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Assessing Sustainable Urbanism In Emerging Chinese Edge Cities: The Case Of Beijing

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Abstract

China has experienced rapid development over the last few decades, with more and more cities becoming metropolitan cities. Such massive concentrations of people have led to the expansion of urban centres, resulting in urban transformation and agglomeration in urban periphery areas. During the rapid development phase, the main objective of cities is to meet the functional demand of people, often to the detriment of sustainable urban design from a human scale perspective. However, as the economy grows, people's needs also grow beyond the merely functional, and their sense of identity and how they experience a place increases.

Against this background, the main objective of this study is to investigate the current state of urbanism in Chinese edge cities and to understand the current performance of this urban structure. To do this, the study explores the present spatial structure of edge cities, typical everyday activities and resulting experiences to identify both the potentials and constraints for an increasing place attachment rooted in walkable environments.

For these purposes, a theoretical framework is used in combination with both quantitative and qualitative analyses to discuss two cases of emerging edge cities in Beijing. The quantitative surveys mainly consist of mapping spatial conditions by using GIS data and Space Syntax to analyse the existing urban structure and its key centralities. Qualitative surveys are urban studies that analyse typical scenario-based everyday activities and experiences of the place via field studies to identify some essential factors promoting or discouraging walks instead of other means of mobility.

An analysis of the Beijing Economic-Technological Development Area (BDA) and Zhongguancun Science Park - Haidian Sub-Park (HSP) shows that most Chinese edge cities start as development zones and gradually develop into edge cities. But based on the research findings, Chinese edge cities are functional entities with high urban densities and a sufficient supply of public transit, however the pedestrian experience suffers from large block sizes and a strict mono-functional land-use distribution discouraging everyday walks, which are essential to diversify spatial developments in future and to establish a unique imageability promoting place attachment.

Key words: Urban design, Chinese urbanisation, integrated urbanism, sustainable city, edge city, polycentric development

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Chapter 1 Introduction

1.1 Research background

Following four decades of unprecedented urban growth in China, there is increasing interest among academia and the government in the future development of smaller towns and cities and rural areas. While the megacities have absorbed finance, development and populations since the early 1980s, the rural areas and smaller cities have been neglected. In this regard, Premier Li (2019) announced at the 13th National People's Congress of the People's Republic of China that China will promote coordinated development across regions and improve the quality of new urbanisation. Today, with China's more advanced economy, significant changes are occurring in employment due to a shift from an industrial to a service sector-led economy. As a result, a significant number of former factory workers are re-migrating back to their hometowns alongside government efforts to boost the economies of third tier and smaller cities (Dou, 2003). Built cities in the periphery area are therefore an inevitable development trend which can improve the quality of life of the rural population and facilitate the efficient and intensive use of rural land. They can also alleviate the problems of megacities caused by an excessive concentration of the urban population.

The planning of small urbanisation in rural areas requires a reasonable allocation of public facilities and infrastructure in accordance with the town's specific location, population scale, geographical conditions and unique, local characteristics and culture to create effective environments that will improve the quality of life of the locals. Premier Li (2019) has mentioned that to address unbalanced and insufficient development, China should reform and refine the relevant mechanisms and policies to equalise access to basic public services, to enable regions to complement each other with their respective strengths and to promote integrated urban-rural development. In the regeneration and creation of holistically sustainable urban and rural environments outside of large cities, it is essential not to simply imitate large cities. The infrastructure and public facilities need to be designed according to the local characteristics. The dormitory towns created should be inherently flexible and sensitive to local conditions.

Against this background, the development of remote areas in big cities is an emerging research area in China. It is important to conduct targeted research to ensure that this new era of development is carried out sustainably and sensitively. For this purpose, further study and consideration are needed to find appropriate methods or principles. Compared to Western countries, the urbanisation development of China is generally younger. In the last century, some developed countries have reached a high level of urbanisation. These countries have already completed the urbanisation process of the return of rural populations and even the relocation of urban populations to rural areas. This means that the theoretical research on urbanisation in Western countries is much more mature than in China, where the scope for research is much wider. Moreover, some Western researchers and academic opinions have a more significant influence globally.

In 1991, Joel Garreau first proposed the concept of the edge city to describe the third stage of development of the suburbanisation of America. In his work *Edge City: Life on the New Frontier*, he explained the phenomenon and principle of the edge city. As the city expands its land use, the land use range rapidly decreases in the suburb area. Therefore, after suburbanisation in the near suburb area, the city must expand to the far suburb area in the form of an edge city. With the transformation of the city's function and the regrouping of the city space, the city's structure also transforms from single-centre to multi-centre as new concentration centres arise in the suburbs. These new concentration centres function like traditional residential and business centres. As a result, the city changes its population, logistics and information flow, energy cycle and space state, thus creating the edge city. Although called a city due to its perfect function and independence, it is actually a result of suburbanisation, promoting spatial integration in emerging centres in the periphery of metropolitan cities (Sieverts, 2004 p.41).

Compared to the American edge city, which is the result of a natural suburbanisation process, the motivations behind the formation mechanism of the Chinese edge city are more strategic because of the government's participation. In the 1980s, urban governance planned and promoted specific economic development zones in Chinese mega cities such as Beijing, which established the first national economic development zones. Initially, more attention was given to economic development rather than the functions of the overall city. In addition, more importance was placed on the construction of infrastructure and the launch of industrial land rather than on residential land and the construction of public service facilities due to factors relating to market regulation and the distribution of construction funds. The imbalance of the land is the direct reason for inequality in employment and the residential population. This will cause many problems such as bad commuting traffic and low quality of life.

Over the last 30 years, Beijing has become more stable in terms of its economic and space development, and is showing a developing trend of industry transformation, function adjustment and space restructure (Wei, Chen and Lu, 2016). With the perfection of the industry development and increase of the population, Beijing has transformed from a single industry concentration area to a comprehensive new city that integrates housing, employment and a perfect infrastructure and public service system. The trend for most developing areas in China is to transform from being industry-based to an integration of industry and city. While these first planned edge cities were mainly defined by industry, accommodation for factory workers and basic services, the economic growth and diversification of mega cities over the last 20 years have led to new development trends in those urban peripheries: most manufacturing industries have been gradually replaced by new logistics centres and technology parks, attracting emerging and well-connected knowledge economies (Zhao and Peng, 2000).

The overall speed of the economic and spatial development in Chinese mega cities has, however, been based on a predominantly infrastructure-led and thus supply-driven development pattern by securing functional but highly regulated urban spaces. Thus, the main research aim of this paper is to investigate the general performance of the integration of everyday life in those new cities and the resulting experiences in order to discuss the current state of edge cities. Using Beijing as an example, this study investigates whether the new development zones can achieve a balance between employment and residence and provide a good quality of life to residents by encouraging daily interaction with the surrounding urban environment, leading to the experience of these zones as emerging edge cities. To maintain a stable development, the development zone should be attractive enough in terms of housing and employment as well as recreational and cultural activities. This study is rooted in architecture and social sciences, focusing on the complex relationship between people and their surrounding built environment. This study will thus analyse and evaluate two development zones in terms of spatial patterns (e.g. densities, blocks sizes) as well as everyday activity patterns and the resulting experiences.

1.2 Research gap

The current situation in China's development zones shows that most of them place a higher priority on economic development than on integrated urban development. Taking into account the laws of the market and the allocation of funds for development and construction, the development zones place more emphasis on infrastructure, industrial land and the development of residential land and public services to meet people's demands in their daily lives. As a result, most of the research at this stage is focused on how a development zone can bring about its economic effects while meeting the functional needs of people in their daily lives.

The research gap that gave rise to the present study is mainly rooted in the fact that most development zones in mega urban agglomerations have only been completed and inhabited for less than one or two decades and thus there have been hardly any studies on these emerging edge cities and their present stage of development. The present study investigates integrated urbanism in emerging edge cities in Chinese mega-urban agglomerations. Integrated urbanism means a place in which people can move around efficiently, find a significant diversity of markets and feel attached because of an emerging identity. This requires a high level of spatial integration, well-balanced densities and a broad range of activities in central places. However, the development of marginal areas in China has focused more on the functional satisfaction of space and neglected the issue of place-making. This has resulted in a monotony of place, with many cities lacking their own unique identity and characteristics and citizens who feel no sense of belonging to the place where they live and work. People's daily activities on a human scale are also neglected due to the gap in research and design. As a result, these places are not sustainable for people and have very low accessibility despite their functionality. From an urban design and urban sociology perspective, the application of a theoretical framework to the analysis of the current state of development in development zone via the lens of integrated urbanism and the edge city can potentially yield valuable insights.

Existing studies on Chinese mega cities and the polycentric city have been conducted from the perspective of urban planning or geography and not from the perspective of urbanism and the relationship between people and places. The existing studies usually use a descriptive approach to summarise the current state of development in development zones without using a theoretical framework. Surveys of edge city use behaviour do not provide an analysis of sustainability issues and human scale and lack the support of a more qualitative approach. Therefore, a mixed-methods study is appropriate to understand the current situation of edge cities in China and how they work.

1.3 Research questions and methodology

An edge city should be attractive to people. The attraction comes from the infrastructure and perfection of living, employment, leisure, life and other aspects, and the quality of life and experience that can be provided for residents under the comprehensive effect of these factors. Quality of life can also be measured and judged by the convenient and fast use of various urban public facilities or walking and whether it takes too long to commute to work. China's development zones are moving from a single function to a comprehensive development path. More and more of them take on a specific scale on the periphery area of mega cities. However, the question of whether those edge cities can function as true cities or whether they still need to be attached to the big cities needs to be further explored. So the main research question of this thesis is how integrated is the everyday urban life in emerging edge cities in China？

For this purpose, the transformation of Beijing's entire urban periphery will be studied in order to identify the emerging places that already have an integrated urbanism. The research will focus on spatial patterns, everyday destinations and resulting everyday experiences of representative walks The aim is to assess the actual emerging reality regardless of what the planned vision may be. This will provide the answer to the key and final research question of how edge cities in China are perceived today and why. In other words, this thesis will evaluate whether these periphery development zones can be regarded as an edge city with its own city centre and residents who have an excellent experience of daily life or as a development zone that still shares a central area with Beijing and residents who only sleep and work there.

This study will also explore a special challenge of these peripheral areas, which is whether the people living in these places really enjoy them, have a sense of belonging to them and whether these places have a space identity. Since most of these fringe areas have no history in China, they are the product of rapid development and construction. More specifically, when people talk about where they live, do they have in mind the metropolitan city or the specific edge city in which they live? Therefore, the research question will focus on how edge cities are perceived today in China and why.

In order to better study Chinese edge cities, a combination of qualitative and quantitative methods is used to explore the current state of development from the perspectives of urban design, humanities and urban sociology. For the case studies, the primary approach consists of mapping the urban development before and after in order to identify the spatial transformation and to evaluate the impact. The analysis of the case study will include a macro-scale approach to mapping and space syntax analysis in order to identify the local urban spaces and then investigate them on a smaller scale. This leads to a specific analysis of diversity, efficiency and identity in China's edge cities from the perspective of integrated urbanism.

1.4 Thesis structure

This thesis is divided into three parts: introduction, main body and conclusion(Table 1). Chapter 2 focuses on Chinese urbanisation and the need for edge cities. In this chapter, the concept of the edge city is examined in the context of urbanisation and its development in the world. The current development and characteristics of edge cities are examined from a global perspective. Chinese urbanisation is then analysed, including the development context of China, China’s development over the past decades and the effectiveness of the policy for the development of marginal and rural areas. This chapter also summarises the characteristics of China's edge cities.

Chapter 3 focuses on the role of the theme of this thesis, defining the field of sustainable integrated urbanism and the factors that make people attach themselves to a place to establish an edge city. This chapter also discusses the importance of urbanism and place in the study of emerging edge cities.

Chapter 4 illustrates the importance of interdisciplinary and mixed research in understanding the current state of Chinese edge cities and exploring how they work. This chapter also introduces the use of a combination of qualitative and quantitative surveys to analyse case studies.

Chapter 5 analyses Beijing's polycentric development pattern, which includes spatial transformation, transport development and population aggregation. And then analysis of Beijing's global integration through spatial syntax to understand the development pattern and form of development zones in Beijing. This chapter will be focused on the selection of these two case studies and give an explanation as to why they were chosen.

Chapters 6 and 7 provide a detailed analysis of the two cases in the form of mapping. First, provide the background of the cases includes their economic things and leading industries. Then the historical map, urban patterns, activities patterns and experience patterns of the two cases are analysed in the form of mapping.

Chapter 8 begins with a comparative analysis of the global and local integration of the two cases using spatial syntax. And then evaluates the two case studies includes three aspects: diversity, efficiency and identity. Chapter 9 summarises the findings of the research and discusses possible policy recommendations for the current situation of marginalised cities in China.

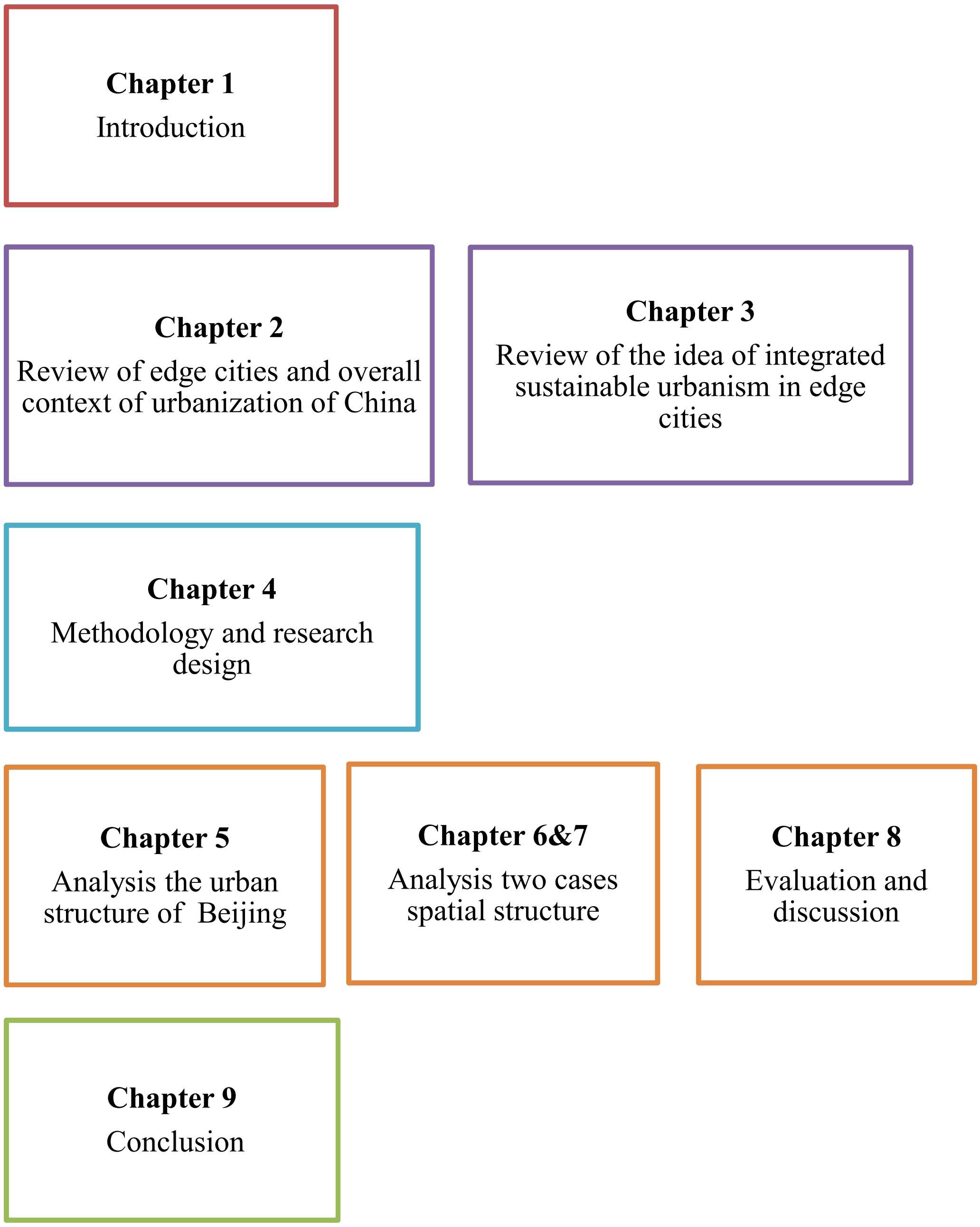


Table 1: Thesis structure (Source: author)

Chapter 2 Chinese urbanisation and edge cities

This chapter analyses urban development and edge cities in China. Section 2.1 contains a background of the literature on edge cities around the world. It describes the emergence and formation of the edge city phenomenon and summarises Garreau's definition of the edge city in order to introduce the characteristics of the edge city. Section 2.2 describes the formation of urban sprawl and urbanisation in China and China's policy strategies regarding edge cities at the national level. Section 2.3 analyses the development patterns of edge cities in China. Section 2.4 summarises the chapter and refers to the goal of integrated urbanisation.

2.1 The idea of edge cities from a global perspective

2.1.1 The formation of edge cities

After Western countries underwent rapid urbanisation, more and more cities in the West entered the vicious cycle caused by high urbanisation, which has resulted in the migration of urban residents to the suburbs (Krisjane and Berzins, 2012). Shen and Wu (2013) added that with the aggregation and expansion of the downtown area, the urban population, industry and business went through an inside-out centrifugation and urban transformation. In their case, a propensity to suburbanisation also gradually arose. The phenomenon continued to boost the market requirements and provide prerequisites and possibilities for suburbanisation(Amati and Yokohari, 2007). In this sense, Kundu (2003) indicated that the urban periphery areas can be seen as one of the inexorable outcomes of suburbanisation when urbanisation in developed countries reached a higher level. Edge cities were naturally places on the fringe of metropolitan cities with the full set of urban functions, including work, life and leisure that evolved out of the original suburb (Garreau, 1991, p.315).

The idea of the edge city was first proposed by *Washington Post* journalist Joel Garreau in 1991 in his book entitled *Edge City*. Suburbanisation in America began in

1920. The social transition in American cities took place in three waves and the urban morphology has changed significantly. The first wave was population living suburbanisation. The second wave was business suburbanisation. The third wave was all-around suburbanisation of employment. Edge cities also emerged out of this phase. In this period, a series of urban problems occurred, including overcrowding, increasing crime rates and the deterioration of the environment in the downtown area (Buchsbaum, 1999,p.823). Following this, the city took on an entirely new look due to the construction of expressways and the widespread popularity of household cars since 1956 (Ruchelman, 2007, p. 14). Therefore, Joel Garreau proposed the concept of edge cities (Figure 1). He believes that suburbanisation has promoted the development of marginal cities in the United States, especially after World War II. Edge cities represent the third wave of our lives pushing into new frontiers in this half-century(Garreau, 1991, p. 4).

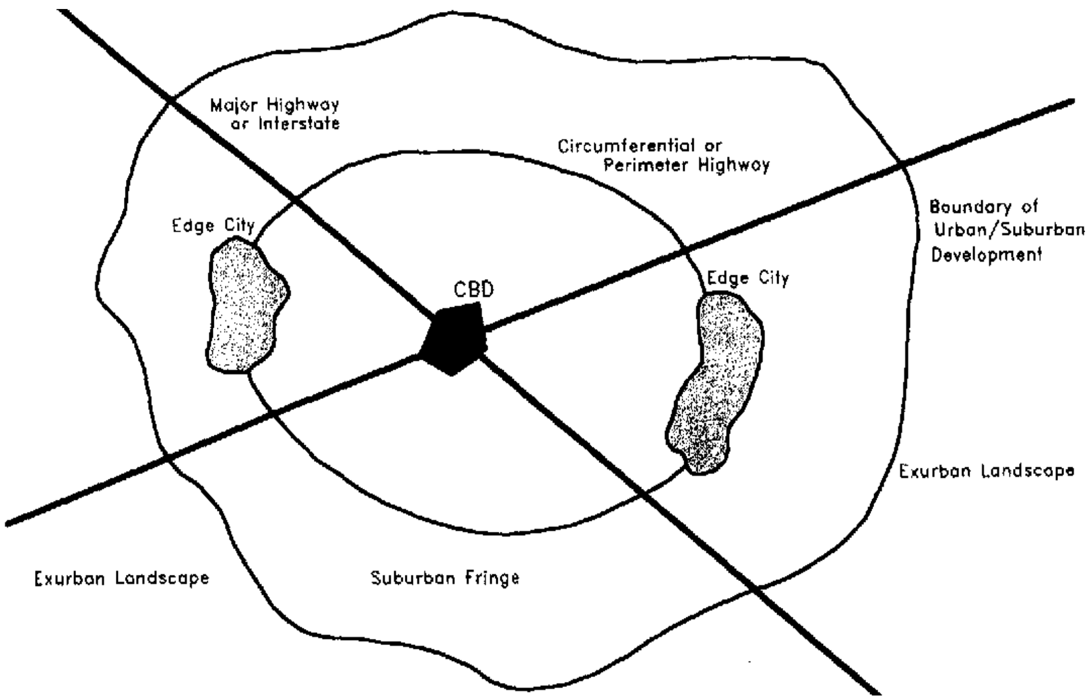


Figure 1: The diagram of the location of the edge cities. (source: Nelson 1993)

Population suburbanisation was the driving force for the formation of the edge city, which was one of the main characteristics of urban development in America after the

1950s(Guest, 1975). Garreau (1991, p. 154) has described how millions of people with a ‘get-up-and-go’ attitude got up and left their towns entirely. This is the largest internal population shift in American history. In 1950, the suburban population made up 26% of the gross population in America. The proportion later increased up to 48% until 1990.Simultaneously, the proportion of the population living in central cities decreased from 35% in 1950 to 29% in 1990 (Zhang, 2003, p.1).

Plenty of issues in central cities such as high crime rates, drug trafficking, expensive housing, high taxes, traffic jams, poor education and severe environmental pollution forced more urban residents to migrate to the suburbs. The suburbs formed a sharp contrast with the central city because of the fresh air, elegant environment, high public security and low tax rate. Such advantages consequently encouraged the migration of urban residents. In addition, in order to ensure a supply of housing, the government provided preferential taxation and fiscal policies such as instalment plans, housing loans, tax savings, etc. This was consistent with the enduring wish of Americans to have an individual residence. Government sponsorship pushed forward the growth of edge cities. The popularity of cars and the extension of road networks (Figure 2) made

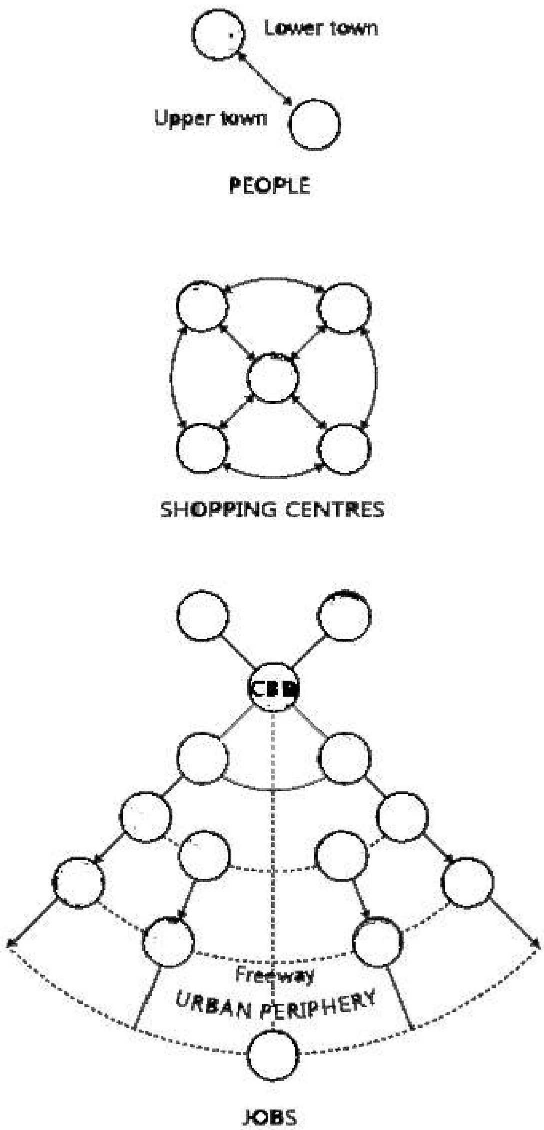


Figure 2: The formation of the American edge city. (source: David and Yosra 2001)

mid- and long-distance commuting convenient and formed a basic urban structure in which people lived in the suburbs and worked in the city (Zhou and Zhang, 2015).

At the same time, the industrial structure also changed in America, with companies enriching the functions of edge cities. In America, with the progressive decline of the proportion of primary and secondary industry in the economy, the manufacturing industry, the high-tech industry and the tertiary industry saw a steady rise to a dominant status (Bingham and Kimble, 1995). According to Beauregard (1995), by virtue of the small coverage of land, high efficiency and superior transport, these industries undermined the reliance of traditional industries on geographical location but posed demanding requirements for environment and quality of the labour force, while the edge area exactly satisfied the demand for its graceful surroundings and high-quality labour force. In addition, Garreau(1991, p. 111) claimed that women made up a larger part of the entire labour market. This means that women began to assume responsibilities for both family and work. As a consequence, it was quite natural for suburban residents to work in a place close to their residence. The aforementioned factors contributed to the outward migration of employment. In 1970, only 25% of enterprises were headquartered in the suburbs. In the mid-1980s, offices on the fringes of New York had overtaken offices in Manhattan city centre. Yet the figure went up to 60% by 1990 (Garreau 2011, p. 120). Apart from emerging enterprises, many large enterprises successively relocated their headquarters from downtown skyscrapers to the suburbs. An example from Garreau (1991, p. 26) is the move by AT&T of its headquarters from Manhattan to an edge city of New Jersey(Figure 3). In the late 1980s, New Jersey's edge cities grew more rapidly and generated more jobs than the entire state of New York. These edge cities now function as their own independent entities.

Figure 3:AT& T corporate office in New Jersey. (source: Buckley 2016)

The rise of commercial use was also inseparable from the formation of edge cities. As the population and businesses migrated outward to the edge area, it became necessary to transform the service industry in order to support the growth of businesses in the suburbs .Also, since residents try to avoid going downtown, shopping is done in edge cities(Garreau,1991, p. 201). Many new commercial facilities have sprung up in the suburbs and a typical example is the shopping mall. The original urban business area was non-adaptable to conventional modes of shopping. With the high density of buildings, the limited size of parking lots, high parking fees and traffic congestion, heavy reliance was placed on transport by car. A large regional supermarket was often located near an inter-state expressway intersection and a vast parking space built for convenience of transport flow(Garreau,1991, p. 156). Pain (2012, p. 23)suggests that the reason for this was the cheap price of land and the low tax rate in large supermarkets, resulting in a low operating cost and more competitive prices for products. Most supermarkets also offered advanced facilities and elegant, safe and fully functional spaces(Figure 4). As a result, any new supermarket was very likely to expand its business and attract other new businesses and customers (Bingham and

Kimble,1995, p. 264). It is worth mentioning that the formation of such shopping centres in turn accelerated the aggregation of other related industries, like most service industries that are supported by heavy passenger flow such as the entertainment industry and the catering industry (Garreau,1991, p. 252). In this way, large supermarkets turned out to be the incubator for the breeding of edge cities.

Figure 4: Large shopping centres in marginal areas and their parking spaces. (source: Gleiter 2022)

It is not difficult to draw the conclusion that the suburbanisation of population and industry not only expanded the scale of the suburban centre but also enriched its functions so that the suburban centre essentially possessed the characteristics of a city(Bingham and Kimble, 1995). The edge city is the product of the suburban development of American cities and represents a new trend of urban development in the United States, with the urban structure changing from a single centre to a multi-centre. Edge cities also have urban functions such as service, transportation, work and life, making edge cities gradually play the role of cities after sharing the problems of big cities. The urban function of the marginal area is increasingly improved and gradually developed into an edge city driven by the transfer of industry and population. According to Saarinen (1945, p. 127),the city comes into being on condition that the population and industrial structure constantly move towards a specific region under agglomerated economic effects. A city takes shape when the aggregation scale reaches a specific level. The edge city is a product of the urban growth of the mega-city. It shares the population and business of the mega-city and has its own commerce, making it both a part of the metropolitan city and an independently functioning city (Calthorpe, 1993).

2.1.2 The concept of edge cities

The edge city is a form of urban development in America where a new business, employment and residential centre develops out of the suburbs, changing the urban structure from a single centre to a polycentric development mode. According to Garreau (1991, p. 4),these centres used to be farmland, villages or pure residential land 30 years ago. These new centres have developed typical urban functions. Edge cities are basically the same as cities in terms of function and infrastructure. Such new centres develop atypical urban function: the polycentric model of development.

Garreau (1991, pp.411-412) sees the edge city as an office centre with a large volume of leased office space to meet the needs of the office environment in the information age and to attract more high-tech industries, businesses and related services industries. The edge city also offers supporting facilities in the form of shopping malls, recreational venues and cafes in its capacity as a rich business centre. These edge cities offered massive job opportunities, including research and service staff in the service industry. To achieve a work-life balance, they should also provide residential areas(Garreau, 1991).

In order to give a clear formula of the edge city, Garreau came up with a five-part test, as follows:

(1) Five million square feet (464,500 m^2) of leasable office space or more

(2) Six hundred thousand square feet(56,000 m^2) of retail space or more

(3) A population that increases at 9 am on workdays, making the location primarily a work centre, not a residential suburb

(4) A local perception as a single end destination for mixed use: jobs, shopping and entertainment

(5) A history in which 30 years ago, the site was by no means urban; it was overwhelmingly residential or rural in character.

Garreau noted that this list is suggestive, not exhaustive. Its purpose is to inspire the observer to go out and to see some of these places. This definition requires the observer to make some judgments and to draw personal conclusions. Thus, he made clear that while every effort has been made to ensure the accuracy of the list, unfortunately, experience has shown that perfection is impossible to achieve (Garreau 1991, pp.425-426).

Garreau considered the first of these five definitions to be the most important. A workplace more than 5,000,000 square feet for lease was equal to a medium-sized city downtown of America such as Dayton in Ohio and Spokane in Washington (Figure 5). Garreau held that the edge city could enough grow to be a fairly independent economic entity by such large office space. The agglomeration of businesses and related service industries in turn laid a foundation for the normal operation of edge cities. It should be noted that the space discussed here is office space, and not ordinary floor space for manufacturing or warehousing. This is what creates the density of the edge city. For the second part of Garreau's test, retail space of more than 600,000 square feet for leasing is about the size of a large shopping mall in America. The third part of the test clearly stipulates for an edge city, the suburban centre must be the employment centre first in order to break through the conventional urban employment-suburban residence mode. The fourth part of the test suggests that when such suburban centres become familiar to people, they form distinctive urban characteristics and even gradually develop a unique urban culture. The last part of the test emphasises that the edge city is an emerging centre in a new socioeconomic context. Almost every large and medium-sized city in America has one or more edge cities around it. Therefore, the edge city is not exclusive to the urban development history in the sunbelt area, but is a universal phenomenon across America(Garreau, 1991, pp.425-426).

Figure 5: Dayton(left) and Spokane(right) town centre. (source: Eleanor health 2021 and Eluna 2018)

Garreau (1991, p. 272) mentioned that buildings in edge cities are mostly low-rise and low-density complexes. As a matter of fact, it was commonplace to see high-rise and high-density buildings across traditional downtown areas in the city. According to Garreau (1991, p. 118), an appropriate walking distance acceptable to Americans is about 200 metres, excluding airports, old downtown areas and other specific areas. Although the central city area has convenient public transport, most Americans still prefer to drive by car. This is quite common in America. For example, Cervero and Wu (1997) also report that the transportation system plays a decisive role in the development of the edge city and promotes the development of marginal cities in the metropolitan city.

The development of transport, especially the construction of highways and the transfer of the industrial structure, pushed the USA to enter the age of the edge city(Garreau, 1991,p.315). According to Garreau (1991, p. xxi),the new world is being built along the ring road of the metropolitan cities of the United States, which also enables the polycentric development model of the edge city pattern(Figure 6). The polycentric mode is to form several scattered and relatively concentrated areas in the metropolitan city that undertake certain urban functions and meet the requirements of daily life (Rosenthal and Strange, 2004). Henderson and Mitra(1996) find that the polycentric development mode evacuates the high concentration of large cities in the downtown area, which fundamentally solves the issues faced by megacities and reactivates the periphery area.

Figure 6: American Western Pacific Railroad. The railway line to Auckland made the city terminus of three transcontinental rail lines across America. It pushed the San Francisco Bay Area to enter the Age of Edge City. (source: Xiao 2014)

Calthorpe (1993) suggests that edge cities should be developed around the metropolitan city and that mega cities should be encouraged to develop polycentrism.

Mega cities and edge cities should be integrated into the unified planning and locations chosen for the main functions of each centre. It is also important to establish the transportation network between the central area and the edge cities so that all areas are integrated. Badoe and Miller (2000) also mention that a rail transit system introduces the population and businesses to the edge cities, promotes interaction and connectivity between periphery areas and central area and directly promotes the development of edge cities. Most edge cities in the United States are formed near highways, which link cities and communities. Transportation systems play an important role in the development of edge cities (Jia, 2002). In this way, the concentration degree in megacities can be mitigated by transforming them into edge cities and using the polycentric development mode. Cervero and Wu (1997) also report that the transportation system plays a decisive role in the development of the edge city as it promotes the development of marginal cities in the metropolitan city. In the polycentric strategy, each area is a relatively independent centre connected by an efficient transportation system to ensure that the necessary connections between them are efficient.

In general, edge cities are new, relatively independent cities with a new population and economic concentrations on the fringes of large cities as the United States enters a phase of suburbanisation and as employment and consumption move away from the traditional core city. As a new area or a place around metropolitan areas, the edge city should basically act like a city and have the same functions as a city. Gans and Laiftownen (1967)claim that suburbia has spawned a new breed of Americans who live in as many houses as they do. They are bored and lonely, alienated, atomised and depersonalised. However, edge cities are a function of growth. According to Garreau(1991, p.14),the edge represents the way Americans bring urban functions (machines) to the edge of the natural landscape. It marks the place where most Americans now live, study, work, shop, play and die. To be more specific, a complete edge city should include office areas, retail space and activities 24 hours a day, either work or living. So the concept of an edge city is a comprehensive functional centre that is located at a certain distance from the central city, has relatively complete functions, has a certain specialised production function and has a high potential for development, both in terms of dependence on the main city and in terms of independent employment.

2.2 Expansion and development of suburbs in China

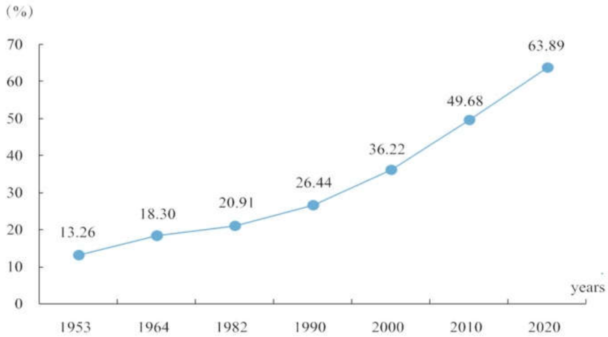
2.2.1 Disorderly sprawl and expansion in China

Rao and Han (2011) observe that Chinese urbanisation entered a rapid development stage in recent decades. Due to a discrepancy in humanity, history, political institutions and economic development, China demonstrates particular characteristics apart from its similarity with developed countries in urbanisation. Zhu (2009) points out that the rise of urbanisation has put an end to the traditional, extensive, land urbanisation development mode but heralds the inception of an urban revolution characterised by urban sprawl and expansion.

However, Chen (2005)says that most Chinese mega cities show a prominent phenomenon of urban sprawl and the urban development has a trend of low-density expansion. Wang and Zhang (2010) say that the main challenge of urban issues is brought about by urban sprawl. The diffusion process of urban space is brought about by urban development and the utilisation of suburban land. It leads to the use of a large amount of cultivated land and forest land around the city. Urban sprawl has led to urban transformation and serious loss of agricultural land, as well as the emergence of a large amount of idle land in the suburbs, constituting a waste of the infrastructure construction costs and to a certain extent (Zhang, 2010).

Li and Yang (2007) add that the population flow between urban and rural areas is essential for establishing marginal areas and suburbanisation. With the development of rapid transportation, the exchange resistance of logistics, people and information flow becomes less and less. This complicates the flow network between districts and changes the traditional pattern of population flow in urbanisation development. According to Gaubatz (1999), new forms of mobility gradually arise inside cities and towns in the form of town-city and city clusters based on the village-city mode. However, Zheng (2010, p. 18) finds that many labourers in cities and towns have not yet integrated into the city because they are excluded by public welfare. The instability of the urban population makes the flow of the labour force between cities commonplace. This has resulted in many people living on the fringes of the city although their workplaces remain in the city centre.

In China, in the last 40 years, urbanisation has grown at about 1% per year (Table 2). The proportion of permanent urban residents is increasing. According to the Table 2 of the 2020 Population Census of China, the urban population in China was 901.99 million in 2020 and the urbanisation rate was 63.89% (China Population Census 2021). Thus, China has entered into a period of rapid urban growth and expansion. In addition, according to the Second National Land Survey (2014), the total area of urban land in China is 8.581 million hectares, of which 47% is urban area and 53% is organic town area. In 2020, China's total urban land area was 10.35 million hectares, with the entire urban area accounting for 5.221 million hectares at 50.4%, while the size of organic towns is 5.129 million hectares at 50.6% (Third National Land Survey 2021). However, according to Sun (2012), during this rapid development, the rise of substantial urban land leads to the quick expansion of urban edge areas, which drains arable land, forests and grassland on a large scale. The structural contradictions between urban and rural areas have also deepened. Marginal areas are mostly converted to residential construction sites. Most of its land uses are mainly residents, which is essentially like land urbanisation without a corresponding population urbanisation. Chen (2005, p. 502) comments regarding this phenomenon that a large number of residential buildings gives the marginal land a single form, while other essential urban functions still mainly rely on mega cities. This means the land is not being fully utilised. As urban sprawl changes the original urban-rural land structure, much farming land and forests are left idle. Newly-built edge areas do not create convenience for residents in life and work. To sum up, the single mode of urban sprawl has prolonged residents' commuting time and does not radically reduce the problem of high population density in the centre of the mega city.



(10000 persons, %)

Census Years	Urban Population	Rural Population	National Population	Proportion of Urban Population to National Population
1953	7726	50534	58260	13.26
1964	12710	56748	69458	18.30
1982	21082	79736	100818	20.91
1990	29971	83397	113368	26.44
2000	45844	80739	126583	36.22
2010	66557	67415	133972	49.68
2020	90199	50979	141178	63.89

Table 2: Population of urban population to national population from population censuses. (source: China population census 2020)

Li and Yang (2007) point out that as urbanisation between cities grew, competition and cooperation between districts expedited this growth. Restructuring and swelling of city clusters and population restructuring may take place inside or among city clusters. As a result, Chinese urban development has turned from blind expansion into a mixture of growth, equilibrium and shrinking. As the most direct medium of urban scale change, the concept of marginal cities directly affects its development and influence. This has led to the idea of edge cities being introduced in China and the model of polycentric development beginning to develop in Chinese cities. Phelps, Li and Wu (2008) also propose that the idea of edge cities as the most direct medium of change in urban patterns and urban transformation plays a direct role in the development and influence of mega cities.

2.2.2 Governance strategies promote the development of edge cities in China

The Chinese rural area is the main space in the revolution of industrialisation and urbanisation. It constitutes a crucial link in the urban system and is a critical bond in integrated urban-rural development. Great emphasis has been placed on new urbanisation construction, especially county construction, by the Party Central Committee and the State Council. A Report on the Work of the Government in 2020 stipulates explicitly that the government will drive investment to sponsor the construction of new infrastructure, new urbanisation construction and significant engineering construction, and vigorously reinforce public facility services in the county. Progress in county urbanisation has practical meaning to social progress in the present and the future. In the short run, it stimulates investment, consumption and domestic demand. In the long run, it optimises urbanisation space layout, promotes urban-rural integrated development and elevates people's living standards as a whole.

Premier Li (2019) at the 13th National People's Congress of the People's Republic of China, announced that China would promote coordinated development across regions and improve the quality of new urbanisation. In the planning of small urbanisation in rural areas, there needs to be a reasonable allocation of public facilities and infrastructure in order to create effective environments to improve the locals' quality of life in accordance with the given town's specific location, the scale of the population, the geographical conditions and the unique local characteristics and culture. He mentioned that to address unbalanced and insufficient development, China should reform and refine the relevant mechanisms and policies to equalise access to essential public services and enable regions to complement each other with their respective strengths and promote integrated urban-rural development. In the regeneration and creation of holistically sustainable urban and rural environments outside of the large cities, it is essential not to imitate them. The infrastructure and public facilities need to be designed according to the local characteristics and to create dormitory towns that are more inherently flexible and sensitive to local conditions.

In 2020, the National Development and Reform Commission proposed that county townships should rectify their short comings and strengthen their weaknesses. In more specific terms, the Chinese government pointed out that promoting the coordinated development of large, medium and small cities and towns is a consistent direction for China's new urbanisation. At present, metropolitan cities have been afflicted with urban diseases such as traffic jams and environmental pollution due to population density and function overloading, while small cities (approximately 90% county-level cities) and periphery areas cannot fully satisfy people's economic, living, ecological and security demands due to the hysteresis of development and poor comprehensive carrying capacity and governance capacity. By expediting county urbanisation, especially in polycentric development model, the rural area takes over the non-core functions of central cities and forms a metropolitan area that is characterised by urban integration. This also reinforces contact with the metropolitan city and mobilises the development in the periphery area, thereby opening the door to the optimisation of the urbanisation space layout.

The Chinese government also emphasises a need to clarify the suburban target area, to determine the construction area, to ascertain the programme's scope and to reinforce programme planning in urbanisation. In other words, all metropolitan cities need to target those public domains where the market cannot make effective resource allocation and requests government instruction. As for the expansion of public service facilities, the government is supposed to energetically consummate medical health facilities, education facilities, pension facilities, culture and sports facilities, social welfare facilities and comprehensive community service facilities. Concerning the upgrade of municipal public facilities, the focus is on the renovation of municipal traffic facilities, municipal pipe network facilities, delivery facilities, old communities, as well as county intelligence reform. Simultaneously, all regions should combine existing shortcomings with the actual local circumstances and development requirements to determine the local programme scope by improving municipal network facilities and build comprehensive community service facilities, develop culture and sports facilities and complete industrial platform supporting facilities. It is suggested that the government should propose a set of programmes to compensate for the gap in local urbanisation programmes and cater to the urgent demands of the masses (National Development and Reform Commission 2020).

The Chinese government posits that construction in suburban and rural areas attracts investment. It ameliorates public facilities, attracts industrial investment, encourages consumption by residents and creates multiplier effects. Nowadays, per capita municipal facility fixed asset investment in the suburban area is around 1/2 of that in the prefecture-level city and downtown. The per capita consumption expenditure of county residents is just 2/3 of those in prefecture-level city and downtown areas. Rural areas are mostly located on the edge of the city and boost the employment of farmers in the city, the cross-border allocation of urban-rural factors and coordinated industrial development. The development of edge areas and urbanisation may optimise rustic space layout, bring the strategy of expanding domestic demands into force, promote people's living quality and activate the region (National Development and Reform Commission 2020).

Now that the socialist market economic system has been more or less established in China, the market-government relationship remains unclear. No consensus has yet been reached as to the boundary between these two entities. Out of this concern, the Report of the 18th National Congress of the CPC (2012) clearly stipulates that the core of economic restructuring lies in the relationship between the government and the market. In accordance with the general theories in contemporary Western economics, under market economy conditions, economic life is regulated by the market. At the same time, the government serves as the provider of public supplies. The government redistributes income and resources, formulates a legal framework and establishes market rules through public policies. This is also the case in urbanisation construction (He and Wu, 2009).

Urbanisation is a matter of socioeconomic development driven by the economy. The government considered complying with the law of the market economy and deregulated power to the market through urbanisation reform (Shen, 2007). The spatial expansion of modern cities in China is more the result of the government's purposeful planning, from passive motivation to suburban industry and the population to the suburbanisation development (Ren, 2013, p.62). The perfection of the function in new centres under the dual role of the local government and the market in the recent period. The formation of edge cities in China is not a process of natural suburbanisation, but is the result of the active participation and intervention of different levels of the government (Lin, 2009, p.28). Wang (2000) finds that edge cities benefit from their location in metropolitan areas, which promotes the development of urban regional spatial centres.

In Section 2.2.3, it was mentioned that the process of urbanisation in China can be divided into three stages, and the government plays a very important role in each step. In the first two stages, the government plays an essential role in promoting rural urbanisation. In contrast, in the third stage, the government only has a general policy of urbanisation, but fails to formulate a specific urbanisation policy. A development mode that consists of blindly increasing the number and scale of small towns and occupying land in various places has emerged. As a result, small towns in this stage are decentralised and unplanned, and most migrant workers work in cities and towns but live in rural areas. At the same time, the government relies on the economy to enforce control over rural urbanisation, which makes urbanisation controlled and far fall behind urban industrialisation. You-Tien (2010) finds that government policies in the first two stages showed a substantial negative impact on rural development and rural urbanisation.

Since the 1990s, the role of the government has changed from a leading one to a guiding one. Land and housing reform have led to market-oriented suburban development in China. The pace of suburbanisation has also accelerated. The government no longer takes direct measures but instead indirectly participates in the provision of land in order to encourage development in the suburbs. It guides the development of urbanisation through macro-control, which is mainly reflected in (a) an urbanisation strategy to change the focus of urbanisation from the promotion of rural and agricultural development to the promotion of the economic and social development of the country; (b) a transformation of the urbanisation development mode from an extensive development mode, emphasising scale and quantity, to an intensive development mode that favours quality and function and takes scientific planning into account; (c) a change in the institutional environment of urbanisation because some systems are not flexible (Zheng et al., 2017).

Since local governments are the actual landowners, they often take advantage of the land market to achieve economic development goals. Yeh and Wu (1996) find that the land market motivated local governments to exchange land for investment and to subsidise finance with land interests. As a result, local governments implemented strategic spatial planning to rapidly expand the road structure to the suburbs. Therefore, many non-development types such as real estate developers, commerce and high-tech industrial parks are emerging in the suburbs and suburbanisation is becoming more market-oriented. The government plays a regulatory role by means of planning and land transactions. The nature of edge cities in China is similar to that of urban development zones. Development zones in many big cities promote transformation and re-development.

In the 21st century, the government has been relentless in developing a productive service industry as the future development strategy. The 11th Five-Year Programme of Economic and Social Development of State Economic and Technological Development Zones issued by the Ministry of Commerce of the People's Republic of China 2016 was proposed to propel the construction of the development zones to improve the quality of absorbed foreign capital. It should also expand the modern manufacturing industry with an emphasis on optimising the export structure in order to develop the high-tech industry and high-value-added service industry and to promote the development of multi-functional comprehensive industrial zones as well as national economic and technological development zones devoted to building comprehensive development zones. In the 14th Five-Year Plan (2021), rural construction will undergo significant modernisation. This includes strengthening the rural area's comprehensive service capacity and turning towns into a regional centre to serve citizens. The construction of transportation will also be accelerated, the transportation network improved and the links between regions made more accessible to rural areas.

In 2005, a new round of the Beijing general plan proposed a multi-centre urban structure to promote the dispersion of employment. An important feature worth mentioning in this plan is the assignment of a new suburban development pilot in Beijing (Zhang and Wu, 2006). Beijing's path in the mid-1990s has distinctive characteristics of 'government-dominated key construction'. Since the 16th National Congress of the Communist Party of China, the integration of urban and rural development has been adjusted and the process of urban and rural development has changed (Zhang and Cui, 2014). There are a range of things that respond to the times, including the overall planning of urban and rural areas, the integration of urban and rural areas, the equalisation of basic public services, etc. The government is prohibited from building towns or villages with prejudice. In fact, the main difference between key small towns and other townships and villages is the increase in government investment and support. As Qin and Ryuzo (2018) emphasise, the target of construction and design was extended from key towns to include buildings and townships by bringing all the established villages and towns into the scope of small towns. Another step in construction is to expand from administrative central districts (town districts) to large villages, including villages with a large population in small towns. By stabilising the urban and rural pattern, various forms of small towns with liveable conditions and good management take shape. At one time, a convenient urban and rural service network was formed, which results in a general improvement in the level of public services and construction in the whole region.

The government has played an important role in promoting rural urbanisation. Hu (2012) put forward in a Report to the Eighteenth National Congress of the Communist Party of China that the government should adhere to the 'new urbanisation road' with Chinese characteristics (Table 3). Urbanisation is characterised by urban-rural overall planning and urban-rural integration under a saving, intensive, ecologically habitable and harmonious development mode. It is a coordinated development and mutual promotion process in large, medium and small cities, small towns and new rural communities. The core of urbanisation is human beings and the essence of urbanisation is the equalisation of basic public services in urban and rural areas. Urbanisation is supported by industrialisation. The fundamental purpose of urbanisation is to turn farmers and the rural population into citizens and to give rural migrant workers the same infrastructure and public services as urban residents. As the founder and executor of urban planning, the government undertakes the responsibility of the long-term survival and development of urbanisation. It plays a guiding role in the sustainable development of urbanisation.

Governance conception	Government will drive investment to sponsor the construction of new infrastructure, new urbanisation construction and reinforce public facility services in the county.
Governance modality	Local governments are the actual landowners, the land market motivated local governments to exchange land for investment and to subsidise finance with land interests.
Governance features	Government-led model gradually moving to market-led. The government redistributes income and resources, formulates a legal framework and establishes market rules through public policies.
Governance principles	The governance is based on the agricultural development and rural stability, which reduces institutional and policy barriers to urbanisation

Table 3: The key features of governance management for development of edge cities in China. (Source: author)

2.2.3 The formation of edge cities in China

There is a long history of city planning in Western countries. As time goes by, urban features have become a product that can be regarded as the long-term historical precipitation. Compared with the lengthy and tardy urbanisation process in Western countries, the process of urbanisation in China has entered a stage of rapid development. In China, most cities are in a period of rapid growth, but some large and medium-sized cities have already experienced or are currently undergoing suburbanisation. Phelps, Li and Wu (2006) say that when talking about the differences between developed Western countries and China, central cities in China still have a significant centripetal agglomeration trend while spreading to suburbs. Suburban and urban centres have extended to various degrees.

Gu and Sun (1998) suggest that the urbanisation of China can be divided into three stages. The first stage started with the decentralisation of industry during the planned economy period in the 1950s. Under a strict policy of government control for metropolitan cities, the periphery area became the primary choice for enterprises. A number of satellite towns dominated by industry were built outside of metropolitan cities. The government also demolished and relocated some industrial enterprises in suburban areas (Gu and Sun, pp. 102-104). This was the start of the industrialisation-led suburbanisation of Chinese cities. Unlike the residence suburbanisation of the migration of populations in Western nations at their own initiative, the rise of Chinese industry suburbanisation was entirely passive and guided by the government.

Li and Yang (2007) find that Chinese urban sprawl began around the 1970s in the second phase of Chinese urbanisation at a time when urban development was guided by policies that prioritised industrial construction and the expansion of industrial parks(Zhao, Zhong and Xu, 2015). The urban development mode moved progressively from a planning economy to a market economy during this period. Owing to the establishment of special economic zones and coastal economic development zones, many cities grew like mushrooms and received an influx of population that accelerated urban expansion. As the urban periphery areas developed considerable new cities for residential purposes, the urban expansion took the form of layer expansion, and location and land price became vital factors affecting the development of edge cities (Gaubatz, 1999). In addition, Zhang and Zou (2001) observe that from the 1980s, a system of compensation for the use of state-owned land by cities was implemented and the outward migration of enterprises and the construction of industrial parks stimulated the re-allocation of land resources under the government's lead. With the passive mobility of the suburban population, the degree of industrial suburbanisation improved immeasurably. Companies started to build many dwellings with basic facilities in the suburbs and employees moved to their places of work or other places of accommodation established by companies in the countryside (Zhu, 2001). In sum, industrial suburbanisation drives population suburbanisation. Furthermore, the government primarily controlled suburban residential development projects triggered by old city renovation. The municipal government took charge of large-scale residential development projects, which resulted in demolitions and the resettlement of residents who had no right to choose their new homes but simply had to submit to the arrangements of the government. In this period, the residential projects led by the government gave strength to the urbanisation of rural areas.

As marginal urban areas mixes population, society, economy and culture, the contradiction in urban development concentrates on fast-growing edge areas. In addition to the substantial impact of the economic boom on urban expansion, the land system and government performance appraisal directly stimulate the enclosure movement outside marginal urban areas (Gu, 2001). The Chinese government takes land as the operation capital of urban development and pushes forward enclosure movement round after round in the suburbs. Both development areas and universities towns are lined with buildings. In contrast with the progress of enclosure movement in cities at all levels, corresponding municipal and public facilities are in severe shortage. In other words, although developers have built lots of buildings in edge areas, existing infrastructure such as primary schools, hospitals and garbage processing facilities cannot satisfy people's demands. Therefore, due to inconvenient traffic conditions, lack of supporting facilities and a low habitation rate of newly built residences in edge areas, new urban areas are unable to attract industries and businesses. As a result, office buildings and commerce are still in the downtown. The singularity of functions lowers the appeal of edge cities once the fervour of excessive housing buying is over.

In the 1990s, the third stage of urbanisation began. The content of industrial suburbanisation was enriched while populations began showing initiative to migrate. In this period, the real estate industry became a new growth point in the national economy. The surge of migrants increased the housing demand in the suburbs, and urban development entered the centrifugal force-driven suburbanisation stage. The popularity of private vehicles and the increase in people's income also encouraged residents to buy houses in edge areas. This caused the government and developers to make large investments in the construction of periphery areas and to improve infrastructure and public facilities. Commercial residential buildings became a key factor in promoting the development of suburbanisation with the deepening of land and residential system reform. Some from the affluent class in metropolises began to build villas in the countryside, whilst the low-density living environment and lifestyle were the main selling point for suburban real estate companies to conduct propaganda. Zhao (2002) stated that with the restructuring of urban industry and the appearance of emerging economic departments, the suburban industry went into a new stage. Industrial suburbanisation of Chinese cities moved towards the orientation of comprehensive development as there appeared a large number of development zones, high-tech industrial parks and township industrial zones.

In the 21st century, the suburbanisation of Chinese metropolises has stepped into a new stage with the following characteristics: (a)suburbanisation is spreading across remote areas and the range of metropolises is broadening; (b)commerce in metropolises shows the trend of diversification - some newly established markets and large shopping malls are built in the suburbs with convenient transportation conditions. The distribution of urban commercial facilities is expanding from central districts to the suburbs; (c) the government pays much more attention to infrastructure construction for shortening the gap between metropolises and the suburbs; (d) the transformation and exploitation of development zones in the suburbs give impetus to the multi-centre-oriented structure conversion for the cities (Wu, 2013). With the continuous growth of urban GDP (gross domestic product), the government provides a better external surrounding for the formation of edge cities by replacing functions through redistribution and adjustment.

Edge cities in the West tend to be located at the intersection of main roads on the edge of the urban building areas or suburban highway intersections (Stanback, 1991). The suburbanisation development of the city is a kind of residential and industrial transformation process. With the full suburbanisation of jobs, edge cities arise because of private developers and the market instead of government intervention. Once the development of edge cities has gained momentum, local governments often begin to act as boosters (Bontje and Burudack, 2005). In China, the story is another case. China's large urban development zone at the source of the city is usually located in the far suburbs away from the central city.

With two-way expansion, the distance between the development zone and the central city is gradually shortened (Chen, Liu and He, 2012). Although the background in China is quite different from that of Western developed countries, the characteristics of urban sprawl ingress in decentralised development also exist in China. Because the central urban areas are the most densely populated and fully exploited, these emerging development areas, which formed under a decentralised development model, are commonly referred to as development zones in China (Zhang, 2000). Development zone-oriented urban suburbanisation development has entered a new stage. Many large cities under the guidance of urban development strategy are faced with transformation and redevelopment, reflecting a development trend of transition to a well-functioning edge city. A new type of edge city with Chinese characteristics is forming or has been formed. According to Chen (2007, p. 91),the early development zones with the relocation of industry only constituted industrial warehouses in the suburbs attached to the large central cities. Compared to the service-oriented edge cities of North America, the development zones in China's suburbs are more the function of manufacturing-oriented economic development zones on the edge of large cities.

2.3 The characteristics of Chinese edge cities

According to He (2012), the suburbanisation development of Chinese cities was closely followed by industrialisation. It was generally based on a certain city with a specific policy to open up that particular geographical area. According to different classification criteria, urban development zones can be divided into different types. Phelps, Li and Wu (2008) point out that the government plays different roles in various stages of urban suburbanisation. In the early stage, i.e. industrial suburbanisation and the process of passive population relocation, the city's development is mainly dominated by the government. The government's macro-control plays a key role. In the 1990s, the government directly arranged relocation sites, providing development funding for land supply. The adjustment and upgrading of the industrial structure of the development zone and the upgrading and perfection of the comprehensive function and the development of a new type of edge city are characteristic of the suburban growth of Chinese cities.

The edge city is the inevitable outcome of suburbanisation when urbanisation develops to a higher level in developed countries. At the same time, the formation of Chinese edge cities is not the result of natural suburbanisation. Instead, as mentioned in the last section, the development of numerous domestic edge cities is inseparable from the proactive participation and intervention of the government at all levels. That is the primary driving force in the formation of Chinese edge cities. Bontje and Burudack, (2005) propose that from a typological perspective, edge cities can be classified into three categories: (a) the edge city covers the traditional town area and further improves and reactivates the original rural area; (b) edge cities have been evolving and which industries have caused them and defined new place typologies (e.g. airport, universities, high-tech research and development area such as technology parks, etc.); (c) the edge city is developed and constructed by the government or relevant departments and its formation and functions are similar to satellite cities and it is near the megacity.

However, Chen (2013) points out that due to the rapid urbanisation progress of China, Chinese edge cities are not a natural product of suburbanisation development since there is essentially no natural evolution occurring in the original suburban centres. The development of Chinese edge cities is based on the definition of a new place typology in the urban periphery. Due to the participation and the interference of the government, Chinese edge cities constitute development zones, i.e. they are primarily industrial transfer and investment entrepreneurship cities (Henderson and Mitra, 1996). To promote the coordinated development of the economy in the whole region, the edge cities accepted industries that were moved away from urban areas. The related industries have been developed further by means of an appealing investment environment in order to attract new investment. Therefore, to do an excellent job in the planning and construction of urban development zones, edge cities are not only for pure residence but also for industry transfer or other functions such as residential, commercial, employment, transportation and recreation.

Development zones in China are mainly developed on the periphery area of metropolitan cities, which is similar to the concept of edge cities in Western countries. Hence, to a certain extent, a development zone of a specific scale is the edge city of China. An urban development zone generally refers to the particular area supported by open policies in a megacity. Urban development zones can be divided into different types according to different classification standards. Functionally, the urban development zone comprises a trade development zone, an industry and trade development zone, an economy and technology development zone, a high-tech development zone and a bonded development zone (He, 2012, p.17). With regard to the distance between the development zone and the mother city, the urban development zone is composed of a suburban development zone and a satellite development zone (He, 2012). The urban development zone has become an important form through which China implements reform and opens itself up to international economic relations. It plays a critical role in the national economy and urban economic growth. By vigorously driving the local economy's fast growth, the urban development mode has become the most developed and most active mode in the country.

Both edge cities and urban development zones are located in marginal urban areas in terms of spatial location. Wang and Cui (2003) stated that Chinese urban development zones are mostly situated at the edge area of the mother city. For instance, in 1984, the first14 economic and technological development zones were mostly 10km to 60km away from the mother city. That is because most urban edge areas in urban newly-built areas after liberation were supplied with modern infrastructure. Secondly, marginal areas on the leading edge of urban land expansion have adequate plots for exploitation. Thirdly, compared with suburbs and villages, edge areas have convenient traffic conditions as well as water, electricity and gas infrastructure. Fourthly, urban edge areas have a good-quality natural environment. The marginal metropolitan area satisfies the requirements for the construction of a development zone. In addition, from the point of view of urban morphology, Gu (2001) finds that the urban development zone also forms a low-density development mode in which edge cities either spread close to built-up areas or distribute on suburban traffic arteries. Ai and Wang (2001) find that the development trend shows that both the urban development zone and the edge city seek to improve urbanisation functions and advocate building liveable modern communities that integrate housing, employment, recreational and commercial functions. The similarity between an urban development zone and an edge city makes it possible to utilise the notion of the edge city and build an urban development zone. Currently, some large and medium-sized cities in China are all busy with the construction of urban development zones. That is why edge cities are emerging on a large scale.

The Chinese city is continually expanding and improving its urban functions according to its changing socio-economic development requirements as it ages. Its urban layout structure is also undergoing gradual adjustment to a polycentric development model. For example, according to Deng et al. (2001),from the late 1950s to the 1970s, Shanghai activated few urban fringe areas. It grew from a single city in the early post-liberation period to a composite city. In the 1980s, the Shanghai municipal planning stipulated the four-layer urban development system comprising a central city, edge areas, small suburban town and a rural fair. However, it was restricted by insufficient investment in urban infrastructure, particularly the traffic system. The focus of construction was still in the central downtown area (Wu and Phelps, 2008). That meant that the urban development morphology was still dominated by monocentric expansion. Lou et al. (2015) finds that the edge city failed to grow adequately, and owing to the gap in town scale grade, no rational town system has yet been reached.

Since the 1980s, Shanghai's industrial structure has been undergoing changes to its urban form. As the focus of the municipal industrial layout has shifted to the suburbs, the local production layout has changed drastically (Zhang and Wang, 2008). According to Derudder et al. (2013),the adjustment of the industrial structure vigorously motivates the economy's growth and the optimisation of urban functions in Shanghai. The urban functions in the Shanghai downtown area are transitioning from the traditional manufacturing industry to the general service industry and partial production service industries. Labour-intensive industries such as publishing and food have emerged in the ring road region as industries and businesses have moved out of the inner city (Zhang, 2001). That means the downtown area is developing a production service industry and other service industries, primarily urban industries, while the suburbs are developing a manufacturing industry. This arrangement is accelerating the formation of new centres in the suburbs and is creating the conditions for the formation of edge cities.

Take Anting as an example. It is located in the west of Shanghai, 32 km from the city centre and 20km from the airport (Lu, 2019). In 1958, Anting was officially planned as an industrial satellite town for the support of the car industry. It is also the central town in western Shanghai. In 2001, the Shanghai Municipal Government initiated the Pilot Opinions on Shanghai's Promotion of Urban Development. It pointed out that Shanghai should develop one main city centre and nine subcentres. The planning emphasises concentrating on the newly built areas of cities and towns and shaping the unique features of the new district according to local conditions and characteristics. According to Huang and Lin (2013, p. 417), Anting plays an important role in migrating urban people to the suburbs and in reducing the central area's population pressure, which controls the scale of real estate development and alleviates intense land use conditions. This has accelerated the process of urbanisation in Shanghai. At the same time, the aim of the government's planning is for Anting to drive investment in the development of real estate, to promote the regional economy and to adjust regional priorities, the structure of the industry and its scale of development. The government also wants Anting to improve the regional traffic conditions, to have close ties with urban areas, to improve the regional support facilities and to promote the quality of life in the outer ring region.

In the development process, the new town pays more attention to sustainable development(Figure 7). The new town of Anting entirely and accurately interprets and expresses the urban concept of sustainability with its complete urban form and pleasant spatial scale (Lu, 2019): German characteristics of the city texture, centripetal central square, organic street space and pleasant scale proportion. In addition, personalised neighbourhoods with affinity, rational density and prosperity make the overall plot ratio only 0.59. The enclosed water system forms the entire length of Anting's boundary, and the water area is 200,000 square metres (Lu 2019).

Figure 7: The satellite map of Anting. (source: Google Earth Pro 2020)

In addition to the proactive intervention of the government, Chinese edge cities also benefit from favourable locations in the metropolitan urban area, which further promotes the development of pluralistic centres in the city. In this sense, the edge city reflects the microscopic mechanism of how the existing poly-centric urban structure came into being. There are some common characteristics in this regard. First of all, compared with the service industry-led edge cities in America, Chinese edge cities mainly undertake the functions of the manufacturing-led urban development zone. These development zones such as Fengtai Science Park in Beijing are strategic edge cities and are more like new suburban cities rather than centres evacuating the downtown population and industry. They have been planned to be the main growth centres in the urban area. Additionally, these edge cities are no longer the pure industrial satellite cities that they were in the past. They are evolving into comprehensive high-tech industry service cities that aim to develop high-standard service industries such as finance, insurance, real estate, etc. (Wang, 2001).

Nevertheless, the proportion of the manufacturing industry in these edge cities is closely associated with the status of China in the global labour division system. These emerging cities attempt to prioritise the development of the production service industry in the future. Secondly, they all demonstrate apparent spatial fragmentation and regulation fragmentation characteristics. For instance, Beijing's Yizhuang New City Century covers the Beijing Economic and Technological Development Zone and some areas under the jurisdiction of Tongzhou and Daxing. There is still a lack a of uniform administrative authority. Another example is Kunshan, it between Suzhou and Shanghai is a poly-centric administrative authority such as national-level Kunshan Economic and Technological Development Zone, provincial-level Huaqiao Commercial City and development zones in each town. By virtue of a favourable location in a sizeable metropolitan sphere and low price and policy preferences, they attract investment from foreign merchants, especially the overseas IT industry, and quickly flourish based on economic growth (Wu and Zhu, 2001). Yang (2004) argues that investment subjects give full play to the initiative and subjectivity of all issues, they reinforce urban development momentum and depend on the land to attract foreign investment. Such movement, however, leads to repeated construction in development zones and a series of phenomena such as excessive land appropriation. A development zone of this type has been referred to as a corporate edge city. Hence, the status of Chinese edge cities will be analysed on the basis of large national projects such as Nansha district in Guangzhou.

Guangzhou established the light industry-led development mode in 1978. It imposed requirements on the restructuring of the industrial layout by gradually transferring heavy-pollution and high energy consumption industries to the suburbs and giving way to the tertiary sector (Yang, 2010). Guangzhou's suburban development was made possible by the passive migration of industry and population during this period. The downtown area underwent aggregation growth. However, with further aggregation and expansion of the city, the drawbacks of the mono-centre development mode became increasingly exposed. Until 2000, the development of Guangzhou in the north and east direction was limited by natural factors. At the same time, the growth in the south and the west reached the administrative boundary. Wen (2010) observes that there was no new development space in the city. In the1990s, global industries and residential suburbanisation coexisted in Guangzhou urban suburbanisation (Li, 2007). The Guangzhou suburban area built new transnational spaces such as economic and technological development zones, bonded areas, industrial information parks and science cities to cater to the financial globalisation process. On the other hand, with improved traffic conditions in Guangzhou's eastern and southern suburbs, large commercial residences appeared to be suitable for middle-class commuters.

Based on Guangzhou's far suburb rural base and under the guidance of the national government and Guangzhou’s policies, Nansha entered the initial exploration stage with the establishment of diversified industries. Its positioning has gone through several stages of evolution. Initially, it focused on the industrial production functions from 1993 to 2000, and then was dominated by industrial production and supplemented by life services from 2001 to 2004. After 2005, it gradually moved toward the comprehensive functions (from 2005 to 2013) and then developed from the functions to areas and created the regional centre of Guangdong-Hong Kong-Macao Greater Bay Area. At the end of 2008, the State Council approved the implementation of the Outline of Reform & Development Plan for the Pearl River Delta Region (2008-2020). It decided that Nansha District was to be one of the five key cooperation zones of Guangdong, Hong Kong and Macao. Therefore, Nansha became responsible for leading regional transformation development and an essential node for Guangzhou to build a national central city. At the beginning of its development, Nansha used the port as the core factor due to its favourable condition for port construction, regarded the port logistics as the leader, focused on the port-vicinity industry, equipment industry and high-tech industries and took the heavy industries of shipbuilding, steel and automobile as the development orientation. As per the industry positioning, large-scale investments were made in port construction in Nansha. Large-scale projects have contributed to Nansha's economic development by more than 50% (Cheng, Liu, He and Shaw, 2017).

In general, Nansha has taken only 20 years to develop since the creation of the state-level economic and technological development zone in 1993. Under the central government policy support and local government development, Nansha changed from a development zone dominated by an industrial production function to a city on the southern fringe of Guangzhou with comprehensive urban functions and the gradual entry of service industries and comprehensive attention to urban construction. In recent years, it has also transformed from an edge city into a regional centre of the Guangdong-Hong Kong-Macao Greater Bay Area. As a result, the development of Nansha has been promoted by the gradual improvement of its industrial structure and the continuous improvement of comprehensive supporting facilities.

In sum, it can be seen from the two typical metropolitan cities of Shanghai and Guangzhou that in the process of China's rapid development, city transformation in the suburbs will be an inevitable trend. The influence of the development zone on the city is reflected in the industrial spatial layout of the city, but it does not only include this aspect. The industrial agglomeration of the development zone also has huge spill over benefits (Jankowiak, 1997). According to Zhang (2005), there are eight main factors that influence urban development zone on regional development: the industrial connection inside and outside the urban development zone; the increase of the employment population, wages and services in the edge area; the increase of local tax revenue and urban infrastructure; the derivation, agglomeration and diffusion of enterprises; the development of cross-provincial branches; the growth of entrepreneurs in the district. According to Zheng (2007),China's development zones have objectively become an effective and distinctive urbanisation development model. This is different from the traditional mode of circular layer expansion, and along with traffic line expansion, it is significant to China's current urbanisation development.

A development zone initially relies on the mega city's centre. Then, as the development zone develops, it gradually becomes independent from the metropolitan city and forms a relatively equal and complementary relationship with the centre city. Wang (2003) divided the evolution process of development zones into four stages(Table 4). In the first stage, the development zone is more reliant and dependent on the mega city and the correlation effect and technology transfer effect between the development zone and the local economy are not noticeable. In the growth stage, the development zone has already existed in the development level of the potential profile and beings to produce a more obvious radiation driving effect in relation to the mega city. In the third stage, the interaction and functional integration between the development zone and the mega city are fully achieved, resulting in spatial agglomeration. In the later mature stage, the attributes of the development zone will fade away but still play a leading and driving role at the level of the metropolitan area. At the same time, the integrated development of the development zone will become more and more evident.

Forming stage	Development zone reliant and dependent on the mega city.
Growth stage	Development zone beginning to have radiation effect to big city.
Maturity stage	Development zone resulting in spatial agglomeration
Post-maturity stage	Development zone beginning integrated development.

Table 4: The evolution process of development zones (Source: Author)

The industrial agglomeration of the development zone creates a large number of employment opportunities, which easily leads to the aggregation of population and residence and drives the economic development of the surrounding areas. In China, many cities achieve the agglomeration of industry and people through the construction of development zones, creating transformation in the growth of space and population in the marginal areas of metropolitan cities. Consequently, like urban development zones and satellite cities, Chinese edge cities still perform single functions and consider other functions. The development of Chinese edge cities is never a natural suburbanisation process as it involves the proactive participation and intervention of the government at all levels. In addition, Phelps and Wu (2017) find that a favourable location encourages the emergence of numerous edge cities in the metropolis, which also accelerates the growth of poly-centre patterns in other urban areas. In the early stage, edge cities in China were mainly dominated by industrial transfer and as shortage of population and land in the central link city and then gradually developed residential areas and supporting facilities. Therefore, the evolution of urban factors is the most fundamental cause of changes in urban morphology. The increase in the number of urban factors has led to the continuous expansion of urban spatial scale, while the changes in the factor structure have led to the succession of urban spatial morphology. As a new urban morphology, the formation of edge cities is closely related to background factors such as the evolution of China's economic development stages, the succession of megacity industrial factors and the development of suburban science parks.

2.4 Summary

In the development of urban agglomerations in the US, different measures were taken to optimise the urban-rural spatial structure of urban agglomerations in order to address the problem of overstuffing core cities, which led to the concept of edge cities. China's rapid economic development has led to the spread of cities, making them expand into the surrounding areas. During China's three urbanisation phases, forms of suburbanisation dominated by industrial areas began to emerge and as a result, the peripheral areas of large cities began to be developed for use. At the same time, the development of the functional regions on the periphery of cities has been driven by the government's promotion of land as a financial tool for development. Industries in China's peripheral areas are often developed in the form of development zones, where a certain industry such as high technology, manufacturing, production services, etc. is concentrated within a region. These economic development models for the periphery have led to the activation of the periphery of large cities. This also leads to differences between Western edge cities and Chinese edge cities(Table 5).

	Edge cities	Chinese edge cities: development zone
Location	Periphery area	Periphery area
Main functions	A comprehensive residential, employment, transportation and entertainment centre with some industry. Service-oriented edge cities.	A comprehensive residential, employment, transportation and entertainment centre with a strong industrial aspect. Manufacturing-oriented economic edge cities.
Spatial patterns	Low-rise, low density	Low density
Formation	The product of economic development.	Government-led development with policy preferences.

Table 5: Characteristics of edge cities and Chinese edge cities.(Source: Author)

The activated urban fringe areas have created a certain amount of population density due to the relocation of companies, universities, etc., thus promoting the formation of new centres in the suburbs and their further development into edge cities. This has also led to a change in the spatial structure of metropolitan cities, which have moved from a monocentric to a polycentric development pattern. At the same time, the development of transport has made the links between these edge cities and central areas possible and efficient.

In the early stages of development, the periphery areas were to some extent dependent on and claimed the megacity. However, as the periphery areas develop, they should gradually become independent of and feed back into the metropolitan city, forming a relatively equal link with it and thus forming an edge city (Yang, 2002). The transfer of industry to the periphery has created a certain amount of population density in these areas, which has attracted a large number of property developers. As the reform of the land and housing system intensified, commercial housing developments became one of the key factors driving the growth of the relocated suburbs. According to Liang (2016), real estate developers built a large number of residential buildings in these areas and their lower prices attracted a large number of people who chose to buy homes on the fringes, further away from the city centre. Since then, the two main functions of housing and work have led to the formation of urban agglomerations in the periphery. In general, the development of China's peripheral cities has followed a pattern of industry first and housing second (Zhu, 2005).

However, to be successful, an edge city should have the same functions as a city. In addition to jobs and housing, it should also, to a certain extent, meet the daily needs of people, with public spaces such as shops, parks and other places where people can gather. Rather than jobs and housing being restricted to the periphery, the rest of life should still depend on the home city. This gap remains to be filled for Chinese edge cities. Furthermore, although the edge city has been developed in the form of a development zone, the edge city is also significant for people's sense of belonging and urban identity. This is still a challenge for the Chinese edge cities that have developed in the context of China's rapid development. It is only when the city has its own identity and attributes and meets the demands of people's daily lives that people can feel a sense of belonging and have a better experience of their place within the meaning of integrated urbanism.

Chapter 3 Sustainable urbanism in edge cities

Chapter 3 defines urbanism and the idea of integrated urbanism to explain this study's main objective. Section 3.1 focuses on explaining the integrated urban morphology, the relationship between place and activities and the importance of urban design to an area. Sections 3.2 and 3.3 focus on sustainable communities where people can effectively reach their destinations on foot and there is diversity of markets and a sense of belonging. Section 3.4 summarises the role of the subject.

3.1 Urbanism as a way of life

3.1.1 Integrated urban morphology

In defining the basis of urban formation, Weber (1978,p.1375) defined the most fundamental characteristic of cities as market agglomerations. He emphasised that cities are not only about production and exchange processes in addition to economic activity but also include the gathering of people. The city is the result of people living and producing in a particular place. The city embodies the relationship between a specific group of people and a particular space and place. At the same time, both the urban space and the people who inhabit it are in a constant process of change over time within a context of social development. Therefore, a discussion of integrated urban morphology needs to start with the relationship between people and space, place and activities.

Space and place are conceptually closely related and at the same time very different. They are two separate but closely related concepts in the urban context. Gieryn (2000,p.469) argues that space emphasises abstract, trans-individual existence. On the other hand, place encompasses the concrete location of individual and group identity and is used for settlement. For Gieryn, space should be understood more as an abstract geometric concept separate from material forms and cultural transcriptions, including distance, direction, size, shape and volume. At the same time, space is the place that is emptied of all social factors. Place is the space that is filled with social factors such as people, their activities and their reproduction of space. For Weber (1978), space is abstract, philosophical, intellectual, ideological, constructed and perceptible. Place is also concrete, everyday, working life, actual practice, construction and palpable. People do not interact directly with space, but places are experienced and used all the time.

For a comparison between space and place, Rendall (1984,p.199) argues that place is an order in which the components are arranged into a co-existing relationship. In contrast, space is activated by the totality of the activities that take place within it. So space is a place that is practised (Rendall, 1984,p.209). For example, Foucault (2008,p.3) discusses power relations in *Discipline & Punish: The Birth Of The Prison*, which uses a panoramic open view of the circular surveillance tower in a prison and its corresponding prison cells, which is in fact supposed to be a place rather than a space(Figure 8). It is only in a specific location such that the form of the particular building comes into play and there is a contrast in the power relations between the watchers and the prisoners. Therefore, place is a more accurate counterpart to space in terms of its intersection with social relations, social structures and social activities that are intertwined and causal.

Figure 8: Presidio Modelo prison in Cuba an example of a Panopticon penitentiary. (source: Stewart 2015)

Edelman (2003,p.474) defines integrated urban morphology as a specific location within a space where people settle and which accounts for their identity. He emphasises the subordination of place to space and argues that place is a specific manifestation of space. More importantly, he emphasises the importance of the identity labels that people derive from a place. Both the indispensability of people to place and the impact of place on people are highlighted. He also mentions that without the superimposition of people's sociality, the spatial-physical nature of a place has no meaning and can only be part of the natural world. On the other hand, place is involved in social activities and its specific properties play an inseparable role in people's understanding of themselves and society. This is why most landmarks in a city may not differ much from their surrounding contemporaries. However, once they have been given a label, people are bound to associate them with something more. They are the identity of a place and are a way to achieve place-making(like figure 9 and 10). This is why the mention of landmarks in many places is associated with a city.

Figure 9 (left): London's Chinatown. London's earliest Chinese settlement grew in popularity with Chinese food and the influx of Chinese immigrants, then gradually formed Chinatown.(source: photo by author)

Figure 10 (right): Canary Wharf, London. The area is known as the Financial City of

London due to the many banks, stock exchanges, gold markets and other financial institutions. The landmark-like buildings give the area a high space identity.(source: photo by author)

If urban growth is the aggregation of people and things in places, then the city is in fact the most visible manifestation of place. Gu (1992, p.6) argues that the process of urban growth begins with the social division of labour. Mumford (1961,pp.31-33) believes that such an aggregation process is a kind of urban revolution with external forces involved. Mumford (1961, pp.5-7) adds that as the organisation of people became more complex, occupations became more diverse and institutional innovations enhanced transport and interaction between people. This made the function of the city more complex and the focus on the activities of people's lives, both in the place and in the city, became more and more important.

By the twentieth century, cities had expanded considerably as the most concentrated places for human beings to congregate. Within the cities, the functional differentiation of urban morphology is thus gradually emerging. People go to the central business district to work, large shopping malls to buy goods, hospitals for medical check-ups, parks for morning exercise or to meet people, libraries for books and information, restaurants for good food and the different spaces have their specific functions. When it comes to a particular area, city residents know what it is and what they can expect when they visit it. The city is like a giant grid of spaces that meet people's demands for living and working and people move back and forth between the smaller subdivisions to get what they need. At the same time, the functions of the city are constantly expanding and developing as new needs emerge. This proves that the city itself is a specific place, which makes the concept of integration necessary in the development of the city and its sustainability. Integrated urbanism is also an important element in the investigation of space in order to guarantee sustainable development and the concept of human scale.

Sustainable integrated urbanism focuses on how people's daily needs can be met within each behavioural grid in a pedestrian context.

3.1.2 Place and activities

In the process of development from settlement to city to integrated urbanism, people, place and behaviour are always closely linked, and the city is in fact a specific place. As mentioned in the previous section, the relationship between human behaviour and place should be an essential consideration in understanding the daily lives of urban dwellers and urban development. Ullman (1954) suggests that urban facilities and infrastructures play an important role in urban development, especially in promoting urban economic growth and the introduction of talent. Jin and Wu (2020) observe that leisure facilities such as parks, green spaces, museums and sports venues became increasingly well-equipped after the industrial revolution. This phenomenon is both a manifestation of the growing demand for life and a contribution to the generalisation of urban activities. Giddens (1986) offers a holistic paradigm for thinking about urban life through a socio-spatial lens. Space and location are seen as an important part of everyday life and everyday social relations, emphasising the importance of place to everyday social life and urban development. However, a common problem in cities today is that highly functional planning makes cities very functional without the ability to meet the needs of activities on a human scale and at the level of urban space.

In Castells' (2014, p.5) critique of urban sociology, he proposes that much of the current research has neglected public spaces instead of treating social institutions as important sites of social communication. The strengthening of the study of public spaces has important implications for the current rise of urban symbolism (Castells, 2014,pp.93-100). Habermas (1991) provides a comprehensive and systematic analysis of everyday life theory based on sociological theory. He argues that everyday life is a realm in which individuals are always engaged in interactional behaviour and that its structure generally has three dimensions: cultural, social and individual. In these three dimensions, individuals seek understanding, harmonious interaction and socialisation to meet the needs of socio-cultural reproduction, social integration and personality growth. Daily life is therefore important for the development of interaction, the formation of society and the production of the individual, and is the basis for further understanding the value of life and the meaning of the cultural world. As a synthesis of places and spaces that accommodate the conduct of daily life, everyday living space is in essence a synthesis of people, activities and spaces, consisting of the activities and interactions of people in their daily lives and social relations. At the same time, as part of the urban public space system, the everyday living space provides a variety of functions for people's daily lives and meets the needs of different people in their daily lives in the city(like cities that give people places to gather or meet friends, Figure 11 and 12).

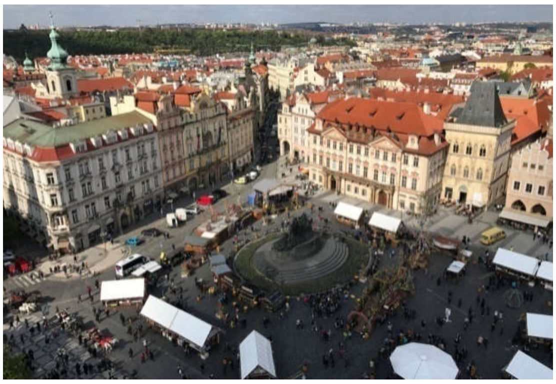


Figure 11(left): Street cafes offering public life, visit in Bruges, Belgium.(source: photo by author)

Figure 12(right): Oldtown Square in Prague. One of the most important places in Prague for people to gather and socialise, with its kiosks and surrounding cafes and restaurants.(source: photo by author)

In Gehl acclaimed book *Life Between Buildings: Using Public Spaces*, he (2011, pp. 6-8) classifies human activities into necessity activities, optional activities and social activities. Necessity activities occur under various conditions such as going to school, going to work, shopping, etc. That is the daily business of work and life and most activities of this type are associated with walking. Optional activities only occur when there is a willingness to participate under suitable outdoor conditions. They are mostly recreational and leisure activities that are suitable to be carried out outdoors and this type of activity is dependent on external physical conditions. Social activities are activities that depend on the participation of others in public spaces, including games, conversations and various public events, and occur in spaces that are open to the public. Fainstein (2000,p.464) finds that human daily activities intersect with these three activities and that their essence is the state of the relationship between people and society. It also guides the development of social space.

In general, the functionality of the city is necessary, while at the same time, the need for sustainable activities for citizens is also taken into account. This includes the public need for parks, shopping malls, etc. in a city. It also considers the daily necessities of people and their social activities. This requires a functional place but also offers a convenient and walkable range of daily activities. Activities occur when people gather in one place and socialise, including children playing, friends gathering and passers-by meeting each other briefly. These activities are often spontaneous and can take place in a variety of settings. Creating a good urban space to encourage as many activities to take place in it as possible is an essential aspect of urban integration. As Gehl said, these activities are resultant because the physical environment of the space constrains activity, and in a dense urban environment, low quality optional activities exist only at a minimum level. However, in a good physical environment, optional activities occur with high frequency.

3.1.3 The role of urban design in edge cities

The point of a city is to bring different people together. As a new area or a place around metropolitan areas, the edge city should basically act like a city and have the same functions as a city. Gans and Laiftownen (1967)claim that suburbia has spawned a new breed of Americans who live in as many houses as they do. They are bored and lonely, alienated, atomised and depersonalised. However, edge cities are a function of growth. According to Garreau (1991, p.14),the edge represents the way Americans bring urban functions (machines) to the edge of the natural landscape. It marks the place where most Americans now live, study, work, shop, play and die. To be more specific, a complete edge city should include office areas, retail space and activities 24 hours a day, either work or living. So the significance of the emergence of edge cities is that they are places where people live, work and play together. Therefore, the emergence of edge cities is significant because they are places where people live, work and play together, not just for functional satisfaction, and the integrated urban identity is also significant.

Garreau (1991) believes that the edge city is an ideal model of development that integrates the advantages of both the city and the village and is indicative of the future orientation of large cities. Edge cities reveal the orientation of people's values regarding ways of working, housing and living under new socioeconomic conditions. The residential land also contrasts sharply with the downtown area in terms of building density. Buildings in the downtown often have smaller foundations and a lower proportion of green space, while in the residential area in edge cities, the building foundations are often several times larger than in the downtown and almost every household has access to a large garden. It fully satisfies the desires of the medium and high-income population for environmental quality.

It is commonplace to see high-rise and high-density buildings throughout traditional downtown areas in the city. This has led to the congestion of people and vehicles, thus making it impossible to adapt to a modern society where the car is the main means of commuting. Industry and tertiary industry buildings are located in low-rise and low-density conditions. There are few traditional factories in existence because they have been replaced by industrial parks, where an area of green space is guaranteed. Garreau (1991, p. 4) describes edge cities as broad, low outlines that dot the landscape like mushrooms, separated by green space and parking lots. Their office towers, frequently guarded by trees, gaze at one another from respectful distances through bands of glass that mirror the sun in blue or silver or green or gold (like Figure 13).

Figure 13: Apple Park is located in Cupertino, Silicon Valley, the edge city of the San Francisco Bay Area. The total land area is 1.46 km^2.(source: Lane 2019)

Garreau (1991) observes that urban centres are easily accessible by public transport, yet most people prefer to drive and transport by car is a common choice. As a result, a horizontal sprawl has been adopted in the edge cities rather than development to vertical altitudes. According to Garreau(1991, p. 118), an appropriate walking distance acceptable to Americans is about 200 metres, excluding airports, old downtown areas or other specific areas. Although the central city area has convenient public transport, most Americans still prefer driving by car. This is rather commonplace in America. This creates a great challenge to sustainable integrated urbanism and to walkable accessibility and makes edge cities in the US still car-based. Thus, edge cities follow the principle of horizontal development instead of high-altitude development. Also, it is important to make the street as attractive as possible when there is horizontal development. A fun and non-boring walking experience can increase the walkability of people. Otherwise, once people get in the car, half of them may decide to leave their destinations completely.

Garreau finds that many commercial and service buildings, apartments, offices and other complex buildings stand irregularly along both sides of the roads in most edge cities in the United States. These cities are surrounded by a large number of scattered houses and each marginal city has its own centre and its own extended suburb. The new city is equipped with public service facilities. The residence area is organised in neighbourhood units and enclosed by trees and large grass lawns. The off shoring of industry has boosted employment. The migration of people further promoted the infrastructure of the fringe areas. However, a large shopping centre needs people to travel by car, so they are mostly dependent on highways. The low density of these places and the large size of each block make it difficult to have a clustered market street, which is almost impossible for people to reach by walking, and these edge cities are still more focused on functional satisfaction. Thus, it is important to promote the spatial integration of new centres in the periphery, whether in residential or office areas.

3.2 Sustainable communities in edge cities

3.2.1 Sustainable communitiesand pedestrian accessibility

In early 20th century, many American cities fell short of their overall planning strategy and were caught in traffic jams and inadequate public space. The concept of community was first proposed to solve a series of urban issues such as inadequate human concerns, insecure traffic and lack of social contact (Calthorpe, 1993). As

Mumford points out, it is necessary to rediscover a sense of affinity and belonging that disappears with the expansion of the urban scale and the rapid development of transport conditions in the community(Mumford, 1961,p. 67). Calthorpe (2015) proposes a comprehensive perspective from the viewpoint of neighbourhood, community, town, city and metropolis, and equates regional urban design with community design. He believes that a regional scale design should combine urban internal revitalisation with suburban updating. Calthorpe suggests a humanistic scale and views diversity and protection as a material morphological design principle in place of standard machinery production.

The key to humanistic scale is walkability. Clarence Pery (2015) developed the idea of a community unit, thus taking into account not only a practical planning design concept, but also social engineering. The core principle of Pery's community concept is to have basic necessities within walking distance of residents. The scale of the community should at least include a primary school, a five-minute walking distance of around 400metres and a neighbourhood accommodating 5,000 households(Tan, 2005). The concept of the small block comes from the block scale in traditional cities. Its significance is to build a dense street network, to construct a humanistic community and to optimise walking, cycling and locomotive traffic flow. As Moughtin and Shirley mentions in *Green Dimensions*(2005), a sustainable block size should be the same as the traditional European city morphology, i.e. from about 70m×70m to 100m×100m. Such a design is able to reduce the use of vehicles and improve the air quality. For Teng (2012),the surrounding building blocks should be further developed to form a common internal courtyard and active pedestrians with appropriate streets and blocks in a humanistic scale. Compared to large blocks, a small block more easily builds a humanistic street space and a dense public space network and reinforces land use across a small district. Small blocks can also give rise to diverse public spaces, buildings and activities, which makes for community vigour and local activities (Rohe, 2009).

The concept of the pedestrian pocket marks a preliminary attempt and exploration of the sustainable community theory in the preliminary stage(Calthorpe, 1989). It focuses on public transport and walking and insists on an equilibrium relationship with public transport instead of a replacement relationship. The concept of the pedestrian pocket places more emphasis on the community unit. The advent of the sustainable community suggests the transition of community planning theory to public transport, walking and traditional community space. According to Girling (1993), the pedestrian pocket creates a more compact urban planning mechanism by reinforcing public transport and protecting open space for walking and hybrid land-use communities. The sketch map (Figure 14) of the pedestrian pocket mixes some mid-intensity and high-intensity building complexes around public transport stations where the ground floor accommodates stores and the upper floors provide business area. The size of the pocket is determined by a 400-metreradius that is suitable for walking. In a check mesh, these pockets adhere to the Radburn mode and the terminal pathway is connected to the pedestrians to the centre (Girling1993).

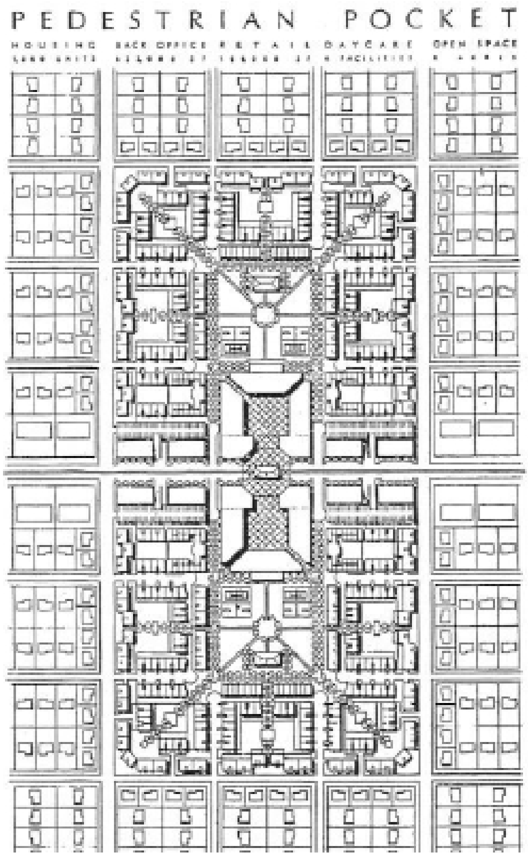


Figure 14: The diagram of Pedestrian pocket.(source: Girling 1993)

As the railway changes the accessibility of edge cities, railway construction motivates the synchronous development of peripheral infrastructure, and lifestyle in edge cities has been gradually accepted by residents (Florida, 2012). Transportation as the carrier, instructs land development and urban construction in edge cities. Small blocks demonstrate greater appeal to residents for more sound facilities, habitable landscape and environment characteristics. The combination of transport-oriented development and the concept of the community is a way in which the construction of edge cities can move from satisfying the functionality of citizens to becoming more sustainable. The combined action of these aspects promotes the integrated development of edge cities.

Calthorpe, Fulton and Fulton (2001)claim that the concept of the pedestrian pocket has gained strength since its emergence and is the driving force of the development of new cities, edge cities and polycentric cities. In *The Next American Metropolis: Ecology, Community, and the American dream*, Calthorpe (1993) deepened the concept of the pedestrian pocket into a more completed spatial structure. Its noticeable characteristics lie in the availability of regional transport, mixed land use, high-quality public space and a pedestrian road network. Walking is the most primitive and basic way for human beings to get around. However, with the rapid urban construction of recent years, the road network formed by the urban motorised transport system has spread to all corners of the city. The growth of motorisation has had a significant impact on the scale and planning of cities. In contrast to the past, contemporary urban transport is a product of a combination of walking and motorisation. The accessibility of the pedestrian system is even more critical at the neighbourhood scale.

Jacobs (1961), in *The Death and Life of Great American Cities*, strongly attacked the policy of banning urban street-level commercial activity in the course of urban development. She argued that such a practice resulted in the disappearance of originally essential behaviours to urban activities. It is such street markets that constitute the territory in which people interact and communicate in the city. Eliminating such markets is tantamount to cutting off the space and opportunity for human interaction. Clearly, in Jacobs' view, the street in the city shows a special socio-spatial relationship between people and space which can facilitate human interaction. This is in line with the theme of public space in the city. Similarly, Zukin (2009) took Jacobs' ideas a step further by focusing on the authenticity of the city. In his perspective, the city's authenticity is found both in its urban architecture and in the city's social fabric. Suppose the process of urbanisation or urban transformation requires the creative preservation of the city's architectural culture. In that case, it is even more important to preserve the social structures and social relations of people that are essential to the construction of an authenticity urban culture.

Jacobs (1961) suggested that the first thing a city is known for is its streets. If a city's streets are interesting, then the city will be attractive. Conversely, if the streets are monotonous and boring, the city will be dull. This showed the importance of the street in the open space(for example Figure 15 and 16). As mentioned before, Jan Gehl, (1987), in *Life Between Buildings*, classified outdoor spatial activities into three types. He stated that most social movements depend on the quality of outdoor space. All these studies confirm the importance of accessibility in urban design. Accessibility and walkability are still mainly analysed on a large scale and from a macro concept. However, as Louis Kahn has commented, cities begin as public open spaces and streets as communication places. So interpersonal communication is the essence of the city. Therefore, the focus on pedestrian accessibility and the dynamic interaction of block spaces is key to exploring integrated urbanism at the human scale.


Figure 15 (left): The Champs-Elysees in Paris. The walkway has been widened to 12-24 metres and the kiosks have been removed to ensure that walkers have a clear line of sight.(source: photo by author)

Figure 16 (right): Tables and chairs outside in the streets of Berlin extending through the restaurant.(source: photo by author)

The analysis of spatial dynamics and interaction in streets can be traced back to Newman's book *Defensible Space* (1972, p.264). He suggested that the distinction between public and private space and between semi-private and semi-public space plays an important role in residents' sense of domain and communication. Hajer (2001) proposed the idea of a liminal space in the new public domain, a place with a 'threshold'(as Figure 17). These theories are superficially contradictory to Jacobs' claims for open grid neighbourhoods, which also imply open versus gated communities. The extent to which the strength or weakness of accessibility facilitates or inhibits interaction is a matter of human scale. Established fundamental theoretical research is an essential part of the analysis, but there is a lack of rational and quantitative methods of analysis at this stage. Hence, accessibility is a significant measure of a place.

Figure 17: Bern, Switzerland. The porch defines the boundary between community and sociability as a shift from the public to the private.(source: photo by author)

The pedestrian walkability and the accessibility of an urban quarter reflect the morphology of its roads and influence the distribution of commercial functions in the area. The most relevant aspect of pedestrian access is the outdoor gathering and interaction of residents, which reflects the spatial vitality of a neighbourhood. A well-connected spatial form increases the opportunities for external flows to pass through and promotes a greater distribution of commercial service functions. The importance of the walkability and accessibility of an area is further illustrated by the concept of walkable urban structure. Spatially-based daily walking activities are still an essential part of citizens' daily lives. It still plays an important role in maintaining social ties and enhancing urban communities' identity and spatial activity.

3.2.2 Gated residential communities in China

The population diversity in edge cities also reflects the characteristics of suburbanisation in the United States. With the continuous inflow and diversification of population in edge areas, social stratification became more and more evident. These communities adhere to a unique form of organisation such as a specific entrance, a security system and common rules. Exchange between communities is rather insignificant in order to maintain property values and prevent the intrusion of outsiders for sake of security. This also supports Garreau's idea: the design of edge cities pays overwhelming homage to one principle: feel safe (Garreau, 1991, p. 49).

Pan (2004) argues that Western countries and China have different definitions ofthe community. According to Chen and Er (2016),citizens canbuild or rebuild houses on their land but various construction aspects such as building density, elevation, building height, municipal administration, etc. must meet the local planning requirements in most Western countries. Citizens can also buy land or housesdirectly. Supporting facilities such as schools, nursing homes, shops, markets, hospitals and post offices are subject to macro-control by the government. In China, a residential community, also called a residential unit, a residential quarter or a neighbourhood, is an urban residential area and its residents are administrated by a sub-district. Usually, different communities are built by different real estate developers. Every community has a community committee, neighbourhood committee or residents' committee and every committee administers the dwellers living in that community (Contemporary Chinese Dictionary, 2016).

Most residential units in China are neighbourhoods with high density and supporting facilities. A sizeable residential community usually has kindergartens, clinics, shops, and businesses (Liang, 2016). As shown in Figure 18, these shops act like fences, so that each neighbourhood is gated, and separate public space and semi-public areas. In addition,most land is privately owned in Western countries. Take a house for example, Usually, a house has a front yard and a back yard. The backyard is more private and secure and can be a place for children to play and family to gather. The front yard is adjacent to the road or public space and has nothing to block it, so it is more of a semi-private garden, and residents manage it(Figure 19). Another example is the 'block' community. The building ismainly based on an enclosure but the ground or first floor facing the street can be used for business or as office space and the upper floors can be residential use, i.e. it is a mixed-use building. The enclosed inner space can be a semi-private garden for the residents. Due to the high population density in China, the housing typology is mostly a closed community composed of middle-level or high-rise buildings. Courtyardsare mostly semi-public or semi-private spaces(Liang, 2016).

Figure 18: Commerce and residential building. (source: photo by author)

Figure 19: Typical residential area in UK (left) and Beijing (right). (source: Google Earth Pro)

Most of the residential areas in China are enclosed. Each neighbourhood is like a circle that includes residential buildings, shops, green spaces and neighbours. Most neighbourhoods have clear boundaries with fences, walls or shops. Xu and Yang (2009) describe two peak periods in the building of a Chinese community. One is the staff accommodation which belongs to a company or a unit. Each company in the city encloses a piece of land in order to build a community-integrated office building, residential building and various supporting facilities. After 1998, China reformed its housing system. The welfare staff dormitory was abolished and people were encouraged to have private homes. Since then, the real estate boom began to develop the neighbourhood. Many aspects such as architectural form, landscape design, property management, community construction and life concept have become selling points. Real estate meets the demands of residents by providing more safety and private space, so the community has fewer exits and more surrounding walls. Also, in traditional Chinese culture, people like to live near mountains and rivers. Some real estate developers even create artificial mountains and water features inside the neighbourhood to attract people to buy (Liang, 2016). In this way, gated communities have become the mainstream form of residential unit in China.

Most gated communities are surrounded by walls or anti-climbing fences. In general, each entrance to the community will have a pavilion for porters. Gated communities are more strictly managed. People and cars enter using a key or access card. Visitors or other outside people are only allowed to enter when they register and specify which premises they are visiting. This has helped to reduce crime rates. According to Tang (2011),the gated community provides safety be strengthening the secure effect of the enclosed space through, for example, strict security management, an access control system and monitoring equipment. Therefore, the closed community can enhance the sense of belonging of residents and improve the community's security.

The Chinese community emphasises functionality but public transport roads are separated from residential areas. There are roads in gated neighbourhoods but other citizens and vehicles cannot enter without permission, improving security but damaging the city's transportation network. Chen (2019) observes that when comparing the road distribution in China and in Western countries with the same proportion and population density, the length of China's urban public roads is only about 2/5 that of

Europe and of the United States. The number of intersections is less than 1/8 of that the Western countries but the average distance between intersections is more than double (as shown in Figure 20 below). In sum, if each residential area covers more than 10 hectares and is not allowed to be traversed, the organisation of a city road network must be sparse and intermittent and reduce the road density. This is a significant cause of traffic jams in Chinese cities. Furthermore, gated communities also affect citizens' lives in that they have a negative impact on residential segregation. Feng (2017) finds that residential segregation in the Chinese city is based on income and reinforced by gated communities. This will tend to increase the homogeneity of homeowners and reduce their contact with the rest of the city.

Figure 20: Shanghai Xujiahui (left) and London Piccadilly Circus (right) public roads within 1 km^2. (source: Chen 2019)

A gated community is an independent entity that is not connected with others. It results in the city or residential area not being walkable and not sustainable. In other words, citizens find it hard to experience public space or the city. As Jane Jacobs advocated in *The Death and Life of Great American Cities*, pedestrian zones are the central public area in a city and are like an essential organ in a district. One of the gated residential area's problems is that when designers design the support facilities and public space, they use a wall or fence to isolate all the parks or facilities from the neighbourhood and city. However, besides the traffic issue, many activities can also be achieved through street space such as shopping, leisure, sports and communication. Feng (2017) points out that most residential units only allow residents to have access even though there are one or two entrances with a security guard every two or three hundred metres. This makes going to a public place very inconvenient. The walkable distance forces people to make detours and even leads to more car usage. This makes the city unwalkable and unsustainable. Jacobs (1961) proposed the concept of 'street ballets': children playing in public spaces, neighbours walking in the streets and nodding to each other. However, gated communities lead to cities with roads and streets which are inaccessible in many places. This results in people just passing through but not staying.

Chinese gated communities can increase people's sense of belonging and provide security. However, there are also some negative issues that may occur. Gated communities have many roads that are not walkable for outside citizens who cannot enter the community. The disruption of the city transportation network leads to serious traffic problems followed by traffic jams and other problems. In many cases, this also forces people to travel by car instead of walking. This makes the city unwalkable and unsustainable. At the same time, people cannot enjoy the space, making them stay at home rather than experience the place.

3.3 Integrated urbanismin edge cities

3.3.1 Creating urban identity in edge cities

After experiencing a bourgeois revolution, Western countries experienced an urbanisation movement, as mentioned in Section 2.1. During the process of rapid urbanisation, the fast expansion of cities made transport a major factor in the characteristics of urban space. The outward development pattern of cities can be seen in the emergence of remote districts of the city. According to Wu(2009),the identity and characteristics of a city directly reflect the history, culture and background of a place. However, more edge cities are emerging that do not have an identity of their own from the outset. The edge city should be a specific area where people can have a sense of belonging (Garreau, 1991). The edge city is not only a part of the megacity, it is also an independent entity. The edge city should also develop its own identity and characteristics in the same way as cities.

Gehl (2013) argues that modern cities were expanded in order to achieve favourable living conditions. Apart from historical sections, new district high-rise building complexes, edge cities and polycentric districts, most districts took shape in the process of chasing after efficiency and solving urban issues. Therefore, they are more functional. Lv (2008) argues that citizens have almost no identity as locals because of their weak perception of new cities. This suggests that apart from historical sections and other featured districts, most edge cities are ordinary. The commonplace phenomenon indirectly explains the stereotype of the city in contemporary times. Von Meiss (2013) argues that while functional requirements should be satisfied through building new cities or developing edge cities, it is also necessary to examine the significance of cities. To reinforce local people's psychological identity and sense of belonging about life and work, cities should form their own identity and characteristics. As stated by Lynch (1964), complex physiological factors of a city such as identity or image not only give a city strong legibility, but also reinforce the symbolic and collective memories of the people living there.

With regard to urban characteristics, Li (2012) finds that cities represented by Brasilia, Chandigarh and Washington take a lead in capital construction by government intervention and initially develop urban characteristics. Secondly, high-rise buildings feature epochal characteristics such as in Manhattan, Chicago and Curitiba in New

York. This construction mode can also be seen in new cities and most peripheral cities. Brasilia, for example, was built as a new city in the middle of a plain in Brazil in around 1965(Figure 21). Cysek-Pawlak (2018) points out that the general layout of the city is patterned on a jet aircraft in order to symbolise the boom of the country. The nose of the jet aircraft is the Square of the Three Powers, the fuselage of about 8 kilometres is a memorial axis lined with public complexes perpendicular to both wings (the cross mirrors the Catholic faith of Brazil) in a curved residence zone and business zone, and the airplane tail is cultural zone and sports zone. This unique urban feature has become the identity of the area and its functional layout meets the daily requirements of the citizens(Tan, 1999). According to Mumford (2018),this actually reveals the urban characteristics of artificial design.

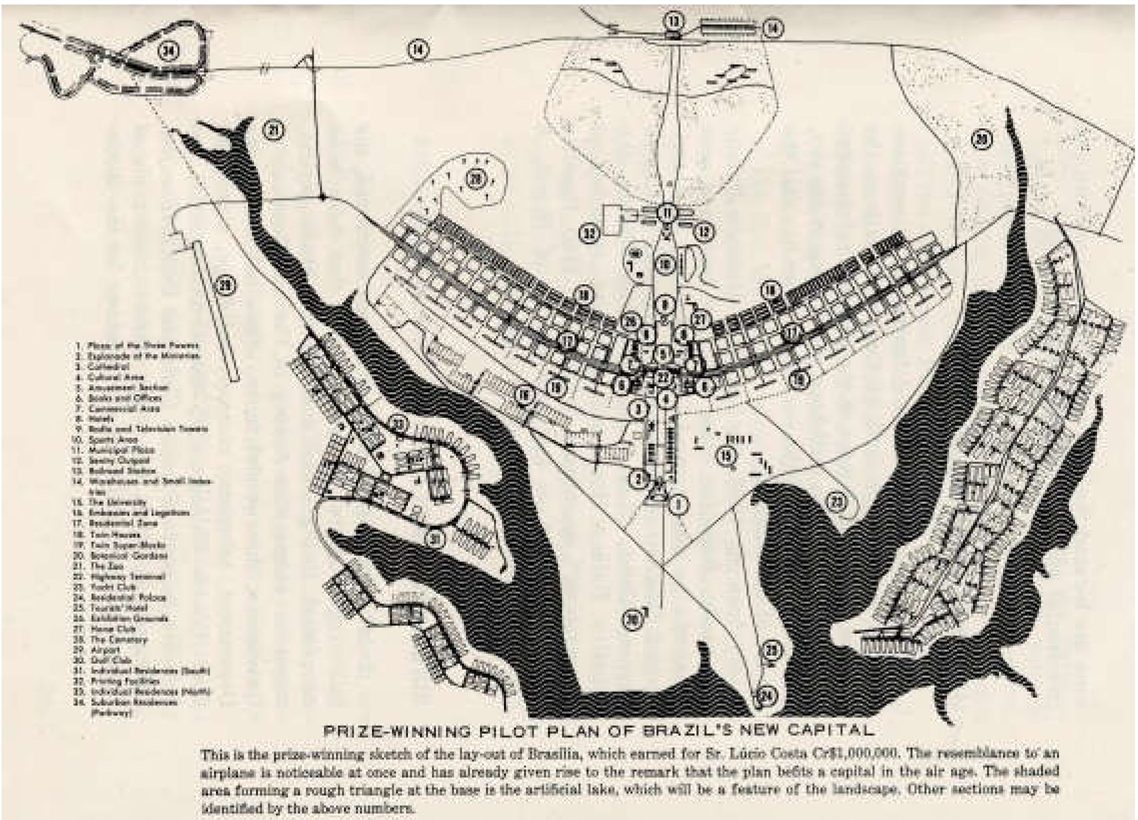


Figure 21:The plan of Brasilia. (source: El Grande Tour 2014)

A city cannot be built in one day, and likewise, urban characteristics also precipitated with the growth of cities. Manley and Guise (1998) claim that urban identity is closely related to the character of a district. A district can only develop its own character over a long period of time when people can change and adapt to it and when they form their own stereotype about the place in their mind. When the Eiffel Tower was first built, it suffered from a strong backlash from the local citizens, who saw it as rigid and incompatible with the surrounding old buildings. However, in a later opinion survey, the Eiffel Tower was chosen to be the new landmark of the city by an overwhelming majority. Whether the mark left by the urban space can become a new factor of the urban characteristics takes a long time to be seen. This can be decades or even centuries (Kaplan, 2006). When people adapt themselves to the urban characteristics, they have formed their own distinctive characteristics and images in their minds. Therefore, whether in natural edge cities or artificial edge cities, polycentric districts in central cities must foster a sense of belonging and identity among the local residents living and working there.

In addition, the cultural environment is an important part of the city. Civilisation is the identity of an area. It represents the characteristics of the city and it is like a city landmark(Figure 22). According to Garreau(1991,p. 214),the edge city should make some effort to bring civilisation into the space as well as other things beyond the office. Using San Francisco as an example, Stegner (1987, p.137) finds that an affinity with San Francisco is ascribed to the cultural appeal of the city. It is a place where secular people believe in the bright prospects brought about by civilisation, for it is worshipped as the most civilised city in America.

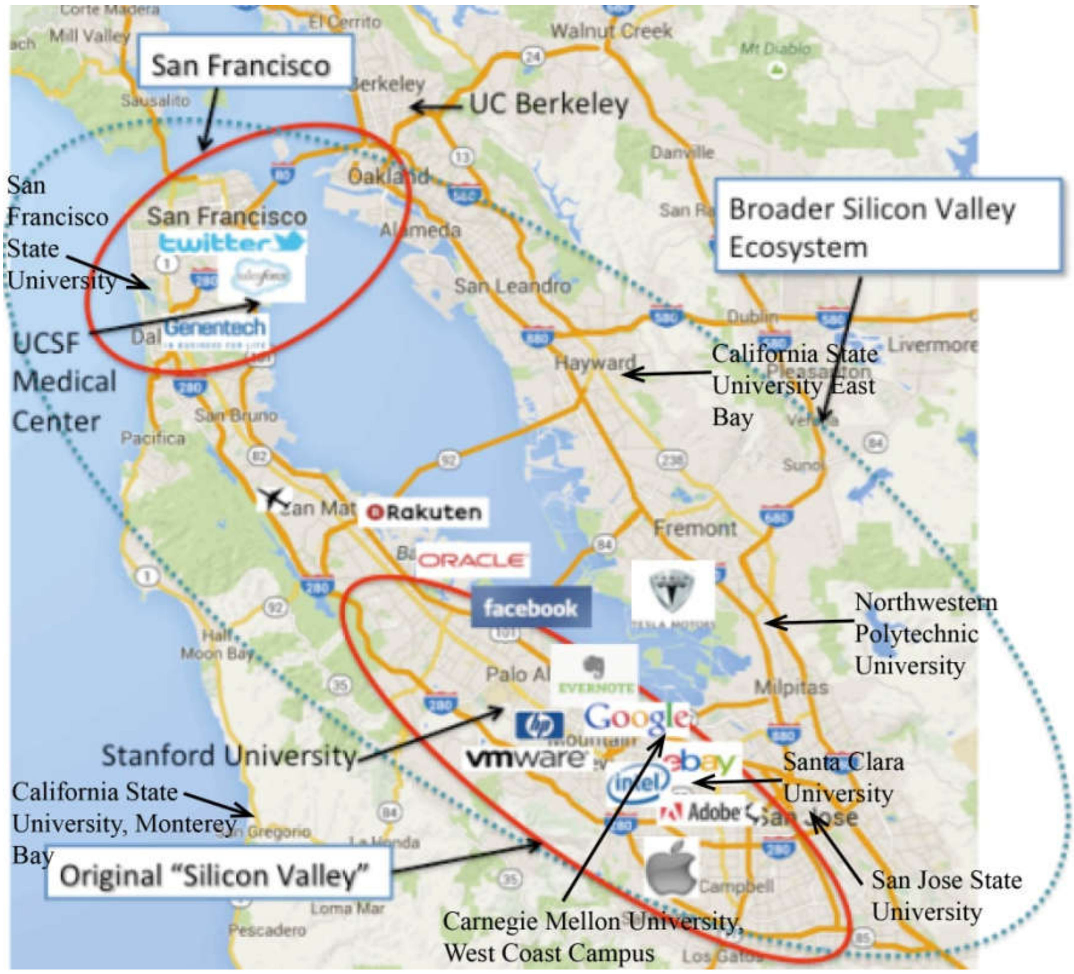


Figure 22:The location of universities and Silicon Valley. (source: Kushida 2015)

According to Garreau (1991,p. 317.),most new jobs and wealth in the San Francisco Bay Area are born in the edge city. From 1950 to 2017, the population of San Jose, the capital city of Santa Clara, increased from 95,000 to 1,035 million, which made San Jose the first major city in the San Francisco Bay Area. Silicon Valley attracted a large number of plants for the production of computers and electronic devices and for the aerospace industry. About half of the employees in San Francisco are in the service industry, financial industry and international trade. Tertiary industry was the backbone industry, in which industry accounted for just 15%. Forty banks and 147 branches were headquartered in San Francisco, including Bank of America, the Pacific Coast Stock Exchange and one of the largest banks in America. San Francisco used to be the financial centre of western America. Decades later, population and enterprise in the

San Francisco Bay Area began to demonstrate homogeneous and disperse growth momentum in space(Cooke, Uranga and Etxebarria, 1997).

With the shift of industry and the continuous expansion of peripheral urban enterprises in the San Francisco Bay Area, the organic combination of education and industry activated regional development and renewed the image of the city. The establishment of numerous higher education institutes and industries contributes to the high population density throughout the area. On this basis, the gradual improvement of local apartments, residence, infrastructure and supporting facilities ensures the superior living standards of people in the marginal area because the people who work in the outskirts are able to balance their work and life and make the edge city more alive.

As Garreau(1991) suggests, the edge city is good for the start of new businesses and to increase employment opportunities and to accumulate wealth. However, it is also essential for edge cities to develop their own culture and identity that can give people a sense of belonging. Most people want to be proud of where they live. An example is the San Francisco Bay Area, where the benign interaction between the higher education industry and the high-tech industry, represented by Silicon Valley, shapes a unique city culture and city identity.

The formation of the marginal city is mainly caused by the development of the transportation system and the migration of people and industries on the edge of the central City. Garreau(1991) believes that the edge city is an ideal model of development which integrates the advantages of both the city and the village and that it is indicative of the future orientation of large cities. Compared with traditional urban downtown areas, edge cities manifest a much stronger industry diversity and possess greater professionalism in terms of the retail industry, wholesale industry, individual service industry and manufacturing industry. Edge cities usually possess distinctive features of professionalism. However, edge cities have not developed over a long period of time, resulting in a very functional development that is still mostly aimed at satisfying the various functions of people's daily life. In their creation of a sense of local identity, spatial attributes are still easily overlooked. Therefore, this research attempts to reveal the spatial patterns and their overall spatial characteristics in order to discuss the integrated and characteristic development of today's edge cities rather than building a space that can be easily replaced.

3.3.2 Creating actual spaces for citizens in edge cities

The urbanisation of the world is one of the most impressive facts of modern times. It has caused profound changes in almost every phase of social life. Despite the dominance of urbanism in the modern world, people still lack a sociological definition of the city. Such a definition would fully consider that although the city is what characterises urbanism, the model of urban life is not confined to the city. From a sociological point of view, a city is a relatively large, dense, permanent settlement of ethnically diverse individuals. Therefore, it is only through organised group action that individuals can become effective. If a sociological analysis is carried out according to such a theoretical system, the complex urban phenomenon can be given unity and coherence.

People's sense of space is vague and muted, but their sense of place is clear and familiar. This explains the importance of place making in urban design and integrated urbanism. Integrated urbanism allows for most places and behaviours in residents' daily work and life to be accessible on foot. In this range, living circles with a high level of pedestrian comfort and thus proximity of people's everyday activities such as shops, schools, parks, etc., to their housing are an important element of sustainable behaviour and integrated urbanism.

According to Louis Wirth (1938),one key to increasing urban consumption is urbanism as a way of life: the density, heterogeneity and anonymity of urban experience that stimulates market activity. More specifically, the delineation of areas for the social governance of public affairs in a given community. In addition to the residential community, areas related to the commercial activities, daily recreational activities, exercise activities and even the parking of the neighbouring residents should be considered as part of the social governance of the community as a whole. This is because these areas are closely related to the community's own life and can easily be translated into public affairs that are relevant to a wider range of residents.

In the field of urban sociology, there is a wealth of empirical research analysing the effects of place on people's behaviour. Tuan (1979,p.316) argues that people’s relationship with place is mixed with a strong sense of personal attachment. Tuan (1979, pp.16-19) also argues that people's perception of a place consists of four aspects: a sense of personal identity, a sense of belonging to a community, a sense of past and future time, and a sense of being at home. From this perspective, people should be very concerned about their place, more engaged and enthusiastic in the promotion of various issues and have active participation and better experience. Thus, in integrated urbanism the emphasis is on the actual and holistic character of a place and on the possibility that a place should offer people encounters rather than fragmented functional needs.

In 1965, Japanese urban planning introduced the concept of a wide living sphere in order to solve problems such as environmental pollution and the uneven distribution of resources. Japan attempted to form a spatial sphere to serve the city through spatial governance and reconfiguration of the transport system in the central city (Hino and Liu, 2011). They conducted a review of living space studies and concluded that the daily living circle is a collection of the scope of people's everyday lives in the city. Sun et al. (2012) further categorised daily activities. They point out that the daily activities circle refers to the range of behaviours that meet the most basic needs of urban residents such as housing, medical care and education. The basic living circle refers to the range of behaviours that meet residents' needs such as employment, recreation and external transportation. The opportunity living circle refers to the field of behaviours that are formed mainly to meet infrequent needs of urban residents.

The daily life circle refers to a substantial spatial area, centred on the place of residence, where residents carry out their daily activities such as commuting, studying, shopping and medical care. It reflects the dynamic relationship between the supply of facilities and the daily needs of residents within a certain area. The core of this is the provision of convenient, accessible and equitable facilities for residents to meet their basic daily needs (Castells, 2014). With the development of the economy and the continuous improvement of the city's basic functions, the frequency and depth of people's demand for leisure life are constantly increasing. Compared to everyday life, leisure life can improve self-image and self-expression. They promote physical and mental health, improve social relationships and contribute to personal growth and well-being. It is an important expression of the high quality development of cities and the deeper pursuits of individuals. The daily life circle corresponds to the everyday life that guarantees people's basic demands, while the leisure life circle covers individuals' higher-level spiritual needs. The leisure life circle is not just a spatial and territorial concept, but a spatial form with sociological significance for the advanced stage of urbanisation. In other words, integrated urbanism not only satisfies the need for sustainability of people's daily lives around their homes but also the need for a sense of identity and belonging to a place.

On a holistic level, the planning of a circle of life positively impacts people's social and social identity. It also can enrich the activities of a place even more. The leisure life is to a large extent involved in the social life, and the individual participates in leisure activities on an ongoing basis. By continuing to participate in leisure activities, individuals are able to enhance their experience and gain expertise in a particular field (e.g. rock climbing, art exhibitions, etc.) while they relax and unwind. This in turn leads to general recognition in the social circles to which the leisure activity belongs and expands the social circle. The economic and educational value attached to the planning of leisure and recreational areas, as well as the assessment and co-ordination of recreational venues and venues in the planning of leisure and recreational areas, is an important step in the rationalisation of social and public resources. At the same time, the process of designing leisure life circles is not only the realisation of people's demand for good leisure, but also their leisure activities. Leisure industries and people's perception of leisure in the leisure life circles can reflect the image and quality of the city, which is a deep reflection of community cohesion, cultural identity and confidence, and social harmony (Pang, 2016).

At the individual level, the quality of life brought about by life circle planning is directly reflected in the improvement of people's physical and mental health and well-being. As part of everyday life, leisure life can relieve physical and mental fatigue, tension and stress, thus promoting and enhancing people's mental health and well-being. Secondly, leisure can satisfy people's needs for self-fulfilment in terms of improving their self-perception, discovering their potential, adjusting their psychological state and improving their cultivation. At the same time, the in-depth experience of leisure life enables participants to engage systematically and with a high degree of concentration. The participants gain skills, knowledge and experience to realise their self-worth (Veal, 2017).

In the context of urban development, the value of leisure life is of great importance for urban spatial design and management. However, life itself cannot be planned, so it is necessary to concretise the sociological values embedded in life from a human perspective, in terms of human scale, through the planning of daily life circles. Specifically, the circle of life is the spatial scope of behavioural space formed by individual-centred activities, such as sports, recreation, culture and entertainment, which are conducive to physical and mental health. It characterises the social links between people and society through spatial connections. For urban development, the life circle directly reflects the spiritual connotation of a high quality of life shared by all and the interaction between the space for human leisure activities and the social public space. The construction of people's cities requires cities to be able to accurately reflect the dynamic relationship between the spatial and geographical allocation of the supply of high-quality leisure resources and the needs of urban residents in order to guarantee high-quality urban development and the equity of space and resources.

The urban sociological perspective proposed that the city is a system that provides the various services required by its inhabitants on a daily basis. Housing, schools, transport, medical facilities, social services and cultural facilities are essential components of everyday life. The concept of space in the city needs to be interpreted in a broader sociological sense. Space, as one of the fundamental dimensions of society, is an expression of social relations. Space and human behaviour cannot be separated from the overall process of social organisation and social change (Stebbins, 1982,p. 253). Therefore, cities can only create high-quality, sustainably integrated urban spaces if they are based on the improvement of public facilities and the optimisation of living spaces for residents. This will create a suitable, convenient, safe and efficient spatial environment for residents, allowing more people to experience the urban space.

The division of urban community governance areas should not be based on the principle of the convenience of administrative attribution. Rather, it should be delineated in terms of a complete area covering the daily lives and activities of the residents. Such coverage of residents' lives and activities would be more sustainable.

Cities are places where people gather and live in production. From a human point of view, people expect a city public space that is clean and beautiful, but also full of life and within walking distance of their daily needs. A tidy street can be a pleasure for many people who walk through it, but others may find a sense of life and inner connection in messy street food. Therefore, it is necessary to use different areas to meet the needs of different groups and, at the same time, to provide distinctive places and spaces for different activities in different areas. In general, integrated urbanism means a place in which people can move around efficiently. They can find a significant diversity of markets and can feel attached because of an emerging identity. The main research aim of this thesis is therefore to investigate the general performance of integrating everyday life in these new cities and the resulting experiences in order to discuss the current state of creation of thriving edge cities.

3.4 Sustainable urban qualities

Henri Lefebvre (1991), in his book The Production of Space, discusses the process of urbanisation as essentially a process of spatial production. This process connects the global and the local, the urban and the rural, the centre and the periphery, in a new and unfamiliar way. Spatial issues are the key to urban issues. Urban development is not only a spatial gathering of population, resources, technology, industry and other elements of civilisation, but also a holistic transformation of the way of development, production, life, interaction and civilisation transmission (Lefebvre, 1991).

Lefebvre (1991) presents his idea of the production of space in terms of a triad of components, including perceived, conceived and lived space. Then, he uses the concepts of spatial practice, representations of space, and representational space to define the three-dimensional properties of urban spatiality: materiality, sociality and spirituality. Firstly, spatial practice is the production and reproduction of activities around urban space, as a specific site of social composition. Spatial practice is strongly linked to urban roads, infrastructures, workplaces, private life and recreation. This specific, empirical space is the perceived space. Representations of space are conceptualised spaces, conceived by designers, planners and governance. It is connected to the relations of production and the order set by them, and is a world of writing and speech, or mental space, made up of elements such as text and logic. Representational space distinguishes itself from the previous two types of space and embeds them in it, relating them to both the fundamental aspects of social life and to the imagination.

Lefebvre was a pioneer in the study of spatial theory, and his urban spatial ideas provided a source of inspiration and theoretical value for further spatial investigation. Watkins (2005) introduces Lefebvre's analytical approach in 'Representations of Space, Spatial Practices and Spaces of Representation: An Application of Lefebvre's Spatial Triad' and translates it into an application. He argues that Lefebvre's ideas offer a meaningful and illuminating set of explorations into the analysis of urban spatial structures. In contrast to the current structural analysis of space, Lefebvre's theory builds a structural analysis of space from the holistic perspective of natural, spiritual and social space. Similarly, Salama, Thierstein and Wiedmann (2012) state that Henri Lefebvre's theory of spatial production can be used as the basis for a framework that combines an analysis of all the various factors that influence urban development. As Wiedmann (2019) states, quality of urban structure requires balancing urban form, function and feasibility from the socio-spatial dimension.

Based on Lefebvre's ideas, the production of urban space can be analysed by using the perceived, conceived-lived triad to investigate each factor (Salama, Thierstein and Wiedmann, 2012). In the spatial production of emerging edge cities, all the factors that influence the character and structure of the urban fabric can be sought out (Figure: 23).

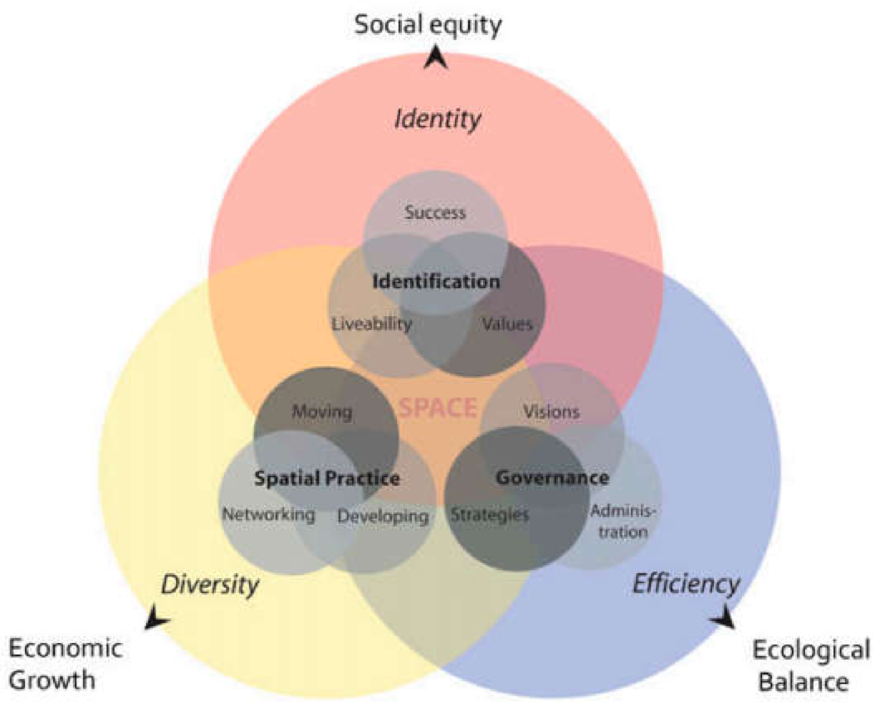


Figure 23: The interdependent production of sustainable urbanism and the key sources of the three main urban qualities. (Source: Wiedmann, Salama and Mirincheva, 2014)

1. Urban diversity: Through the analysis of urban land use, house typology and urban growth, it is possible to understand the diverse marketplaces of urban space and thus to verify the factors of a sustainable integrated urban space. The diversity of urban spaces allows for sustainable integrated functional urban forms through demand-driven urban dynamics.

2.Urban efficiency: By mapping the activities of the city in the context of urban patterns it is possible to have direct access to citizens' necessity activities, optional activities and social activities. The evaluation of urban efficiency can help urban environments to define the resources needed to further enhance lifestyles through effective governance and planning, with the aim of achieving more sustainable urban spaces.

3.Urban identity: Edge cities as emerging areas around megacities need to play a role in satisfying people's needs for work and housing while also having a place attachment instead of remaining dependent on the major city. Sustainable urban space is the meaning of the existence of edge cities, rather than a space of segregation around large cities. By analysing urban image and experience and combining qualitative and quantitative surveys, the quality and identity of urban space can be better understood and attractive urban forms can be achieved.

Figure 23 shows the key elements of all the components that generate the urban environment, quality and sustainability factors. They are all interconnected. This means, for example, that identity is key to building social equity, but it also contributes to economic growth and ecological balance (Wiedmann, Salama and Mirincheva, 2014). .In more detail, these criteria can distinguish three main urban qualities that are the basis of sustainable integrated urbanism. To provide an effective urban structure through urban governance is key to improving the ecological balance of cities. This thesis refers to the aforementioned authors' criteria for assessing sustainable urban quality: defined urban diversity, efficiency and identity as the production of urban qualities for sustainable urbanism. This framework addresses how to investigate urban quality and its production in space in order to clarify the challenges and constraints of sustainability planning (Wiedmann, Salama and Mirincheva, 2014). Then this framework is used to investigate the integrated sustainable urbanisation of edge cities in the context of China.

3.5 Summary

Edge cities area new concept in urban suburb development. It attracts a large number of populations from megacities and industries to suburbs with complete infrastructure: offices, public transport and comprehensive urban functions. In the 1980s, edge cities adapted to the needed social and economic development of the United States to some extent. At present, there are more than 200 edge cities in the United States, with two thirds of office buildings built in edge cities, 80% of them after the mid-1980s (Zhao and Peng, 2000). In China, the rapid growth has led to the construction and development of edge cities.

In the early stages of development, the periphery areas were to some extent dependent on and claimed the megacity. However, as the periphery areas develop, they should gradually become independent of and feed back into the metropolitan city, forming a relatively equal link with it and thus forming an edge city. However, China's gated communities also significantly affect the efficiency of a city, and this is not just a problem for edge cities. Closed communities inevitably have an impact on people's activities. This can also lead to great challenges in the formation of integrated cities or spaces with activities and markets in the limited areas of the edge cities.To be successful, an edge city should have the same functions as a city. In addition to jobs and housing, it should also, to a certain extent, meet the daily needs of people, with public spaces such as shops, parks and other places where people can gather. Rather than jobs and housing being restricted to the periphery, the rest of life should still depend on the home city.

Furthermore, it is not enough for a space and a city to have a balance of jobs and housing. Although the edge city has been developed in the form of a development zone, the edge city is also significant for people's sense of belonging and urban identity. This is still a challenge for the Chinese edge cities that have developed in the context of China's rapid development. It is only when the city has its own identity and attributes and meets the demands of people's daily lives that people can feel a sense of belonging and have a better experience of their place within the meaning of integrated urbanism.

The edge cities that have emerged from the metropolitan cities of the developed countries have been made possible by transport. As they have developed over a long period, they have grown to a certain size so that their function of integrated urbanism is also fulfilled. In conclusion, it is difficult for a single urban function to really activate the periphery of an area. A balance of jobs and housing and a unique urban character make an integrated development of the space possible. Suppose edge cities are to develop as cities and become independent of metropolitan cities. In that case, it is important to meet the needs of people in their everyday activities and to give them a sense of belonging. In other words, the walkability and spatial accessibility of people's daily activities within the edge city is also an essential factor in the area's sustainability.

However, most Chinese edge cities still have limitations when it comes to solving traditional city problems. As previously mentioned, gated communities are more conventional for Chinese customs. Most Chinese find it difficult to accept an open neighbourhood. As a result, communities between neighbourhoods are limited. Therefore, residential areas in edge cities need to consider the question of sustainability and to find a way to strengthen connections between communities and cities. The residential area should have an essential openness in a sustainable city. This requires convenient public transport to the centre of the megacity and access to nature to enhance citizens' perception of a place. A sustainable city aims to be car-free. Excessive reliance on vehicles not only leads to mixed traffic and air pollution but also the government needs a large budget to maintain the ever-expanding road network every year. It also causes social problems such as less walking and pedestrian space, the decentralisation of settlements and reduced interpersonal communication.

The government and relevant policies or documents guide the development and construction of edge cities. The government plays the leading role and China's edge cities are intended to be sustainable cities. Sustainability seeks to reduce car dependency and to take into account citizens' everyday demands and experiences in a place, rather than just urban planning that encourages people to walk instead of using vehicles. Sustainability also strengthens the communication between neighbourhoods, rather than closing them in and treating each community as a mysterious existence. The experience of a city is an essential factor for people to live in a city. Thus, the present study focuses on the spatial form of the edge city, the spatial representation of everyday life and the urban experience that emerges from it, in order to discuss the opportunities and threats of everyday urbanisation in China today and thus to describe the current state of the edge city.

Chapter 4 Methodology

Chapter 4 introduces the methodology and research design of the thesis. Section 4.1 give the importance for select the appropriate theoretical framework. Sections 4.2 and 4.3 will develop a clear comparative approach for selecting case studies and analysing cases from quantitative and qualitative to determine the development status of edge cities in China. Section 4.4 is data analysis. The thesis will investigate the case from macro and micro aspects. Firstly, the development background of the case is analysed and use space syntax analysis the spatial structure. Secondly, the research will focus on the communities to understand urban spatial from three aspects: urban patterns activities and experiences.

4.1 Theoretical framework

In China, the continuous development of urbanisation has led to the rapid expansion of the urban population, which has brought severe challenges to the development of urban resources and urban space. Of these, the sustainable development of cities urgently needs to be solved appropriately (Tsou, Lin, Xue and Selina, 2003). In order to better understand the development of the integration of edge cities in the context of China, it is necessary to analyse and to study an area visually in order to learn how a place works.

Carmona (2020) says that the current urban planning and design for urban development proposed reasonable evacuation layouts, residential layout strategies, and developed residential design and planning standards. These are aimed at urban development space from various aspects of effective control to ensure the functional development of urban space. However, the sustainable integrated urbanism of urban space is a massive systematic project which involves lots of aspects of urban life and urban activity (Irwin, Jayaprakash and Munroe, 2009). Hence, before correctly solving this complex frequent problem, the first critical problem was understanding the urban space scientifically and systematically. It is necessary to examine and to analyse urban space from different perspectives in different disciplines and application backgrounds in order to provide reference information about different urban space levels and attitudes (Berta, Bottero and 2018). Muller (2004) proposes that a comprehensive, visually clear and detailed understanding of urban space allows a better experience of a district as a whole. To achieve this aim, the various information materials need to be integrated. First of all, there is a need to understand and to grasp urban space from an interdisciplinary perspective in order to provide further play to the original information and data in an interdisciplinary field analysis.

Tsou et al. (2003) point out that it is necessary to analyse the urban spatial information provided by different disciplines through data integration and to discuss the opportunities and challenges faced by the information integration, processing and analysis of metropolitan areas based on multi-disciplines. For Hirt and Luescher (2007),the structure of modern cities has become increasingly complex and it has become a consensus that urban elements are highly concentrated. The city's economic system, social structure, spatial structure, population density, urban layout and urban form have undergone tremendous changes. It was mentioned in Section 2.2 that under the guidance of government and policy, China is constantly building the urban fringe in the mode of the development area. These places gradually develop into new cities and edge cities on the periphery of metropolitan cities. As a result, these regions have increasingly encountered the dual pressure of high concentration of population and high concentration of resources. The present study will analyse the current state of development zones by combining demographic and site observations with data available on the internet. Through data integration, the urban spatial information will be analysed and the opportunities and challenges discussed based on a multi-disciplinary approach.

According to Jutla (1996), the function of humanistic ecology requires urban planning to pay close attention to the rules of culture generation of edge cities as new regions by providing real humanities. For such complex urban requirements, in addition to urban planning that fulfils the needs of infrastructure, it is also necessary to consider the relationship between social science and urbanism, humanities and urbanism in order to implement the real meaning of sustainable urban design in edge cities. Carmona (2020) argues that such requirements for cities have already gone beyond the professional boundaries of only meeting functional requirements in the traditional sense.

Han(1988) argues that under the fast-changing patterns of urbanisation and urban modernisation, cities should not only fulfil the function of development, but also fulfil the function of service and at the same time consider people's experience in a place. In addition to the basic infrastructure, people's daily activities and perception of a place should also be taken into account in the edge city. This requires the development area to consider how to solve the job and housing problems of different families, ages and income groups in edge cities. The expansion of such urban services is closely related to sociology. After meeting people's demand for an urban experience, local cultural construction, identity and characteristic construction also have dramatic meaning for edge cities, as mentioned in Chapter 3. Thus, in the understanding and analysis of the edge cities, it is necessary to change the standard professional view and improve the validity, scientific basis and comprehensiveness in a more interdisciplinary and multi-theoretical way.

Pang (2001,p.481) argues that from a sociological perspective, analysing the structure, content and value of citizens' activities and the social behaviour of their life is significant. He says that the function of the city should take into account daily life and other leisure activities in addition to work and housing. In an era when peace is becoming more and more common, the leisure demand of urban residents will be greatly increased. The relationship between leisure sociology and sustainable urban design focuses on the use of leisure time in urban areas, the impact of mass media on leisure life and people's leisure lifestyle in post-industrial and consumer societies (Xiang, 2005, pp.5-8). As leisure becomes more and more a mainstream part of people's lives, the sociology of leisure and integrated urban design needs to provide new perspectives and inspiration for urban design by studying the relationship between urban activities and lifestyles, travel patterns and time. Hence, the main goal of integrated urbanism and urban sociology is to explore the new demands caused by the changes in urban residents' lifestyle, living and working environment, which will improve and optimise urbanism and meet the higher demands of different groups of citizens at the same time.

China is undergoing urbanisation and urban modernisation at a faster speed. Cities and periphery areas will continue to become more prominent, diverse, complex and heterogeneous (Tsou, Lin, Xue and Selina, 2003). The psychology and demand of citizens will also require higher requirements, which will be more complicated with the deepening of urbanism. Consequently, to better learn the current states of edge cities in China and analyse the degree of sustainable urban design in edge cities, the interdisciplinary perspective on the development of edge cities can reach the systematic thinking of urban studies. In terms of theory and method, only with contributions from multiple disciplines can edge cities be truly analysed from a sustainable perspective. For Cheng (2010,p.37),the interdisciplinary approach pays attention to comprehensiveness and dynamic issues, which is embodied in the continuity of urban development. He also argues that urban sociology and the humanities should be introduced into the process of urban understanding in order to enhance scientific research. Only in this way can urban construction meet the increasingly diversified material and spiritual needs of urban residents in a more interdisciplinary, scientific and optimised way.

In sum, exploring the concept of integrated urbanism in Chinese edge cities is an interdisciplinary approach that requires the consideration of functional urban design in a place and an integrated analysis in the context of urban sociology and humanities. From a human scale, the analysis of everyday activities in the context of social phenomena is followed by sustainable urban design for these edge cities. In this way, it is possible to meet both urbanisms as a way of living in the city and integrate it to meet the everyday activities that people can do within a walking distance, bringing the city into a sustainable position.

4.2 Research strategy

4.2.1 Pilot study in Beijing

Throughout the development and changes in China over the past decades, the most significant and widespread impact has been the process of urbanisation, which has seen a massive population and economic transformation. China has entered a phase of counter urbanization in many of the cities, with hundreds of medium-sized villages and thousands of small towns forming a system of towns and cities. As the capital of China, Beijing is a city that has been highly regarded and valued by the government since the founding of New China. Beijing is explicitly positioned as a national capital, a world city, a cultural city and a liveable city. These four positions are the basis for adjusting Beijing's urban functions (Government of Beijing Municipality, 2017). However, with a highly expanded population scale and issues in the urban centre, the evacuation of population and industry has being on the schedule for a long time. The urban space in Beijing is spreading to the periphery, which is a general trend. Regarding Beijing's suburban districts and distant suburbs are still in the early stages of industrialisation. They are predominantly rural landscapes with low levels of urbanisation. Beijing's peripheral areas are mostly activated in the form of development zones, but their current status needs further investigation.

The changes in scale, quality, positioning and function, the restructuring of industry and the development of infrastructure have had a significant impact on the development of the Beijing fringe. As a major model of polycentric development strategies, development zones and edge cities represent one of the most important solutions to the urban transformation in China. Nevertheless, how they actually work requires further research and discussion. Ma and Li (2008) proposed that by introducing a case study approach to the analysis of the current situation of Chinese edge cities, the efficiency, mechanisms and implementation dynamics of cities can be better understood. Analysing cases can provide new approaches to the current situation and sustainable development of edge city, which will also become a necessity for studies to develop them.

In 1984, the case study was defined by Robert K. Yin as an empirical inquiry that examines contemporary phenomena in real-life contexts. Under such a research context, the boundaries between the phenomenon and its context are not evident and the researcher can only develop the research with the extensive use of evidence (Yin, 1989, p.166). Moughtin et al. (2003) say that case studies are conducted through the collection and accumulation of large amounts of data. By analysing complex phenomena, data and empirical knowledge can be obtained. It preserves a realistic view of real life and a sense of the complex nature of things in order to organise ideas and gain a comprehensive knowledge of the problem. The case study method is objective, intentional, inspiring, practical and comprehensive. Davey (1990) says that case studies can adequately expand the existing body of knowledge and play a role in the accumulation and transmission of professional knowledge and experience that cannot be replaced by other methods.

Bruns and Schmidt (1997) say that urban design is a comprehensive, cross-cutting discipline that manages and anticipates urban space and development. As mentioned in the previous sections, integrated urbanism and urban design are connected to the disciplines of sociology and the humanities. Moroke, Schoeman and Schoeman (2019) say that urban is a coordination of urban spatial layout and the integrated and sustainable deployment of various activities for citizens. It requires a great deal of on-site research and exploration to understand the realities of urban development and to discover the advantages and disadvantages that actually exist. Moughtin et al. (2003) explained that as part of the process of exploring how cities work, it is necessary to use the method in a rational way to better understand the complete structure and composition of urban space. Then, the case study method allows a large number of examples to be presented accurately. For the researcher, it reduces the time spent on searching for information and makes it easier to find the right methodological and theoretical support system in a large number of cases (Ma and Li, 2008). They also mentioned that case studies usually begin with a practical precedent, and sort out the causes and effects of the issues and the relationships between the factors.

In addition, the case study method creates a bridge between disciplinary theory and practice. By analysing the case studies, it is possible to fully understand the process and context of the practical application, and to better experience space from the perspective of a human being rather than as a designer. Ma and Li(2008) indicated that case studies of urban design can help designers to improve their study of socio-spatial relations in relation to the real world. Bao's (2005) *Urban Tourism: Principles, Cases* and Zhang's (2003)*A Case Study in Urban Sociology* both presented case-based discourses and studies in the planning and design of urban landscape, transport, activities, tourism and architecture. By applying the case study method to the analysis of edge cities, using its characteristics of objectivity, inspiration, practice and synthesis (Miao, 2007).

This thesis explores the integrated development of the peripheral areas of megacities in China. Currently, the general assumptions about edge cities and integrated urbanism in China are more reflected in the development area zones on the fringes of each metropolitan city. The development of mega cities in China is a massive project, long in duration and encompasses many elements, involving both master plans and national goals, as well as citizen participation. While planning has begun to turn development areas into edge cities, patterns, behaviours and perceptions should correspond and create a clear city image. Therefore, this research will select two well developed cases which are similar in scale and construction time to analyse in detail. The selection of the cases will be presented in Chapter 5. The two cases are chosen because they provide a better opportunity to compare and analyse the emerging spatial structure of edge cities in China, whether they are similar or different, or whether the overall plan is similar but with a different perspective.

In addition, case studies can also help to better explore and visualise how edge cities work in China. It is because the periphery areas would benefit from a more rigorous discourse on the importance of edge cities in the context of Chinese megacities. The current state of the Chinese edge city's development is investigated through a case study and described using an illustrative approach.

4.2.2 Mixed methods approach

The way to integrate space is to add new empirical data and qualitative studies. Social science and architecture are never theoretical disciplines and require the validation of multiple aspects of actual facts and contexts (Wiedmann, 2019). Chai and Zhao (2009) believe that research regarding the development of edge cities is mainly concerned with space and the use of space. A case study of a city refers to a written, objective description of one or more examples of planning, design, management and the current situation of a city (Babbie, 2005). Its study is an elaboration of the case study methodology applied to cities after extensive data collection, research and analysis.

First of all, it is essential to have objectivity about the selected cases and it is important to analyse them with objectivity. This thesis aims to investigate how edge cities are defined and developed in China today, how people interact with edge cities in China and to identify a typical pattern to describe the current situation of people living in edge cities in Beijing. Through case studies, the sense of identity, character and culture in Chinese edge cities can be analysed in terms of lifestyle and life quality. Thus, there is a need to develop a methodological approach between applied sciences and social sciences. This is an inductive approach and mixed methodology following a framework to explain how to study the perception of a city and to understand edge cities and how they are perceived in China.

This thesis aims to investigate the development of Chinese edge cities and how they serve their citizens and big cities. Hence, it is necessary to consider the number of cases, the representativeness of the cases and whether multiple cases require a comparative approach in order to identify clear parameters. In addition, the selection of case studies is extremely fundamental. In selecting the case studies, a macro-analysis strategy is adopted to discover where urban transformation and agglomeration have taken place in Beijing over the last 20 years. Through mapping and space syntax, two cases will be selected for more specific analysis. By using the theories of integrated urbanism of Jan Gehl and Louis Wirth and other urban theorists mentioned in Chapter3, a framework is developed to analyse the current development of the Chinese edge city.

To better understand place-making challenges and what these edge cities currently represent, and inform the essential aspects for future master plans for designers. To contribute a more integrated approach in studying urban experiences and the city images is significant. Flyvbjerg (2006) indicated that multidimensional is a quantifiable change with an impact. So integration of qualitative and quantitative methods could reach a more comprehensive academic analysis. This thesis designs a mixed-method approach that combines quantitative and qualitative methods. There are a number of advantages to applying a mixed research approach to a research project, even though a mixed approach is more complex than a single approach. Hughes (2006) supported that, firstly, mixed methods can be used to validate the results of a single process. Secondly, the application of mixed methods may help to enhance or strengthen the results. Thirdly, the sequential application of each method contributes to the development of theory or knowledge. For instance, the findings of the first method may inform the design of the second method. Lastly, the findings of each method may stimulate each other in a dialectical stance, thereby leading to interesting ideas or new discoveries.

The quantitative approach is to explore development with quantifiable results. In this thesis, data is the result of the spatial survey and observational surveys to identify key centralities. The quantitative approach can indicate the extent to which each event occurred, while the qualitative approach is used to understand what, how and why it happened (Crouch and McKenzie, 2006). This thesis will use urban studies such as walking routes and qualitative mapping to identify key spatial experiences. The approach is to investigate meanings and identities and establish a general contextualisation. According to Stern (1993),the quantitative method allows for a more accurate understanding of lifestyles, rather than being limited to the variables of the data.

Mixed methods research designs can be divided into two general types: component designs where each component method maintains the separation and integrity of the method, and integrated designs where the methods interact with each other throughout the research process (Hughes, 2006). In this thesis, a component design was chosen due to the multidimensional research objectives of this study. It aims to understand the development of edge city integration in China(Table 6). Nevertheless, the analysis of these data and maps was limited in its perception of a space. Relying on the data was not sufficient to adequately understand how edge cities work. In order to resolve the limitations of the spatial survey, urban studies were designed to experience the perception of edge cities and people's lifestyles and activities, etc. The combination of spatial integration and experience contributes to a better exploration of the complex issue of edge city development.

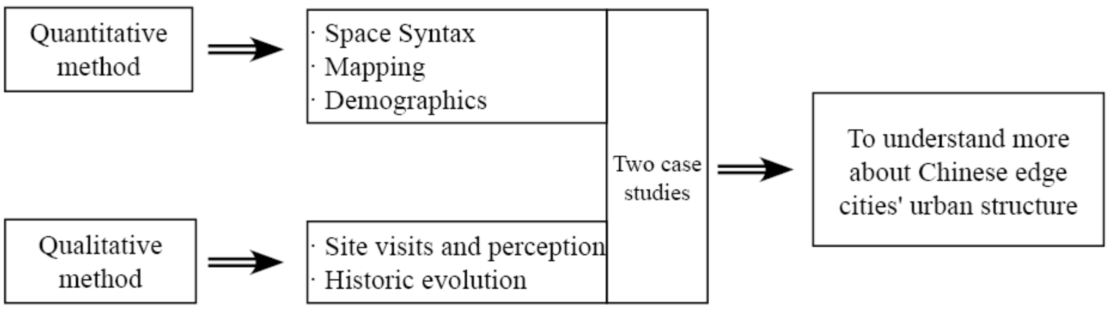


Table 6: Research strategy(Source: Author)

4.2.3 Research design

The research for this study is divided into three steps: preliminary work, data collection and analysis. The research design stage consists of defining the research objective, literature review and research design. Following extensive reading and understanding of the literature in the design field, a comprehensive analysis is carried out of the current state of research, academic perspectives and possible problems in the field of study. The latter two stages focus on the evaluation of the current situation of Beijing's edge cities after data collection and analysis so as to better understand edge cities in China. Each of the three stages of this research offers important findings. The case study and evaluation are presented in Chapters 5 to 7.

This thesis aims to develop an assessment method or tool to check if an edge city performs as it should: are the patterns in edge cities integrated and efficient? Does the city offer a place to all the different markets? Does the city have an identity and its own characteristics? The tool will be tested in the case of varying edge cities to show how it works and how the performances differ or are the same. An edge city should function as a city that is always an efficient and diverse place with a distinctive identity. Therefore, a framework must be developed to enable a performance review that can compare edge cities and discuss the typical opportunities and challenges.

Based on the research objectives, this thesis adopts a mixed method including quantitative and qualitative methods to develop a comprehensive assessment methodology to understand the current development of edge cities in China. It aims to investigate whether the peripheral city has the function of a city or whether it is still dependent on the metropolitan city. Firstly, Chapter 2 analyses the background and current situation of edge city development from a global and Chinese perspective. From a worldwide perspective, it analyses the origins of the concept of edge cities while describing the context and modes of development of edge cities in large cities. This is followed by a description of the expansion and development of Chinese cities and a review of the role of the Chinese government in the development of the urban fringe areas and the relevant policies. The main types of edge city development in China are also analysed. The development of edge cities has taken place gradually in the form of development zones on the periphery of metropolitan cities.

Chapter 3 focuses on the purpose of the project. It begins by defining the concepts of urbanism and integrated urbanism and describes the idea that people need to interact but also need to be relevant to a place. It also analyses the need for sustainable urban design in edge city development. The chapter focuses on defining the field of urbanism and what makes people attached to a place through an analysis of urban spatial patterns, activities and experiences of spatial performances in order to better understand how people live in the edge city.

Chapter 4 defines the approach of the thesis and explains how the study will go about doing this. The theoretical framework of the thesis is presented as well as the selection of the research methodology. This is done through a combination of a mixed methods approach and qualitative and quantitative analysis in order to understand the development of edge cities through the analysis of patterns, activities and experiences in the selected case studies. This evaluation system feeds into the practical application of future edge city projects.

Chapters 5 to 8 present the collection and analysis of data. Chapter 5 focuses on Beijing and its edge city. It describes the growth and urban transformation of Beijing. This chapter collects and analyses the changes in Beijing's urban form, population transformation and transportation network over the past 20 years. The analysis of mapping and space syntax was used to discover which parts of Beijing have experienced urban agglomeration in the last two decades and to determine the scale of their development to date. This is to understand the polycentric development pattern of Beijing and to better assist in the selection of complete and representative cases for specific analysis.

Chapter 6 and 7 focuses on the analysis of two selected case studies: BDA and HSP. The spatial structure and spatial experience of the cases are analysed using both quantitative and qualitative methods. As per the principles of integrated urbanism established by urban theorists, a framework for the analysis of China's edge cities will be applied, including an analysis of urban patterns, activities and experiences. The quantitative analysis of urban patterns and activity can be used to determine the scope of urban experience and thus obtain a qualitative analysis. By combining urban experience and activity, the pattern of the city can be better studied. This triadic theoretical framework can therefore show what Chinese edge cities are about.

Chapter 8 is an evaluation and discussion of the research based on the analysis of the case studies. This chapter cross-analyses and summarises the results of the chapters in order to answer the research question: how are edge cities defined and developed in China today? It also answers the question of the value of applying appropriate theoretical frameworks and research methods to this research context. Chapter 9 a summary and conclusion of the entire thesis and points out the limitations of the research and gives recommendations for future investigation.

4.3 Data collection

4.3.1 Quantitative survey

In many areas of the social sciences, there are well-established theories and systems for the use of quantitative methods to determine elements of ambiguity (Zhu, 2003). For Cai and Zhu (2001),quantitative analysis involves the analysis of quantitative characteristics, quantitative relationships and quantitative changes in social phenomena. It serves to reveal and to describe the interactions and trends of social phenomena. Data collection, validation and processing as well as presentation play an important role in the research, where the methods of data acquisition and processing directly influence the final results of the urban spatial analysis (Lee and Kwan, 2011). Cosgrove (1999, pp.7-8) finds that the earth and space imagery generated by satellites and computers has dramatically stimulated our senses, turning our original perception of the world upside down and radically altering the world constructed in our minds on the basis of Euclidean geometry and Ptolemaic geography. For Li (2016),mapping is an increasingly important phenomenon in the study and practice of contemporary architecture, suggesting that mapping is different from planning and requires searching, discovering and layering complex and underlying forces from the current environment, rather than imposing an idealised design solution.

According to Casey (2005),the map is formed by the act of mapping from a blank sheet of paper into a virtual map space, thus representing the real world. The spatial structure of cities is revealed through contemporary visual mapping techniques and through the construction of views on paper. People are directly integrated and experience the current state of urban space and also offers humans the space to imagine and to create. For Lootsma (1999),mapping is the drawing of a three-dimensional urban space on a two-dimensional map and providing the relevant information. For Yin, Li and Hu (2021),mapping is based on various means and media such as photography, satellite imagery, remote sensing, etc. They add that the modern practice of mapping has transformed from a traditional programmatic tool to a creative and imaginative cognitive medium and way of thinking by using techniques such as cutting, hypothesis and generation. It has increasingly become an integral part of urban design practice.

Li (2016) adds that historical imagery has also been introduced in Google Maps version 5, which allows users who access it via the time slider to travel back in time. Urban designers and planners can now interpret the development patterns of sites and the evolution of the historical context with this new feature. A number of factors influence urban spatial surveys, and the extent to which they are influenced by different factors varies. A mapping model was developed by using digital map as the research method. Based on government data such as census data and the annual statistical yearbook, a comprehensive analysis was conducted to demonstrate the scientific nature of quantitative research from first-hand data collection. In addition, the use of multi-dimensional mapping to reproduce this complex data reveals a variety of spatial information about places. For example, the Space Syntax Lab at the University of London and Google Earth.

In the 1970s, British scholar Bill Hillier first introduced the theory of spatial syntax. For Yi et al. (2008),spatial syntax is a quantitative approach to the study of urban spatial morphology and a tool for urban morphological analysis. Spatial syntax aims to represent the evolution of urban spatial form, urban traffic, urban network structures and patterns. It is based on a spatial perceptual analysis based on visibility, which is presented in this thesis through the urban transport network, using the axial segmentation method. The axial method identifies the relevant traffic lines in the area under analysis, defines each traffic line as a unit space and each unit space as a node, and uses these nodes to construct a topological map of the axial lines and calculate the relevant variables. The fundamental variables of the spatial syntax are connectivity value, depth distance, integration value and intelligibility. This thesis concentrates on connectivity, integration, intelligibility and choice and uses the software Depthmap to analyse them.

Connection value C_i: this indicates the number of other cell spaces in the system that intersect the selected cell space. The equation is (Wu, 2010):

$$C_i = \sum_{1}^{j} R_{ij}$$

Where i is the i-th unit space; j is the unit space connected to i; R ij is the i-th unit space connected to the j-th unit space, and the value is 1. In a real spatial system, the higher the connectivity value of a space, the better the space is connected to other spaces (Lima, 2001).

Integration I_i: integration indicates the degree to which a unit space is clustered or discrete from all other spaces in the system. If the integration is high in a spatial system, the comprehensibility and spatial permeability of the space is also good. The formula for calculating the degree of integration I_i is (Wu, 2010):

$$I_i = (n\text{-}2)/2°(D\text{-}1)$$

This thesis will calculate the global integration (r=n) to reflect the full range of commercial centres, etc. The value of micro scale (according to spatial syntax theory a walking distance of 800 m radius is used) will also be calculated for pedestrian integration respectively, to analyse the potential for commercial sub-centres and population gatherings.

Intelligibility: intelligibility indexes the degree to which the number of immediate connections a line has is a reliable guide to the importance of that line in the system as a whole (it is a correlation between connectivity and integration value). A strong intelligibility implies that the whole can be read from the parts (Hillier et. al., 1987, p.237).

Choice: choice measures the probability that an axis or a street sector will be passed on all shortest routes from all spaces to all other areas in the system or within a given distance (radius) of each block. The shortest path refers to the path of least angular deviation and the straightest route through the system (Hillier and Iida, 2005,p.475). In order to obtain the data, this thesis combines digital maps and spatial syntax for the urban analysis. Firstly, a satellite map is obtained from Baidu Maps (it offers more detailed information of mainland China) and Google Maps as the primary basis for the road network data. Afterwards, the road network is mapped with CAD to summarise the traffic network of the site, ignoring the small curved roads and turning the curved roads into straight ones to highlight the structural characteristics of the free space. Following this, the road network is abstracted into an axial map and each traffic axis is transformed into a unit space to create a topological map of the axes, which is combined with diagrams to draw conclusions and comments.

In addition to the analysis of spatial syntax, the thesis will also use mapping methods to analyse the urban patterns and activity of the two cases to obtain more quantitative data such as spatial land use, urban growth, density and a pedestrian traffic survey. This will enable a better understanding of spatial structure and the identification of key centralities, as well as the key spatial experiences for quantitative analysis. Then after identifying the main spatial experiences the quantitative analysis can be continued.

4.3.2 Qualitative survey

Quantitative research analyses space by acquiring the data to analyse the spatial integration and identify the key centralities. However, Matthews, Detwiler and Burton (2005) say that a holistic perception of space requires a qualitative approach to analysis and synthesis through induction, deduction and comparison, and a formal, logical approach to thinking to understand the attributes and characteristics of things. Sheppard (2001) says that qualitative analysis enables the processing of non-quantitative data such as images, videos and narrative material, and the integration of contextualised knowledge. Pavlovskaya (2006) argues that spatial structure is not inherently limited to quantitative analysis as traditional geographers would have us believe. On the contrary, space is open and qualitative analysis is dramatic. The relationship between spatial and qualitative research is mostly about integrating spatial data and people's perceptions in the mapping (Weiner and Harris, 2003). Matthews, Detwiler and Burton (2005) stated that through mapping-based data analysis, mapping and visualisation processes etc. They provided a complementary or multivariate validation of findings from qualitative methods: The researcher is able to identify the research question more clearly than with either method individually, thereby allowing qualitative surveys to explore spatial issues in great strides supported by Knigge and Cope (2006).

Mapping has a close relationship with the study of spatio-temporal behaviour, and the analysis of spatial integration pairs is inseparable from the study of spatial behaviour. This thesis presents qualitative mapping as a way to integrate the spatial experience patterns of the studied objects, forming a unique geographical environment system and spatial mechanism analysis for the study of spatial-temporal behaviour. Mcquoid and Dijst (2012) argue that it is impossible to explore how a region serves human beings by neglecting individuals' subjective choices and preferences, without taking into account their daily lives, and simplifying the spatio-temporal paths of the behavioural subject to a neutral container.

Anderson and Smith (2001) say that feelings and emotions are generally invisible in public life and research, yet the human world is constructed and experienced through emotions. For example, an individual's performance at work may depend on family life situations, experiences on the commute, and other complex emotional factors involved in more private lives. Thus, spatial experience and socio-cultural factors are an integral part of the way humans live and behave in their daily lives. In addition, Clandinin (2006) says that urban experience analysis refers to a qualitative approach to the study of stories that people tell about their life experiences such as turning points or important events in their lives. It focuses on the individual experiences of people as stories, as well as on the contextualisation of individual experiences. By combining perceptions, lifestyles and activities with mapping, urban experience analysis integrates the subjective and social aspects of behaviour into the spatial, which provides an essential basis for the analysis of behaviour in relation to everyday life, as well as for the analysis and visualisation of spatial experience.

A more understandable approach to the daily behaviour of the research subject provides a set of research tools for its integration into the qualitative analysis of behaviour and issues, from data integration and data analysis to interpretation and presentation. The combination of urban experience analysis and mapping is an important exploration of spatial behavioural research. Hence, quantitative analysis emphasises the data analysis of a space. In contrast, qualitative analysis is more oriented towards urban design, which perceives space from the perspective of people such as lifestyle and daily activities. The qualitative approach in the present study will focus on spatial storytelling in the form of spatial experience patterns in order to determine the key spatial experience. In this way, a mixed qualitative and quantitative approach allows for a better exploration of the quality of urban life in the Chinese edge city.

4.4 Data analysis

The purpose of this research is to analyse the urban transformation in rural areas in China. The methodological approach is based on an integrated research framework relating to the question of how edge cities are perceived today in China and why. Beijing was chosen mainly because Beijing is the capital and the most important focus of urban governance and planning to establish polycentric urban development and edge cities. The study of the urban development of Beijing is also used to select the primary case studies. Thus, the main objective of the framework is to analyse the urban typologies and spatial fragmentation of Beijing and to study the perception of a city that involves two layers.

Firstly, a quantitative survey is used to identify the key centralities, which includes drawing the Space Syntax map of Beijing using satellite images from 2002 and 2019. This offers a rough historical overview of the urban development to show how Beijing has been growing over the last 20 years and allows the identification of the critical districts for the case studies, which will be presented in chapter 5. After the cases are identified, chapter 6 and 7 describes the evolution of the urban spatial structure of the two case studies, which includes the general information and development background of the cases. The case studies will also be used to study different degrees of spatial integration. This analysis will focus on the spatial structure of the cases and the form and vitality of the street network.

Secondly, a qualitative observation is needed to explain what these experiences share in common and what they ultimately represent in the context of Chinese cities from the point of view of historical evolution, lifestyle, etc. The methodological approach has been developed to investigate urbanism as a product of resident communities interacting with urban patterns. The development area in China has attracted new industries, driven the economic growth of the rural area, provided a place for full employment and relieved the land use pressure in Beijing. However, another important function of the edge city is to relieve the megacity of excess population, i.e. edge cities should provide people with work and achieve a work-life balance. Therefore, one of the key points to consider is people's daily life. In this regard, the present study analyses residential areas in edge cities. For feasibility purposes, a residential zone in the district is selected for further analysis of the function and the influence of the development area as an edge city.

The urban space of the case is analysed using all the mappings to obtain a quantitative survey. Then, the neighbourhoods of the edge cities are analysed with regard to income, market, etc. to obtain the activities mapping. Thus, the quantitative survey is used to obtain the qualitative survey. The space of the edge city is then analysed on the basis of storytelling images, which constitutes the qualitative survey. In addition, a quantitative survey can be carried out to analyse the spatial experience through mapping. In this way, the framework of the triadic principle can be cycled.

In this way, a framework (Figure 24) is developed which is used in conjunction with the previous analysis of integrated urbanism and the theoretical framework proposed by urban theorists. Urbanism is the way citizens live in the cities. Integration means that people can do their everyday activities in close quarters without commuting. However, this condition is only produced by diverse market conditions that allow social and economic integration, functional and efficient urban structures with a good urban grid, densities, and land uses, and place attachment because people identify with the place. Therefore, the thesis will be used to determine whether people only work in the place or whether the region can satisfy their other daily needs as well. For this purpose, three dimensions of urbanism need to be investigated:

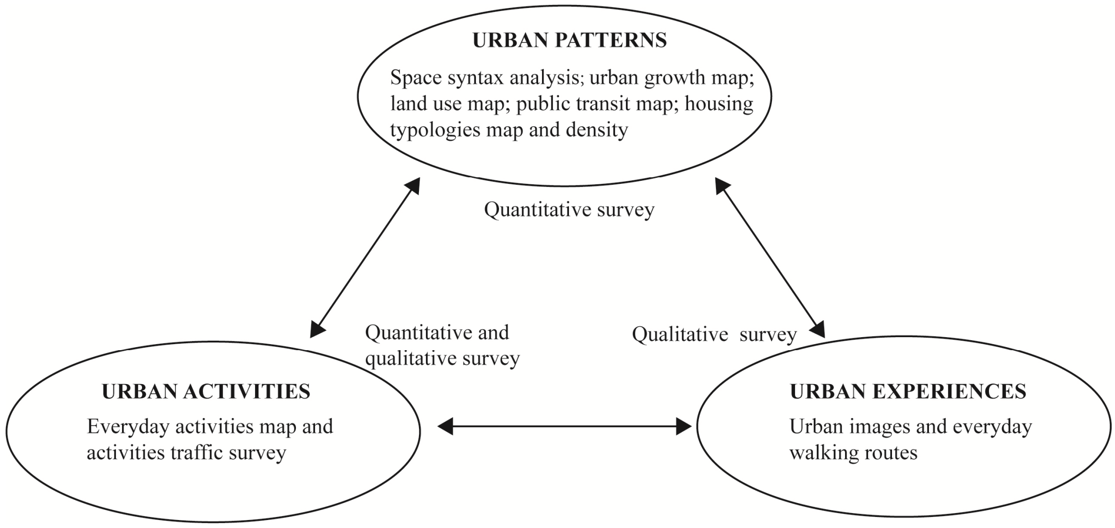


Figure 24: The framework of the triadic principle. (Source: author)

1. Urban patterns: After a survey of all development zones to identify the two most completed and representative case studies in Beijing, various methods were applied to assess everyday urbanism. To study the current interaction between residents and their surroundings, various interrelated patterns need to be identified first, which are the product of both time and space: spatial patterns, resulting activity patterns and associated experience patterns. Existing spatial patterns need to be analysed based on mapping surveys via available public GIS data, including land use distribution, densities and public transit stops. Densities need to be explored in the context of a typical household size in Beijing of 2.62 residents per household (National Bureau of Statistics, 2021). Some land uses needed to be confirmed by on-site field investigations.

2. Urban activities: In addition to existing spatial patterns, resulting everyday activity patterns can be surveyed and mapped. To make this study more feasible, a typical scenario has been assumed after investigating the current socio-economic conditions: at least one parent works in the local development zone and one in the central region of Beijing resulting in five work-related commutes per week; there is at least one

child going to school; three grocery shopping trips per week; two outdoor leisure activities (park) and one trip to a local shopping mall. These scenarios of weekly activities were mapped to understand the typical distances and to test the overall walkability. Subsequently, field surveys of routes with walking distances below 20 minutes were carried out to investigate the resulting experience patterns. And in this research, the acceptable walking distance is 800m, although Garreau's acceptable walking distance is 200m and Pery's ideal walking distance is 400m. However, this thesis uses 800m as the acceptable walking range based on spatial syntax theory.

3. Urban experiences: More general everyday experiences were explored by identifying key public engagement corridors based on Space Syntax models. These shared experiences along main corridors were again investigated via field studies and observations to explore both the current condition of the built environment and its overall narrative as well as everyday human behaviour in these most representative urban links. Space Syntax has been a pioneer in modelling spatial relations to identify likely scenarios of human behaviour which can be vice versa factors in producing those spatial relationships. Choice is calculated via the modelling software Depthmap to identify the spatial links which would experience the biggest frequency of movement due to their role in connecting intersections. These calculations can be conducted on a global scale taking all segments into account, or on a local scale focusing on a specific radius. In this investigation, a local dimension with a radius of 800 metres (equal to a walking distance of less than 20 minutes) was modelled to identify the current concentration of movements and thus experiences.

Furthermore, two options for the structure of the case study analysis are discussed. One is to analyse the cases in parallel and to compare them. The other option is to analyse each case study on its own and then do a further case study using the same approach. However, it is more interesting and clear to finish the each elements rather than the case studies from the reader's perspective, so the first option is chosen.

In addition, according to Keeble (1988), sustainable means development that meets the demands of the current generation without compromising the capacity of future generations to meet their needs. According to the theory of sustainable integrated urbanism described in previous section, the urban environment is created from a variety of factors and in order to avoid endless lists, a triadic theoretical framework is developed: urban patterns, activities and experience in order to understand urban structure and to enhance the balance of scales of the urban cells. In chapter 5, the urban form of Beijing is analysed, and the case of two edge cities are examined to understand how this new urban structure works in Beijing and China.

In Chapter 6 and 7, the urban spaces of Chinese edge area will analyses in detail through urban patterns, activity patterns and experience patterns. All the factors that influence the nature and structure of the urban structure in the spatial production of an edge city such as the case studies could be looked for and investigated. However, the key qualities of a sustainable Chinese edge city requires an evaluation framework to analyse the qualities of the space. When all the analytical discourse regarding the data is complete, it is necessary to point out the significance of the findings. Wiedmann, Salama and Mirincheva (2014) developed a framework in their study of sustainable urban qualities in the emerging city using a variety of methods to analyse all aspects in order to investigate the direct relationship between the development of urban qualities and the factors that weaken or strengthen them (Figure 25).

Based on the three elements for assessing urban quality as defined by Wiedmann, Salama and Mirincheva, and combined with Chapter 3 and the analysis of the case studies, a triad of space production is defined: Similar to these authors' criteria, this thesis draws on diversity, efficiency and identity, but the data used to assess them is more integrated with the triadic principle of this thesis. Specifically, the urban patterns are used to assess the diversity of the city and the urban activities are used to analyse the everyday lifestyles of the urban space and the everyday needs of the citizens, thus allowing for a consideration of the efficiency of the urban space. Then, the urban experience is used to define the urban identity by looking at the image and spatial experience of the urban space.

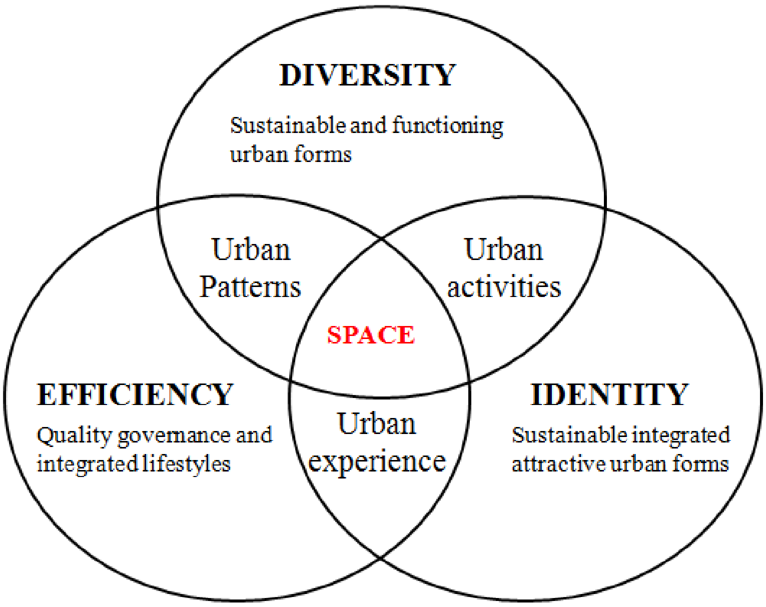


Figure 25: Triad of space production.(Source: author)

In conclusion, the analysis of urban patterns uses a quantitative approach. Then, a qualitative analysis of urban experience can be obtained to better understand the quality of space, on the basis of which the urban pattern can be optimised and designed to feed into future spatial applications. This model not only allows for an understanding of the current system of spatial development in the edge city, but also for a sustainable and integrated development of the city.

4.5 Summary

An edge city should be attractive to people. The attraction comes from the infrastructure and perfection of living, employment, leisure, life and other aspects, and the quality of life and experience that can be provided for residents under the comprehensive effect of these factors. Quality of life can be measured and judged by the convenient and fast use of various urban public facilities or walking and whether it takes too long to commute to work. In other words, the present study will evaluate whether these periphery development areas can be regarded as an edge city with its own city centre where residents have an excellent everyday experience or whether the development area still shares a central area with Beijing and residents can only sleep and work there.

This study of Chinese integrated urbanism in edge cities uses an interdisciplinary approach that combines urban design and urban sociology(Table 7). A combination of quantitative and qualitative research methods can help to understand the integrated urbanism of China's marginal cities. Thus, for the design of the research methodology, a macro analysis of the whole Beijing region based on mapping and space syntax was first carried out to discover the urban and demographic transformations over the past 20 years. This then helped to determine the case study selection strategy. Then, a triadic model was developed to allow a better analysis of the extent of integrated urbanism in these two cases.

Based on the foregoing, Chapter 8 will be an evaluation and discussion of Beijing's edge cities in terms of the three aspects of diversity, efficiency and identity. For example, how many people share their neighbourhoods? How integrated and serviced is the entire district? How do people commute and perceive the city during daily routines? Integrated urbanism would permit residents to access all the essential elements of their everyday life, from workplaces to park visits and school trips, in short and walkable distances. This integration leads to less time lost commuting, less functional aspects such as the provision of infrastructure and services and suitable densities, the market has to respond and provide a diversity of restaurants and other commercial services.

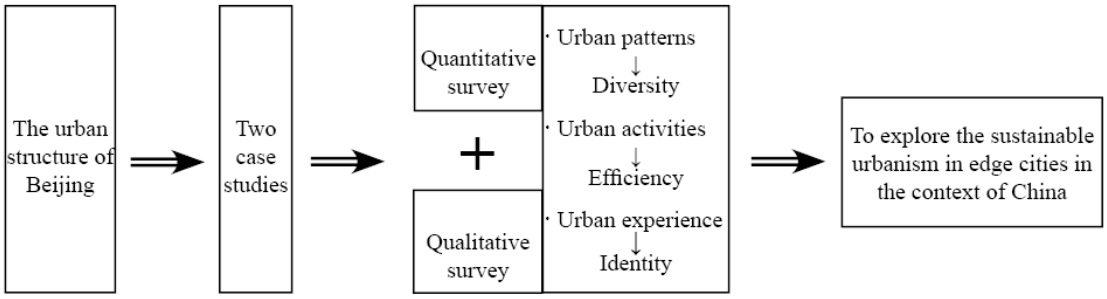


Table 7: Research logic flow of developing in this research. (Source: Author)

Chapter 5 The urban structure in Beijing

Chapter 5 analyses the process of urban expansion and related development data of Beijing based on remote sensing data in 2000 and 2020 and the data released by the Beijing Bureau of Statistics in the past two decades. Section 5.1 reveals the history and background of Beijing's urban planning. Section 5.2 will analyse the urban form of Beijing, will analysis its spatial and population development, and focuses on the transportation network in Beijing: the development of rail transit in the past 20 years and analyses the Beijing road network by using space syntax. Section 5.3 mainly focuses on the development zones and edge cities of Beijing and determines the specific cases to be analysed in the following chapters through the provided data. Section 5.4 mainly concludes this chapter with a short conclusion.

5.1 Beijing's urban planning history

According to information provided by Beijing Planning Exhibition Hall (2021), The history of Beijing dates back to over 3,000 years ago. It was built in 581, thrived in 1125 and declined after 1912. The People's Republic of China was founded in 1949 and Beijing became the capital. Since then, Beijing has developed in terms of urbanisation but for political reasons it has been unstable and even stagnant. After 1978, China had a stable environment for economic growth, and from then on, Beijing's urbanisation process continually proceeded. In 1978, Beijing's permanent resident population was approximately 8.72 million, in which the urban population was 4.79 million, with a total urbanisation rate of 54.96%. Whereas, until 2020, Beijing's permanent resident population was approximately 21.89 million, including an urban population of 19.16 million with a total urbanisation rate of 87.52%.

According to Beijing Planning Exhibition Hall (2021),Beijing implemented seven overall plans throughout its urban development process since 1949, which played a vital part in developing the country and the capital. In the early years after the state's founding, the national economy was in total collapse and the government was confronted with huge threats. Likewise, urban planning was also faced with complex challenges and difficulties, embodied in the poor urban municipal infrastructure, backward public facilities, dirt urban roads and lighting by kerosene lamps in most urban households. The first edition of the urban planning draft concerning the reconstruction and expansion of Beijing was enacted in 1954. It marked the first major transformation of Beijing's urban development. Its main strategy was to transform Beijing from a typical consumption city to a productive city and expand to the marginal area from the old metropolitan area. At the same time, the administrative division of Beijing was also adjusted, with parts of Changping, Tongzhou, Huairou and other surrounding cities and towns being included in Beijing, expanding the total area of the city from 3,210 km^2 to 164,000 km^2(Figure 26).

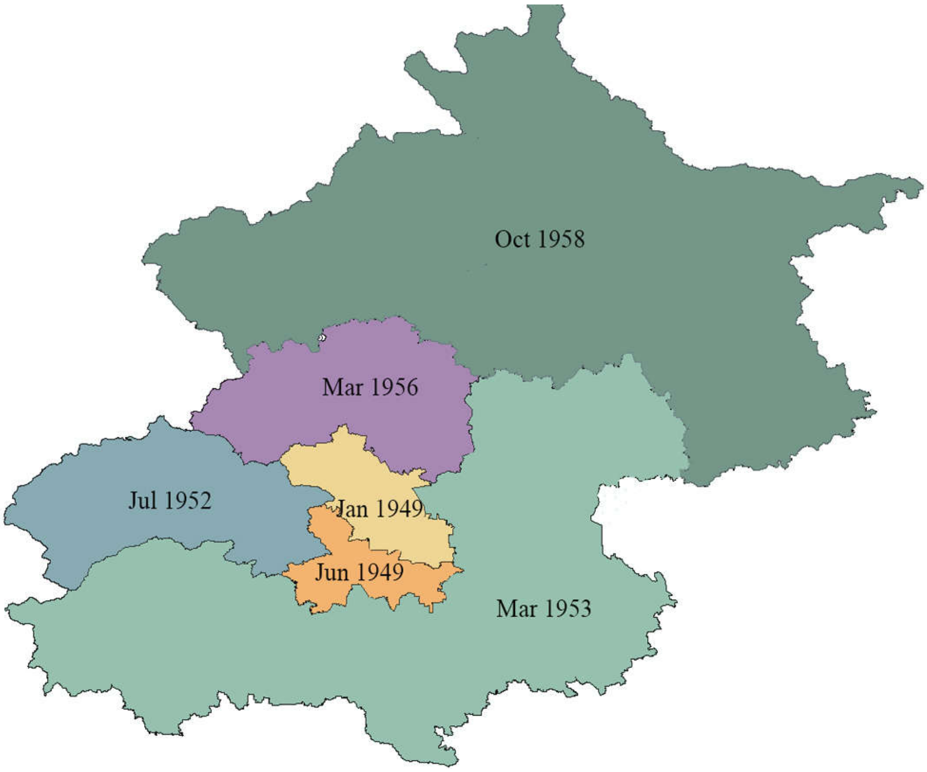


Figure 26: The evolution of Beijing's administrative boundaries. (Source: by author)

With the implementation of the second edition of the overall plan in 1958 (Figure 27), Beijing ushered in the first industrial development construction climax in its history.

The government imposed a decentralised urban pattern and proposed the principle and conception to control the urban area and develop the suburban area in industrial development. In 1973, the third edition of overall plan was enacted (Figure 27), which proposed to address the problems in life and production supporting facilities and environmental pollution caused by industrial development, and gradually build Beijing into an emerging and modern socialist city. The fourth edition of the master plan in 1983 refers to 21 specific planning regulations that provide for detailed planning in the areas of housing construction, urban regeneration, transport networks, etc. The three versions of the urban plan led to a massive expansion of Beijing and a change in the urban structure from a single-centre development to a decentralised development, which led to a polycentric development pattern and the activation of Beijing's peripheral areas.

Figure 27: The master plan of Beijing in 1958 (left) and 1973 (right). (Source: photo by author)

With the stability of China's government leadership and the rapid expansion of urban construction, some regulations in the original urban construction planning could not adapt to the new situation of the accelerated reform and opening-up. In 1993, the fifth edition of the overall plan (Figure 28) clearly identified Beijing as the national political and cultural centre, a world-level ancient capital and a modern international metropolis. The plan insisted that the government should preserve the decentralised urban pattern of Beijing and it further pointed out the urban development direction of Beijing in the market economy system. The plan emphasises the transition of the focus of urban construction from urban areas to fringe areas, strengthening the construction of urban peripheral areas, expanding the scale of peripheral cities, evacuating the dense population and industries from the central cities and opening up new development space.

In 2001, Beijing's GDP was RMB 370 million, per capita GDP exceeded USD 3,000, the proportion of the tertiary industry was 67.2% and the urbanisation rate was 78%, marking the entry of Beijing into the middle and late stage of industrialisation. Since China’s accession to the WTO in 2001 and Beijing’s successful bid to host the Olympic Games, Beijing has continued to promote the implementation of New Beijing for the further development of the city. While in this period, the functions in Beijing's central area were excessively concentrated and traffic jams became increasingly severe, the built area showed an obvious trend of sprawl and the gap between the urban and periphery areas was significant. In response to the fast development needs in the economic society and urban construction, the sixth edition of the overall plan was presented in 2005 (Figure 28). The new overall plan focused on urban issues and industrial development as the driving force to explore the problems of urban development, and highlighted a polycentric urban spatial development model for Beijing. The planning adjusted and optimised the central urban area and divided the new city area as the key development area. Beijing's urban construction has gradually transferred the focus to rural construction, expanding urban construction to the periphery areas.

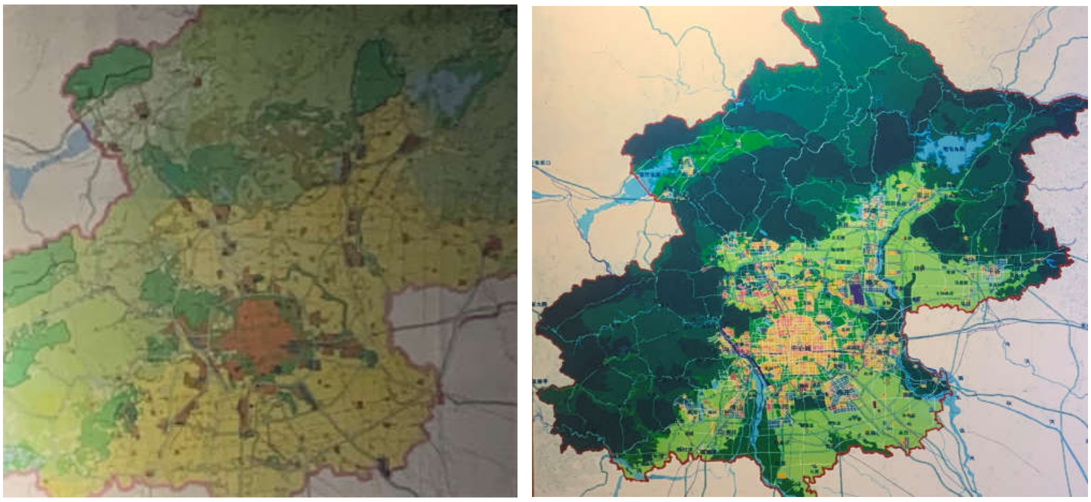


Figure 28: The master plan of Beijing in 1993(left) and 2005(right).(Source: photo by author)

In 2016, the overall plan for Beijing placed more emphasis on urban-rural construction and sub-centre construction. Greater requirements were imposed for urban green development and sustainable urban design. The plan gave full play to the capital's functions as a political and cultural centre and continued to optimise the urban pattern and improve the urban environment in order to satisfy the citizens' growing material and cultural needs. The overall plan formulated by the Beijing government emphasised that the city’s urban development planning should facilitate the gradual shift from the metropolitan area to the vast suburbs, adjust urban functions and layout, vigorously develop the suburban towns and exploit new development spaces (Zhang et al., 2018). According to Long et al. (2010), the ultimate objective was to create a central area with the old city as the core and multiple independent marginal clusters. Later, Beijing gradually initiated reform in the old town, adjusted supporting facilities in the suburbs and vigorously developed the outer suburbs.

Throughout the seven editions of Beijing's master plan, the principle of a decentralised group layout forms the urban texture of Beijing. The successive editions of the master plan have emphasised the importance of guiding the layout of various functions on a larger spatial scale. The main focus of development has shifted to the periphery of the city, thus alleviating the problem of overcrowding in the central city. Strategically, Beijing mainly built new residential districts and supporting facilities with land adjustment in the suburbs while planning the construction of satellite cities in the outer suburbs. According to Beijing's master plan, the administrative region of Beijing is divided into a capital function-core zone, urban function expansion zone, new urban development zone and ecological conservation development zone (Figure 29). The urban function expansion zone and new urban development zone, surrounded by high-tech industry, modern service industry and emerging industries, have been acknowledged as the key areas in Beijing's urbanisation construction planning.

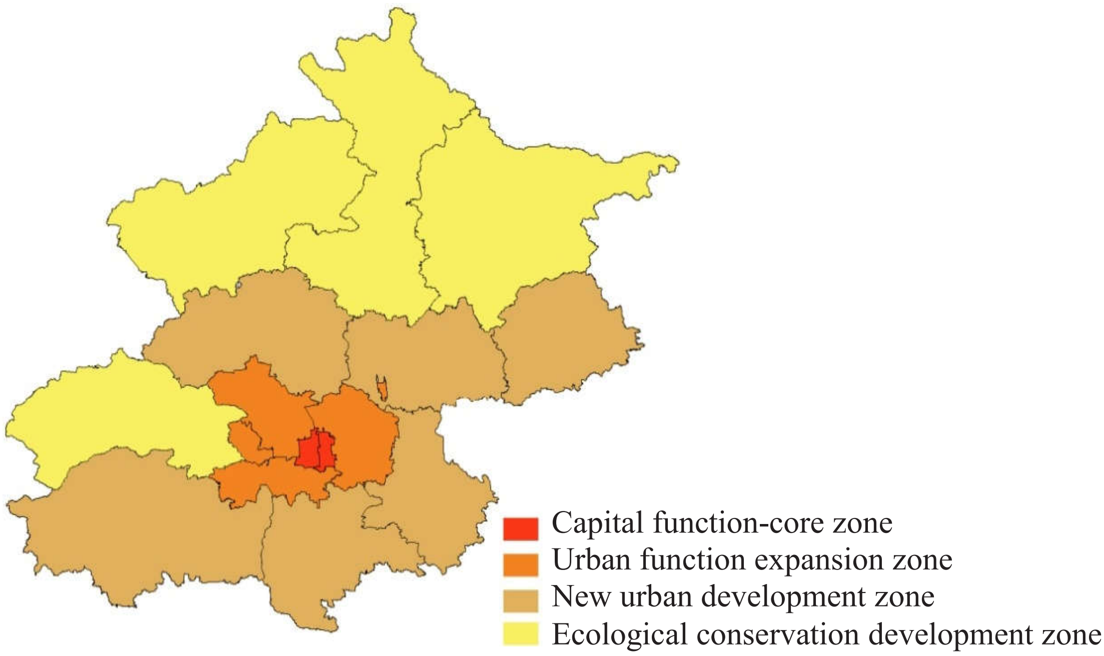


Figure 29: Beijing function layout. (Source: by author)

5.2 Urban morphology in Beijing

5.2.1Beijing's urban spatial patterns

Chen(2021) proposes that urban morphology is the study of urban form, which puts emphasis on the formation and transformation of urban morphology in a specific area in different periods and promotes the sustainable development of the city according to its physical characteristics. According to Ke (2003), the urban space layout of Beijing was developed from the basic structure established in the 1950s. With the progress of the economy and society, the urban scale and urban space kept expanding, which gave rise to a change in the urban layout.

Beijing follows an expanding circular pattern, which is mainly observed in the expansion along the marginal area. According to Zhou (2007, p.9),factories and their workers and the homes for these workers initially settled in the frontier areas or the suburbs. Later, the development of public facilities attracted investors, and commercial and general residences filled the gaps in the space, joining the edge area with the original central urban area. As the original metropolitan periphery area gradually became a part of the urban area, and the factories and their supporting facilities and workers continued to move towards the outer suburbs, the new urban marginal area took shape. The alternating movement between the marginal metropolitan area and the urban area is characterised by a clear tree-ring phenomenon, known as layered expansion(Zhou, 2007).

After experiencing decades of high-speed development, Beijing has developed into a metropolitan city composed of 16 districts, including the central city and the marginal area in the suburbs and outer suburbs. According to the fifth census (2002), six of the 14 marginal areas had a population of less than 100,000 in 2000. Except for Changping, the migrant population is less than 20%. About 90% of the new population came from the suburbs and other provinces. Those from urban areas are less than 10%. This shows that the periphery areas are not effective in attracting urban populations. In 1995, only 1.2% and 1.8% of the people who moved to Shunyi and Liangxiang came from urban areas. The spatial expansion of Beijing is characterised by the simultaneous expansion of the main area and the marginal area.

As shown by the spatial changes in the city in Figure 30, the city cluster of Beijing in 2000 consisted of one central location and seven edge cities, including Fangshan, Changping, Shunyi, Yanqing, Huairou, Miyun and Pingu. Over the past 20 years, with the expansion of the central and marginal areas, Shunyi and Changping's two periphery areas have gradually merged with the central city. This has resulted in the formation of a polycentric city comprising one central region and the four outer suburbs of Yanqing, Huairou, Miyun and Pinggu, with a close distance between the newly developed urban area and the original urban area, and the integration of the newly developed metropolitan area and the expanded old urban area. In addition, because the built-up area has good public facilities, it is less expensive to develop the peripheral region, which is attractive for investment (Lee, 2007).

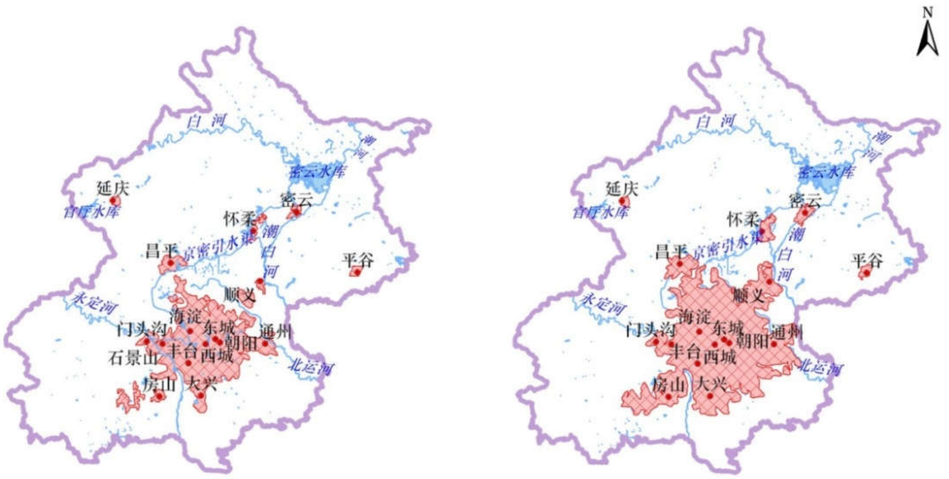


Figure 30： Morphological changes of city space in Beijing from 2000 to 2010. (Source: Xie et al. 2015)

According to Chai and Ta (2009),Beijing has undergone rapid urbanisation, evidenced by the gradual shift of suburban farmland to non-agricultural land and the continuous expansion of urban space. Due to the change of the built-up area (Table 8), Beijing accelerated the pace of urbanisation in 2000-2009, and particularly in 2001-2003.The annual expansion rate of the urban built-up area reached 35%. Thus, in the 10 years, the built-up area increased from 490.1 km² in 2000 to 1349.8 km² in 2009. Jiang et al.(2007) point out that the change in Beijing's macroeconomic policies stimulated the development of the urban built-up area during this time. Liu and Zhang (2020) add that at this time, a wave of housing construction swept across Beijing as the real estate market became increasingly popular. In particular, the increase in the population, a smaller family structure, higher housing requirements of urban residents and an increase in real estate investment led to a huge housing demand in Beijing. However, Zhao, Shen and Zhang (2013) say that by 2010, the urban built-up area sharply decreased and the metropolitan built-up area even shrank due to unfinished buildings and urban reconstruction. The built-up area began to grow again from 2012 but at a lower growth rate, and remained unchanged after 2016.

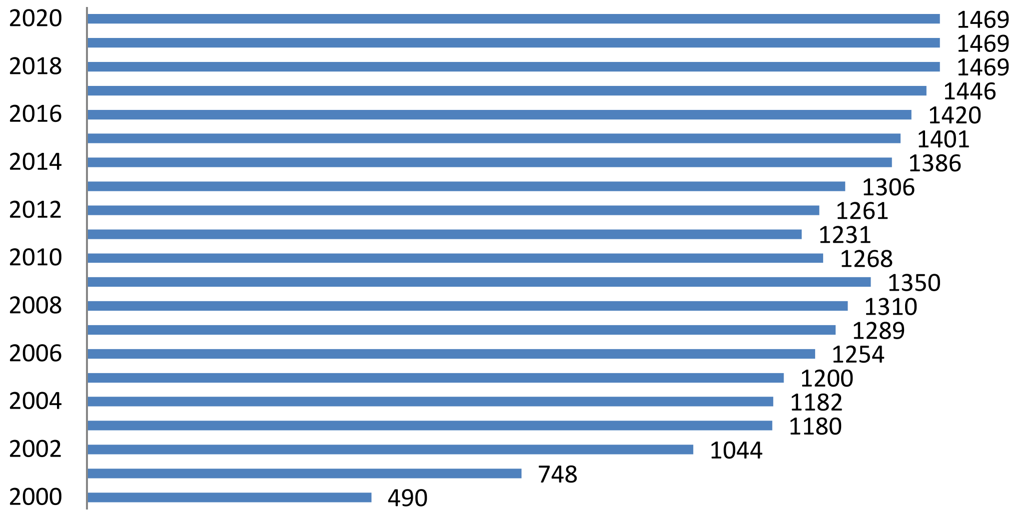


Table 8: The area of built-up area in Beijing.(Units: km^2) (Source: data from National Bureau of Statistics; table by author)

In the process of space expansion in Beijing, the farmland outside the 4th ring road was covered by many buildings (Xie et al., 2015). The land use for urban construction reflects the coverage of buildings. The urban space expansion in 2000 and 2010, as shown in Figure 30, also reflects the change in the urban construction land distribution, with the substitution of farmland by numerous buildings in the built-up area in a decentralised manner. Such substitution exhibits different characteristics in different locations (Irwin and Bockstael, 2007). Table 9 shows the change of the building cover within the six ring roads. It can be seen that the building cover area within the 4th ring road remains basically unchanged, meaning a high maturity of urbanisation in this district. The building cover area between the 4th and 5th ring roads is decreasing at a rate of 5.88km^2 annually, meaning that the district is in the stage of urban ecological transformation and reconstruction. The building cover area between the 5th and 6th ring roads is in the transitional zone between the city and the village, and the building cover area is replacing farmland at a rate of 15.43km^2 annually, reflecting that large-scale construction of buildings is underway. This also explains the population surge in the marginal suburbs near the central urban area mentioned in the next section.

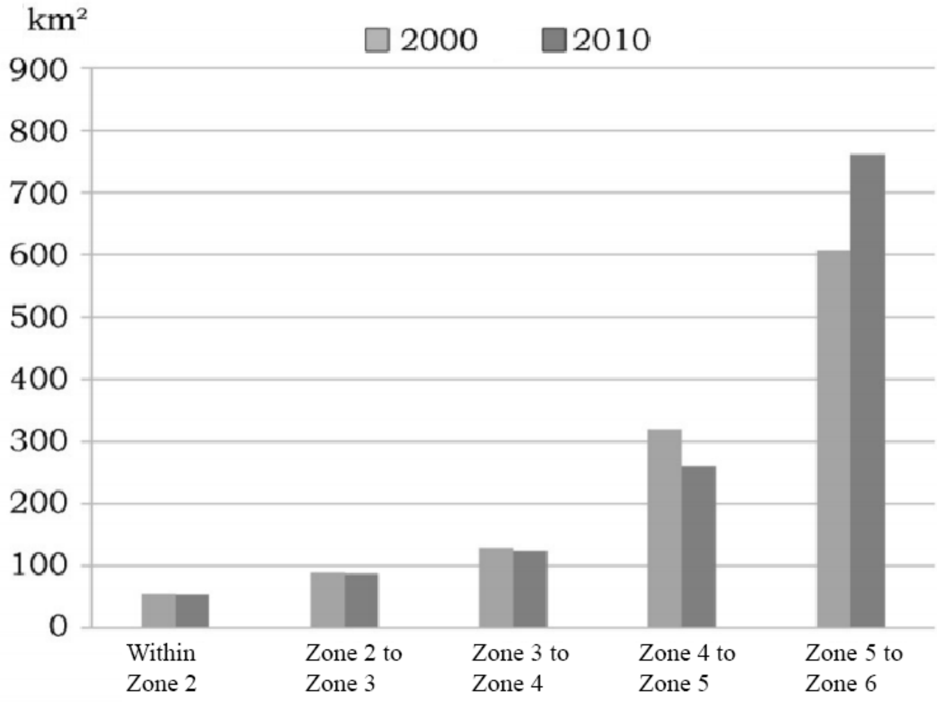
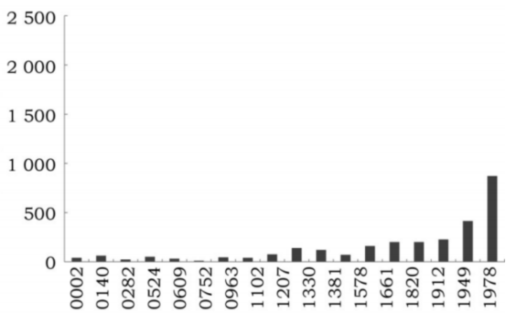


Table 9: Area of buildings in Beijing in 2000 and 2010. (Source: Xie et al. 2015)

5.2.2 Beijing's urban population aggregation

Population distribution is another significant aspect of urban form according to Liu and Zhang (2020). They conclude that population distribution affects the spatial structure of urban land use and shows the results of urban space development. Population flow and transformation can give a glimpse into the changing trend of the urban space. For thousands of years before 1100, there were approximately 200,000 people in Beijing. In 1100-1949, the population was 2-4 million. In 1949-1978, the population increased to 8 million. From 1978, the population increased by 350,000 per year on average (Xie et al., 2015).

The data in Table 10 and Appendix 2 show that the permanent residents of Beijing reached 13.63 million in 2000 and subsequently increased to 19.62 million in 2010, with an annual growth rate of 600,000 people. By 2020, Beijing become a megacity with 21.89 million permanent residents. Obviously, Beijing underwent a rapid population growth in the past decade, but the corresponding population growth rate significantly declined in this period. Upon reaching the peak of 21.95 million in 2016, Beijing's permanent resident population slowly decreased.



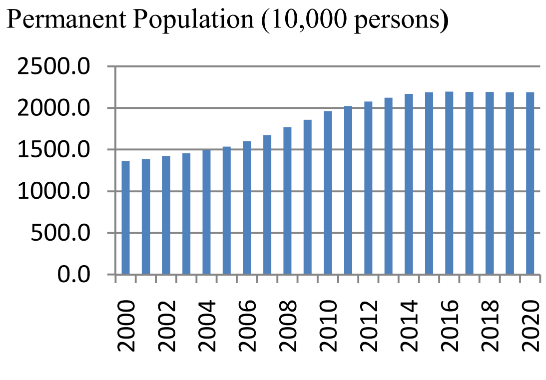


Table 10: Trends of permanent population before 1978 (Left) and from 2000 to 2020 (Right). (Source: left table: Xie et al. 2015; right table: data from 2021 Beijing Statistical Yearbook, table by author)

In terms of space (Figure 31), although residents were scattered throughout Beijing in 2000, the population density was obviously high in the central urban area, with approximately 21% of the population in the Dongcheng and Xicheng districts and nearly 28% of the population in the Haidian and Chaoyang districts. Around 37% of the permanent resident population lived in the eight communities close to the central urban area. Only 14% of the population lived in marginal areas further away such as the Yanqing, Miyun, Huairou, Pinggu districts. An obvious shift of population to the marginal areas near the central urban area was observed in 2010, together with a reduction of the population in the central urban area. For example, the Dongcheng and Xicheng districts had a permanent resident population of only around 11%, and the Chaoyang and Haidian districts witnessed a 35% increase in their permanent resident population. Marginal areas near the central urban area, including the eight suburban districts, among them Changping, Daxing and Fengtai, contained about 19.58 million people with a 5% increase in2000, constituting 35%. The population in marginal areas far from the central urban area declined to 9%. By 2020, the permanent resident population in the central urban area had declined even further. The Dongcheng and Xicheng districts had a permanent resident population of only around 8%. The Haidian and Chaoyang districts had basically the same population proportion. The population in the districts around the central urban area increased further to 48%, and that in the remote districts was basically constant compared to 2010.

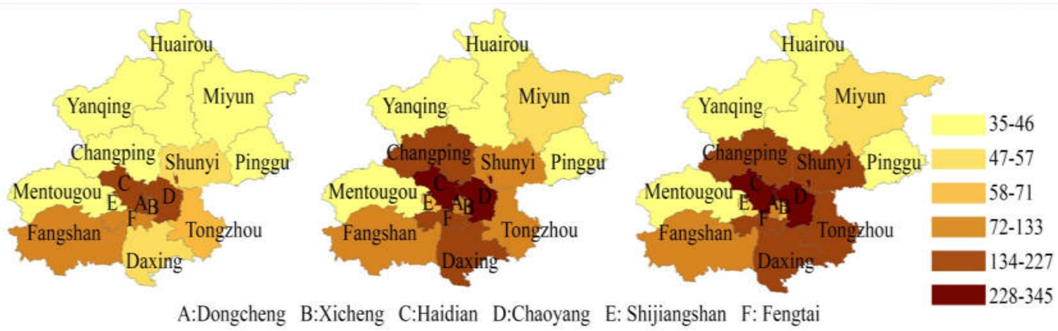


Figure 31: Population density map of Beijing districts in 2000, 2010 and 2020. (unites:10,000 persons) (Source: Data from the 5th,6th,7th census; figure by author)

Combined with the data in Figures 31 and Table 11, the population size and proportion of Beijing’s two central districts, Dongcheng and Xicheng, significantly decreased. The permanent resident population of the Chaoyang and Haidian districts roughly doubled from 2000 to 2010, and then fell slightly in 2020. Nevertheless, the change in the population proportion of these two districts was insignificant, increasing by around 7% from 2000 to 2010, and remaining the same until 2020. The population size in the marginal suburban area gradually increased annually. In 2000-2010, the population nearly doubled in most districts, and the population increased approximately threefold in the Changping and Daxing districts. In 2010-2020, the eight districts all witnessed a slow growth in population size. The population size in the outer suburbs increased slightly and the proportion was basically stable.

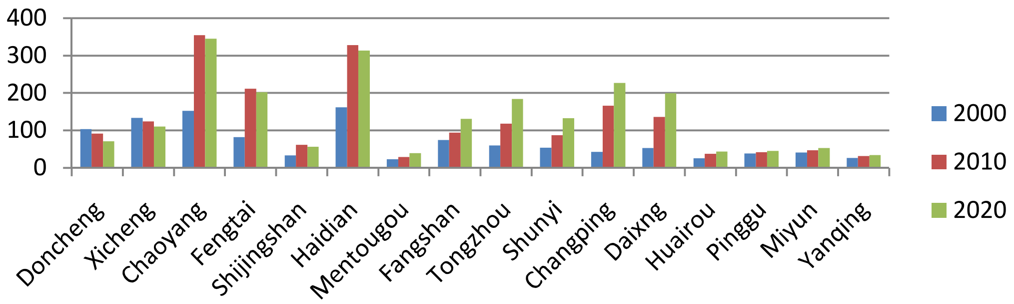


Table 11: Population of each administrative region of Beijing in 2000,2010 and 2020. (Unit: million people) (Source: Data from the fifth, sixth and seventh census; table by author)

In sum, in the past 20 years, Beijing has witnessed the outward movement of population from the centre. The population in the Dongcheng and Xicheng districts is falling year after year. The population in the Chaoyang and Haidian districts doubled sharply from 2000 to 2010 and then declined slightly over the past 10 years. The population in the eight suburban districts has been on the rise in the past 20years, with a two-fold increase on average. Among them, Daxing's population increased around fourfold, Changping's population increased around fivefold, and the population of the five districts in the outer suburbs experienced a small increase. In terms of population proportion, apart from the decline in the Dongcheng and Xicheng districts, the population proportion in 14 districts in the suburbs and outer suburbs basically remained stable. The settlement of a large population in the development zones affects the spatial structure of the urban population. With the migration of the urban population, the spatial agglomeration in the urban function expansion zone and new urban development zone will also be improved step by step.

5.2.3 Transport analysis and Space Syntax analysis

The circular road system in Beijing guides the direction of urban space development (Huang and Pan, 2004). Zhou (1995) argues that traffic land is a part of construction land and that the expansion of infrastructure, especially road construction, creates favourable conditions for the growth of urban space. With the rapid development of people's range of activity and improved traffic accessibility, urban space expansion can also be achieved (Mou et al., 2007). The growth of the urban population and the land use scale in turn accelerates Beijing's urban suburbanisation. With the expansion of urban construction land, the average commuting radius of Beijing citizens is gradually increasing year by year and commuting times are growing.

According to the Maple Urban Travel Index - China City Travel Index 2006 Annual Report, Beijing has the longest average motor vehicle commuting distance nationwide, at19.3 km. Its average commuting time also ranks first in the country. The traffic structure of Beijing shows strong centrality. However, in 2020, the city commuting report revealed that Beijing still has the longest average motor vehicle commuting distance across the country. However, the overall commuting distance is as short as 11 km, and the average one-way commuting time is over 45 minutes. It is observed that after decades of development, although the relationship between work and life is still imbalanced in Beijing, the commuting distances are continuously decreasing.

Economic growth and a longer commuting radius led to a significant increase in the number of Beijing's private cars and the frequency of their use. Until late 2020, Beijing had as many as 6.57 million monitor vehicles. Table 12 shows the rapid growth momentum of motor vehicles in Beijing before 2020. Although the number of motor vehicles in the past decade was increasing, the trend became significantly more stable. In the past 20years, the number of motor vehicles has increased by around 5 million more than in late 2000, and Beijing's traffic network has suffered increasingly heavier traffic pressure.

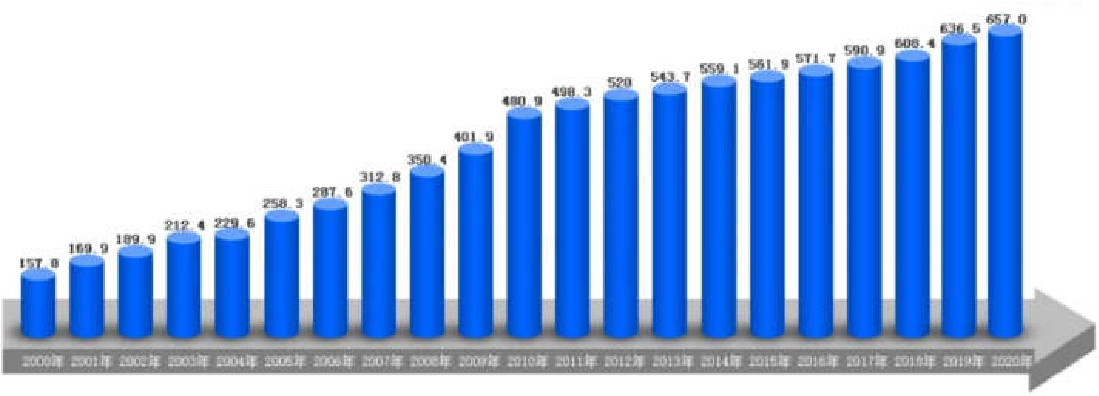


Table 12: Motor vehicle growth trends since 2000. (Unit:10,000 cars) (Source: Wang 2021)

In addition, over the past two decades, Beijing has made great changes to develop transportation networks in the subway, railway and other aspects(Cai, 2000, pp.1-3). In 1953, the government of Beijing in the Draft of the Reconstruction and Expansion of Beijing City emphasised that the construction of the underground should be planned as soon as possible. Beijing started subway construction in 1965 and the first subway line in Beijing was completed by1969. From then on, in a long course of over 30years, Beijing’s subway system has developed slowly. Until 2001, Beijing won the hosting rights for the 29th Summer Olympic Games, which expedited Beijing's steps in subway construction work and Beijing’s subway network began to take shape (Figure 32).

The Olympic Games provided an opportunity to develop and construct Beijing’s transportation. When Beijing successfully won the Olympic bid in 2001, Beijing developed quickly and the number of vehicles exploded. But at that time, Beijing’s public transportation service remained weak and the transportation situation was also not promising. Considering the Olympic Games as an opportunity, Beijing Olympic transportation combined with urban development requirements and Olympic transportation requirements. Beijing began to build the new transportation system from demand analysis to the planning and construction of transportation facilities. It sped up to improve the transportation facilities and functional structure. In the meantime, it increased investment in rail transportation. This new transportation network that had initially realised the integration of urban, suburban and intercity transportation met the growing transportation demands and guaranteed the comprehensive achievement of the new Beijing and new Olympic strategy conception (Chen 2008).

After the completion of Line 13 and Batong in 2004, the operating mileage reached 114 kilometres. At this time, the northern suburbs of Wangjing, Huilongguan, Tiantongyuan, Beiyuan and other large residential communities began to form, creating a large number of residential areas in the periphery area. By 2008, the gross mileage increased from 42 km at the time of the Olympic bid to 200 km. The opening of the Beijing Olympic Games fundamentally activated the construction of the Beijing metro system (Liu, Guo and Sun, 2008). Before 2008, Beijing almost constructed one line every two years. And after that, it basically constructed two or even three lines every year. Driven by the Olympic Games, the number of Beijing subway lines increased from two in 2000 to 20 in 2020. However, the dynamic matching between Beijing's subway network and the speed of urban space development proves that Beijing's urban rapid rail transit network has only experienced a fast increase in recent years. It is far behind the development speed of urban construction and urban road traffic, as shown in Figure 33.However, Beijing's subway lines are only connected with the districts within the five ring roads and many farther marginal areas have not been covered.

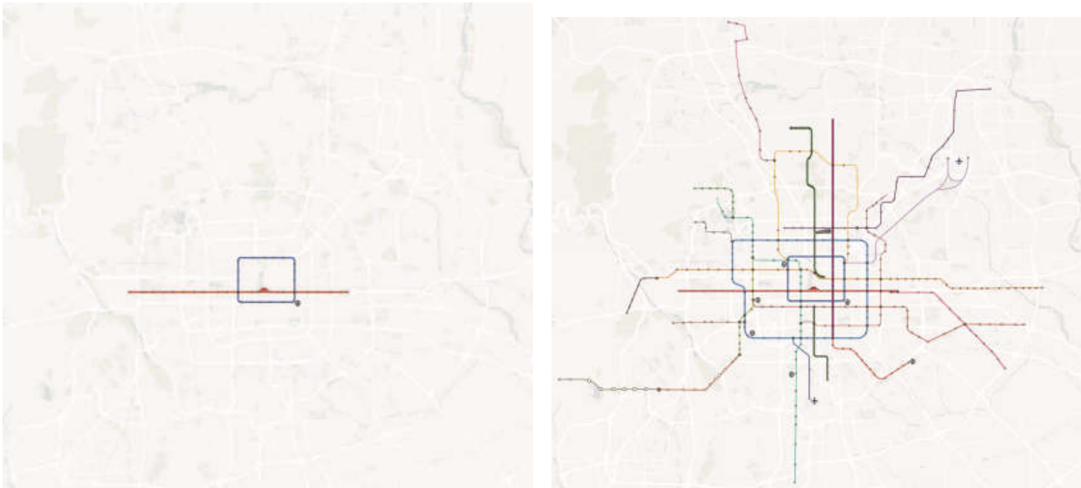


Figure 32: Beijing subway lines in 2000 and 2020.(Source: by author)

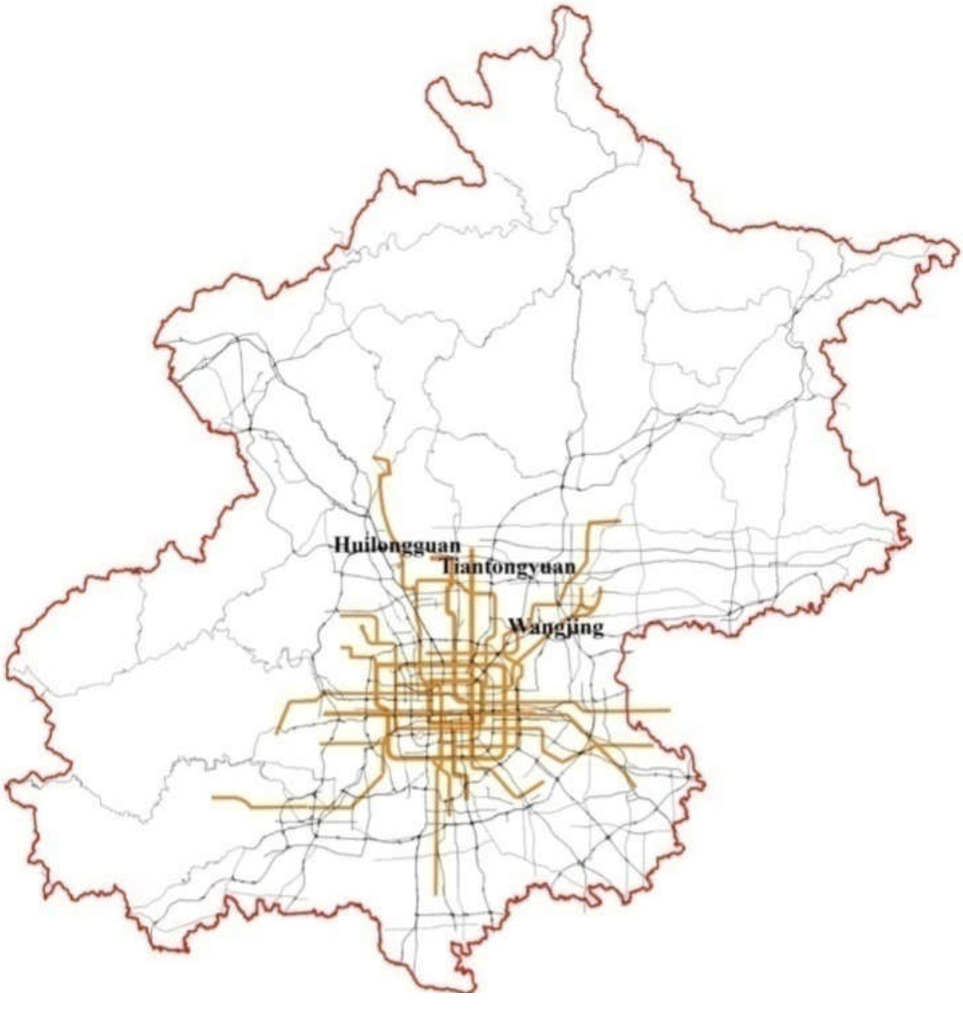


Figure 33: Underground coverage map in 2020. (Source: by author)

As shown in Figures 32 and 33, rail transit line construction and planning in the central urban area have always focused on Beijing's planning, mainly to alleviate the traffic pressure in the main metropolitan area, construct the network rail transit lines in the central urban area and support efficient transfer and fast connection with other public traffic lines. The rail transit construction in marginal areas has attracted more attention increasingly and the lines have become more interconnected and networked, basically covering all the key marginal areas.

Based on the Beijing Urban Planning and Design Institute research data, approximately 60% of job- and residence-intensive areas in Beijing's urban planning are within 750 m of urban rail transit, as shown in Figure 34. In the line network laid down in 2015, although many job- and residence-intensive areas are strongly connected with a certain urban rail transit line, frequent transfer between lines via urban rail transit hubs in commuting is still required. Further validation should be performed to test whether the connection efficiency satisfies urban requirements. Guo et al.(2021) argue that the rationality of urban road network planning determines the city's development potential and backward driving force. As a result, it is necessary to explore Beijing's urban road network accessibility.

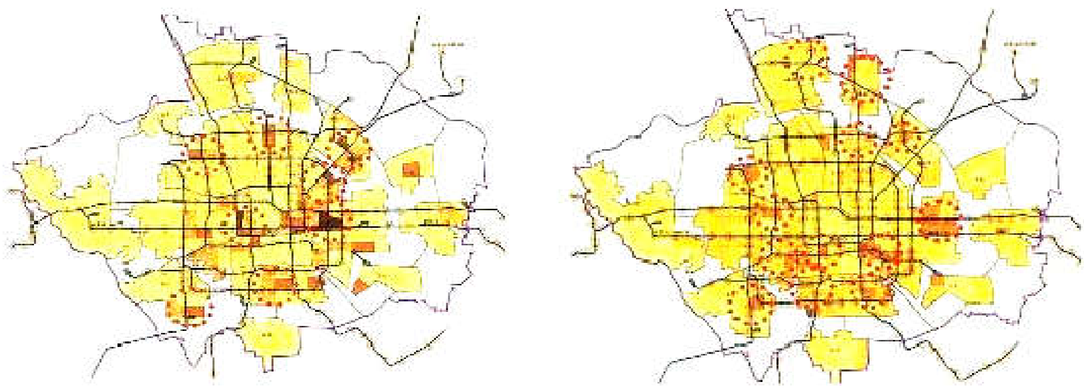


Figure 34: The relationship between Beijing transport network of employment areas (left) and living areas(right). (Source: Zhou and Yang 2007)

Garreau (1991) believes that a change in urban accessibility can also give rise to a change in relative location value and then promote the development of the urban economy and spatial morphology. He emphasises that the development of urban transportation networks will affect the formation and development of urban corridors and marginal cities. Taking the road network in 2000 and 2020 as an example, Google Earth road network data is used in Depthmap to construct the road network axis model and to compute the values of the spatial analysis variables under the space syntax axis model theory. This is followed by a road accessibility and integration analysis of the urban traffic integration, connectivity and other relevant factors. The axis model in Figure 35 and 36 shows the ever-changing spatial structure as the city has developed over the past 20 years. This reveals the role of changes in spatial structure in the maintenance and evolution of Beijing’s central area and marginal area (high values are indicated in red, low values in blue).

It can be seen from the figure that Beijing has a weak centre and radial space, but the circumferential connection between the radial spaces is strong. An analysis of the integration map reveals that compared with 2000, Beijing's urban road accessibility had clearly improved in 2020, featuring a more even road network distribution, further development of secondary and branch roads, and reinforced interconnectivity of multiple routes in the central urban area (the highest connectivity value in 2020 was 166, in 2000,it was 9). The road network has a standard orthogonal layout, meaning that urban road construction planning is clear and mainly characterised by roads' orthogonal and vertical intersection. Most urban roads are connected by intersections instead of T-roads or acute angle intersections by two routes. With a focus on constructing main roads, Beijing has constructed a circular radial road network. Zhan and Zhang (2016) supported that the connectivity of Beijing's road network is high in the inner circle and low in the outer circle. Areas closer to the central urban area have more increased road network connectivity, better spatial permeability and higher traffic accessibility. However, most of the ring roads are closed and continuous multi-lane expressways alternately connected by overpass and flyover, exhibiting apparent concentric circle characteristics. The absence of closed expressways, as well as the connection with other traffic networks, lay down the independent traffic structure, which is detrimental to the sustainability of the city.

Figure 35: The integration map in 2000. (Source: by author)

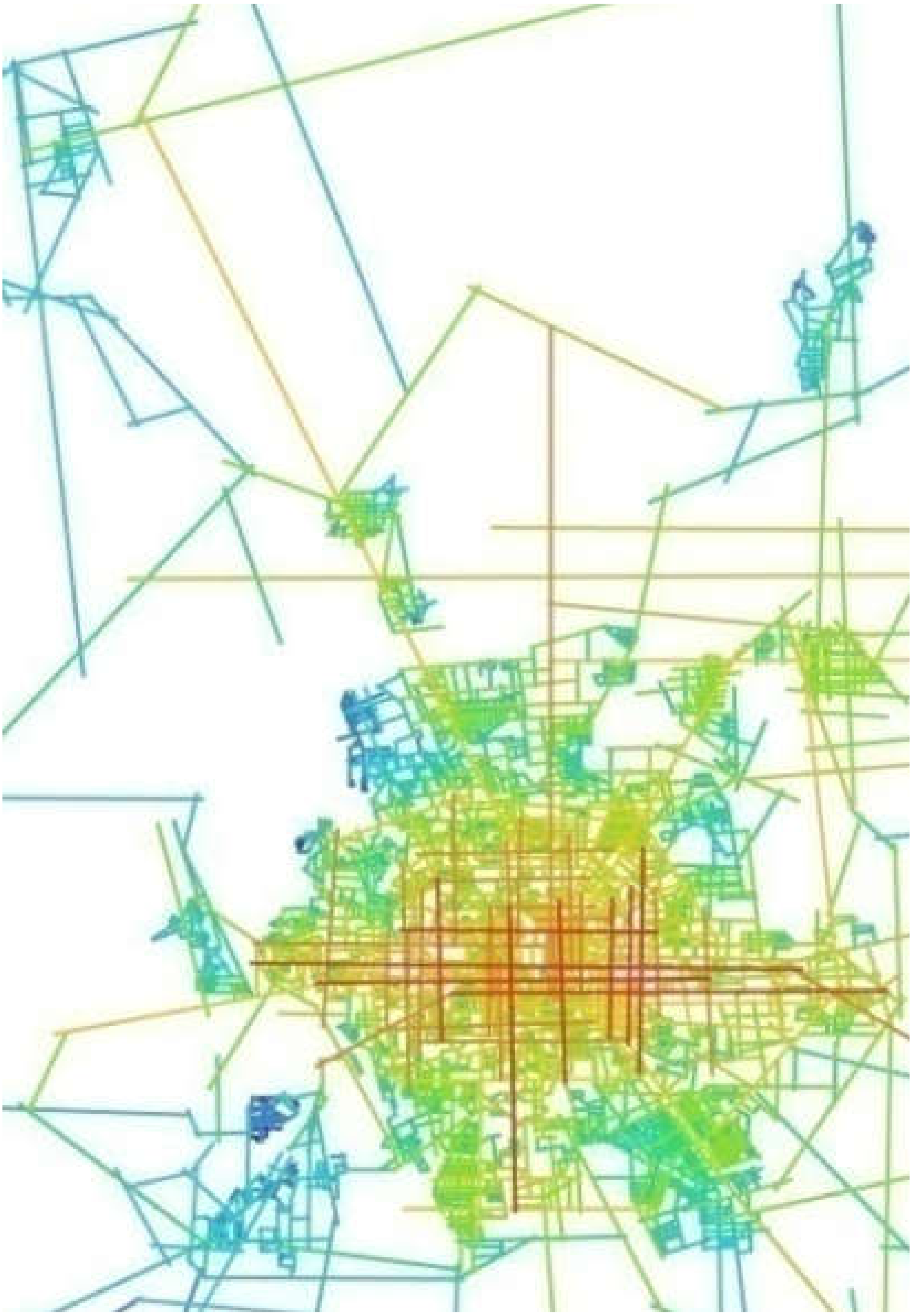


Figure 36: The integration map in 2020. (Source: by author)

The intelligibility value is derived from the linear regression equation of connectivity value and integration value. As a method that assesses accessibility from a subjective perspective, it reflects the possibility of understanding the whole space from local space. The intelligibility R^2 of Beijing was 0.17 in 2000 and 0.32 in 2020. Compared with 2000, the overall space of Beijing was more regular, and the local area and overall space were more coordinated and unified with significantly improved correlation. However, the intelligibility in these two years was both less than 0.5, and there was no correlation in intelligibility. Guo and Wang (2011) indicated that Beijing's road network was in a regular form, and thereby, the similarity of the urban road system was enhanced, which could more easily reflect the morphology and law of road network and further improve urban road accessibility. Heterotropic roads extend along with multiple directions and arbitrarily interweave with each other, inevitably destroying urban road network distribution law and pattern, making the road network disordered and further reducing urban road network accessibility. T-roads lower the traffic efficiency of vehicles and intensify the traffic pressure and congestion risks of nearby roads by forcing the cars to make a detour. For this, T-roads severely affects the accessibility of urban roads and weaken road capacity. Also, the low intelligibility to the poor connectivity between local road network and general morphology. In other words, given that the development of development zones and marginal areas in the outer suburbs is still the main challenge to Beijing's urban construction at the current stage, and these districts generally have low intelligibility because they are separated from the urban road network by mountains.

A comparison of global integration and intelligibility shows that Beijing's urban layout was more compact in 2020 and its development followed the block mass mode. Zhao et al.(2014) explain that urban development in the block mass mode is centralised and balanced, and all parts of the city are in a closer connection but less constrained by terrain. In this case, a compact and regular road network can be easily formed, which eventually reinforces the connection of all nodes and functional areas in the city, and forms a road network system with high accessibility. Road network density is also one of the factors influencing road accessibility. The higher the road network density, the better the connectivity of the road system. Figure 36 shows that in 2020, Beijing had more roads, higher density, developed branch roads and various means of transportation. Zhang and Xie et al.(2015) argue that a high-density road network enables passengers to have multiple commuting choices in any district of the city as long as more lines connect the districts as a whole.

However, in both the 2000 map and the 2020 map, the accessibility to the peripheral area is obviously lower. The decline in accessibility to the marginal area in the outer suburbs is dramatic. Although these areas are connected with expressways and railways, less construction land is left. The road network density here is necessarily smaller than that in the city or the suburban marginal area. Thus, peripheral roads have significantly poorer accessibility than roads in the urban centre. The general accessibility to suburban marginal areas is significantly better than in 2000. To be more specific, the improved accessibility to the frontier area is mainly ascribed to the development of Beijing's ring roads in the past 20years. Apart from that, the ring roads in clear texture exhibit strong traffic dredging functions. These expressways connect the suburban marginal cities. Zhao (2009) argues that ring road construction allows all sorts of land surrounding the city to be quickly connected, and the central urban area and the suburbs can be quickly accessed via other roads. In this way, peripheral regions of the city break their isolation with ring roads and weaken the disadvantages of their geographical conditions by integrating into the urban road network system. Compared to the outer suburbs without ring roads, the suburbs with mature ring road construction show are clearly superior. This suggests that ring roads promote the accessibility of urban roads and promote traffic development and connectivity in the surrounding land by considering the traffic connection between the urban centre and the suburbs.

Montgomery (2008) believes that traffic is the basic framework of a city. Given its intricate correlations with urban space morphology, traffic is considered to be the main inherent adaptive factor in the expansion of urban space. For macroscopic objects such as a city, a comprehensive consideration of connectivity, integration and intelligibility can accurately assess road accessibility. In general, the integration map in 2000 shows that Beijing's commuting pressures were mainly in the central urban area. By 2020, due to the rapid growth of the suburban marginal regions and the corresponding increase in integration, the traffic pressure in the central urban area was alleviated to some extent. In its rapid urbanisation process, Beijing has experienced a shift of morphology from the single centre to marginal areas. With improved urban traffic accessibility, traffic corridors promote regional economic activities, alter the spatial layout in the city and guide urban morphology to change along the traffic axis and continually develop towards the suburban marginal area.

5.3 Development zones and edge cities in Beijing

5.3.1 Beijing's development zones

In the 1990s, Beijing entered a rapid development stage, accompanied by rapid urban construction. The overall planning was designed to forma four-tier town system comprising the urban area (city centre), central towns(town), village and general administrative town (hamlet)(Figure 37), as well as to build the development zones of Yizhuang, Changping and Liangxiang and central towns. To develop the economy of the capital city and give full play to Beijing's education, technology, and talent advantages, much effort was put into the planning and construction of Zhongguancun Science Park. Thus, the high-tech industrial park with Haidian Park as the centre began to take shape. The industrial layout based on the municipal, industrial development zone is mainly located in the periphery. In the master plan of 1992, Beijing put forward two strategies of strategic transfer, and decided to build 14 satellite cities and 10 marginal groups around the central city.

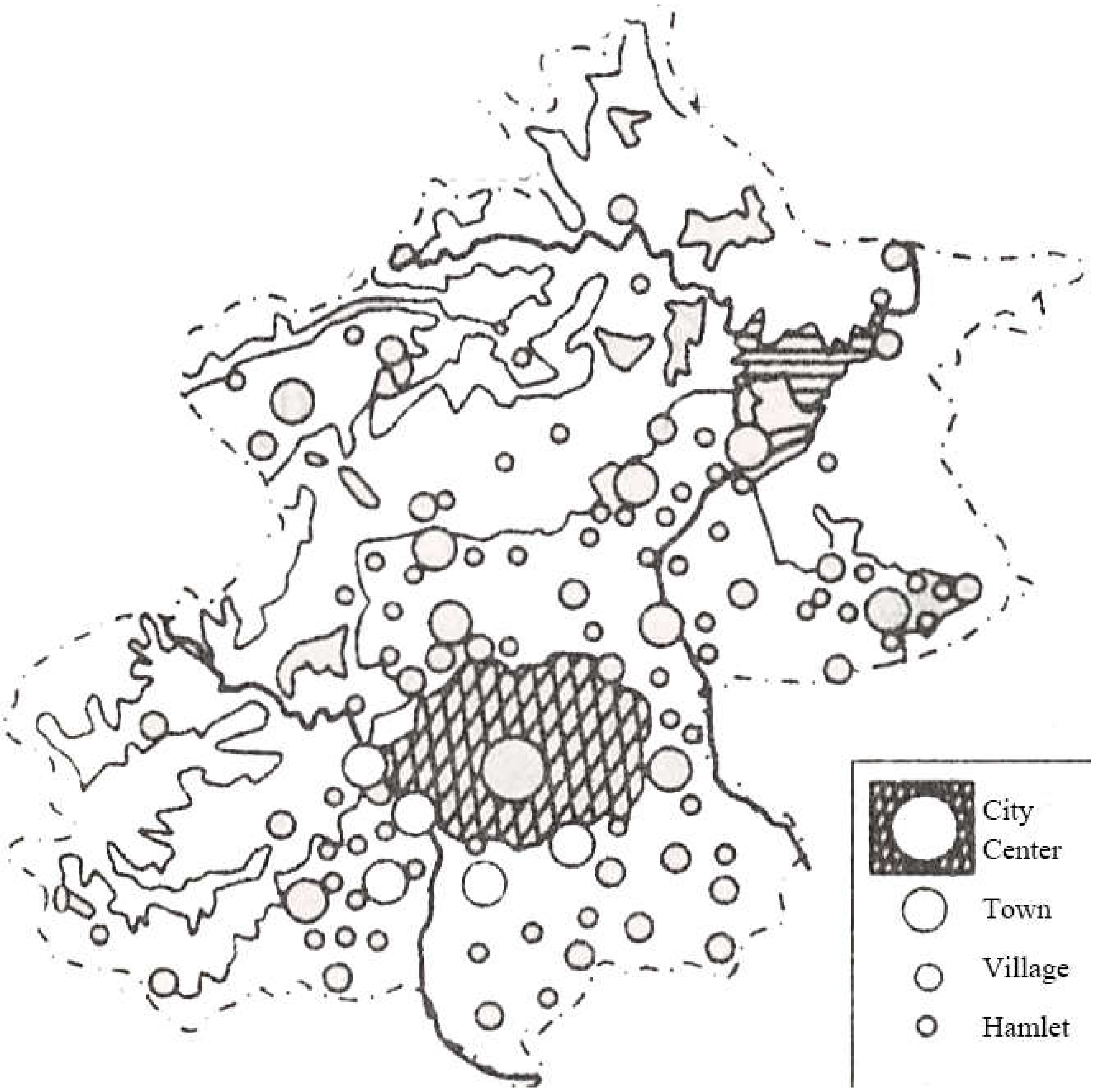


Figure 37 :The administrative division of Beijing. (Source: Easylearn 2016)

In combination with the adjusted urban industrial structure and layout, multiple industrial and economic development zones have been constructed, which have brought in new industries and businesses that have driven the process of suburban urbanisation. Through reinforcing the infrastructure, housing and environment in the development zones of Yizhuang, Huangcun, Tongzhou, Changping, Shunyi and Liangxiang, the overall planning improves the urban quality by incorporating the urban population. Some education and research institutes have also relocated to the new edge areas of Changping, Tongzhou, Huangcun and Liangxiang (Ke, 2003).

Table 13 and Appendix 1 show that the planned scale and the completed construction scale in Beijing's development zone are continuously expanding in direct proportion to the development trend. These two values increased stably for years except for a sharp increase in 2012-2013 due to the expansion of Zhongguancun. Tables 14 and 15 show that the number of enterprises has been growing over the past 20 years, increasing tenfold from 130,000 in 2000 to 1.3 million in 2020. Total investment and total income were continually growing. The growth rate of total income has exceeded that of total investment since 2010. The total investment of 2020 was 45 times that of 2000, and the total income of 2020 was 72 times that of 2000. As a result, given its strong development momentum, the development zone has become a great contributor to Beijing's economy. According to Chen and Chu (2004),as the development zone attracts investment, it stimulates the transformation of leading industries in Beijing, gradually giving rise to excellent industrial clusters.

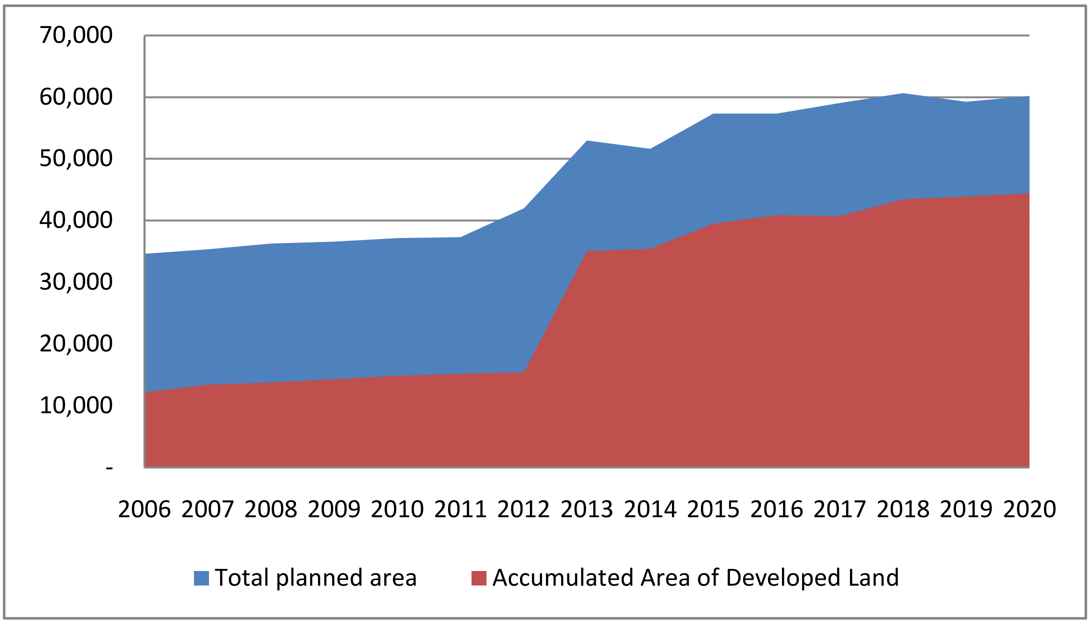


Table 13: Beijing development area total planned area and accumulated area from 2006 to 2020. (Unites: hectare) (Source: data from Beijing Statistical Yearbook, table by author)

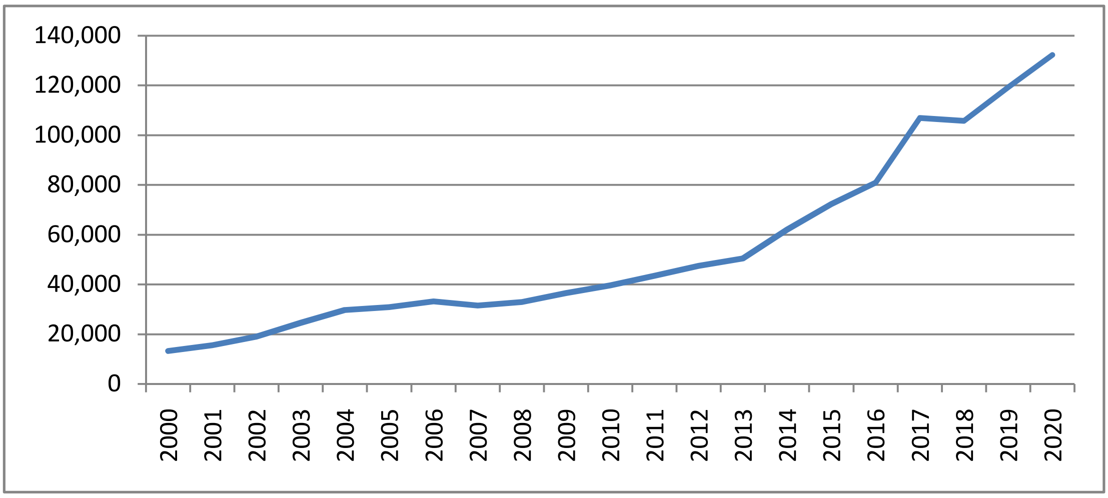


Table 14: Beijing development area total number of enterprises from 2000 to 2020. (Source: data from Beijing Statistical Yearbook, table by author)

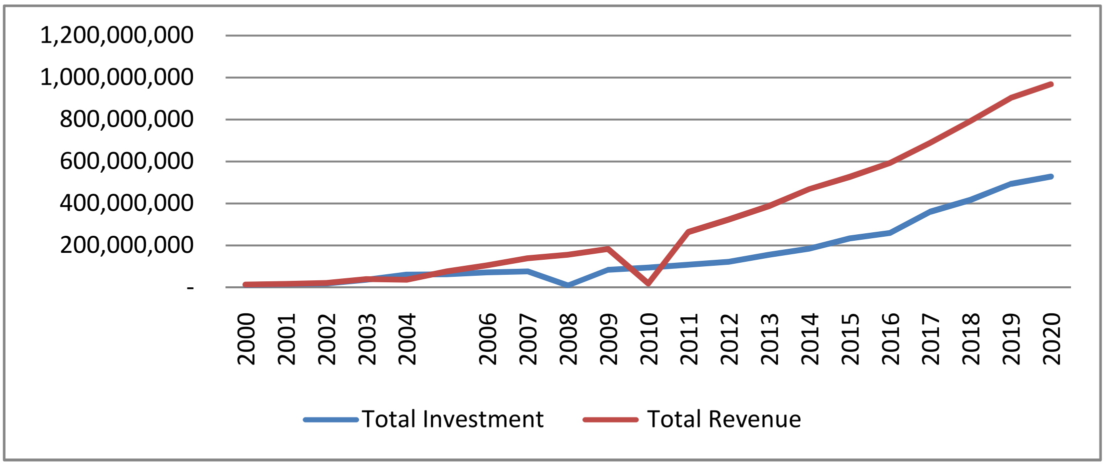


Table 15: Beijing development area total investment and revenue from 2000 to 2020. (Unites:10,000 yuan) (Source: data from Beijing Statistical Yearbook, table by author)

With reference to the Beijing Statistical Year Book annually published by the Beijing government, Appendix 1 summarises the data of development zones since 2000, which includes the total planned area, the accumulated area of developed land, the number of enterprises, the total investment and the total income of each development zone. However, as the government records for 2000-2005 only include statistics on the investment and production of development zones, data regarding land exploitation are absent.

The analysis in Appendix 1 shows that there were 30 development zones in the central and marginal areas of Beijing in 2000. Some of the main development zones such as Wangfujing Business District have become core business areas. In addition, though there were four sub-parks in Zhongguancun, the Zhongguancun Group was not formed yet. After the reorganisation of development zones in 2004, new districts of Beijing such as Xiaotangshan Industry Zone and Mafang industry Zone, as well as six districts, were excluded. In 2006, with the further development of Zhongguancun, municipal development zones were also replanned. The development zones were integrated by reorganising the 30 development zones into 17 municipal development zones and two national development zones: Beijing Economic-Technological Development Area and Zhongguancun Science Park. Eventually, Zhongguancun Group was formed, which covers 11 sub-parks. Most industrial development zones were renamed economic development zones. In 2008, Beijing Tianzhu Export Processing Zone was renamed Beijing Tianzhu Bonded Area and then listed as a national development zone. In 2013, Zhongguancun Industrial Centre developed 17 sub-parks, basically covering each district in Beijing. Until 2020, Beijing had 16 municipal development zones and three national development zones in total (Figure 38).

The favourable effect of development zones on Beijing’s urban form can be seen in how they have turned the industrial structure and industrial space layout into new economic centres. The urban expansion in Beijing is centred around the ancient city and expands outward, typically in a concentric circle pattern. As the newly developed urban land approaches the original urban area, it becomes part of it (Tian, Wu and Yang, 2010). The general growth of Beijing's urban space can be divided into the following stages: before the 1950s, expansion centred around the Dongcheng and Xicheng districts. After that, a number of colleges, universities and research institutes were established in the Haidian district and marginal clusters were built evenly in different directions in the inner suburbs, resulting in a polycentric development in the periphery area (Li and Gao, 2013).

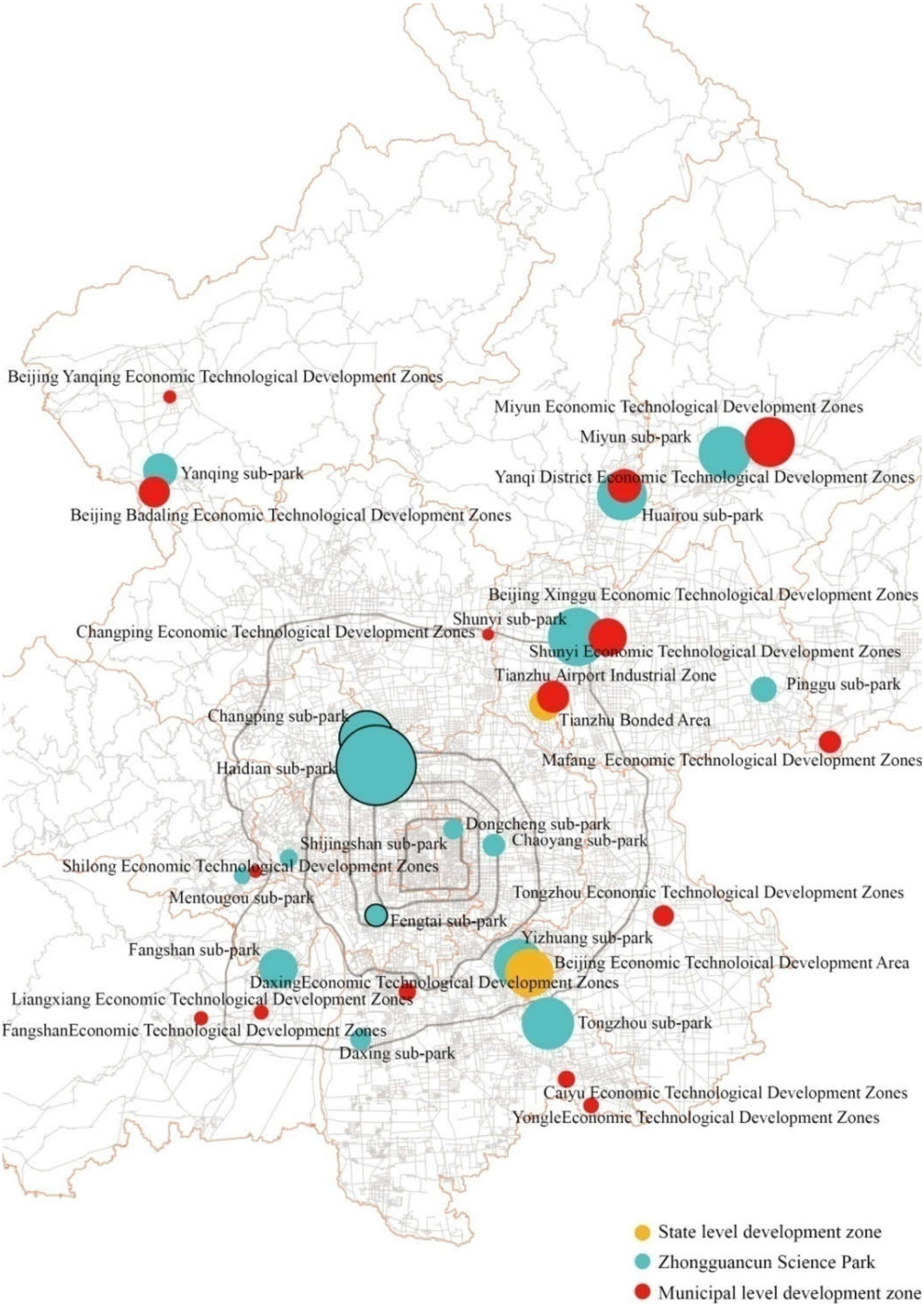


Figure 38: Location map of Beijing Development Zone. (Source: by author)

Since development zones are mostly in the peripheral area, the spread of industrial centres to development zones eventually causes changes in the spatial layout. As Beijing's industrial centre continues to move from the urban area to the suburbs, the industries in the central city decline and those in the suburbs grow. In this way, development zones are the core carriers stimulating Beijing's economic growth, attracting both foreign investment and new urban industries(Zhao et al., 2017). The growth of development zones also contributes to rapid population growth by attracting a large number of employees(Zheng et al., 2017).This has led to development zones that were initially work-based to acquire additional residential functions as a result of the transformation of the population, thereby increasing the urban scale and giving rise to integrated urban functions, thus forming a characteristic Chinese edge city.

5.3.2 Edge cities in Beijing

Wu and Ma (2000) believe that edge cities are one of the inevitable outcomes of suburbanisation when urbanisation in megacities has reached a higher level. This concept is a new product of the post-suburbanisation development in Western cities, indicating the agglomeration area of employment rather than residence and the emerging node of the multi-centre network development in urban area. The edge cities that emerge in China are different from American or European edge cities. Chinese edge cities have their own distinct characteristics and in most cases grow out of technology parks called development zones (Zhao et al., 2017). Lv and Tang (2008) observe that in China, edge cities usually have a moderate population size. They approach the traffic lines but have a certain distance from the central urban area, and exhibit strong comprehensive strength as a product in the new economic growth stage.

In terms of terminology, 'edge' means the distance from the central urban area, usually on the marginal main roads in the metropolitan built-up area or suburban expressway intersections. 'City' means the possession of sound facilities and functions. According to Zheng (2010),in the suburbanisation stage, a large population and other factors begin to leave the central city and move outwards. This gives development zones an advantage as well as the conditions and momentum to grow into a comprehensive new city. Since the establishment of the initial 14 national development zones in big cities in 1984, large development zones have been successively constructed across the country and have become a significant means to achieve industrial transfer and economic growth. Over the past 20 years, Beijing has been expanding towards the marginal area, and the scale of the frontier area is also continuously enlarging.

In terms of spatial location (Figure 39), Beijing had just four ring roads in 2000, approximately 8 km away from the urban centre on average, with a total distance of 98 km. By 2020, Beijing had six ring roads with a total distance of 187.6 km. According to Zhang and Hao (2008),apart from their role in crossing interception, inflow and outflow interception and internal relief, the ring roads have several roads that radiate from the centre to form a radiating road network in order to satisfy the traffic requirements of vehicles, reduce the detour distance, expedite the formation of periphery areas and deepen the connectivity of loops. As seen from Figures 38 and 39, most development zones are within the six ring roads in the city. According to Yang (2002), the area within the ring roads was critical for the overall urban planning that connected most neighbouring marginal areas in Beijing. There are plenty of mountains in the peripheral area of Beijing, especially in the north and the west. Affected by the landform and topography, the connectivity between marginal areas and the central urban area is restricted, which also slows the growth of development zones in these areas.

Figure 39: Road map of Beijing in 2000 and 2020.(Source: by author)

	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Profits	Total Revenue	Total Investment
Municipal level development zone	11,118	7,843	34,240	8,877,050	101,713,531	3,314,006
Shilong Economic Development Zone	189	120	11,538	498,576	10,175,791	845,990
Liangxiang Economic Development Zone	241	136	84	81,999	3,164,955	
Daxing Economic Development Zone	416	395	7,275	134,820	3,573,514	771,153
Tongzhou Economic Development Zone	1,948	771	89	318,654	1,818,724	
Yongle Economic Development Zone	460	219	106	4,300	101,485	6,000
Yanqi Economic Development Zone	1,096	1,096	2,041	449,800	4,452,046	8,000
Xinggu Economic Development Zone	503	572	331	56,201	2,052,348	43,565
Miyun Economic Development Zone	1,249	1,249	266	255,575	4,146,341	200
Beijing Shunyi Science and Technology Innovation Industry Functional Area	1,332	943	2,230	843,781	13,113,034	
Beijing Airport Economic Core Area	1,360	1,246	4,364	3,902,418	45,354,288	1,552,743
Yanqing Economic Development Zone	419	173	97	2,996,510	8,353,652	
Badaling Economic Development Zone	491	324	5,574	121,792	2,185,593	
Fangshan Industrial Park	219	160	29	32,948	688,468	67,925
Changping Xiaotangshan Industrial Park	257	23	78	346	45,108	
Caiyu Economic Development Zone	355	327	61	180,827	2,121,866	6,000
Mafang Bonded Area Industrial Park	346	202	77	4,254	366,317	12,430
State level development zone						
Beijing Economic-Technological Development Area	5,960	5,115	33,262	6,697,334	157,596,540	123,388,094
Beijing Tianzhu Bonded Area	547	350	769	365,968	5,333,245	5,077,387
Zhongguancun Science Park	42,804	31,010	64,257	42,274,514	722,763,686	270,165,560

Table 16: Statistics for land and business in development zones in 2020. (Unit: hectare;10,000 Yuan) (Source: data from Beijing Statistical Yearbook, table by author)

	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Profits	Total Revenue	Total Investment
Zhongguancun Science Park	42,804	31,010	64,257	42,274,514	722,763,686	270,165,560
Haidian Sub-park	17,431	14,594	32,378	14,550,106	294,962,678	112,521,384
Fengtai Sub-park	818	470	13,109	3,871,145	66,486,585	34,164,448
Changping Sub-park	5,140	2,749	4,754	2,581,634	48,030,585	37,317,242
Chaoyang Sub-park	2,610	1,472	2,322	4,247,909	83,909,661	14,324,805
Yizhuang Sub-park	2,678	2,678	1,013	5,198,590	75,597,574	19,313,689
Xicheng Sub-park	1,000	1,000	1,052	3,129,427	34,809,844	26,250,679
Dongcheng Sub-park	603	289	2,820	2,462,112	29,135,659	2,762,313
Shijingshan Sub-park	1,334	403	3,334	3,097,585	31,690,184	7,708,725
Tongzhou Sub-park	3,435	2,323	649	480,349	10,058,897	2,639,197
Daxing Sub-park	2,074	843	209	556,718	7,062,910	428,013
Pinggu Sub-park	508	228	260	26,301	1,691,408	529,247
Mentougou Sub-park	189	120	333	117,200	4,148,805	1,910,950
Fangshan Sub-park	1,573	1,214	422	132,959	4,861,954	394,955
Shunyi Sub-park	1,208	912	765	1,234,212	17,424,666	8,132,060
Miyun Sub-park	1,001	699	209	224,237	3,842,737	917,400
Huairou Sub-park	711	693	375	338,388	7,075,704	850,453
Yanqing Sub-park	491	324	253	25,642	1,973,835	

Table 17: Statistics for land and business in Zhongguancun Science Park in 2020. (Unit: hectare;10,000 Yuan) (Source: data from Beijing Statistical Yearbook, table by author)

Appendix 1 and Table 16 show that the planned area and the built-up area were basically stable in most municipal development zones in the last decade, and almost no development zone is still under construction. Some development zones have experienced no major changes in urban form during the past 20 years, e.g. Shunyi Science and Technology Innovation Zone and Caiyu Economic Development Zone, whose overall scale was relatively small in the planning stage. The Beijing Statistical Yearbook shows that the business development in most municipal development zones has been intensifying year by year, but in some districts, local industries have witnessed a decline, as in the case of Linhe Industrial Development Zone, Fangshan Industry Zone and Changping Xiaotangshan Industrial Zone. These development zones have poor traffic conditions because of there is no direct link to any of the six ring roads. The outer suburbs have a large area for development, with only a few hundred hectares unbuilt because of infrastructural constraints, the topography or other limitations.

By 2020, there were 16 sub-parks in Zhongguancun, covering almost every district in Beijing. Figures 38 and Table 17 show that some municipal development zones and Zhongguancun's sub-park areas overlap or are adjacent to each other. The sub-parks within the six ring roads and in the outer suburbs basically share the same development trend of business with municipal development zones. The difference is that the sub-parks of Haidian, Tongzhou and Changping are the top-ranking places in the business development in Zhongguancun. Of these, Tongzhou Sub-park is the core economic area in the east of Beijing. Table 17 shows that the Haidian Sub-park ranks first in both construction scale and economic growth. As the earliest development zone, HSP is the core of Zhongguancun. In 2000, it was the fringe area furthest away from the city centre. In addition, due to the circular development model of Beijing, HSP has now become an important edge city with its own economy as well as its own identity and market. As Li and Gao (2013) point out, HSP, known as the Silicon Valley of Beijing, is now an important economic centre for Beijing.

HSP has grown to be a new centre driving the development of the surrounding areas with the continuous enlargement of scale and the growth of the periphery areas. This also explains why Changping ranks top 3 in general data and development. The development of HSP promotes the development of Changping and forms the Shangdi districts. Changping also covers two large residential communities in Beijing: Huilongguan and Tiantongyuan (Figure 33). Huilongguan has degenerated because of its few functions and lack of industries and supporting facilities. In contrast, Tiantongyuan has become the largest community in Asia. A good number of passengers shuffle between the urban area and Huilongguan and Tiantongyuan. However, due to its long distance from the central metropolitan area, proximity to HSP and Changping Sub-Park and access to the subway, many people still work and live in Haidian and Changping Sub-Parks.

According to the Beijing Statistical Yearbook, the Beijing Economic-Technological Development Area (BDA) is unquestionably the second leading development zone after HSP in terms of planned area, built-up area and business data. It is superior to all the municipal development zones and the national development zone of Beijing Tianzhu Bonded Area. Yizhuang, where BDA is located, is a key node in Beijing’s eastern development strategy, and local governance has been focusing on the development of comprehensive service functions to propel the shift from a development zone to an edge city. Yizhuang Sub-Park in Zhongguancun is another essential part of the current strategies to strengthen polycentric urban growth in Beijing’s mega urban agglomeration. In sum, when comparing the 16 sub-parks in Zhongguancun with other development zones, BDA and HSP are the largest and most profitable and completed development zones among all the development zones in Beijing and thus very suitable case studies to investigate the current form of everyday urbanism in their neighbourhoods.

Both the Beijing Municipal Party Committee and the Beijing Municipal Government decided to draw on the development model of south-eastern coastal areas in 1991 to establish BDA. By 2020, BDA had become Beijing's sole national economic and technological development area, enjoying the preferential policies for both national economic and technological development areas and national high-tech industrial parks. On a macro scale, the total development area of 195.1 km^2 of the so-called Yizhuang Satellite City was defined in 2001. In 2005, regional planning extended the area again and named it Yizhuang New Town with a total area of approximately 225 km^2(BDA Management Committee, 2019). While the surrounding area of the original BDA has been extended and defined as New Town, the core area of the BDA and its area of 59.6 km^2 is still to be considered the main centre and is thus the case study area.

During the same period, the Zhongguancun Science and Technology Park was established and developed in the 1990s, which accelerated the urban growth of the district along the North Fourth Ring Road. The second case study of HSP is the main core of this expansion. HSP has been evolving into a new versatile urban area in the northwest of Beijing with its own central business district. Including the surrounding areas, the administrative boundaries of HSP cover a total area of approximately 359 km^2. However, the central area of HSP covers an area of only around 75 km^2 (HSP Management Committee, 2012). To ensure that the research scale is consistent with the first case study of BDA in Yizhuang, the study focuses on HSP's central area. Both cores are of a significant size comparable to many downtown areas of cities with similar populations and are thus very representative for an investigation of everyday urbanism and its various patterns in order to see if 20 years of strategic development have led to emerging edge cities with a high level of integration and distinctive identities or just functional settlements and works.

5.4 Summary

Beijing's urban spatial expansion is centred on the old city (the Second Ring Road) and continues to expand outwards. The newly expanded urban district is connected to the original city region, thus forming the Third, Fourth, Fifth and Sixth Ring Roads. The spatial pattern of Beijing shows a pattern of circling expansion. In specific terms, Beijing entered a period of rapid development in the 1990s. In order to facilitate the evacuation of population and industry from the urban areas, Beijing proposed a strategy of building sub-centres in the peripheral regions of the city. After three decades of rapid development, Beijing consists of a central city and its periphery comprises 16 districts, forming the metropolitan city.

Under Beijing's polycentric development strategy, the city activates districts by developing development zones in peripheral areas. Under this development model, 16 municipal-level development zones and three national-level development zones have been formed. The Zhongguancun Science Park, a national-level development zone, also includes 11 sub-parks. The development of the development zones has contributed to the urban transformation of Beijing in that they have gradually become the new economic centre. At the same time, they have changed Beijing's industrial structure and spatial layout. In addition, as a result of changes in Beijing's economic and macroeconomic policies, the city has experienced a boom in residential construction. This has also led to the emergence of areas with a single form of development on the fringe, such as Huilongguan, also known as the dormitory town. This has led to a shift in population and industry from the central area to the periphery, leading to rapid economic and population growth in the city's peripheral areas.

In addition, the analysis of the development zones shows that the development scale is uneven. Therefore, in order to better analyse the current situation of Beijing's edge city development, two of the most completed cases are chosen: the Beijing

Economic-Technological Development Area (BDA) and the Zhongguancun Science Park -Haidian Sub-park (HSP). BDA and HSP were chosen as the case studies mainly because these two development zones were developed earlier in Beijing and rank top two in accumulative used land area. So their development is relatively complete and are representative of the edge area of Beijing and even of China. The cases will also be analysed in order to refer back to the main objective of the thesis: the current state of integrated development of Chinese edge cities.

Chapter 6 Case studies: development context

Chapter 6 analyses the overall spatial structure of the case to understand how edge cities developed in Beijing. Section 6.1 introduces the development background of BDA and HSP while analysing the historical context of the two areas, and showing the mega-communities near the HSP and their spatial structure in section 6.2. Section 6.3 shoes the urban growth over the last 20 years in BDA and HSP. Section6.4 summarises and compares these two cases based on their development history and spatial changes over the last 20 years.

6.1 Background analysis

6.1.1 Beijing Economic-Technological Development Area (BDA)

The main industrial projects in Beijing that were constructed from 1949 to 1970 made an excellent contribution to urban development. In the 1980s, China initiated the transformation from a planned economy to a market economy. At that time, the industrial level of Beijing could not meet the needs of its economic growth (Wang, 1994). Thus, it was essential to establish a new development zone in order to adapt to the industrial structure adjustment. The high-tech industries in the further development zone were expected to facilitate the general economic development of Beijing (Liang, 1995). Under the circumstances, the Beijing Municipal Party Committee and Beijing Municipal Government decided to draw on the development model of south-eastern coastal areas in 1991 to build Beijing Yizhuang Industrial Area. Located in the southeast suburb of Beijing, it is at the junction of Daxing District, Tongzhou District and Chaoyang District. It is also the starting point of the Beijing-Tianjin-Tanggu Expressway, approximately 16.5 km from Tian'anmen Square and 7km from the South Ring Road (Wei, 2012). Yizhuang outperforms the remaining candidates in terms of its site because of the natural conditions such as the superb geographical structure in the non-earthquake fault zone, flat terrain, an abundant reserve of underground water and satisfactory climatic conditions (Wei, 2012). Since its establishment, BDA has gradually evolved from a development zone to a satellite city and a new city, with continuous regional construction and planning scale expansion(Table 18).

By 2020, Beijing Economic-Technological Development Area (BDA) had become Beijing's sole national economic and technological development zone that enjoyed the dual preferential policies for national economic and technological development zones and national high-tech industrial parks. It consists of Yizhuang New Town (approximately 15 km^2 according to the 1992 Overall Plan of Yizhuang Industrial Area), Eastern New Area of Beijing-Tianjin-Tanggu Expressway and Southern New Area Liangshui River (about 24 km^2 in total, plus the expanded part in the development zone in 2002). Yizhuang City is within the scope of adjusted planning in 2001, covering part of the administrative areas of Daxing District and Tongzhou District with a total area of approximately 195.1 km^2. Yizhuang New Town is within the scope of adjusted planning in 2005, covering more administrative areas of Daxing District and Tongzhou District as well as some marginal areas of Chaoyang District with a total area of 508.5 km^2 (Figure 40). Given the complexity of the research questions and the feasibility and controllability of the research work, the paper takes the core area of BDA as the research area, the total planned construction area of which is approximately 58 km^2.

	Area (km^2)
BDA core area	58
Yizhuang satellite city	195.1
Yizhuang new town	212.7
Yizhuang new town district	508.5

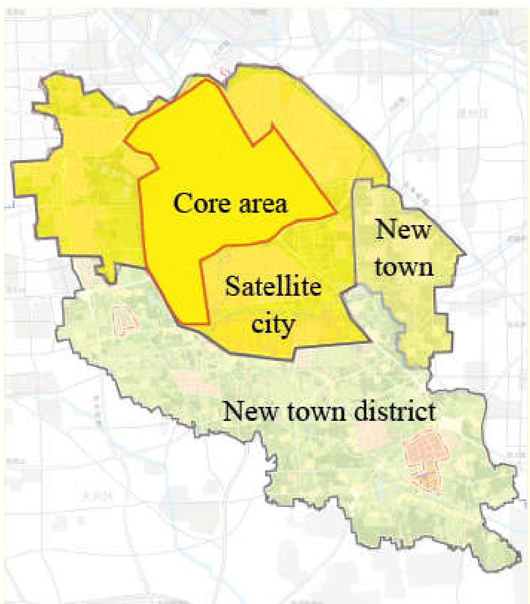


Figure 40: Spatial range map of BDA. (Source: by author)

Stage	Time	Event
The development area stage (1991-2002)	1991	Yizhuang Industrial Area was constructed on the approval of the Beijing Municipal Government.
	1992	Capital Planning and Construction Office approved the overall planning of Yizhuang Industrial Area.
	1994	Yizhuang became Beijing's sole national economic and technological development area (BDA) on the approval of the State Council.
	1999	The construction of Zhongguancun Science and Technology Park was expedited on the approval of the State Council. The area covering 7 km^2 in BDA was named Zhongguancun Science and Technology Park - Yizhuang Science and Technology Park. Yizhuang enjoyed the dual preferential policies for national economic and technological development zones and national high-tech industrial parks.
The satellite city stage (2002-2005)	2002	Beijing Municipal Government approved the overall planning of Yizhuang Satellite City (2001-2020).
	2005	Zhongguancun Science and Technology Park introduced an optical machinery and environmental protection science and technology park in Yizhuang Science and Technology Park.
The new town stage (2005-2010)	2007	Beijing Municipal Government approved The Planning of Yizhuang New Town (2005-2020), beginning to promote the integration of administrative resources in Daxing District and BDA.
The resource integration stage	2010	Beijing Municipal Party Committee and Beijing Municipal Government began to promote the integration of administrative resources in Daxing District and BDA, clearly stating the goal to construct cluster areas of high-tech manufacturing and strategic emerging industries in the south and build the brand of Beijing based on the integrated spatial resources.

Table 18: The development timeline of Beijing Economic-Technological Development Area. (Source: by author)

The Overall Urban Planning of Beijing (2005-2020) clearly puts the development of the three new towns of Tongzhou, Shunyi and Yizhuang in the eastern development zone on the agenda. These new towns are intended to dredge the population and functions of the central city and agglomerate new industries, thus forming a scale effect and aggregation effect and altogether constructing the anti-magnetic system of the central city(He, 2006). BDA is functionally positioned as an essential node of the eastern development zone and is one of Beijing's key development marginal areas. At the same time, it guides the development of high-tech industries in electronics, automobiles, medicine and equipment and fulfils functions in modern manufacturing, research and development, exhibition, commerce, logistics and housing. In terms of spatial layout, it continues to expand towards the southeast and forms a comprehensive functional cluster(Lu, 2005). BDA has a good industrial basis and has formed some leading industries such as the electronic information industry, biological medicine, equipment manufacturing and automobile manufacturing.

By the end of 2012, about 4,800 companies from more than 30 countries had launched and invested in BDA, including 77 Fortune 500 companies such as Nokia and Daimler, of which the efficiency of technology transition reached 80%, much higher than the national average. Furthermore, the output of the high-tech industry has taken more than 80% of the industry’s total output value of this region for nine consecutive years. It ranks first in the national level development zone (Department of Commerce 2012). In 2018, BDA achieved a total regional GDP of £1,60.9 billion, which increased by 10.6% compared with the previous year, and the growth rate was 4% higher than citywide: the GDP of secondary industry attained £1,25 billion and increased 12.1% year-on-year; the third industry had a GDP of £58.9 billion and increased 7.5% compared with the same period of the previous year; the growth rate of the secondary and the third industry were 7.9% and 0.2% respectively, exceeding the average city growth rate. In the key trades of this zone, both light and heavy industries became the core driving force in the economic growth of the whole city of Beijing. Their increments were £112 billion and were 7.1% higher than for the whole of Beijing, which grew 11.6% compared with the previous year (Department of Beijing Economic-Technological Development Area

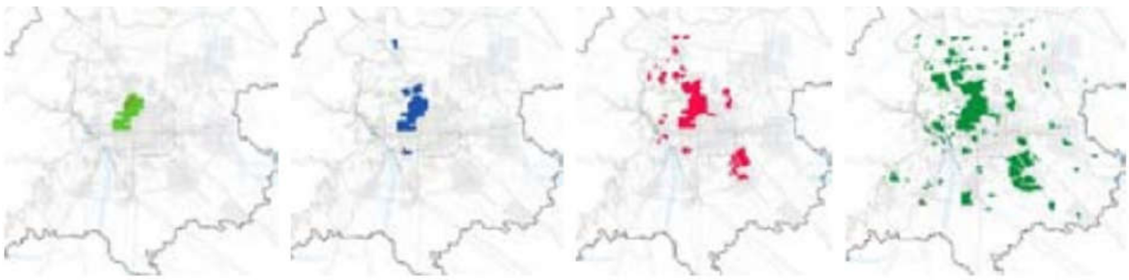
2019). Therefore, Yizhuang is intended not only to evacuate the population and industries in central Beijing, but also to be an important economic growth centre of Beijing. It evolved from a development zone into a comprehensive high-tech industry and service centre. To some extent, BDA should have the primary function of a city.

In general, at the beginning of construction, the function in the development zone is relatively single. The infrastructure is completed as the development matures. However, the population also grows with the industry agglomeration. In order to satisfy the citizens' daily demands, the development zone needs to change from a single industry area transformation to have housing, employment, completed infrastructure and a public service system and other functions of a comprehensive new town. Liu (2007) finds that BDA is in a significant development trend to transform from a signal-function area to an organic integration of industry and city. In the early stage of construction, the development zone pays more attention to infrastructure and industrial land construction. In contrast, residential land and public service development and construction lag behind. This research aims to analyse the urban transformation in rural areas in China. One of the key points that needs to be considered is people's living and daily life.

However, Meng (2011), who examined the general situation of commuting and travel in Beijing in terms of residents' travel time, distance and behaviour based on information obtained from a large-scale distribution of questionnaires. He argued that the spatial distribution of residential and employment agglomerations in Beijing is obvious, and therefore problems such as long commuting times and traffic congestion are difficult to be improved in the short term. Zheng and Cao (2009) developed a theoretical framework for analysing travel times and the factors influencing the commuting times of their sample, arguing that spatial relationships and travel times are influenced by the spatial layout of the triad of housing, employment and public service facilities. Therefore, this study will focus on the residential areas of the BDA and analyse the travel times and activities of people under different methods of travel. Then, the BDA will be analysed for its spatial structure to determine whether it provides spatial diversity and efficiency and to see if it is overly dependent on the centre of Beijing for comprehensive living functions.

6.1.2 Zhongguancun Science Park - Haidian Sub-Park (HSP)

The origin of Zhongguancun Science Park dates back to the electronic street in the 1980s. The construction of Zhongguancun Science and Technology Park in the late 1990s accelerated the growth of the district within the North Fourth Ring Road(Luo 2009). The development of Zhongguancun can be roughly divided into four stages in history, from Electronic Street to Beijing New Technology Industry Development Pilot Zone, Innovative Science and Technology Park and World-class Science and Technology Park (Table 19 and figure 41). Currently, Zhongguancun Science Park has a spatial layout comprising one district and multiple sub-parks, which includes 17 parks such as the Haidian Sub-Park (HSP), Fengtai Sub-Park and Tongzhou Sub-Park. Among them, Haidian Sub-Park is the area where the site was first selected. It has evolved into a new versatile sub-business centre on the northwest margin of the central city to this day, fulfilling office, exhibition and other business functions(Yu, 2000). The park is filled with incubators such as Haidian Overseas Students Innovation Park and Tsinghua Science Park. Niu and Jiang (2008) observe geographical advantages close to the universities and the development zone. Zhongguancun has a prominent position in Beijing's Science and Technology Centre.



Electronic Street (1980-1988) | Beijing New Technology Industry Development Pilot Zone(1988-1999) | Innovative Science and Technology Park (1999-2009) | Science and Technology Park(2009- until now)

Figure 41: The development map of Zhongguancun Science Park.(Source: Li (2014))

<table>
<tr><td>Stage</td><td>Time</td><td>Event</td></tr>
<tr><td rowspan="2">Zhongguancun Electronic Street (1983-1988)</td><td>1980</td><td>Beijing Plasma Society Advanced Technology Development Service Department was established.</td></tr>
<tr><td>1984</td><td>A large number of state-owned technological companies were successively established.</td></tr>
<tr><td rowspan="2">Beijing New Technology Industry Development Pilot Zone (1988-1999)</td><td>1988</td><td>The State Council approved the Provisional Regulations for Beijing's New Technology Industry Development Pilot Zone.</td></tr>
<tr><td>1994</td><td>After two adjustments for the New Technology Industry Development Pilot Zone range, Beijing generally acquired a spatial layout of one district with five sub-parks.</td></tr>
<tr><td rowspan="2">Zhongguancun Science and Technology Park (1999-2009)</td><td>1999</td><td>The State Council approved to turn Zhongguancun Science and Technology Park into a world-class science and technology park.</td></tr>
<tr><td>2006</td><td>The State Council approved the new planning scope of Zhongguancun Science and Technology Park, aiming to turn it into a high-end industrial area with one district and 10 sub-parks in various administrative regions.</td></tr>
<tr><td>Innovation Science and Technology Park and Innovation City</td><td>2009</td><td>The State Council approved the construction of the Zhongguancun National Independent Innovation Demonstration Area.
Beijing Municipal Government approved the construction of Zhongguancun National Independent Innovation Demonstration Area's Core Area in the HSP.</td></tr>
</table>

Table 19: The development timeline of Zhongguancun Science park. (Source: by author)

To adapt to and urge the construction of the Core Area of Zhongguancun National Independent Innovation Demonstration Area, Haidian District takes an active role in integrating the functional area and the administrative district and has introduced regional strategic development, industrial development and spatial development into an integrated framework (Li and Gao, 2013). Geographically, HSP is located in the north-western Haidian District, in the middle of the Northwest Third Ring Road and the Northwest Fourth Ring Road. More importantly, it is adjacent to China’s two most famous universities, Tsinghua University and Peking University, as well as the Chinese Academy of Sciences. HSP comprises a central area and a development area, covering an area of approximately 359km^2, of which the central area is 73km^2 and the development area is 286km^2. Jia (2014) points out that the planning highlights the business model, layout structure and service functions of the central and development zones. To ensure that the research scale in the current study is consistent with that of the study on BDA, the central area of HSP is taken as the main research subject for subsequent urban spatial analysis(Figure 42).

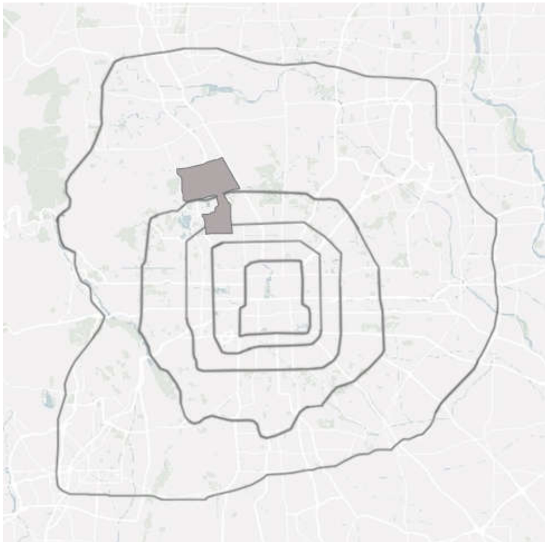


Figure 42: The Location of HSP.(Source: by author)

HSP has attracted many colleges and universities, key national scientific research institutes and national laboratories(Yu, 2001,p.12), making HSP one of the most intellectually dense areas in China (Mu, 2007). HSP and Zhongguancun Science Park have the advantage of policy. It has been at the forefront of China's reform, opening up and policy pioneering. In 2009, the State Council approved the construction of Zhongguancun National Independent Innovation Demonstration Area to turn Zhongguancun into a science and technology innovation centre with global influence. It is also the first national independent innovation demonstration area in China. In 2012, the nine ministries and commissions of the State Council, led by the Development and Reform Commission and the Beijing Municipal Government, jointly enacted Opinions on Building Zhongguancun National Independent Innovation Demonstration Area into a National Science, Technology and Finance Innovation Centre. According to the file, Zhongguancun should make further efforts to construct and perfect a science, technology and financial innovation system that organically combines government capital with social capital, industry capital with financial capital and natural capital with indirect capital so as to speed up the building of the national science, technology and financial innovation centre.

The first new artificial intelligence research and development centre based in Beijing Zhongguancun Science Park gathers all the elites in this field. It will be devoted to the topics of artificial intelligence data foundation, knowledge learning, natural language understanding, intelligent information retrieval and mining, smart architecture and chips(Mu, 2007). One example mentioned by Li and Gao (2013)are the well-designed smart seats at the entrance of Huangzhuang Subway Station. The USB ports on both sides can be used to charge electronic devices. The nearby intelligent light poles are equipped with various functions such as touch screens, WiFi and access to the Internet. All of these products are the epitome of the application of the Haidian District’s ‘urban brain’ system for the improvement of people’s well-being. For the past few years, Haidian District has been the main area of the national science and technology innovation centre. There have been unremitting endeavours to seek a scientific and technological path to improve grassroots governance ability and to build a new intelligent city through a highly intensive smart management system (Li and Gao, 2013).

In addition to artificial intelligence, HSP continues to enhance independent innovation capacity in electronic information, railway transport, integrated circuit design, biomedicine and intelligent manufacturing. It makes breakthroughs in advanced and key core technologies to initially construct a business-dominated technical innovation system. HSP has attracted around 10,000 high-tech companies, including Lenovo and Baidu, and established six leading industrial clusters in Internet, mobile Internet, new-generation mobile communication, satellite application, biology and health, energy conservation and environmental protection, and rail transportation (Cao et al., 2019).

Since HSP's establishment, it has been the main driving force and carrier in reconstructing Beijing's urban space(Jia, 2014). When Beijing undertook the large-scale transfer of the international manufacturing industry, HSP significantly affected urban spatial structure by virtue of its impact on the spatial structure of the manufacturing industry. The appeal of science and technology parks for production-oriented service industries is ascribed to the following contributors: the first is preferential policy, including preferential corporate income tax and household registration policy for talents. The second is a favourable industrial atmosphere. After development for over a decade, these sub-parks have generally built advantageous industrial clusters dominated by new technological industries such as electronic information, biology, new medicine and new energy and enjoyed good government services, which lays a sound industrial foundation for the entry of production-oriented service industries. The third is the relatively low land price. Far from the city centre, HSP has a much lower land price and rent compared with the CBD, financial street and other central areas (Phelps and Wu, 2011). As a marginal area in Beijing that had been developed earlier, HSP is beginning to take shape in its current stage. It forms a sharp contrast with BDA. As a consequence, HSP can be taken as a representative case for the analysis of the urban transformation in Beijing's marginal areas.

6.2 Large communities near HSP

As suggested by the site observation, since HSP and Haidian District are close to colleges and universities, the local housing price is much higher than the average housing price of Beijing. On the other hand, considering that the southern part of the HSP was developed earlier, many of the residences are now approaching saturation. That is why many people who work in HSP would like to live in the marginal communities with much cheaper housing prices and a closer commuting distance. The observation also explores Huilongguan, a famous sleeping city in northern HSP and Tiantongyuan, the largest community in Asia in the northeast(Figure 43). Most of the residents in these two large residential areas can afford the house prices and they either work in HSP or other central areas of Beijing.

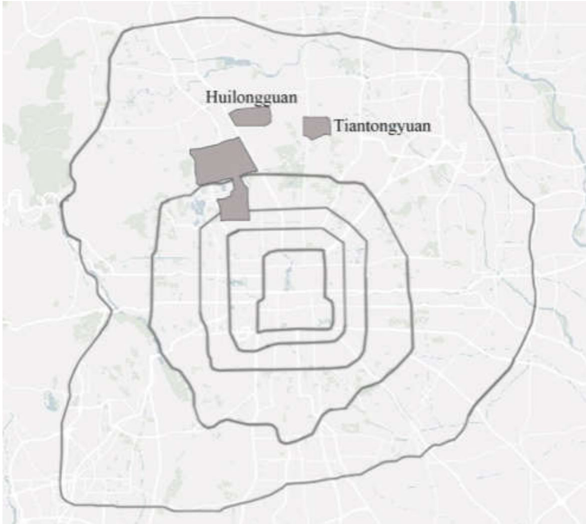


Figure 43: The Location of Huilongguan and Tiantongyuan. (Source: by author)

According to the statistics of the population census(Table 20), in 2000, only55,000 people lived in Huilongguan. By 2010, the population surged to 300,000 but the native population was only 45,000. 260,000 people were aged 16-64, making up 86% of the total population. The percentage of the elderly and children was 5% and 9%, respectively. By 2020, the statistics of the seventh population census showed that Huilongguan had a total population of around 410,000, of which the population aged 16-64 accounted for 89.6%. Based on the statistics, most residents are adults. The family structure is dominated by the household of the husband and the wife, with an average population per household below Beijing's average. In terms of their work, residents are mainly managers and technical personnel who work in HSP or colleges and universities such as white-collar workers in Shangdi and HSP and teachers in Tsinghua University, Peking University, etc.

	Year	Total population	Number of household	Native population
Huilongguan	2000	5.5	1.3	2.1
	2010	30	2.3	4.5
	2020	41	13	6.2
Tiantongyuan	2000	4.2	1.2	2.1
	2010	26	6.8	2.8
	2020	30	8.1	3.7

Table 20:Population statistics in Huilongguan and Tiantongyuan.(Unit:10,000)

(Source: data from 5th, 6th and 7th censes data, table by author)

Similarly, Tiantongyuan has also witnessed a surge in the population over the past two decades. In 2000, Tiantongyuan had a population of 42,000,and in 2010 the population in Tiantongyuan sharply increased to 260,000 around six times that in 2000. There were around 240,000 people aged 15-64 and the elderly and the children only accounted for 9% of the total population. Over the past decade, the population in the local area increased by only 40,000, reaching 300,000 in total. A comparison between Tiantongyuan and Huilongguan reveals that Tiantongyuan's population surge occurred in 2000-2010, while Huilongguan has seen its population surge by 200,000 in the past decade. In terms of population age composition, the people in these two areas are mainly aged 16-64, accounting for around 90% of the total population. Most of the residents are commuters.

In contrast to the BDA, the HSP was developed earlier and is saturated with space. In order to better meet the housing demand, it was necessary to continue to build more communities in the surroundings to meet the high demand for residential space. Also, Li (2012) points out that Beijing's residents have shown a strong tolerance for long-distance, residence-work spatial dislocation in the recent decade. Large suburban residential districts represented by Huilongguan play an important role in suburbanising residential space and decentralising and multi-centralising commercial and leisure spaces. The high intensity of Beijing's suburbanisation development in the past decade is also verified. In terms of community function, Huilongguan has transformed from a pure sleeping city into a comprehensive community and is now a residential district with multiple living spaces. Due to the connections between different living spaces, change in a certain living space usually leads to change in another living space.

A field investigation of HSP demonstrates that a great many commuters live in Tiantongyuan and Huilongguan. As proposed in the Overall Plan of Beijing City (2016-2035) and Changping District Planning (National Space Plan), Huilongguan and Tiantongyuan are located between the North Fifth Ring Road and the North Sixth Ring Road, under the jurisdiction of Changping District. As the main areas expand from the central urban area to the north part along the central axis, these two communities mainly dredge the central city's functions and become the main sites connecting with HSP. Consequently, in the following sections, Longzeyuan of Huilongguan and Tiantongyuan will be taken as the research residential districts and HSP as the commuting site to carry out an urban spatial analysis.

6.2.1 The largest community: Tiantongyuan

In 1988, the Beijing Municipal Government identified Tiantongyuan as one of the key sites of an affordable housing project. Located in Changping District, Beijing, Tiantongyuan was developed by Shuntiantong Real Estate Group in 1999, with a planned building area of over 6 million square metres. It thus became known as the largest community in Asia. By 2002, 14 blocks were completed. With the completion of all 18 blocks in 2010, the area approached saturation (Figure 44).

Figure 44: Urban growth in Tiantongyuan.(Source: by author)

Tiantongyuan is dominated by residential land and is well-equipped with diverse commercial, education, leisure and entertainment supporting facilities and large shopping malls. There are 23 kindergartens and five primary and middle schools(Figure 45). Based on a walking survey of different neighbourhoods(a relatively even dispersion of selected neighbourhoods in the region to try to obtain more general and representative data) and combined with the time used by different modes of travel provided by Google Maps, as shown in Table 22, schools in this area are all within walking and cycling distance. In addition, it is remarkable that the site has a large hospital with the capacity to meet the needs of the local residents. And the land is dominated by residential land and the land use is single. Limited by single function and affected by the division of work and residence, few residents are in Tiantongyuan during the daytime, which directly reduces daily activities in the community, this can lead to safety issues. Likewise, the severe division between work and residence aggregates the commuting pressure to the urban area.

In line with the house typology map (Figure 46), most of the buildings here are low-rise or high-rise with over 13 stories. Because most blocks were constructed before 2002, only a few houses on the ground floor are used as shops or for commercial purposes. Despite the commercial services available in the area, residents still find it difficult to buy vegetables or to go shopping, and residents from most blocks cannot reach their destinations on foot. In addition, the closed large block structure makes the long road boundary straight and less functional within the residential area. There is also a lack of street space nodes that are suitable for public activities. Because there are few shops along the street, peddlers selling miscellaneous items on both sides often encroach public roads.

Figure 47 analyses the public transportation in Tiantongyuan. A total of 45 public stations with 33 bus lines are used throughout the area. Subway lines 5 and 13 are also available. The distribution of bus stops is efficient and accessible within walking distance for all blocks. However, the survey samples in table 22 show that residents spend over 60 minutes commuting. That is because of the large distances between blocks. Residents have to walk to the community's gate and then take a detour before reaching the bus stop. Moreover, given the uncertainty of bus transportation and other unavoidable factors such as transfer bus line, the time cost of choosing bus transportation increases. Likewise, limited by location, only the residents from at least four blocks can walk to the subway station, while the other residents need more time to walk or to travel using mixed travelling modes. For example, they may take a taxi to the subway station and then travel by subway. Because Tiantongyuan is in a marginal area with single functions, residents have to travel by car or public transportation. This entails a high time cost.

Table 21 shows that the average house price in the area is around 40,000 RMB/m^2 (£4,590/m^2), lower than Beijing’s average house price and the housing prices in the

HSP. As a result, regardless of the single functions of local blocks and their inability to satisfy the work and housing demands of people, many still want to settle in the area. To build habitable suburban blocks, residents' employment accessibility and transportation convenience should also be considered apart from basic living needs. The planning should also consider residents' walking distance and service coverage for public spaces such as parks instead of functions alone.

Simultaneously, public space in the community is insufficient and monotonous. Only two large public spaces have been exploited. The two public spaces are equipped with complete facilities with high use rates as closed community parks in the area. Nevertheless, the service scope only covers a few neighbouring communities instead of the whole area (Figure 45). In combination with Table22, it is obvious that most residents are unable to walk to the park. In addition, public green space in the area is clearly insufficient, mainly evidenced by the centralised vast land within blocks and the limited green space on roadsides (Figure 48). Hence, the limited public space of Tiantongyuan and its inaccessibility on foot greatly prohibit the organisation of public activities, which in turn leads to a shortage and fragmentation of community public life. When residents' activities are limited in space and their life and social activities are separated by space, it is impossible to see sustainable urban activities in the community. In this case, residents' regional experience is suppressed and their regional identity is weakened.

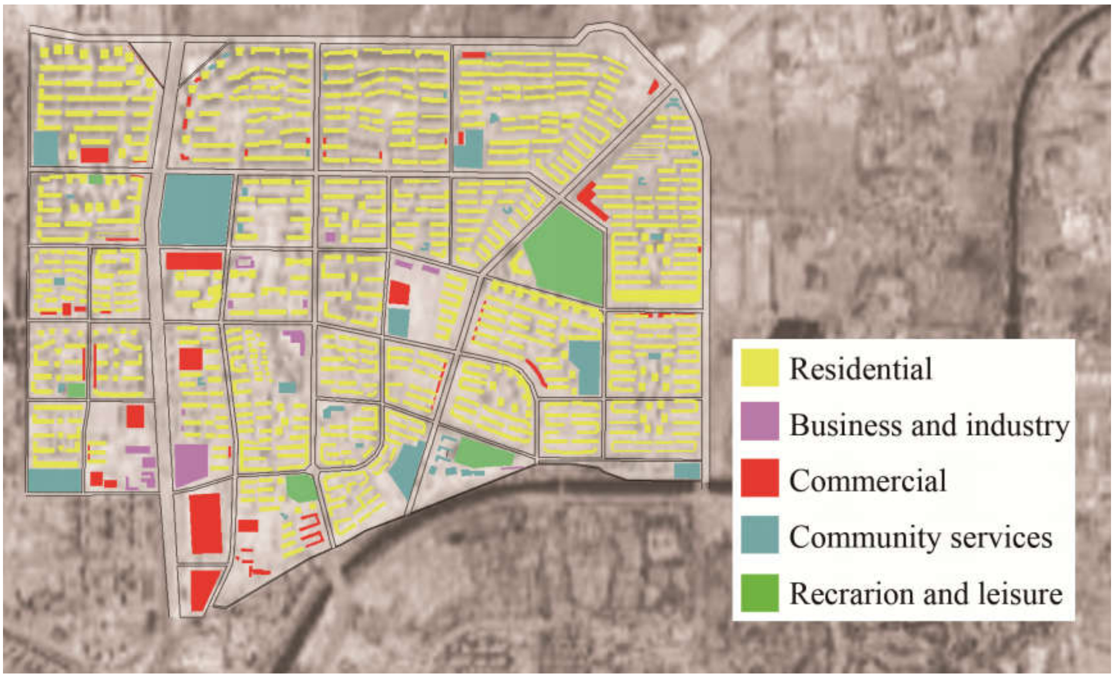


Figure 45: Land use distribution in Tiantongyuan.(Source: by author)

Figure 46: Housing typology in Tiantongyuan.(Source: by author)

Figure 47: Public transport map in Tiantongyuan.(Source: by author)

Table 21: Statistics for each neighbourhood in Tiantongyuan. (Source: by author)

Neighbourhood	Year	Number Of households	RMB/ m^2
1	2002	8,096	38,702
2	2001	5,162	39,913
3	2002	6,406	39,299
4	2003	6,762	41,184
5	2004	6,617	40,640
6	2003	5,644	40,966
7	2001	4,095	39,457
8	2000	6,599	39,274
9	2000	7,710	35,462
10	2007	6,384	44,868
11	1999	783	32,720
12	1999	901	45,568
13	1996	1,318	38,668
14	1999	1,858	44,483
15	1998	1,895	39,194
16	2000	1,563	43,881
17	1995	1,538	44,650
18	1998	673	29,913

Neighbourhood 2	Gate	Bus station/ subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	2	3	264	217	292	2	38	8
cycling	2	2	113	87	126	1	14	3
Bus/subway	-	-	104	92	102	-	9	13
car	1	5	39	37	41	1	12	2
Neighbourhood.8	Gate	Bus station/ subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	6	10	244	182	315	11	11	39
cycling	3	4	104	85	120	4	7	17
Bus/subway	-	18	65	34	39	33	26	11
car	4	9	38	68	60	7	6	12
Neighbourhood 12	Gate	Bus station/ subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	3	4	236	206	304	4	13	20
cycling	2	2	102	86	115	2	5	7
Bus/subway	-	-	76	76	72	-	24	19
car	3	1	34	30	35	2	5	6

Table 22: The typical activities times for three neighbourhoods in Tiantongyuan. (unit: minutes) (Source: by author)

Figure 48: The typical walking experience in Tiantongyuan(Source: photo by author).

6.2.2 Commuter Town: Huilongguan

Huilongguan was initially built to satisfy the demands of Beijing's affordable housing project, urban population out-migration and resettlement projects while achieving greening between the urban area and marginal area (Long-Term Plan of Huilongguan in 1995). It was planned as an economically affordable residential area. Huilongguan used to be the former site of a suburban farm, comprising a farm agency, affiliated family dormitories, farmland and four villages. Later on, following the relocation of the factory, residential buildings were constructed on the original site. Since the construction of the first affordable houses in the Phase 1 Huilongguan Project by the Beijing Municipal Government in 1997, the Huilongguan community has been developed on a large scale. The second phase of the project was initiated in 2000, followed by the development of phases three to six. From 2002 to the present, the six project phases have been completed. Thus, the research period for Huilongguan in the present study is from 2002 to the present.

Figure 49 explores the urban growth of Huilongguan over the past 20 years. The figure shows that many residential areas had been completed by 2002. With the ongoing construction of the residential regions in the following eight years, Huilongguan had approached saturation by 2010. Only three communities were completed in the last decade. Currently, the area is completely saturated. Figure 50 shows that the primary function of Huilongguan is residential and businesses are concentrated along the main road going through the area. The other regions usually satisfy people’s daily needs with ground-floor shops or low-rise shops along the street. There are 21 kindergartens and seven primary and middle schools in the area. Combined with Table 24, residents from all the blocks can walk to these schools, which means that the schooling demand is basically met. Given its large scale, Huilongguan is in great need of medical care. By contrast, local hospitals in Huilongguan are of low grade and in small sizes, and even lack supporting facilities and medical equipment. It takes residents a long time to see a doctor in the central area. Furthermore, the gap in Huilongguan’s cultural site, sports site, park and other sports and leisure facilities exists as usual. The majority of residents cannot walk to the places where they can exercise and engage in physical activities or leisure activities.

An analysis of the local housing typology is given in Figure 51. Low-rise buildings with less than six storeys prevail in the area, and middle-rise and high-rise buildings only account for 12%. There is also a villa district in this area. A good number of mixed-use residential buildings can be observed on the east-west main road. The ground floor of these buildings is often used for shops, restaurants or other small stores that can satisfy people's daily needs. It is notable that these shops are connected with residential buildings on the upper floors but the entrances are separated. Such an arrangement is for the security of the residents.

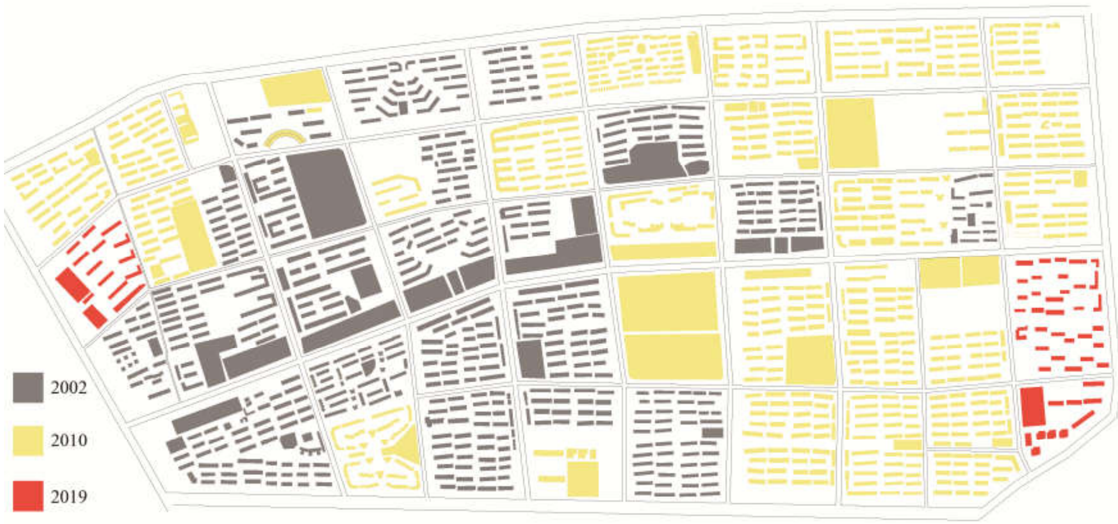


Figure 49: Urban growth in Huilongguan.(Source: by author)

Figure 50: Land use distribution in Huilongguan.(Source: by author)

Figure 51: Housing typology in Huilongguan.(Source: by author)

Figure 52: Public transport map in Huilongguan.(Source: by author)

Figure 52 shows all the bus stations and bus lines in the area. There are 45 bus stations and 36 bus lines. Based on an analysis of the distribution of bus stations, most of the closed blocks have bus stops on at least two sides, and some of the blocks have bus stops on four sides. Furthermore, the five subway stations and two subway lines are all located in the marginal areas, so not all residents can walk to the subway station. Table 24 shows that it is very convenient for residents to walk to bus stations. However, with limited bus lines and poor flexibility, residents need a lot of time for commuting, and the one-way commute consumes over one hour. Another fact that cannot be ignored is that compared with the subway, buses are affected by more uncontrollable factors such as bad weather, traffic jams and long shifts. As most subway stations are far from the blocks, residents tend to use multiple means of transportation.

Table 24 shows the travel time that a typical family may take during a week, and the selected neighbourhoods are evenly distributed in the area which results in a more general travel data. As most blocks are closed, the time to reach a bus stop should be measured by adding the time to walk from the door to the gate. Depending on where the entrance is located in some blocks, residents may have to take a detour to get to the gate of the community. This inevitably increases their walking distance. Under the circumstances, many travel by car. At the same time, since the area is for residential purposes, almost no workplace can be reached on foot or by bicycle. It even takes more than one hour to get to work by bus. In addition, all the schools in the area are within walking distance, usually eight minutes on foot or four minutes by car. Based on the land use map and Table 24, activities in shops, markets and shopping malls have higher transportation efficiency and most of the destinations can be accessed on foot. However, public spaces such as parks that occupy a large area are not within walking distance for all residents. This suggests that residents from farther blocks cannot get to these places in a sustainable way.

As inferred from a site observation, plenty of shared bicycles gather around subway stations in the morning peak and shared bicycles are ubiquitous in front of the gates of communities in the evening peak (Figure 53). In other words, owing to the numerous uncontrollable factors in bus transportation and the popularity of bicycles in China, many people ride to subway stations to take the subway and

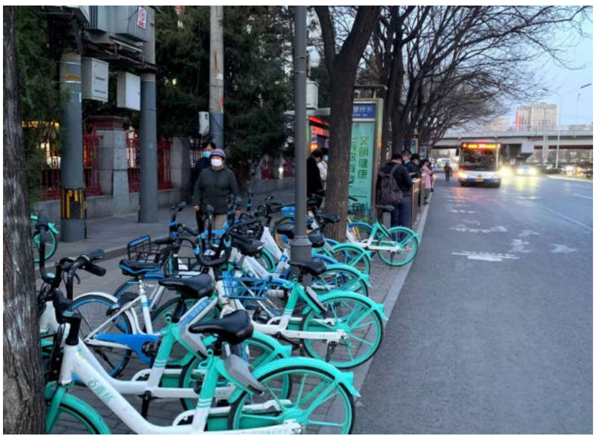


Figure 53： the shared bicycles in front of the bus station (Source: photo by author) then walk or ride to work in the morning. When they leave work, they take the subway and ride to the community. That is the so-called home (workplace) - ride - public transportation - ride - home (workplace) commuting mode. Additionally, an interesting phenomenon was found during the survey: the carpooling mode of transportation at the gate of communities. Many taxis or Uber cars wait at the entrance of such large and populated communities during the morning peak. Residents can carpool with those who want to reach the same destination (subway station or workplace). In this way, they can save at least 2/3 of the cost (with each car accommodating 3-4 people). This is also an excellent way to save commuting time. Similarly, a home (workplace) - carpooling - public transportation - carpooling - home (workplace) commuting mode is formed.

Most land in the area is exploited for residential purposes. Table 23 summarises the number of households and the housing prices per square metre in 32 communities. There are 70,000 households in the area and each unit contains approximately 4,742 people on average. The area is competitive in terms of housing price. Specifically, the average housing price is only RMB 49,000 (around £5,700), which is much lower than the average housing price in Beijing's central area of RMB 68,000 (around £7,800). Therefore, the housing price is a significant concern that attracts many people to live there.

In sum, Huilongguan, like a sleeping city, can meet residents' life needs by providing basic service facilities such as shopping malls, shops and schools. Nevertheless, there are pending problems with regard to medical resources. Meanwhile, leisure service facilities such as parks are beyond walking distance to most residents and they have to rely on public transportation or private cars. In terms of commuting, even though the straight-line distance between Huilongguan and HSP is short, residents still need to drive cars or choose mixed means of transportation due to the diversity and low efficiency of public transportation. Generally, the area is appealing for many because of its competitive housing prices and close distance to HSP. However, limited by single functions, Huilongguan can only meet the fundamental life needs of the local residents. It is impossible to turn Huilongguan into an efficient and sustainable suburban area.

Neighbourhood	Year	Number of households	RMB/ m^2
1	2005	1,814	42,517
2	2007	1,196	43,821
3	1999	768	45,304
4	2000	1,728	46,792
5	2002	912	46,862
6	2003	812	55,230
7	2003	314	52,312
8	2004	1,033	48,055
9	2005	1,886	51,392
10	2005	756	46,976
11	2005	742	45,925
12	2006	1,492	46,808
13	2003	1,139	46,759
14	2002	1,204	41,733
15	2003	2,196	54,611
16	2000	940	46,133
17	2005	468	49,821
18	1998	1,012	47,062
19	2000	686	47,193
20	2007	897	44,980
21	2012	2,625	29,001
22	1994	1,177	50,319
23	2000	679	46,455
24	2000	438	46,460
25	1999	1,386	47,375
26	2002	515	53,022

Neighbourhood	Year	Number of households	RMB/ m^2
27	2009	4,194	34,078
28	2002	1,227	47,875
29	2004	402	47,579
30	1996	581	59,856
31	2002	1,013	58,095
32	2007	712	59,566
33	2006	1,235	46,503
34	2012	2,377	69,986
35	2015	1,538	75,876
36	2005	965	50,056
37	2003	1,552	46,761
38	2003	1,399	44,466
39	2002	1,559	47,547
40	2002	1,390	49,197
41	1993	2,866	54,490
42	1996	2,185	52,199
43	2003	1,595	51,261
44	2002	1,951	46,761
45	2002	783	43,060
46	2010	1,664	42,969
47	2002	1,992	47,632
48	2003	2,317	45,807
49	2005	1,908	44,396
50	2006	1,027	47,356
51	2005	760	47,887
52	2011	2,452	69,673

Table 23: Statistics for each neighbourhood in Huilongguan (Source: by author)

Neighbourhood 11	Gate	Bus station/subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	3	4	235	149	399	13	44	36
cycling	1	2	90	62	150	5	16	14
Bus/subway	-	-	76	66	77	17	25	6
car	2	3	34	26	42	3	9	27
Neighbourhood 19	Gate	Bus station/subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	2	3	206	98	400	5	11	13
cycling	1	2	84	41	156	2	6	5
Bus/subway	-	-	68	55	80	-	15	16
car	3	5	22	16	32	2	4	3
Neighbourhood 28	Gate	Bus station/subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	5	5	224	120	400	5	21	14
cycling	2	2	96	51	165	2	8	6
Bus/subway	-	-	80	61	80	-	23	3
car	3	4	27	24	37	2	7	19
Neighbourhood 42	Gate	Bus station/subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	5	5	194	86	387	6	14	28
cycling	2	2	84	40	157	3	5	11
Bus/subway	-	-	59	50	71	27	15	19
car	2	5	24	19	35	2	6	9
Neighbourhood 52	Gate	Bus station/subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking		6	215	128	376	11	38	30
cycling		3	98	55	142	4	16	12
Bus/subway		-	76	60	72	16	28	28
car		3	28	26	38	4	9	9

Table 24: The typical activities times for six neighbourhoods in Huilongguan. (unit: minutes)

(Source: by author)

6.3 Historical context

6.3.1 Urban growth and development

To gain a deep insight into the urban configuration, the research on the development of the regional historical context reveals the general spatial distribution and the spatial transformation. Based on a review of the historic satellite map and urban growth image (Figure 54), it can be found that most buildings in BDA were completed after 2002. Whereas, owing to its early development and proximity to colleges and universities, HSP had some major building clusters before 2002.

The spatial scale of BDA was continuously enlarged from 2002 onwards. During the period from 2002 to 2010, considerable buildings and blocks were intensively constructed in the northern core area of the development zone. By contrast, no building clusters emerged in the south. In the recent decade, BDA has not ceased its development and construction, and the whole park has been formalised. At the same time, there remains a gap in the construction of the farther southern area, with large plots of vacant land being undeveloped. Since 2002, the building clusters in HSP have basically taken shape, and the core area in the south and the north has been generally completed. In 2002 to 2010, most areas were completed. In particular, the southern part of the site was almost saturated. The marginal areas have been intensively developed over the past 10years in the northern region. The general scale of BDA quickly expanded from 6.75 km^2 in 2002 to 58 km^2 in 2019, with an annual growth rate of up to 30%. Thus, it can be reasonable concluded that the area has experienced rapid construction and development in the past 20 years. Unlike BDA, HSP was developed much earlier, and its core area was already complete in 2010. Most places in the site are saturated now, although some vacant plots remain undeveloped.

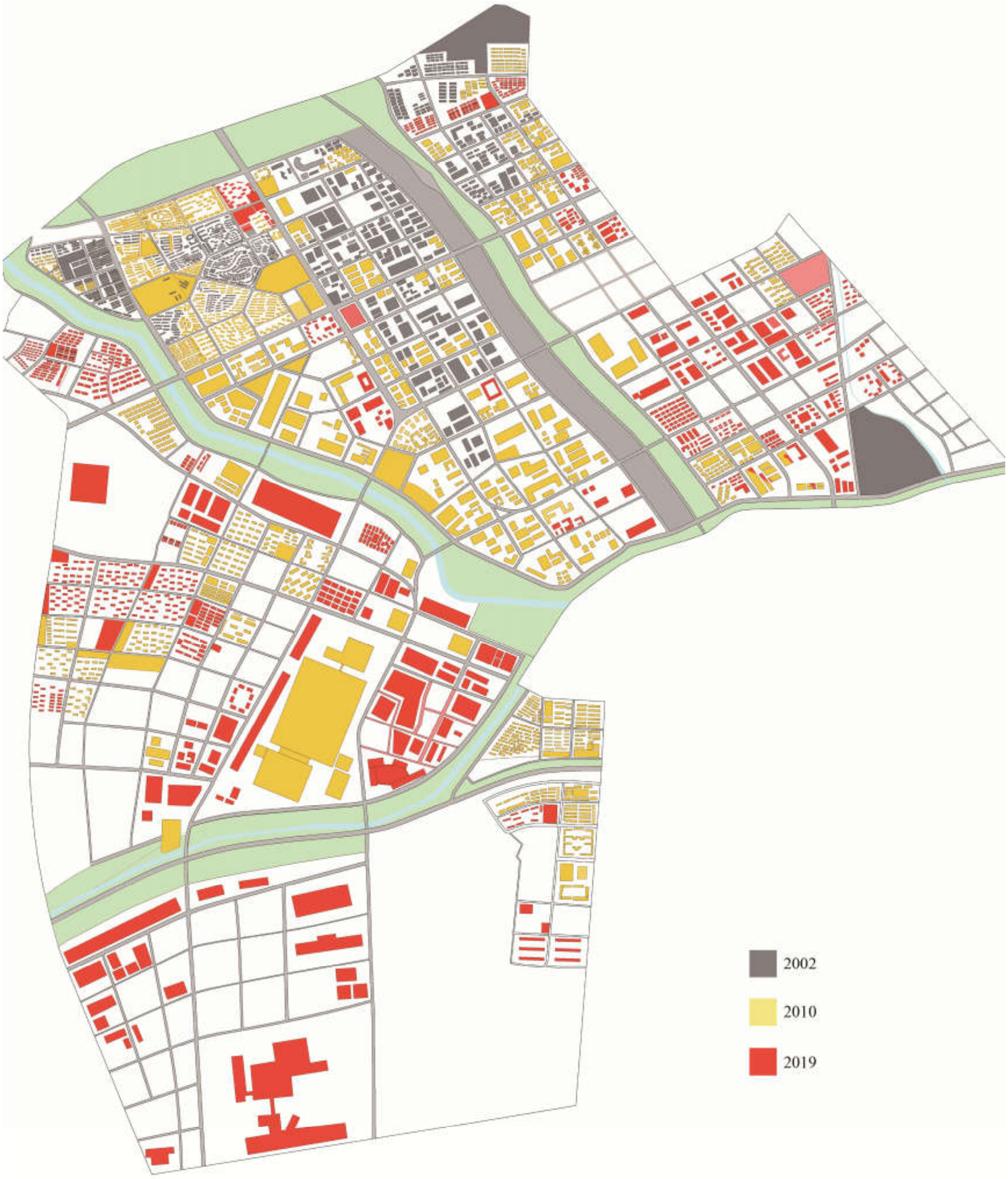


Figure 54: Urban growth in BDA. (Source: by author)

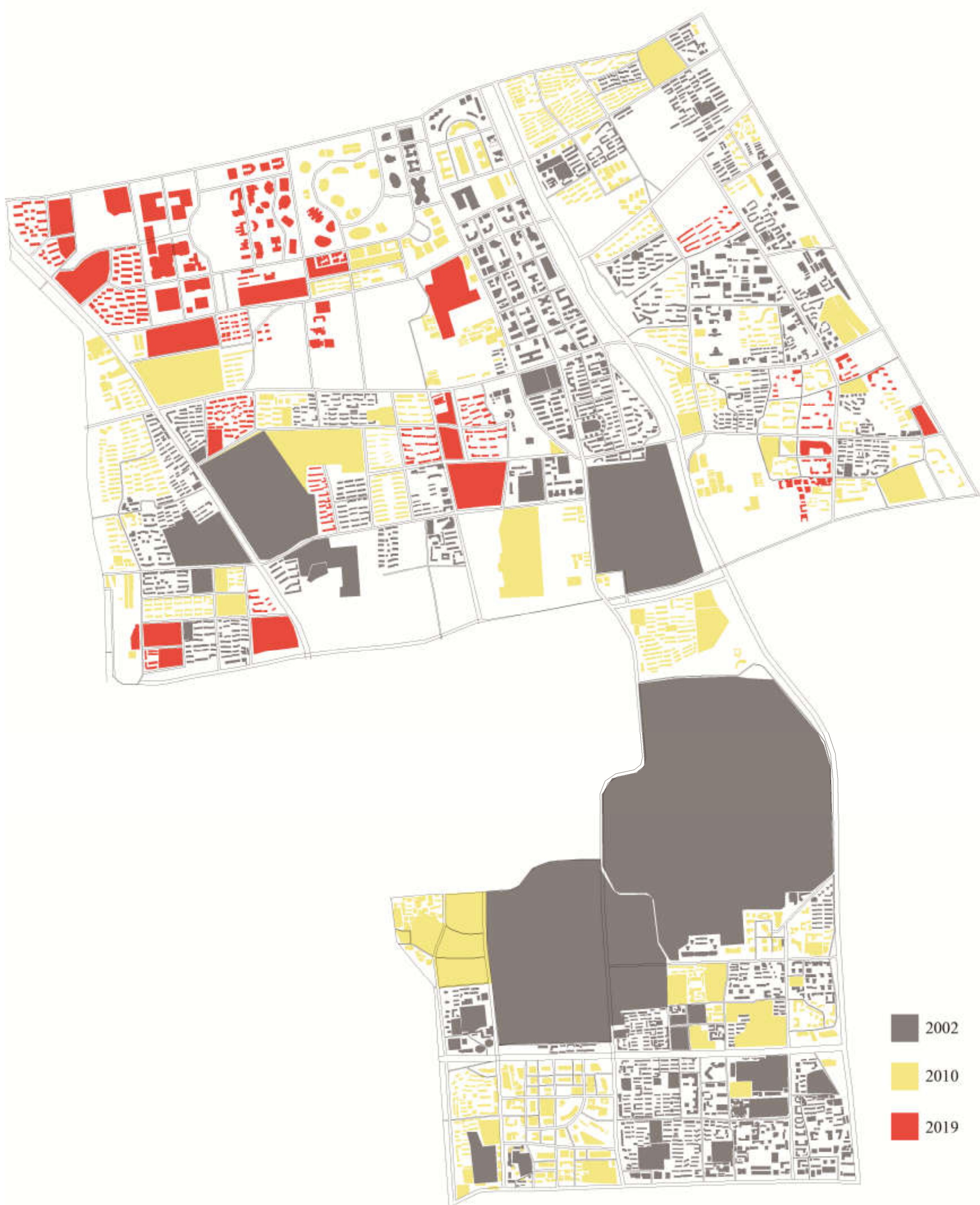


Figure 55: Urban growth in HSP. (Source: by author)

In 2002, around 50% of the industrial land in BDA had been built in terms of the total amount of the construction land, while only about 30% of the residential land had been built (Figure 56). Residential construction obviously lags behind industrial development and is uneven at this stage. In 2002, residential land accounted for only 15% of construction land, while the total amount of land available for employment (including industrial land, office, commercial use and financial land) accounted for nearly 75% of construction land. Therefore, it can be seen that residential land development lagged behind industrial land development in 2002. The speed of development of residential land was also slower than for industrial land in terms of land supply and construction at that time, which was not advantageous for the balance of development between employment and housing.

Generally, urban space is divided into residential land, public service land, commercial and financial land and green land. The spatial expansion area of these four types of land in 2000-2019 was 22.79 km^2, 3.19 km^2, 2.27 $km^2$and 5.15 km^2 respectively in BDA. In particular, the spatial expansion of residential land and corporate office land is most pronounced and contributes the most to the expansion of urban space. From 2002 to 2010, BDA has been developing the residential area and the government has tried to balance work and housing from the point of view of land planning. The land use map of BDA in 2010 shows that the scale of residential land and industrial land was developed further. However, it can be seen that construction and development are still focused on the core industry, with housing, infrastructure and public facilities lagging behind. Therefore, BDA is still showing an obvious imbalance between working and living areas. The proportion between working and living is reflected in the fact that the size of the working population exceeds the residential population. By 2010, the land use map shows that a large number of residential communities had been built, which, to some extent, alleviates the imbalance problem between employment and housing. And the land use map above and the spatial distribution in 2010 show that the industrial land is still mainly concentrated in the core area of BDA and the residential area is on the edge. Thus, citizens have to spend a long time going to work. Although the proportion between housing land and working land has reached a balance, some potential obstacles still exist. For example, it is difficult for people to walk to work from home.

Figure 56: Timeline of spatial development for BDA and HSP. (Source: by author)

HSP was developed earlier than BDA. In 2002, there were plenty of built residences, colleges and universities and office areas in HSP and the south-eastern part of the site was almost saturated. HSP seemed more mature than BDA due to the presence of the colleges and universities. The residential and commercial office land in the north was still under construction and much of the rural land remained undeveloped, while the developed areas were isolated and functionally monotonous. In the following decade, land use in the area was further improved and enriched. By 2010, most places were nearly saturated and the southern part was also approaching complete saturation(Figure 55). Only the north-western part of the site was still under construction. By 2019, a great many residences and office buildings had been completed (Figure 56). The completed area contained many business formats and more mixed-use buildings. Nevertheless, the land analysis shows that commercial land is limited across the whole site. Irrespective of the presence of numerous shops and cafes on the ground floor of office buildings, the scale effect has not yet formed. The newly built office region (Zpark) in the north has a large occupied area and a small built-up area. Each independent block has more green space. Due to the long distance from residences, the radius of businesses and of the service population is greatly limited. Moreover, the clear block division makes these areas more semi-public in nature.

In terms of spatial layout, the newly built-up area of HSP forms a grid pattern constituting an urban space with small blocks. There are only two squares in the north part of the site in environmental construction with less street green space and limited open places available for the public. As a consequence, the inactive public space atmosphere fails to meet citizens' basic needs. The small open blocks surrounding the office area ensure accessibility to different places. After all, because the office and residential areas are independent, the commute-induced traffic pressure cannot be avoided at peak hours.

From Figure 56 can be seen that both areas were developed residential area after development of business and industry. Both areas were developed as single-function clusters, like one area for housing and the other for working, with other mixed-use facilities. For example, the commercial areas in both areas emerged in the later stages of development when there was population density, and in the form of large compounds. It indicated that they were mainly shopping malls to making the areas more integrated from functional aspect. The Recreation and leisure area was also built on a large block of land and was constructed in the middle to late stages of development. It is worth noticing that the map clearly shows that HSP already had a large area of land for university use in 2002 (marked in blue) and that in the later years, there was little expansion of the university's land use, while a lot of housing was built around its universities.

From a comparison between BDA and HSP, it is can clearly be seen that BDA was developed later and its grid road network structure is more apparent with a clearer land use division. Since 2002, BDA has continuously developed the construction of housing and the core industry area has also been continuously developed during the same period. The functions of residential areas and public facilities such as shopping malls, hospitals and schools are also being constantly improved. Therefore, it can be seen from the figure above that BDA is pursuing comprehensive urban functions as an edge city. In addition, BDA's urban development has shown an obvious sequential feature of developing the core industry first before developing housing. In contrast, HSP is a university-driven followed by industry and business and housing development. In addition, as the analysis of the land use shows, except for the gap in public space, the urban functions in both areas can satisfy the everyday needs of people, they all provides comprehensive commercial services. The similarity between BDA and the northern part of HSP is that they first constructed lots of business areas and then built massive residences to balance work and life needs. However, the residential and office areas are now relatively concentrated and independently located and the commuting problems of the residents may still be car-based. The strict distinction between each function makes people feel a strong sense that one area is work and another area is residential. This makes residents is difficult to integrate their life and work, which can be very challenging for people to develop an attachment to a place.

6.3.2 Land use distribution

Until 2019, most of BDA's area was occupied by commercial use, covering an area of 5.3km^2 (Figure 57). And around 3.5 km^2 were developed as residential land in the northwest. There is an area of around 1.6 km^2 along the centre of BDA, which is used for public services, and more than 3.4 km^2 of road infrastructure and municipal land. The total public green space covers around 1.2 km^2. In the east and north of the core area, there are wide green belts separating the highway and the main urban districts. In the west and south of the river, green belts have been established with a width of about 100 metres to improve the overall air quality. Besides, in the interior of the development zone, there are wide green boulevards on both sides to separate each block. These 15 square kilometres have now become the core area of BDA.

Other open spaces can be found in the form of a central park next to residential areas and a golf course in the business district. BDA also has three shopping malls and most neighbourhoods integrate some individual shops and/or restaurants as well as a number of nurseries. There are many kindergartens in various neighbourhoods. Primary schools, middle and high schools and a university are also located in the core area of BDA close to residential areas. There is also a third-grade hospital (the highest level of hospital in China) in the core area of BDA, as well as several small clinics and specialised hospitals. There is a park (Boda Park) in the north of BDA, located in a residential area, which is the only landmark of BDA.

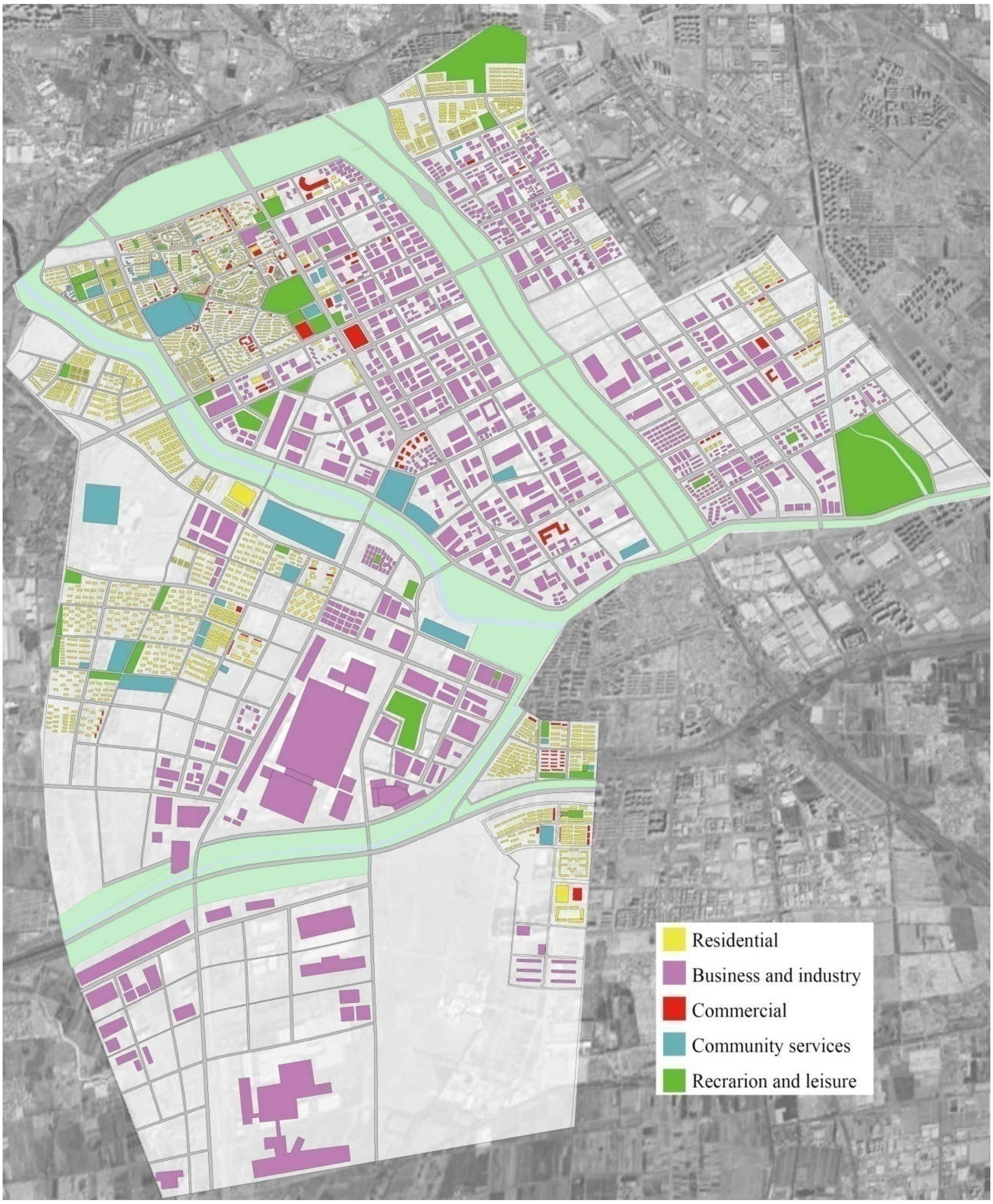


Figure 57: Land use distribution in BDA in 2019.(Source: by author)

Figure 58 shows the land use map of HSP. The map shows that the area is divided into two parts, north and south, by Tsinghua University and Peking University. There are two concentrated office areas, the south of which is the earliest development of Zhongguancun, and the north of which is the Zhongguancun Software Park (Zaprk), which was constructed and completed in the last 20 years. During the research, it was found that the ground floors of these office buildings generally contain small retail businesses such as convenience stores, cafes, etc. The shopping malls and other commercial services in the area are mostly located in residential areas and near universities where the density of permanent residents is high. In addition to markets, there is also a wide range of commercial businesses.

In addition, the two centralised office areas to the north and south are surrounded by a large number of residential areas. There are 31 kindergartens and 30 primary and secondary schools in the vicinity of the residential area. In addition to two universities, Tsinghua University and Peking University, there are also universities such as the Chinese Academy of Sciences and Beijing Agricultural University. Many research institutes have offices in the area, such as the Beijing Academy of Quantum Information Sciences. The eastern part of the area is also home to a large recreational facility and a social welfare institution. The site is already saturated, but there is still vacant land under construction. For public space and green space, the area shows its limitations. To the south, there are only two public spaces located in the centre of the office area and close to the university. There are no parks near the residential areas and even green space is rare. Although there is a significant increase in green space in the northern part, it is still a long distance for most residents and does not have enough leisure area.

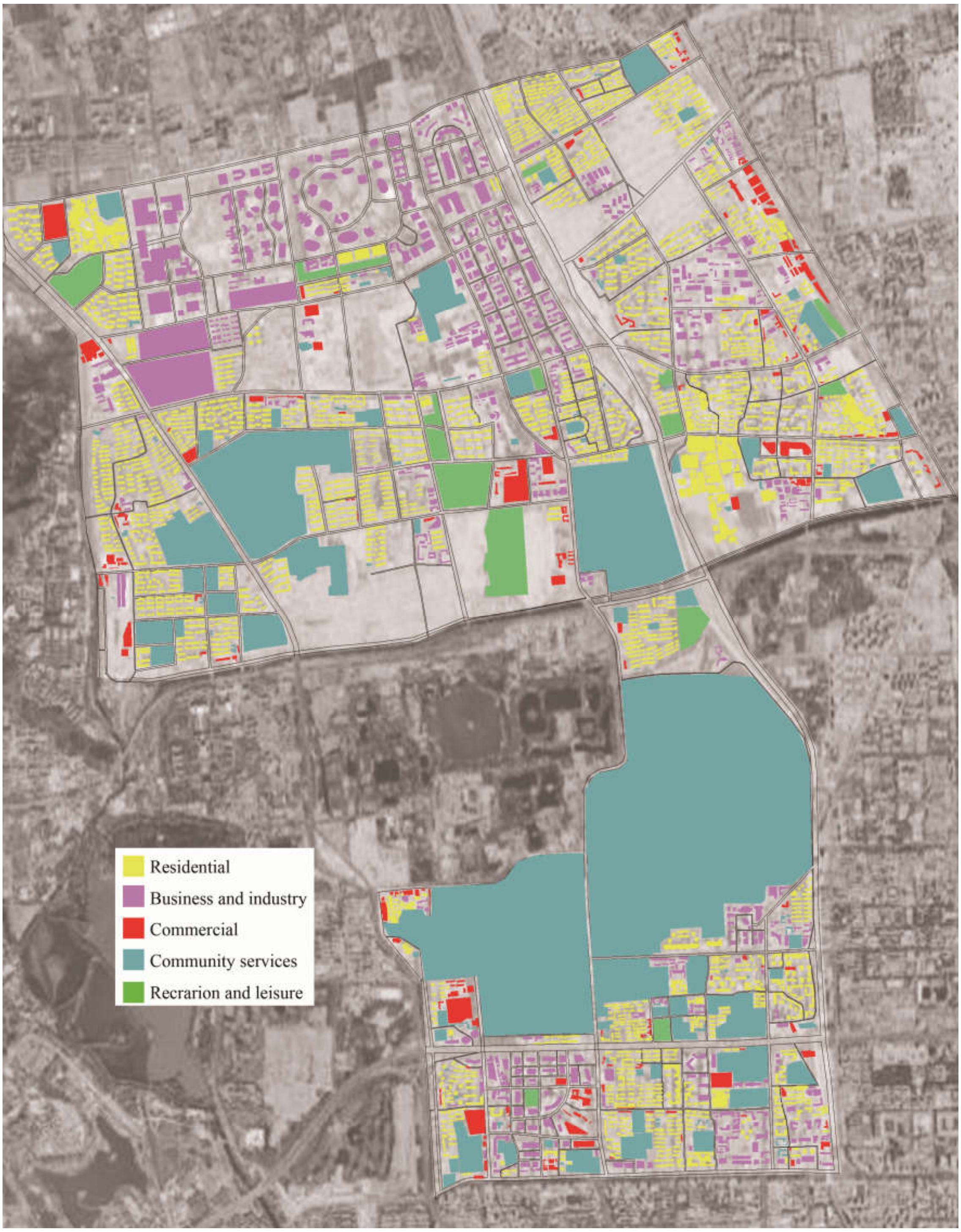


Figure 58: Land use distribution in HSP in 2019.(Source: by author)

By comparing the land use of the two cases, both sites are well-supplied with shopping malls and other major commercial projects. However, overall, the urban area of HSP offers a bigger diversity of commercial services. The residential area of BDA is rather concentrated in the northwest of the area and formed by major compound-projects. In contrast, the residential area of HSP is more dispersed within larger residential clusters concentrated around the university and business districts. Both case studies share an overall low supply of central and accessible public space. They do not provide enough space to meet the needs of the local residents for public space, which can also impact the overall living experience of the residents in the district.

6.4 Summary

After analyzing the two case development contexts, it is clear that BDA was built with industry as the core of the development, resulting in housing construction being delayed in the early stage. The BDA spatial has been expanding since 2002 and has expanded around 8.6 times in the last 20 years. In the later stages of BDA's development, the amount of housing was increased to ensure a reasonable density as well as the surrounding facilities, including schools and hospitals. By 2019, the BDA has formed a sizeable industrial area and a residential area with services such as parks, shopping malls, schools and hospitals for residents that functionally satisfy the area's development.

In contrast, HSP was one of the first development areas in Beijing and China and was officially established in 1988. From an ordinary street of less than $4km^2$, HSP has grown to include a number of Chinese universities, research institutes and high-tech enterprises. It has developed a unique geographical concept and has been named the Silicon Valley of China. At the beginning of its development, HSP was located on the north-western fringe of Beijing. An intensification of its commercial function has accompanied the rapid construction of the community. The central area of HSP has become more agglomerated and is close to being saturated with building space. However, with the development of HSP, there is still a large number of corporate headquarters, development companies and investors flocking to the area. This has created a great demand for development space from the increasing size of universities and the rapidly developing high-tech industries. This has put massive pressure on the limited land and environmental capacity of the central area of HSP. The rapid development of the HSP has also led to the emergence of large residential-oriented communities in the surrounding area: Tiantongyuan and Huilongguan

Over the last two decades, these two large communities have experienced aggregation of the population with the population increasing by approximately 7.3 times compared to 2000, due to their lower prices compared to HSP. They are both residential in nature, with educational and leisure facilities in the later development stages, especially in kindergartens and primary schools, which are all within walking distance. In addition, there are many bus and metro routes to choose from in terms of daily commuting in addition to travelling by car. However, the gated compounds will increase the walking distance to the final destination significantly compared to the open city area. This would make it challenging for people to get around by walking. In addition,

In general, the development of both the BDA and HSP has been characterised by industry-led development, with a large number of community and service facilities at a later stage. In the case of HSP, the saturation of space and the large concentration of people and high housing prices have created two large communities around HSP to meet the housing demand. They functionally meet the everyday demands of people. However, whether these two areas can satisfy the concept of sustainable integrated urbanism requires further analysis of the spatial structure to determine whether they are merely places of employment and residence or whether they can already worked as cities and not dependent on metropolitan cities.

Chapter 7 Case studies: urban spatial analysis

Chapter 7 mainly focuses on the current situation of the cases and how they work using a mapping approach. In this section, the urban pattern will be determined by land use, transport networks and density surveys of the case studies. The activity patterns of the two cases will be identified by analysing the daily activities of the inhabitants and drawing a typical activity map. The urban experience will be investigated through on-site observations and photographs of 32 representative neighbourhood walks. Section 7.4 provides a summary of the two cases.

7.1 Urban patterns

An urban pattern is the combination of urban functional layout, road network, building density and other aspects. It mainly refers to the spatial location of the elements in the city. It shows the specific spatial material patterns of the area. By analysing the urban patterns of BDA and HSP from multiple perspectives, the current status of their urban spatial can be better understood.

To investigate the spatial patterns of neighbourhoods the existing and inhabited neighbourhoods in BDA's north-west have been explored. In the case of HSP, overall, 32 neighbourhoods were strategically selected for analysis (Figure 59 and 60). Both BDA and HSP provide different residential typologies: villas, multi-storey apartment buildings and towers. It should be noted that the mixed-use residential buildings, marked in blue, have shops on the ground floors and residences on the upper floors. However, the shops are not part of an apartment. The shops and the apartments above are usually located at two different entrances to ensure the security and confinement of the neighbourhood and provide for commercial needs. The multi-storey apartments are mostly commercial and residential buildings, which are not very numerous in these two areas. BDA only offers this type of housing in the outer regions of one neighbourhood. In HSP, this housing typology is more dispersed and detached, without a cluster.

The housing typology maps shows that low-rise buildings dominate both cases but their typology is different. BDA has many 3- to 4-storey buildings in addition to the traditional 6- to 7-storey low-rise buildings. They only have a few households per building (usually 4-8 families per building) and they have a better living environment and higher quality of housing. In contrast, the low-rise houses in HSP are mostly bungalow buildings or early rural homes with lower living conditions which are now in need of development or redevelopment. There are also three rural housing areas that are due for demolition and many old buildings in the area that are undergoing renovation. In addition, there are very few middle-rise buildings in BDA with the exception of villas and low-rise buildings, most of which are taller than 13 or even 20 storeys. HSP is dominated by 6- to 7-storey buildings and middle-rise buildings less than 13 storeys, with few high-rise buildings.

Figure 59: Housing typology in HSP.(Source: by author)

Figure 60: Housing typology in BDA.(Source: by author)

The public transit map shows that a subway line connects BDA with Beijing’s centre, passing through the residential area and ending at Yizhuang railway station (Figure

61). In addition, 17bus routes have been established in the investigated residential areas. Five of these bus routes are located within the development area, seven bus routes link BDA with main central areas in Beijing and five bus routes connect the area with BDA's new expansion. However, in order to further enrich the level of rail transit and improve the traffic infrastructure of Yizhuang New Town, the new town is planning to establish a 76-kilometretram line, which includes four tram lines connecting the interior of BDA New Town to provide faster and more convenient transportation (Xia, Shen et al., 2017). The construction of the public transport will bring more development possibilities to BDA and the relationship between land use and traffic construction will also be more straightforward.

The public transport analysis of HSP is also based on the mapping of the surrounding transport stations and bus routes around the 32 selected communities(Figure 62). The more focused distribution of public transit stops along outer and inner corridors does not guarantee that every neighbourhood has at least one bus stop as illustrated in the mapping survey. Overall, 51 bus routes were counted as passing through the investigated communities. The map shows that a large number of bus routes repeat through the main roads of the area, while many of the side streets do not have any bus stops, which is why there are no bus stops in front of many of the neighbourhoods. This form of distribution makes public transport travel limited. It also has the potential to cause traffic congestion problems, especially during peak commuting hours. In general, the two cases are not fully covered by bus routes. The HSP bus routes have a higher density but as they occur mainly on the main roads, they also limit their efficiency. In comparison to BDA, HSP is more accessible via metro due to a total of 13 metro stations with five metro lines passing through, leading to a high connectivity with Beijing's main centres.

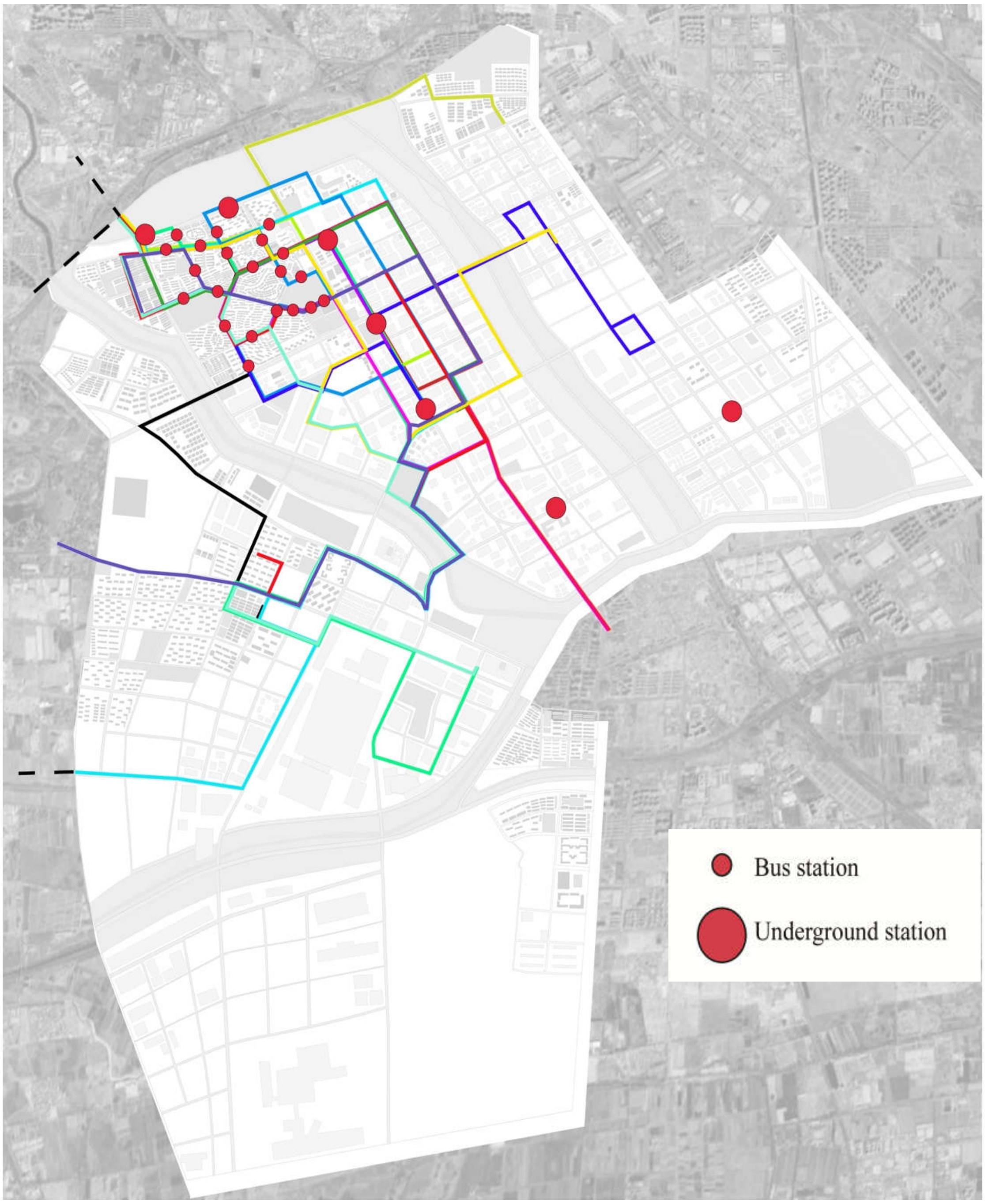


Figure 61: Public transport map in BDA.(Source: by author)

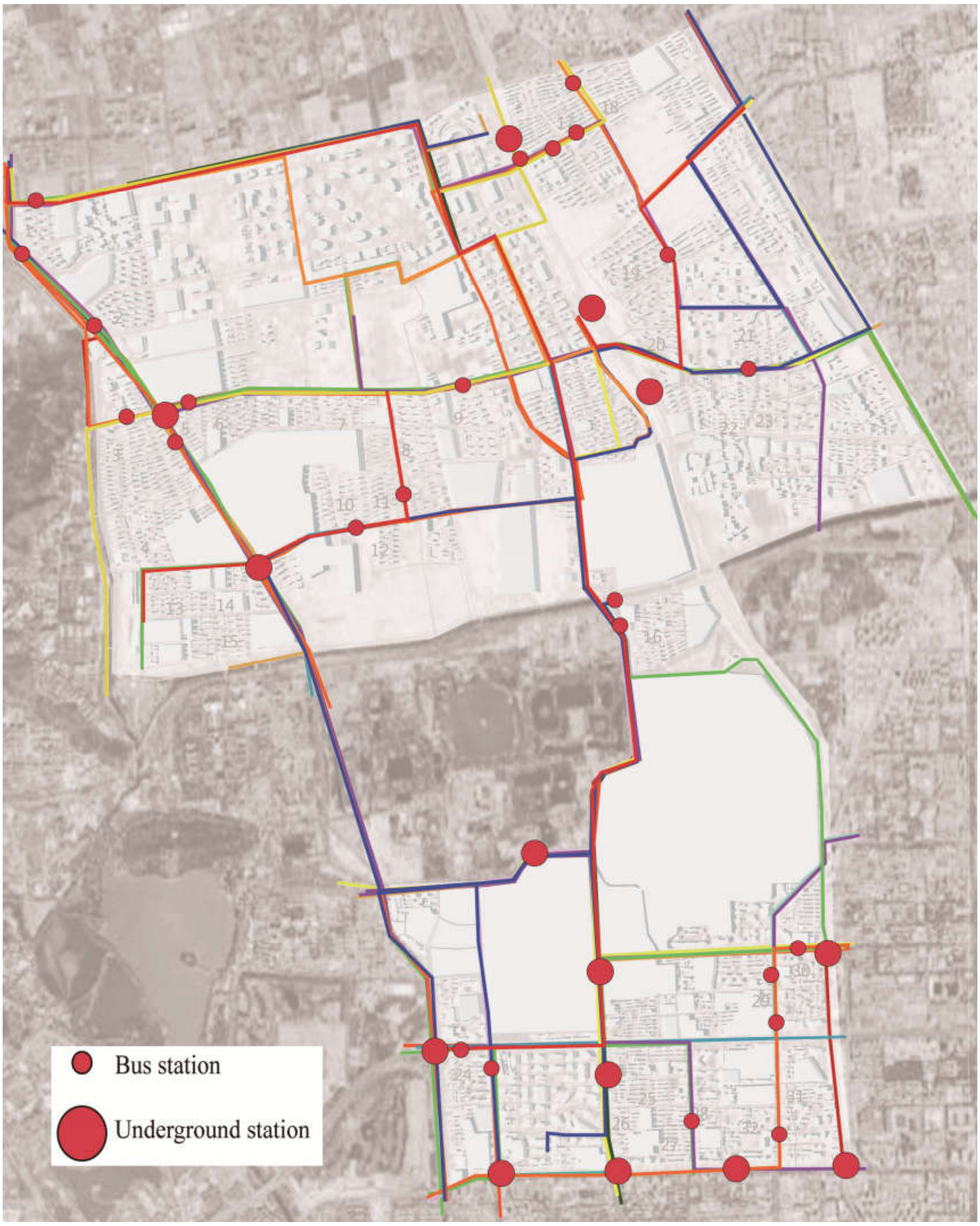


Figure 62: Public transport map in HSP.(Source: by author)

The following survey analyses the density of the two case studies. The average area of the plot per neighbourhood block in BDA is large, averaging approximately 17.6 hectares each. The average built density and thus floor area ratio in the selected residential areas is111% in BDA (Table 25). The total population of BDA is around 49,452 residents and the average number of households per block is approximately 1,280.The average population per dwelling unit is 3,354 (2.62 persons per household according to the 7th census data in 2020). The number of families in the villas is significantly smaller than in the multi-storey residential blocks, with an average of 340 households. Within the area there are six villa areas, and the rest are general residential communities comprising low-rise, mid-rise, high-rise and mixed-use buildings. The gross floor area and the number of people living in each neighbourhood are calculated to be approximately 71m^2 per person. The average salary in Beijing is £875 per month, and in BDA it is £708 per month. There is not much difference in wages. However, the housing price is significantly different. The average house price within the fourth ring road in Beijing is £9,600/m^2, but in BDA it is £5,891/m^2 (50,000 RMB). As shown in the table and diagram, house types and construction periods greatly affect the building density. At this stage, the planning function is suitable in terms of density.

As the residential areas of the HSP are scattered, 32 plots of different locations, construction years and sizes were selected for the analysis (Table 25). The average land area per plot in this area is 11.7 hectares and each plot has an average of about 1,200 households, or about 3,144 people per neighbourhood, based on 2.62 persons per family. According to the gross floor area, the average living space per person is 47m^2. And the floor area ratio here is 1.7. Although HSP has a high density of population and buildings, prices are very high, with the average price being around 103,375 RMB/m^2 (£12,162/m^2) and the most expensive being 166,000 RMB/m^2 (£19,109/m^2). In general, the area is more densely populated, with smaller plots but more households, resulting in higher plot ratios and less living space per person, yet more expensive prices.

When comparing the two areas, it can be seen that BDA is on average 1.8 times larger than HSP, but the average number of people per neighbourhood in both locations is about the same. In other words, HSP has a higher floor area ratio and less living space per person. At the same time, prices in HSP are more than twice as high as in BDA and much higher than the average price in Beijing. In summary, it can be stated that the spatial patterns of BDA and HSP are both formed by a main grid and large plots that are usually built by one or two major developers in the form of large-scale residential compounds forming each neighbourhood. However, the average plot size is significantly smaller in HSP, leading to higher densities, while the newer BDA neighbourhoods offer significantly more open space. Another significant difference is that the residential area of BDA was more cohesively planned and developed within a shorter period in the west of its commercial zone, while HSP's neighbourhoods are more spread out around its central commercial spine.

	Gross Floor Area m^2	Plot area m^2	Floor area ratio	Number of households	Number of people living in each neighborhood	Living space per person m^2	Price/ m^2 (RMB)
BDA	187,689	176,049	1.11	1,280	3,297	71	51,260
HSP	187,568	115,247	1.71	1241	3,253	63	103,375

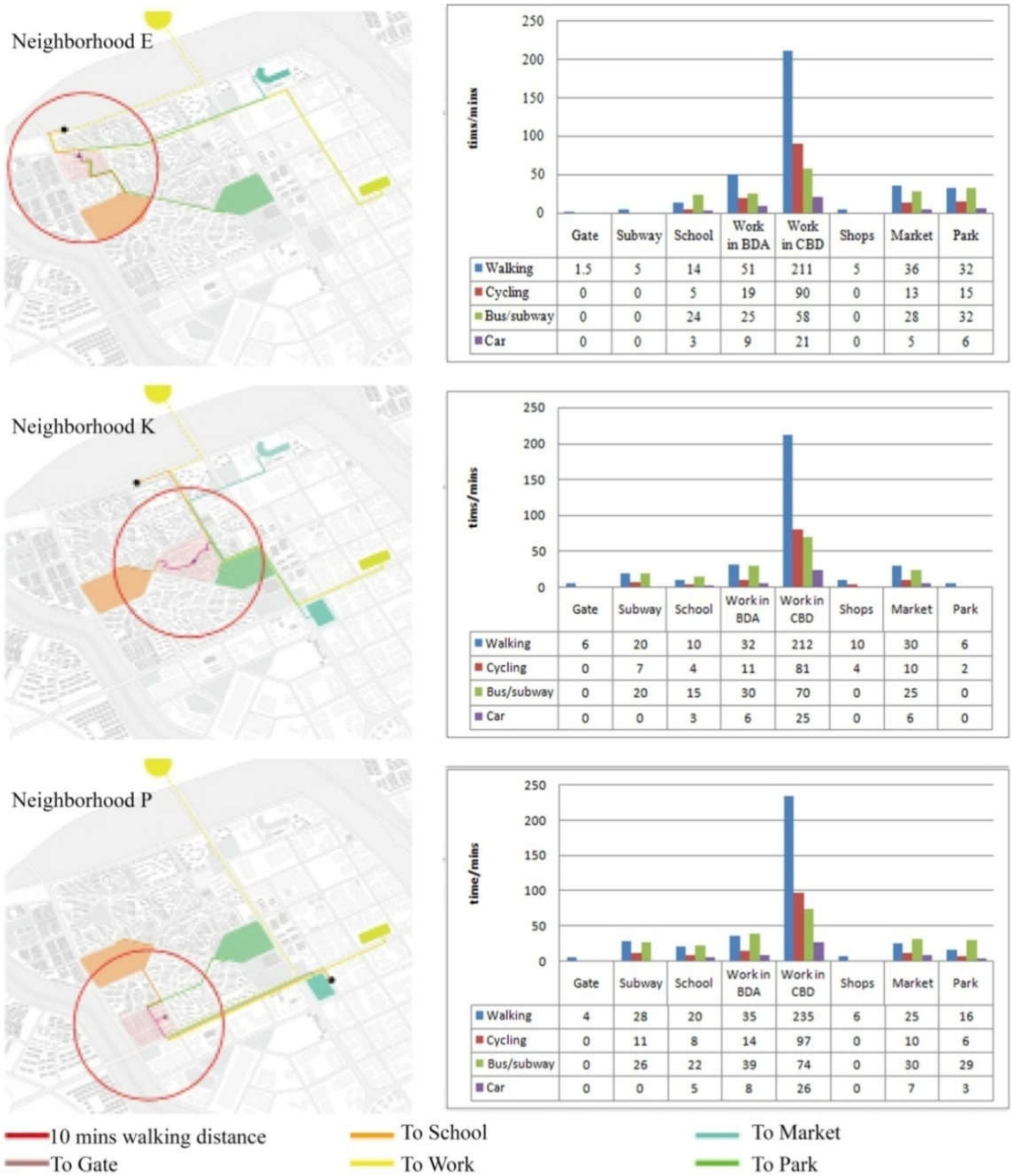
Table 25: Average data for urban density in BDA and HSP. (Data from Appendix 3) (Source: author)

7.2 Urban activity patterns

To study the current interaction between residents and their surroundings, various interrelated patterns are identified, which are the product of both time and space: spatial patterns are analyzed land use distribution, densities, and public transit stops, which resulting activity patterns, and associated experience patterns. More specifically, land use and transport routes are used to determine the people's activity around the neighborhoods and citizens' choice of travel method. Then, the activity patterns can be used to better explain the efficiency of the area, as the spatial pattern is intended to evaluate the diversity of the area.

Table 26 shows the weekly activity routes of three neighborhoods in BDA and the diagrams show the average time taken by each activity differentiating the mode of transit in comparison to walking. Most neighborhoods are gated with differing degrees of access: some neighborhoods require key cards and personal identification, while others have an open gate with or without a guard. As a result, people who want to travel on foot must spend a significant time walking from their residence to the neighborhood's gate, usually needing five minutes. Residents of the investigated communities in BDA need to walk at least 20 minutes to reach the nearest subway station and thus mainly rely on accessible bus stations (5-10 minute-walks) to travel to the subway or other destinations in BDA.

According to the mapping survey, BDA's residents spend the most time travelling to work because all commutes rely on travel by public transit or car. Statistics show that almost every block has at least one bus station and people usually need 5-10 minutes to reach the station. It is almost impossible to walk to work. Even if residents work in BDA, they need to drive or to use public transportation. Residents who work in the centre of Beijingusually need 25 minutes by car and 70 minutes by bus to reach their workplace when there are no traffic jams. However, Long et al. (2014) find that people will spend at least 50minutes travelling by car to the centre of Beijing to work during rush hour. Schools are within a walkable radius:the residents of most neighbourhoods need no more than 15 minutes to get to a school by walking and no more than five minutes by car. There are no highstreets or shopping malls in the residential area, so residents need to travel to do hang out even meet friends, with an average walking distance of more than 30 minutes or public transport around 27 minutes and about 10 minutes by car. However, there are some small shops supplying groceries, clothes, etc. and small massage shopsnear the residential area and the main vehicle and pedestrian road. These shops are not only used for commercial purposes but also function as walls around the residential area. Within the residential area, there is a central park that can be easily accessed by the adjacent neighborhoods. It takes around 15minutes on foot to reach the park.



Neighborhood E

	Gate	Subway	School	Work in BDA	Work in CBD	Shops	Market	Park
Walking	1.5	5	14	51	211	5	36	32
Cycling	0	0	5	19	90	0	13	15
Bus/subway	0	0	24	25	58	0	28	32
Car	0	0	3	9	21	0	5	6

Neighborhood K

	Gate	Subway	School	Work in BDA	Work in CBD	Shops	Market	Park
Walking	6	20	10	32	212	10	30	6
Cycling	0	7	4	11	81	4	10	2
Bus/subway	0	20	15	30	70	0	25	0
Car	0	0	3	6	25	0	6	0

Neighborhood P

	Gate	Subway	School	Work in BDA	Work in CBD	Shops	Market	Park
Walking	4	28	20	35	235	6	25	16
Cycling	0	11	8	14	97	0	10	6
Bus/subway	0	26	22	39	74	0	30	29
Car	0	0	5	8	26	0	7	3

Table 26: Mapping of typical activities in three neighborhoods in BDA. (Unit: mins). (Source: by author)

In terms of commuter traffic, the work-life balance in BDA is a big problem. Besides going to work and shopping malls, most of the daily activity places are reachable by walking. However, the cycling time is also counted in the table above. In China, shared bicycleshave become ubiquitous recently. Almost every street in BDA has bicycle parkingspots. People can borrow and return them quickly. Bicycles make it more convenient for people to travel in BDA. For example, under most conditions, it takes at least 30 minutes for people to walk to aplace or to aworkplace by public transport. When riding a bicycle, it only takesaround 10 to 20minutes and the rush-hour traffic jams can be avoided. Cycling can save about two-thirds of walking and public transport, and its time is only slightly longer than that of driving. To some extent, riding a bicycle can replace a car for people in BDA. This will not only reduce commuting costs but also make the place more sustainable.

For the analysis of HSP, a representative sample of nine of the 32 neighborhoods was selected to analyse the daily activity patterns(Figure 63). The nine communities were selected in different residential clusters of the area, ensuring a diversity of housing types, locations and years of construction. In addition, unlike the BDAcase, there are two clusters of business districts in the area. It is assumed that one member of the family works in the northern part of the area (Zpark) or works in the south of HSP, and one works in central Beijing to take daily commuting into account. According to the activity survey in Figure 63, residents' daily lives are more dependent on the main road, which validates the analysis of the spatial syntax in the previous section, where the clustering of the main streets in the area is higher. The red circles (10-minute walking radius) show that very few activities can be reached in convenient walking distances, and it is easy show that it is almost impossible for people to do their daily activities in this area by walking alone.

Tables 27 and 28 show that the residents of the gated communities in HSP still require approximately fiveminutes of walking to reach the entrance of their compounds. The average walking distance to the nearby bus stop is about 8 minutes, or 3.8 minutes of cycling. With regard to choice of schools, the main analysis was the distance from the neighbourhood to the primary school, which is basically within walking distance, with an average walking time of about 15 minutes. Most residents in the area have a longer average distance to a public space, with an average walk of 22 minutes to the nearest park. The distribution of shopping malls and the main commercial services (e.g. weekly groceries) is also largely dependent on public transit, cycling or car. Short walking trips to work are completely out of reach for most of the neighborhoods, and even the use of public transit can still take up to an hour of daily commuting. Compared to Huilongguan and Tiantongyuan mentioned in the last section, the commuting time is considerably reduced. As can be seen, a single employment centre or residential centre has significantly longer commuting distances compared to areas with relatively mixed employment and residence. Thus, despite the location of an integrated central commercial spine, the strict functional land-use division and residential typologies in the form of mega compounds have led to astrong dependency on cars or public transit options. Due to the generally higher income, car ownership has been increasing in HSP, leading to a new lifestyle of high mobility, which however has caused increased traffic congestion (Wang, 2021).

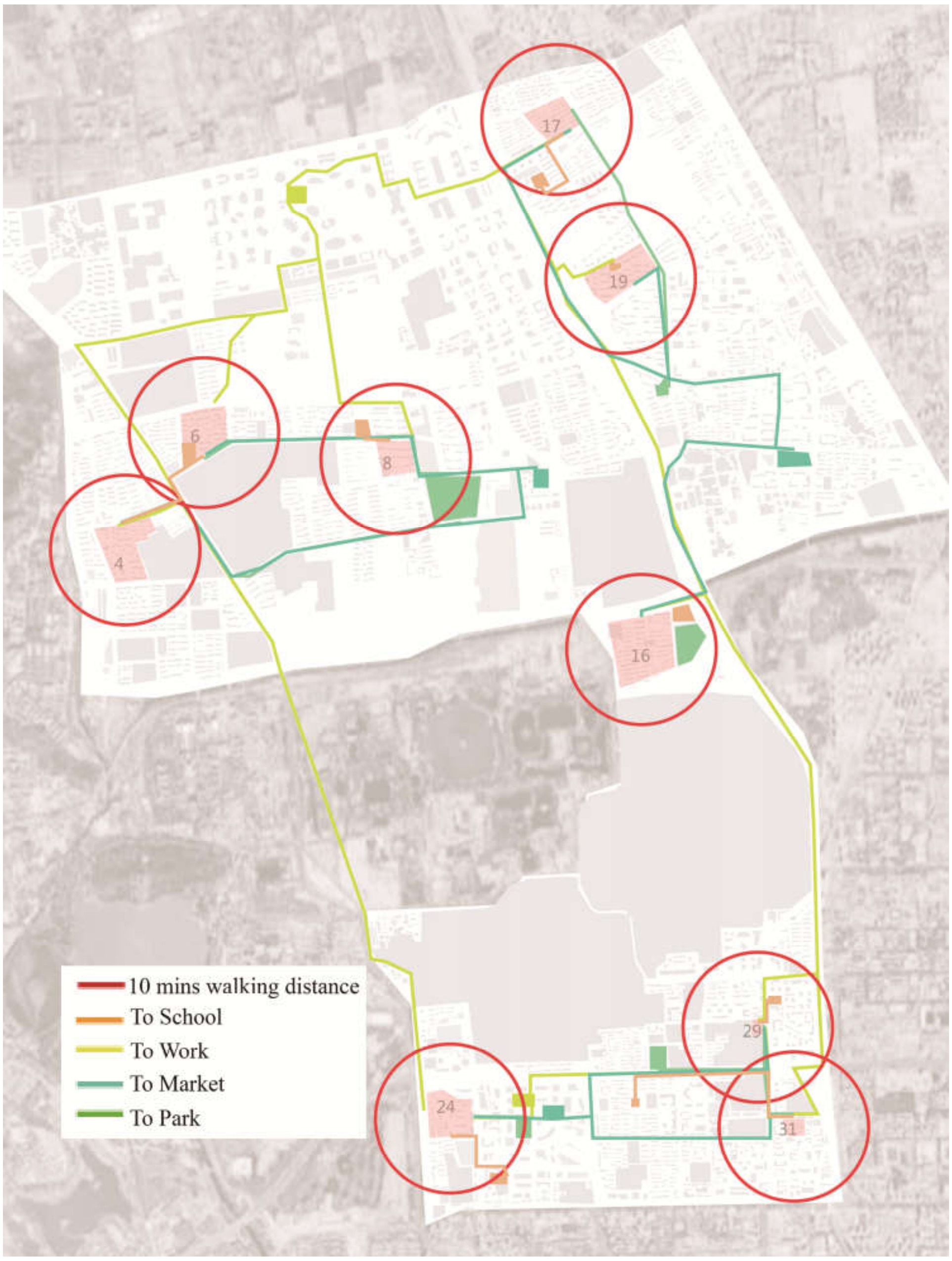
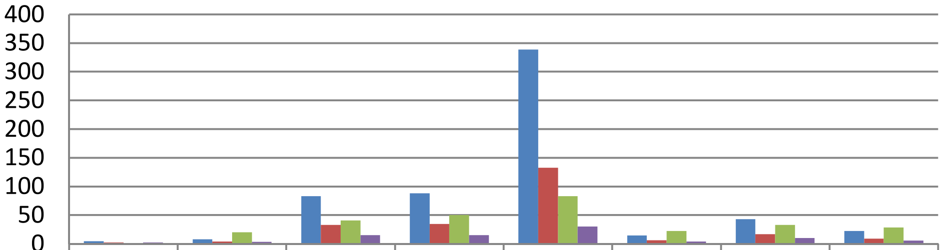


Figure 63: Mapping of typical activities for nine neighborhoods in HSP. (Unit: mins). (Source: by author)

Neighborhoods 4	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	3	8	97	80	387	30	57	44
cycling	2	3	38	30	153	13	22	17
Bus/subway	-	-	40	54	78	26	35	38
car	2	4	12	15	32	6	11	9
Neighborhoods 6	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	-	5	107	43	393	13	47	43
cycling	-	2	42	16	153	5	18	16
Bus/subway	-	21	41	35	81	-	32	29
car	-	3	17	8	35	3	8	7
Neighborhoods 8	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	4	2	114	38	371	6	32	19
cycling	2	1	44	15	146	2	12	7
Bus/subway	-	-	53	38	88	-	23	24
car	2	1	15	7	35	2	7	5
Neighborhoods 16	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	6	4	66	84	314	11	44	4
cycling	3	2	26	33	124	5	18	2
Bus/subway	-	21	32	41	77	19	35	26
car	3	3	15	15	33	3	11	7
Neighborhoods 17	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	7	10	140	39	373	7	59	40
cycling	3	5	54	15	145	3	24	16
Bus/subway	-	17	59	33	77	-	37	25
car	3	3	25	8	31	3	12	12
Neighborhoods 19	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	-	2	124	63	353	2	39	23
cycling	-	1	51	26	137	1	16	9
Bus/subway	-	-	51	46	84	-	36	20
car	-	1	25	13	31	1	10	5
Neighborhoods 24	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	-	11	17	140	305	22	30	18
cycling	-	7	7	53	122	9	11	7
Bus/subway	-	20	23	80	80	20	26	23
car	-	5	5	21	26	6	8	5
Neighborhoods 29	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	3	14	39	146	292	8	16	16
cycling	2	5	16	57	113	3	6	6
Bus/subway	-	16	35	65	87	-	20	47
car	2	5	10	25	26	4	7	4
Neighborhoods 31	Gate	Bus	Work in Soho	Work in Zpark	Work in CBD	School	Market	Park
Walking	-	4	41	160	262	15	35	24
cycling	-	2	17	64	102	6	14	10
Bus/subway	-	-	30	58	76	24	29	22
car	-	2	11	26	24	8	11	5

Table 27: The typical activities times for nine neighborhoods in HSP. (Unit: mins). (Source: by author)



	Gate	Bus station/subway	Work in SOHO	Work in Zpark	Work in CBD	School	Market	Park
Walking	4.6	7.9	82.8	88.1	338.9	14.7	42.7	22.11
cycling	2.4	3.8	32.8	34.3	132.8	6.1	16.8	8.7
Bus/subway		19.8	40.4	50	82.9	22.2	33	28.6
car	2.4	3.1	15	15.3	30.3	4.1	10	5.7

Table 28: Distance distribution of typical activities for nine neighborhoods in HSP. (Unit: mins). (Source: by author)

Compared to BDA and the two large residential areas, the greater dispersion of commuting times in HSP indicates a higher variability of commuting times in the district. The current distribution of people working and living in the case is diverse. It varies greatly among individuals, with longer travel distances and times for people commuting across the area compared to those who both live and work in the area. In comparison, BDA has a more average commuting time for those working in the region but is also still car-based.

By analysing the activity space of the residents in the 12 communities in BDA and HSP, it was found that the average distance and commuting time of the residents of HSP is higher than that of the residents of BDA. Combined with the analysis in Appendix 3, the reason seems to be that HSP has a higher population density and higher traffic pressure, which can require extra commuting time. In addition, the schools in both areas are mostly within a walkable distance but mixed-use businesses such as shopping malls or other public spaces are not. This will have a significant impact on the efficiency of the district and the citizens' sustainable use of these spaces, which will affect the overall experience of the space. To a certain extent, the residents will lack a sense of local identity.

7.3 Urban experience patterns

7.3.1 Spatial analysis model of Space Syntax

In addition to field studies via walking tours of selected and representative everyday routes, another investigation of main experiences can be conducted using Space Syntax models and Choice, calculated using Depthmap (Figure 64). This method permits a probability calculation where the main movements aggregate. By using a local radius of 800 metres, the core links in each district can be identified. Core links are often experienced due to their main role in linking major urban areas. The rather even grid in both BDA and HSP has led to a rather even distribution of movements and thus fewer dominant routes. However, in each district, two main axes can be identified as core links, which are often experienced by most residents via vehicles or by walking. In BDA, the two main links have up to 10 lanes, indicating high traffic loads and a typical urban highway experience in Beijing's urban expansion. There are no pedestrian dimensions considered, and the created spaces mainly represent fast transition and movement.

Very similar spaces can be found in the case of the two main links in HSP. There is, however, a higher concentration of commercial use and other major services along the southern link known as North 4th Ring Road, which is one of the main hubs of public life in the north-eastern part of Beijing. The Space Syntax method clearly indicates the main traffic concentrations in both districts and the field observations of the four main links share a dominant presence of traffic in common, including pedestrian bridges and overpasses as well as parking sites. Some of the main shared experiences of all residents can thus be identified rather typical for a newly built suburb with a diffuse centre and a high-level of fragmentation. While all residents must move between their residence and workplaces, there is no shared high-street on a neighbourhood- and district-level with typical pedestrian dimensions and directly accompanied by integrated public spaces and services, such as parks. The only bigger park is located in BDA and is surrounded by inactive roads without any commercial use and thus only serves adjacent neighbourhoods as recreational space rather than contributing to a shared public image of this edge city. Commercial uses are mainly distributed in strategic and accessible locations by car, and everyday consumption experiences can thus mainly be found in shopping malls. Based on this, a more typical urban image will be chosen and explored in both BDA and HSP.

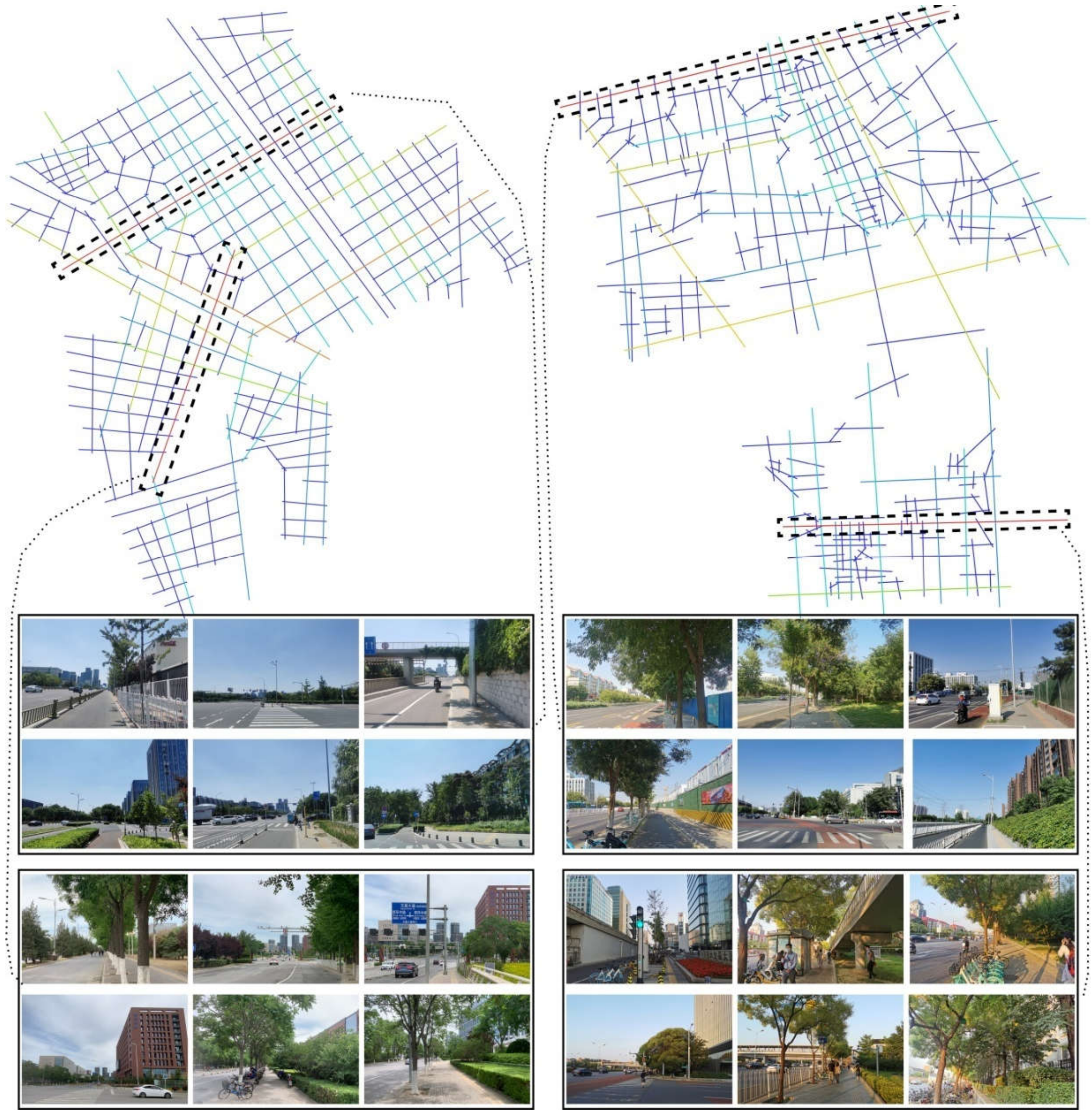


Figure 64: The choice map with a radius of 800 metres of BDA(left) and HSP(right). (Source: author)

Subject to the space syntax theory, socioeconomic factors mainly mould the city through people's mobility and the interconnections of urban networks. A well-functioning city can be regarded as a travel economy. A good environment can leave spaces to attract people, thus generating the multiplication effect of specific land use and construction density and maintaining a high consistency of street network structure, stream of people, traffic flow, land use and density (Hiller, 1996). The globally integrated core is the street combination with maximum accessibility among all spatial network systems. Therefore, it can most directly show a regional spatial network's functional structure and spatial vigour. In a study on the spatial network morphology of BDA and HSP, Depthmap spatial syntax software is adopted to calculate the spatial network axis maps in these two areas. And the colour range proportional method is employed for determining the integrated core of spatial network axis structure.

Figure 65 shows a model of a street network axis map. The spatial network structure composed of the red axis represents BDA and the globally integrated core of the entire spatial network structure of the HSP. BDA’s average global integration value is higher than that of HSP, which is 1.80 and 1.43, respectively. The maximum of BDA is 3.15, while that of the HSP is merely 2.63. Through a comparison of the global core morphology of spatial networks in these two areas, it can be seen that BDA’s axis map shows grid spatial development characteristics. The spatial network structure of HSP contains more traditional streets, fewer main roads and more axes and branches.

Under the space syntax theory, the globally integrated core of the two areas has the most intensive mobility in the spatial network. It is also the area that can maximise the potential social functions of a regional spatial network. According to Table 29, BDA’s intelligibility value R^2 exceeds 0.5, meaning that its connectivity and globally integrated degree are moderately correlated. The overall space has higher accessibility, the acquired visual penetration depth is significant and the spatial structure is reasonable in this case. HSP's intelligibility value $R^2$is less than 0.5, indicating that its connectivity value and global integrated degree are generally correlated. The overall spatial accessibility is poor and the integrated degree of spatial structure is inferior to that of BDA.

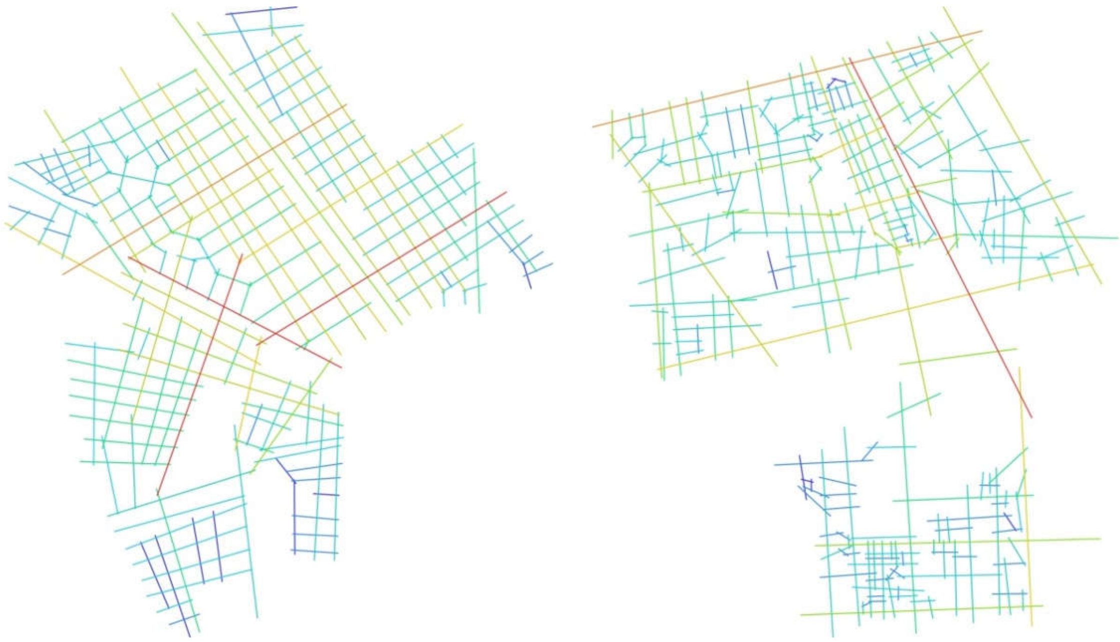


Figure 65: The global integration map of BDA (left)and HSP (right). (Source: by author)

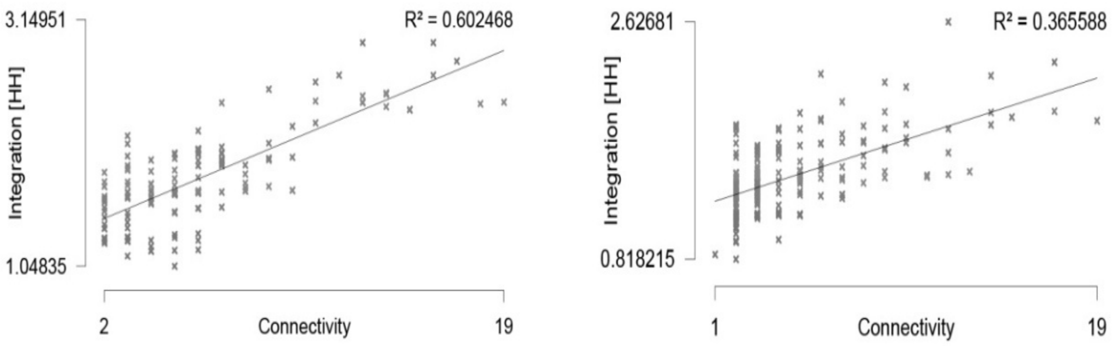


Table 29: The intelligibility of BDA (left) and HSP (right). (Source: by author)

As stipulated by the space syntax theory, the walking mode in the urban street network is mainly decided by the structural characteristics of the road network. To better understand the internal spatial network structure in BDA and HSP, and thoroughly talk about the syntax structural characteristics in walking space, it is of necessity to examine the integrated regional degree of the spatial networks in the two areas within 800-metre walking distance.

Figure 66 shows the local integrated core of BDA and HSP. Based on a comparative study, the average local integration value in these two areas is 2.17, and the maximum is 3.6. Nevertheless, the minimum in HSP is only 0.42, and in BDA,1.17. According to the figure, BDA's local integrated core is in the central area, and the most pronounced red axis connects the north and south parts while the local integrated core in HSP is scattered in the four corners of the area, forming the main ring road. The regional central axis is nearly consistent with the average of an integrated degree across the area, leading to the formation of secondary roads. There are closed-in universities and colleges in the local area, so nearby streets have a relatively low connection value. The intelligibility value R^2 in BAD and HSP exceeds 0.5, and the R^2 in BDA even exceeds 0.7 (Table 30). This indicates that the connectivity and a local integrated degree in the two areas are correlated, especially in the case of BDA, i.e. regional accessibility within walking distance is relatively high from the perspective of the spatial network structure.

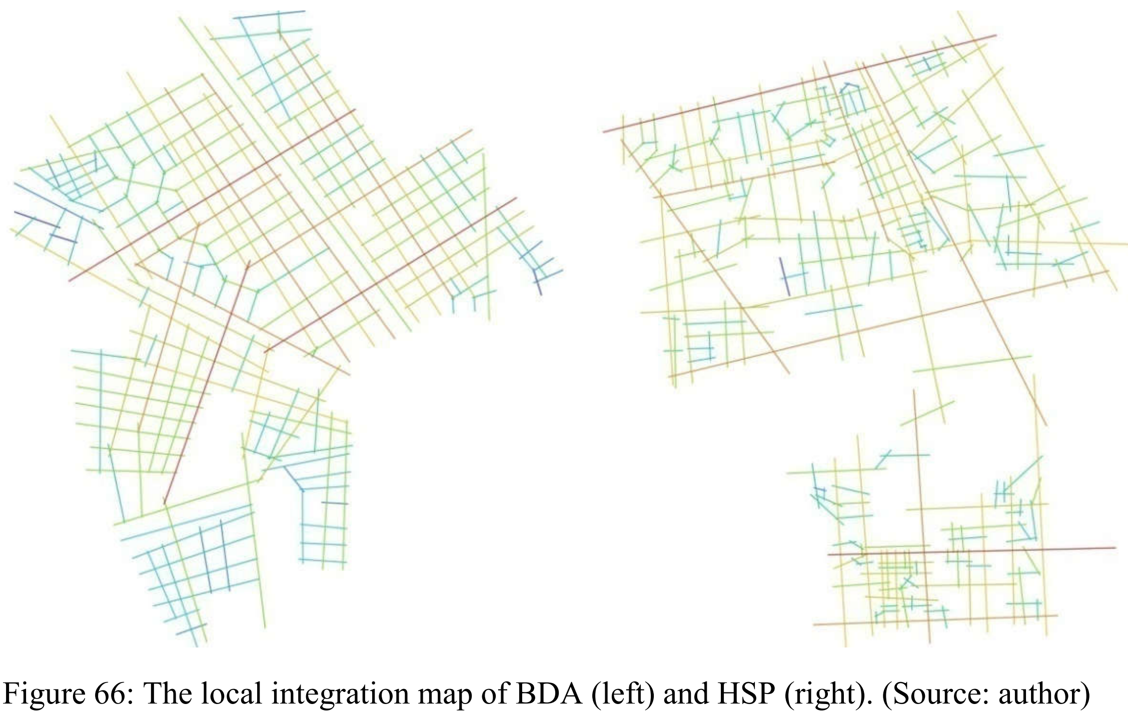


Figure 66: The local integration map of BDA (left) and HSP (right). (Source: author)

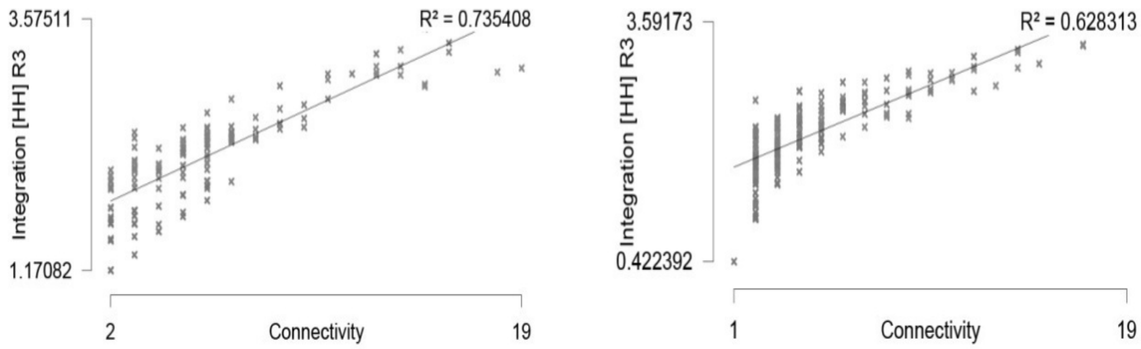


Table 30: The intelligibility of BDA (left) and HSP (right).(Source: by author)

In sum, BDA's spatial axis has a grid structure, while HSP has a traditional axis structure. BDA has a higher integrated degree than HSP, whether in global integration or local integration. In terms of intelligibility, the R^2 in these two areas is greater than 0.5, indicating the high global accessibility and walking accessibility of the regions in terms of spatial structure. Noticeably, in terms of globally integrated degree, the intelligibility of HSP is less than 0.5, which denotes the absence of correlation. Overall, the general axis distribution is relatively even in the area, and the road network is relatively sparse. As most inner roads within blocks are semi-private, the general connectivity value of the site is relatively low. There is also a difference in integrated degree between the global area and the local space. Neither of the two areas has a high value of the integrated degree, and the general value is average. Therefore, the areas show poor overall aggregation ability and lack a core zone with an apparent and distinguishable identity.

7.3.2 Urban images

Based on the activity mapping of everyday routes, key experience patterns can be studied. To be more specific, more general everyday experiences were explored by identifying key public engagement corridors based on Space Syntax models. These shared experiences along main corridors were again investigated via field studies and observations to explore both the current condition of the built environment and its overall narrative as well as everyday human behavior in these most representative urban links.

To establish a realistic sample of routes which could be experienced by everyday walking, the selected routes cannot exceed a walking distance of 20 minutes. Overall, 32 routes in 12 neighbourhoods have been investigated in both BDA and HSP via field studies to investigate the typical representations of existing spatial conditions(Table 31). Despite field studies and walking tours of almost 18 hours, only four key experiences can be identified. This is the result of the rapid development and rather restricted planning guidelines and policies. One key experience is the walk through a private compound, which can be experienced in just 1-2 minutes or up to 7 minutes depending on the size and the location of the residence. Since residential compounds are rather large, 14.6 hectares on average, most movement concentrates along the main grid with multi-lane roads and heavy traffic. In addition to the major traffic arteries, another major element of the experience patterns can be identified by a dominant compound wall, landscaping or commercial use.

The average walking time of all the investigated walks is around 17 minutes and the most dominant experience with a share of 38% are walks between compound walls and main traffic routes, followed by similar walks along those roads but with dominant landscaping features (19%) and with commercial use (15%), mainly smaller shops. The remaining 25%, and thus a quarter of the average walking experience, is located in the private or semi-private precincts of compounds. On average, there are only 0.78 encounters with commercial services per investigated walking route, and there are no encounters with any shops in 17 out of 32 routes (53%). On average, there are 2.19 crossings per walking route, which is notable because most main roads have four to eight lanes. The resulting stop-and-go experience is another important factor impacting the overall impression of a rather car-oriented grid with large and walled residential, and thus private, compounds.

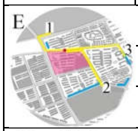
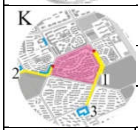
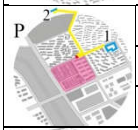
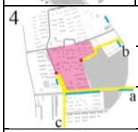
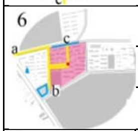
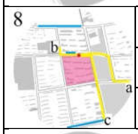
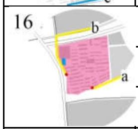
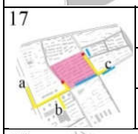
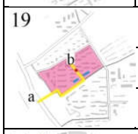
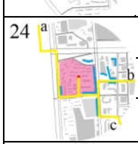
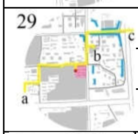
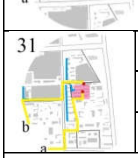
Neighbourhood	Routes	Compounds /mins	Along traffic roads with walls /mins	Along traffic roads with trees/mins	Along traffic roads with commercial/ mins	Final destination /mins	Encounters with the commercial services	Junctions cross
E 	1	1.6	0	8	3	Metrostation:13	1	2
	2		8	4	2	School: 16	1	3
	3		0	10	4	Shops:16	0	2
K 	1	6	5	1	0	Park:12	0	1
	2		0	4	6	School:16	2	2
	3		5	11	0	Shops:22	0	3
P 	1	4	8	10	2	School:24	1	4
	2		2	4	0	Shops:10	0	1
4 	a	3	9	0	11	Metrostation:23	2	4
	b		11	0	0	Shops:14	0	1
	c		13	0	1	Market:17	1	3
6 	a	-	12	0	0	Metrostation:12	0	2
	b		6	0	0	School：6	1	1
	c		2	0	0	Shops：2	0	0
8 	a	4	13	6	0	Park:23	0	3
	b		5	0	1	School：10	1	1
	c		17	0	0	Shops:21	0	1
16 	a	6	0	4	0	Park:10	0	0
	b		6	3	2	School：17	1	2
17 	a	7	2	11	0	Metrostation:20	0	3
	b		0	7	0	School：14	0	2
	c		0	6	4	Shops:17	2	2
19 	a	-	10	5	0	Metrostation:10	1	1
	b		2	0	0	School：2	0	0
24 	a	-	5	3	9	Metrostation:17	1	3
	b		6	2	10	Park:18	4	4
	c		13	0	9	School：22	2	3
29 	a	3	16	0	0	Park:19	0	3
	b		8	0	0	School:11	0	2
	c		9	0	7	Market:19	2	4
31 	a	-	10	7	0	Metrostation:17	0	4
	b		4	0	11	School：15	2	3

Table 31:A sample of everyday walking routes in BDA and HSP. (Source: authors)

In addition to everyday activities routes the walking tours were carried out to research the general quality of the public walkway linking gated communities to the public park. Figure 67 shows the view of a typical road in the BDA residential area, which defines the most integrated street according to the spatial syntax within the neighbourhood district. On the footpath's left is a green belt, followed by a plot fence. To the right is a cycle path and a two-way vehicle lane. Pedestrian walkways and cycling routes are distinguished but cyclists often use the walkways because of mopeds. The left side of the pedestrian road is a wide and dense plant, and there are one or two benches every 60 metres. The right side of the street has trees and there is a classification bin for every tree. The trees on both sides of the sidewalk provide shade to the neighbourhood and provide shade for pedestrians. The pavement is 20cm higher than the cycling track and there are railings between the bike lane and carriageway, which increase the safety of pedestrians and cyclists. The sidewalk is paved with cement tile and the yellow floor tiles indicate disabled paths. There are bicycle points at the crosswalk so that pedestrians can use shared bicycles more conveniently. Many trees were planted to enhance the attractiveness of the walking experience. While the walkway is green, urban safety is compromised because very few people watch the sidewalks or engage in outdoor activities. In the centralized office area, the roads are relatively wide with limited urban furniture and landscapes(Figure 68). The walking experience is thus dominated by a feeling of needing to reach one’s destination as quickly as possible.

Figure 67: Typical urban image of BDA residential area. Walking tour to convey the general impression of modern but often deserted walkways with compromised urban safety. (Source: photo by author)

Figure 68: Typical urban image of BDA streets. (Source: photo by author)

Similar to the BDA pavement system, Figure 69 show the typical road images of HSP, this street have the high degree of local integration. The pavement in the HSP is separated from the motorway by hedges or railings. It effectively prevents the possibility of motor vehicles occupying the pedestrian road for parking and ensuring a clear pavement. In this case, the separation by hedges blurs the boundary between the pavement and the motorway with plants, increasing the greenery of the area and creating a safe space for walking, but the dullness of the street scene and the lack of urban furniture make it difficult for people to stay and rest on the street. In addition, As this road is one of the major street networks in Beijing, it is a wide road with 12 lanes in both directions. Despite this, there are still traffic jams during rush hour. It is also clear that although HSP is served by several metro lines, many people still choose to commute by car. As it is the main road, the area also has a crossing to satisfy the needs of pedestrians. However, the boring streetscape and the long, wide road also make it a tool for people to pass through, not allowing people to stay and even less to empathise with them.

Figure 69: Typical urban image of HSP streets. (Source: photo by author)

Figure 70 shows the only park in BDA's residential quarters and covers an area of approximately 180,000 m^2. In comparison, the park's accessibility, local integration value and choice of degree within the residential area are relatively high. However, in terms of BDA as a whole, it is still lower than in other business areas. The entrance to Boda Park is closed to vehicles and bicycles, which improves the safety of the park. There is a central square with a landmark sculpture. The square is equipped with water facilities and water fountains which improve the experience of the place. In the morning and evening, citizens do some exercise or relax in the square. Elderly people and parents come to the park in the daytime with their children. The large area of grassland and landscape provide a good viewing experience. The accessibility to the inside of the park is enhanced by stone paths on the lawn but not every place is accessible.

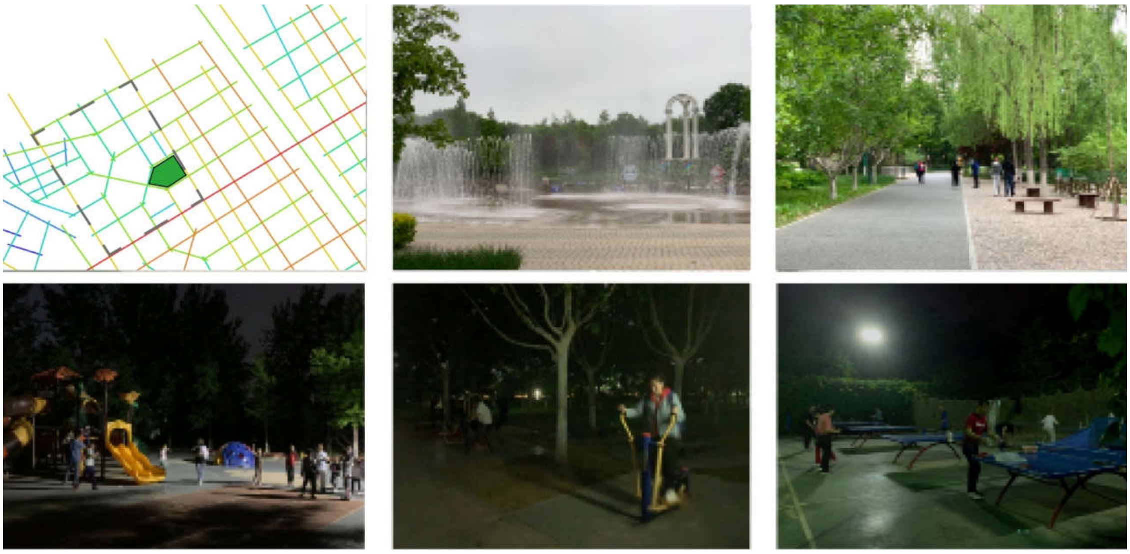


Figure 70: Park and the activity that can take place in parks. (Source: photo by author)

The shopping mall in BDA seems to be another landmark where residents can gather in addition to the park (Figure71). The roads in the area are the most connected and integrated with the whole area. The shopping mall not only offers people the opportunity to eat, shop and enjoy the cinema. The plaza in front of the mall has also become a place where many residents can meet friends and family in the evenings and on weekends. Another basic form of business in BDA are the one- or two-storey shops on the outskirts of the gated community (Figure 72) that provide the residents of the community with a wide range of products such as vegetables, fruit and meat, as well as pharmacies, massage parlours, etc.

Figure 71: Large shopping mall in the BDA with a square. (Source: photo by author)

Figure 72: BDA's typical business model: shops around the community. (Source: photo by author)

In contrast to the BDA, HSP relies heavily on Zhongguancun Square (Figure 73) to create distinctive spaces and shape the identity of the city. The square has a relatively high degree of integration and choice and attracts many users, including users from well beyond HSP. It is a walkable and sustainable urban square. The square creates a variety of spaces through a rich mix of spaces and topographical changes and the site infrastructure is well-equipped to cater to the needs of a variety of people. In addition, the wedge-shaped Zhongguancun Square extends from the southeast corner to the inner centre, guiding the urban open space from the western edge to the inner west. On the square, people can see a huge sculpture of a DNA double helix, which is the symbol of Zhongguancun. In the distance can be seen a 120-metre high office building and a skyscraper cluster. This shows the modern, high-tech urban image of the area. It also gives the area its own character and identity, creating a sense of spatial belonging for the residents.

Figure 73: Zhongguancun Square: there is a pedestrian street with a gathering of

commercial, shopping malls and a sculpture. (Source: photo by author)

Apart from Zhongguancun Square, other parks or public spaces in the area are not very efficient in terms of spatial quality and use. For example, Shucun Country Park is too large in scale and the surrounding buildings are loosely enclosed, making the space too empty (Figure 74). Access to these areas by residents or pedestrians from the surrounding office buildings must be via crosswalks at intersections or across railings. In general, public transport stops are approximately 300metres away from each boundary, which is significantly less walkable than the public areas of Zhongguancun Square. Also, the enclosed interfaces have very different architectural styles, few direct links to the plaza and insufficient commercial enclosure, which results in a high proportion of people walking through and a short dwelling time for those staying. Furthermore, although these public areas are equipped with urban furniture such as benches, there are no small shops or stalls and no toilets or other facilities, which also impactsthe time spent by users in these places.

Figure 74: Shucun Country Park. (Source: photo by author)

In addition, part of BDA's subway is overground so that passengers can overlook BDA's core industrial area (Figure 75). The spatial syntax of the map in Figure 76 shows that this location has the average degree of connectivity and integration of the business area and its urban images are very typical. The picture shows that the office buildings in the zone are mostly factory-style low-rise buildings and more modern mid-to high-rise office buildings. Compared with residential areas, the trees on the main roads block most office buildings, while the trees on the sidewalks of the enterprise areas are not as dense as those in residential areas. During office hours, there are few pedestrians and little traffic. Each office building group is clearly divided according to the street, and most office buildings have aboveground garages next to them. Some office buildings are equipped with small shops and restaurants on the ground floor. Due to the development of the takeaway industry, BDA's three shopping malls can also provide convenience for workers. As seen in Figure 70, BDA’s roads are wide but there are very few vehicles or pedestrians on them except during the commute to and from work. The roads with high values of integration show that almost all of these places look the same and each street does not have its own identity, which makes generating a sense of local identity a significant challenge.

Figure 75: The view along the subway. (Source: photo by author)

Figure 76: Typical urban image of BDA business area. (Source: photo by author)

The office building in HSP has been transformed from a single old-fashioned warehouse building to a modern building with a sense of design. As a result of this shift in building function, the office area will have large areas of green space and recreational space, and its function will change from simply meeting the needs of users to enhancing the quality of the park and enriching leisure life. Unlike BDA, most of the office areas in HSP, apart from the office building, have green space or small squares for public interaction that can accommodate a relatively large number of users due to their large scale and blurred boundaries. However, these types of public interaction spaces currently have large challenging paving areas and lack urban furniture and other facilities that would allow people to linger, and they are mostly gated (Figure 77). This also results in the local integration within the office areas being low on average. Public spaces in office buildings such as commercial facilities (restaurants) and amenities (canteens) are small in scale and have clear boundaries, accommodating relatively few users. The non-open spaces result in poor sound diffusion and a high degree of silence. Take the canteen as an example. The indoor space lacks reasonable spatial zoning, the density of tables and chairs is high, the noisy environment is not conducive to public interaction activities and workers in the park tend to leave quickly after dining without stopping.

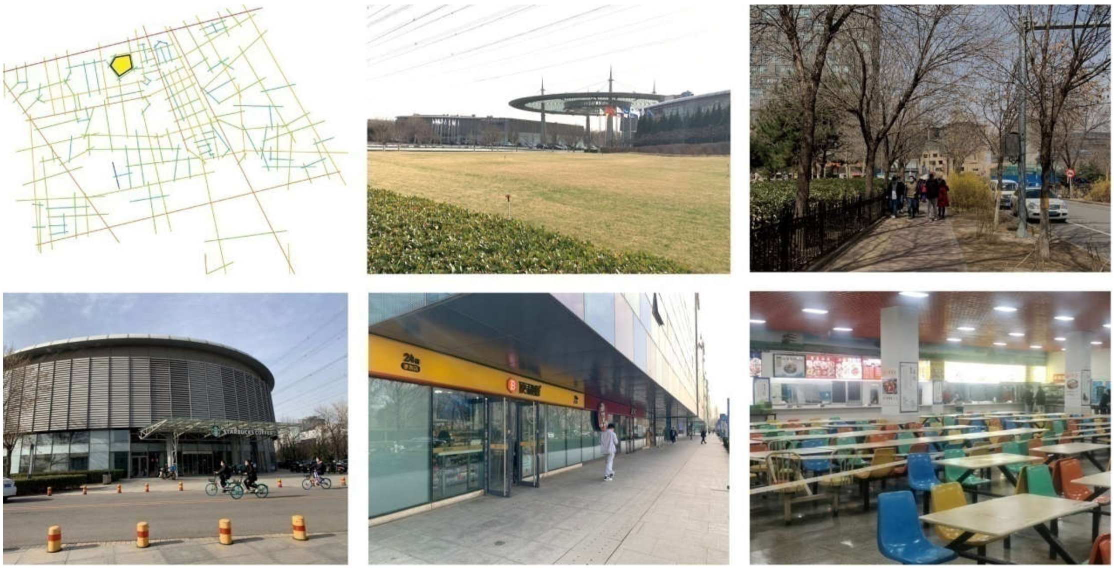


Figure 77: The urban image of HSP business area. Each block of the office area is large, with an open public area in addition to the office buildings but with minimal urban furniture. There are also service facilities such as a canteen and shops. (Source: photo by author)

The office area is densely populated with commuters, resulting in a distinctive urban image near the metro station and in front of the action units during peak commuting hours. Figure 78 shows a metro station during peak commuting hours. As the metro can be used as a more manageable means of commuting than buses and cars, many people choose to commute by metro, even if they have a long distance to travel to their workplace after arriving at the station. This has led to the phenomenon of mixed-use of transport for commuting. To be more specific, people choose to ride to their workplace after taking the metro, which makes for a much more efficient commute. This has led to a large number of shared bicycles gathering in front of workplaces in the morning, while at the end of the day, these bicycles gather in front of metro stations and residential areas.

Figure 78: HSP's commuter urban image: Use a shared bicycle to get to the workplace after arriving at the underground station. 26 minutes walking distance, 10 minutes cycling (Source: photo by author)

In addition to the urban image and perceptions, comparing the two cases, although their office spaces are in separate blocks, the overall public interaction space in HSP's office area is better. It has a full range of space types and a higher density. It can be more attractive for office workers to meet colleagues or friends near their workplace during their lunch break or after work (Figure 77). However, overall, the scale of the public spaces in both areas is still inadequate and their location does not guarantee that most people can reach them on foot. Their public spaces for interaction are dominated by parks and shopping malls, except for road facilities which are not sufficient for people to stay. In addition to these two functions, the commercial spaces also have their own specific uses such as sports facilities, gyms and dance studios, as well as commercial facilities such as restaurants and cinemas. In general, the existing functions of the various types of public spaces in these two areas are more focused on leisure and communication and there are fewer places for people to hang out and stay. The forms are homogeneous and repetitive.

7.4 Summary

Based on the urban spatial analysis, In the residential area, each block is clearly planned but there is no central place where people can gather. In terms of urban furniture, there are only benches on the pavement and the surrounding environment does not attract people to stay to experience the place. Usable public space is essential for an area, and although there is a public park in BDA, its concentration is lacking. The clear separation of jobs and housing in both cases has led to a concentration of commuters in the morning and evening rush hours and a high concentration and imbalance of commuter traffic flows, causing urban problems such as congestion and tidal wave traffic. It also leads to long commuting distances and times, making people more reliant on motorised transport, exacerbating the environmental pollution caused by motorised vehicles and seriously undermining people's travel experience. In additional, the legacy of the traditional Chinese community has led to an over-reliance on vehicles. As long as the family can afford it, there will be a car in the family. This does not satisfy the concept of sustainable urban design for travel.

BDA and HSP are functionally well-served by various housing, hospitals, schools, shops and shopping malls. However, with regard to the strategy of integrated urbanism, it is clear that these functions are not concentrated and it is difficult for citizens to move around efficiently. People still need a car to get around and these functions are primarily decentralised. It is difficult to find a significant diversity of markets in BDA where people can feel attached because of their emerging identity. On the other hand, the construction of transport infrastructure, the underground, and the development of large-scale residential developments, Huilongguan and Tiantongyuan, have motivated HSP to spread to the periphery of the city. Some of the population and industries have moved to the periphery more aggressively and clusters of communities have gradually formed along the main transport routes in the periphery of the central area of HSP. However, there is still a lack of efficient and convenient connections between the various neighbourhoods and no core market street has been formed, so people do not feel a strong sense of belonging in the residential area. In general, the industrial core of HSP has a commercial street with an identity but the walkability to the surrounding neighbourhoods is weak. The communities have shops and restaurants to meet their daily needs but no place where people can gather. Zhongguancun Square is still accessible by car for most residents.

In general, HSP has a functional urban structure integrating the urban grid and densities. However, its walkability remains a challenge. Especially in the residential areas, there are no diverse market conditions enabling social and economic integration. However, the concentration of universities and businesses gives HSP a certain place attachment because people identify with this place. The BDA is relatively weak in creating a sense of urban identity. Both cultural creation and people's sense of belonging could be further developed to improve the quality and character of the spatial structure of the BDA, to enhance the activities of residents and achieve a more attractive city area.

Chapter 8 Evaluation and discussion

Chapter 8 is an evaluation of the case studies based on the analysis in the previous two chapters. This chapter will explore three aspects of urban quality for the sustainable integrated development of Chinese edge cities, based on criteria of space production. BDA and HSP are assessed in terms of urban diversity, efficiency and identity.

8.1 Urban qualities analysis

8.1.1 Urban diversity

The analysis of the urban patterns in sections 6.3 and 7.1 provides a visible picture of the landuse distribution, housing typology, public transport routes and urban density of the two cases, which allows for an analysis of spatial diversity to determine the diversity of sustainable integrated urban spaces.

A diversified housing typology breaks the monotony of residential communities and realises the diversification of residential areas. Each community in the selected residential areas of the two regions has a different time of development and a different type of housing, divided into villas, high-rise, low-rise residential and commercial residential dual-use housing. Yizhuang is located on the edge of Beijing, so the land price is relatively low compared with the downtown area. Therefore, some residence communities have been developed into villas, which is rare in downtown Beijing. The houses in HSP are relatively old, with a traditional five- or six-storey low-rise building housing pattern and a middle-rise building and a high-rise building in the newly built housing stock. Due to the high price of the land, there is only one villa complex in the area. In general, both cases have a mix of different residential neighbourhoods that create a diverse and complementary residential area that meets the needs of different income groups.

The building density of BDA's residential areas is quite average, the average number of residents in the communities is stable and there is a more suitable living environment. Different residential areas meet the needs of different families. There are various types of rooms in the selected residential areas, ranging from 30 m^2 to 460 m^2, including one-bedroom flats, three-bedroom suites suitable for families and even larger ones. Housing prices vary with the different developers and supporting facilities, which meet the needs of different income groups. However, according to the average wages in

Beijing and Yizhuang, the overall housing prices in BDA's residential areas are still slightly higher. Even if there are houses with different prices to choose from, the lowest price is about £4,000, which is unaffordable for those who work in Yizhuang with an average monthly salary of £708 such as sales clerks and sanitation workers. However, compared with the overall housing prices in Beijing, the housing prices in BDA are reasonable.

HSP has many old houses but because of the development system and the many universities, it has attracted a large number of people. The high density of the population and the excellent location has led to house prices that are higher than the average price of a house in Beijing. The density is also higher than in BDA. In terms of price, HSP is more attractive to people than Yizhuang. Even though housing is more expensive, the area's current situation still makes a large number of people want to live there.

Diversity is not only an issue of diverse house typologies but also the integration of local businesses of various sizes. The residential areas of BDA are concentrated. Some neighbourhoods are mixed-use buildings. There are several shops on the outskirts of some residential communities and some kiosks and pop-up shops are located around the neighbourhood. The residential area of HSP is also centrally distributed in the three spaces of the district and the scale of the residential area is relatively large. However, in both cases, its current structure does not integrate any particular mixed-use or commercial road in the centre of the residential district, which would attract many different kinds of businesses and interactions. Therefore, people go to malls or do online shopping instead, which does not add to urban diversity.

In these two cases, apart from the differences in housing types, the residence communities built in different periods of time have little impact on people's daily lives. For example, there are schools, shops and restaurants within walking distance around the communities. The residential areas of BDA are more accessible by public transport and bicycle. However, the metro is not walkable for most residential areas and even for cyclists the distances are long. HSP has limited coverage of residential areas and not all neighbourhoods have a bus stop within walking distance. However, there are more metro stations and lines in the area and more neighbourhoods can be covered, so more residents can walk to them.

Overall, the edge cities in China has relatively low house prices and densities compared to the average house price in Beijing. However，HSP has higher house prices and density. The residential areas in both areas are diverse and offer a choice of different numbers of rooms to meet the needs of different groups. There are few differences in terms of the services provided to residents in the residential areas, although the developers and construction times differ. In addition, the Chinese edge cities are functionally satisfying, and offer a diversity of functional options, including parks, shopping malls and different travel options. However, their efficiency needs to be further analysed..

8.1.2 Urban efficiency

After identifying the activities provided by the city based on the urban patterns of the case, Section 7.2 analyses the urban activities of the BDA and HSP to obtain the time spent by different modes of travel for different behaviours in cases, which allows further analysis of the efficiency of Chinese edge cities.

At present, the functional spatial distribution of BDA is characterised by obvious zoning between residential areas and employment areas. There is spatial isolation among various functions, which is not conducive to strengthening urban comprehensiveness. BDA is well-equipped with a large-scale shopping mall, a hospital and other supporting facilities. In BDA, public transportation is convenient. There are 17 bus lines covering almost every street in the residential areas. People can take buses to the centre of Beijing, the BDA core area and Yizhuang New Town. There is also a subway line in BDA. In terms of the overall planning, the position of the subway line is reasonable but in reality is not very practical. Most residents cannot walk to the subway station, so the subway is only convenient for people who live near the station. HSP has more underground lines and a relatively large number of underground stations and the neighbourhoods and offices that are covered are more numerous. There are about 50 bus routes to choose from. However, many neighbourhoods are located on secondary roads that are not accessible by public transport, making them less walkable in general.

For most neighbourhoods, due to the long distance, the long time spent on public transportation and the unreasonable location of subway stations, every family should have at least one car if people can afford it. However, the use of shared bicycles has reduced energy consumption in cities. For example, people can ride bicycles to the subway station and then take the subway. Instead of walking for half an hour, people now only need to ride for 10 minutes. To some extent, cycling replaces driving in BDA. For long-distance travel such as going to downtown Beijing, people, especially office workers, cannot replace their dependence on cars. Therefore, although the residents of BDA cannot walk to every place, the use of bicycles can make the city more efficient and sustainable.

Qin and Ryuzo (2018) shows that people's outdoor activities are related to accessibility, environmental support and other factors. There are complete supporting facilities in residential areas, including schools, supermarkets in the lower floors of residential buildings, restaurants, and so on. In addition to work, people can walk to most of the places they need in daily life, except that it takes a long time to walk to Boda Park for a few communities. The only problem with the selected residential areas, which is also the only problem with most Chinese residential areas, is that most communities in China are closed communities, each of which is insulated. Even if people live in adjacent neighbourhoods, they are mysterious to each other. People in their communities do not know the space, facilities and different communities. This also makes many public spaces or parks in other neighbourhoods inaccessible, reducing the possibility of people's space experience. Local residents mostly use the roads inside the community and it is difficult for other residents to reach a certain place through the community in the shortest distance. This increases walking distances and times, which is also a major factor for people staying at home and ordering online.

The main roads in these two areas cater mainly to motorised traffic. However, there are pedestrian paths and bicycle paths in the inner city. This promotes the restoration of the traditional human scale of the street and the reactivation of street life. It is difficult to attract people to stay on the street with other activities. The walking experience will be replaced by getting to the destination as quickly as possible. At the same time, the large scale of the street deteriorates the walking conditions of the city. Lu (2006) proved that the space becomes too empty and people feel disorientated and distant. Such a feeling becomes a sense of expansiveness and grandeur if the ratio is increased to a certain size. This subtle change is interesting, as is usually the case with interspersed spaces, large squares, etc. However, most of the public space in both areas is primarily functional.

To sum up, the Chinese edge cities are well-served by infrastructure and support services. The density of public transport is high in the inner city and the central city but the walking accessibility of transport stations is average. There are many options for urban transportation that make up for the shortcomings. The only factor blocking efficiency is the closed community. It is challenging to connect residential areas, each of which is an individual existence. The road infrastructure is perfect but there are many more private roads. As a result, many pedestrian streets are not available and walking out of the community is a great challenge, causing people to drive directly if they have a car. Closed communities do not create an experience between people and place. The communities only develop an internal infrastructure to attract customers with the functions people need to use, without considering people's feelings about the site. Besides, always the same activities and uncharacteristic walking experiences can limit the experience of the city and the sense of belonging it gives to people This makes many places inaccessible on foot and makes for a poor walking experience.

8.1.3 Urban identity

Different cities possess a different spirit. A city provides everything that people need to live in. Ziyaee (2018) points out that urban characteristics can be defined by environmental factors and activities or events within the area. After analysing urban patterns and activities, it is possible to derive the main spatial experiences of the city, as described in Section 7.3. It is possible to use this to investigate whether Chinese edge cities create the unique urban identity.

In Chinese edge city, most of the closed communities have their small plazas. So do these two cases. There are water facilities inside each community, some of which are in the recreational areas. However, every community is independent. Even in adjacent neighbourhoods, people have no idea what the interior of next-door neighbourhoods looks like. For those who do not live in this community, they are mysterious. Boda Park is regarded as the landmark of BDA in Yizhuang and is the only place where residents gather. There is a plaza and water features in the park for the recreational activities of residents. Although most communities can reach the park on foot, its location is not in the centre of the residential area. Encouraging contact requires unobstructed views, short distances, low speeds, being on the same level as the object of experience and more consideration of view perspective. However, most of these public areas are in a block, surrounded by a fence, have obstructed views and are too large.

In HSP, there are three concentrated residential areas, all of which are surrounded by the park and public space. However, only the public space in the south of the district has left a lasting impression. The large and distinctive Zhongguancun Square attracts a large number of local residents and people from other areas and tourists. This makes it a landmark of the area and an identity of the region. In addition, most of the other public spaces in the district are like Boda Park (Figure 65), which is a larger and more independent space. In other words, the location of the park is quite remote compared to the concentrated residential area. As a result, there are residential areas that are not close to the park. In addition, since every community is generally closed, most of the roads inside the community are unusable. People have to take the public pedestrian track, which requires extra time for a detour. Moreover, as most sidewalks are near driveways, it is a poor experience for people to go to the park even if it is only a few minutes' walk away. Therefore, BDA does not seem to have a place for people to gather compared to the concentrated residential areas and the public areas of each community. These places are more likely to be designed to meet a functional need than to create public spaces on a human scale.

To create a sustainable place, it is necessary to determine whether both sides of the road are inviting to people and whether there is a place to stop and rest. There is a big gap between the pavements in these two areas in this respect. Urban furniture in residential areas is a priority for people compared to office and residential areas. In some residential areas, shops alongside the residential buildings make up for the inconvenience of shopping centres being too far away. Nevertheless, these shops do not have outdoor tables and chairs or space for people to feel the place. People leave after they buy what they need and there is a lack of charm for people to stop and feel the attraction of the place. The benches, bicycle parking spots and rubbish bins are set up at certain distances on the sidewalk, providing convenience to the public. However, as there are no other activities or facilities, people do not need to rest on the benches except when tired. That is to say, although some urban facilities have been provided in residential areas, however, existing urban facilities are far more satisfactory compared to people's needs. BDA has taken into account the layout of the facilities on the streets but it does not meet the real needs of the citizens. The mapping also shows that from a bird's eye view, the city is one street after another with the exception of some office buildings. Each house is almost the same. At the level of the perspective view, there is still no distinctive character to attract people to form a unique sense of belonging.

Edge cities establish their place branding, promotion and production of landscape identity and experience in order to give residents a better sense of identity and belonging. Most of the Chinese edge cities performed ad BDA that satisfies the needs of residents in terms of function but the city does not have a strong identity or features. There is no place in the centre of residential communities that can attract people. They have to either walk to the unreachable mall to meet friends and engage in recreational activities or order take-out and watch TV at home. This makes people have no desire to experience a place or have a relationship with a place. HSP has developed its own culture and is known as China's Silicon Valley because of its large office space and the university located in the area. Therefore, when society transforms from satisfying demand to improving quality, the quality of space and people's experience of the area should not be ignored or abandoned. In other words, in addition to meeting the necessary infrastructure for people's lives, it is essential to consider how to attract people to the outdoors and feel the nature and the place.

8.2 SWOT Analysis

The subject of the present study is sustainable integrated urbanism, which includes living, working and everyday activities in an edge city in China. Most of the edge cities in China start as development zones, then take the form of dormitory settlements and rely on commuting modes of travel. These areas become inhabited and gradually form the urban agglomeration. This is the biggest challenge facing China's marginal cities today. Both case studies have led to clear insights about the current state of emerging edge cities in a mega urban agglomeration such as Beijing. Hence, a SWOT analysis model can be derived in order to better assess the strengths, weaknesses, opportunities and threats of China's edge cities spatial structure (Table 32). The significance of using a SWOT analysis is that by analysing strengths and opportunities could develop profitable strategies, and analysing weaknesses and threats could develop coping strategies.

Table 32: SWOT analysis. (Source: by author)

The rather fast and strict development of both areas in mainly two decades has given both BDA and HSP modern infrastructure, including public transit. The overall urban densities differ from any typical suburb in the United States at 180 to 280 inhabitants per hectare, which is comparable to many European cities and can be identified as a major strength in the integration of many everyday destinations for walking and cycling as well as the transit-oriented development. Many community services such as schools have been clearly planned and developed in walkable catchment radii. Major efforts have also been undertaken to landscape the main traffic routes, with around 20% of all investigated everyday routes being dominated by trees and other landscaping features to balance the experience of increasing traffic. Most private compounds have also been generously designed around landscaped spaces, leading to an overall walking experience of up to 45% on average being accompanied by vegetation.

The mapping analysis shows that people living in these marginal areas have a diversity of housing options. They can find functional satisfaction in their daily lives but nothing else. The urban image shows that people can walk to the places they can walk to, but from the starting point to the final destination, the whole journey is dull and meaningless and does not provide a good experience. Most people walk along the pavement, lined only by green spaces or the fences of the neighbourhood. The view is the same wherever people go, with lots of traffic and traffic junctions. This is the pattern language of a place and these characterless areas are the current state of Chinese edge cities.

A large part of the walking experience is still dominated by compound walls and multi-lane roads. Roads are often experienced as hazardous, especially for younger children, and can only be crossed at designated crossings, which are usually far apart. There are only few encounters with shops and there is no high street with pedestrian dimensions in either district. This lack of a commercial life on key corridors with many public amenities can be seen as the main weakness in both case studies, since any place making and as such, any traditional understanding of a city depends on a shared open market which is both spatially integrated and diversified to attract the various interests of a complex community. The traditional Chinese market street has not found its modern translation and development in either BDA or HSP. Instead, the typical suburban model of supplying shopping malls has been followed, leading to replaceable and privatised consumption spaces instead of an opportunity for public life to emerge around a unique image of a new city.

One ancient, essential part of the city is an integrated public centre where there are services, markets, entertainment and cultural facilities and landmark commercial streets. Chinese edge cities have shopping centres and parks but not pedestrianised shopping streets with a wide range of activities from entertainment to consumption. Therefore, it is clear that the main problem of Chinese edge cities at this stage is that the people living in them will have a fragmented relationship with these places. These activities do not have a shared relationship, which a large-scale commercial complex cannot replace. Like the Gruen transfer phenomenon, the mall never conveys the feeling of a shared access centre but an enclosed consumption temple. It is convenient but like another world and replaceable, it can be anywhere, and new shopping centres will emerge and compete with it. Like BDA's mega-malls, they are dispersed to make them easily accessible but only to meet the needs of life and not to give any sense of character. The emergence of a new complex in the vicinity and the tastes of the people will displace the original shopping centre. HSP is an early-development edge area but its central business district is commercialised with no memorable character. Instead, the Silicon Valley-like culture and the presence of Chinese universities are what give them an urban civilisation similar to that of the San Francisco Bay Area.

Sustainable integrated urbanism is to allow places to be used with functions and each behavioural in a pedestrian context. So the opportunity is to understand the relationship between people, place and function. And having the correct spatial configurations to make people actually use them. But people remembered this area is a shopping mall and people‘s homes, these can easily be replaced, so the threat is a lack of identity that people do not attach to new places easily. In general, the city is an integrated public centre with both services and cultural facilities. This is what miss in Chinese edge cities. Chinese edge cities more focus on function development, they have malls and parks but they have no walkable integrated areas and place making with diverse activities, the full function made the area like a high-density suburb, not like a city. this is why urban design matters and why needs to be more integrated into future in these projects. And is very important to understand the relationship between people & place and function

Therefore, the strength of Chinese edge cities is fast and strict development led to a functional structure, but the view is same and with lots of traffic and traffic junctions. And, some small shops have been planned within walkable distance, but no high street with pedestrian dimensions. It met the needs of life but didn't give any sense of character and like no place making. Also, people living in these periphery areas have diverse housing options, but the stop-and-go experience made people who live here have a fragmented relationship with these places. And this stop-and-go experience gives the impression of a car-oriented grid with large and gated residential.

In general, the edge city can meet people's daily lives in terms of functionality. However, it is a somewhat fragmented experience. It is compound-based and there is little incentive to explore on foot, so people's travel is still mostly car-based. As a result, it is likely that the last thing that is remembered about the edge of town is a shopping mall and people's homes. However, these can easily be replaced and cannot be defined as the identity of a place. The idea of sustainable integrated urbanism is to allow places to be used, with functions that allow people to attach to them and experience them on a walkable basis.

The biggest challenge for Chinese edge cities is that they are new places with no history and no generations of people building them. China's edge cities function like high-density suburbs. They try to develop a polycentric model and to activate the periphery. However, the vision does not fully translate into reality. There is a plan to decentralise but there is a lack of understanding that people do not attach to new places easily. Therefore, it is even more important to have the correct spatial configurations, landmarks and public spaces to make people actually use them. It is more important to understand the relationship between people, place and function. This is also why edge cities need to be more integrated with these aims in future.

In the future, this vacuum of shared market streets and public corridors linking neighbourhoods needs to be addressed by investigating the potential to break down compounds into a smaller number of key blocks and by opening a new layer of pedestrian movement inside those previous compounds rather than along the main access roads with heavy traffic. The rigid grid has enabled a fair and even distribution of traffic but it has also led to replaceable spaces with hardly any identifiable spaces of public life. To establish consolidated edge cities, the role of public spaces is, however vital to attract everyday walks resulting in new explorations which lead to new investments in time. In many ways, the suburban expansion of Beijing mainly differs from urban agglomerations in the United States due to the differing residential typologies and thus higher urban densities. However, in both regions, edge cities are challenged to emerge because of dominant private spaces and increasing traffic inhibiting any pedestrian movement.

8.3 Summary

This chapter is based on Lefebvre's theory of urban space and Wiedmann, Salama and Mirincheva's triad of space production as a criteria to analyse these issues in order to understand the complex interdependencies between current diversification strategies and their impact on urban quality. According to the theoretical framework, the issue of urban spatial equity is implicit in all the cases of the above-mentioned issues, and therefore the issue of urban spatial equity in edge cities needs to be addressed.

Whereas in the past, modern urbanisation was largely guided by centralised planning and policy makers' understanding of urban space, the urbanisation of edge cities has entered a new phase where sustainable and integrated design needs to become a more important factor in spatial transformation. Thus, contemporary urban studies of Chinese edge cities need to focus on the various interdependencies between liveability and integration by analysing and assessing all the factors that influence the spatial transformation of the city. The current development strategy and its focus on rapid urban growth has resulted in cities focusing more on the satisfaction of functionality, while the lack of urban space has led to a decline in urban quality.

Urban diversity in China is mainly determined by governance and the spatial practices of developers. In these two cases, the real estate offers a diverse typology of housing options for the citizens surrounded by convenient shops and kindergartens, which to a certain extent meet the daily shopping and other needs of the residents. However, most real estate is developed for short-term investment benefit rather than with the expectation of long-term returns. Real estate developers have built these neighbourhoods efficiently and quickly, giving them a uniform layout and design even though they offer different house typologies. One of the main problems with this urbanisation is the lack of direct interaction between the developer and the users of the property. Thus, the main challenge for the construction of Chinese edge cities remains the market's reliance on real estate. In addition, the large-scale gated communities have made travel options for citizens extremely limited. A diverse, safe, efficient and at the same time appropriately sized gated community is the main challenge for the development of these areas.

The quality of urban efficiency is fundamental to any sustainable integrated urban growth. It is heavily dependent on urban governance and is responsible for providing a comprehensive vision, development strategy and implementation of the legal framework. In the case of BDA and HSP, they are well-developed in terms of functionality due to policy support. However, the result of the excessive pursuit of functional planning has led to these edge cities ending up with a fragmented urban structure: extensive mega-projects, high-rise buildings and continuous urban sprawl. This means people are still dependent on cars to get around. Even with the construction of pedestrian walkways on both sides of the road, their boring walking experience is also unsatisfactory.

The quality of a city's identity is based on the citizen's experience of a place's liveability, character and sense of belonging. For edge cities like BDA and HSP, identity is very important for the internal integration of a society. Only in this way can these edge cities truly act as a city, otherwise they will remain a fringe area that caters for people who live and work on the edge of the mega city. A society can only be considered sustainable if it has a shared sense of identity for its context. The images created in BDA are fragile because they are superficial in nature. They do not give people a strong urban character and identity. However, in HSP the sense of local identity is extremely high due to the development of the large-scale electrical engineering sector and the large number of universities in the surroundings. Hence, the main challenge for China's edge cities is how these peripheral areas can create their own identity and give their citizens a strong sense of place in the future development of HSP.

Chapter 9 Conclusion

Chapter 9 begins with a summary of the whole thesis and in the second section points out the shortcomings of the thesis and the issues that can be discussed further in the future.

9.1 Findings from the research study

The idea of integrated urbanism in edge cities can be traced back to Howard's Garden Cities in the late 19th century. Howard proposed that once a city has grown to a metropolitan city, a new city should be developed near it. There should be a full range of services and a balanced distribution of employment and residential space to maintain residential and employment distances within walking distance. An edge city is an emerging growth point in the post-suburbanisation phase of development. The suburbs of a large city gradually form a fully functional combination of business, employment and housing and have become an independent node on the city-regional network. Garreau (1991) argues that edge cities represent the future orientation of cities, a generation of citizens making value-based choices about their future work, residence and lifestyle in a new socio-economic context.

Edge cities in Western countries are the result of a combination of demographic, commercial and employment factors. In contrast to the West’s service-based edge cities, China's edge cities are more likely to be government-led. Since the central urban areas in Chinese mega cities are densely populated and fully exploited, newly emerging development areas in urban peripheries have been initiated via a decentralised development model and are commonly referred to as urban development zones (Zhang, 2000). In the 1980s, urban governance planned and promoted specific economic development areas in Chinese mega cities such as Beijing. The first incentives towards polycentric urban development were driven by an urgency to establish new industrial centres to prevent the concentration of manufacturing industries in few urban areas (Wei, Chen, and Lu, 2016). Development zones enjoy some preferential policies since they play an increasingly important role in the national economy and the overall transformation of Chinese mega cities into more advanced hubs for services and manufacturing industries (Chen and Liu, 2014). The urban development zones are usually located in strategic areas within the urban periphery to promote a more polycentric network of centres(Huang, He and Wei, 2016). The main factors in the selection of the locations of these development zones include a vast availability of land and infrastructural considerations, so that existing suburbs or villages can be connected, providing basic road networks and utilities for the first development phase.

While these first planned edge cities were mainly defined by industries and labour accommodation for factory workers as well as basic services, the economic growth and diversification of mega cities over the last 20 years have led to new development trends in those urban peripheries. Most manufacturing industries have been gradually replaced by new logistics centres and technology parks that attract emerging and well-connected knowledge economies (Zhao and Peng, 2000). This development zone-oriented expansion of mega urban agglomerations has entered a new stage, transitioning from the previous industry-led urban expansions towards well-functioning edge cities. The latter not only provide workplaces and shelter, but also a high quality of urban life for a diversity of lifestyles and economies (Chen, 2007, p.91).

In recent years, the urban development zones have gradually been developed and transformed into entities with higher population densities supplied with state-of-the-art infrastructure. An increasing number of these urban development zones could be technically identified as edge cities due to their size and land use composition. However, the overall speed of the economic and spatial development in Chinese mega cities has been based on a predominantly infrastructure-led and thus supply-driven development pattern that gives rise to functional but highly regulated urban spaces. Beyond the functional aspects of housing, workplaces and services, the overall interaction and experience in these new cities as lived places requires increasing scientific attention regarding the overall potential for urban consolidation.

In this study, Beijing’s urban periphery and its transformation are investigated in order to identify recently completed urban development zones that meet the general criteria of an edge city. This timely research aims to portray the current spatial conditions and to identify everyday activity patterns and the resulting shared experiences. The research reveals the spatial patterns and their overall language and discusses the opportunities and threats of today's everyday urbanism with regard to the creation of actual edge cities rather than cities without cities. Thus, the main aim of the research is to investigate the general performance of the integration of everyday life in those new cities and the resulting experiences in order to discuss the current state of edge cities.

The investigation of both everyday activities and experiences is key to understanding the complex relationship between people and places. As Louis Wirth (1938) defined urbanism as the way people live in our cities, the aim of this investigation is to analyse everyday life in a distinctive spatial configuration. By mapping and observing activity patterns, as well as the triadic theoretical framework, it is possible to learn from built spaces and their impact on human behaviour. Any successful polycentric development requires residents to share and to identify an urban area as part and ideally the centre of their everyday life. Once a place is only experienced as a dormitory settlement or transit space, there is a general trend of human beings interacting within a smaller radius from their homes and relating to a different and often distant centre (Gordon and Richardson, 1996). Worldwide, rapid growth has promoted fragmentation trends in urban peripheries and thus residents are experiencing a dependency on long-distance commuting to identify a place of belonging beyond the walls of their dwellings (Lee, 2007). Increasing everyday commuting in Chinese mega cities indicates that there is a significant need to promote a more integrated form of urbanism in emerging edge cities beyond the functional aspects of infrastructure and land use management. Chinese cities have been developing very rapidly but face various quality-of-life concerns.

Firstly, there is often a phased imbalance in the relationship between employment and housing in development zones. This is because in the early stages of construction, the peripheral areas usually focus more on industrial development and economic construction, while the construction of residential functions and comprehensive service functions lags. As a result, the residential capacity and public services in these areas cannot meet the needs of the fast-growing employment population. At the same time, the separation of jobs and housing has resulted in an overall urban environment that is not sustainable on a human scale. Neighbourhoods have formed and matured against a scarcity of housing and the need for extensive construction. But as society evolves from satisfying quantitative needs to raising the level of quality, the space making and people's experience of it cannot be ignored either. The large patches of gated communities are the result of the overall development process, in which major investors have been bidding for large pieces of land. Subsequently, the same housing typologies have been repeated within each gated compound, leading to monotonous sites within a large patchwork of developments (Chen, 2019; Feng, 2017; Tang, 2011). The focus on functional planning has minimised public roads with state-of-the-art transit solutions and landscaping along the primary grid. However, the gated communities have an average size of 15 hectares and offer no public thoroughfares, leading to in efficient connections within the district.

The result has been a relatively low efficiency regarding the overall spatial integration from a pedestrian point of view. While a few restaurants and small shops have been integrated with rather random junctions, requiring local knowledge and orientation to be found, there is no commercial high street offering space for a diversity of businesses and shops. In order to move away from car dependency, both areas have tried to maximise the spatial structure of public transport and walk. For example, almost every road has clear pedestrian and bicycle lanes, and bike-sharing has been introduced to help reduce bicycle ownership. However, the overall spatial monotony makes it difficult for people to have any activity on the street. Getting to their destination as quickly as possible becomes the main goal rather than experiencing the area.

The overall layout will encourage an increasing amount of car purchases for the convenience of reaching shopping malls as the most favoured leisure spaces. While schools have been integrated, most children have to cross large junctions, and the general safety is further compromised because of walkways along stretches of walls with hardly any activities and public observation. The overall spatial configuration also encourages an introverted indoor lifestyle, which is promoted by the ongoing digitalisation and online services. The rapid urbanisation has thus led to a certain degree of social isolation and the lost opportunity to create spaces for smaller businesses to thrive in a new and active urban centre. Subsequently, the integration of various social groups can be regarded as low and problematic.

The explored edge city is a good example of how functional planning concerns such as traffic management and efficient housing supply can lead to a division of land uses and a missed opportunity for integrated urbanism. The modern outer shell of this new city cannot replace the missing inner core, in the form of the main marketplace open for public interaction and demand-driven economic developments. While traditional cities in China and worldwide have been formed along the function of a market to trade goods and services used by many different social groups, modern edge cities are top-down planning efforts based on created consumption worlds with rather constrained opportunities for public interactions including basic commerce.

Thus, it is no surprise that the heart of these emerging cities can only be identified in malls and some green spaces for representative purposes to create a certain image of a green, modern and clean city. However, with just 0.2 m^2 of public green space per person, it can be stated that there has never been a focus on an alive and thriving public urban life (Qin and Ryuzo, 2018). Therefore, contemporary edge cities are very suitable representations of a fast urbanisation process focused on delivering decentralised production centres and adjacent consumption districts in the form of gated neighbourhoods dependent on malls and introverted lifestyles. However, an emerging urban identity requires public life and thus social interaction and exchange, leading to a distinctive local culture associated with the new edge city. These places are currently lagging in terms of integrated urbanism in the development of urban edge cities. For example, there is too much emphasis in the development process on prioritising the development of regional industrial functions. In contrast, the strategic understanding of sustainable urban design for urban functions is vague, especially on a human scale.

As a result, the current phenomenon of excessive spatial separation of functional areas such as residential, business and commercial service areas in edge cities has led to an imbalance between jobs and housing. This leads to a concentration of commuting trips during the morning and evening peak hours and an extremely concentrated and unbalanced flow of commuter traffic, causing urban problems such as traffic congestion and tidal wave traffic. On the other hand, it also leads to long commuting distances and times, making people more dependent on motorised transport, exacerbating the environmental pollution caused by motorised vehicles and severely damaging people's travel experience. The quality of a living environment directly impacts the quality of life, the environment in which people live, their emotions, and even their character. Therefore, a sustainable edge city should be based on a rational analysis of the people's structure, lifestyles and habits, community atmosphere, outdoor activities, recreational areas, public facilities and other factors to achieve the concept of integrated urbanism, rather than remaining functional and limited to grid-based development.

9.2 Effectiveness of theoretical framework and contribution to the field

Through a literature review of edge cities and sustainable integrated urbanism, a sustainable urban qualities strategy is proposed as the theoretical basis for this paper. The aim of this study is to discuss and understand the new urban spatial structure of the edge cities in China.

The research was designed to test the performance of Chinese edge cities' spatial structure by assessing urban patterns, activity and experience of urban space in order to explore diversity, efficiency and identity. It is a more comprehensive explanation of spatial practice beyond traditional design knowledge. It is an everyday urbanism understanding of the new urban area. The case studies indicate that most of the development areas are functional, the result of unified planning with little place-making. But they are not completely universal, for example, HSP is a very successful urban identity and culture place, and has attracted many people to form a population aggregation. Although they are not yet fully sustainable in terms of urban efficiency. Therefore, the current situation of Chinese edge cities still needs to be analysed case by case, but in new edge cities, the urban efficiency and identity aspect can be improved based on the experience of existing cases. So an obvious suggestion for future construction is to try to find a way to break the big compounds, but keep the residential area gates and not challenge people's view: still providing safety. And then place-making. However, it is very challenging to have it done against the planning system. Another consideration is that the unified planning and the separation of jobs and housing that is currently implemented is also a constraint to building sustainable integrated urbanism. In the future, in addition to the design level, the government can specify unified guidelines and then design the place according to local conditions, thus trying to achieve a high-quality urban structure in the edge area.

To study a social phenomenon, a way to explain a social phenomenon from the micro perspective and a way to understand a problem in depth. So the implications of this theoretical framework could explore how this area works. It is a bottom-up view from the people's side. This could reflect the role of the designer as citizens to use the area. And preparation and exercise for future research to be conducted this way. And this framework or methodology is not alternative, because it is a way to study a phenomenon in depth. For the practitioners who are relevant in this work, they can know where they are, what they could change, and how to change, and the importance of designers still exists, but how to distinguish it in a special context and how to make good form and space for people is quite important. So the practical contribution is it could feed into future development for this area, And reflect the positions and potentials of designers.

In general, the main finding based on this framework is a distinct spatial configuration, that is very functional. But its experience is fragmented, and fragmented relationship to these places and no shared relationship. However, This cannot direct generalisation. It is only suit the area with similar conditions and should be case by case. But the way to think and answer the research questions could be continued used to understand how a place work and feeds to future development. And the implications of this practice are a view and a way to see the problem. This is a kind of knowledge to better understand the fully functional planned area, and based on this consider more from a more human scale, and place-making.

9.3 Limitations and future recommendations

For the analysis of the cases, detailed data and information such as the early construction timeline are missing due to word limits and lack of information. As a result, there is no unified framework for comparison and analysis of the early development stages of development zones and edge cities. The thesis is limited to the development characteristics of key years and the development trends of phases, which can be verified by further extensive data collection.

The individual activities of residents are different for different age groups, and there is a significant difference in activeness between weekdays and rest days. For example, many residents need to commute on weekdays, with relatively large activity spaces. There are instances of shopping, leisure and other activities that remain near their place of employment after work. On the weekend, there is more individual variability in residents' space use, but overall there is a greater reliance on the neighbourhood and its nearby spaces. This could be further investigated in the analysis of daily activities. In addition, the analysis of urban activities also relates to the issue of walking time, which also seems to be different. For example, the walking time required for a disabled person in an urban activity or the walking time required to travel with a child is different.

However, in this thesis only a general, average figure is provided.

In terms of integrated urbanism, the thesis only measures the integrated design of edge cities in terms of residential land use, as industrial and business land use is still dominant in both cases in terms of providing employment land and the concentration of the population is relatively high. However, in the future, as the transformation of the cases develops, the impact of commercial and business land, public-facilities land and the part of the mixed-use land that can provide population transformation for urban integration will become more evident. Therefore, in future studies, land for the tertiary industry can be included in the research and integrated urbanism can be analysed in a more complex land use context. In addition, when analysing the density of the city, the population density of the each neighbourhood is calculated based on an average of 2.62 persons per household according to the Chinese National Bureau of Statistic. However, the number of people per household should also be discussed on a case-by-case basis, such as two-child families, single-parent families and elderly people living alone. Such data could also be further optimised for future research.

Finally, the focus of this paper is the development and transformation of urban integration for sustainable urban design in marginal areas. However, the development of edge cities also involves social, economic, institutional and management issues, and the emergence of edge cities is also closely related to these and many non-planning factors, so the analysis of urban integration in edge cities can also be studied from the other perspectives mentioned above.

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Appendix 1：Statistics for land and business in development zones (from 2000 to 2019)

Wangfujing Business District					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			26	2,852,288	
2001			26	2,852,288	
2002			26	2,852,288	
2003			26	2,852,288	46,804

Beijing Xisanqi High-tech Building Materials City					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			22	155,552	57,018
2001			19	138,367	71,240
2002			15	109,418	72,389
2003			12	82,510	76,490

Wangjing Industrial Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			87	405,873	36,512
2001			172	514,075	175,578
2002			273	535,501	122,666
2003			316	658,510	319,991

East Tourism economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			5	201,939	
2001			5	201,939	
2002			5	178,699	
2003			3	192,159	4,838

Yanshan Dongshui Industrial Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			13	2,677	2,531
2001			13	2,677	3,188
2002			16	8,169	20,390
2003			21	13,618	56,640

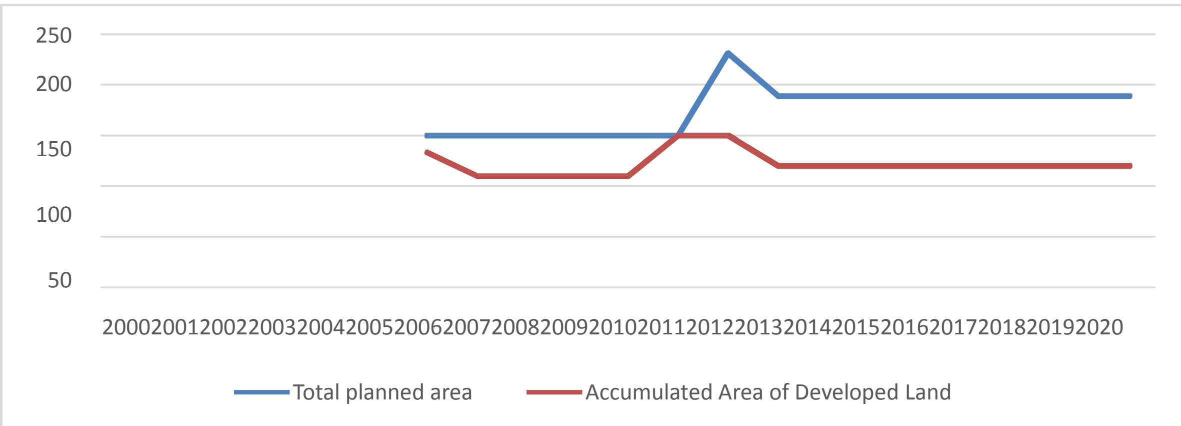
Beijing Ciqu Industrial Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			13	184,600	183,136
2001			13	184,600	21,000
2002			13	184,600	21,000
2003			13	184,600	31,474

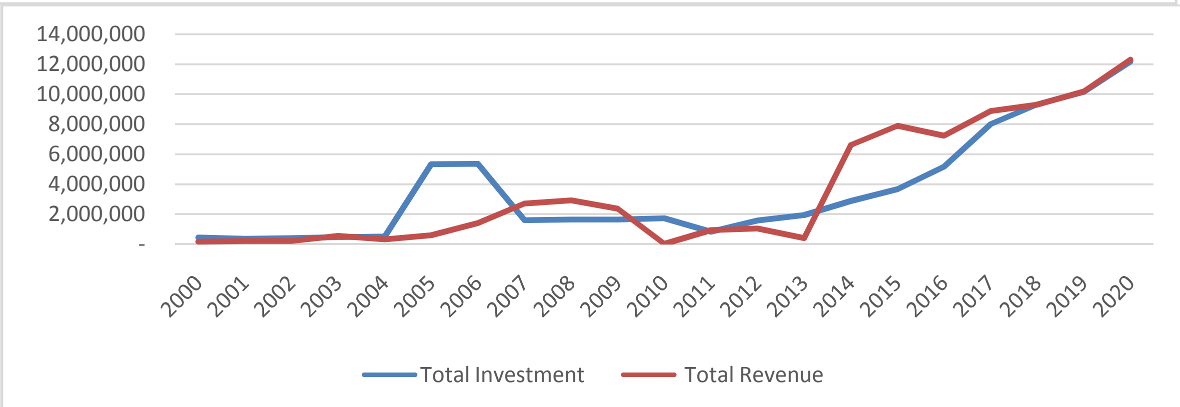
Badachu High-tech Park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			640	236,452	23,424
2001			774	288,542	103,219
2002			896	650,000	80,306
2003			962	388,502	752,207
2004			1,016	431,593	166,031

Fengxiang Techonology Industrial Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			224	75,910	73,865
2001			241	79,380	85,789
2002			255	81,480	34,577
2003			262	82,330	58,890
2004			472	124,580	86,516
2005			501	158,850	71,026

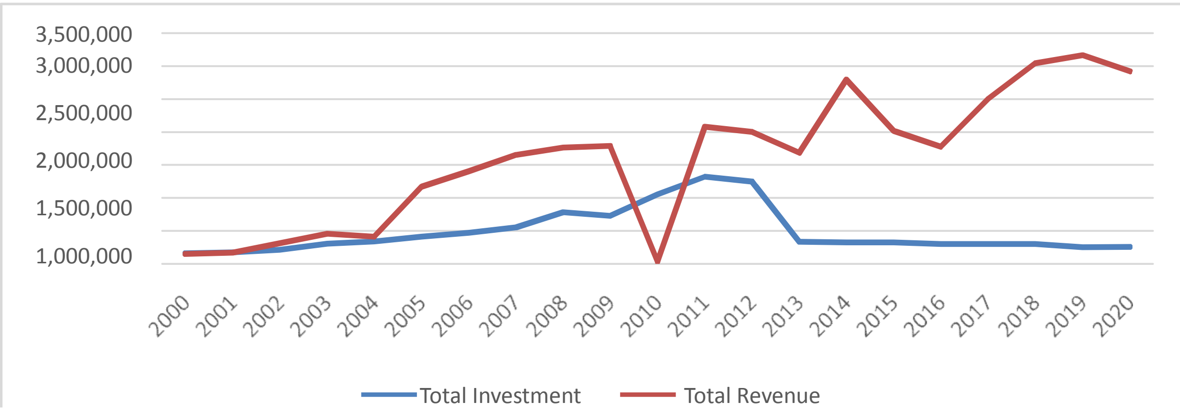
Municipal level development zone

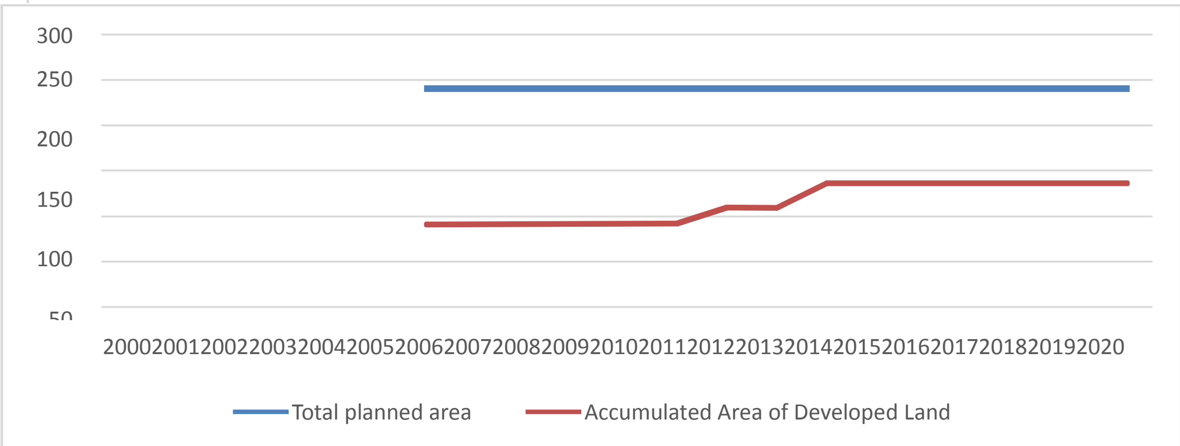
Shilong Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			1,006	446,105	185,824
2001			1,008	362,802	220,357
2002			1,079	406,212	232,968
2003			1,205	478,713	576,847
2004			1,296	509,927	340,422
2005			1,319	5,339,778	612,859
2006	150	133	1,327	5,341,788	1,419,376
2007	150	110	1,331	1,591,336	2,729,947
2008	150	110	1,386	1,632,942	2,937,413
2009	150	110	1,406	1,633,140	2,375,198
2010	150	110	1,558	1,722,940	39,134
2011	150	150	3,308	839,000	957,100
2012	232	150	4,468	1,569,914	1,065,725
2013	189	120	5,605	1,933,437	423,530
2014	189	120	9,692	2,888,137	6,625,760
2015	189	120	10,265	3,671,137	7,913,192
2016	189	120	11,065	5,163,430	7,249,209
2017	189	120	11,810	7,999,588	8,882,938
2018	189	120	12,572	9,314,570	9,317,718
2019	189	120	12,963	10,160,559	10,175,791
2020	189	120	11,538	12,175,791	12,318,082



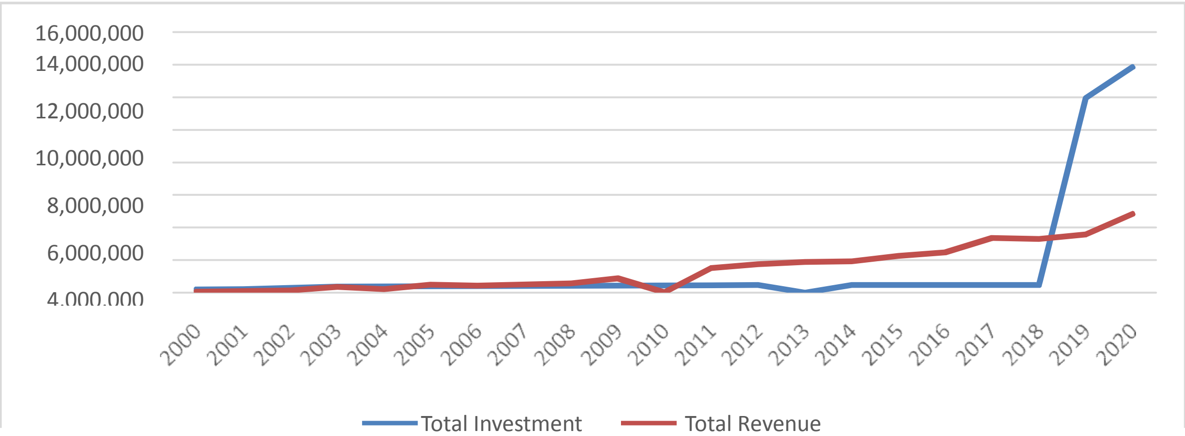


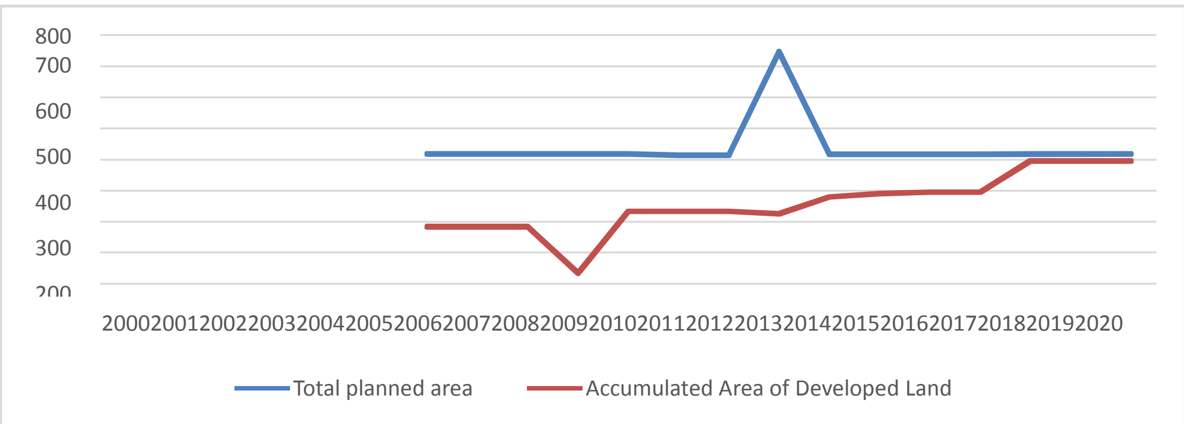
Liangxiang Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			305	163,791	154,500
2001			428	180,000	170,000
2002			488	218,505	320,000
2003			667	308,505	460,000
2004			687	344,000	413,000
2005			930	417,280	1,172,680
2006	240	91	1,260	474,697	1,406,031
2007	240	92	1,456	556,864	1,651,543
2008	240	92	1,688	786,950	1,767,151
2009	240	92	1,589	734,217	1,788,031
2010	240	92	1,628	1,057,698	35,821
2011	240	92	1,703	1,324,942	2,081,457
2012	240	110	1,695	1,252,852	2,001,761
2013	241	109	82	336,327	1,686,355
2014	241	136	81	328,327	2,794,208
2015	241	136	83	328,651	2,020,028
2016	241	136	84	304,676	1,782,283
2017	241	136	80	302,451	2,501,824
2018	241	136	80	302,451	3,043,583
2019	241	136	80	258,102	3,164,955
2020	241	136	84	263,172	2,923,662



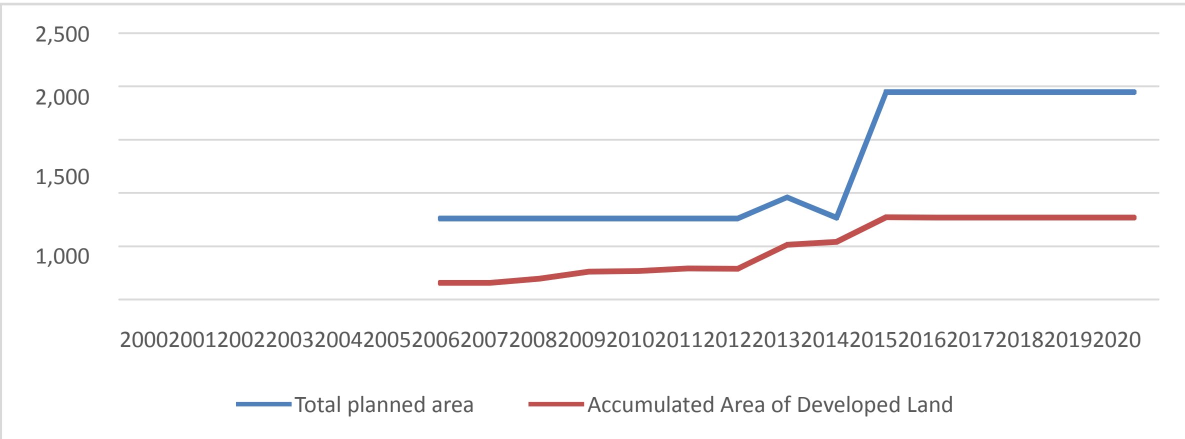


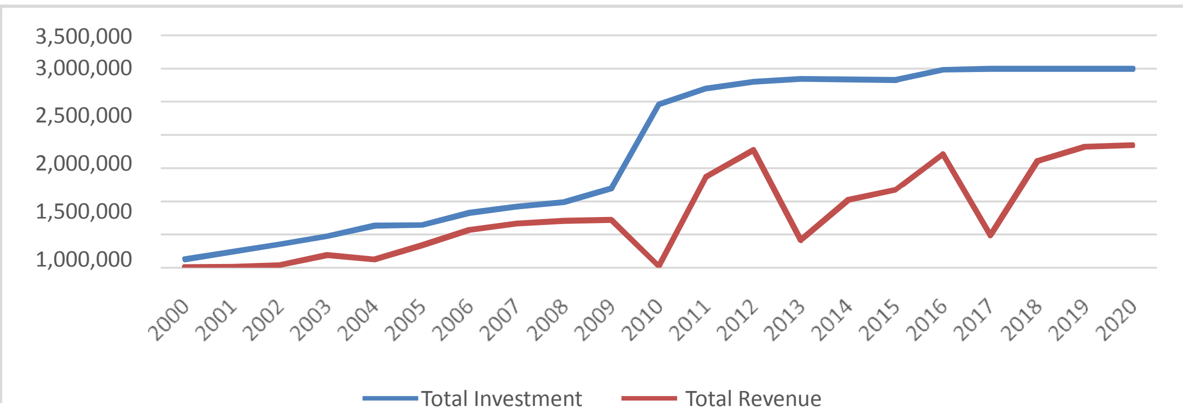
Daxing Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			263	191,103	72,187
2001			357	206,485	112,145
2002			490	298,240	151,474
2003			632	375,044	365,184
2004			706	400,863	217,054
2005			736	404,357	493,573
2006	416	183	645	452,500	435,551
2007	416	183	645	452,500	511,152
2008	416	183	645	452,500	575,319
2009	416	34	645	452,500	882,893
2010	416	233	676	452,500	28,563
2011	412	233	673	452,500	1,512,390
2012	412	233	748	463,940	1,747,960
2013	746	225	321	-	1,899,844
2014	415	279	2,064	478,512	1,939,455
2015	415	290	2,451	478,512	2,266,631
2016	415	294	2,849	478,512	2,489,200
2017	415	294	3,614	478,512	3,375,121
2018	416	395	3,615	478,512	3,303,585
2019	416	395	6,451	11,949,236	3,573,514
2020	416	395	7,275	13,849,112	4,839,454



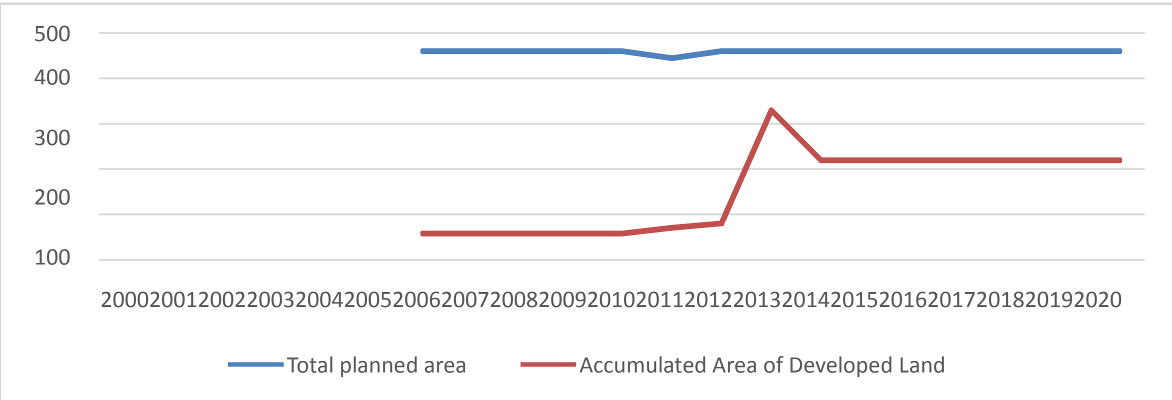


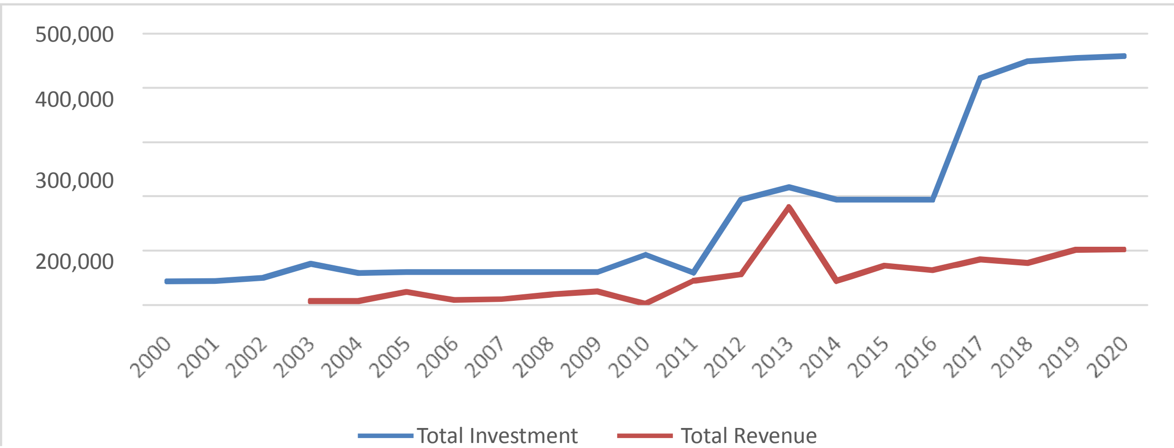
Tongzhou Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			77	133,200	11,281
2001			35	242,680	18,145
2002			70	359,412	44,762
2003			114	478,628	193,114
2004			178	637,089	126,047
2005			180	647,089	338,126
2006	762	158	228	828,797	571,588
2007	762	158	230	922,627	667,504
2008	762	198	233	987,627	707,938
2009	762	264	240	1,198,627	724,028
2010	762	268	343	2,458,234	26,813
2011	762	294	334	2,700,249	1,370,076
2012	762	289	336	2,798,564	1,773,439
2013	961	516	305	2,841,426	421,454
2014	767	541	80	2,839,846	1,022,455
2015	1,948	773	79	2,827,846	1,177,231
2016	1,948	771	87	2,981,539	1,710,741
2017	1,948	771	89	2,996,539	486,444
2018	1,948	771	89	2,996,539	1,611,139
2019	1,948	771	89	2,996,539	1,818,724
2020	1,948	771	89	2,996,539	1,844,562



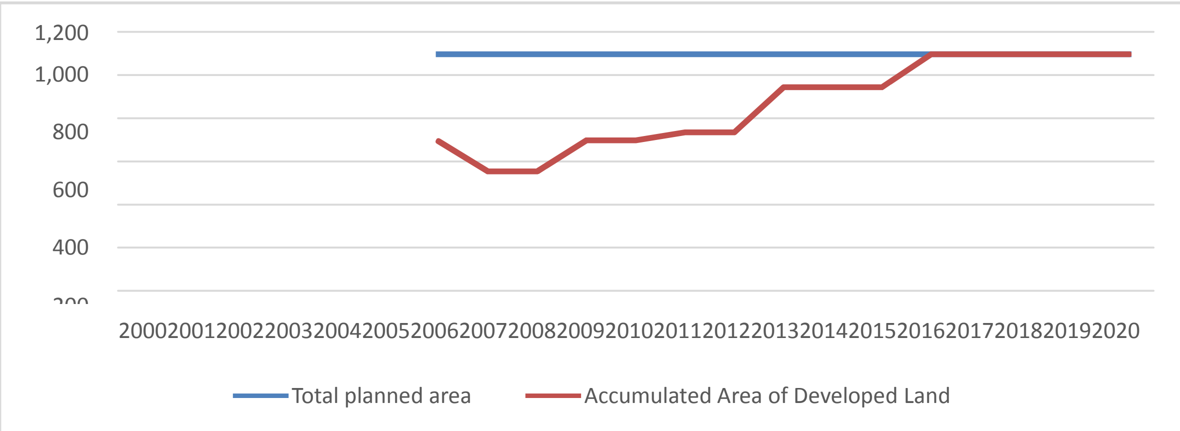


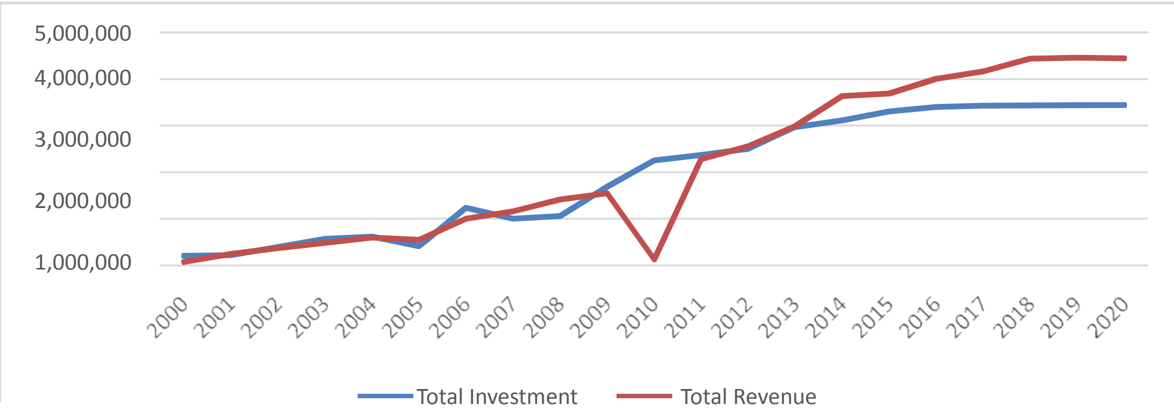
Yongle Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			30	43,091	8
2001			43	43,732	
2002			52	49,690	
2003			57	75,549	7,076
2004			758	58,352	7,219
2005			22	60,152	24,215
2006	460	58	22	60,152	8,905
2007	460	58	22	60,152	10,223
2008	460	58	22	60,152	18,631
2009	460	58	22	60,152	24,754
2010	460	58	23	92,152	2,207
2011	444	70	27	58,769	44,064
2012	460	80	25	193,769	55,858
2013	460	329	25	216,934	179,850
2014	460	219	26	193,769	44,385
2015	460	219	26	193,769	72,441
2016	460	219	26	193,769	63,306
2017	460	219	79	417,562	83,760
2018	460	219	101	448,817	77,282
2019	460	219	105	454,817	101,485
2020	460	219	106	458,187	101,717



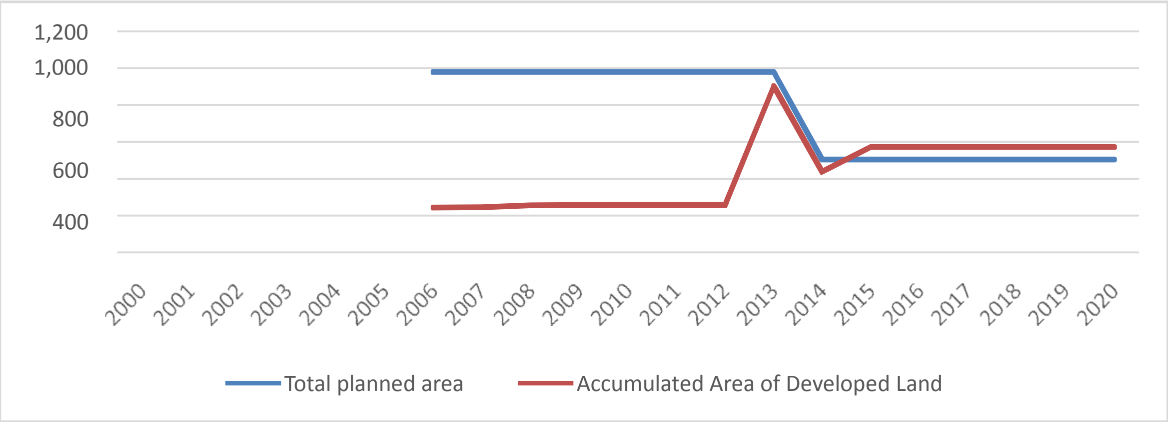


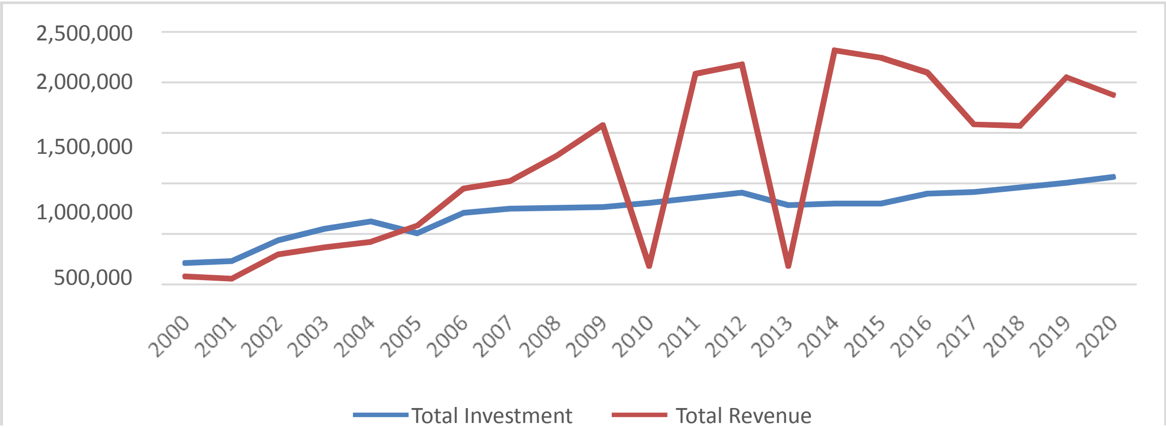
Yanqi Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			53	208,132	76,496
2001			68	222,132	250,000
2002			93	391,246	371,260
2003			134	573,000	479,461
2004			155	623,338	600,410
2005			492	416,425	550,743
2006	1,096	692	816	1,234,715	1,003,906
2007	1,096	552	260	1,002,170	1,160,817
2008	1,096	552	292	1,056,204	1,413,477
2009	1,096	696	1,126	1,688,563	1,540,995
2010	1,096	696	1,239	2,255,933	131,639
2011	1,096	734	1,249	2,371,093	2,278,208
2012	1,096	734	1,262	2,498,593	2,554,078
2013	1,096	942	1,286	2,970,448	2,987,593
2014	1,096	942	1,695	3,113,958	3,630,877
2015	1,096	942	1,707	3,303,258	3,685,540
2016	1,096	1,096	1,720	3,403,598	3,996,512
2017	1,096	1,096	1,732	3,426,648	4,155,480
2018	1,096	1,096	1,738	3,433,444	4,432,818
2019	1,096	1,096	1,846	3,441,444	4,452,046
2020	1,096	1,096	2,041	3,441,444	4,439,058



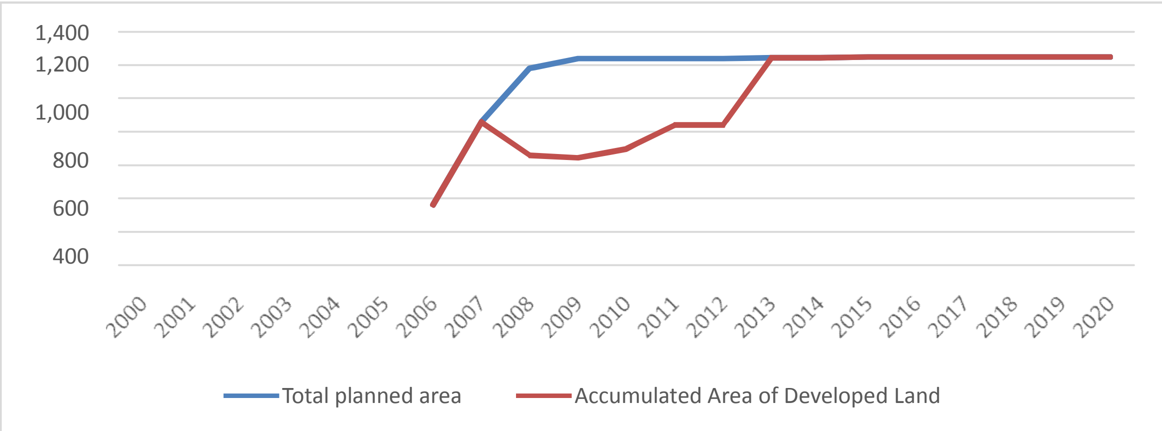


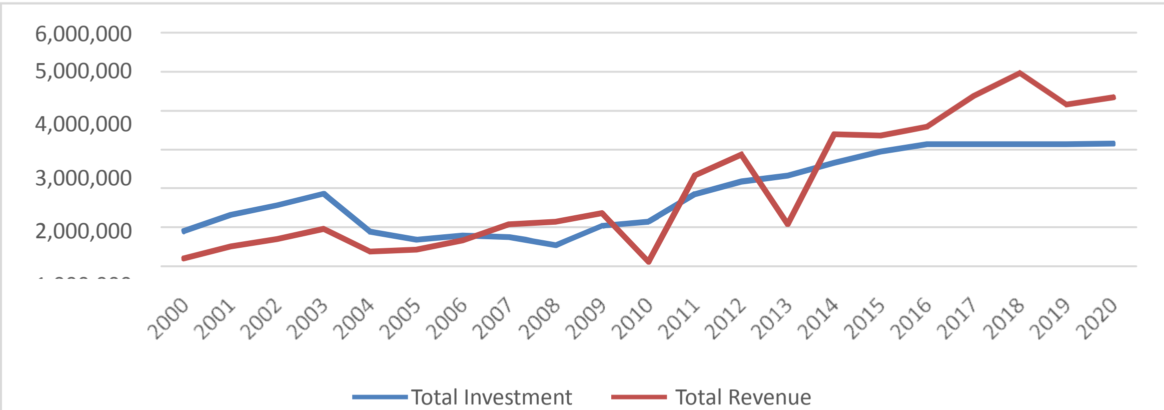
Xinggu Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			141	210,943	78,801
2001			152	229,321	55,923
2002			502	435,728	296,613
2003			601	550,393	365,206
2004			605	623,302	421,720
2005			160	505,672	582,134
2006	979	243	214	707,478	950,289
2007	979	245	221	751,567	1,022,007
2008	979	255	226	759,067	1,272,846
2009	979	258	228	766,067	1,577,863
2010	979	258	233	806,567	181,899
2011	979	258	241	856,717	2,087,070
2012	979	258	250	909,717	2,177,563
2013	979	901	195	784,886	182,910
2014	503	437	198	799,886	2,318,314
2015	503	572	198	799,886	2,245,375
2016	503	572	207	899,986	2,100,095
2017	503	572	214	916,128	1,587,176
2018	503	572	236	962,726	1,570,457
2019	503	572	309	1,006,291	2,052,348
2020	503	572	331	1,064,360	1,879,132



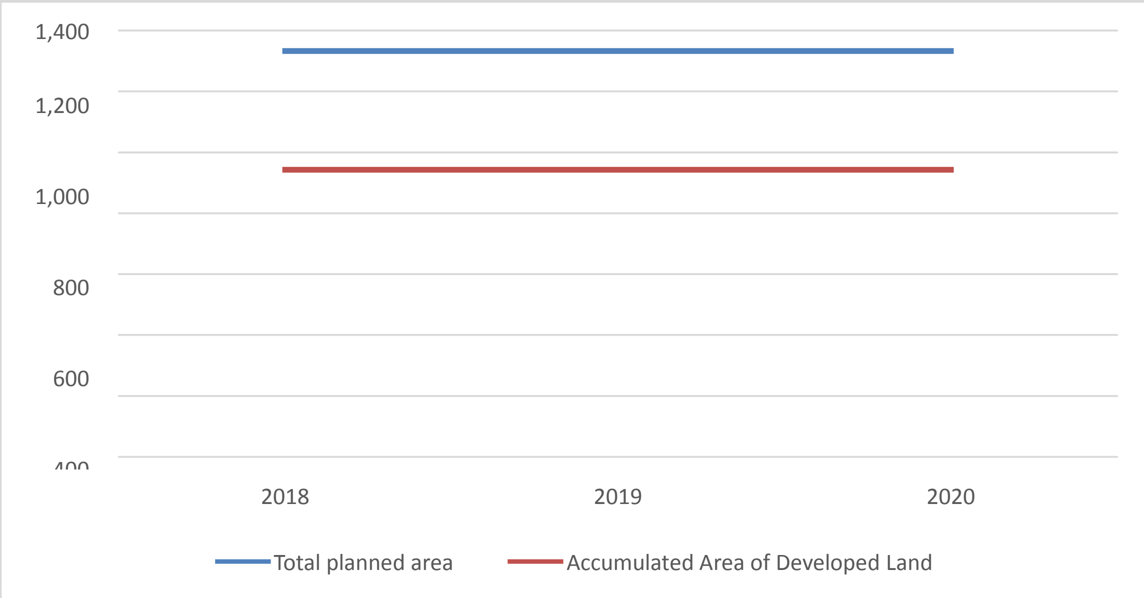


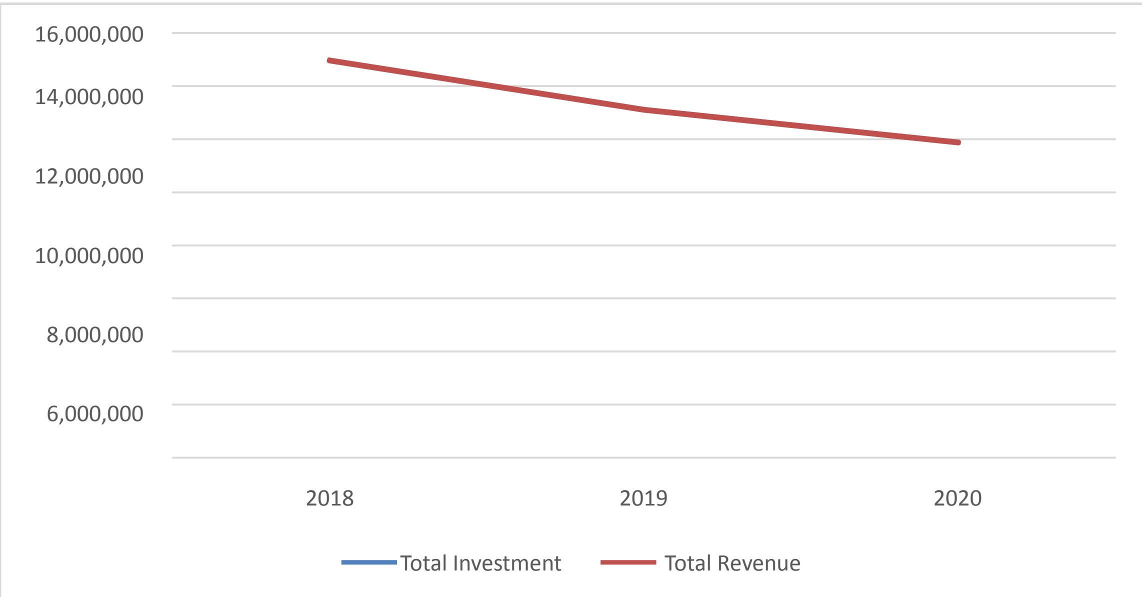
Miyun Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			86	900,000	195,500
2001			163	1,308,000	504,840
2002			292	1,563,000	692,900
2003			377	1,861,493	957,451
2004			119	886,014	369,567
2005			97	678,314	421,101
2006	363	363	110	791,400	660,076
2007	858	858	114	753,086	1,071,801
2008	1,183	659	165	535,000	1,133,716
2009	1,240	644	179	1,034,200	1,360,805
2010	1,240	697	183	1,144,000	105,420
2011	1,240	839	207	1,858,000	2,326,667
2012	1,240	841	227	2,177,100	2,864,675
2013	1,246	1,246	230	2,325,071	1,078,521
2014	1,246	1,246	242	2,666,371	3,381,768
2015	1,249	1,249	251	2,946,471	3,347,449
2016	1,249	1,249	260	3,137,471	3,582,381
2017	1,249	1,249	260	3,137,471	4,368,435
2018	1,249	1,249	262	3,140,471	4,957,740
2019	1,249	1,249	264	3,140,671	4,146,341
2020	1,249	1,249	266	3,149,671	4,331,445



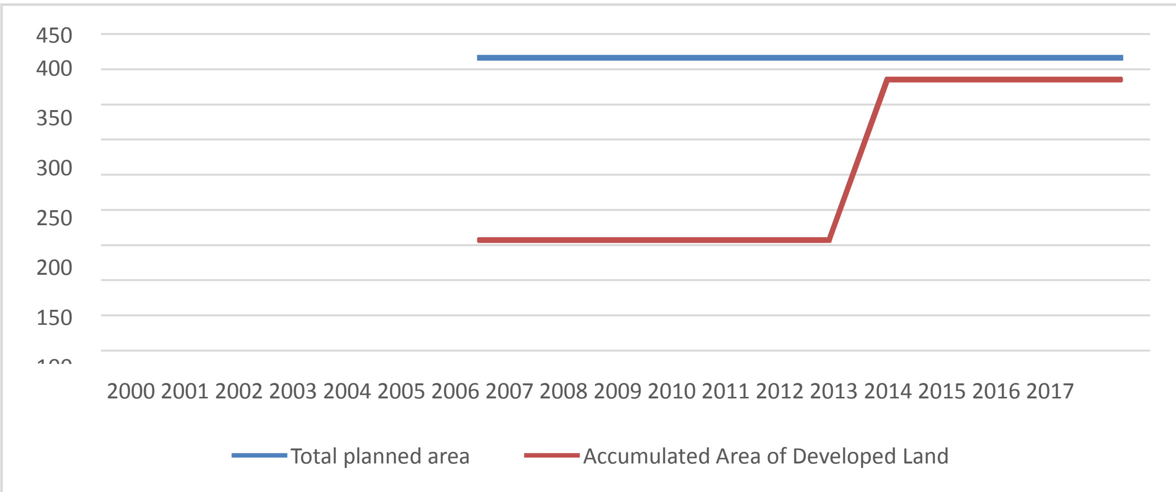


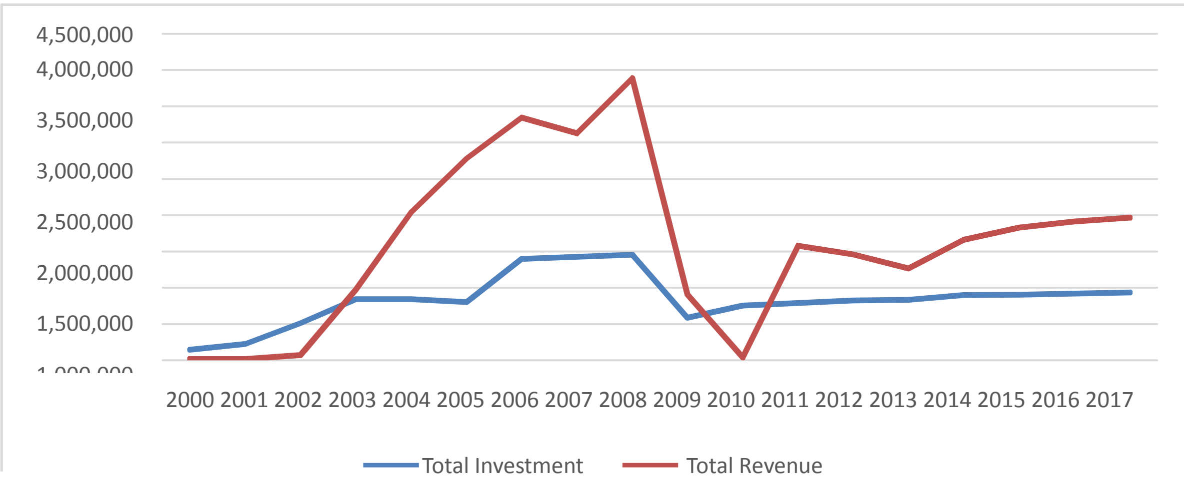
Shunyi Science and Technology Innovation Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2018	1,332	943	1,871		14,969,656
2019	1,332	943	2,019		13,113,034
2020	1,332	943	2,230		11,884,224



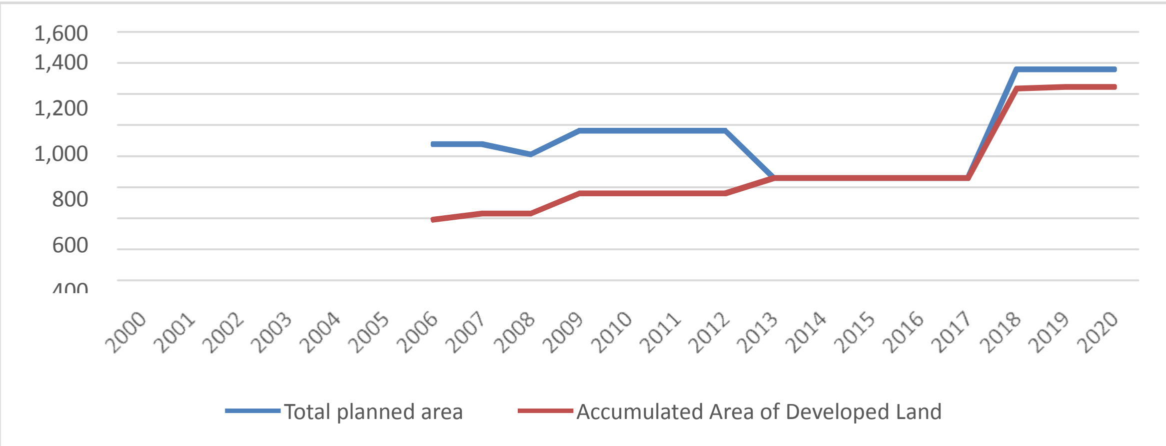


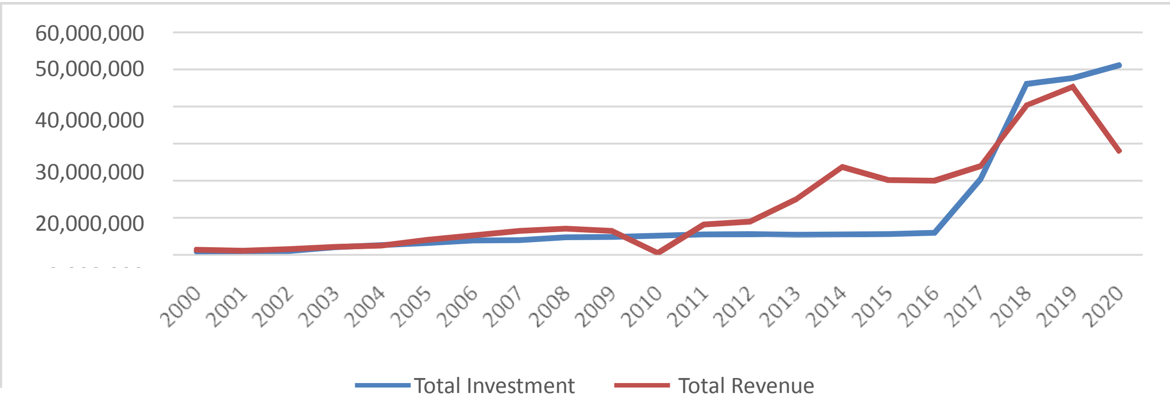
Linhe Industrial Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			48	149,234	20,901
2001			52	228,477	21,988
2002			46	512,325	72,300
2003			58	843,103	976,513
2004			63	844,674	2,043,365
2005			68	805,109	2,784,345
2006	416	157	76	1,398,258	3,346,607
2007	416	157	78	1,429,840	3,133,563
2008	416	157	81	1,455,359	3,889,714
2009	416	157	85	587,979	912,586
2010	416	157	87	755,250	42,288
2011	416	157	92	789,282	1,582,630
2012	416	157	94	828,008	1,463,552
2013	416	385	177	835,156	1,265,997
2014	416	385	282	902,107	1,666,175
2015	416	385	292	905,300	1,829,856
2016	416	385	316	924,762	1,914,358
2017	416	385	336	938,113	1,967,556



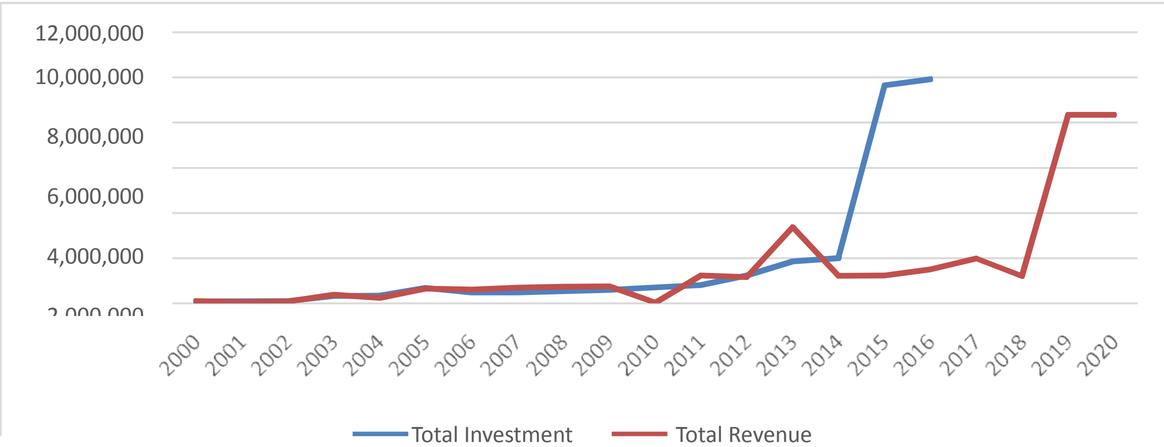


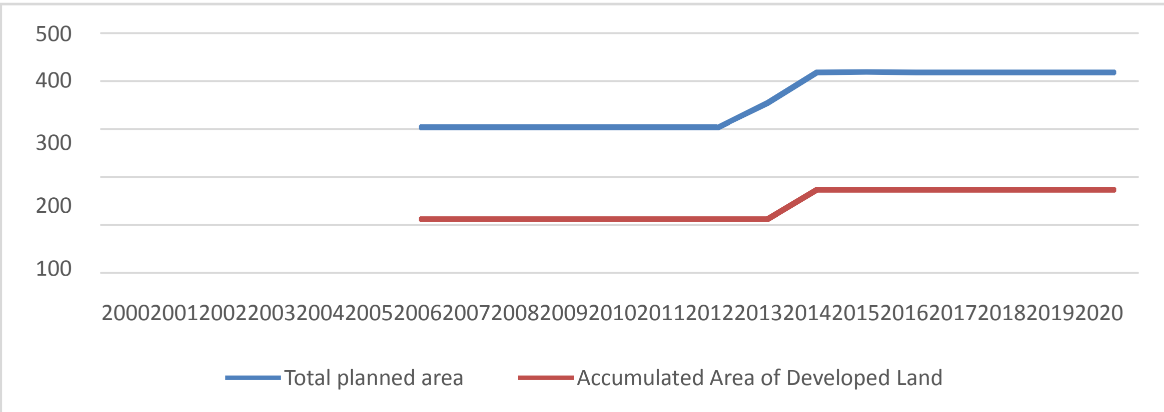
Beijing Airport Economic Core Area					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			113	910,206	1,306,772
2001			147	1,018,127	1,097,827
2002			244	1,001,795	1,469,990
2003			311	2,033,119	2,119,661
2004			348	2,604,141	2,445,504
2005			298	3,134,132	3,998,752
2006	878	391	358	3,818,141	5,233,399
2007	878	431	377	3,971,627	6,421,195
2008	812	431	413	4,708,008	7,029,827
2009	965	560	431	4,808,557	6,458,441
2010	965	560	472	5,145,025	464,368
2011	965	560	502	5,463,747	8,138,475
2012	965	560	540	5,589,373	8,917,910
2013	660	660	527	5,438,959	14,985,858
2014	660	660	634	5,494,036	23,693,482
2015	660	660	751	5,567,894	20,184,970
2016	660	660	961	5,940,018	19,948,331
2017	660	660	1,045	20,400,476	23,952,106
2018	1,360	1,235	3,888	46,126,538	40,376,812
2019	1,360	1,246	4,196	47,679,281	45,354,288
2020	1,360	1,246	4,364	51,149,057	28,074,322



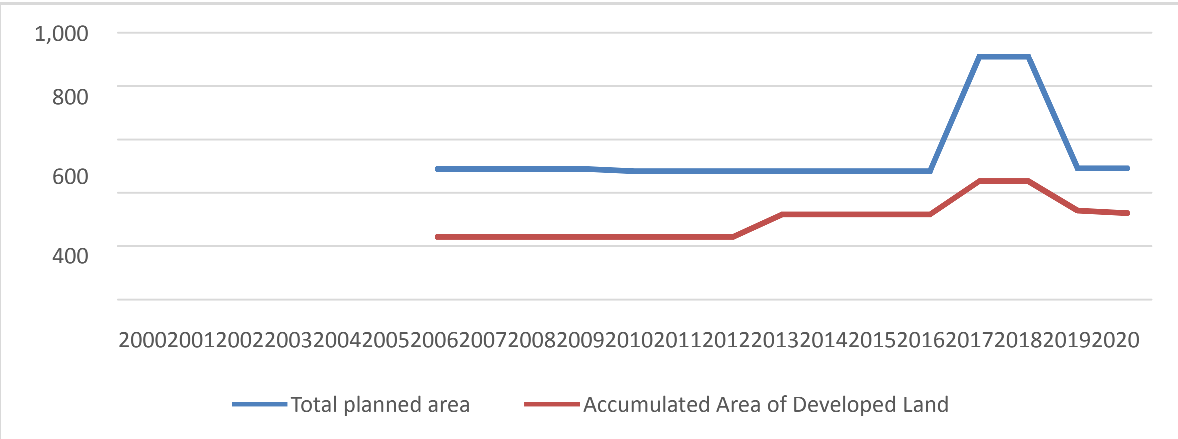


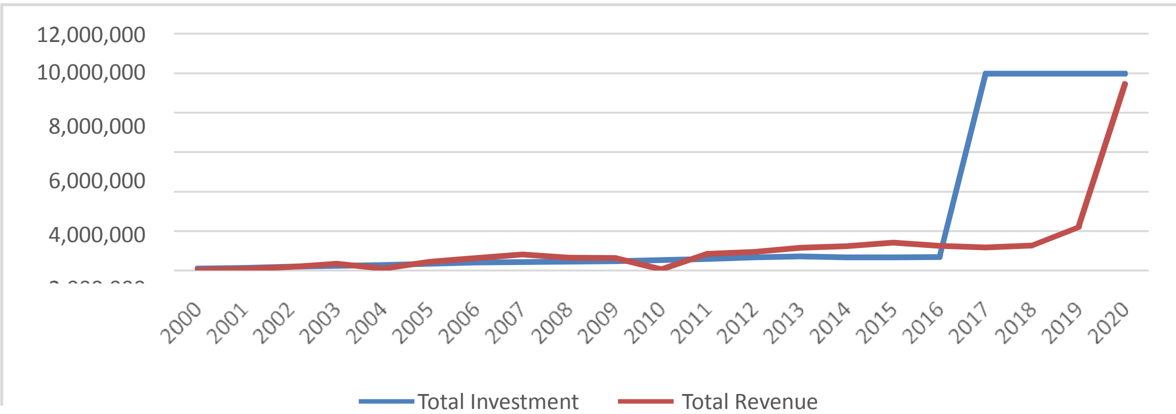
Yanqing Economic Development Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			316	91,681	97,746
2001			375	101,682	58,497
2002			402	112,233	87,307
2003			539	332,041	373,492
2004			436	352,648	231,603
2005			147	688,756	646,603
2006	304	112	530	488,859	609,212
2007	304	112	484	489,146	696,937
2008	304	112	470	545,381	734,172
2009	304	112	509	604,885	743,078
2010	304	112	567	720,744	23,555
2011	304	112	652	813,640	1,228,322
2012	304	112	725	1,238,484	1,164,601
2013	354	112	833	1,867,915	3,373,354
2014	419	173	962	2,003,533	1,219,931
2015	419	173	1,184	9,661,968	1,235,541
2016	419	173	1,242	9,925,464	1,498,546
2017	419	173			1,987,177
2018	419	173			1,201,725
2019	419	173			8,353,652
2020	419	173			8,353,652



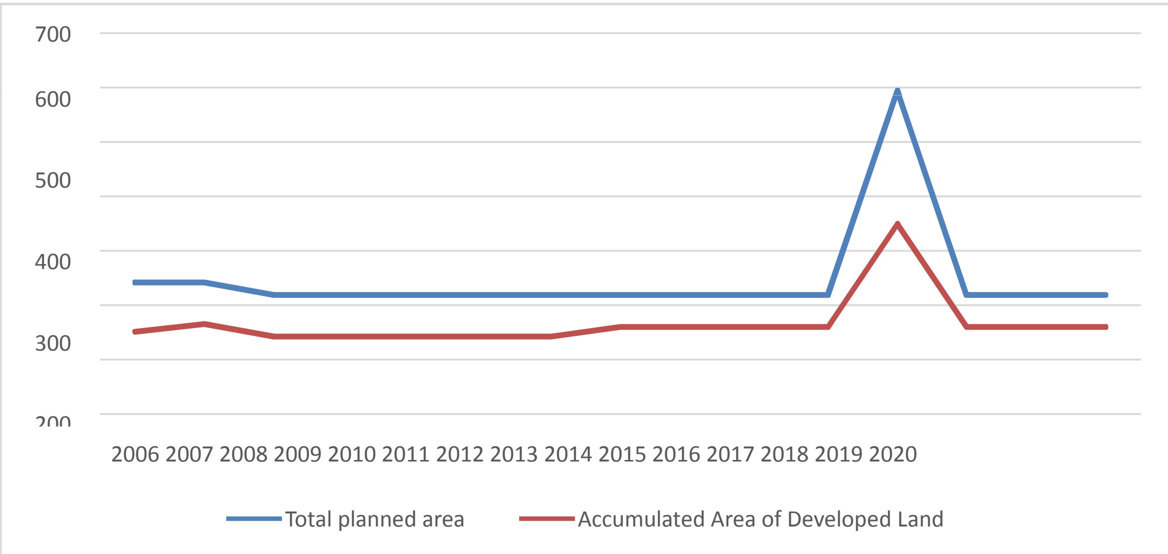


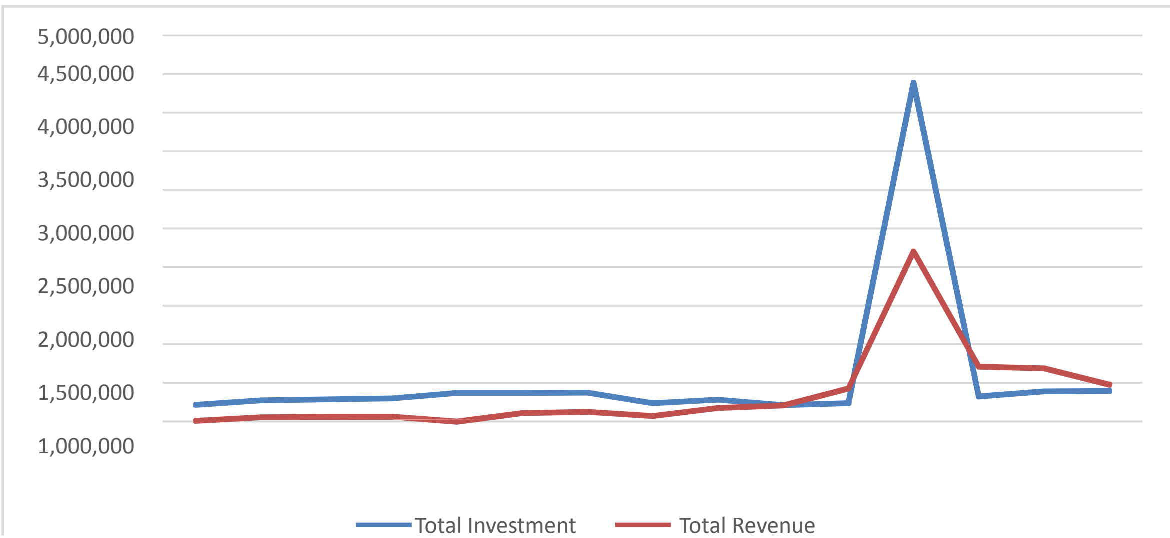
Badaling Economic Develompent Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			301	95,000	27,015
2001			310	126,000	73,530
2002			367	198,000	166,597
2003			447	219,405	340,348
2004			585	279,326	99,304
2005			644	341,949	440,116
2006	489	234	650	395,149	619,816
2007	489	234	568	418,816	805,665
2008	489	234	599	431,996	650,094
2009	489	234	724	470,001	624,924
2010	481	234	831	526,932	49,350
2011	481	234	957	575,854	831,467
2012	481	234	1,074	657,317	932,606
2013	481	319	1,191	716,221	1,148,551
2014	481	319	1,224	662,045	1,217,984
2015	481	319	1,386	664,745	1,411,368
2016	481	319	1,608	681,764	1,240,347
2017	910	443	3,071	9,960,770	1,167,938
2018	910	443	3,656	9,960,770	1,265,677
2019	491	332	4,533	9,960,770	2,185,593
2020	491	324	5,574	9,960,770	9,424,328



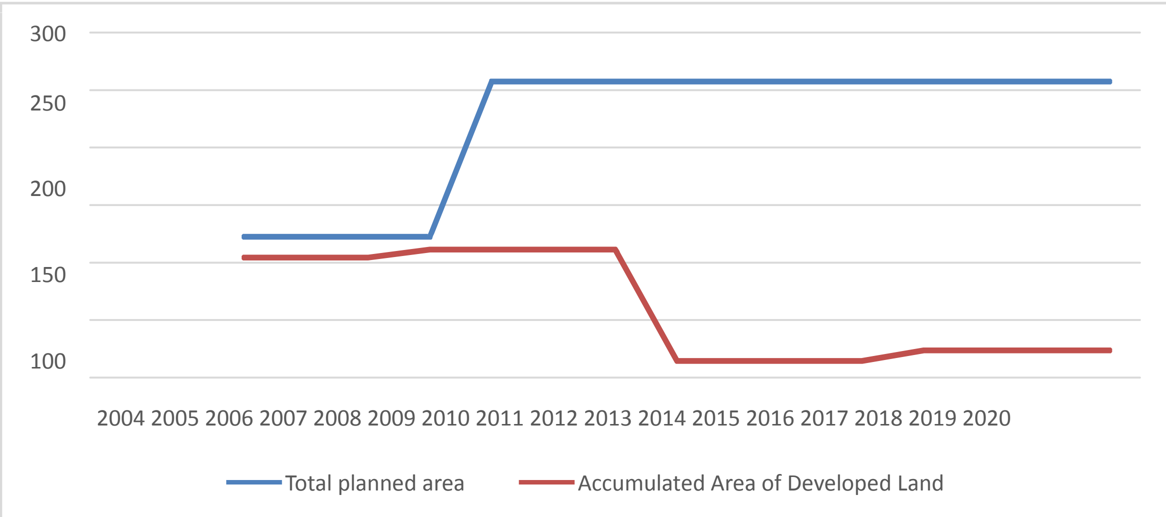


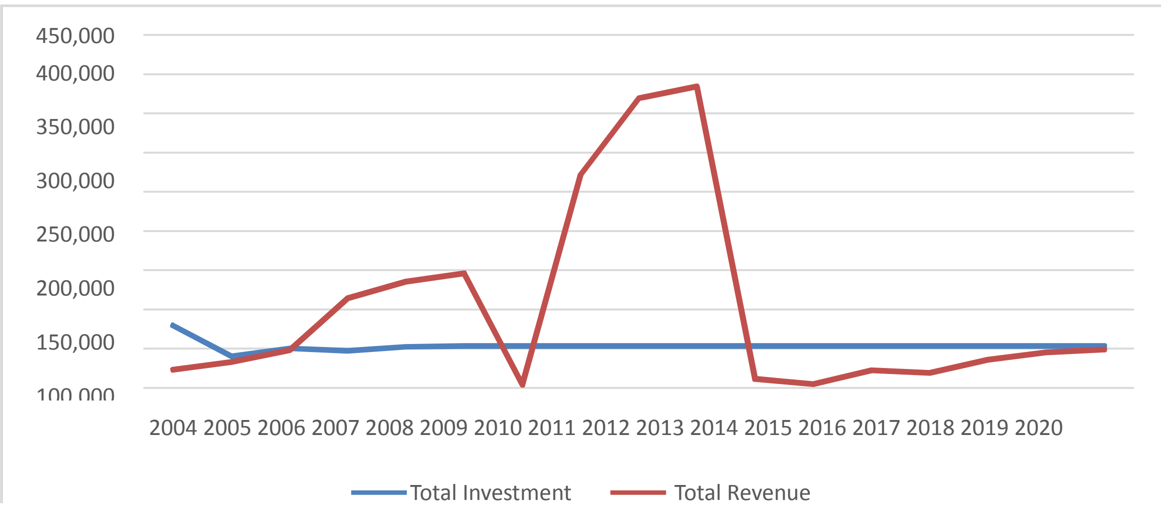
Fangshan Industry Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2006	241	151	352	215,057	10,034
2007	241	165	271	272,631	54,109
2008	219	142	402	278,622	61,210
2009	219	142	542	298,787	63,062
2010	219	142	690	365,881	-4,070
2011	219	142	714	368,667	109,215
2012	219	142	721	370,991	122,742
2013	219	160	25	236,258	70,401
2014	219	160	25	278,946	173,573
2015	219	160	23	209,822	208,566
2016	219	160	26	232,722	428,839
2017	594	350	345	4,387,277	2,202,169
2018	219	160	30	321,830	708,754
2019	219	160	31	389,755	688,468
2020	219	160	29	393,931	475,200



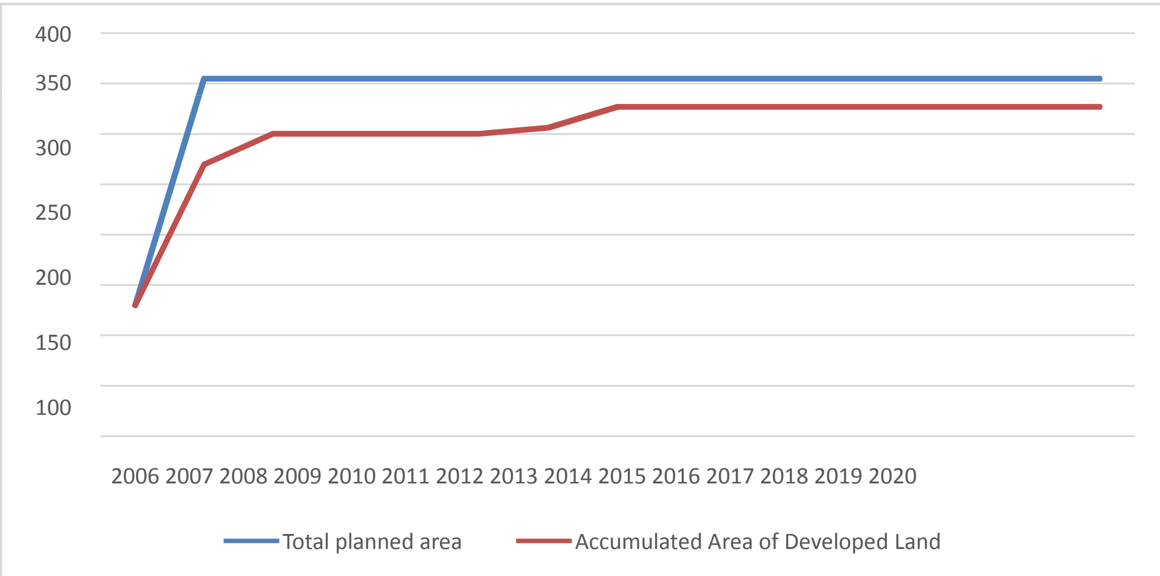


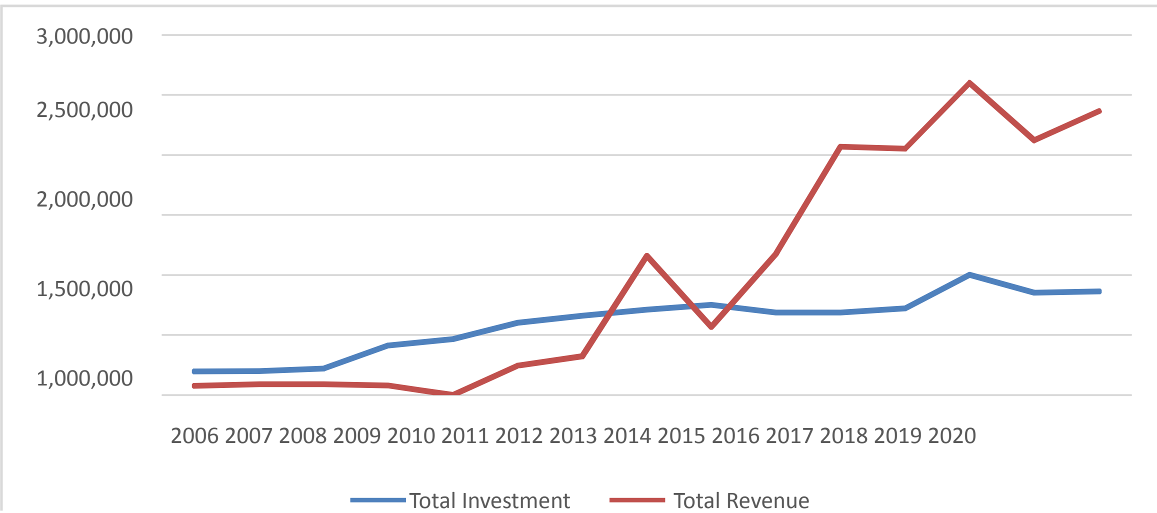
Changpin Xiaotangshan Industrial Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2004			30	79,000	23,000
2005			36	39,700	33,000
2006	122	104	39	49,840	47,892
2007	122	104	39	46,800	114,167
2008	122	104	50	51,800	135,439
2009	122	111	70	52,800	146,032
2010	257	111	74	52,800	3,822
2011	257	111	78	52,800	271,863
2012	257	111	78	52,800	369,708
2013	257	14	78	52,800	384,632
2014	257	14	78	52,800	11,336
2015	257	14	78	52,800	4,457
2016	257	14	78	52,800	22,273
2017	257	23	78	52,800	18,901
2018	257	23	78	52,800	35,783
2019	257	23	78	52,800	45,108
2020	257	23	78	52,800	48,971



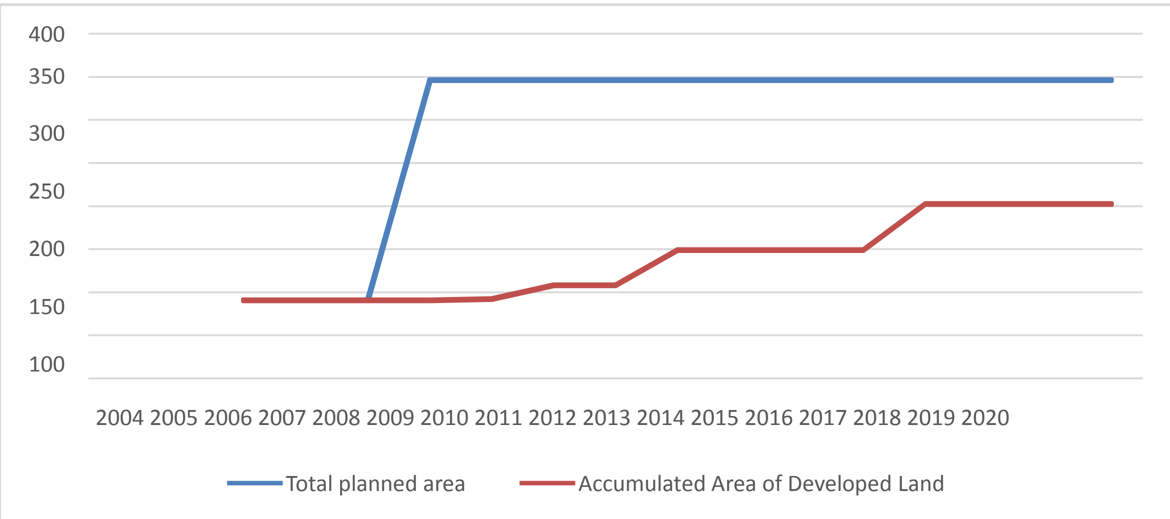


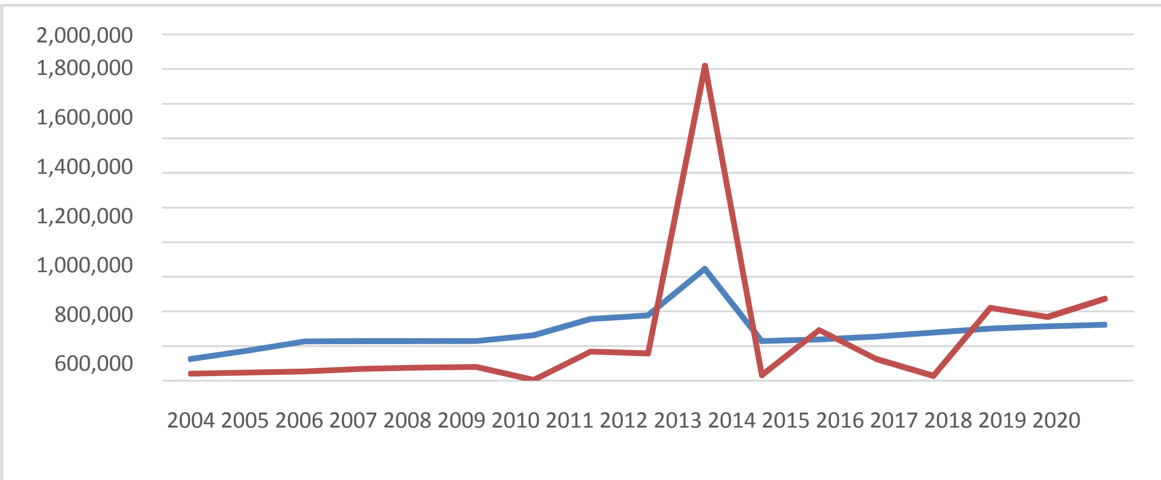
Caiyu Economic Develompent Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2006	130	130	34	198,354	76,943
2007	355	270	37	200,854	92,020
2008	355	300	39	222,854	92,227
2009	355	300	45	413,154	80,671
2010	355	300	50	467,272	358
2011	355	300	53	604,272	246,406
2012	355	306	57	662,972	322,723
2013	355	327	57	713,971	1,160,250
2014	355	327	59	753,971	567,288
2015	355	327	54	690,041	1,175,579
2016	355	327	54	690,041	2,070,405
2017	355	327	56	723,925	2,054,039
2018	355	327	58	1,003,429	2,599,760
2019	355	327	60	854,874	2,121,866
2020	355	327	61	864,874	2,364,581





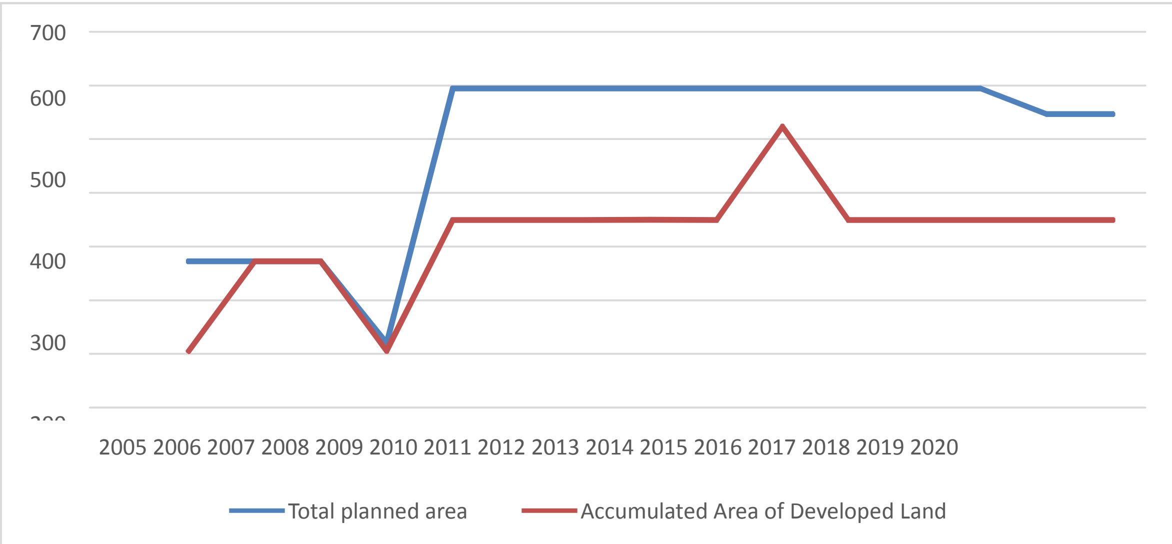
Mafang Industrial Zone					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2004			26	125,900	39,709
2005			31	173,900	45,011
2006	90	90	41	226,900	53,265
2007	90	90	42	229,900	67,380
2008	90	90	42	229,900	74,380
2009	346	90	42	229,900	79,042
2010	346	92	45	262,900	3,247
2011	346	108	50	356,559	166,822
2012	346	108	57	376,818	156,487
2013	346	149	57	646,772	1,818,155
2014	346	149	56	230,141	30,884
2015	346	149	60	238,941	292,025
2016	346	149	64	255,258	124,590
2017	346	202	67	277,597	26,933
2018	346	202	72	302,087	420,519
2019	346	202	74	314,517	366,317
2020	346	202	77	323,017	472,961

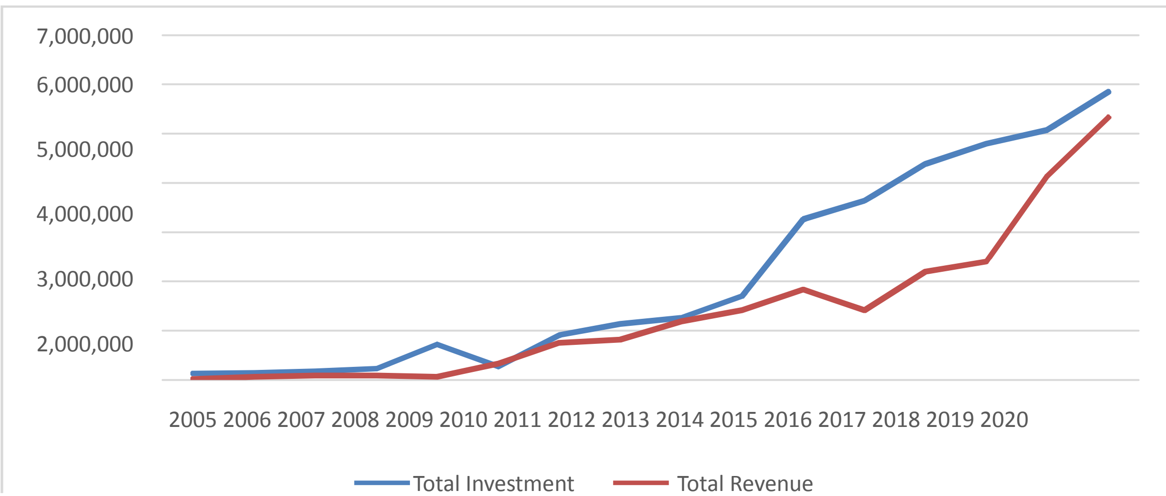




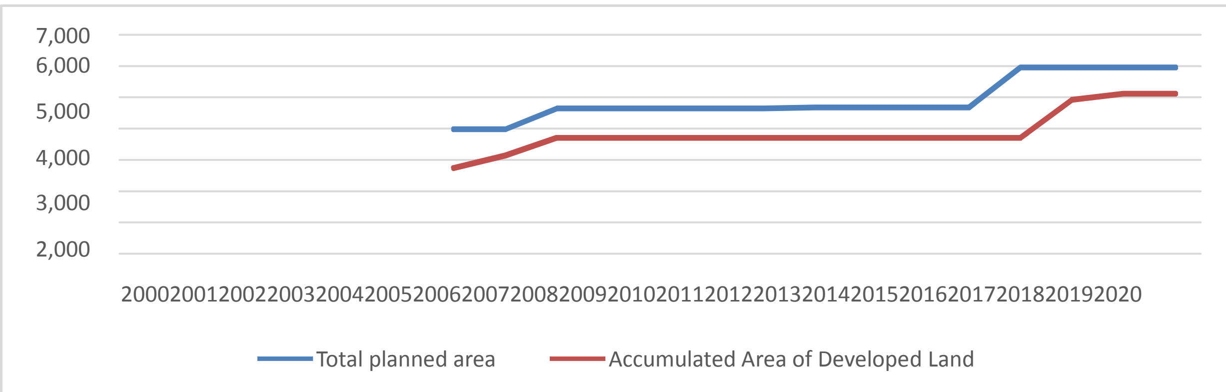
State level development zone

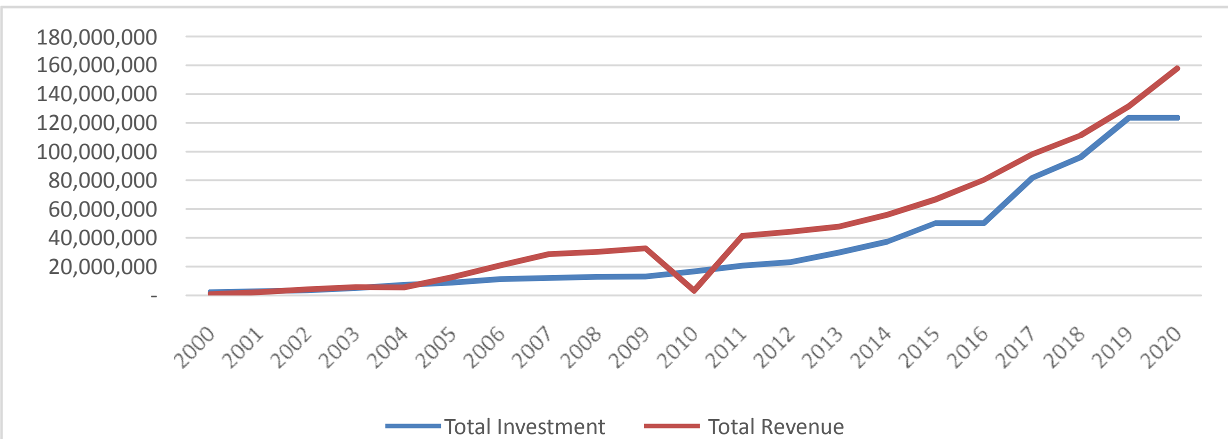
Beijing Tianzhu Bonded Area					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2005			16	127,939	19,862
2006	273	106	22	140,184	62,134
2007	273	273	25	173,362	88,078
2008	273	273	32	221,798	90,535
2009	120	106	31	714,891	67,438
2010	594	350	35	266,949	335,916
2011	594	350	76	909,402	754,206
2012	594	350	119	1,132,262	816,694
2013	594	350	162	1,261,162	1,192,434
2014	594	350	205	1,698,062	1,419,041
2015	594	523	261	3,259,112	1,834,793
2016	594	350	295	3,635,772	1,413,818
2017	594	350	345	4,387,277	2,202,169
2018	594	350	435	4,796,580	2,404,989
2019	547	350	541	5,077,387	4,138,264
2020	547	350	769	5,848,153	5,333,245



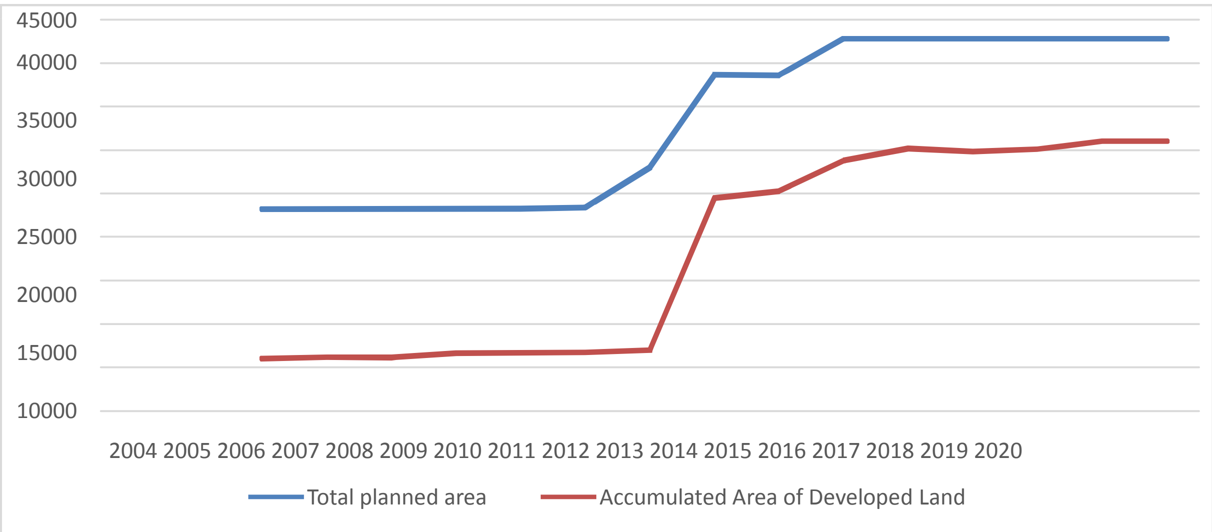


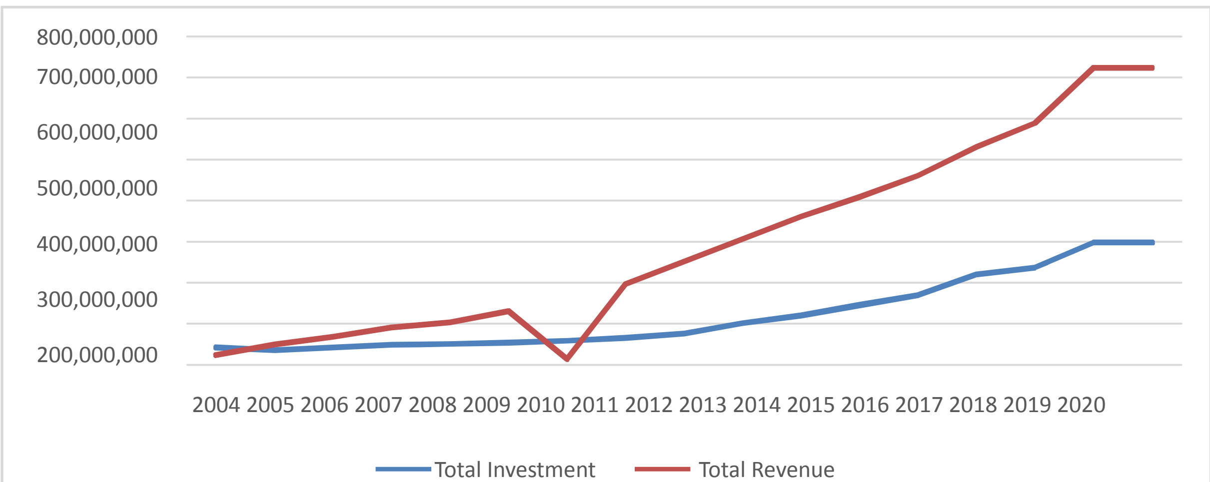
Beijing Economic-Technological Development Area					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			817	2,229,297	838,792
2001			986	3,007,231	2,070,000
2002			1,108	3,558,293	4,068,701
2003			1,383	5,171,722	5,659,783
2004			1,596	7,314,690	5,480,180
2005			1,800	8,850,362	12,601,816
2006	3,980	2,741	2,170	11,238,640	20,880,000
2007	3,980	3,141	2,356	12,309,457	28,663,486
2008	4,650	3,700	2,559	12,950,451	30,274,994
2009	4,650	3,700	3,276	13,121,165	32,624,720
2010	4,650	3,700	3,870	16,609,263	3,355,064
2011	4,650	3,700	4,672	20,614,867	41,411,379
2012	4,650	3,700	5,684	23,060,218	44,281,638
2013	4,680	3,700	6,669	29,855,173	47,861,613
2014	4,680	3,700	9,350	37,417,718	55,953,685
2015	4,680	3,700	12,722	50,330,270	66,707,451
2016	4,680	3,700	12,722	50,330,270	80,131,999
2017	5,960	3,700	18,634	81,611,835	98,100,980
2018	5,960	4,923	22,238	95,785,248	111,118,817
2019	5,960	5,115	25,894	123,388,094	131,441,149
2020	5,960	5,115	33,262	123,388,094	157,596,540



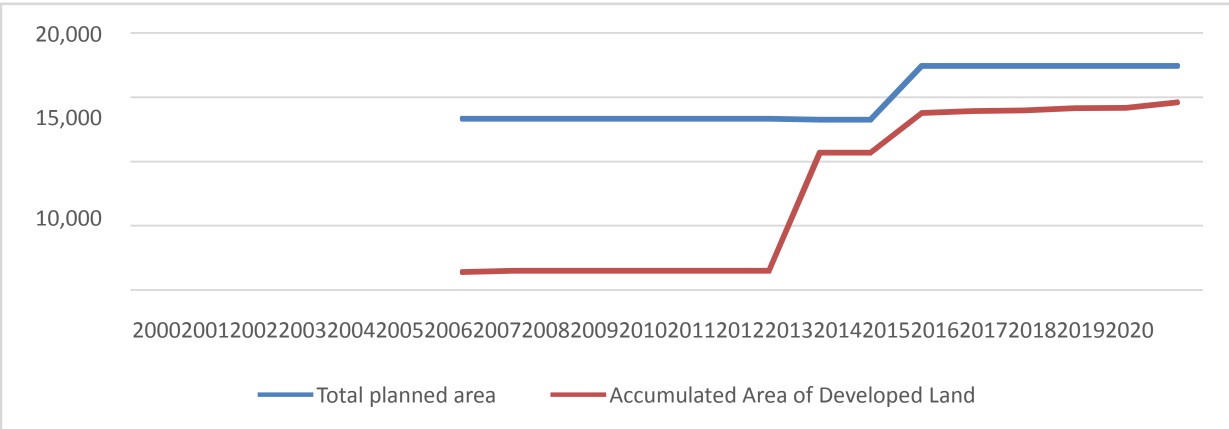


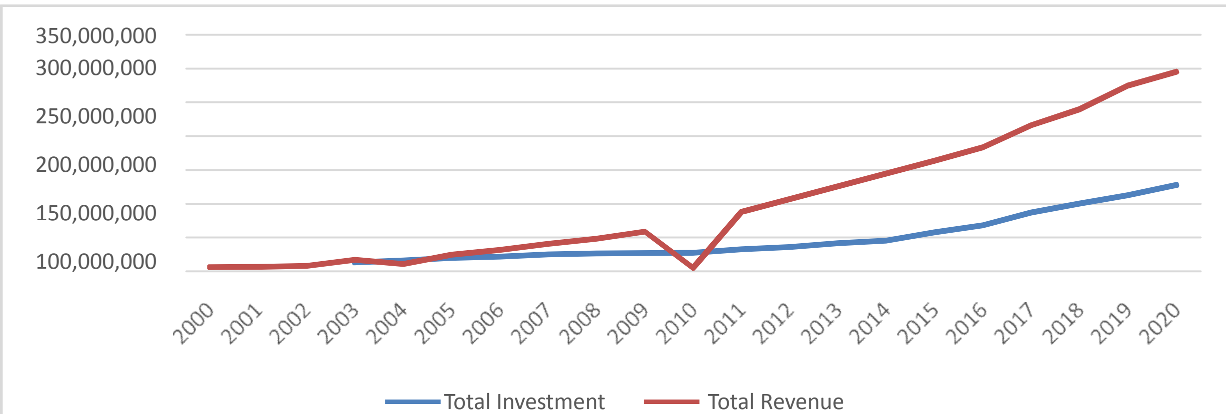
Zhongguancun Science park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2004			19,783	41,846,735	22,954,118
2005			21,481	35,695,955	48,729,126
2006	23,212	6,021	24,251	42,968,509	67,447,225
2007	23,239	6,182	22,969	48,883,459	90,356,849
2008	23,239	6,135	23,601	50,745,416	102,224,442
2009	23,246	6,602	25,362	53,786,018	130,046,324
2010	23,249	6,697	26,955	58,647,485	12,989,078
2011	23,390	6,722	27,862	65,402,617	196,460,188
2012	27,983	6,967	29,344	75,158,479	250,249,575
2013	38,694	24,461	32,529	100,804,243	304,974,327
2014	38,611	25,279	35,026	119,829,035	360,575,733
2015	42,799	28,779	40,443	145,564,747	408,119,156
2016	42,799	30,178	47,264	169,368,988	460,476,182
2017	42,799	29,829	65,364	220,240,994	530,257,999
2018	42,799	30,084	54,655	236,559,230	588,308,988
2019	42,804	31,010	64,004	297,332,331	722,763,687
2020	42,804	31,010	64,004	297,332,331	722,763,687



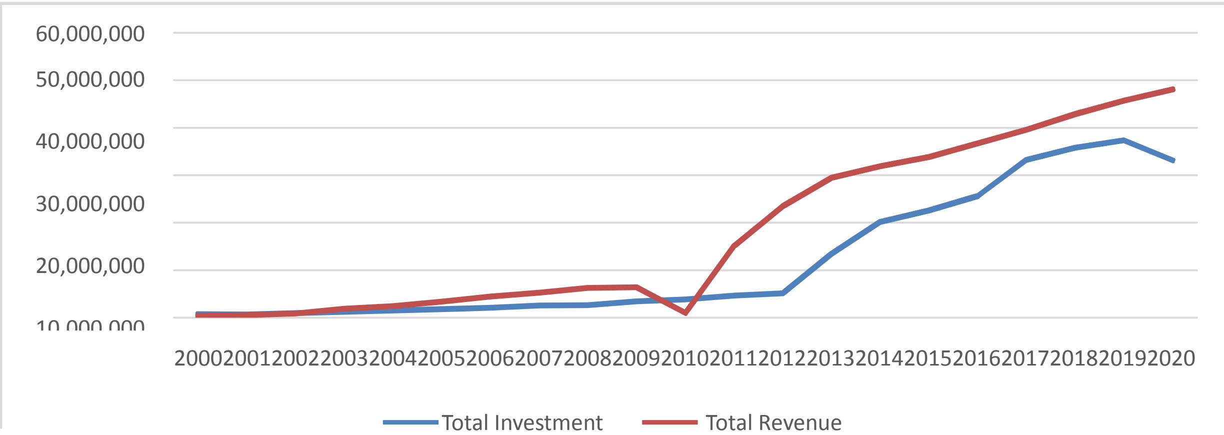


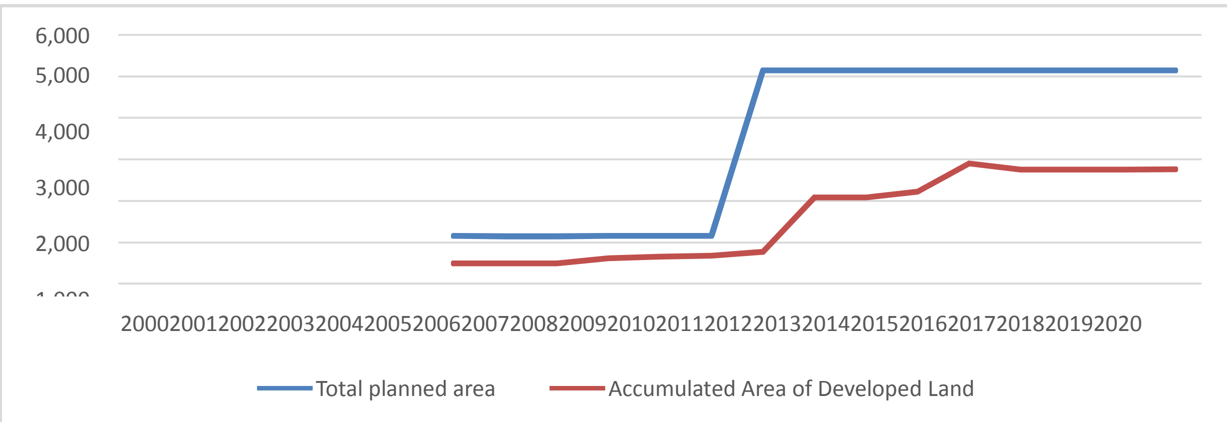
Haidian Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			5,711		6,401,200
2001			6,780		6,635,000
2002			8,274		8,306,300
2003			11,291	13,020,330	17,054,800
2004			14,280	15,730,400	10,817,997
2005			15,193	19,704,500	24,853,255
2006	13,306	1,384	18,022	21,618,400	31,897,271
2007	13,306	1,484	16,290	24,715,900	40,773,822
2008	13,306	1,484	16,958	26,100,637	48,462,924
2009	13,306	1,484	17,532	26,838,942	58,520,652
2010	13,306	1,484	17,987	27,437,275	5,338,392
2011	13,306	1,484	18,106	32,186,275	87,828,160
2012	13,306	1,484	18,743	35,563,518	106,657,471
2013	13,242	10,684	19,737	41,585,339	125,335,753
2014	13,242	10,684	20,247	45,046,850	144,494,589
2015	17,431	13,764	22,051	57,377,660	163,573,321
2016	17,431	13,930	23,963	68,101,834	183,553,601
2017	17,431	13,971	25,734	87,007,053	216,100,468
2018	17,431	14,136	27,772	99,960,137	239,784,913
2019	17,431	14,176	29,985	112,521,384	274,594,303
2020	17,431	14,594	32,378	127,513,952	294,962,678



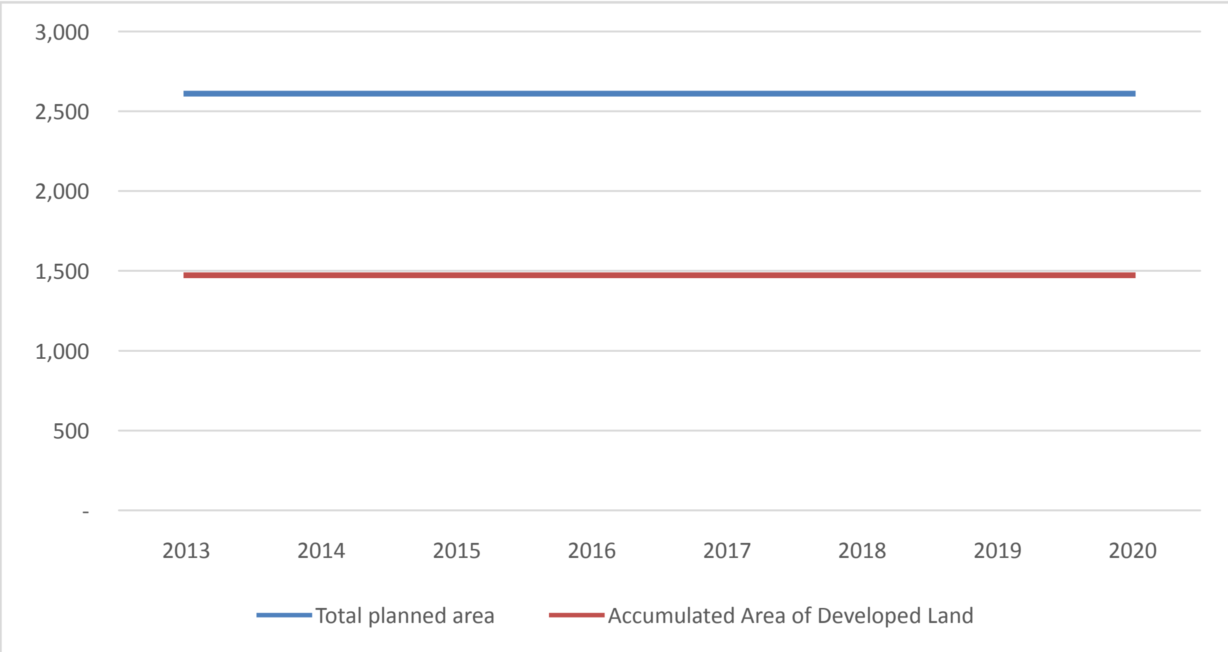


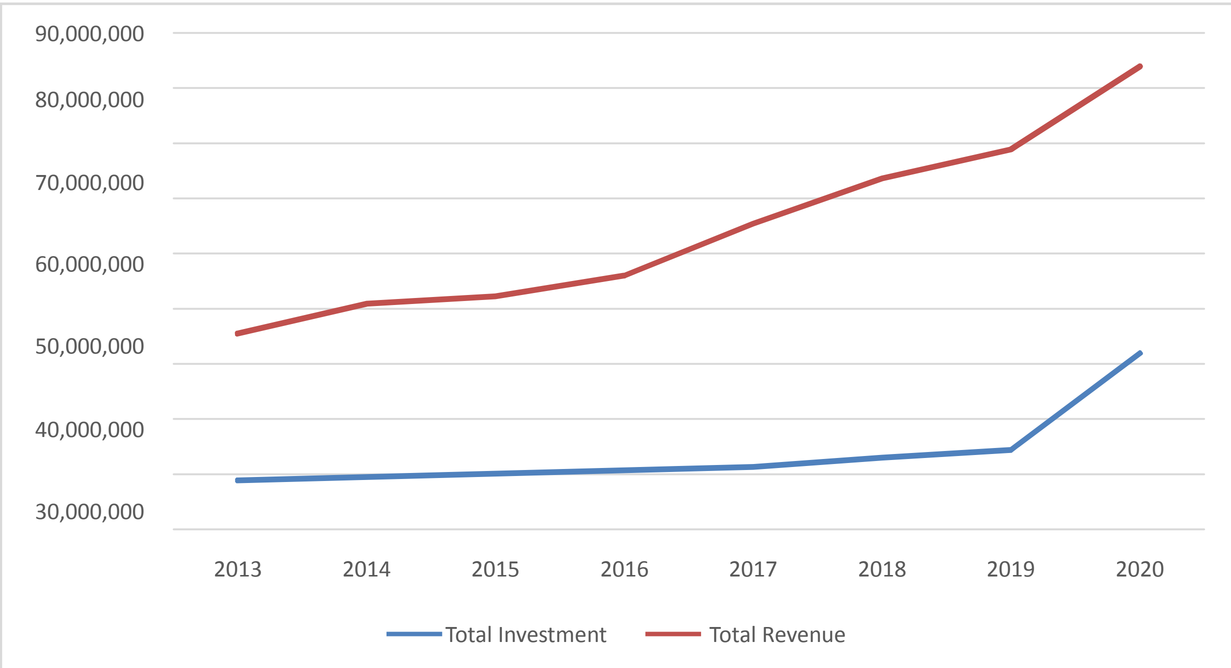
Changping Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			947	747,000	317,766
2001			994	689,758	528,401
2002			1,183	983,000	849,319
2003			1,505	1,306,000	1,837,803
2004			1,396	1,492,500	2,396,115
2005			1,564	1,738,100	3,352,411
2006	1,148	481	1,742	2,085,841	4,397,984
2007	1,141	481	1,539	2,600,318	5,264,878
2008	1,141	482	1,474	2,673,475	6,236,200
2009	1,148	607	1,331	3,476,484	6,360,693
2010	1,151	646	1,460	3,869,129	986,475
2011	1,151	668	1,601	4,639,108	15,070,872
2012	5,140	758	1,698	5,112,239	23,441,944
2013	5,140	2,069	2,104	13,383,559	29,434,078
2014	5,140	2,069	2,576	20,125,765	31,836,041
2015	5,140	2,210	3,246	22,552,785	33,816,229
2016	5,140	2,891	3,778	25,601,069	36,691,286
2017	5,140	2,742	4,043	33,219,532	39,539,925
2018	5,140	2,743	4,316	35,780,918	42,863,266
2019	5,140	2,743	4,813	37,317,242	45,700,100
2020	5,140	2,749	4,754	33,135,014	48,030,585



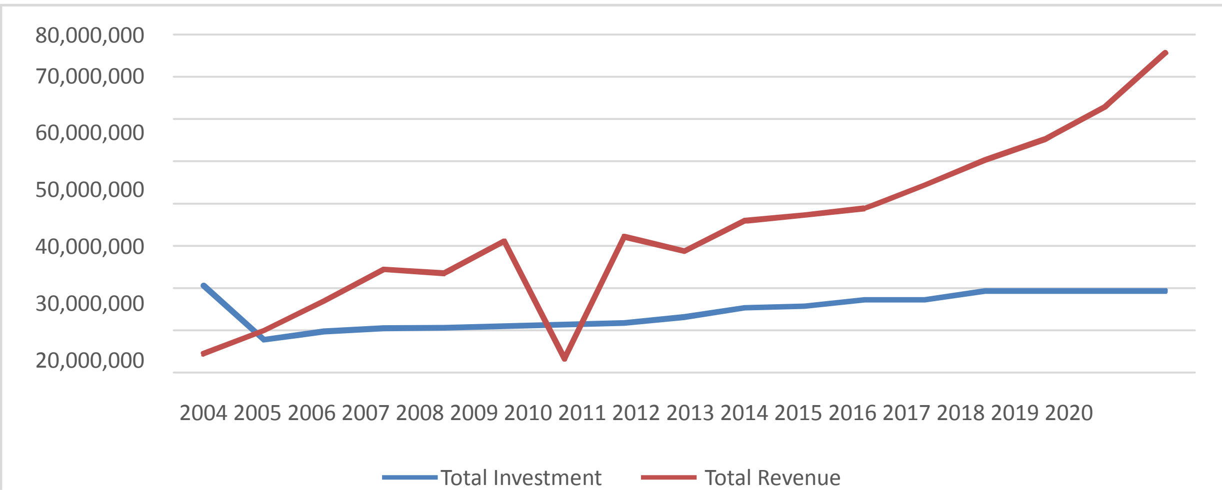


Chaoyang Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	2,610	1,472	1,374	8,843,383	35,511,248
2014	2,610	1,472	1,434	9,271,027	40,901,144
2015	2,610	1,472	1,463	9,906,380	42,256,585
2016	2,610	1,472	1,635	10,666,826	46,035,935
2017	2,610	1,472	1,782	11,250,975	55,388,944
2018	2,610	1,472	2,150	12,960,116	63,623,009
2019	2,610	1,472	2,212	14,324,805	68,890,057
2020	2,610	1,472	2,322	31,870,454	83,909,661

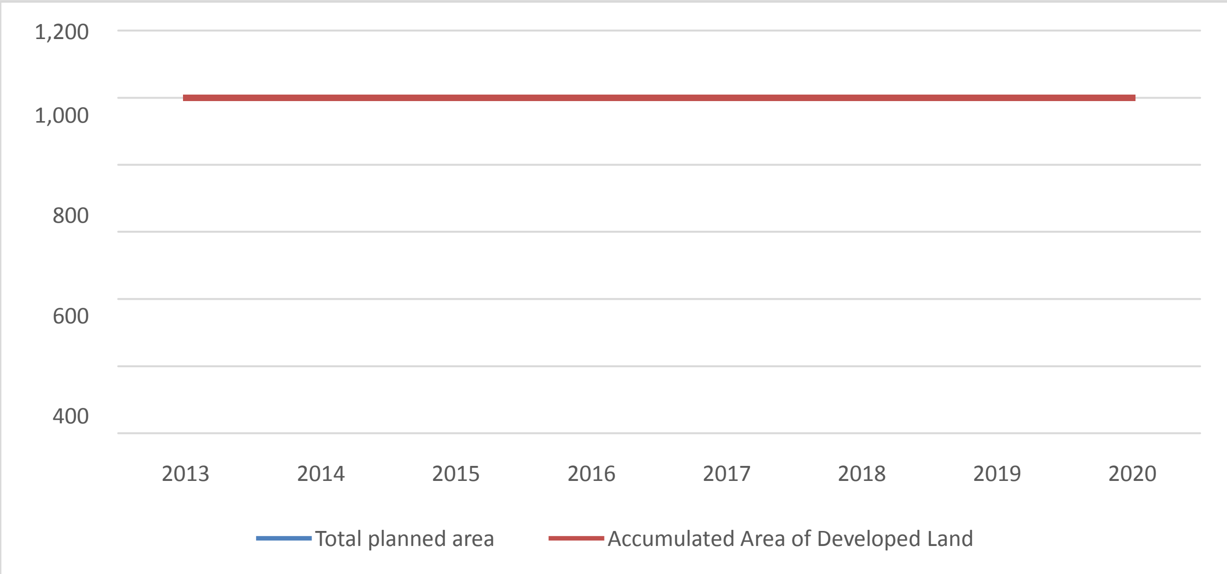


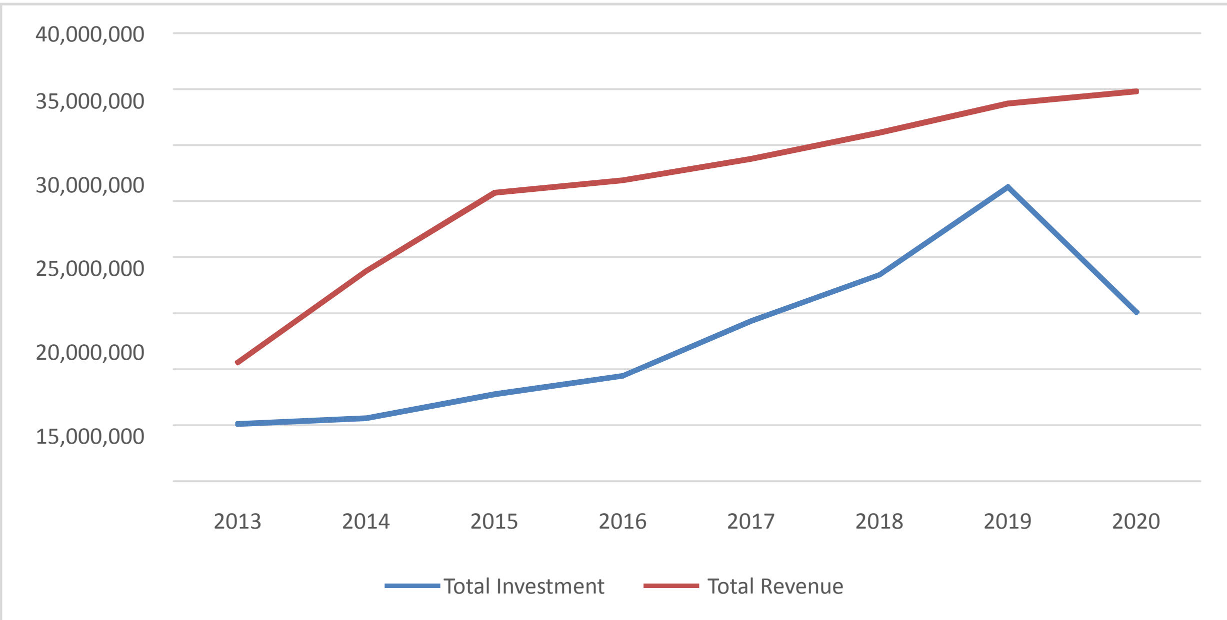


Yizhuang Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2004			376	20,542,790	4,476,487
2005			407	7,725,840	9,990,546
2006	2,678	2,678	476	9,733,445	16,916,645
2007	2,680	2,678	583	10,479,101	24,365,963
2008	2,680	2,678	583	10,547,768	23,458,556
2009	2,680	2,678	508	10,927,226	31,031,915
2010	2,680	2,678	528	11,264,926	3,300,256
2011	2,678	2,678	476	11,684,962	32,127,206
2012	2,678	2,678	564	13,126,385	28,696,461
2013	2,678	2,678	665	15,280,431	35,878,281
2014	2,678	2,678	720	15,685,308	37,222,959
2015	2,678	2,678	852	17,213,168	38,810,670
2016	2,678	2,678	852	17,213,168	44,369,315
2017	2,678	2,678	1,013	19,313,689	50,263,007
2018	2,678	2,678	1,013	19,313,689	55,197,594
2019	2,678	2,678	1,013	19,313,689	62,801,499
2020	2,678	2,678	1,013	19,313,689	75,597,574

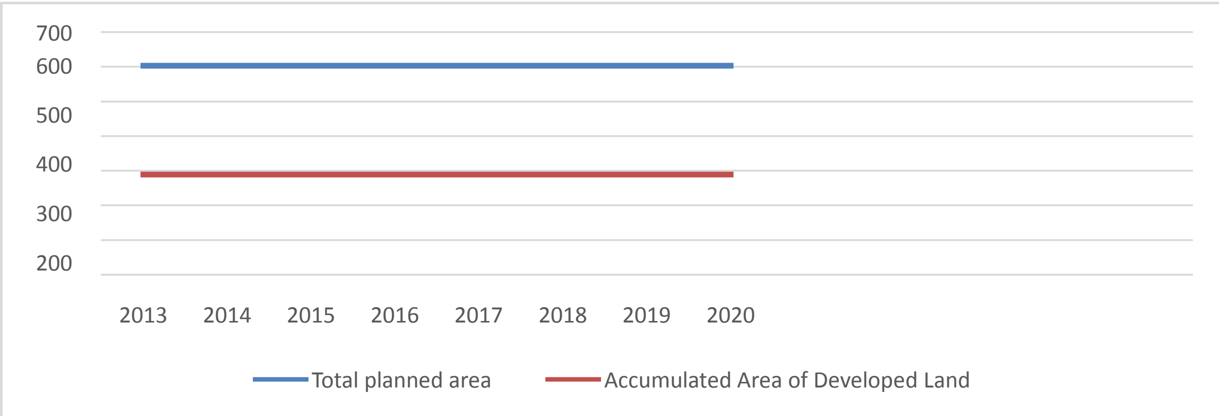


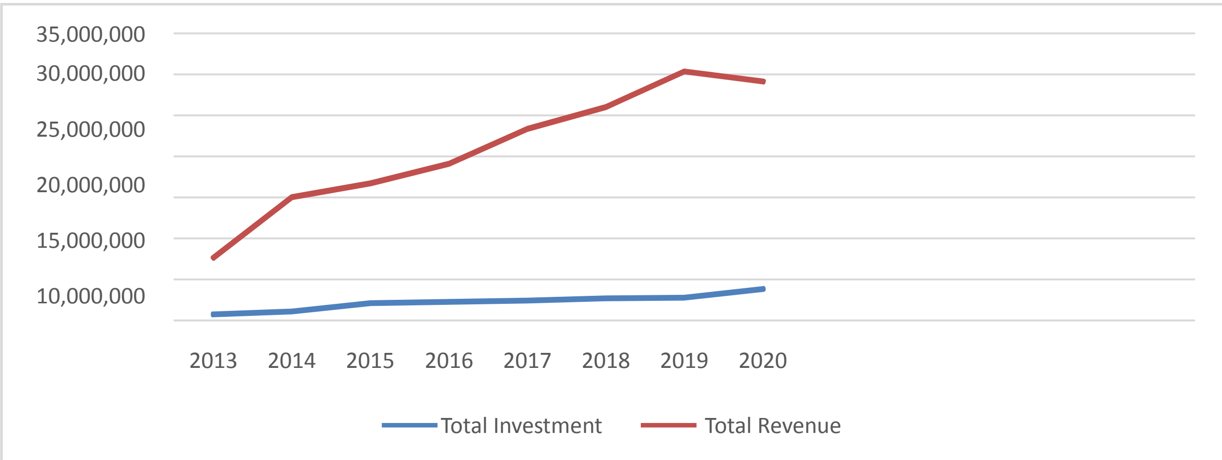
Xicheng Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	1,000	1,000	546	5,111,775	10,606,371
2014	1,000	1,000	473	5,617,476	18,747,680
2015	1,000	1,000	523	7,774,996	25,751,554
2016	1,000	1,000	649	9,426,511	26,869,228
2017	1,000	1,000	723	14,285,146	28,772,046
2018	1,000	1,000	679	18,421,085	31,119,575
2019	1,000	1,000	842	26,250,679	33,711,680
2020	1,000	1,000	1,052	15,101,293	34,809,844



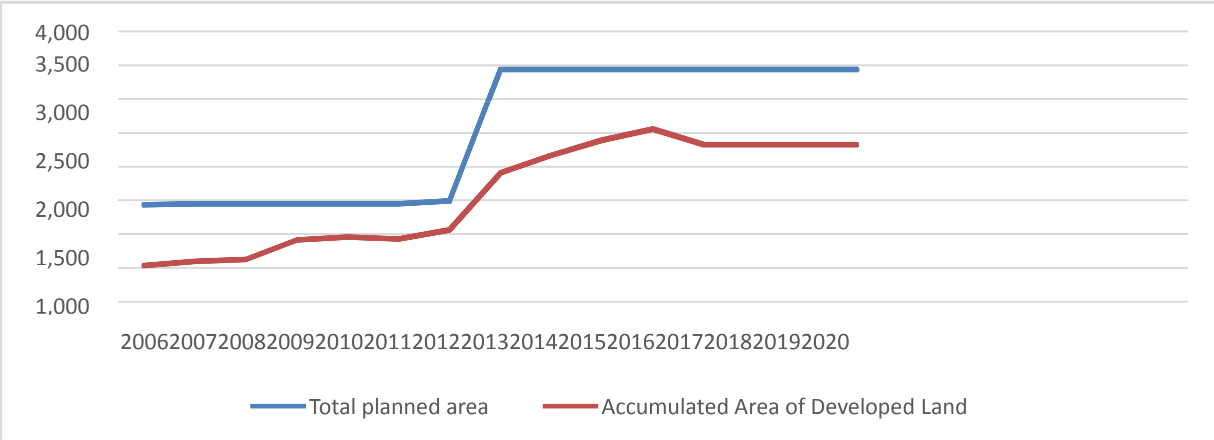


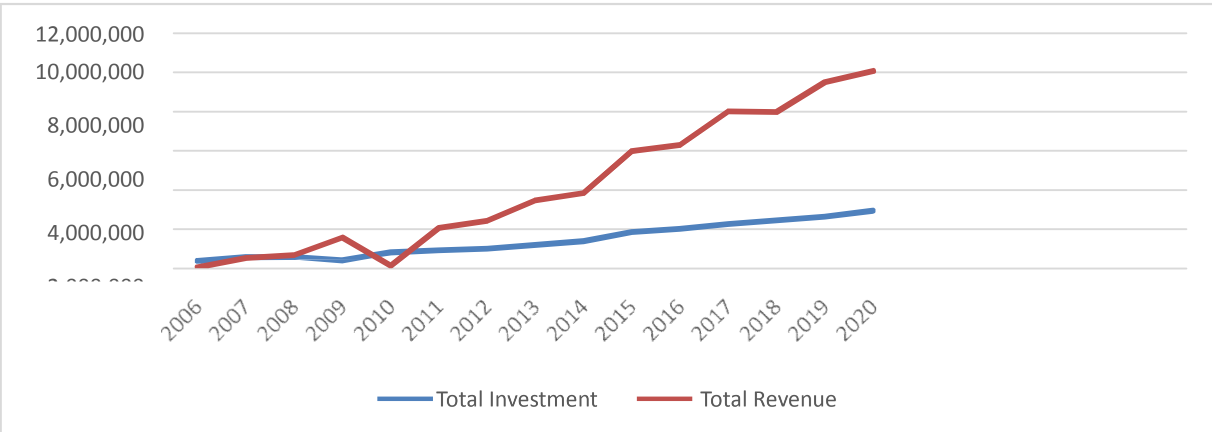
Dongcheng Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	603	289	545	748,592	7,646,107
2014	603	289	1,084	1,112,380	15,019,392
2015	603	289	1,912	2,093,000	16,703,702
2016	603	289	2,207	2,255,929	19,104,337
2017	603	289	2,415	2,414,874	23,363,931
2018	603	289	2,525	2,680,211	26,006,440
2019	603	289	2,630	2,762,313	30,365,751
2020	603	289	2,820	3,813,056	29,135,659



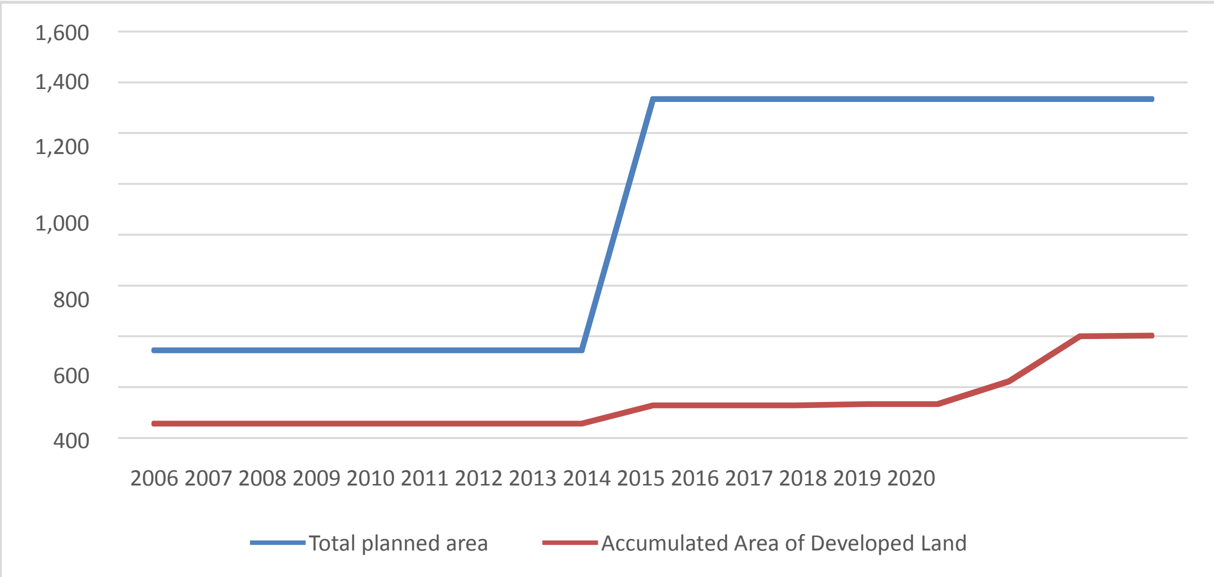


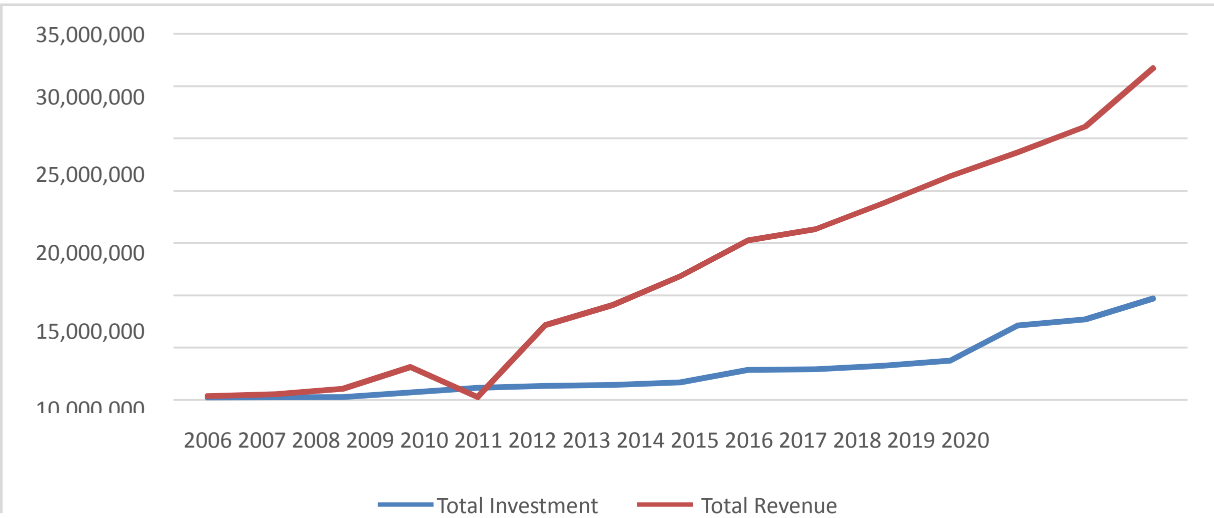
Tongzhou Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2006	1,436	532	10	369,000	37,343
2007	1,452	593	38	561,540	508,655
2008	1,452	623	48	580,688	652,951
2009	1,452	912	68	400,381	1,561,033
2010	1,452	954	82	805,581	120,663
2011	1,452	924	97	929,452	2,049,431
2012	1,491	1,056	99	1,005,652	2,415,391
2013	3,435	1,902	176	1,205,084	3,461,837
2014	3,434	2,158	200	1,386,947	3,835,649
2015	3,435	2,387	250	1,844,603	5,976,446
2016	3,435	2,553	296	2,022,938	6,276,446
2017	3,435	2,323	355	2,260,940	7,996,794
2018	3,435	2,323	423	2,450,530	7,963,804
2019	3,435	2,323	526	2,639,197	9,482,538
2020	3,435	2,323	649	2,935,663	10,058,897



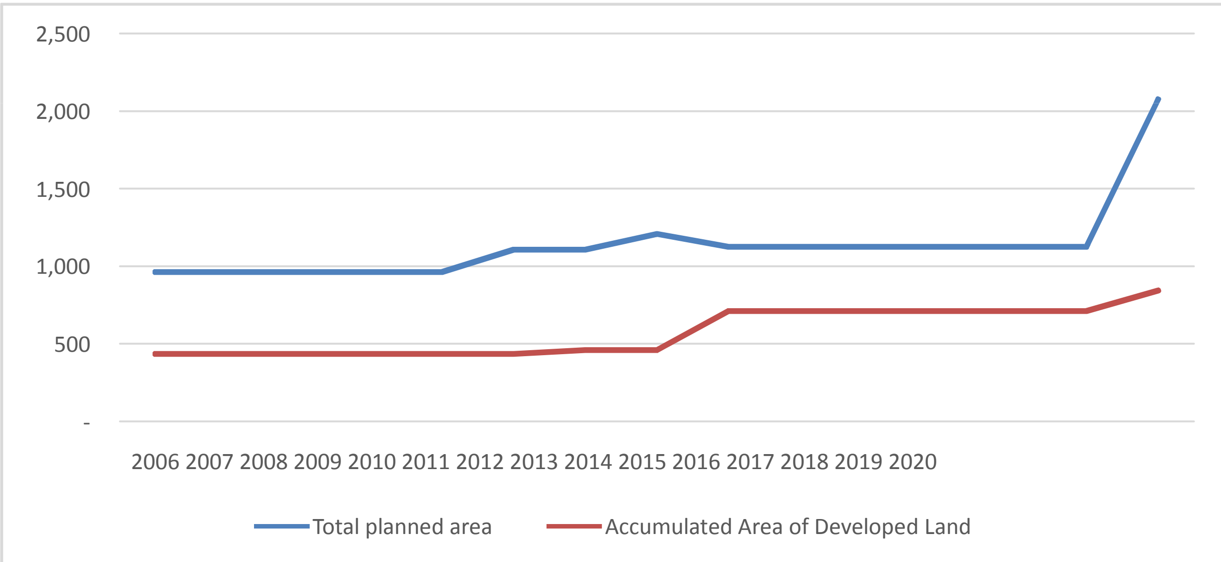


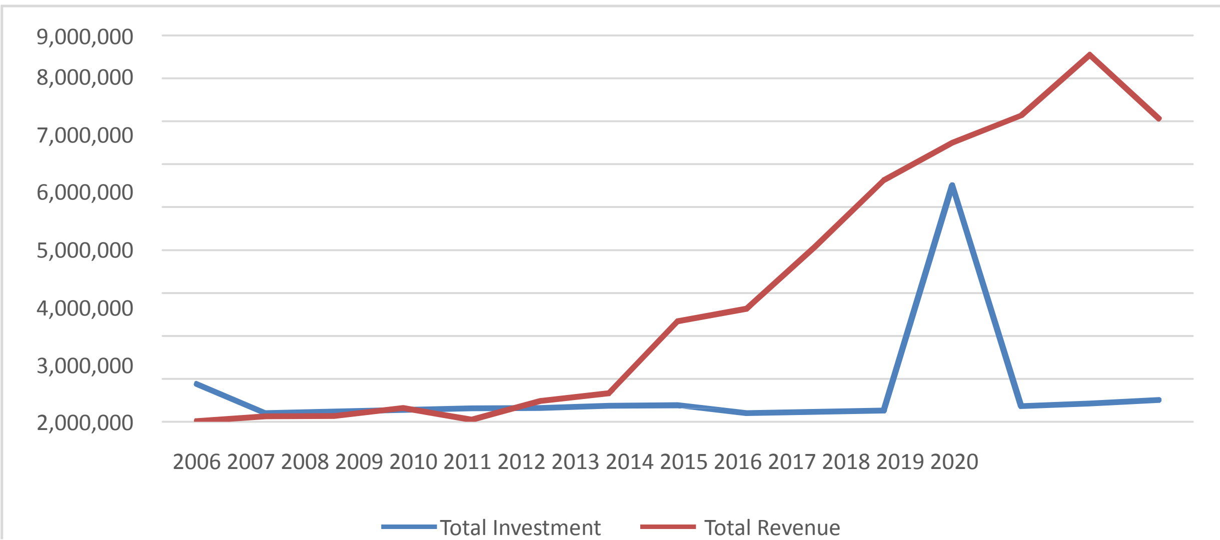
Shijingshan Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2006	345	56	153	233,464	386,589
2007	345	56	255	273,569	571,090
2008	345	56	255	273,569	1,099,764
2009	345	56	1,181	702,259	3,155,128
2010	345	56	1,806	1,152,384	290,759
2011	345	56	2,075	1,340,855	7,162,006
2012	345	56	2,153	1,436,073	9,094,780
2013	1,334	128	2,239	1,672,536	11,836,061
2014	1,334	128	2,429	2,862,123	15,259,599
2015	1,334	128	2,487	2,919,449	16,324,566
2016	1,334	133	2,656	3,256,892	18,814,871
2017	1,334	133	2,794	3,740,224	21,395,179
2018	1,334	222	2,986	7,134,395	23,641,915
2019	1,334	400	3,163	7,708,725	26,131,947
2020	1,334	403	3,334	9,691,337	31,690,184



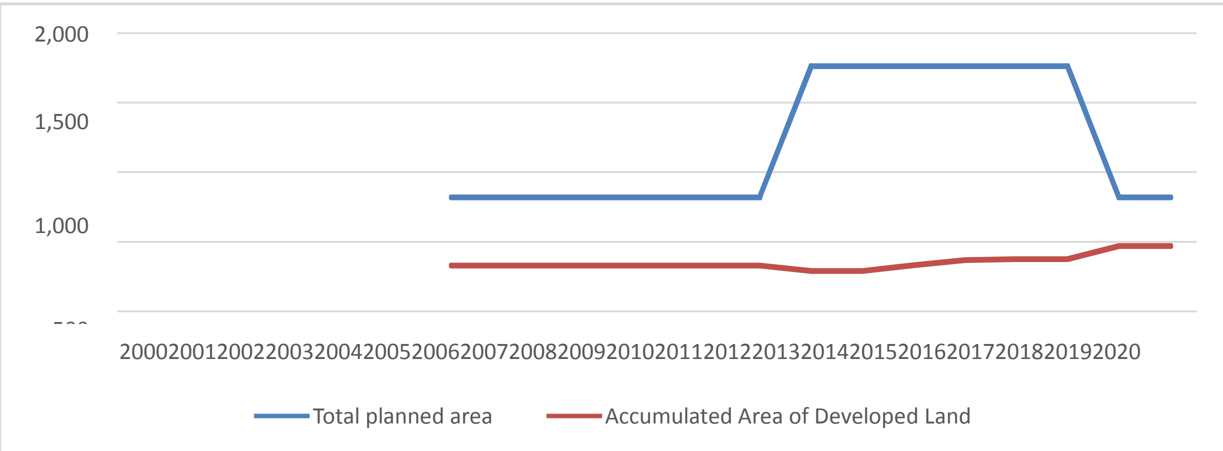


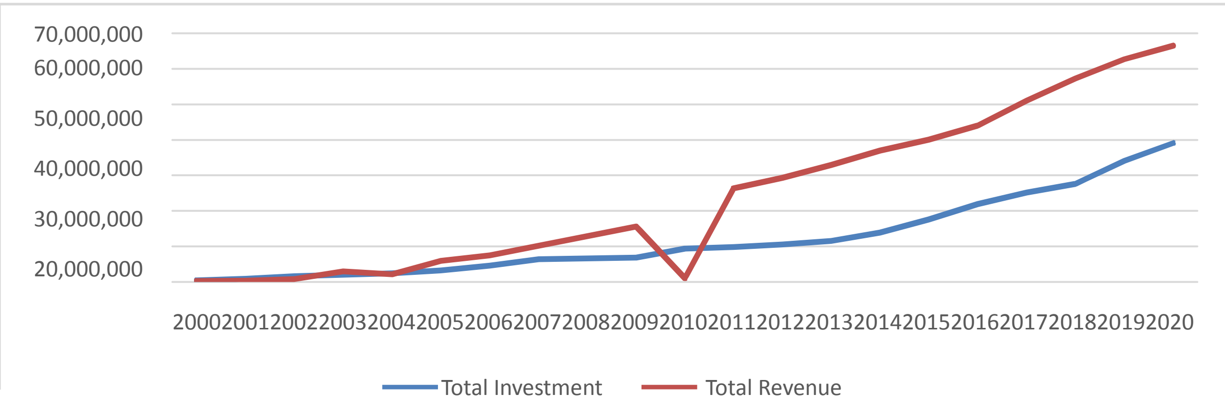
Daxing Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2006	964	436	80	881,508	13,968
2007	963	436	24	204,197	124,496
2008	963	436	28	251,197	130,759
2009	963	436	37	287,878	322,527
2010	963	436	45	317,066	43,150
2011	1,106	436	48	321,966	487,269
2012	1,106	460	60	376,405	663,278
2013	1,207	460	65	393,669	2,341,734
2014	1,125	710	74	206,809	2,633,186
2015	1,125	710	89	233,304	4,079,480
2016	1,125	710	101	264,984	5,628,465
2017	1,125	710	2,515	5,510,771	6,500,183
2018	1,125	710	154	370,100	7,135,687
2019	1,125	710	176	428,013	8,541,829
2020	2,074	843	209	510,222	7,062,910



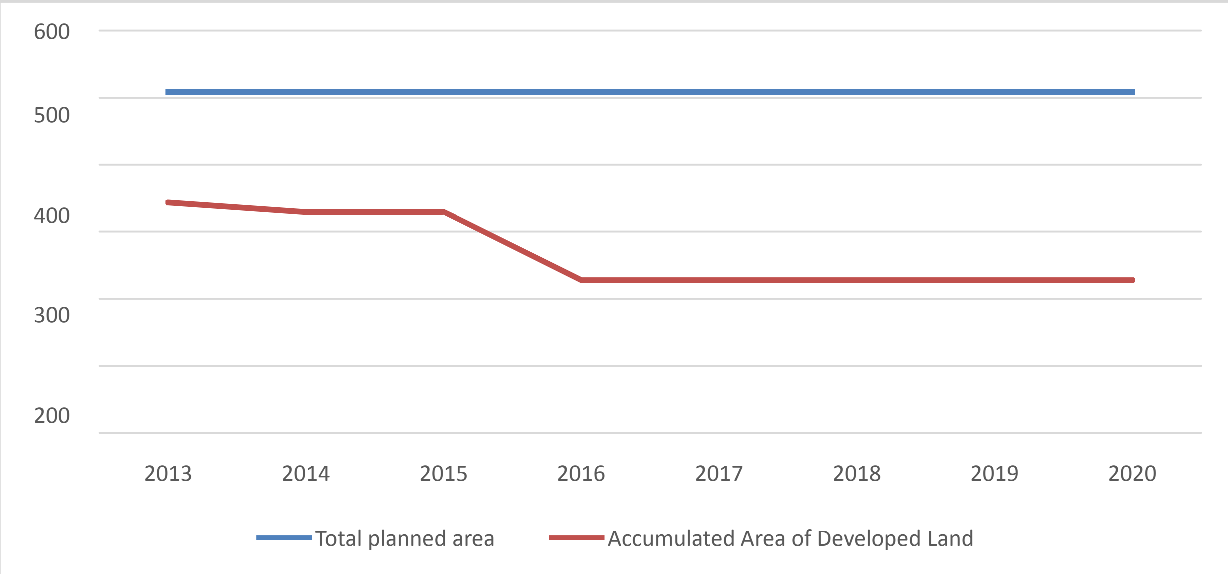


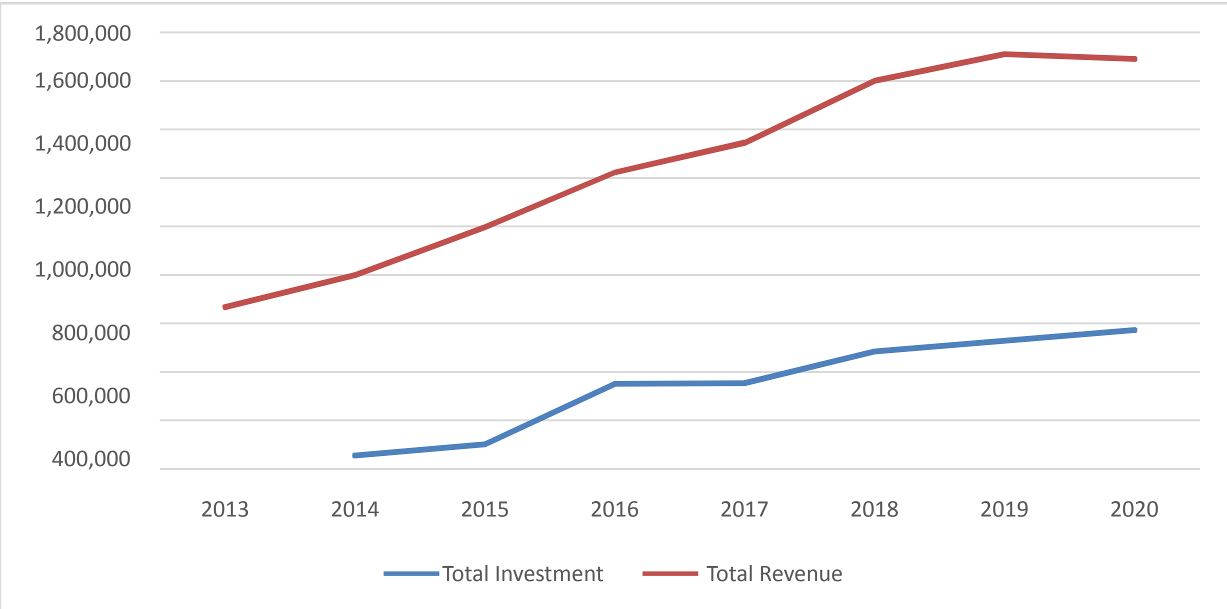
Fengtai Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			1,427	495,241	307,682
2001			1,699	929,676	440,000
2002			2,000	1,693,425	880,150
2003			2,350	2,138,316	3,007,961
2004			2,714	2,443,800	2,232,649
2005			3,059	3,280,674	6,023,995
2006	818	328	2,272	4,600,654	7,556,187
2007	818	328	2,589	6,408,860	10,178,970
2008	818	328	2,681	6,635,739	12,850,134
2009	818	328	3,193	6,892,815	15,666,569
2010	818	328	3,428	9,456,942	1,075,853
2011	818	328	3,938	9,893,342	26,408,838
2012	818	328	4,368	10,570,142	29,384,764
2013	1,763	289	4,798	11,591,742	32,955,947
2014	1,763	289	5,303	13,965,808	36,993,851
2015	1,763	331	6,863	17,647,845	40,041,748
2016	1,763	367	10,181	21,944,409	44,032,802
2017	1,763	375	11,204	25,237,299	51,043,879
2018	1,763	375	11,305	27,637,299	57,316,591
2019	818	470	12,506	34,164,448	62,728,342
2020	818	470	13,109	39,094,642	66,486,585



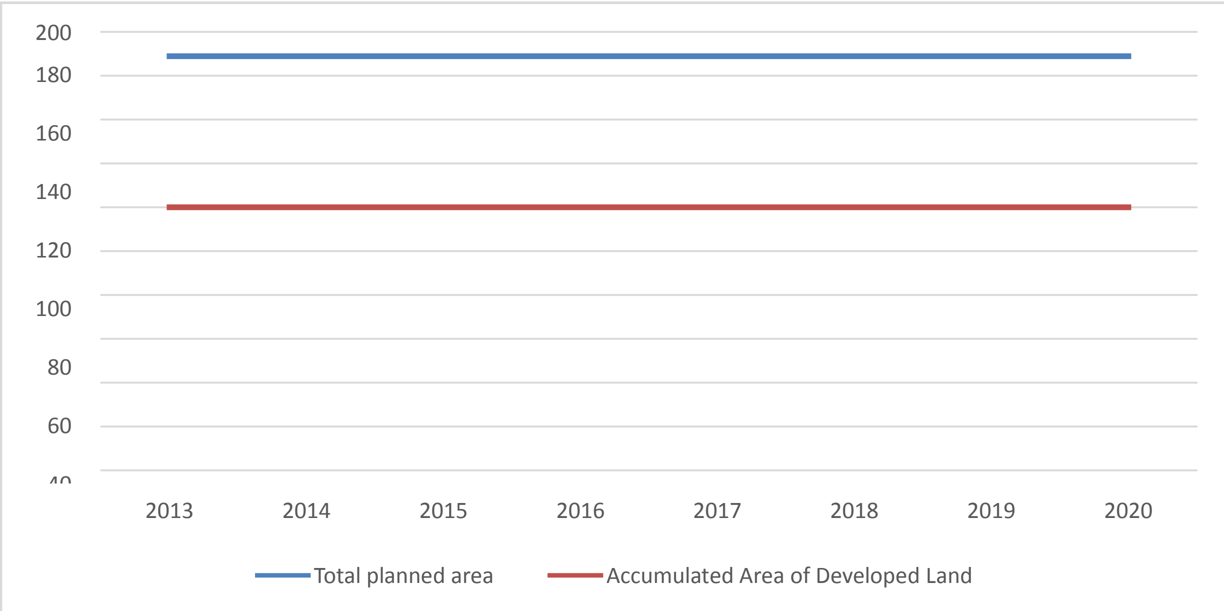


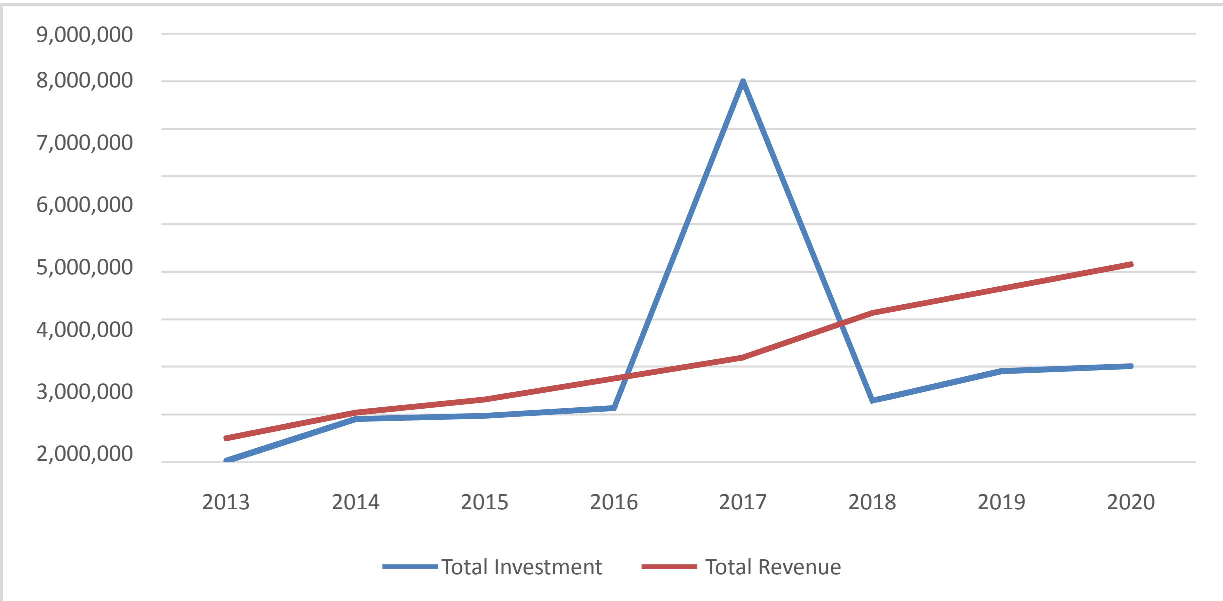
Pinggu Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	508	343			667,659
2014	508	329	60	54,669	800,251
2015	508	329	37	100,987	997,035
2016	508	228	147	349,604	1,222,230
2017	508	228	154	353,104	1,344,780
2018	508	228	168	483,104	1,601,061
2019	508	228	245	529,249	1,710,799
2020	508	228	260	571,949	1,691,408



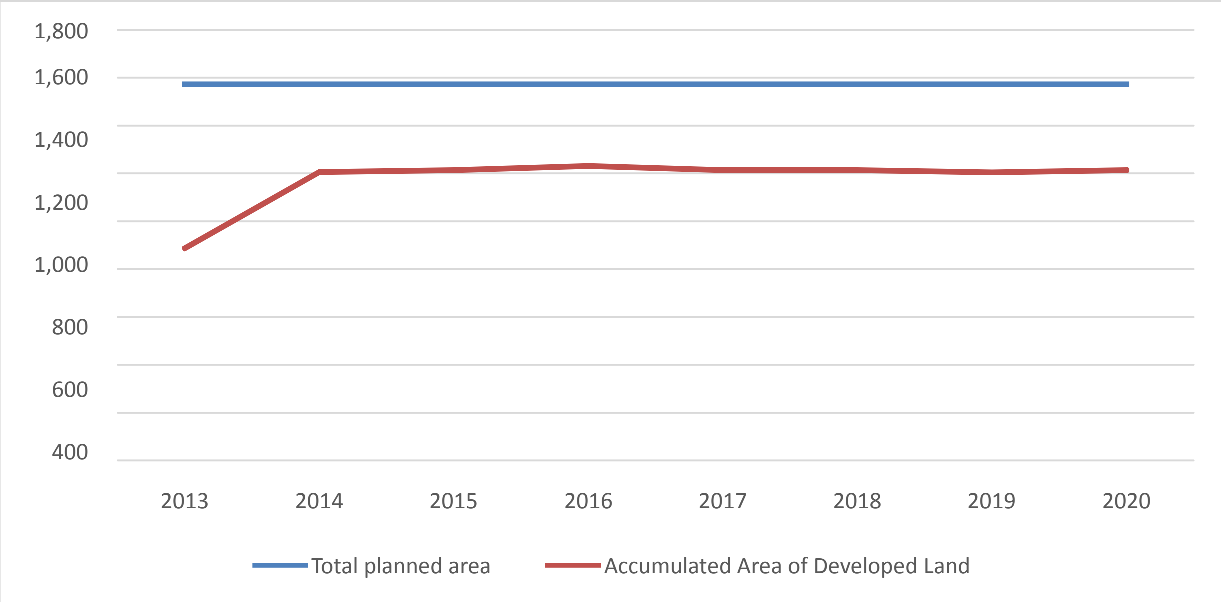


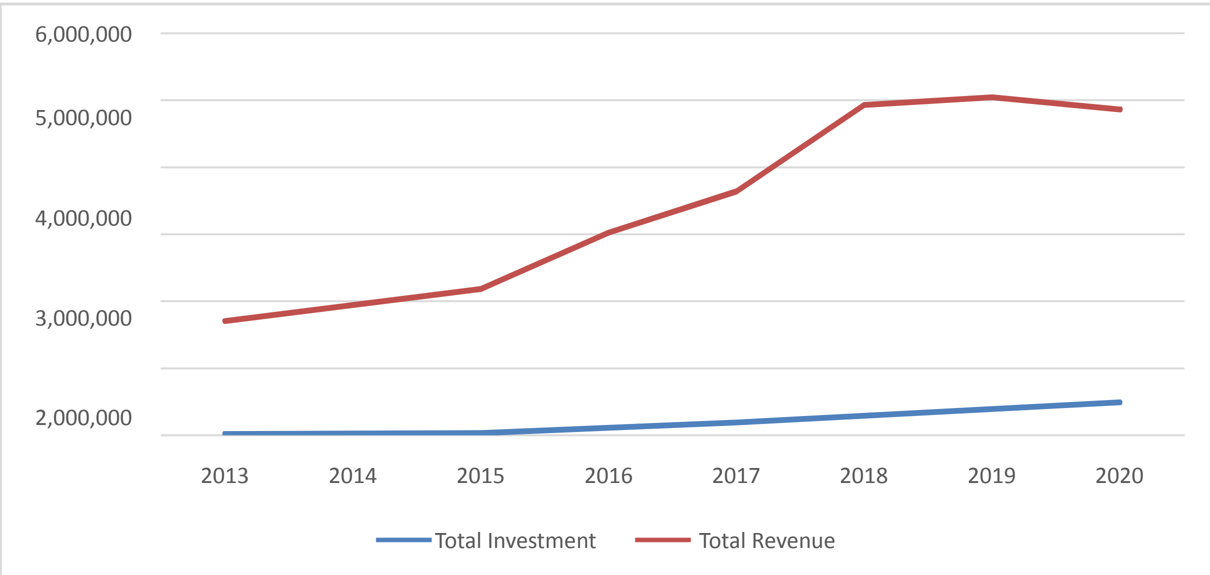
Mentougou Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	189	120	71	27,313	498,710
2014	189	120	86	908,731	1,039,420
2015	189	120	100	973,270	1,309,775
2016	189	120	118	1,135,329	1,745,658
2017	189	120	11,810	7,999,588	2,192,614
2018	189	120	191	1,293,696	3,130,212
2019	189	120	278	1,910,950	3,651,255
2020	189	120	333	2,017,659	4,148,805



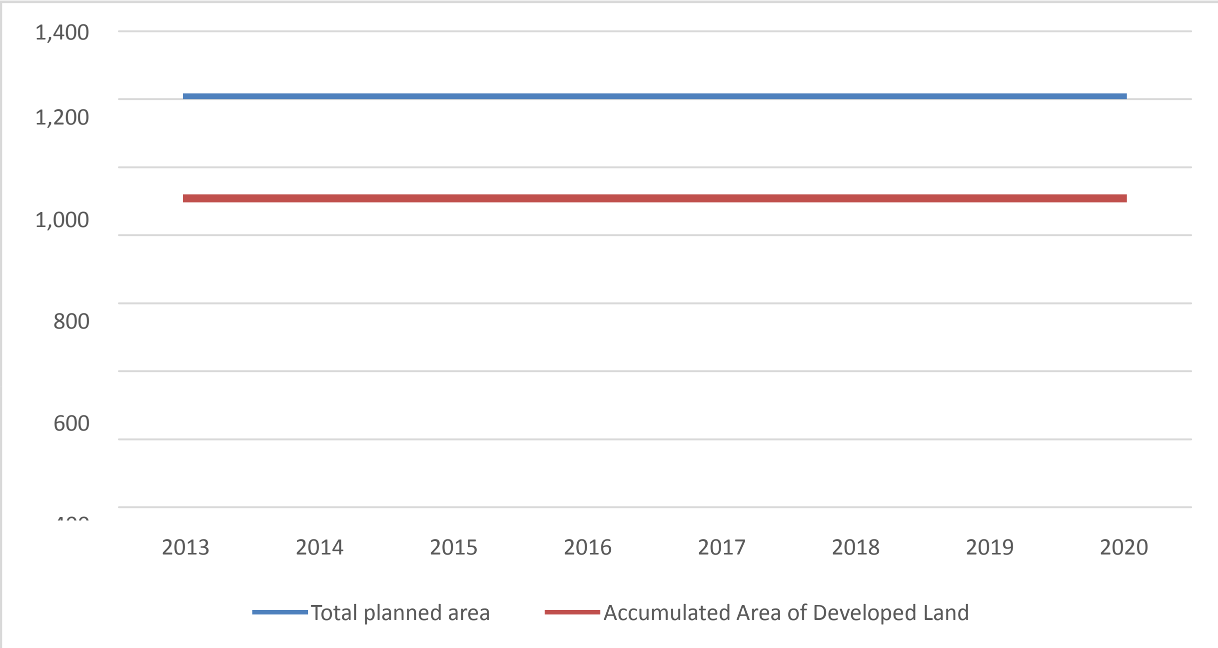


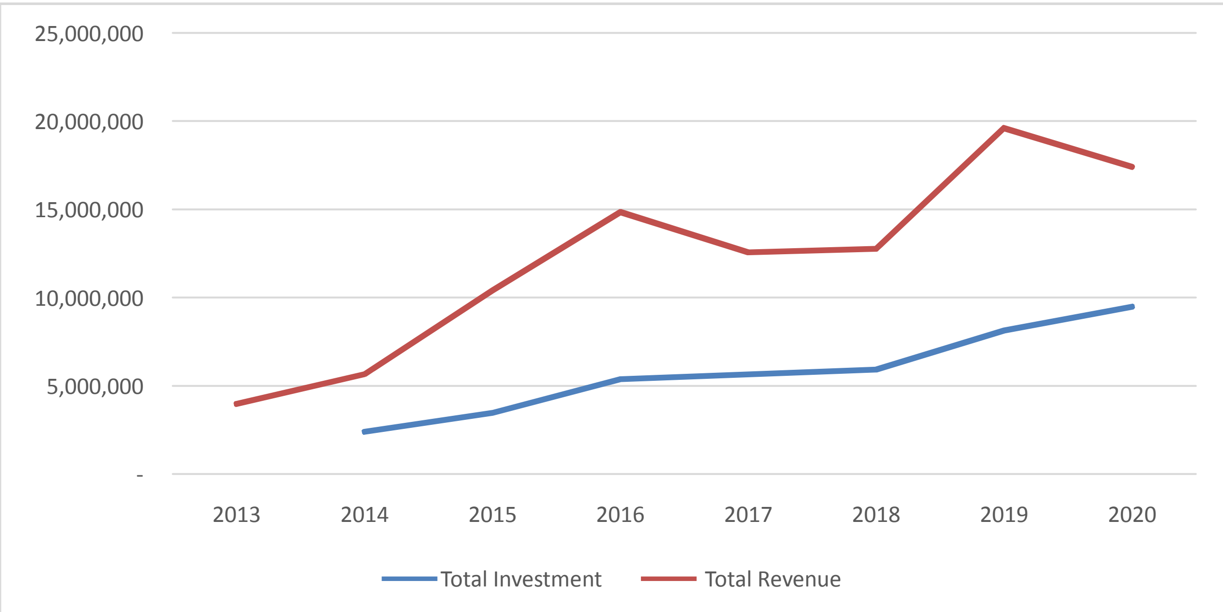
Fangshan Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	1,573	887	40	20,685	1,703,568
2014	1,573	1,205	58	28,860	1,932,637
2015	1,573	1,214	120	32,684	2,183,593
2016	1,573	1,231	150	107,255	3,021,033
2017	1,573	1,214	207	191,068	3,641,091
2018	1,573	1,214	255	291,263	4,932,474
2019	1,573	1,205	340	394,955	5,044,805
2020	1,573	1,214	422	491,578	4,861,954



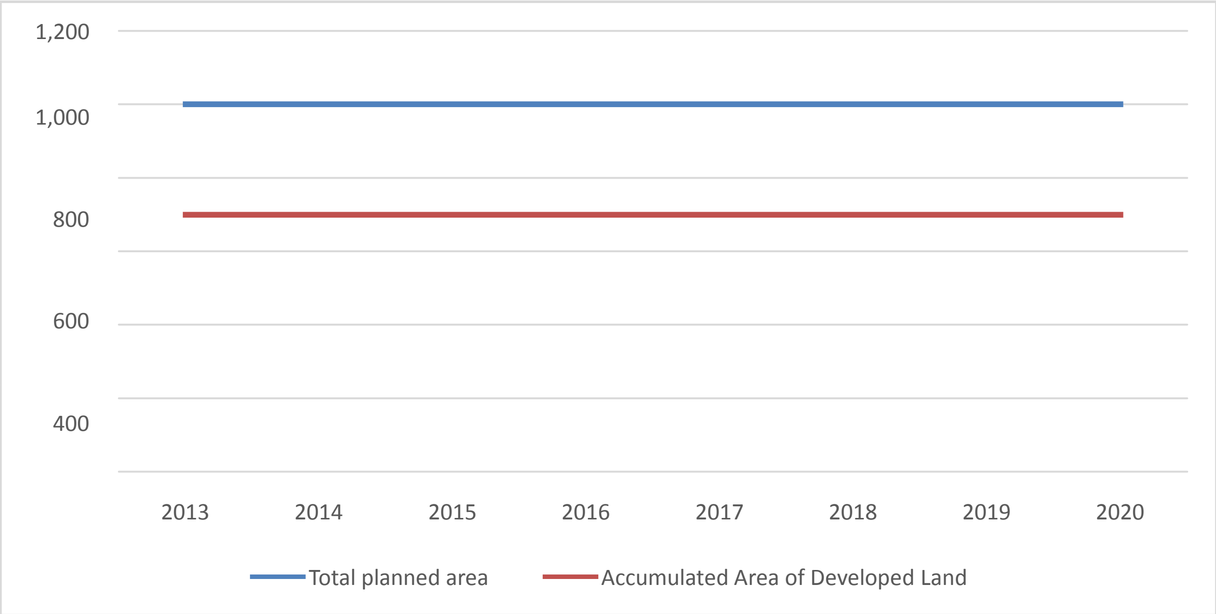


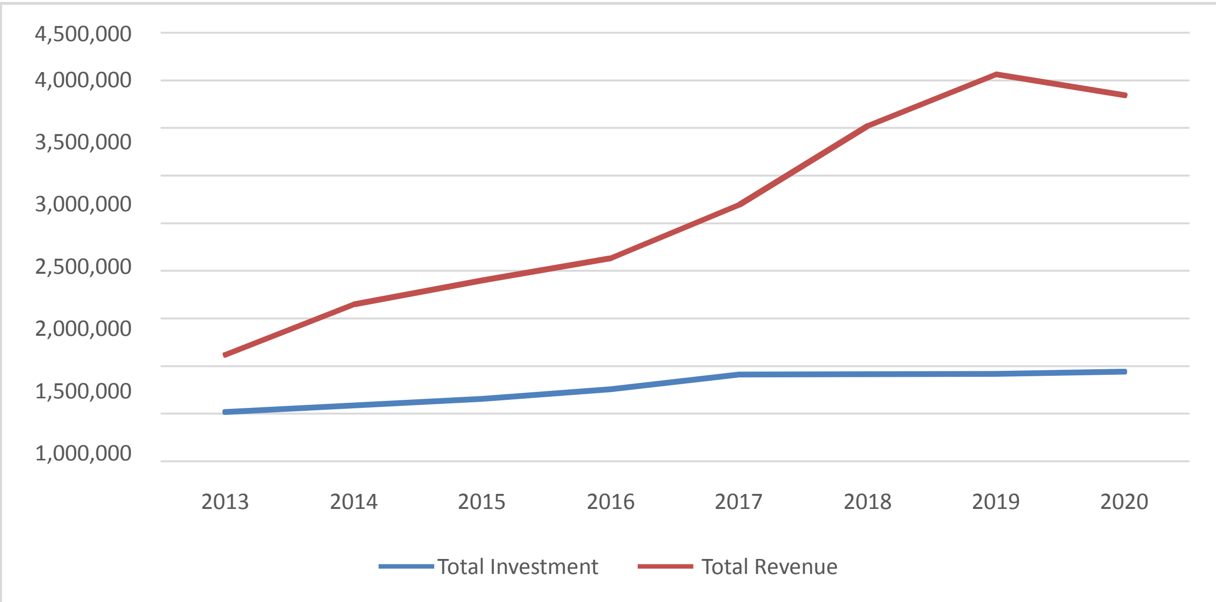
Shunyi Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	1,208	905			3,968,182
2014	1,208	912	142	2,400,468	5,652,372
2015	1,208	912	251	3,476,293	10,397,049
2016	1,208	912	283	5,370,136	14,845,663
2017	1,208	912	350	5,614,337	12,560,149
2018	1,208	912	441	5,924,974	12,771,579
2019	1,208	912	577	8,132,060	19,615,168
2020	1,208	912	765	9,478,762	17,424,666



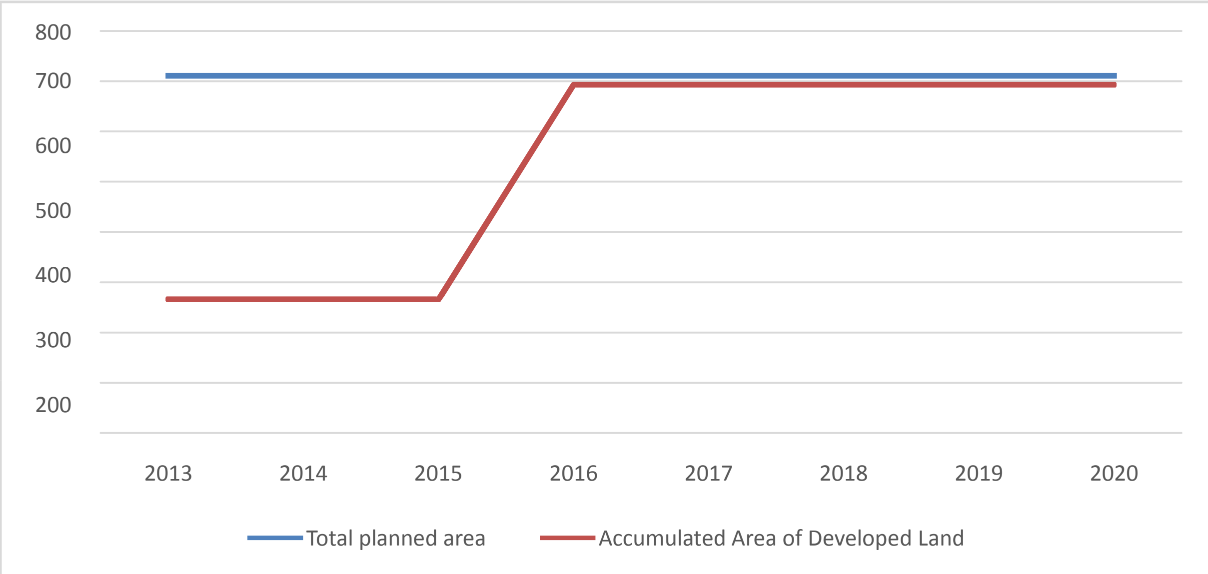


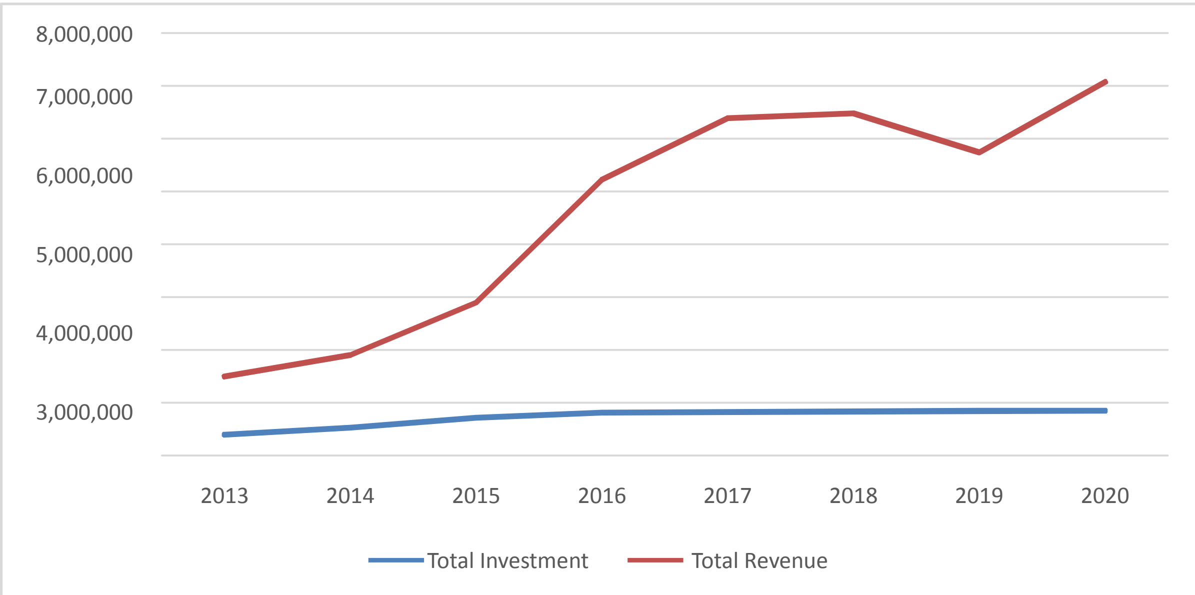
Miyun Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	1,001	699	66	517,900	1,120,487
2014	1,001	699	84	586,500	1,649,237
2015	1,001	699	120	657,000	1,901,008
2016	1,001	699	136	758,500	2,133,504
2017	1,001	699	147	913,500	2,693,534
2018	1,001	699	148	915,500	3,521,202
2019	1,001	699	159	917,400	4,060,496
2020	1,001	699	209	942,609	3,842,737



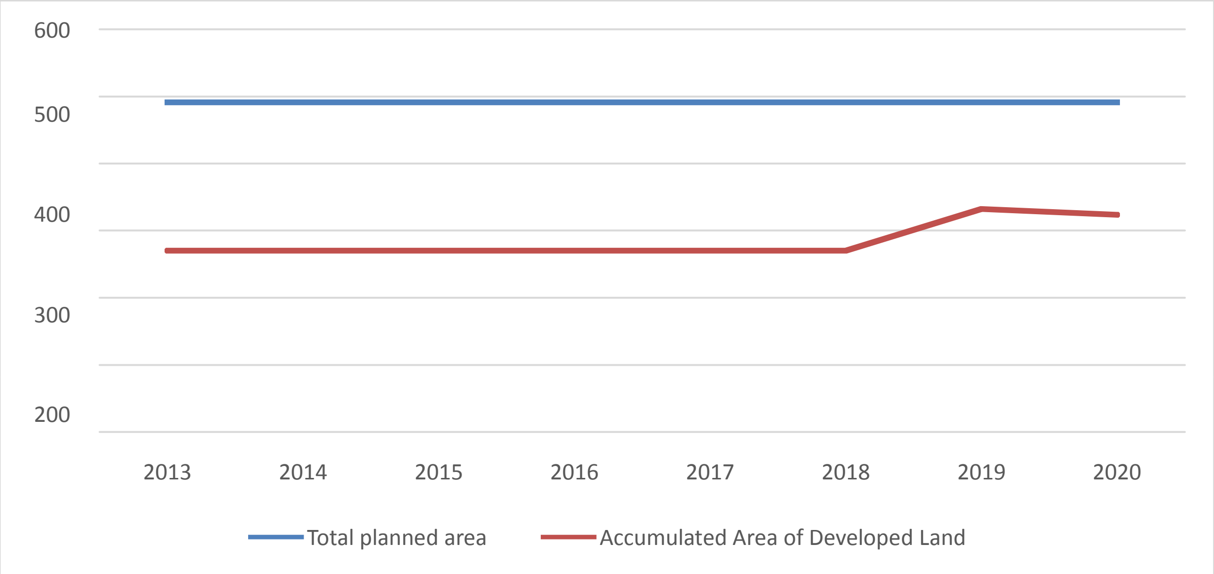


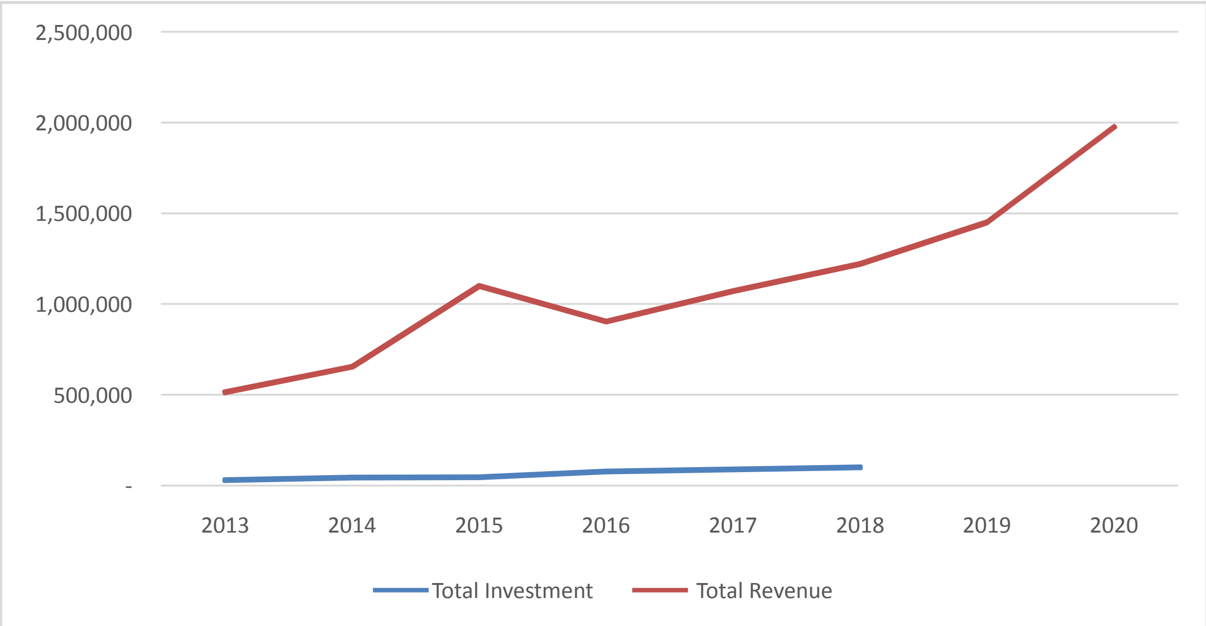
Huairou Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	711	266	76	392,865	1,494,039
2014	711	266	29	526,365	1,903,318
2015	711	266	41	715,665	2,898,388
2016	711	693	54	816,005	5,228,006
2017	711	693	66	839,055	6,390,504
2018	711	693	72	842,453	6,479,701
2019	711	693	180	850,453	5,741,853
2020	711	693	375	850,453	7,075,704



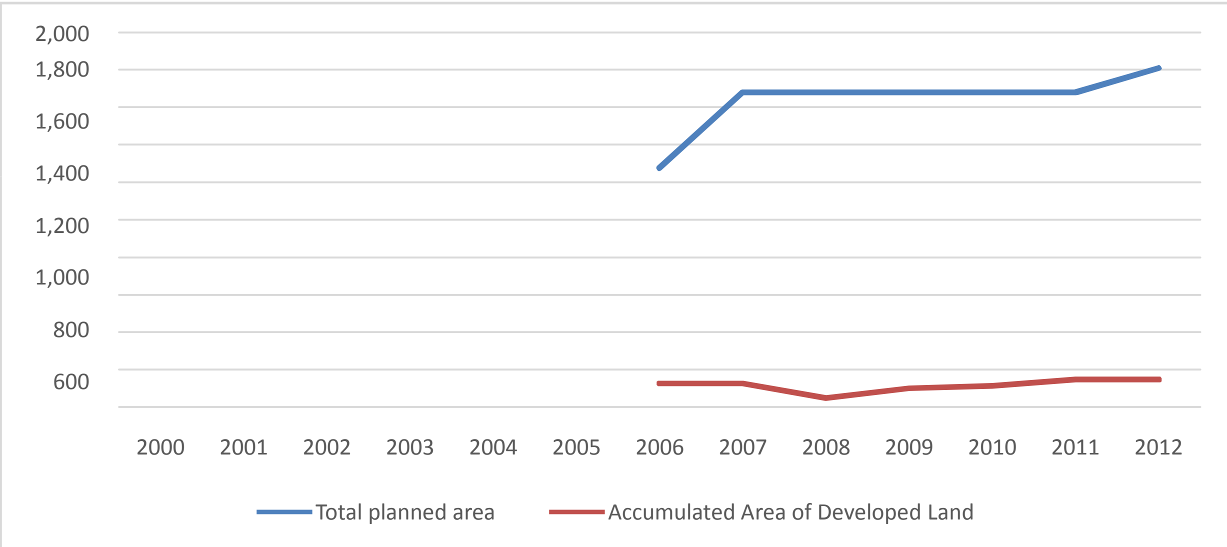


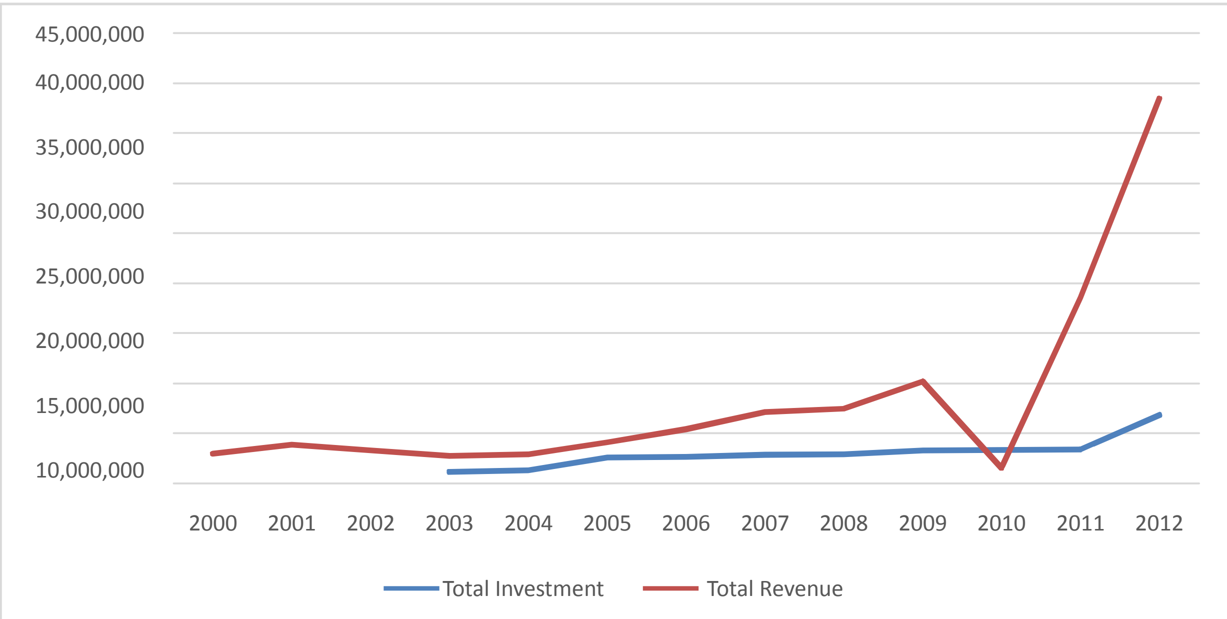
Yanqing Sub-park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2013	491	270	27	29,370	514,268
2014	491	270	27	42,948	654,410
2015	491	270	38	45,658	1,098,007
2016	491	270	58	77,600	903,804
2017	491	270	52	89,840	1,070,971
2018	491	270	57	99,761	1,219,965
2019	491	332			1,449,369
2020	491	324	253		1,973,835





Electronic-Tech Park					
	Total planned area	Accumulated Area of Developed Land	Number of Enterprises	Total Investment	Total Revenue
2000			101		2,950,000
2001			192		3,900,000
2002			365		3,320,476
2003			555	1,153,000	2,750,733
2004			693	1,320,800	2,908,555
2005			815	2,599,470	4,109,778
2006	1,276	127	876	2,630,469	5,425,688
2007	1,680	127	1,236	2,860,848	7,125,028
2008	1,680	49	1,114	2,879,739	7,476,436
2009	1,680	102	1,145	3,279,074	10,193,727
2010	1,680	115	1,235	3,316,415	1,553,676
2011	1,680	147	1,125	3,379,888	18,600,796
2012	1,809	147	1,225	6,819,067	38,451,875





Appendix 2: Population statistics of Beijing (since 2000 to 2020)

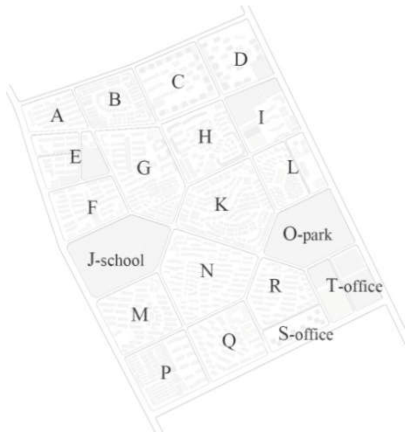
Year	Population (10,000 persons)
2000	1363.6
2001	1385.1
2002	1423.2
2003	1456.4
2004	1492.7
2005	1538.0
2006	1601.0
2007	1676.0
2008	1771.0
2009	1860.0
2010	1961.9
2011	2023.8
2012	2077.5
2013	2125.4
2014	2171.1
2015	2188.3
2016	2195.4
2017	2194.4
2018	2191.7
2019	2190.1
2020	2189.0
Source: 2021 Beijing Statistical Yearbook	

Year	District	Population (10,000 persons)
2000	Doncheng	104
2000	Xicheng	134
2000	Chaoyang	152
2000	Fengtai	82
2000	Shijingshan	33
2000	Haidian	162
2000	Mentougou	23
2000	Fangshan	74
2000	Tongzhou	60
2000	Shunyi	54
2000	Changping	43
2000	Daixng	53
2000	Huairou	26
2000	Pinggu	39
2000	Miyun	42
2000	Yanqing	27
Source:the fifth census		
Dongcheng district include Dongcheng and Chongwe district, merged.		
Xicheng district includes Xicheng district and Xuanwu district, merged.		

Year	District	Population (10,000 persons)
2010	Doncheng	92
2010	Xicheng	124.3
2010	Chaoyang	354.5
2010	Fengtai	211.2
2010	Shijingsha	61.6
2010	Haidian	328.1
2010	Mentougo	29
2010	Fangshan	94.5
2010	Tongzhou	118.4
2010	Shunyi	87.7
2010	Changping	166.1
2010	Daixng	136.5
2010	Huairou	37.3
2010	Pinggu	41.6
2010	Miyun	46.8
2010	Yanqing	31.7
Source: the sixth census (2010)		

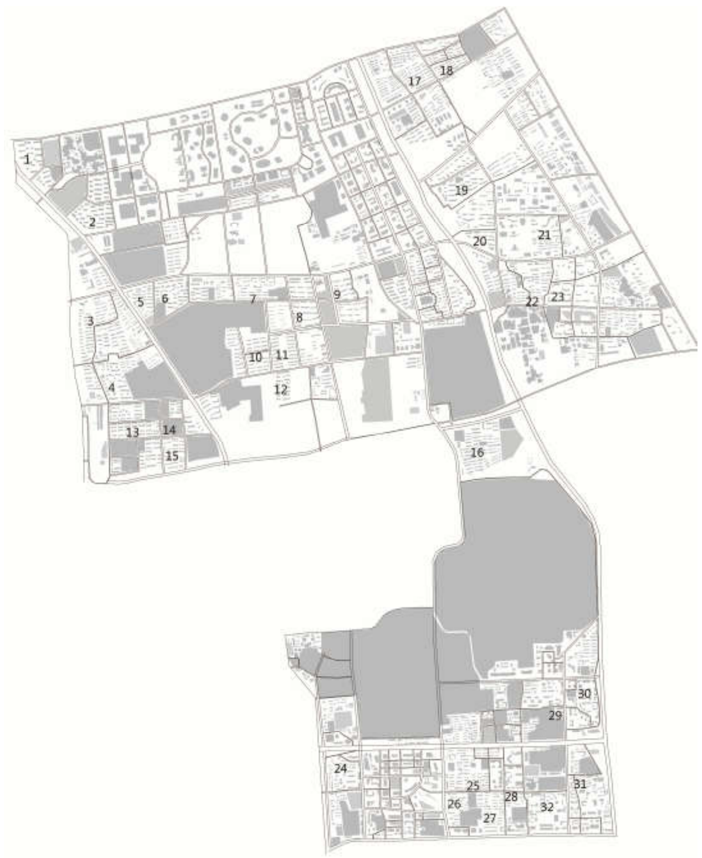
Year	District	Population (10,000 persons)
2020	Doncheng	71
2020	Xicheng	110.62
2020	Chaoyang	345.25
2020	Fengtai	201.98
2020	Shijingsha	56.79
2020	Haidian	313.35
2020	Mentougou	39.26
2020	Fangshan	131.28
2020	Tongzhou	184.03
2020	Shunyi	132.4
2020	Changping	226.95
2020	Daixng	199.36
2020	Huairou	44.1
2020	Pinggu	45.73
2020	Miyun	52.77
2020	Yanqing	34.57
Source: the seventh census (2020)		

Appendix 3: Calculations the average urban density in BDA and HSP



Neighbou rhood	Gross Floor Area m^2	Plot area m^2	Floor area ratio	Number of households	Number of people living in each neighborhood	Living space per person m^2	Price/ m^2
A	140,859	87,524	1.60	702	1,839	77	51,095
B	82,119	144,041	0.57	177	464	177	76,918
C & D	582,120	179,838	3.24	3,495	9,157	64	40,525
E	160,258	133,836	1.20	1,134	2,971	54	34,061
F	85,878	145,379	0.59	480	1,258	68	50,643
G	225,699	249,591	0.90	2,192	5,743	39	53,749
H	356,973	190,986	1.87	1,950	5,109	70	47,382
I	128,568	149,917	0.86	632	1,656	78	47,441
K	130,620	262,263	0.50	650	1,703	77	55,254
L	50,502	153,005	0.33	146	383	132	37,532
M	201,188	185,172	1.09	1,455	3,812	53	53,897
N	106,794	264,552	0.40	1,370	3,589	30	58,116
P	103,716	176,143	0.59	276 villas, 686 flats	2,520	41	45,866
Q	273,870	170,738	1.60	2,196	5,754	48	55,637
R	186,171	147,755	1.26	1,334	3,495	53	60,787

Calculations the average urban density in BDA. (Unit: Yuan). (Source: author)



Calculations the average urban density in HSP. (Unit: Yuan). (Source: by author)

Neighbourhood	Gross Floor Area m^2	Plot area m^2	Floor area ratio	Number of households	Number of people living in each neighborhood	Living space per person m^2	Price/ m^2
1	265,291	120,587	2.2	585	1,533	173	110,226
2	297,234	202,200	1.47	1,052	2,756	108	104,677
3	216,384	200,356	1.08	1,427	3,739	58	86,131
4	397,911	361,737	1.1	1,227	3,215	124	84,637
5	157,537	82,914	1.9	1,708	4,475	35	81,895
6	168,456	110,826	1.52	496	1,300	130	106,313
7	274,357	122,481	2.24	1,723	4,514	61	82,843
8	374,741	162,931	2.3	1,756	4,601	81	55,844
9	107,763	63,390	1.7	1,055	2,764	39	50,810
10	182,643	114,152	1.6	1,406	3,684	50	46,969
11	126,612	117,233	1.08	1,264	3,312	38	102,972
12	100,549	64,044	1.57	756	1,981	51	94,055
13	113,261	100,231	1.13	742	1,944	58	100,111
14	75,950	30,380	2.5	582	1,525	50	46,904
15	492,400	246,200	2.0	1,644	4,307	114	117,609
16	197,686	101,900	1.94	782	2,049	96	133,835
17	181,137	108,465	1.67	1,223	3,204	57	91,457
18	196,620	174,000	1.13	813	2,130	92	76,507
19	341,000	200,588	1.7	2,191	5,740	59	94,549
20	90,737	60,491	1.5	530	1,389	65	79,836
21	227,781	87,608	2.6	1,858	4,868	47	79,393
22	52,984	26,492	2.0	344	901	59	85,502
23	151,934	67,526	2.25	1,264	3,312	46	114,818
24	230,989	177,684	1.3	2477	6,490	36	118,910
25	121,074	100,895	1.2	1,593	4,174	29	166,253
26	161,001	107,334	1.5	1,873	4,907	33	154,144
27	169,200	120,857	1.4	2,296	6,016	28	155,195
28	79,210	49,506	1.6	1,230	3,223	25	117,435
29	36,375	24,250	1.5	259	679	54	144,855
30	316,750	126,700	2.5	2,475	6,485	49	140,457
31	47,810	24,901	1.92	312	817	59	132,414
32	48,794	29,044	1.68	784	2,054	24	150,432