Urban Form for China’s Larger Cities
— the example of Beijing Municipality

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Abstract

The urban form is crucial to a city’s sustainable development. For the fast growing larger cities in China, the rapid urban sprawl has obviously caused many problems. In order to find out what is the most suitable form for China’s cities, I study two extreme urban models: urban sprawl and the compact city. Based on the study and the analysis of particular situations in China, I get the conclusion that compact development is more sustainable for China’s cities compared with urban sprawl. I consider the “decentralized concentration” model a practicable way to carry out the ideas of the compact city. In the case study of Beijing, traffic congestion and unreasonable land use are two serious problems which I focus on. The concrete patterns of “decentralized concentration”-urban villages and transit-oriented city are suggested to solve the present problems and achieve the sustainable development.

Acknowledgements

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1. Introduction

For planners one the most important jobs is to determine what urban forms are sustainable and achievable in the future. (eds Jenks et al, 1996). The debate between centrists and decentrists has been going on for years. Nowadays, the centrists have the upper hand, because that the space consumption by urban sprawl and the over dependence on automobiles have become a major concern all over the world. Since the publication of *Our Common Future* by the Brundtland Commission in 1987 (WCED, 1987), the concept of sustainable development has become increasingly significant as a target for creating a better future for the world economically, socially and environmentally. There is a widespread belief that the compact urban development is a more sustainable model as an alternative to urban sprawl. However, experts have not reached consensus on the development model and the debate continues on whether the compact city model can be realized as designed and attain the targets it promised.

The proponents of the compact city argue that cities developed at a higher density with comprehensive land using can reduce the dependence on automobiles, and increase the utilization of public transportation. Concern over traffic congestion, as well as environmental pollution and resource costs by using the private automobile is an additional major argument used by advocates for compact urban development (Newman & Kenworthy, 1999). Hillman claims that urban residents could enjoy lower transport expenditure, less pollution and lower heating costs because of the reduced consumption of fossil fuels. Yet, the opponents argue that the high density cities are unlikely to bring about the high quality of life as the centrists promise, and say that the crowded living environment is more likely to make citizens suffer from mental illness. And the decentralized urban sprawl is more attractive at individual level which makes the implementation of the compactness policies very hard (eds Jenks et al, 1996). Except the extreme centralists and decentralists, there are some compromisers who are in favor of the approaches under a middle line. The representatives are Breheny, Thomas and Cousins (eds Jenks et al, 1996). Breheny
believes the effects of compact city hypothesis is ambiguous, and it is also difficult to convince the general public to accept the urban compaction. Therefore, he advocates a position which supports both the merits of centralization, for example urban containment and urban regeneration, and the benefits of the inevitable decentralization to towns and suburbs which offer a range of public facilities (Breheny, 1995a). In my opinion, it is more meaningful to discuss the urban form according to cities’ specific circumstances. In this thesis, I choose China’s capital Beijing as a study case to represent the development of the country’s metropolis.

In China, the urban sprawl has been prevailing for decades because of the undergoing process of urbanization. From 1978 to 2004, China’s urbanization level increased from 17.9% to 41.8%. And following Paulussen, it will increase to more than 50% in the next 20 years. The large inflow of people to cities brings great pressure to the city centers and forces the cities to expand rapidly. Most cities in China, no matter what sizes, are undergoing a process of sprawl since they are more attractive to inhabitants compared to the rural areas. The urban areas offer more job opportunities, nicer infrastructure, and better social welfare and so on. The trend of urban sprawl in China is unavoidable, since it is essential to develop the country’s economy and to improve people’s living standard.

Dose this mean that building compact city in China is insignificant now that the trend of urban sprawl is irreversible? Actually, there is no contradiction. After studying the impact of different urban forms on urban sustainability, the Compact City researchers consider that “compact” is not a concrete and specific urban form, but an urban development strategy. Its implementation, inspection and modification should be verified by the time, while it is urban managers and policy makers’ responsibility to decide the most sustainable urban form based on the given situation. A lot of big sprawling western cities have taken some measures to increase the compactness. In the report Sustainable Development: The UK Strategy, it states that: ‘The Government’s objective for 2012 is to continue to make the best use of the land resource by maximizing the use for development of urban land, especially where it is vacant, derelict or contaminated land, and protecting the open countryside and open
land of importance in urban areas.’ (HM Government, 2005, p.43). In Australia, compaction policies have been on the political agenda for over twenty years. In America, many cities have been trying to stop sprawl through the Smart Growth policies which is identical to the compact city model.

2. Urban Sprawl versus the Compact City

2.1 The Forces of Urban Sprawl

Modern usage of the term “sprawl” was coined by Earle Draper, one of the first city planners in the United States in 1937. The definition of sprawl in simple terms is the rapid growth in the urban fringe of a city (Madureira & Mollers, 2006, p.8) while in reality it is much more complicated and can be explained differently from different perspectives and areas. Therefore, there is no agreed comprehensive definition. Burgess (1998) defined sprawl as “…expanding physical development, at decreasing densities, in metropolitan regions, where the spatial growth exceeds population growth”. And Bruegmann (2005) tried to define it in a basic and objective way as “low-density, scattered, urban development without systematic large-scale or regional public land-use planning”. Wassmer (2005) points out that “urban planners often choose to identify sprawl through the description of specific types of undesirable urban land uses.” He quotes what Ewing (1994) summarizing that the characteristics of sprawl’s occurrence have most widely appeared in the planning literature include: (1) low density, scattered, and/or dispersed development, (2) separation of where people live from where they work, and (3) a lack of functional open space. Although the definition varies a bit, there is undoubtedly an agreement that urban sprawl is the main form of urban development in developed countries throughout the whole 20th century while in developing countries the speed of sprawl is still fast and has a strong aftereffect.

The driving force of urban sprawl is complex, because it is related to many fields and in areas with different levels of urban development the main factors are diverse. I
make a summary of the most frequent causes of urban sprawl from economic, technical, and social aspects separately.

### 2.1.1 Technology: Transportation and Infrastructure

To some extent, technical conditions determine the cities’ internal organization as people do not like to commute, on average, more than half an hour to reach major urban destinations. Higher transportation technology means greater human mobility, thus urban land usage and transportation are tightly inter-linked. Newman and Kenworthy (1999) have classified three types of cities according to the stages of development of transportation technologies: the Walking City, the Transit City and the Automobile City (Figure1).

**Figure1. The Layout of Transit City**

![Transit City Diagram](image)

Source: Newman & Kenworthy, 1999, p.29

From the first settled cities about 10,000 years ago until the middle of the 19th century, the form of the city was based on walking. Most of these cities were compact with mixed land use and high density, and the distance from one end of the city to another was limited within 5 km in order to keep within half an hour for
people to arrive their destinations. Since the 1860s, cities pushed increasingly outward due to the widespread use of trains and trams. As a result, the Transit Cities were formed. In this kind of cities, many sub-centers were created along the railroads at the railway stations, which were described as “Pedestrian Pockets” by Newman with the same characteristics of the Walking City; meanwhile, trams accelerated the linear development along the “main streets” within the city centers. Now cities could spread 20 to 30 km based on these technologies. After the Second World War, the automobile has become the transport technology that shapes the city. People with private cars can drive as far as 50 kilometers within half an hour and the development direction has no considerable limitations any longer. Since the speed and flexibility of transport are greatly improved, low-density housing was feasible and popular. “Using an automobile became not so much a choice but a necessity” (Newman and Kenworthy, 1999). In automobile cities, all the conditions mentioned above have provided advantaged preconditions for urban sprawl.

Dieleman and Wegener believed that the accessibility which can be prominently improved by efficient transport and sufficient infrastructure is an important element during the urban sprawl. They claimed that “Locations with good accessibility to workplaces, shops, educations and leisure facilities are more attractive for residential, industrial, office and retail development. If accessibility in the entire metropolitan area is increased, it will result in a more dispersed settlement structure.” For example, the famous L.A. Freeway era has basically ended the Transit City era in the United States, particularly once the Federal Highway System began in 1956.

2.1.2 Economy: the Private Wealth and Business Structure

There is no doubt that the development of economy is a main driving force of urban sprawl. Miller (2003) asserted that our increasing wealth has raised living standards and allowed widespread automobile ownership. With the rising household incomes, most of the citizens in western countries can afford private cars which are essential support for living far away from working places, and the desire for more living space
has become achievable. “As urban economic theory predicts and the result of Brueckner and Fansler’s study supports, if an urbanized area has larger acreage and population and its residents have more income, the agricultural land price and the commuting costs will be lower in the area”(Wassmer, 2005). This theory easily explained the rapidly built suburbs in the interwar years (1918-1939) both in northern Europe and America. According to Bruegmann (2005), at that time the rush to the urban periphery was no longer confined primarily to the wealthy and powerful; it had become a mass movement. For example, in London at that time tens of thousands of families with modest income were able to move out from congested central neighborhoods to row houses or single-family detached houses on the periphery. Until now, the cheaper suburban land is still an important reason for people to move out of the inner city area.

The change of business structure also can be a driving force of urban sprawl as it not only brings about the change of enterprises’ location and investments as well as the labor market. Firms always look for the locations which can maximize the profits and minimize the costs. In most cases, the huge shopping malls and retail centers, different from before, are built on the outskirts of cities or undeveloped areas beyond city fringe. Low land price, easy accessibility and leisure facilities might be the reasons. This transform increases the attraction of suburbs for some residents, because it means job opportunities to some people while to others it becomes more convenient for avoiding the suburb-centre commune for shopping. But these developments put a further burden on the transportation. Sometimes either the population from the city centers or the people from sprawling areas further out have to commute to the shopping malls since they are often poorly connected to public transport.

2.1.3 Society: the Population, Environment and Policies

Over the second half of the 20th century, the total population of the world increased 1.75% annually. In comparison, the world urban population increased at an average
annual rate of 2.68% (UN). The difference of the data can be explained by the urbanization process. The definition of urbanization on Wikipedia is “the physical growth of rural or natural land into urban areas as a result of population immigration to an existing urban area”. In many countries (especially in developing countries), there is still a large amount of migrants from rural areas to urban areas to pursue better living standard. Migration was thought to be a natural process in which surplus labor was gradually withdrawn from the rural sector to provide needed labor force for urban industrial growth process. But it has greatly exceeded rates of job creation and service provision and became the cause of many of cities’ political and social problems. The increased pressure on the provision of dwellings accelerates the spreading out of cities and farm land is being rapid urbanized at the same time. In developed countries, the years of substantial influx of migrants have passed for a long time, while in developing countries like China this is probably one of the main causes for sprawl.

The English-speaking cities have had a long cultural tradition of residents desiring as much space (private and public) as possible to be planned into their urban environment (Newman and Kenworthy, 1999). The desire of such a living environment is one of the most important forces for residents to move to outer districts. The detached house with an own garden became the synonym for a successful, happy, satisfied family life style after the World War Two. Surveys of Americans by Time Magazine (Lacayo et. al., 1999) and the National Association of Home Builders (NAHB, 2000) “…show that most people want to have their own homes in their own lots”. The lure of a large house on a large lot, with good automobile access to facilities (even if they are located far away) is unsurprisingly attractive at the individual level, even if unsustainable at the city or regional level. Despite the nice natural environment provided by the suburban districts, individuals believe that the crime rate is lower than that of the inner city (between the city centre and the suburbs). Since most middle-class were able to move out and the heavy industry was closed down or relocated to suburbs, this area has been associated with the working-class and immigration population and has been regarded as the
lower-class environment of the city.

In some countries, the governments also play an important role in the urban sprawl process. The planning system and government policies are fundamental to encourage or prevent urban sprawl. For example, in America the Interstate Highway Act greatly accelerated suburbanization process and the local governments are urgent to change the vacant land into commercial land because of the taxation generated by retail. In conclusion, urban sprawl is the result of the combined effect of objective conditions (the development of technology and economy) and subjective wishes (people’s pursuit of a better living environment). Under “natural evolution” theory (Mieszkowski and Mills, 1993), suburbanization is a natural phenomenon, a result of increasing incomes and population, transportation improvements, consumer choices, and the influence of competition for land in the urbanized from non-residential use.

2.2 The Characteristics of Sprawling Cities

According to Holcombe (1999) and Gillham (2002), four kinds of development are typical “urban sprawl”, which reflect the summary of characteristics of sprawl made by Ewing mentioned above. They include: leapfrog development, strip or ribbon development (commercial strip development), low-density development and single-dimensional development (single land use development). All of these forms contribute to the dependence of automobile because the facilities of different functions in these kinds of cities are often located beyond the walking distance and the public transport’s service scope.

Leapfrog means development goes beyond the urban fringe, bypassing some vacant parcels, to undeveloped areas and creates built-up communities which are usually called ‘bedroom communities’. Unlike careful planning for satellite towns based on the existing or planned public system, it is often a haphazard patchwork supporting by highways and private cars. Eventually the remaining land between communities and the city centre will be quickly filled for its attraction to commercial development. Therefore, this way of land use is quite inefficient and vital to the fast-developed
Gillham (2002) characterize the commercial strip development as another kind of urban sprawl: “...huge arterial roads lined with shopping centers, gas stations, fast food restaurants, drive-thru banks, office complexes, parking lots and many large signs”. Because the commercial strips are often away from residential districts and areas with other functions, the use of automobiles is encouraged and the development of pedestrian and non-motorized traffic is hindered. Moreover, it grows outward the capacity of urban area damaging the natural open space around the city.

Low-density development occurs accompany with the process of suburbanization. Many new residential districts have been built up at the city periphery with detached houses to satisfy the increased need of citizens. Residents have to rely on private cars to travel since there are only similar houses nearby.

Single-dimension development more often than not happens together with low-density development. It is originated as a positive response to the problems of early industrialized cities. However, after World War II the separation of land uses has been taken to the extreme, with large spatial separation between all the different facilities and the only possible method of transportation is the automobile.

As explained above, without other choice, urban sprawl is tightly related to the use of automobile. Therefore, dependence on automobile is also an important characteristic of sprawling cities. Streets are full of cars at most times of the day and traffic congestion is too common to complain. Over-dependence results in problems in many other areas besides traffic congestion. Newman (1999) elaborated them from the following aspects.

First, it causes low economic efficiency. There are excessive costs for new suburban infrastructure such as highways, heating system and sewer system, while the old city infrastructure is not fully used or lack money to update. Thanks to the traffic congestion, people waste too much time in their cars. And more far away people live to avoid congestion, more time they spent on driving. It not only costs time but also wastes land. The loss of land to parking and roads is greatly reducing the amount of available productive land.
Second, it accelerates the damage to environment from human activities. On the one hand, the increasing automobiles need huge amount of oil to provide and they consume more natural resources. On the other hand, a mass of greenhouse gases is released to aggravate air pollution. Countryside is rapidly converted into urban land in sprawling cities threatening the life of other biology.

Third, it has negative impact on social life. The difficulty of people without cars increases. Over half people in automobile-dependent cities who do not drive are transportation disadvantaged. The growing volume and speed of traffic generate the fear and anxiety of death and injury in traffic accidents. People’s over-dependence has changed the function of streets to a channel only for motor vehicles and former community life is almost collapsed. The vitality and culture of the city is reduced as public spaces are dominated by cars rather than people.

The Los Angeles area has long been famous as a leader in suburbanization. From 1980 to 1990, its central-city population fall more than 43 percent, while the population in the surrounding suburbs shot up 66 percent. The city was a pioneer in freeway development which greatly accelerated the sprawl. The Arroyo Seco Parkway (today’s Pasadena Freeway), which opened in 1940, is considered by many to be the first true urban freeway. However, its mass transit system is underdeveloped and inadequate. Because of the over-dependence of automobiles, the city is also known for its horrendous commuting times and clogged freeways. In 1994, the Texas Transportation Institute rated Los Angeles the United States' worst city for traffic congestion. Thanks to the great distances between far-flung destinations, Angelenos drive considerably more miles than most Americans. Drivers in Los Angeles now spend an average of seven working days a year motionless in traffic, according to a study by the Texas Transportation Institute. Nevertheless, the government has been implementing the intensification policies for years, since no adequate land is available for further sprawl. The outcome is that ‘in the riot zones of South Central, hundreds of houses have risen on weed-choked lots, and throughout the city, parking lots are giving place to densely built apartments and commercial buildings.’
Although it has bad effects, urban sprawl as a corollary of urban development is irresistible but not uncontrollable. At the individual level, sprawl is attractive though it destructs the communally. The key is to achieve the balance of collective interests and individual interests, and the balance of recent development and long-term development. As to different kinds of sprawling patterns, none of those is absolutely wrong. Sometimes it becomes a negative model because of lacking controls from government’s right regulations. No statement demonstrates that urban sprawl and efficient land use can not exist together. As long as the government can slow down the speed of sprawl to avoid the over-spread, try to reduce the negative impacts and make full use of the developed land, every pattern which has its own merits could be an efficient one. Yet, how to maintain the balances? Many sprawling cities have been taking effects to this direction under the guidance of compact city hypothesis. For example, the mayor of London has made a special development strategy for London named ‘the London plan’. It states the design principles for compact city policies:
“London must achieve more intensive development in the right places. It must be designed and managed to ensure long-term efficient use, and in forms that are safe and sensitive both to their own operational needs and to their surroundings.” Now completely stop the urban sprawl of China’s cities is impractical, because it is in the stage of rapid urbanization. But there are still many measures can be taken to solve the current problems, and promote its sustainable development (in Chapter 4).

2.3 The Compact City Hypothesis

The term ‘compact city’, as the antithesis of sprawling cities, can be seen frequently in planning literatures since 1990. It is espoused as an effective solution to the economic, environmental and social problems caused by urban sprawl. What is ‘compact city’? The first emergence of this city model can be traced back to medieval towns, which had clearly limitation and confined all the daily activities within the city’s walls (Thomas and Cousins in Jenks, 1996). At that time, without modern means of transport, the city life was based on walking. Walking Cities were characterized by ‘high density (100 to 200 people per hectare), mixed land use, and narrow streets in an organic form that fits the landscape’ (Newman and Kenworthy, 1999). Due to the development of transport technology, this city form has been eliminated, while some planners who oppose urban sprawl reintroduced it and caused a lot of discussion.

Cities nowadays can not return to the form of the past, and few of the supporters of compact city describe it in ways which are explicit. But many scholars do have expressed their own interpretations (in Jenks, 1996): McLaren (1992) discusses the benefits of high population densities in compact cities in his Compact or dispersed? Elkin et al. (1991) points out the necessary to intensify the urban land use by increasing residential density. Newman and Kenworthy (1989) as well support the intensification of land use and higher density. And Neass identifies it as encourage development to where ‘technical encroachments on nature have already taken place’. Breheny (in Blowers, 1993) provides a summary of these as a high density, mixed
land use city, where growth is encouraged within the boundaries of existing urban areas, but with no development beyond its periphery. For Breheny the compact city’s final aim is clearly and significantly articulated in *Green Paper on the urban environment* of European Union: The aim is to ‘avoid escaping the problems of the city by extending its periphery; [to] solve its problems within existing boundaries’ (CEC, 1990, p.45) High density and mixed land use are claimed to be able to reduce the trip lengths and make public transport an attractive option. Limit the growth of urban area within the existing boundaries is thought to contribute to preserve the countryside.

The ‘compact city’ model has become the focus of discussion partly because its relation to sustainable development. It has been suggested that a sustainable city must be of ‘a form and scale appropriate to walking, cycling and efficient public transports, and with a compactness that encourage social interaction’ (Elkin et al., 1991, p.12). ‘Sustainable development’ became widely fashionable after the UN’s World Commission on Environment and Development published its report: *Our Common Future* (WCED, 1987). In this report, it is defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (WCED, 1987). To urban development, how to use space is a critical issue when addressing sustainability, like what Breheny (1995b) states: if cities can be designed and managed in such a way that resource use and pollution are reduced, and then a major contribution to the solution of the global problem can be achieved. Thus the land use planning which has long-term effects on the physical environment requires careful consideration.

Urban sprawl is considered as an unsustainable development form because it brings on the rapid consumption of landscape, serious air pollution from automobiles, inefficient use of services and infrastructure, and many social problems such as reduced social equity, negative health impact, a loss of community, segregation and so on. On the contrary, compact city is commended for its sustainability. And its benefits is summarized as assisting the process of urban regeneration by redeveloping underused or abandoned sites; capitalizing on existing investment in
infrastructure and community facilities by increasing the density of existing urban areas; and improving the range and quality of facilities available to local residents. For the environment, benefits would be in terms of promoting the use of public transport; reducing the need to travel and journey lengths, particularly by private cars; decreasing the pollution from traffic; and reducing pressure on the countryside (Jenks, 1996). According to Williams (1999), in addition to the above, high density urban living is seen as a prerequisite for city’s vitality. It can promote the cultural activities and social interaction which is important to citizens. Face-to-face interaction is a critical element for sustainability in cities today, while most cities’ quality of street-based ‘accidental interaction’ is disappearing as a result of the highly reliance on automobiles.

2.4 The Characteristics of Compact Cities

According to Neuman (2005), the compact city has a lot of characteristics such as contained urban development, high degrees of accessibility, multimodal transportation, increased social and economic interactions, while two most important ones are: high-density and mixed-use of urban land. High-density development means high-efficient use of urban land which is helpful to protect the countryside and reduce the daily travel distance. Compared with single-use development, mixed-use avoids people spending a long time on the way to work from ‘bedroom communities’ to ‘office parks’ by locating businesses among residential areas. Hong Kong has been recognized as a good example of compact city with more than 6000 people per sq km.

Hong Kong’s development is exactly based on the ‘Transit City’ model defined by Newman. Most planning is focus on the development of rail nodes from where extending to surrounding areas. Due to topographical constraints, Hong Kong is facing intense pressure on available land therefore the principle of Hoang Kong’s physical planning is to ensure the development of rail nodes compact with high-density and mixed-use. Within these super-compact nodes, anywhere is linked
by comprehensive pedestrian system and people can access most local needs within a short walk. Between these nodes, convenient transit system makes the ownership of private cars not that necessary. The figure below shows a high utilization rate of public transport. This development model not only encourages the public to use public transport travel and reduce traffic congestion but also retain a wide range of land as country parks and green areas.

![Image of urban form](image)

**Figure 3. Integration of Land Use with Transit in Hong Kong**

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>% of Passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Hong Kong population living within a mass transit railway (MTR) catchment area — a walking distance of 500 meters from any MTR station.</td>
<td>50.0%</td>
</tr>
<tr>
<td>Percentage of passengers who walk to and from MTR station</td>
<td>69.4%</td>
</tr>
<tr>
<td>Percentage of passengers who either to or from MTR station, requiring feeder service at only one end</td>
<td>28.3%</td>
</tr>
<tr>
<td>Percentage of passengers who require a feeder service at both ends of an MTR journey</td>
<td>2.3%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
</tr>
</tbody>
</table>


Hong Kong is one of the world's most densely populated cities. In the city center, the population density is about 21,000 people per sq km. The older areas comprise 8-12 storey mixed use districts interspersed with high rise blocks. New estates, both public and private, consist of 30-40 storey blocks, up to twenty clustered together, easily housing populations of around 10,000. This density is the result of a series of strict policies which aim to constrain the extending of urban land. As a result, more than 80%
of the city territory is maintained as parks or wildness. For example, the ‘Country 
Parks Ordinance’ promulgated in 1976 has greatly contributed to the preservation of 
the countryside. It prescribes that the land occupied by country parks areas could 
ever be conversed into urban uses. At present, there are total 23 country parks and 
15 special areas (among which 11 are in the Country Parks) covering more than 40% 
of the whole city area.

Figure 4. The High-density Building in Hong Kong

Source: www.everyoneforever.com/content/2006-10-27/hong_kong_high_density_housing

Burton (2002) points out that despite being a high-density city and a mixed-use city, 
compact city should be an intensified city as well. This aspect is focus on the process 
of making city more compact which is prevailing on urban planning, because ‘more 
compact cities can only be achieved through a process of making existing cities more
dense, of encouraging more people to live in urban areas and of building at higher densities: of intensifying cities’ (Williams et. al., 1996, p.83). Lock (1995, in Williams et.al., 1996, p.84) suggests that intensification is a process which ‘ensures that we make the fullest use of land that is already urbanized, before taking green field.’ Naess has describes it as the process of encouraging development to where ‘technical encroachments on nature have previously taken place.’ Roseth however, defines it as ‘the increase of population and/or dwellings within a defined urban area.’ The description by Roseth clearly indicates that the link between compact urban living and sustainability rely heavily on higher densities of people and buildings (in Williams et.al., 1996).

In reality, the implementation of intensification requires the support of local community. Blowers, among many others, argues that the intensify policy might not well accepted because people would not like to give up their suburban homes and cars (in Williams et.al., 1996). On the contrary, the majority of people will choose to live at moderately low densities as long as resources permitted. In some cases, some local communities fight against the intensification process for which they think it is over-crowded and occupies their amenity space.

2.5 Conclusion

Any form has its merits and drawbacks (summarized in Figure 5) and the debate will probably never end. However, it is surprising that few people would like to stand at the compromise position which might be more attractive and feasible. It can combine the strong points of two and avert the weak ones, as Breheny claims, ‘the compromise line might seem like a little idea; perhaps properly packaged it could be big.’ (eds Jenks et. al., 1999, p.32) Moreover, in reality, cities would not go towards either extreme form but a complicated synthesis. Many forms are emerging as sustainable, and the most suitable one in a given local, regional or national context should follow a combination of them.

It is inspiring that many of the compact city proponents have conceded that
“decentralized concentration” is a realistic alternative to the compact city. Under the guidance of this thought, some practical models have emerged such as Transit Oriented and Traditional Neighborhood Development and Urban Villages. For a particular city, the most suitable model of development must be determined based on the local conditions. Facing the serious problem of urban sprawl, Beijing could be inspired by these models for its future development.

Figure 5. Respective Advantages and Disadvantages of Urban Sprawl and Compact City

<table>
<thead>
<tr>
<th></th>
<th>Urban Sprawl</th>
<th>Compact City</th>
</tr>
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<tbody>
<tr>
<td>advantages</td>
<td>1. Increased satisfaction of housing preferences</td>
<td>1. The reduction of pollution</td>
</tr>
<tr>
<td></td>
<td>2. High quality of living environment</td>
<td>2. Preservation of open countryside</td>
</tr>
<tr>
<td></td>
<td>3. The accommodation of automobile travel</td>
<td>3. Efficient use of existing infrastructure</td>
</tr>
<tr>
<td></td>
<td>4. Consistent to the development trend of the land market</td>
<td>4. Revitalization of city centre</td>
</tr>
<tr>
<td>disadvantages</td>
<td>1. Traffic congestion</td>
<td>1. The difficulty of implementation</td>
</tr>
<tr>
<td></td>
<td>2. Environmental contamination</td>
<td>2. The uncertainty of the good results expected by centrists</td>
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<td>3. Conversion of countryside to urban uses</td>
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<td>4. Income and racial segregation of neighborhoods</td>
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<td>5. Civic alienation</td>
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3. The Urban Sprawl in China: Case Study of Beijing

3.1 Introduction

In 2006, the famous Chinese planner Lu Dadao pointed out that over the past decade the phenomenon of urbanization in China is seriously out of control, forming a dispersed urban sprawl. This pattern of urban development is described vividly as "making pie" in China: Urban centers expand outward rapidly and agricultural land in semi-urban areas is quickly turned into urban land, which eventually leads to environmental degradation and traffic jams. In history, the most typical example is North America in the 1950's. Because of the irrational expansion of cities, the urban centers gradually declined, communities increasingly disappeared, and people rely on motor vehicles more seriously. Eventually, the energy consumption per capita in the US was times of the world average. At present, Chinese urban areas are expanding at an unprecedented speed, engulfing a large amount of farmland and green space. And because urban structure is irrational, serious problems emerge in many cities, such as traffic congestion, environmental pollution, high land prices, more difficult in urban management, deterioration of social environment and so on. Out of question, these issues have greatly influenced the sustainable development of cities, and the most serious consequences are the following three.

1) Result in sharp reduction of arable land resources.

China has huge population but scarce land resources, especially the arable land resources which are essential to ensure people’s food and clothing. According to data from China's Ministry of Land and Resources, there are about 1.2 million Sq km arable land totally, while per capita possession of cultivated land is only about 900 Sq m. This number is merely 37.3% of the world level, and 1/10 of that in United States. Moreover, 60% of the arable land is lack of irrigation water, 40% has degradation, 30% is suffering from soil erosion, 78% belongs to low-yielding fields, and their soil fertility has continued to drop. Much worse, a large amount of arable land is being changed into housing and industrial land, since the profits from
commercial property development could be much higher than agriculture production. To some extend, the enormous short-term profits are obtained at the cost of long-term development. The potential value of arable land is neglected. Meanwhile, the environment gets non-reversal damage.

According to another government statistics of China's Ministry of Land and Resources, the area of arable land occupied by blind expansion of urban land accounts for 18.52% of the total misused land. In the past decade, about 18600 Sq km land has been permanently converted to urban built-up area. This is a serious problem to China who owns less than 10% of the world's arable land while need to feed 20% of the world population. Further more, the reserve arable land resources are nearly used up, while the expansion rate of city size is increasing. If lack of supervision, the cities’ current high-speed expansion will not only affect the ability of China's self-sufficiency of grain but also pose a threat to food security.

2) Bring down the urban land use efficiency seriously and bring about the tremendous waste of city resources.

Rational urbanization is developed as the need of increasing employees in urban areas. In contrast, the urbanization in most Chinese cities is boosted by property development since urban managers take the way of changing the function of land (such as sell arable land to real estate developers) to stimulate urban economic growth. The irrational development model, on the one hand, consumes a large number of land resources; on the other hand, makes the city greatly increase the demand for basic urban infrastructure, such as freeways, pipelines and other facilities. However, as a matter of fact, the construction of basic infrastructure can not meet the request of the constantly expanding city for financial limitation. Since urban development is more or less leaded by the projects without unified construction planning, the proper urban spatial configuration has been disrupted and tremendous resources are wasted.

3) Reduce the accessibility of public service facilities and deteriorate urban traffic problems

A main defect of suburbanization process in China is that new-built rural areas,
which are mostly with single land use, can not be dependent from the downtown in infrastructure, social service facilities and employment. These new areas not only fail to reduce the population pressure to downtown but add more loads to it in social, economic and environmental aspects. The tight contact between new suburbs and downtown generates the traffic jam in rush hours on trunk roads. And the ever-increasing commuting distance, more or less makes the urban residents more rely on the vehicles. As a result, the number of private cars has a tremendous growth. Accordingly, the consumption of gasoline and other substantial energy increase, and the environment pollution in urban areas is getting worse. These are overwhelming problems that should be resolved during China’s urban expansion. In my opinion, the ideas of the compact city hypothesis are meaningful to the planning of this stage. Taking china’s current condition into consideration, we must take the way of intensive development. As mentioned above, there is too little land per capita in China, and the proportion of plain area is only 12%. If cities continue to expand at present speed, no remaining plain would be left to be arable land in the near future. Therefore, there is no choice but make full use of the developed urban land. At least now, Chinese residents have no privilege to enjoy the American Garden City. The academician Ye Jia has said, “Cities in China are impossible to develop as low-density as America's towns. The United States has plenty of land to its 20 million people and the way of consuming land in the United States has no vital influence, while it is a really critical issue to China.”

3.2 The urban sprawl of Beijing

3.1.1 The Background Situation of Beijing

Within the metropolitan area of Beijing (16410.54km² in total), 62% of the total area is covered by mountains in the northwest part, higher than 100m above sea level, only 38% of the land is available for urban use and agriculture (Figure 6). In order to understand better the local situation of Beijing, there are some concepts regarding administrative divisions of Beijing metropolitan area, identifying urban and suburban
areas. Such as “central city”, “central urban area”, “urban districts”, “near suburban districts”, “outer suburban districts”, which sometimes overlap each other. Beijing has four urban districts (Dongcheng, Xicheng, Chongwen, Xuanwu), and the suburban area is officially divided into four near suburban districts (Haidian, Chaoyang, Fengtai, Shijingshan), eight outer suburban districts (Changping, Huairou, Shunyi, Pinggu, Tongzhou, Daxing, Fangshan, Mentougou), and two outer counties (Miyun, Yanqing), in total there are 4003 villages in 143 towns (Qu Lei, 2007). This administrative division was made in 1950s, and within that period, the urban area of Beijing was the old city, and the four near suburban districts were around the old city boundary. During the past 50 years, this administrative division was hardly modified, while the urban area has already extended much more, that is to say, the four near suburban districts are partly urban and partly rural today. Nowadays, the total urbanized areas are named as central urban area, and the four urban districts plus the four near suburban districts are called central city which is my main study object.

Figure 6. Geographic and Administrative Divisions of Beijing Metropolitan Area

Source: Qu Lei, 2007

3.1.2 The Current Situation of Sprawl

Beijing is the area that with the typical problems of urban sprawl because of the stress of prominent population growth. The urban area is extraordinary inflation in the way of concentric-style spread, local fan-type expansion, corridor-type radiation, enclave-type growth and adhesion-type filler. This expansion gradually forms a
"making pie" extension development. In fact, the initial planning does not want to have the current situation. Early in 1958, the planning of Beijing has made a target of the "Scattered Groups" development model which is basically equal to the “Satellite Towns”. (Figure 7) From 1982, the blueprint began to be implemented. According to the principle of layout, within the region of 1040 sq km from the urban center outward, it is supposed to form an urban pattern with an urban center (around 320 sq km), an isolated greenbelt (more than 240 sq km) as well as ten scattered groups at the urban edge (Beiyuan, Jiuxianqiao, Dongba, Dingfuzhuang, Longtou, Nanyuan, Fengtai, Shijingshan, Xiyuan, Qinghe).

Figure 7. The Layout of “Scattered Groups”

Source: Google earth

Under this arrangement, the government, on the one hand, should strictly control the expansion of urban construction land and switch the emphasis from development to adjust and land transform; On the other hand, should speed up the construction of the greenbelt between the center and the groups to guarantee that there is enough green space. However, this plan has not been implemented definitely and failed to achieve the desired goals, because of the industrial dispersion, the unexpected large growth of
population (from 4 million in 1950s to 17 million in 2008) and the rapid development of real estate industry which will be explained in the next section.

Since the city center has been growing continuously, now the big central group and many small groups at the edge have basically been connected to a whole. Although in 1993 the comprehensive planning re-emphasized the need to "prevent the central region and the marginal groups becoming inter-connected" , it still had no actual result. The planned greenbelt which is 300 sq km originally has shrunk to only 60 sq km, that is to say there is four-fifths of the "greenbelt "has become in fact the built-up area. From 1981 to 2005, the built-up area of urban center is from 346 sq km to 1209 sq km, increasing more than 30 sq km per year on average with the main pattern that the center urban area grew rapidly along the arteries towards near suburban areas. Furthermore, the expansion of Beijing exactly demonstrates the general characteristics of urban sprawl (Jiang, 2007, p.653):

1. Leapfrog development: the average distance from new construction land to the city or district center is 12.02 km, and about 55% of new construction land is more than 10 km away from the city or district centers.

2. Strip or ribbon development: the average distance from new construction land to the highway is 8.57 km, and about 22% of the new construction sites are located within the 1 km buffer zone of highways.

3. Low-density development: the analysis of the plane-building density shows that the density of the suburban district is less than 1/5 of urban center’s density, and less than 1/3 of urban fringe’s density. The analysis of three-dimensional building density shows that the average plot ratio (the total building area divided by the site area) of new construction sites is 1.26, and about 90% of new buildings’ area ratio is less than 2.0. Buildings in outer suburban district generally have low volume levels, at about 1.5. It reflects that the overall expansion of new construction sites is under a low density and the degree of intensive use is not high.

Based on the analysis above, Jiang Fang (2007) summed up the influence of sprawl to the formation of the present urban pattern of Beijing:

1. The outward spread taking place near the edge of the central group has directly
brought about a huge loss of farmland and open space, destructed the planning assumption of "scattered groups", and then added to the burden carried by the city center.

2. The strip development along the expressway, as the "axial expansion + space filling" model, has accelerated the pace of urban expansion, promoted the formation of "making pie" space pattern instead of the satellite pattern.

3. The decentralized independent development of industrial land and residential land has disrupted the overall layout, resulting in inefficient use of land resources. It also hindered the development of multifunctional sub-centers.

3.3 The Forces of Beijing’s Sprawl

The reasons for the rapid sprawl of Beijing, especially in the past two decades, can be summarized into three points: First, during the industrial dispersion, a lot of industries move out of the city center to relocate in the suburbs. Second, a large amount of migrants flow into Beijing to pursue better job opportunities. Third, the incremental demand of dwellings encourages the development of real estate industry. The suburbanization process of Beijing that started from 1990s was propelled by the process of de-industrialization. During the period of de-industrialization, the spatial distribution of the three main industries was affected differently. The primary industrial sector had a decrease of 60% in the city center, as well as an extensive decrease in the suburbs. The second industry also recorded a decrease rate of 30-40% in the central urban districts, while there is an increase in the suburban areas demonstrating a relocation tendency. Tertiary industries on the other hand grew slowly in the urban districts, but increased very rapidly in the near suburban areas. The industrial growth in the suburban areas attracted some people move to the nearby suburbs. To some extend, this trend benefited the development of the suburbs which can shoulder some pressure for the city center, and brought higher living standard for people. But because the planning of this periphery area was not cautious enough, the urban and rural network interweaved together that there is no clear
boundary anymore between urban and rural area. Such a vague interrelationship has caused inefficient land use in the periphery reflected mostly by the scattered settlements.

The population of Beijing has kept growing for decades, among which the migrants account for a big proportion. The central urban area of Beijing which is undergoing fast economic development and construction tide is quite attractive to floating population mostly who seek jobs in cities from rural areas. Increased residents ask for more dwellings to accommodate them. This, on the other hand, promotes the construction of settlements in the periphery because of the cheap land price. The real estate developers have built large residential communities in the periphery before the public transport system can extend to, and the communities are mostly only with single function.

### 3.4 The Main Problems Caused by Sprawl

The most serious problem caused by the “making pie” model is the traffic congestion. The long-standing "Single center + Ring road" growth pattern that ring roads are built outward, the old town is surrounded by new districts and urban area spreads concentrically and coaxially has led to the defects of urban transport. Since the jobs are over-concentrated in the old town where is filled with commercial and official functions, for the past 20 years, the central area of Beijing has not escaped from the traffic jams though the roads have been built from the second ring to the sixth. It is even aggravating particularly during the morning and evening peak flow when 90% of all roads are saturated, and even a slight accident will cause a large-scale traffic jams.
Beijing's public transport development lags far behind the urban build-up, and many residents have to rely on private cars to travel. That is one important reason for traffic jams. First, since the completion of the first two lines in 1984, the construction of subway had been almost stagnant for decades. Until 2001, the total length was only 42 km far less than other cities’ of the same size in the world. Fortunately, after realizing the urgent need from public, the government started a long-time plan for subway construction extending to 2015 when the total length will reach 561 km. Now there is about 200 km in use.
Second, another public transport, buses are facing the situation of excessive use. In order to encourage people to get out of their private cars, the policy of low-cost public transport was launched. It indeed stimulated citizens' enthusiasm for public transport, and there was a marked increase in demand. However, the existing capacity of buses in fact can not afford such a sudden huge surge. Because of financial, spatial and other factors, the increased number of buses is very limited even if the existing public transportation resources are over-used in serious condition. Therefore, buses are even more crowded than before. Moreover, because of irrational planning, bus stations and subway stations do not have a very good convergence. They belong to entirely different systems, leaving blank between them. So the public have no choice but walk to fill up. This seriously affects the efficiency of the use of public transport.

The disordered spread of single-functional suburbs makes the traffic situation worse. Now that office land occupies the central area, more residential land can only be concentrated in the suburbs. For example, the Wangjing residential area located at the urban fringe with a total land size of 17.8 sq km is planned to accommodate population of 330,000. Famous for the large-scale residential development, it is known as Beijing's "sleeping city". Another big residential district named Huilongguan is also planned for more than 300,000 residents. Their population has been the equivalent of a city scale, but their function is only residence mainly. This makes massive employees must travel between the city center and their home everyday, the life costs of people hard to decrease and public transportation facilities overloaded.

3.5 Ideas on the Future Urban Form

Many planners have realized that the previous strategy could not work on the present situation anymore. Facing the existing situation, planners have been trying to find a new development way for Beijing. One of the most famous is the “grape cluster” model suggested by professor of Tsinghua University Wu Liangyong. He considers
that it is the only way to stop new towns from expanding. “Grape cluster” can be explained as “urban districts + transport axes + green land” for short. The central viewpoint is that the spatial layout, land use, transportation system and ecological environment must be coordinated and orderly development in order to create a multi-central urban structure. The grapes stand for the built-up functional units which should be developed intensively. The stems represent the main roads connecting the sub-centers. Wu claims that the transportation system should be eco-friendly which requires the improvement of public transportation. It is necessary to strengthen the construction of transport hub (including the placement of service centers, shops, restaurants and parking lots), while control the land development along the main road. Except that, the rest surrounding space should be preserved as green land. They can be parks or greenbelts interspersing between the traffic axes and combining with the natural green land.

Based on the present situation, the Overall Planning of Beijing established in 2004 made a new strategy: “Two belts, two axes and multiple centers”. It basically absorbed the idea of “grape cluster”, picking up the regions that need to be focus on in the next ten years. One axis is the north-south axis of the old Beijing town, the other one is the west-east extension line of Changan Avenue. The north-south axis is an important cultural heritage witnessing the history of Beijing as capital city for several hundred years. It is the best reflection of the highest state of spatial layout of Beijing City in history. The extension line of Changan Avenue is a typical microcosm of the history and culture more than 50 years since the foundation of the Republic of China. It carries almost all the functions of Beijing including the political, economic and cultural. The “two belts” are “eastern development belt” and “western ecological belt”. The “eastern development belt” is proposed for a strategic adjustment of Beijing’s spatial structure. It aims to transfer some functions out of city center by develop it into an industrial zone, and thus divert the industrial development spots of new Beijing. The “western development belt” as an important barrier against the sand storm from northwest is critical to Beijing’s living environment. It is planned to adjust and transform the exiting industries into environmental protection industry and
preserve the green space as far as possible. The "multi-centers" refers to the sub-cores with different urban functions. They are expected to help to improve the service efficiency and to disperse the traffic pressure of the city center. There are eight sub-centers in all including Zhongguan Village High-Tech Park, the Olympic Central District, Central Business District, Haidian Technology Innovation Center, a modern manufacturing base in Shunyi, Tongzhou General Services Center, Yizhuang High-tech Industry Development Center, Shijingshan multi-service centers.

Figure11. The “Tow belts, Two axes and Multi-centers” Planning

Source: Google Earth

The key point of this planned form is still the development of multi-centers. If there are no effective strategies to promote the formulation of sub-centers, they probably will have the similar end of the satellite towns. In my opinion, the arguments of applying mixed land use and improving public transport system supported by the compact city hypothesis have a high reference value.
4. The inspiration from compact city hypothesis

4.1 Sustainability goals for Beijing

Without any doubt, increasing urban sprawl, serious traffic congestion and aggravating air pollution are not in accordance with Beijing’s sustainable development. But then, what are the key factors to a city’s sustainability? As Newman said (1999), “it is possible to define the goal of sustainability in a city as the reduction of the city’s use of natural resources and production of wastes, while simultaneously improving its livability, so that it can better fit within the capacities of local, regional, and global ecosystems”. It can be explained in the Extended Metabolism Model of human settlements.

Figure 12. Extended Metabolism Model of Human Settlements

Source: Newman and Kenworthy, 1999, p.8
The figure shows that anything coming into this system must pass through and turn into outputs in the end. Therefore, reducing the resource inputs at the initial stage is the easiest way to eliminate the negative impact on environment. This approach might be understood by scientists but definitely could not be accepted by developers. Especially for Beijing, a city that undergoes a rapid economy growth, reducing resource inputs is really hard to impracticable. Another effective method is to improve the efficiency of resource utilization, in other words, product higher livability with the same quantity of resource. For example, the public transport that consumes less energy per capita is a more energy-saving way compared with private cars.

With the Extended Metabolism Model as the fundamental basis, it is possible to derive a set of practical goals or indicators for a sustainable city. Considering the urban problems of Beijing, it is quite necessary to introduce proper indicators to monitor the transportation and land use. This is a scale-down version of the indicators suggested by the World Bank and UN Center for Human Settlement (Newman and Kenworthy, 1999, p.18).

**Transport:**
- Increase transit, walk/bike, and carpooling and decrease sole car use.
- Reduce average commute to and from work.
- Increase average speed of transit relatives to cars.
- Increase service kilometers of transit relative to road provisions.
- Increase cost recovery on transit from fares.
- Decrease parking spaces in central business district.

**Land use:**
- Preserve agricultural land and natural landscape at the urban fringe.
- Increase the proportion of urban redevelopment to new development.
- Increase green space in local or regional parks, particularly in “green belt” around city.
- Increase the number of specially zoned transit-oriented locations.
- Increase the density of population and employment in transit-oriented locations.
The goals can only be realized when they are combined with policies. In the *Comprehensive Planning of Beijing* (2004-2020), some strategies based on these indicators are made to ensure urban sustainable development. The figure shows the basic content of this planning.

Figure 13. The Basic Content of the Comprehensive Planning of Beijing (2004-2020)

<table>
<thead>
<tr>
<th>vision</th>
<th>The country’s political center and culture center</th>
<th>The worldwide famous ancient capital and modern international city</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles</td>
<td>Coordinate the development between urban and rural area</td>
<td>Promote the urbanization process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Highlight the government’s public service functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respect the culture and history of the city</td>
</tr>
<tr>
<td>Goals</td>
<td>Improve the status of Beijing as an international city</td>
<td>Enhance the ability as a diving force of development for surrounding areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase the degree of inclusiveness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Create a better living environment for citizens</td>
</tr>
<tr>
<td>Strategies</td>
<td>Economic Development Strategy</td>
<td>Social Development Strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eco-environment Development Strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordinated Regional Development Strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Urban Space Development Strategy</td>
</tr>
<tr>
<td>Strategy Priorities</td>
<td>The sub-centers development</td>
<td>The transport and infrastructure improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The ecological and environmental protection</td>
</tr>
<tr>
<td>City Scale (2020)</td>
<td>Population: 18 million, the average annual growth rate keeps under 1.4%</td>
<td>Urban construction land: 1650 square kilometers</td>
</tr>
<tr>
<td>Time perspective</td>
<td>Short term: 2004-2010</td>
<td>Long term: 2010-2020</td>
</tr>
</tbody>
</table>

This is only a very short introduction of the basic ideas, and each one requires further explanation and detail. Because my thesis is focus on the urban form, I study the Urban Space Development Strategy emphatically. The “two belts, two axes and multi-centers” urban model which I have discussed in Chapter 3 is suggested and explained in this strategy. The construction of the sub-centers is highlighted: At the basis of previous satellite towns, the sub-centers should be developed into relative independent new towns with good functions, beautiful environment, convenient transport and advanced public service facilities. Under this strategy, some practical goals are stated:

- Focus on the individual development model of each new town and boost the cooperation among them.
- Focus on the scale, layout, particular function and the spatial planning of each new town.
- Pay attention to the uncertainty and dynamic elements of urban development and adjust the size and construction order of new towns according to the change of development environment.
- Formalize a rail transit-oriented urban model. Urban land development should conform to the construction of transport facilities. The spatial layout and land use planning in new towns should consider the location of public transport junctions.
- Construct the new towns’ education, culture, health, sports, social welfare and other public service facilities with high quality and status in order to increase their attractiveness.
- Continuously increase the land use efficiency and reserve the land resource for long-term development.

“According to the trend of urban economic development and a comprehensive analysis of new towns’ geography condition, development base, carrying capacity of
resources and environment, Tongzhou, Shunyi and Yizhuang located on the eastern development belt should be the key areas for development. The three new towns are planned to be the major areas for alleviating the population and function pressure on the city center, and planned to be the gather place of new industries. The formulated impacts from the certain scale and gathering together build a repelling system to city center”. (The Comprehensive Planning of Beijing)

The statements in the strategy that forming a rail transit-oriented model and increasing the land use efficiency are obviously in accordance with the arguments of the Compact City ideas. The overall planning of the urban form “two belts, two axes and multi-centers” is basically under the claim of “decentralized concentration” supported by some Compact City proponents. I believe it is the right development guidance for Beijing. However, how to build the sub-centers specifically is still without a clear description, while this is exactly the key point related to the success of the planning. In my opinion, the model “urban village” and some successful examples which will be introduced next can provide the significant suggestion for Beijing.

4.2 The application of compact city hypothesis

4.2.1 The idea of urban villages

The Urban village development, in a word, is a kind of transit-oriented development like Hong Kong, aiming to bring greater walkability within the villages to reduce the transit use (Figure 15). The key characteristics of urban villages are summarized by Newman and Kenworthy from their examination of some of the best examples in Europe and North America. They can be listed as below (Newman and Kenworthy, 1999, p.166):

- High-density land use, especially at the center, so that everything within the “village” is within the walking and cycling distance.
- Mixed land use with offices, shops, businesses, and community facilities integrated into residential development.
● A heavy rail or light rail station near the sub-centers.
● Considerable landscaping, including gardens on the top of building and on balconies and attractive gardens in public space.
● Community facilities, such as schools, libraries, child-care centers, senior centers and creation centers. If these facilities can not within the village, they are always nearby.
● Pedestrian and cycle links with parking facilities placed underground where possible. The aim is a traffic-free, people-oriented environment, not one designed around the space demands of surface parking lots.
● Public space with strong design features (water, street furniture, sculptures and playgrounds).
● A high degree of self-sufficiency in the community to meet local needs, but with good rail and bus links to the wider city.

Figure 14. Calthorpe’s model of transit oriented development

Figure 15. A Cluster of Urban Villages

Source: Jenks, Burton and Williams, 1996, p.61, p.62

Exactly as the first point listed above, Bernick and Cervero (1997) concludes from their study that density is by far the biggest factor in determining the level of transit use in a city. For example, European cities have less than half the car use of US cities, not just because fewer people use cars, but because they travel shorter distances. If
all the transit travel in European cities were transferred to cars, the cities would still have a total of only 8,500 passenger kilometers per person compared to the US level of 16,500 passenger kilometers per person. Density is also closely linked to urban energy consumption because of its influence on transportation model. The energy consumption on transport in cities depends on a variety of factors including the nature of the rail and road networks, the extent of the development of mass transportation systems, and the modal split between public and private transport. Evidence shows (Figure 17) that there is a significant decrease in travel related energy consumption as densities grow. Newman and Kenworthy conclude that generally the compact cities with higher population densities are more energy efficient. Evidence from 17 cities around the world in 1990 (Figure 16) as well shows a consistent link between population density and energy consumption.

Figure 16. Population Density, Energy Consumption and Cost of Transport

<table>
<thead>
<tr>
<th>Density (population + jobs per hectare)</th>
<th>Annual energy consumption for travel (mega joules per inhabitant)</th>
<th>Cost of transport (% of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25</td>
<td>55000</td>
<td>12.4</td>
</tr>
<tr>
<td>25 to 50</td>
<td>20200</td>
<td>11.1</td>
</tr>
<tr>
<td>50 to 100</td>
<td>13700</td>
<td>8.6</td>
</tr>
<tr>
<td>&gt;100</td>
<td>12200</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Source: Newman and Kenworthy, 1999, p.102
Figure 17. Energy use per capita in private passenger travel versus urban density in global cities, 1990


Except a reasonable high density, a mix of activities is another essential character within urban villages. Newman and Kenworthy quote Bernick and Cervero’s summary based on numerous studies: “there will be more cycling and walking when land uses are mixed rather than uniform.” Bernick and Cervero claim that settings with a mixture of land uses can encourage people to walk or ride to destinations instead of driving. Locating shops and restaurants within a nice landscape near office buildings likely make more people walk to these destinations during lunch time. It might also mean some who otherwise would drive to work now ride transit instead because they do not need a car to be mobile in the midday.

Stockholm’s satellite centers are successful examples of urban villages. What they have done might be enlightening to the construction of Beijing. Stockholm has been focus on the development around stations on the rapid transit system for a long time. The centers are strung together like pearls on a necklace along the railway system.
and are all of a high density, particularly around the station core. The general physical planning principles in Stockholm on which these centers are based can be summarized as follows: (Newman and Kenworthy, 1999, p.173)

- Locate workplaces to houses.
- Minimize distance from houses to shops.
- Concentrate service functions in easily accessible areas and make premises easily convertible to meet new service needs as time change.
- Create housing variety with two-storey dwellings with good ground contact; four to six floors around country yard, and ten to thirteen floors near stations.
- Urban environment to have variation in form and color.
- Multifamily housing to be no more than 500 meters from a station.
- Single-family housing to be no more than 300 meters from a bus stop (or station).
- A bus-rail interchange to be available in all communities.
- Centers to be linked and permeated by a coherent net work of food and bicycle facilities separated from roads with the convenience of seniors and people with disabilities in mind.

Stockholm’s sub-centers are compact and walking scale, with a rich array of facilities clustered together within a relatively small area. In Kista, for example, the rail system delivers passengers directly into an enclosed large shopping mall, which opens onto a car-free town center surrounded by community facilities, shops and housing; and the excellent network of foodpaths and cycleways feeding into the town center makes these modes the easiest and most convenient way to move around.

It is hard to further increase the density of central city of Beijing because the population per sq km is already 1000 which is much higher than most European cities and the living condition is rather crowned within some residential areas. In addition, Beijing was built on the old capital city so that many old buildings like traditional courtyard dwellings are culture heritages which could not be modified or intensified casually. However, the density of the periphery areas has great scope for further enhancement based on the analysis of Jiang Fang. I think it is a good
opportunity to implement the intensification process during the construction of the
sub-centers.

The mixed land use is a crucial determinant to the success of new towns. Beijing has
experienced the failure of previous satellite towns for this reason. Some satellite
towns are developed as huge residential areas like the “Sleeping Town” Wangjing,
while others are developed as pure commercial centers and industrial parks. For
example, the CBD (central business district) used to be an empty town after the
working time because of the single land use. This is not only detrimental to the
healthy growth of sub-centers but also increase the traffic. It is essential to diversify
the functions of the sub-centers and increase their independent. I think urban village
is a feasible form. In horizontal, the office, residential, commercial, services, culture
and entertainment facilities should be arranged as compact as possible and relatively
close to each other. In vertical, multi-functional buildings should be built through
changing the ground floor of office building into business use, and try to make the
number of people within the blocks in daytime and evening tend to a reasonable
proportion.

4.2.2 The Development of Transit System

A city’s transit system is closely inter-linked with the development of urban form.
New suburban development without adequate public transportation typically
increases the demand for private car use which is an essential reason for Beijing’s
congestion. In contrast, the construction of new light rail systems has a tendency to
increase housing densities around access points. This can be the explanation that the
construction of urban villages generally originates from the transit nodes. Therefore,
a perfect transit system is the prerequisite for forming a sub-center with high density.
Moreover, it is also helpful to induce people to get out of their cars and use public
transport. The belief of Stockholm’s planners shows their highly attention to transit
system: a railway station within 500 to 900 meters (a short walking or cycling
distance) of most housing; train service without a timetable (a frequency of twelve
minutes or less); and people living not more than 30 minutes from the city center. It is exactly these policies that make the urban villages achievable.

Hong Kong and Singapore are representations of compact cities with positive strategies to release from traffic congestion and promote public transport. The strategies are summarized in Figure 18.

Figure18. Singapore and Hong Kong’s Strategies for Overcoming Automobile Dependence

<table>
<thead>
<tr>
<th>Focusing Alternate Modes</th>
<th>Heavy investment in mass rapid transit system. Priority to buses through bus-only lanes, bus-only streets, and bus-only turns. Heavy parking restrictions, effective integration between trains and buses. Development of circumferential rail transit services as well as radical services.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Penalties</td>
<td>High cost of car ownership and use through high taxes on cars and fuel and certificates of entitlement to purchase cars in Singapore. High parking charges.</td>
</tr>
<tr>
<td>Land Uses</td>
<td>City-wide planning totally based around the integration of high-density, mixed-use nodes at rail stations on the rapid transit system. Increasing orientation toward pedestrians and cyclists for local access to nodal centers and to transit.</td>
</tr>
</tbody>
</table>


Through the implementation of these strategies, the number of cars in Hong Kong is controlled as only 43 cars per 1,000 people. Most people choose public transport as travel mode, while Beijing has 168 cars per 1,000 people and the total car number adds 1,000 everyday by average. Nowadays, 68.9% of Beijing’s traffic flow is occupied by cars while only 10.2% is occupied by public transport (53.1% of Stockholm’s traffic is occupied by public transport). Though there are no policies or
measures to restrict the purchase of cars because of the economic reasons, the governments do realize the gravity of this matter and some measures are proposed to encourage the use of public transport and limit the use of private cars.

Besides the rapid expansion of the subway system, the bus system is also undergoing a reform process. For the first time, people who choose public transport exceed those who use cars thanks to the lowered ticket price. Other measures such as improving the bus network and transfer facilities and provide bus line priority are being implemented step by step. During the 2004-2020 planning stage, the total input for public transport will arrive 71.5 billion euro. What’s more, the government had decided to reduce the parking place and increase the parking fee within the urban area in order to bring a rational use of motor vehicles. Since 2008 all motor vehicles must comply with the policies that private cars’ using time is reduced one day of a week. Which cars should not be used on the certain day is determined by the last figure of their plate number. For example, on Monday all motor vehicles with 1 and 6 as the last figures of the plate number should not be driven in certain crowned area. This measure is quite effective and the traffic congestion is relieved by one third within the central city until now.

Nowadays, China is still under the circumstance that economy development is the biggest priority upon anything else. In order to stimulate the automobile industry, the government would not limit the purchase of private cars. Therefore, there is no choice but to limit the use of them. The restriction policy according to the plate number might be an effective method to reduce cars on the road, while it does bring inconvenience to travelers for it is too rigid. The Mobility Management promoted in the Nordic countries seems much more flexible. Likewise, with the aim to reduce the dependence on private cars, many alternative modes are intended to be emphasized such as public transport, cycling, walking, car pooling, car sharing, E-work etc. “Car-sharing means a system where a private or public company owns the cars and the users buy the right to use them. The users normally pay the running costs of a single trip according to kilometers travelled or time spent. Car-pooling comes into play if a person gives a lift to another person in his/her own car. Car-pooling is
normally organized by the persons themselves without any mediators. Car-pooling services, however, can be provided via Internet or a company’s intranet” (Atterbrand, 2005). Solving traffic congestion problem is not the sole responsibility of public administration. The promotion of this project needs many private sectors to make efforts together by offering various alternative modes. The concrete measures include employer paid public transport, car parking regulation, company bicycles etc. Compared with the Nordic countries who has set about this project already, China still has a long way to go.

4.3 Summary

The long-term sustainable development is the final target of Beijing’s planning. All the strategies established in the Comprehensive Planning of Beijing basically follow the indicators of the sustainable city. The present serious problems that traffic congestion and misuse of urban land have been attached great importance, and thus the transport and infrastructure improvement and sub-center development are picked out as the strategy priorities. But there are two intense contradictions that must be confronted. First, to decrease the traffic pressure, public transport is advocated; however, to boom the automobile industry, more cars need to be sold. Second, to preserve the farm land and green land, the rapid urban sprawl requires to be braked; on the other hand, the accelerated urbanization process will literally fuel the sprawl. Consequently, how to deal with the contradictions is the most important and difficult issue. Though they could not be completely solved, the decentralized concentration urban model is the right approach to greatly alleviate them and make Beijing more sustainable.

I believe the goal of solving the traffic problem is being gradually achieved through the improvement of public transportation and the implementation of all kinds of policies for limiting private cars. The situation will be much better at least by 2020. However, the urban space planning lacks particular policies to supervise the implementation. Though all the statements try to guide the new town’s development
to the right track, the planning is still silent about how to build them in detail. Another drawback is that the network of the transit system and the development of new towns are not considered together, and the areas near the transit stations are not well planned as they should be. I think this is opposite to the transit-oriented development strategy.

On the contrary, the Landon Plan (published in 2004) with the similar aim (to accommodate significant population and economy growth with in city boundaries) and approach (put emphasis on the intensification of Landon’s new towns) with Beijing’s plan has a clear regulation on land development. No matter on housing or employment development, it proposed to be concentrated near public transport centers. It is claimed in the Sustainability Residential Quality that “the new growth must happen where it can best be served by existing or planned public transport and access to shops and services. It directly links the level of density to the proximity and frequency of public transport, enabling the best use to be made of sites within walking distance of public transport, whilst allowing lower densities where public transport accessibility and capacity is less” (Chris Gossop, 2008). The density of the settlings is arranged by referring to the Public Transport Accessibility Level (PTAL). PTAL (Figure 19) is a London-wide measure of how well different areas are served by public transport, the scale running from 0 (worst served) to 6 (best served). Figure 18 shows the relationship between the planned inhabitants and the PTAL. For Beijing with a much larger population, it is impossible to use the same matrix with London, but it is essential to make one based on the same theory.
Figure 19. The PTAL

Access to public transport


Figure 20. Density Matrix (habitable rooms per hectare)

<table>
<thead>
<tr>
<th>PTAL</th>
<th>Setting</th>
<th>0 to 1</th>
<th>2 to 3</th>
<th>4 to 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Suburban</td>
<td>150-200hr/ha</td>
<td>150-250hr/ha</td>
<td>200-350hr/ha</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>150-250hr/ha</td>
<td>200-450hr/ha</td>
<td>200-700hr/ha</td>
</tr>
<tr>
<td></td>
<td>Central</td>
<td>150-300hr/ha</td>
<td>300-650hr/ha</td>
<td>650-1100hr/ha</td>
</tr>
</tbody>
</table>


In the future, Beijing needs to follow the example of Stockholm, Hong Kong and Singapore, keeping the high speed construction of the subway and inter-city train system to improve the accessibility of new towns. More flexible measures like Mobility Management could be applied to boost various traffic modes. And the land use of the transit nodes should be further considered to improve the efficiency.
5. Conclusion

My study aims at finding a suitable urban form for rapidly growing big cities in China. I started the paper by studying the two extreme models of urban forms: urban sprawl and the compact city. The information on them has helped me to better understand Beijing’s spatial development for decades and make a precise analysis of the problems it is facing. And then, under the guidance of the theories, some experiences from the successful examples are suggested to apply to Beijing’s planning.

The comprehension of the characters of urban sprawl is quite various, and that is a conclusion from the study of my extensive study of the literatures. I think the most representative description of urban sprawl is low-density and scattered urban development with high dependence on private automobiles. This urban form like any other one has both advantages and disadvantages to urban development. It is consistent to the development trend of the land market. It also allows many residents to have good natural environment around their houses. After all, owning a detached house in suburbs with nice environment is many people’s dream.

Although the sprawling urban form seems in accordance with the individual desires, it has many drawbacks for the wider society. Its four typical development models (leapfrog development, strip or ribbon development, low-density development and single-dimensional development) show the inefficient use of land and infrastructure; while the over dependence on private cars increases the use of resource and deteriorate the air pollution. The social life of people is also influenced. It is reflected as the disadvantage of people without cars, social segregation, and the disappearance of the community life.

The compact city is an alternative urban form which has less drawbacks for the society as a whole to urban sprawl. It requires cities to be more centralized with high density and mixed land use, and it also encourages residents to use public transport to replace private cars. The aim is to make efficient use of existing urban land and infrastructure, protect the open countryside, save the natural resources and alleviate
the pollution from traffic. Because it seems much more sustainable, the compact city model gets support from most planners and governments. However, the criticisms from supporters of urban sprawl still exist. They argue that the previous compact cities like medieval walking towns have been eliminated since as early as the 1860s, and there is no clear layout suitable for the present situation at all. The implementation process is refuted as a serious problem as well, because the drift of urban sprawl is impossible to be totally reversed. In addition, besides the expected good results would not be gained by merely intensifying the city center, the centralization development which is the main pattern of previous compact cities might cause many other urban problems.

In this case, some proponents of the compact city hypothesis who also thought the goals were too ambitious to achieve have made a few concession (these people are sometimes called “compromisers”). They tried to combine the merits of centralization and decentralization and finally proposed the “decentralized concentration” development model. This model permits the necessary sprawl of cities but puts more emphasis on attaining the compact development. It concludes some practical concrete urban forms such as Transit Oriented and Traditional Neighborhood Development and Urban Villages. I think the compromise line is a good way to take some Compact City proposals into practice. And the expression that “compact is not a concrete urban form but an urban development strategy” should be remembered by urban managers and policy makers”.

Every city has the most suitable development method according to its unique condition and national circumstances. I believe that it is unreasonable to choose the most suitable way without an extensive research and analysis. Some cities with sufficient reserved land and without pressure from population growth and resource deficiency might be all right with a dispersing development, but Chinese cities must keep intensive development because of the particular national conditions: The arable land per capita (9 hundred Sq m) in China is much less than world average level, and it is reducing sharply because of the encroachment of urban area. The urban areas are confronted with rapid population growth and there is no way to accommodate them
with dispersed settlements. Actually, the urban sprawl in China is seriously out of control in most cities. If no measures are taken to decelerate it, the consequence will be a disaster on physical and social environment.

My study case Beijing Municipality is a typical sprawling region in China. From 1981 to 2005, the built-up area went from 346 Sq km to 1209 Sq km, increasing more than 30 Sq km per year on average. The city has kept mono-center development for decades and the main growth way is sprawl along the trunk roads. This development pattern could not make full use of the precious urban land and other resources. It also resulted in a series of urban diseases such as traffic jams and air pollution. Though I agree that urban sprawl in a fast growing city like Beijing is quite normal because it is still in the stage of rapid urbanization, yet considering the present growing speed, it must be slowed down and turned into a more sustainable direction. My suggestion is that some ideas from the compact city hypothesis can be applied to change the current situation. In my opinion, the strategy of “decentralized concentration” is proper for Beijing.

In fact, planners and governments have already realized the necessity to change. In the latest comprehensive planning of Beijing published in 2004, a new model—“two belts, two axes and multi-centers” was introduced as a guidance for the future development. Since mono-center development has been the primary pattern for a long time, job functions are mostly concentrated in the city center, and this has induces a great pressure for the central area. The aim of this strategy is to transfer the functions into other areas by building up some independent sub-centers which are called new towns in the plan. These areas are picked out according to their comprehensive conditions.

I think the construction of these new towns is very crucial to the final success of this strategy, and the experience of urban villages summarized by Newman and Kenworthy is worth to be learnt. The urban village is a way to build independent communities with the aim of decreasing residents’ daily travel. I would like to describe its characters briefly as three points: transit-oriented, high-density and mixed land use. The successful example of Stockholm’s satellite towns is introduced
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in Chapter 4, which I think can give some inspirations to Beijing.

In all successful cases, the urban villages are linked to the central urban area by fast transit lines. However, because the construction of subways and local trains in Beijing is lagging far behind the speed of urban sprawl, the transit net can still not extend to the outer suburbs. Moreover, the buses are seriously over used especially during the morning and evening peak flow. The government should speed up the construction of transit system and ensure the good accessibility of all the new towns.

What is satisfying is that, in the latest comprehensive planning for 15 years (2004-2020), a specific plan for the further construction of transit system has been made and a reform of bus system has started.

To build a transit-oriented city, it is not sufficient to merely provide convenient public transport. People must be induced to use it instead of private cars. I find that the incremental use of private cars in Beijing is a serious problem worth more attention. Hong Kong and Singapore both have a nice performance on limiting the use of private cars (see Figure 18 in Chapter 4), and Beijing is supposed to learn something from them. Besides the compulsory policies implemented by the governments, many other measures also can be used to reduce the dependence on private cars. For example, the project Mobility Management which is promoting in Nordic countries encourages many alternative modes like cycling, walking, car pooling, car sharing and so on. What should be emphasized is that solving traffic congestion problem is not the sole responsibility of public administration, and supports from related sectors and individuals are essential as well. Such projects have not been promoted in China until now but I believe it is necessary to be disseminated and adopt. Based on the implemented strategies and policies, I am basically optimistic to the traffic condition of Beijing in the next 15 years. At least, it would be improved better.

The study of Newman and Kenworthy proved that high-density and mixed land use are also helpful to reduce transit use. Beijing did a bad job on the construction of satellite towns from 1950s to 1990s, because the towns were developed mostly with single function. The mixed land use strategy is emphasized in the present planning
which is a big progress, but I think policies and regulations should be added to make sure its implementation. What is worse, Beijing does not have a systematic regulation to control the building density of different areas. The London Plan can be an example worthy of study. It connected the planned inhabitants with the Public Transport Accessibility Level (Figure 20).

Altogether, though Beijing has its own uniqueness, while all the principles abstracted from the successful examples are worthy to be referenced and the Compact City hypothesis can provide significant guidance to the development of Beijing.
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