. The set of open-ended questions are used for the interview to elaborate the opinions and views if you decided to take part.

5. **What are the possible disadvantages and risks of take part?**
The research does not include any activities aim to shock or offend participants. Participating in the research is not anticipated to cause you any disadvantage or discomfort. No potential physical or psychological harm or distress is expected.

6. **Can I withdraw from this study?**
You will be able to stop the interview at any time, and you do not have to answer any questions, but it will not be possible to remove the data from the study up until final analysis has been undertaken.

7. **What are the possible benefits of taking part?**
Whilst there are no immediate benefits for those people participating in the projects, you will be able to inform the research by sharing your experience and opinion of living in mainstream housing or related work. This will inform the research findings and design and policy framework for age-friendly environments to support ageing-in-place.

8.   Will my taking part in this project be kept confidential?

All the information that we collect about you during the course of the research will be kept strictly confidential. Data will be anonymized. You will not be able to be identified in any reports or publications.

9.   What is the legal basis for processing my personal data?

According to data protection legislation, we are required to inform you that the legal basis we are applying in order to process your personal data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further information can be found in the University's Privacy Notice https://www.sheffield.ac.uk/govern/data-protection/privacy/ge

10.   Will I be recorded, and how will the recorded media be used?

The interview will be audio record. Your answers will be recorded and analysed by the researcher self, and all the records will be stored in a form protected by passwords or in a locked space. The original recordings will be destroyed after the research finished.

11.   What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

You will be asked some interview questions based on your personal experience. Interview questions will target at your opinions of ageing-in-place, physical design features of the housing and community. In order to identify the role age-friendly environment in promoting ageing-in-place in urban China context, it is vital to understand the current perspectives of older people and multi-stakeholders, such as architects, policymakers, and housing providers. Your participation is very important for us, and it will help us to identify the meaning and value of age-friendly environment to improve older people's ability to age-in-place.

12.   What will happen to the results of the research study?

It will be disseminated widely: at a research seminar and a conference, and a paper will be published in an academic journal. We will send you a copy of the final report and we will invite you to attend the research seminar if you are happy to be involved. Due to the nature of this research, it is very likely that other researchers may find the data collected to be useful in answering future research questions. We will ask for your explicit consent for your data to be shared in this way and if you agree, we will ensure that the data collected about you is untraceable back to you before allowing others to use it

13.   Who is organising and funding the research?

This research is self-funded by the individual researcher Yiru Pan.

14.   Who has ethically reviewed the project?

This research has been ethically approved via the School of Architecture's ethics review procedure. The University's Research Ethics Committee monitors the ethics application.

15.   What do I do if I have any issues or complaints ?

If you have any complaints about this research or researchers, or if you are unhappy, please feel free to let me know by contacting myself or my supervisor.

16.   What will happen if I want to stop taking part?

You can withdraw at any time, without explanation.

Contact for Further Information

If you have questions about this study and the interview, please contact Yiru Pan, The School of Architecture, The University of Sheffield, Arts Tower, Western Bank. Sheffield S10 2TN, UK Email: ypan13@sheffield.ac.uk If you have any complaints about this research or researchers, please contact Professor Karim Hadjri, School of Architecture, The University of Sheffield, Arts Tower, Western Bank, Sheffield S10 2TN, UK. Email: k.hadjri@sheffield.ac.uk

Appendix 4.7 Participant Consent Form

Please tick the appropriate boxes	Yes	No
I have read and understood the project information sheet dated (___/___/_____) or the project has been fully explained to me. (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.)		
I have been given the opportunity to ask questions about the project.		
I agree to take part in the project. I understand that taking part in the project will include being interviewed with audio recorded (For Phase 1 and Phase 2).		
I agree to take part in the project. I understand that taking part in the project will include participating in a focus group with audio recorded (For Phase 4).		
I understand that my taking part is voluntary and that I can withdraw from the study at any time before final analysis has been undertaken; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw.		
I understand my personal details such as name, phone number, address and email address etc. will not be revealed to people outside the project.		
I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.		
I understand and agree that other authorised researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form.		
I understand and agree that other authorised researchers may use my data in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.		
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield.		

Name of participant [printed]   Signature   Date

Name of Researcher [printed]   Signature   Date

Appendix 7.1 Raw data for Figure 7.20 Overview of the comparison between older people group and the experts group in the built environment

Main category of older people group	Sub-category of older people group	Sub-category of experts group	Main category of experts group	
Mobility	Stairs only, no lift	Safety	Design of age-friendly environment	
		Mobility	Design of age-friendly environment	
		Original building layout and structure	Home modification	Retrofitting of existing apartment and community environment
		Design standards	Design of age-friendly environment	
		Limited space	Community retrofitting	Ditto
		Cost sharing	Community retrofitting	Ditto
		Policy support	Community retrofitting	Ditto
		Practical guidance	Community retrofitting	Ditto
		Flexibility	Ageing process and lifetime needs	
	Wheelchair accessibility	Mobility	Design of age-friendly environment	
		Design standards	Design of age-friendly environment	
		Social needs (Chapter 8)	Design of age-friendly environment	
		Original building layout and structure	Home modification	Ditto
		Limited space	Home modification	Ditto
		Policy support	Community support and management	
		Public awareness	Community retrofitting	Ditto
		Limited space	Community retrofitting	Ditto
		Built environment maintenance	Community support and management	
		Parking management	Community support and management	
		Policy support	Community support and management	
		Dynamic demand	Ageing process and lifetime needs	
		Flexibility	Ageing process and lifetime needs	

Mobility	Road obstacle	Safety	Design of age-friendly environment	
		Mobility	Design of age-friendly environment	
		Built environment maintenance	Community support and management	
	Discontinuous accessibility	Mobility	Design of age-friendly environment	
		Design standards	Design of age-friendly environment	
		Original building layout and structure	Home modification	Ditto
		Limited space	Community retrofitting	Ditto
		Policy support	Community retrofitting	Ditto
		Built environment maintenance	Community support and management	
		Parking management	Community support and management	
		Flexibility	Ageing process and lifetime needs	
	Lack of handrail and ramp	Safety	Design of age-friendly environment	
		Mobility	Design of age-friendly environment	
		Design standards	Design of age-friendly environment	
		Original building layout and structure	Home modification	Ditto
		Limited space	Community retrofitting	Ditto
		Policy support	Community retrofitting	Ditto
		Practical guidance	Community retrofitting	Ditto
		Built environment maintenance	Community support and management	
		Dynamic demand	Community support and management	
	Limited parking space	Mobility	Design of age-friendly environment	
		Design standards	Design of age-friendly environment	
		Limited space	Community retrofitting	Ditto
		Policy support	Community retrofitting	Ditto
		Limited space	Community support and management	
		Built environment maintenance	Community support and management	
		Parking management	Community support and management	
		Dynamic demand	Ageing process and lifetime needs	

Mobility	Limited parking space	Flexibility	Ageing process and lifetime needs	
	Indiscriminate parked bicycles	Mobility	Design of age-friendly environment	
		Public awareness	Community retrofitting	Ditto
		Limited space	Community support and management	
		Parking management	Community support and management	
Safety	Slippery and uneven ground	Safety	Design of age-friendly environment	
		Design standards	Design of age-friendly environment	
		Older people's awareness	Home modification	Ditto
		Policy support	Community retrofitting	Ditto
		Built environment maintenance	Community support and management	
		Service	Community support and management	
	Fire or medical emergencies	Safety	Design of age-friendly environment	
		Design standards	Design of age-friendly environment	
		Original building layout and structure	Home modification	Ditto
		Limited space	Community retrofitting	Ditto
		Policy support	Community retrofitting	Ditto
		Practical guidance	Community retrofitting	Ditto
		Public awareness	Community retrofitting	Ditto
		Built environment maintenance	Community support and management	
		Service	Community support and management	
		Parking management	Community support and management	
		Policy support	Community support and management	
		Dynamic demand	Ageing process and lifetime needs	
		Flexibility	Ageing process and lifetime needs	
	Theft	Safety	Design of age-friendly environment	
		Security	Community support and management	
	Monitoring system	Safety	Design of age-friendly environment	
		Security	Community support and management	

Safety	Monitoring system	Financial issue	Community support and management	
		Policy support	Community support and management	
	Psychological security	Safety	Design of age-friendly environment	
		Sensory	Design of age-friendly environment	
		Cognitive	Design of age-friendly environment	
		Original building layout and structure	Community retrofitting	Ditto
Sensory	Easily awakened by the noise	Sensory	Design of age-friendly environment	
		Construction waste and noise	Community retrofitting	Ditto
		Prefessional designer and workers	Home modification	Ditto
		Dynamic demand	Ageing process and lifetime needs	
	Sense of hearing	Sensory	Design of age-friendly environment	
		Prefessional designer and workers	Home modification	Ditto
		Sensory	Design of age-friendly environment	
		Prefessional designer and workers	Home modification	Ditto
	Temperature sensitive	Sensory	Design of age-friendly environment	
		Prefessional designer and workers	Home modification	Ditto
		Dynamic demand	Ageing process and lifetime needs	
	Landscape needs	Sensory	Design of age-friendly environment	
		Social needs (Chapter 8)	Design of age-friendly environment	
		Limited space	Community support and management	
		Blockage of views	Community retrofitting	Ditto
		Built environment maintenance	Community support and management	
		Community sanitation	Community support and management	
Cognitive	Rely on familiar surroundings	Cognitive	Design of age-friendly environment	
		Prefessional designer and workers	Home modification	Ditto
		Flexibility	Ageing process and lifetime needs	
		Needs Classification	Ageing process and lifetime needs	

Cognitive	Way finding	Cognitive	Design of age-friendly environment	
Technology	Hard-to-operate	User-friendly technologies	Lack of professionals and technologies	
	Unaffordable price	Affordability	Home modification	Ditto
n/a	n/a	Targeted policy support	Ageing process and lifetime needs	
n/a	n/a	Architects	Lack of professionals and technologies	
n/a	n/a	Policymakers	Lack of professionals and technologies	
n/a	n/a	Care providers	Lack of professionals and technologies	
n/a	n/a	Property managers	Lack of professionals and technologies	

Appendix 8.1 Raw data for Figure 8.6 Overview of the comparison between older people group and the experts group in the social aspect

Main category of older people group	Sub-category of older people group	Themes of older people group	Themes of experts group	Sub-category of experts group	Main category of experts group
The value of social networks for older people	Social contacts	Family ties	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks
	Social contacts	Family ties	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Neighborhood	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Friend (as well as former classmates and colleagues)	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Friend (as well as former classmates and colleagues)	Social cohesion	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Friend (as well as former classmates and colleagues)	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Community workers (including government officers, property managers, care providers)	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Community workers (including government officers, property managers, care providers)	Social cohesion	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Community workers (including government officers, property managers, care providers)	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Diversified social relationships	Living arrangements and intergenerational households	Social contacts	Supporting individuals to maintain social networks

The value of social networks for older people	Social contacts	Diversified social relationships	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Diversified social relationships	Social cohesion	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Diversified social relationships	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Move to a nearby place to maintain existing social contacts	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks
	Social contacts	Move to a nearby place to maintain existing social contacts	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Move to a nearby place to maintain existing social contacts	Social cohesion	Social contacts	Supporting individuals to maintain social networks
	Social contacts	Move to a nearby place to maintain existing social contacts	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Daily routines	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks
	Personal lifestyle	Daily routines	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Daily routines	Social cohesion	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Daily routines	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Personal hobbies and interests	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks
	Personal lifestyle	Personal hobbies and interests	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Personal hobbies and interests	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Participation in physical exercise	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks

The value of social networks for older people	Personal lifestyle	Participation in physical exercise	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	Participation in physical exercise	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	The company of peers	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks
	Personal lifestyle	The company of peers	Community engagement and participation	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	The company of peers	Social cohesion	Social contacts	Supporting individuals to maintain social networks
	Personal lifestyle	The company of peers	Familiar environment and people with a sense of safety and security	Social contacts	Supporting individuals to maintain social networks
Older people's needs for support and service	Informal and formal support	Meal service	Meal service	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Informal and formal support	Cleaning/housework assistance	Cleaning/housework assistance	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Informal and formal support	Mobility service	Mobility and transport service	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Informal and formal support	Shopping and delivery service	Shopping and delivery service	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Informal and formal support	Visiting and accompany	Visiting	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Informal and formal support	Health service (Medical/Nursing)	Medical	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Informal and formal support	Health service (Medical/Nursing)	Nursing	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations

Older people's needs for support and service	Informal and formal support	Emergency	Emergency	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Main influence factors	Health status			
	Main influence factors	Living arrangements	Living arrangements and intergenerational households	Family structure	Supporting individuals to maintain social networks
The role of technology in support social aspect for older people	Benefits	Reducing physical exertion			
	Benefits	Enabling online social network			
	Benefits	Obtaining information and knowledge			
	Benefits	Reducing loneliness			
	Benefits	Enhancing safety and sercurity			
	Technology acceptance	Usefulness	Usability	Technology acceptance	Developing the technology that older people want
	Technology acceptance	Usefulness	Older people's awareness of their vulnerability and need for help to maintain independence	Technology acceptance	Developing the technology that older people want
	Technology acceptance	Ease of use	Usability	Technology acceptance	Developing the technology that older people want
	Technology acceptance	Privacy	Privacy and security	Potential negative effect	Developing the technology that older people want
	Technology acceptance	Personal economic security	Privacy and security	Potential negative effect	Developing the technology that older people want
			Bathing and washing	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
			Entertainment	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations

	Chatting	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Learning	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Spiritual comfort	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Setting up family beds for the older people	Support and service from community care centre (Formal support)	Providing support and service from the community and organizations
	Accessibility	Technology acceptance	Developing the technology that older people want
	Affordability	Technology acceptance	Developing the technology that older people want