
Urbanization and Mobility in China
New Patterns and Intermodal Connections

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Summary

Chinese cities are getting bigger and are also growing into each other. To ensure that the rapidly increasing number of urban residents have access to adequate transportation not only requires increased investment in transportation, but also careful deliberation to allow an optimal tradeoff between different modes of transport as well as a coordinated approach to land development and transport development.

With regard to the built-environment that shapes the environment for everyday travel, Chinese city governments generally carry out carefully conceived spatial planning. Driven by the garden city idea, Chinese cities often plan multi-center spatial structures. The actual end product, however, varies depending on the local context. In urban areas in geographic situations that limit continuous expansion, cities tend to become multi-centered, interspersed with green spaces or bodies of water. On the other hand, in urban areas on large plains, municipal governments seem to have difficulty in preserving green spaces that separate the planned centers.

Investment in roads alone cannot fuel continuous expansion in China. High-density cities are now ripe for rail transportation investment. As a result, areas around stations are center points for new developments with price and density gradients arising around them. Expansion of transportation systems and transit-oriented development also provide a potential solution for congestion problems. Yet there are still challenges to overcome. China's ambitions for urban expansion based on transit-oriented development may not be realized until a viable funding plan for sustainable transport operation is put in place.

Transporting passengers within expanding and high-density urban areas requires a multi-modal approach and transportation hubs that provide intermodal connectivity. Railway stations and airports are typical transportation hubs that not only provide inter-city connectivity, but also function as intra-city transfer hubs. The economic benefit of this infrastructure is obvious. It allows more efficient movement of passengers across regions and consolidates trips with similar destinations into higher-occupancy and higher-speed modes of transport.

Inter-connection of transportation systems developed separately by neighboring municipalities is an emerging challenge in developed parts of China. As urban functions extend beyond the

administrative boundary of a single municipality, demand for multi-jurisdictional transport services is increasing. The Guangzhou - Foshan case demonstrates the need for a multi-municipality framework for transport planning, investment and management.

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Introduction

Urbanization in China has caught the world's attention. This is due, in part, to the country's massive population, fast rate of urbanization, and the associated transportation and environmental issues. As of December 2012, China had 65,600 km of limited-access highway, second only to the USA. From 1990 to 2011, the number of privately-owned motor vehicles increased annually by 14.4%, with a much higher rate in urban areas. This trend is expected to continue into the next several decades. In 2011, only slightly over 50% of China's population was urban-based. If that percentage increases by just one percent each forthcoming year, there will be 14 million new urban residents every year. Providing the necessary means of transportation for the increasing urban population will be a significant challenge.

There are reasons for both concern and confidence. First, there is concern that China will follow the highly motorized example set by the developed world. The urban Chinese have been taking more daily trips and logging up many more kilometers traveled in cars over the past several decades. China shares many common features of the developing and developed worlds in terms of growth, motorization and congestion (Gakenheimer, 1999; Ng, et al., 2010). Current economic growth and increased wealth have been major factors driving motorization. In addition, the transition of land use from a planned economy to a market economy has had its own consequences for transportation. This comes not only from the density changes, but also the location of different land uses in relation to one other. Taking the changing workplace-residence relationship in Beijing as an example, one study found that the distance between workplace and residence has increased significantly in the process of housing relocation, which has lengthened commuting time by 30% and increased motorization from 25% to 41% (Yang, 2006).

Secondly, it is still unclear exactly how Chinese cities will evolve as a result of the multi-dimensional economic and social forces currently in play (Doulet, 2008). Ma and Wu (2005) consider that the resulting urban forms in China will not closely resemble cities elsewhere in the world, nor will they converge on a single widespread

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Chinese pattern. A primary reason for this is that different city governments tend to respond to similar forces with varied local development strategies. Chinese city governments still have much flexibility to direct the growth of urban spatial structures with infrastructure investment strategies, land development guidance and taxation; three policy tools which are widely used by nations around the globe (Bertaud, 2004). For example, Chinese governments are investing in a massive high-speed rail network, with 13,000 km in operation by December 2012. Over 50 Chinese cities have urban rail transit either in operation, under construction or in planning. Beijing and Shanghai each has over 400 km of mass transit rail in operation, twice the amount of that in Paris.

It is imperative to consistently monitor China's performance in terms of land development and transportation supply. Building upon existing research on China's urban transportation, this paper reviews certain ongoing and emerging aspects of transport and land development in urban China, with five key points outlined below.

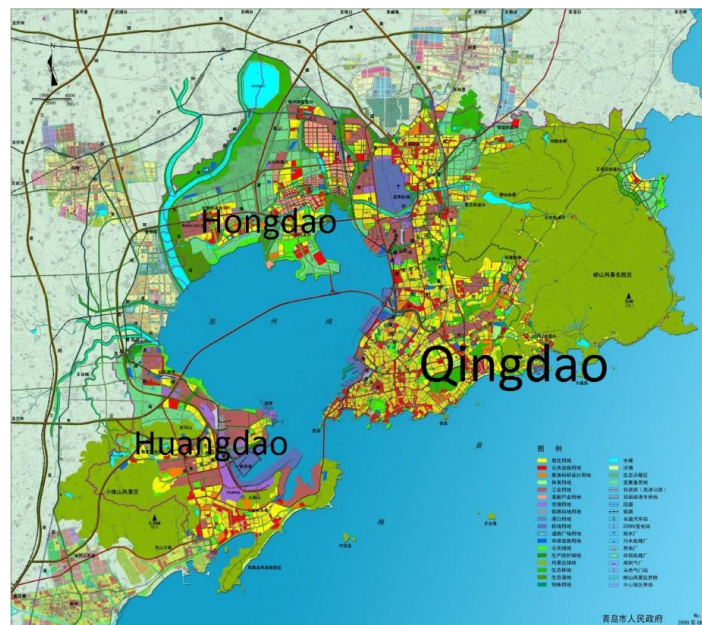
1. In terms of the built-environment that shapes the environment for everyday travel, Chinese city governments generally engage in carefully conceived spatial planning, but the tangible outcomes are highly varied.
2. After decades of road investment, China is now ready for rail transport investment, but operational funding challenges are anticipated.
3. Construction of mass rail transportation systems has significant impacts on land development. Development and redevelopment hubs follow rail transport investment. However, many issues surround the decision as to the location of railway stations.
4. Urban transport systems in China are becoming multi-modal, and modern transfer hubs are producing significant user benefits. Non-motorized transport is still in need of more attention.
5. Demand for multi-jurisdictional transport services is increasing, yet no systematic approach exists to integrate transportation systems developed separately by different municipalities in the same urban region.

Spatial planning for multi-center layouts

One particular characteristic of China's urban planning is the creation of new urban – not suburban – centers within suburbs. Research on American cities suggests that the multi-center layout appears to be a better choice for transportation efficiency compared with dispersed patterns (Yang, et al., 2012). The potential for the realization of multi-center layouts in Chinese cities is of great interest.

Among cities with over one million people, Qingdao is well on the road to becoming a multi-center metropolitan region. This coastal city has had a booming economy since the liberalization of the national economy in the 1980s. The expansion of the city, however, is highly confined by its geographical situation. Surrounded by coastal waters and a mountain, the only section that can be developed is on the north side of the urban centre. In order to overcome the problem of geographical confinement, the city is to become a three-center city with the existing urban center, Qingdao at the harbor and two more, Huangdao and Hongdao. The plan includes a series of new transport projects, including a bridge across the bay to link these three centers together (Figure 1).

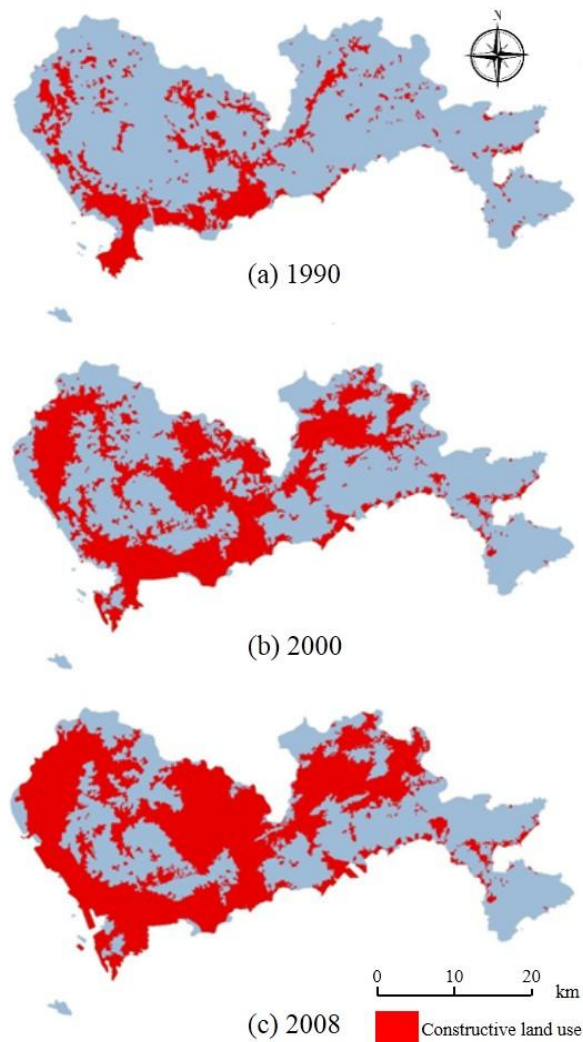
Figure 1: Multicenter-layout in Qingdao Municipality



Source: Qingdao Master Plan (2006-2020)

While Qingdao's multi-center layout largely follows the coastline, Shenzhen's multi-center layout came about as a result of mountainous terrain. Bordering Hong Kong to the north, this megacity is confined by the mountains and the sea. A group of basins with developable land are connected by a road network. The number of urban residents increased as Shenzhen encompassed several fishing villages in the early 1980s. The present population is 11 million and land parcels in the basins have been converted from agricultural or forest use to urban use. The maps below (Figure 2) illustrate the developed land in 1990, 2000 and 2010. A multi-center layout is clearly observable. Tunnels and roads have been constructed to link the different clusters together.

Figure 2: Multi-center layout in Shenzhen



Not all cities are as successful in developing multi-center layouts. Beijing is a typical example of a city on a large plain. It has repeatedly failed to preserve green spaces between developed

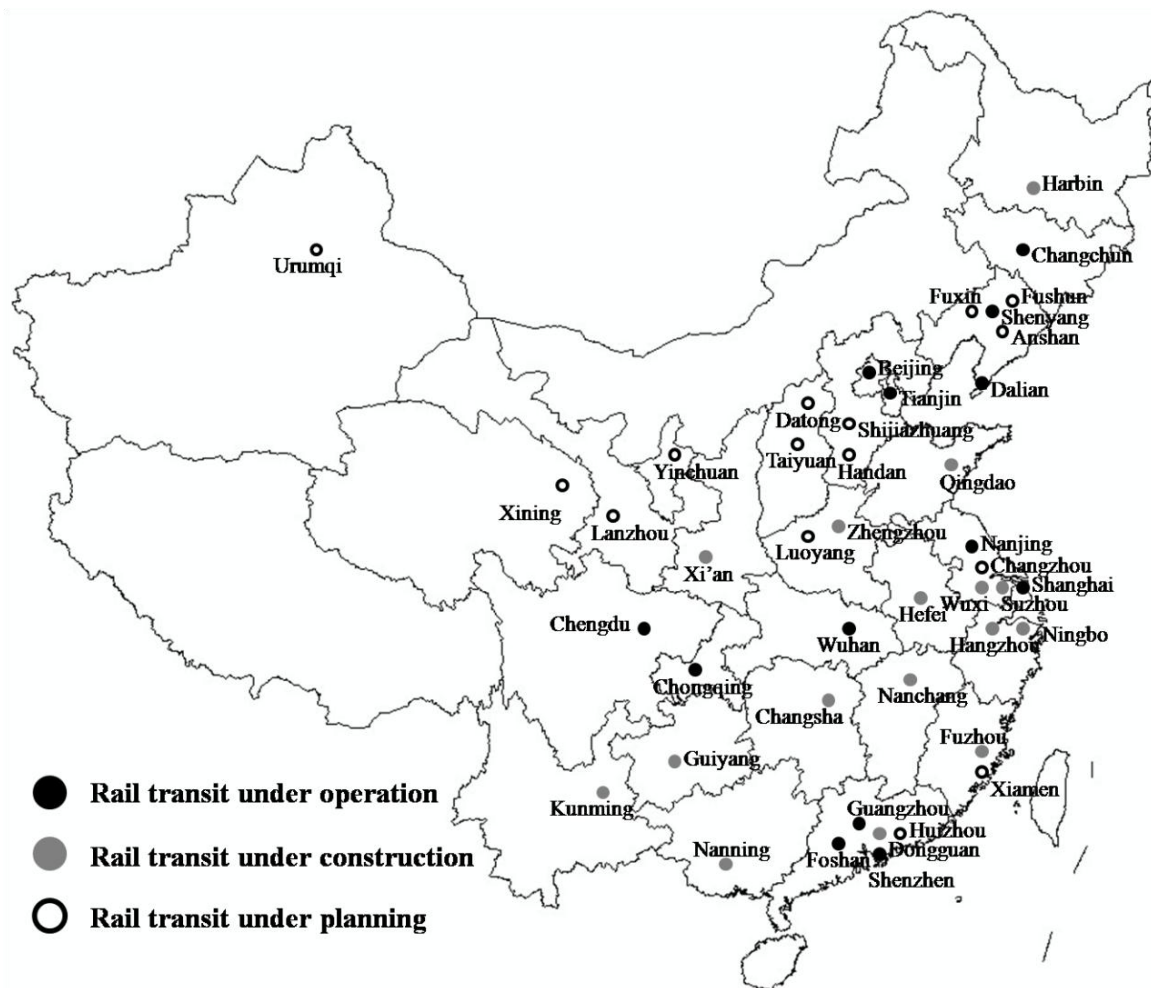
centers. Beijing's spatial planning was strongly affected by the multi-center garden city idea and the 'New Town Programs' in Britain (Madge, 1962). A decentralized concentration strategy has been employed by Beijing's municipal government to direct its spatial development. The major motivation for this strategy has been to mitigate overcrowding in the central built-up area, to encourage the reuse of infrastructure and previously developed land and to improve access to places of work and green spaces.

The implementation of the spatial framework, however, has been subject to increasing criticism as the green spaces between existing centers disappear. Yang et al. (2012) used three-dimensional population density maps to illustrate the spatial expansion process in Beijing and to demonstrate how suburban clusters have been absorbed by the central city. Many factors impact planning and development outcomes, including the choice of the mode of transport (mainly road versus mass-transit), the geometric design of the network, and associated land planning and growth strategies. Beijing's urban expansion has been accompanied by continuous addition of ring roads. Beijing presently has six ring roads and the distances between the first five are quite short. Yang et al. (2012) explains that the densely spaced ring roads contribute to the expanding mono-centric structure, together with other factors from the land and housing markets. Today, the single-center layout is criticized for its association with high traffic density in the urban core. The concentration of offices and commercial activities results in high-intensity vehicle use that the expanding road network struggles to deal with (Zhao and Tian, 2004).

Investment in Urban Rail Transit

China is currently well placed for investment in its mass transportation industry. As congestion increases almost everywhere in China's megacities, rail transit becomes an affordable and reliable alternative to private vehicles. There has been explosive growth in urban rail transit systems in recent years. The total track length of rail transit systems has increased more than eightfold from 2000 to 2010 (Salzberg et al., 2012). The number of rail transit lines in Chinese cities went from 10 in 2006 to 48 by 2010. By the end of 2012, there were 62 lines and 1,800 kilometers operating in 26 cities, with a further 64 lines and 1,600 kilometers under construction (Ministry of Housing and Urban-rural Development, 2013). The map below (Figure 3) shows the cities with urban rail systems in operation, under construction or in planning. Such a huge amount of construction in a short period of time requires rapid expansion of investment, particularly in the form of bank loans.

Figure 3. Cities with urban rail in operation, construction or planning



Similarly to metro systems in other parts of the world, these systems require high operational subsidy. In Beijing for example, one billion Chinese Yuan (approx. 160 million US dollars) was spent on subsidizing the metro in 2012. While most of the funding will come from the municipal government directly or indirectly, China is also actively seeking out funding sources from foreign investors and the private sector, so far with limited progress. Among the 26 cities with mass rail transportation systems in operation, only Beijing, Hangzhou, and Shenzhen have forged public-private-partnerships for transit investment and operation. In all three cases, the Hong Kong Mass Transit Railways Corporation (HKMTR) is the sole private partner.

HKMTR's involvement has made a noticeable difference in operational cost recovery. Shenzhen's metro is principally operated by the Shenzhen Metro Corporation Limited (SZMC). From 2009 to 2011, HKMTR built the 16 km extension of the Longhua Line from Children's Palace to Qinghu and operated the Longhua Line from Futian Check Point to Qinghu. Shenzhen's municipal government wanted to benefit from HKMTR's longstanding excellence and experience in the field, and the outcome confirms their reputation. HKMTR's operational cost recovery rate is much higher than other parts of the metro, with the Longhua Line's operational revenue even surpassing its expenditure in 2012. In contrast, SZMC's cost recovery rate was around 40%. Cost control is one of the primary reasons for HKMTR's high recovery rate. The Longhua Line operates with shorter trains, lower frequency and higher occupancy rate.

How successful Chinese municipalities will be in securing participation from the private sector and increasing metro operational efficiency in the long-run is yet to be seen. Public private partnership (PPP) in China should not be taken for granted and there have been many reasons for PPPs to fail. Halcrow prepared a report for the World Bank in 2004 that provides considerable background on the fates of three cities' PPP agreements in Manila, Bangkok and Kuala Lumpur (World Bank, 2010; Halcrow Group Limited, 2004; Phang, 2007). All failed due to low use or financial insolvency.

In China it should be noted that unrealistic and unreasonable guarantees are sometimes made by government officials which can lead to insolvency, and that sometimes distortions are made in order to attract foreign direct investment (FDI). Some officials may overstate their capacity in their commitments and subsequently their pledges may not be kept, due in part to the individual career mobility of many administrative officials. This "changing of the guard" phenomenon, whereby officials who initiate a project are not accountable throughout the project's term is a distinct problem in this regard (Ke, 2011; Sachs et al., 2007). Also of concern is investors' overreliance on officials' promises, especially verbal ones, as well as

corruption, the cost of entertaining government officials, and guanxi¹ (Sachs, et al., 2007).

¹ Guanxi is a Chinese term meaning "connections," it refers to a network of relationships designed to provide support and cooperation among the parties involved in doing business.

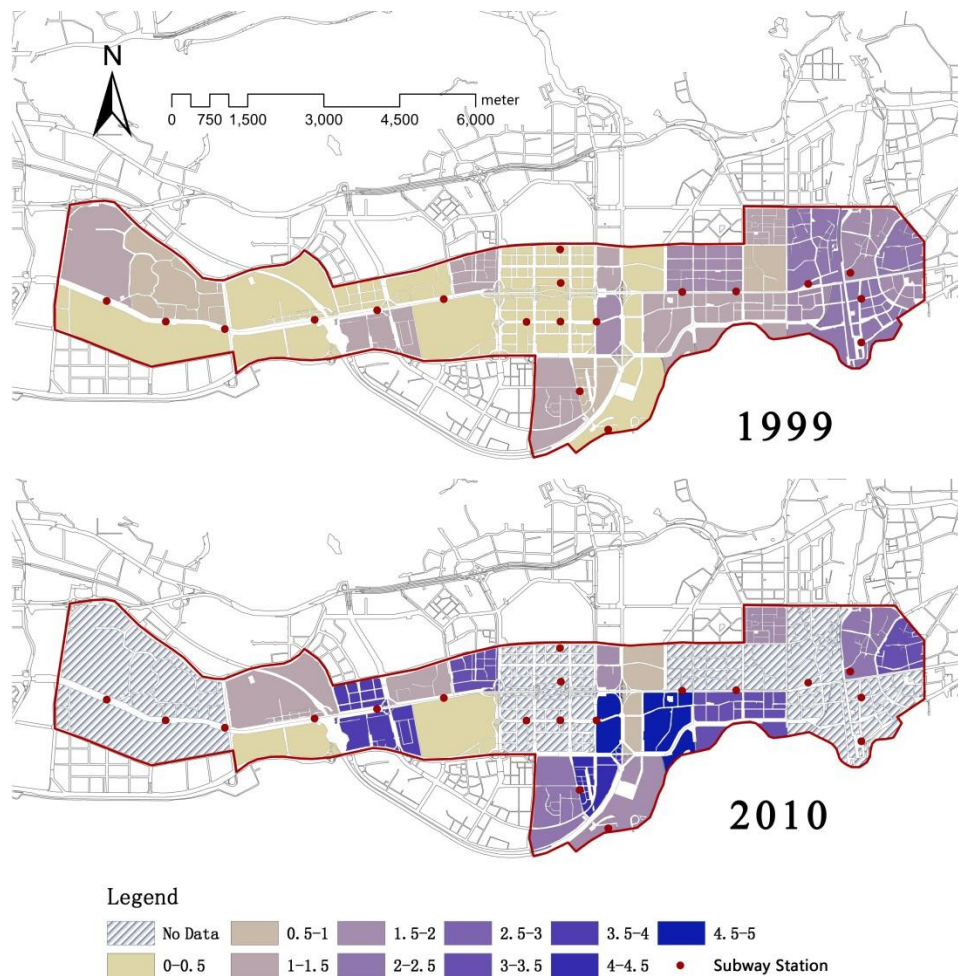
Development hubs around metro stations

For some time, Chinese media has frequently used the American term “urban sprawl”, to refer to the format of urban expansion driven by large amounts of freeway and limited public transport. China’s recent investment in high-capacity, fixed guide-way transit, however, has the potential to reshape the spatial trajectory of urbanization.

Analyzing employment growth based on Beijing’s 2001 employer census, Yang et al. (2012) discovered increased employment density around railway stations. Supposing employee density is 1.0 in an outer zone (1-2 km from the station), the comparable density increases to 2.5 in the middle zone (0.5-1 km), and further increases to 5.1 in the inner zone (0-0.5 km). The density grade has become steeper over time, which indicates that job growth is becoming increasingly rail-oriented, despite the fact that urban rail was designed to serve areas of pre-existing high-density employment.

Similar trends have been observed in Shenzhen. Analyzing land development around stations of Shenzhen’s first 20 km of metro transit corridor, we have found that the station’s floor area ratio has become much denser. Using a parcel database, the average floor area ratio (FAR) in this corridor was 0.75 in 1999, 5 years before the operation’s commencement. It increased to 1.81 in 2010, six years after the operation’s commencement. The parcel with the lowest FAR was 0.15 which increased to 0.41 by 2010. The maximum FAR increase was from 2.46 to 4.66. There is also a density gradient. In 1999, within 200 meters from the station, average FAR was 1.35. This decreased to 1.02 by 500 meters. In 2010, the 200 meter radius had an average FAR of 2.91 and the 500 meter zone had an average FAR of 2.40.

Figure 4. Changing FAR around Metro Stations in Shenzhen



Clustered development around railway stations, as shown above, suggests the potential that urban rail services have to attract new development or redevelopment into a relatively contained area. Meanwhile, it provides regional mobility comparable to automobile-based travel. This is a positive move towards a more energy-efficient urban form.

Decisions about the location of stations, however, have been much debated. One would typically think that transit stations should serve pre-existing high-density nodes, particularly when a city is catching up with transit investment. The different fiscal institutions in urban China, however, have pushed station location in a different direction. Many new transit stations are located outside high-density areas. One of the main reasons is the lack of annual property tax. In order to recover infrastructure costs, municipal governments have turned to developers' lump sum payments for multi-decade land use or bank loans backed by predicted land development revenue, excluding land leased for manufacturing plants. In this fiscal environment, high transit investment in pre-existing high-density

areas cannot result in immediate cash flow for the municipal government. Without an annual property tax, the appreciated real estate value stemming from transit investment does not lead to significant fiscal benefit for the city government.

It is thus not difficult to envision a tradeoff between revenue from land lease and fare revenue when deciding upon a station's location. The former is a function of the amount of land available for new development or redevelopment, but the latter is a function of the amount of developed land functioning with its current, established land uses. With a fixed amount of land around each station, a municipal government's motivation for land lease revenue will come at the expense of the pre-existing built-up settlements in the form of low use and a high operating subsidy, at least in the interval before the station area becomes fully developed. Low use has been reported in various cities, including Nanjing and Zhuhai, despite affordable fares (Yin, 2011). Many stations are located in order to serve new developments.

Seen from a slightly different perspective, using transit stations as anchor point to stimulate new growth in suburbs may not be a bad idea, considering China's continuous urbanization. The urbanized part of China's population surpassed 50% in 2011, and is projected to increase by 1% in each forthcoming year, which means 14 million new urban residents each year. Accommodating for new growth in high-density areas around rail stations would be much more efficient than growth along highways. The use of transport investment to attract new developments has been employed in other cities such as Hong Kong, Tokyo, and Copenhagen, where investors are also involved in ownership of surrounding land parcels (Curtis, et al. 2009; Knowles, 2012).

Strengthening intermodal connections

Chinese cities have typically adopted a multi-modal approach to transport infrastructure. Firstly, limited expressways have been built as either ring roads or radial roads in order to streamline increasing vehicle traffic. Secondly, the traditional fixed-route bus systems have been further expanded. These systems are usually stratified to meet the demands of different user groups. A typical bus system in a first-tier city might include fixed-route buses, express buses, commuter buses, and local circulators. Rapid transit buses have also been built in a group of Chinese cities including Kunming, Guangzhou and Beijing. Because of safety concerns, paratransit has been gradually eliminated. Big cities such as Beijing and Shanghai have phased out motorcycles a long time ago, a move which has been followed by second-tier cities and even third-tier cities, such as Dongguan on the Pearl River Delta and Quanzhou in the Fujian Province.

Transportation hubs, particularly intermodal hubs, have played significant roles in assuring mobility. This can easily be observed at airports, railway stations and satellite airport check-in locations. Airports are typically served by metro, airport express buses, fixed-route buses, inter-city buses, and taxis. This is generally the same for railway stations. Terminals for inter-city services usually also serve as major transfer points for urban transportation.

Guangzhou South Railway Station, also known as the New Guangzhou Rail Station, is one example of a passenger transportation hub. It is located 17 km south of Guangzhou's CBD. Construction began in December 2004 and it was operational by January 2010. This station has a floor area of 379,000 sq meters. It is the meeting point of high-speed rail, the Pearl River Delta inter-city passenger rail, and conventional passenger rail.

This station is well connected with other parts of the urban area by various modes of transport. The station is at the end point of Guangzhou's metro line 2, which runs through Guangzhou's CBD. The inter-city bus services deliver passengers to and from nearby cities, including Shenzhen, Zhongshan, Zhuhai, Foshan, Jiangmen, Huizhou and Dongguan. For those carrying a lot of luggage or require door-to-door connection, taxi services are also available underground.

Figure 5. Guangzhou South Rail Station



Another important intermodal transport service innovation is the creation of satellite airport check-in centers. The Pearl River Delta (PRD) is a good example of this innovation. As economic development drives up demand for passenger aviation services, improved airport access is required. Residents in the PRD mainly use three airports: Guangzhou Baiyun Airport, Shenzhen Baoan Airport and Hong Kong International Airport. While the Guangzhou and Shenzhen governments can design their transit services for airport access, travelers coming from other municipalities have to resort to driving, taking a taxi, or use the time-consuming bus service with several transfers.

In order to facilitate connections to airports, local governments have collaborated with the airports to create satellite airport check-in centers. Here travelers can get their boarding passes at the satellite check-in center and then board an airport express bus, eliminating the need to drive or take time-consuming fixed-route buses. Such services have been established as a collaborative effort between local government, airport and bus companies. Satellite lounges serve all three airports. Dongguan was the first municipality in China to operate satellite airport check-in. The Dongguan municipal government has created five satellite check-in centers at different locations. Express buses deliver passengers to Shenzhen, Guangzhou and even to Hong Kong Airport. The benefit of this service is obvious. It enables passengers to access the airport in an

affordable and time-efficient way, without having to pay much higher taxi fees or fuel costs and without having to carry luggage through several connecting bus trips with much longer travel times.

Figure 6. Satellite airport check-in and bus services in Dongguan



Despite the considerable progress made, non-motorized transport has still not received enough attention. Streets have been made wide to streamline traffic, however, this imposes safety problems for cyclists and pedestrians. It is still quite common to see parts of bike lanes used by cars or for curbside parking. Additionally, there is an insufficient number of over-passes and under-passes for pedestrians to cross streets. Secure bike parking is still uncommon at metro stations, increasing the likelihood of theft. The movement away from pedestrian- and bike-friendly urban-environments has significant impacts on travel choices in Chinese cities (Pan et al., 2009).

As for freight, it is handled at various seaports, railway stations, truck terminals and logistics centers. According to Yang et al. (2011), the trucking industry is growing rapidly as a result of fast economic growth and road construction. The adoption of container-based transportation increases the efficiency of intermodal transfer. Chinese governments have actively invested in logistics centers as a part of economic development strategy. These centers are typically located near transportation hubs, industrial parks, warehouses or in the vicinity of the wholesale industry.

Integrating systems of adjacent jurisdictions

Chinese municipalities typically expand planning and service area boundaries as urban areas expand. When an urban area does not go beyond the boundary of a single municipality, one municipal government can easily coordinate its transportation planning, investment and operation. A limited number of commuting trips going beyond municipal boundaries can be catered for with inter-city bus services, taxis and car driving. However, neighboring municipalities will eventually grow into each other and the increasing volume of inter-municipality trips requires innovation in transportation management and operation.

The urban area composed of Guangzhou and Foshan is an example of this situation. Guangzhou is the capital and largest city of the Guangdong Province and a key national transportation hub and trading port. According to the 2010 census, the city had a population of 12.8 million. Foshan lies to the southwest of Guangzhou and has a population of 7.1 million. The central business districts of these two adjacent cities are less than 20 km apart. In March 2009, Guangzhou and Foshan worked together on the Guangzhou-Foshan region unification development, a plan covering just over ten years, from 2009-2020. The plan's objective is to create a well-connected mega-region with over 20 million residents.

Implications for the transportation systems are interesting. Of course, both Foshan and Guangzhou have their own transportation systems with road networks oriented toward the center of each city, rather than toward inter-city connectivity. Road transport too has been the primary means for those travelling between Guangzhou and Foshan. Both Guangzhou and Foshan have their own urban expressways. These two systems are not connected by expressway, but by local streets, which therefore become quite congested areas of travel between the two municipalities. In order to unify the two systems, plans to improve capacity have been approved by both municipalities. Implementation, however, has fallen behind schedule. Under the joint plan, each municipality shoulders the engineering costs for the section of roads within its boundary. In reality, the Foshan government has shown itself more willing than the Guangzhou government. For example, Foshan has built two major corridors within its boundary expressways in order to connect up to Guangzhou's inner ring or outer ring directly. But improvements to the corresponding connection roads within the Guangzhou municipality have

been delayed for various reasons, particularly the high right-of-way costs.

Progress in public transport services, however, has moved faster. With partial funding from the provincial government, Guangzhou and Foshan jointly constructed a metro line, which links western Guangzhou and central Foshan. The first segment of this line began operating in 2010, with the remaining part to be completed by 2015. This inter-city metro helps to link the two cities closely. Since its opening, use has steadily increased and headway at peak period has been reduced from 8.5 minutes to 5 minutes. Following the funding for this metro line, six additional inter-city metro lines have been planned, which will further integrate the two municipalities.

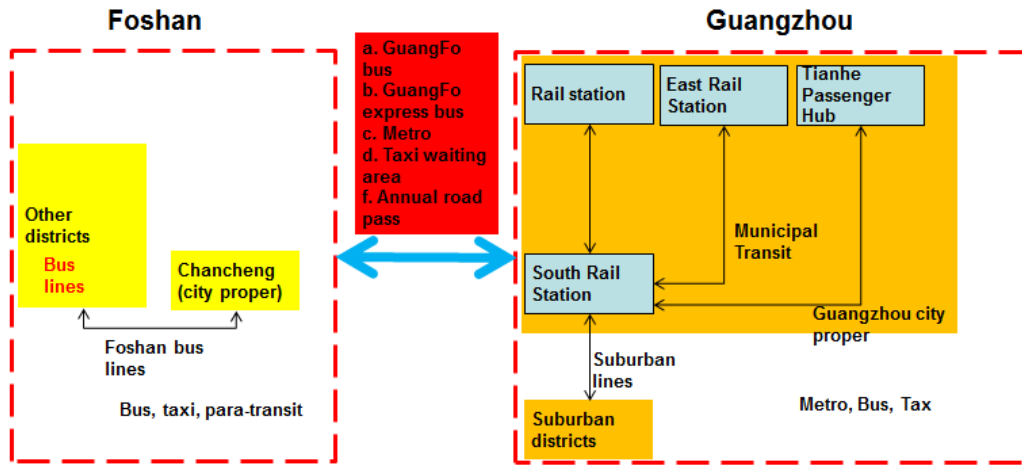
Responding to demand, bus services from Guangzhou into Foshan began operating seven or eight years ago. The most significant progress came in 2007, when Guangzhou's Bus Company No. 2 acquired a 70% stake in Foshan's Nanhai Passenger Transport Company. In September 2009, Guangzhou-Foshan bus lines began operation, with 24 conventional municipal-style bus routes and 15 express bus routes.

The road toll system has also been regionalized into an annual pass program. Previously, drivers in Foshan could buy an annual pass issued by the Foshan government, replacing pay-per-use tolls in Foshan, but not on Guangzhou's toll roads. The same situation existed for drivers in Guangzhou. But, from Oct 1st 2008, Guangzhou's annual pass can be used in Foshan and Foshan's annual pass can be used in Guangzhou's central districts, but not the four suburban districts (Panyu, Conghua, Huadu, Zengcheng). Why this unbalanced situation exists has never been clearly explained by the relevant governmental body².

In China, taxi services are licensed by municipal governments. It was previously the case that taxis licensed by the Foshan government could only pick up passengers in Foshan, not in Guangzhou. A taxi delivering passengers beyond the municipal boundary had to make its return journey with empty seats, and violation would lead to a penalty of 5,000-10,000 RMB. Based on the idea of regional integration, Foshan and Guangzhou created passenger waiting areas for taxis licensed by the partner city. In January 2010, Guangzhou created three waiting areas for Foshan's taxis, and Foshan opened 16 waiting areas for Guangzhou's taxis. This arrangement surely increases taxis' operational efficiency, despite a certain inequality in the partnership.

² This regional annual pass program was expanded to include Zhaoqing in March 2010, and finally all cities in Pearl River Delta in 2013. But the unequal treatment between Foshan and Guangzhou persists.

Figure 7. Multi-modal and multi-city transportation system in Guangzhou and Foshan



Summary and Conclusion

Chinese cities are getting bigger and are also growing into each other. To ensure the rapidly increasing number of urban residents have access to transportation not only requires increased investment in transport infrastructure, but also careful deliberation to ensure an optimal tradeoff between different modes of transport as well as coordinated development between land development and transport development. The trends discussed in this article reflect China's reaction to the increasing mobility challenges in expanding urban areas. Whether this action is sufficient is difficult to assess in the short term.

Firstly, when developing and expanding urban areas, Chinese cities have tried to lay out a clear spatial structure, often driven by the garden city idea and featuring multiple centers. The actual outcomes however have varied depending on local contexts. In urban areas with a geographic condition that restricts continuous expansion, such as Qingdao and Shenzhen, cities have become multi-centered, interspersed with green space or bodies of water. For urban areas on large plains, such as Beijing, the municipal government has repeatedly failed to preserve green spaces that separate the planned centers. The result is an expanding urban mega-center sprawling outward without interval. The backbone of this spatial structure is densely spaced ring roads.

Secondly, road investment alone cannot drive continuous expansion in China. There is currently no doubt that investment in other transportation modes should be prioritized. China's urban population density is high, which makes it necessary and also attractive for high-capacity transit investment. Indeed, the effects of investment in this area are quickly noticeable. Station areas become loci for new development and price and density gradients are found around them. Real estate prices and density tend to decrease as the distance from stations increases. Continued expansion of the transit system and transit-oriented development can provide hope for congestion mitigation. There are still, however, many challenges to overcome. China's ambitions for urban expansion based on transit-oriented development may not be fully realized until viable funding mechanisms for sustainable transport operation are brought about. HKMTR's involvement in Shenzhen, Beijing and Hangzhou provides interesting examples in this respect.

Thirdly, assuring effective passenger mobility within China's expanding and high-density urban areas requires a multi-modal

approach and transportation hubs that provide intermodal connectivity. Sidewalk, bike lanes, varied bus services, and fixed route transport systems co-exist in Chinese megacities and serve different socio-economic groups and different types of travel. Railway stations and airports are typical transportation hubs that not only provide inter-city connectivity, but are also locations of intra-city transfer. The economic benefit of this infrastructure is obvious. It allows quicker movement of passengers across regions and consolidates trips of similar destinations into higher-occupancy and higher-speed modes of transport. It also reduces travel time and travel cost for users.

Finally, one significant challenge facing China is the question of how to best inter-connect transportation systems developed separately by neighboring municipalities. As cities merge into each other and form multi-municipal urban areas, the separate transport systems need to be united. The Guangzhou – Foshan case is an example of how this conundrum can be dealt with. The development of an inter-city metro line with subsidy from the provincial government, and the procurement of part of Foshan's bus service by one of Guangzhou's bus companies are interesting examples. Also, the establishment of a regional road pass program has proved a good time- and money-saving measure for those who travel frequently across the municipal border. The region, however, still lacks a systematic funding mechanism for transportation projects that span the two municipalities, and a sense of unbalance can be easily detected in the partnership. Whether a more western-style urban planning organization might eventually be adopted in the future deserves some consideration.

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