International Transport Forum

Modern Tram and Public Transport Integration in Chinese Cities: A case study of Suzhou

21

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Abstract

This paper explores the role of modern trams in Chinese cities and identifies issues and challenges of integrating modern trams with other public transport modes. The Suzhou National High-tech District (SND) Tram is chosen as a representative case for study. The findings show that, due to the strict national policy and approval procedures, trams are often planned and constructed as a good alternative to metro systems. Instead of practically addressing transport congestion, with a "development-driven" and "control and management" ideology, the current approach emphasises new development and avoids potential confrontation and social unrest in dense urban areas. As a result, despite massive investment in tram and other public transport modes, public transport mobility is not competititve against car mobility. Lessons learnt from the Suzhou tram case include prioritising public transport, well articulating public transport systems at multiple levels, combining strategic planning and supportive policies, enabling open competition for tram operation, and exercising leadership for collective goverance.

Table of Contents

Figures

Tables

Introduction

The past decade saw buoyant development of urban rail in the People's Republic of China (China hereafter). By 2015, more than 3 600 kilometres (km) of urban rail tracks had been constructed in 26 Chinese cities while modern tramways in 10 cities amounted to merely 161 km (CAMET, 2016). In comparison with metro systems, modern tram development is in its infancy. With supportive national policy and gradual cost reduction through localising tram technology development, more than 2000 km of new modern tram network are currently in the planning stage across the country. Transport network development in China has been undertaken with a "planning for growth" ideology (Wu, 2015). After an era of massive construction of highways in the 1980s, around the mid-1990s the automotive industry was designated as one of the key pillar industries for the national economy. Around this time, several large cities started to develop mostly metro rail systems, while much smaller cites could not justify the construction and operation of metros. Public urban rail development had not been officially regulated on the national scale by the Central Government until 2003 (GOSC, 2003, No.81) and not advocated until the early 2010s (GOSC, 2012, No.64). It naturally leads to a key question: whether, and if so to what extent, public transport in China can be an effective alternative to private cars. This paper examines integrated public transport planning practice in Chinese cities based on the case of the Suzhou National High-tech District Tram.

The paper is structured in four parts. The first section reviews key policies and mechanisms underlying urban public transport planning and decision-making in the Chinese contexts. The second section provides a background introduction to rapid urbanisation and rail development in Chinese cities. The third section draws on a case study of Suzhou to gain insights into the uniqueness of Chinese approaches including the motivation of choosing modern tram over other modes, the current approaches to public transport integration and its impacts. The final section concludes with future implications.

Policies and mechanisms for developing urban rail in China

Definition of urban rail systems in China

According to the "Standard for Classification of Urban Public Transport" (CJJ/T 114-2007), urban public passenger transport is categorised into four categories (Level 1), including street, rail, water and other transport modes. Each category can be further sub-divided into more detailed definitions (Levels 2 and 3) (Ministry of Construction, MoC, 2007).

Within the category of Rail Transport (GJ2), varying in coach types and carrying capacities, seven systems are classified at the Level 2 (Table 1) namely metro, light rail, monorail, tram, maglev, automatic people mover (APM), and city-regional express rail. In China, metro is defined for high and large carrying capacities while light rail, monorail, maglev, and APM have medium carrying capacities. In addition to carry capacities, a major distinction between light rail and metro lies in the types of railcar. The metro systems use Railcar Type A and B while light rail systems use Railcar Type C.

Tram (GJ24) in China is defined to provide low carrying capacities. There is no standard definition of tram systems worldwide. It is worth noting that light rail and tram are regarded as different systems in China, while in Europe, tram is largely regarded as a kind of light rail systems.

Table 1. **National policy framework and guidelines for urban rail development in China**

Level 1	Level 2	Notes
GJ2 Rail urban public passenger transport		
	GJ21 Metro	• For high and large passenger capacity • Suitable for underground, ground, or elevated tracks
	GJ22 Light Rail	• Medium passenger capacity • Suitable for underground, ground, or elevated tracks
	GJ23 Monorail	• Medium passenger capacity • Suitable for elevated tracks
	GJ24 Tram	• Low passenger capacity • Suitable for ground tracks (Independent right of way), mixed use, or elevated tracks
	GJ25 Maglev	• Medium passenger capacity • Suitable for elevated tracks
	GJ26 Automatic People Mover	• Medium passenger capacity • Suitable for underground or elevated tracks
	GJ27 City-regional Express Rail	• Serving city-regional territory • Medium-to-long distance passenger transport

Source: MoC (2007)

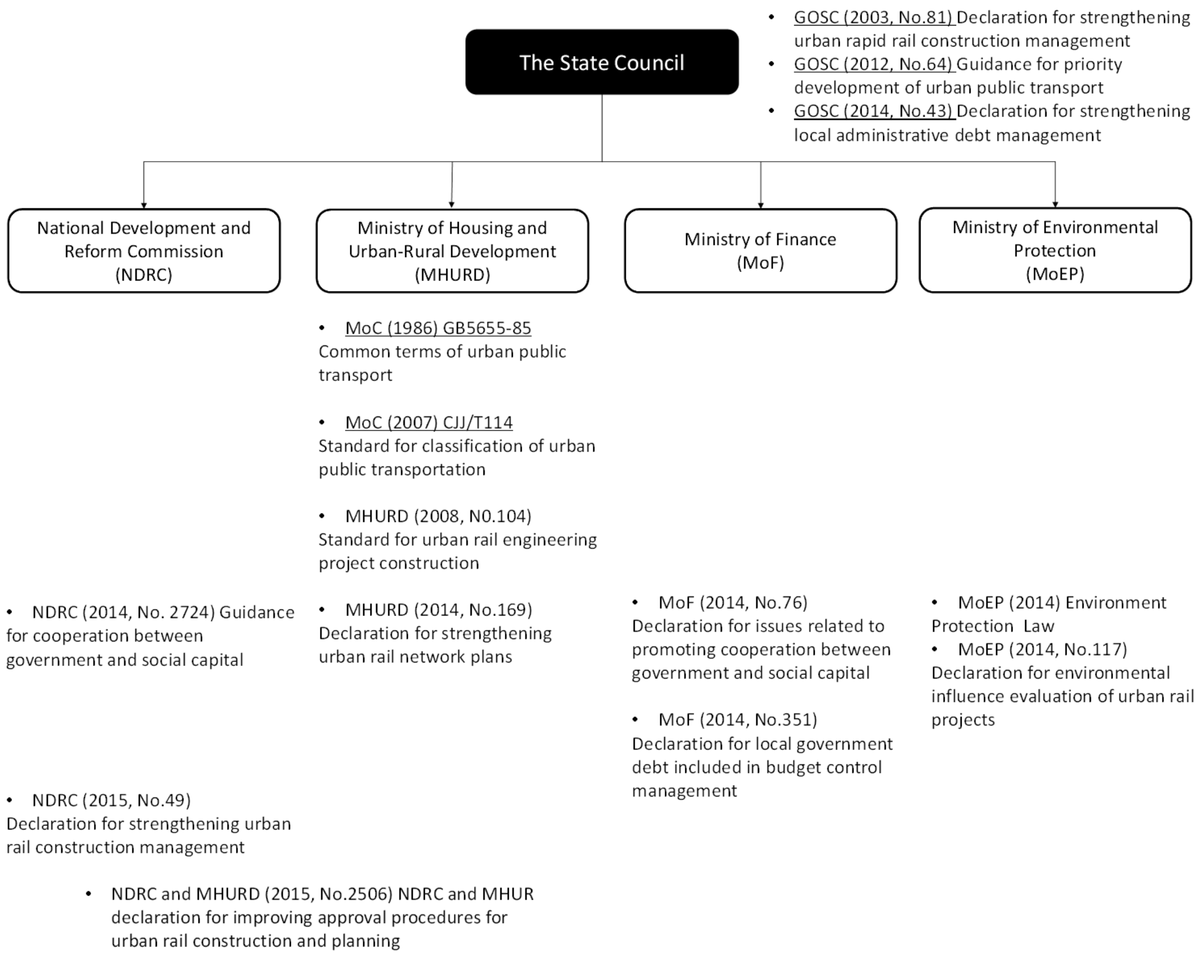
National policy for urban rail development

Although the first metro system appeared in Beijing in 1969, it was not rail but road building that had facilitated the rapid urbanisaiton in China from the 1980s. Prior to 2000, China's urban rail systems covered a total of just 135.8 km in four cities e.g. Beijing, Tianjin, Shanghai and Guangzhou. It was not until the early 2000s, national government started to institutionalise urban rail development in China.

Policy framework

Since 2003, the national policy framework related to the development urban rail has expanded to include roles for four major ministries: National Development Reform Commission (NDRC), Ministry of Housing and Urban-Rural Development (MHRUD), Ministry of Finance (MoF), Ministry of Environmental Protection (MoEP). The framework has four main objectives: "integration and linking up", "economic efficiency and suitability", "convenience and efficiency", and "safety and reliability". The framework also sets out the procedure for evaluating and approving as well as the specific guidelines for planning and design, environment protection, and financial capacity (Figure 1).

Figure 1. **National policy framework and guidelines for urban rail development in China**



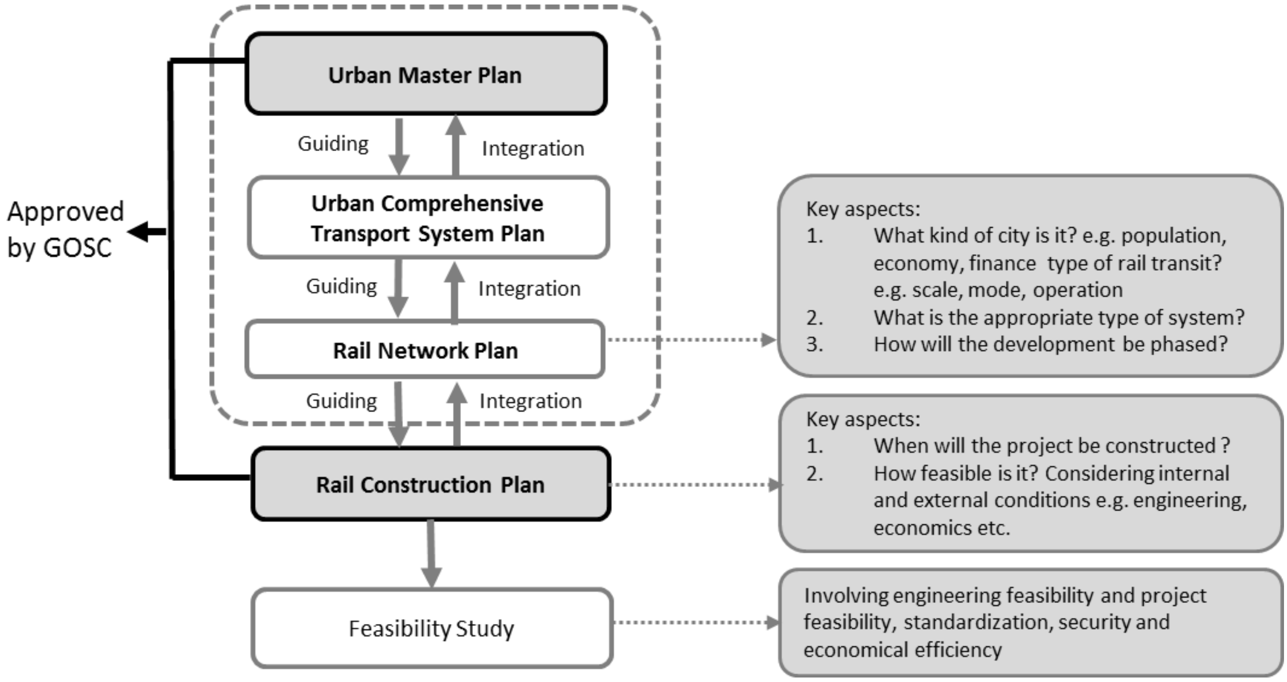
Notes: 1. Some relevant policies are under the Ministry of Transport (MoT), such as Urban rail transit trial operation standard (MoT, 2013-GB/T 30013). 2. Ministry of Construction (MoC) was reshuffled to create Ministry of Housing and Urban-Rural Development (MHURD).

Planning integration

Urban rail network planning is required to integrate with urban development master plans and comprehensive transport system plans. According to the national regulation No.81 (GOSC, 2003), a long-term “Urban Master Plan ” guides a subject plan “Urban Comprehensive Transport System Plan” and a sub-subject plan “Rail Network Plan”. Once the urban rail network plan is determined, rail construction plans need to be proposed in line with urban development needs and financial capacities, including short-term (within 5-6 years) and long-term schemes and corresponding financial schemes.

In practice, rail development often deviates from this strict approach according to local context. A local municipality might propose a rail construction plan after upper-level planning documents have been drafted but not fully completed the approval process. Although the upper-level planning documents have the guiding role, they are required to reflect and integrate the latest rail construction plan into the upper-level planning documents. Figure 2 shows planning integration and rail construction plan procedures in China, which illustrates an interactive relationship between the upper-level plans and lower-level construction plans i.e. guiding and integration at the same time. In most cases, Urban Master Plans will be approved before Rail Construction Plans are accordingly approved. It implies that Rail Construction Plans will not be approved if they are not consistent with Urban Master Plans. However, if the local municipalities insist on specific Rail Construction Plans, Urban Master Plans need to be revised and approved before Rail Construction Plans are approved.

Figure 2. **Planning integration and rail construction plan procedures in China**



Source: Author (modified based on General Office of the State Council (2003) No.81)

Environment protection

An Environmental Impact Assessment (EIA) is required for each rail proposal before construction can be permitted. The EIA aims to facilitate a balance between construction and environmental protection. Key principles guiding the EIA are (MoEP, 2014, No.117):

- EIAs are approved by the MoEP.
- The schemes with favourable EIA results should be prioritised. The sites for urban rail schemes should be consistent with City Masterplans and the results and comments in the EIA.
- Pollution prevention facilities should be designed, constructed, and operated as an inseparable part of the main construction project.

Financial capacity

Urban rail schemes belong to local governments' responsibilities. To prevent over-borrowing by local governments, national guidance instructed that public capital should not be lower than 20% of the overall project's capital cost and this government contribution is generally not allowed to be higher than 5% of its annual financial budget (MoF, 2014, No.76 and No.351). Moreover, the rail construction project is not allowed to exceed 30% of the local government's urban construction budget. The percentage of borrowing allowance is subject to adjustments announced by Central Government.

- Every city has to establish a transparent mechanism that can deal with long-term public capital investment, balance financial expenses and incomes, and ensure sufficient income to cover operational costs.
- Innovative financial approaches are encouraged by the framework. Private investment is possible through a wide range of public-private partnerships, such as franchise concessions for rail construction and operation, and private-led transit-oriented developments.
- Rail operators are entitled to have discounted electricity bills and supported by the government to issue bond issuance.

Threshold

In practice, the policy framework allows development based on "warrants" rather than case-by-case assessment of policy proposals. Current national policy specified in GOSC (2003) document No.81 and National Development and Reform Commission (NDRC, 2015) No.49 sets out "population scale", "transport demand" and "economic development level" as the main criteria to evaluate whether a city qualifies for a rail system. Table 2 shows the thresholds for developing Metro and Light Rail systems based on city characteristics and demand forecasts of the proposed system/line.

Table 2. **Threshold of urban rail construction planning**

	Metro	Light rail
Population	≥ 3 000 000	≥ 1 500 000
Gross Domestic Product (GDP)	≥ CNY 100 billion	≥ CNY 60 billion
Local government financial income	≥ CNY 10 billion	≥ CNY 6 billion
Passenger flow scale	Peak time one way over 30 000 persons per hour	Peak time one way over 10 000 persons per hour
Initial passenger flow	≥ 7 000 persons/ day.km	≥ 4 000 persons/ day.km

Source: GOSC (2003, No.81) and NDRC (2015, No.49).

The approval procedure of urban rail construction plans in China

Urban rail construction plans have been required to comply with a rigorous approval process. Referring to Figure 2, both the "Urban Master Plan" associated with a long term vision and the "Rail Construction Plan" are required to get approval from the GOSC at the national level. Feasibility studies of urban rail systems need to conform to a "construction plan" approved by GOSC. In comparison, according to two national policies, NDRC (2015, No.49) and NDRC and MHURD (2015, No.2506), tram systems do not need to be approved at the national level. Construction plans of tram systems are approved by either the provincial or municipal Development Reform Commissions.

Rapid urbanisation and development of urban rail and trams

Since the economic reform in 1978, and particularly from the 1990s onwards, China's rapid urbanisation has been manifested in population growth and urban expansion by converting lands from rural to urban uses. Table 3 shows the unprecedented rapid urbanisation phenomenon in China. The urban share of population increased from 29% in 1990 to 56.1% in 2015. More land had been used for development. Built-up areas had more than tripled. Enlarged territories led to longer distances for commuting, shopping, business travel, and other activities. With the progression of economic growth and higher income levels, more and more people could own their own vehicles, with private vehicles increasing 55.4 times over the 25 years to 2015. This resulted in serious traffic congestion and wider concerns of social justice underlying transport provision (Zhang, 2011; Wang, 2012).

Table 3. **Rapid urbanisation in China**

Indicator	Unit	1990	2015	1990-2015 increase
Urban population share	%	29.0	56.1	+27.1%
Urban population	million	302	771	+1.6 times
Built-up area	km^2	12 855	52 102	+3.1 times
Private vehicles	10^4 cars	250	14 099	+55.4 times

Source: China Statistical Yearbooks (1991 & 2016)

The role of transport infrastructure in the rapid urbanisation process can be identified in three stages between 1978 and 2015:

- In the first stage, from 1978 to 1995, a US approach was dominant in large-scale road building programs. In the 1980s, several large Chinese cities expressed a willingness to learn lessons from the motorisation experiences in the advanced economies and considered a strategy of prioritising public transport instead. However, ultimately policy settings aimed to maximise personal mobility and the initial idea of prioritising public transport was neglected (Chen, 2005).

- From the 1990s onwards, when the road building approach had started to bring about urban congestion, investment in public transport vehicles had begun to increase (Table 4). However, at the same time, car manufacturing was promoted as a key industry, which brought about an unprecedented increase in car ownership without effective constraint policies. This is also clearly reflected in the remarkable increase in the number of taxis shown. Around this time, the financial distress caused by an overambitious rail scheme in Shengyang led the Chinese Government to suspend any approval of urban metro and ligh rail systems (GOSC, 1995, No.60).

- From the early 2000s, the explosive growth of private cars had dramatically increased the seriousness of transport issues such as congestion, chaotic parking, worsening air quality, etc. There was a resurgent awareness of the importance of public transport at this stage. A new wave of large-scale investment of urban rail systems took place.

Table 4. **Number of public transport vehicles in China**

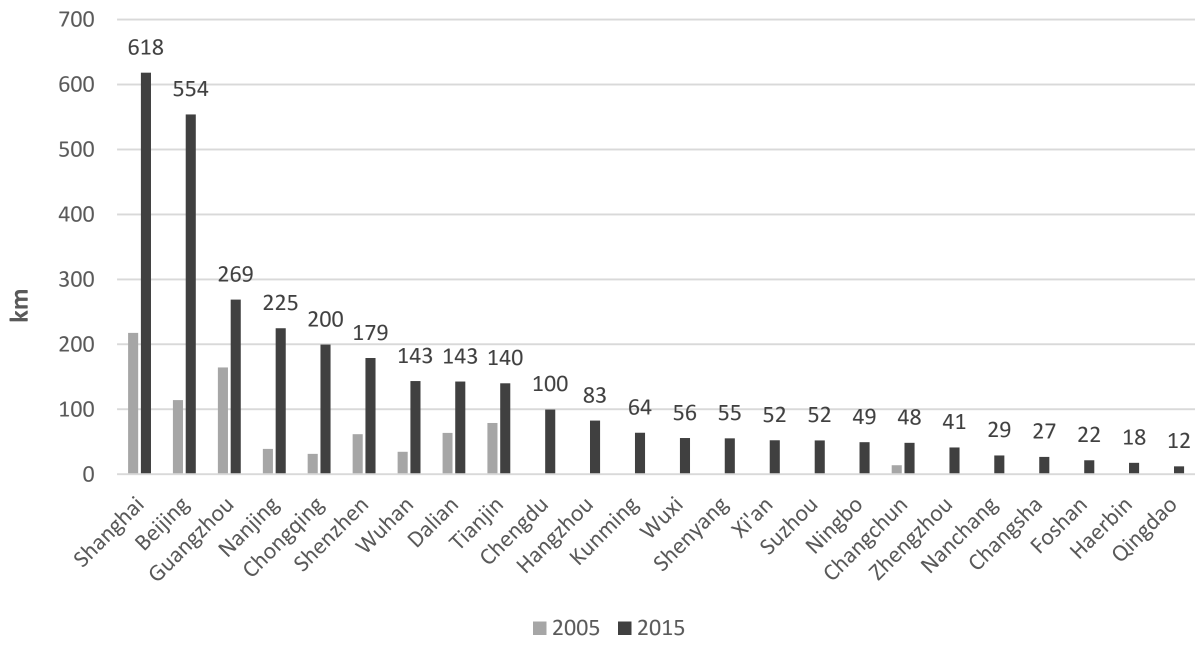
Indicator	1985	1989	1996	2000	2005	2010	2015
Number of Public Transport Vehicles	45 155	59 671	147 591	225 993	313 296	383 161	502 916
Number of Public Vehicles/per 10^4 people	1.8	2.1	3.6	4.9	5.5	5.6	6.2
Number of Taxis	27 078	98 508	585 369	825 746	936 973	986 190	1 092 083

Source: China Statistical Yearbooks (1991-2016)

Urban rail development in China

The rapid development of urban rail in China had been phenomenal. Figure 3 shows the growth of urban rail network not only in terms of length in operaion but also the number of new metro cities over a period of 10 years from 2005 to 2015. Shanghai had the largest urban rail network, 618 km, followed by Beijing, with 554 km. Underground lines have the largest share of urban rail networks, 57.8% with a total length of 2093 km (CAMET, 2016). More than twenty cities have more than two urban rail lines.

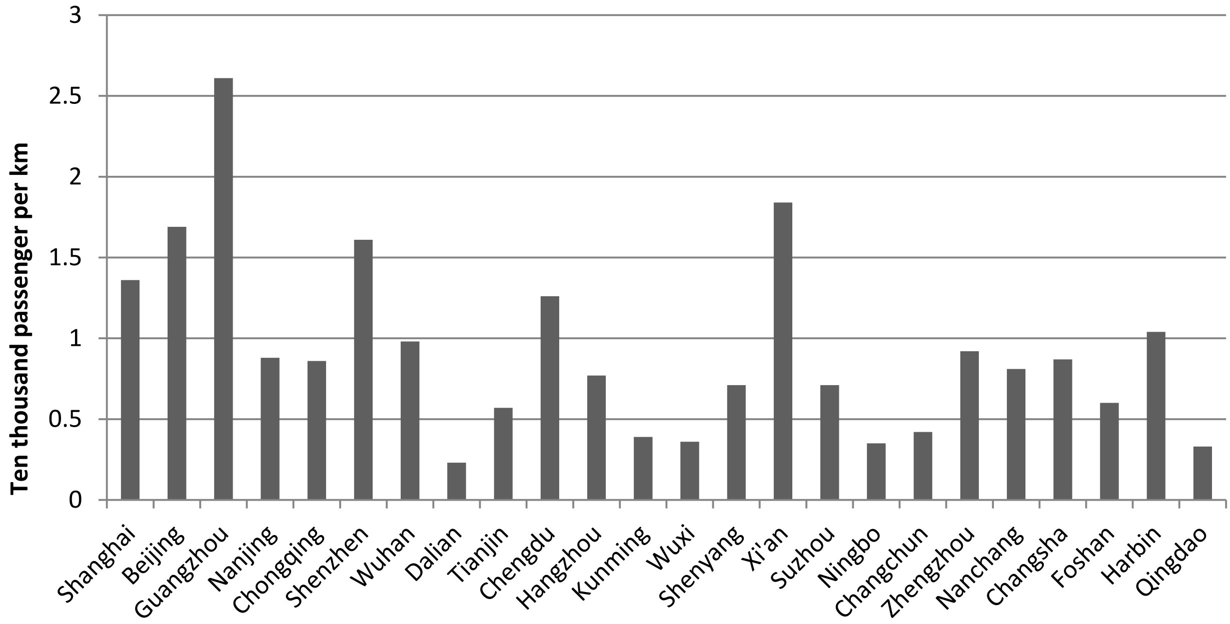
Figure 3. **Extent of urban rail public transport networks in operation in Chinese cities, 2005 and 2015**



Note: The figures presented here do not include the operational length of tram (GJ24) and city-regional express rail (GJ27).
Source: CAMET (2016) and various metro operators' websites.

Urban rail passenger numbers have been increasing rapidly. Excluding 400 km of five city-regional rail lines and six tramlines, the passenger traffic on the urban rail networks in China amounted to 13.8 billion in 2015, 1.2 billion more than the previous year (CAMET, 2016). However, the passenger traffic is not necessarily proportional to the overall length of urban rail network (Figure 4). Some cities with smaller networks have managed to serve more passengers. For instance, Guangzhou had less than half of Shanghai's network length while it has nearly double the passenger traffic of Shanghai. Similarly, Shenzhen and Xian also had relatively high passenger flows.

Figure 4. **Urban rail passenget traffic, 2015**



Source: CAMET (2016)
Note: Different from Figure 4, due to the constraints of limited available data sources, the figures presented here for each city include tram (GJ24) and city-regional express rail (GJ27).

Tram development in China

Tram development in China is not new. The first tram system in China was constructed in Beijing in 1899 by German Siemens. The tram initially connected suburban areas with the central gate of Beijing city and was subsequently extended within the city walls in 1924. Port cities such as Hong Kong (1904), Tianjin (1906) and Shanghai (1908) followed suit. Later on, Japan and Russia built tramlines in main cities in the North East of China e.g. Dalian (1909), Shenyang (1925), Harbin (1927), Changchun (1941). These tram cities were mainly capital, port, or colonial cities subject to foreign influences. From the 1950s onwards, tram removal in China involved an aspiration towards modernisation, which regarded personal cars as a symbol for the future while then trams were obsolete, noisy, slow, expensive for operation and maintenance, occupying large road space etc.. Consequently, urban space (including roads) were rearranged for urban development and moderisation such as industrialisation. By 2006, only three north-eastern cities, namely Harbin (until 2008), Changchun and Dalian still operated tram systems. A new generation of tram systems arrived in 2007 in Tianjin which adopted a French rubber-wheel guided rail trolley system.

Table 5 shows ten Chinese cities were operating tram systems in China in 2016. Among them, Shengyang has the most extensive tram network. Most tram systems are constructed in large cities (Tier 1 and Tier 2 under the grading of administrative divisions) which already have their own metro/LRT systems except Huaian. Passenger volumes are very small on all systems; most have less than 10 000 passengers per day, except Dalian, Shenyang, and Huaian which have more than 25 000 daily passengers, though this is still lower than the designed tram capacities.

Table 5. **Tram systems in Chinese cities by 2016**

City	Year of opening	Length (km)	Daily passenger (persons)	Tier of cities	Existing metro/LRT systems	Population 2015 (million)
Dalian	1909 & 2015	24	16000 (L201) 55000 (L202)	Tier 2^B	Yes	7
Tianjin	2007	8	4000	Tier 1	Yes	15.5
Shanghai	2009	10	6000	Tier 1	Yes	24.2
Shenyang	2013	60	30000	Tier 2^A	Yes	8.3
Guangzhou	2014	7.7	9000	Tier 2^A	Yes	13.5
Nanjing	2014	7.8	2000	Tier 2^A	Yes	8.2
Changchun	2014	9.6	4000	Tier 2^A	Yes	7.8
Suzhou	2014	18.2	6000	Tier 2^C	Yes	10.6
Huaian	2015	20	25000	Tier 2^C	No	5.6
Qingdao	2016	8.7	2200	Tier 2^B	Yes	9.2
Zhuhai	Trial	8.9	-	Tier 2^C	No	1.6

Note: In China, there are three city tiers in the administrative divisions including Tier 1: Province-level city; Tier 2: Prefecture-level city; and Tier 3: County-level city. Within Tier 2, there are three variations, including Tier 2^A: Sub-provincial city; Tier 2^B: Prefecture-level city with Independent Planning Status; Tier 2^C: Ordinary Prefecture-level city.

Source: Ministry of Transport (2016)

Tram system development in China can be grouped into three types according to the system's urban assets, role, service route and city size (Table 6). Type A refers to those systems in north-eastern cities that are inherited from the early 20th century. In these cities, trams run through the traditional city centre. Trams as well as other rail systems developed more recently can collectively form the key public transit backbone. Type B represents the majority of new tram cases. Trams are constructed in the newly developed urban districts of large cities that already have metro lines. The planning ideas are closely associated with development-oriented instead of addressing traffic congestion. In this approach, trams are associated with city images such as as modern, sustainable, with a high quality of life, etc. Type C serves those small cities which are not exceeding the threshold of building a metro or light rail system develops a tram system as a public transport network backbone, though with consideration of future metro considered possible. Currently the only case of type C is Huaian, though places like Gueyang and Yunnan, with populations around one million, may be considered suitable for this model but do not currently have any trams in operation.

Table 6. **Three types of tram development in China**

Type	Features	Examples
A. Tram runs in traditional city centres	• An existing/inherited tram system • Common in north eastern cities in China • Trams integrated with modern rail systems	Dalian, Changchun,
B. Tram serves newly developed urban areas	• Trams do not run through traditional city centre, but instead serve new urban districts • Usually larger cities with metro and light rail systems • Trams aim to: (1) extend a metro line, (2) provide a service before a metro line is constructed, or (3) connect two metro lines at the outskirts	Shanghai, Tianjin, Nanjing, Guangzhou, Suzhou, Qingdao, Shenyang*
C. Tram is the main urban transport skeleton	• Implemented in small and medium sized cities that do not (yet) qualify for metro systems • Tram is developed as the main urban transit system • Motivations for the tram routes vary among cities	Huaian, Zhuhai (Trial)

Note: Shenyang could be a Type A city but it becomes a Type B city because of its disappearance of tram systems in the old city centre and the arrival of new trams in the newly developed urban areas.

Source: Modified on Qin et al. (2013), Shi (2014), Xue et al. (2008), Zhou (2013), & Zi et al. (2009).

Whether a modern tram system is a good alternative to express bus or other transit systems has been controversial in China (as elsewhere). Tram supporters maintain that trams have advantages such as high capacities, efficiency while tram skeptics argue that if the actual passenger volume could not reach 5 000-10 000 passengers per hour, it is unlikely to fulfil the key value proposition of the new tram system. In that situation, it was argued that there might be a case in the future to remove tram systems from cities, just like what happened 50 years ago (Qin et al., 2013), albeit for different reasons.

A case study of Suzhou

Suzhou's tram is an example of Type B development that involves issues of tram planning and its integration with existing public transport systems. This section provides a case study of the Suzhou National High-Tech District tram to gain deeper insight into the current tram practice in China.

A brief introduction to Suzhou and Suzhou National High-Tech District

Suzhou is located in Yangtze River Delta Area to the west of Shanghai, 30 minutes by high-speed rail between main stations of the two cities. Suzhou, a prefecture-level city with an administrative area of 8 488 km^2 (akin to a concept of city region) has six urban districts as well as four county-level cities (Taicang, Kunshan, Changshu, Zhangjiagang) (see Table 7 and Figure 5). In 2015, the total population of Suzhou prefecture was 10.6 million, of which approximately 5.5 million was in Suzhou's urban districts. Regarding GDP and financial revenue, Suzhou has been performing stronger than two provincial capitals Nanjing and Hangzhou, only second to Shanghai within the Yangtze River Delta Area.

Table 7. **Profile of Suzhou urban districts**

	Population ('000s)	GDP (CNY billion)	Land area (km^2)	Public financial budget revenue (CNY billion)
Suzhou prefecture-level city	10 616	1 450.0	8 488	156.1
Urban Area	5 492	749.4	2 895	83.0
- **Gusu district**	952	60.0	85	5.9
- **Wuzhong district**	1 121	95.0	742	12.1
- **Xiangcheng district**	729	60.5	439	7.0
- **New & High-tech Zone, Huqiu District (SND)**	591	100.6	258	11.0
- **Suzhou Industrial park (SIP)**	803	206.0	278	25.7
- **Wujiang District**	1 297	154.0	1 093	27.0

Note: Suzhou city region includes cities at County level, namely Changshu, Zhangjiagang, Kunshan, Taicang. Here, figures for county-level cities are not further specified. In 2002, Suzhou National Hi-Tech District (SND) was created by merging Suzhou New & High-tech zone and Huqiu district.
Source: Suzhou Statistical Yearbook 2016; National Economic and Social Statistical Bulletin (Gusu, Wuzhong, Xiangcheng, SND, SIP, Wujiang).

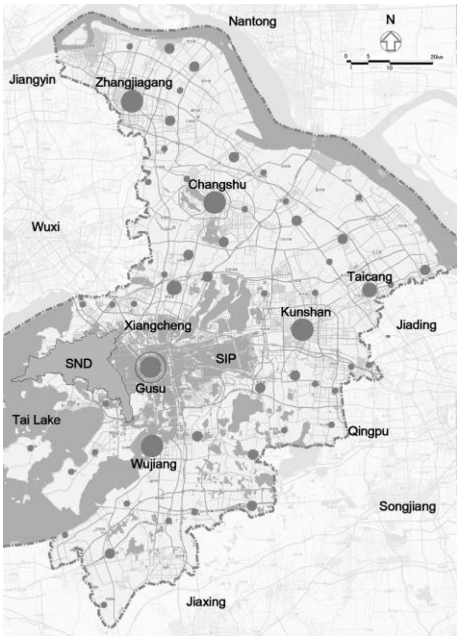
From the early 1990s, Suzhou started to expand its urban area in four directions. Two major industrial development zones i.e. National High-Tech District (in 1992) in the west and Suzhou-

Singapore Industrial Park (in 1994) in the east were created. In 2001, Xiangcheng district was created in the northern Suzhou; and Wujiang in the south was re-classified as an urban district. Consequently, over the past two decades, Suzhou has vastly expanded its urban area from 312 km^2 in 1990 to 2 895 km^2 in 2015.

Suzhou National Hi-Tech District (SND), an urban district in the west of Suzhou, has nature resources such as mountains and close proximity to Tai Lake, which overall offers a favourable position for leisure and tourism development in addition to science and technology industries and housing development. The territorial development has been envisaged at four key themes: technology, culture and humanity, ecology, and efficiency (SUCDRI, 2012).

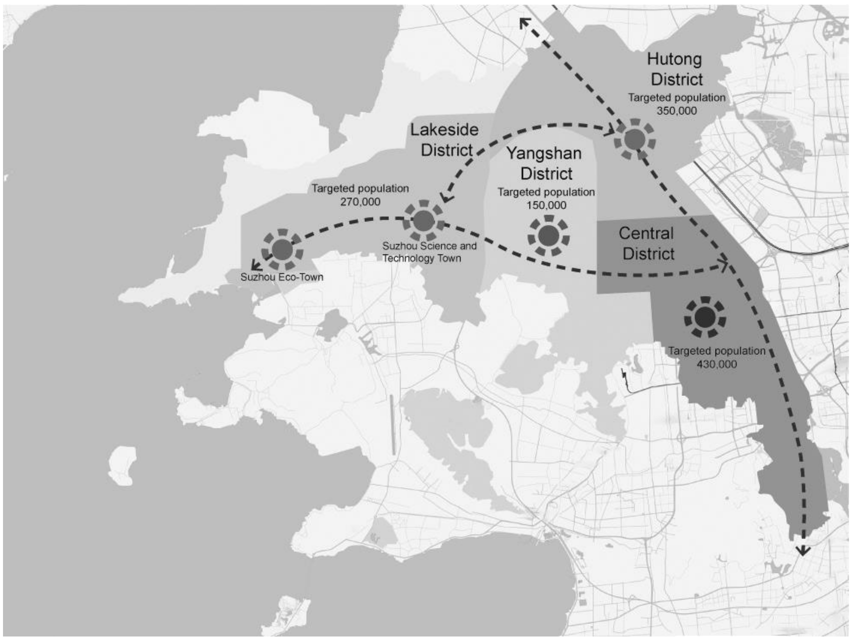
The SND City Masterplan defines four spatial districts (Central, Hutong, Yangshan, and Lakeside; see Figure 6), which together are planned to accommodate an estimated 1.2 million residents (against the current population 0.6 million) on the newly converted developable land (from 107 km^2 to 143 km^2) by 2030. The most populated area of SND is located in the east with Central District (Shishan) at the south-east corner adjacent to the old Suzhou Gusu district while the west part was nearly rural until the recent decade with two major designated development zones i.e. Suzhou Science and Technology Town and West Eco Town.

Figure 5. **The location of SND within Suzhou**



Source: Modified based on open street map

Figure 6. **Key development zones in SND**

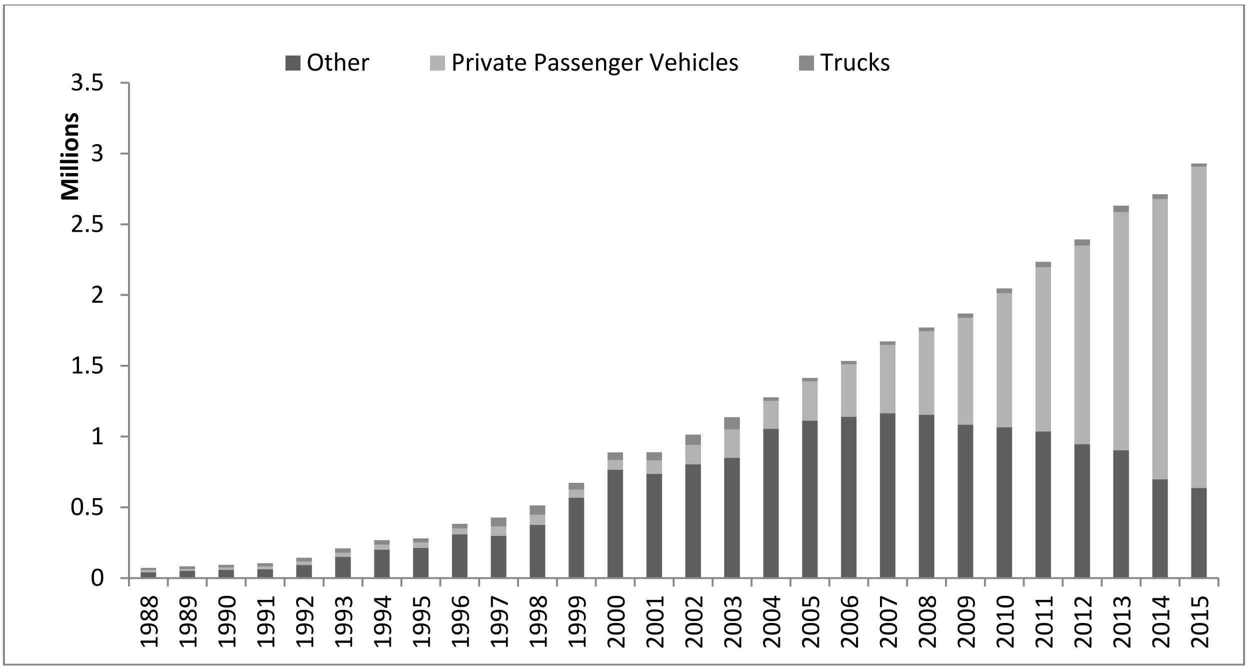


Source: Open street map and SUCDRI (2012)

Urban rail development in Suzhou and SND

Suzhou is not an exception to the rapid motorisation and worsening traffic congestion that most Chinese cities have encountered during the rapid urbanisation process. By 2015, the total motor vehicle number in Suzhou had reached 2.9 million, which is ranked 9th in China (China statistical yearbook, 2016). Within the total motor vehicles, the percentage of personal passenger vehicles has increased extremely fast (see Figure 7). Year 2007 was a pivotal turning point where personal passenger vehicles grew in contrast to a marked reduction of quantity in other vehicles.

Figure 7. **Composition of motor vehicles in Suzhou, 1988-2015**



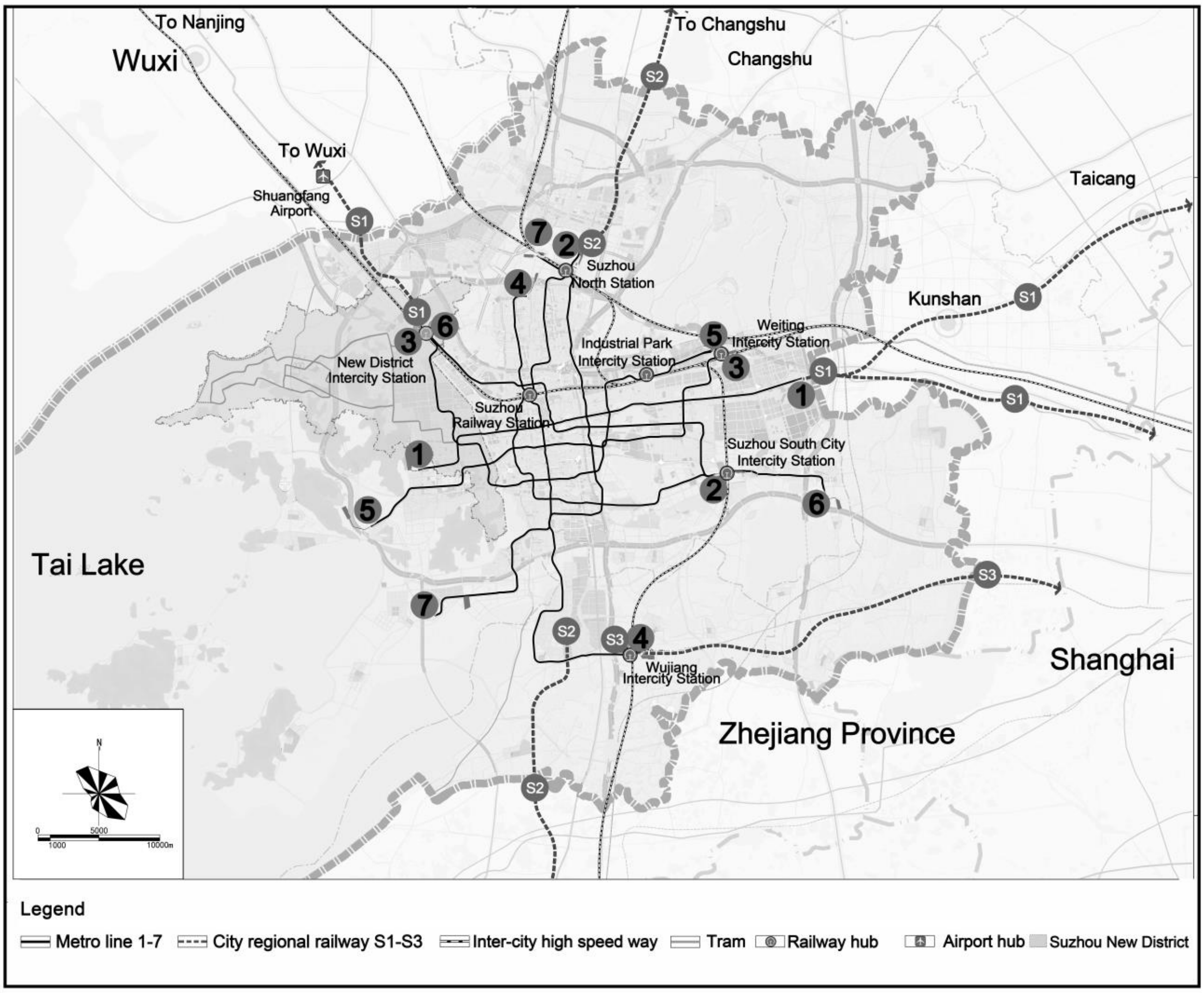
Note: Category "other" refers to anything outside the category of "private passenger vehicles" and "trucks", including motorcycles (two wheels, three wheels, light…), tractors, agriculture transport vehicle, specialised vehicles etc.

Source: Suzhou Statistical Yearbooks (1989-2016)

Suzhou rail network planning started in 2002. In 2007, Suzhou became the 15th city nationwide (and the first prefecture-level [Tier 2C] city) that was granted permission to construct metro lines. According to Suzhou's "Comprehensive Transport Plan" (covering the period 2007-2020), the rail network was to develop three levels of systems, namely inter-city rail, city-regional express rail (S1-S3)[1], and urban metro systems (Suzhou Urban Planning Bureau, 2008).

Figure 8 displays the revised long-term rail network plan (Suzhou Urban Planning Bureau, 2012), which is required to be consistent with Suzhou's City Master Plan "2007-2020". In this 2012 revision, the tram network for SND was included.

Figure 8. **Suzhou long-term rail network plan (2007-2020)**

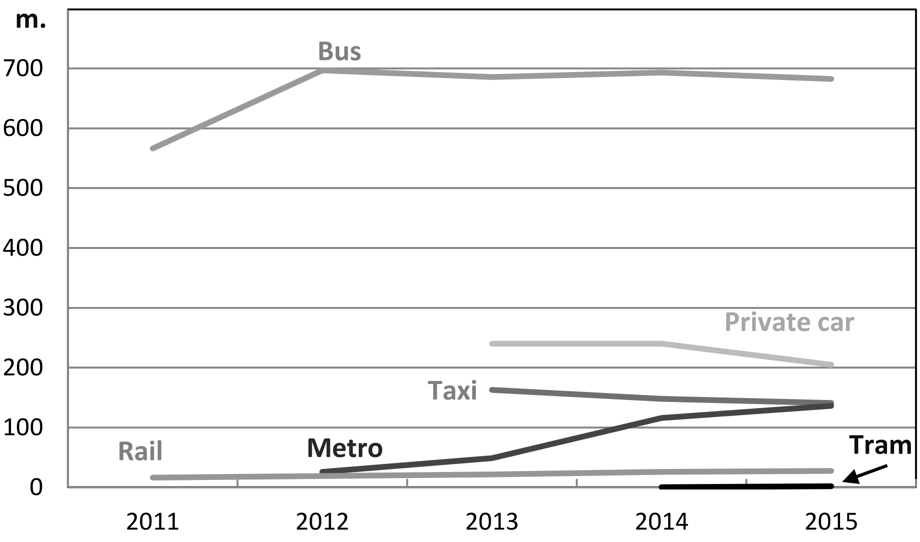


Source: Redrawn based on Suzhou Urban Planning Bureau (2012)

Suzhou's Metro Line 1 was inaugurated on 28 April 2012, followed by Line 2 on 28 December 2013. The current total length of metro operation is 52 km (by March 2017). Lines 3, 4, and 5 that will add about 139 km are under construction. Another three lines have been planned but no confirmation of construction dates has been made so far.

The arrival of Metro has attracted a satisfactory number of passengers. Figure 9 shows the passenger traffic of different transport modes from 2011 to 2015. It is evident that, except for the number of metro passengers which rose remarkably, other modes had shown slight decline. The average daily metro passenger flow in Suzhou reached 373 500 in 2015 (equalling to 7 182 people per day per line km), above the threshold of initial passenger flow, 7 000 people per day per line km.

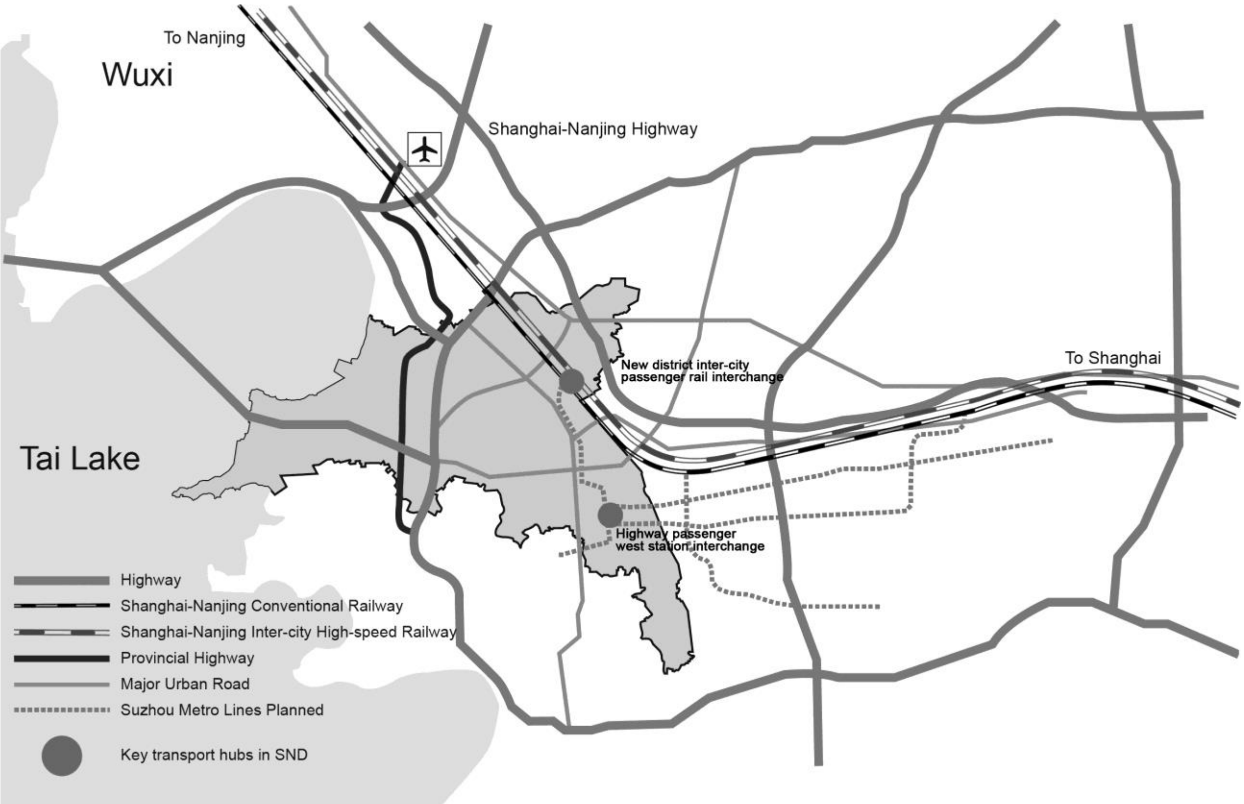
Figure 9. **Passenger traffic by transport modes in Suzhou urban districts, millions of trips**



Source: Suzhou Statistical Yearbook 2016.

Figure 10 shows how the external transport network relates to SND. Transport systems including the inter-district transport between SND and other Suzhou urban districts and the intra-SND district transport are closely shaped by the natural contour, the demographic distribution and development strategies. Two major transport interchanges are planned respectively around SND train station (the north east corner) and West Bus interchange (the south east corner).

Figure 10. **External transport links in SND**



Source: Modified from SUCDRI (2012)

Generally speaking, SND is well served by various external transport systems, including highways, urban road, nearby airport, etc. Shanghai-Nanjing inter-city railway runs along the east fringe (north west-south east direction); however, the planned urban rail network in SND is limited and partial. Prior to the tram's introduction, the local government argued that an efficient and comfortable public transport backbone system did not exist to serve the urban development need in SND (SUCDRI, 2012). Metro lines mainly route through the east edge of SND and the main inter-city rail station in SND, Suzhou Xinqu. In addition, the Suzhou Xinqu has very low frequencies compared with other rail stations in Suzhou — only four trains a day inbound and outbound (Table 8).

Table 8. **Rail frequencies in four rail stations in Suzhou**

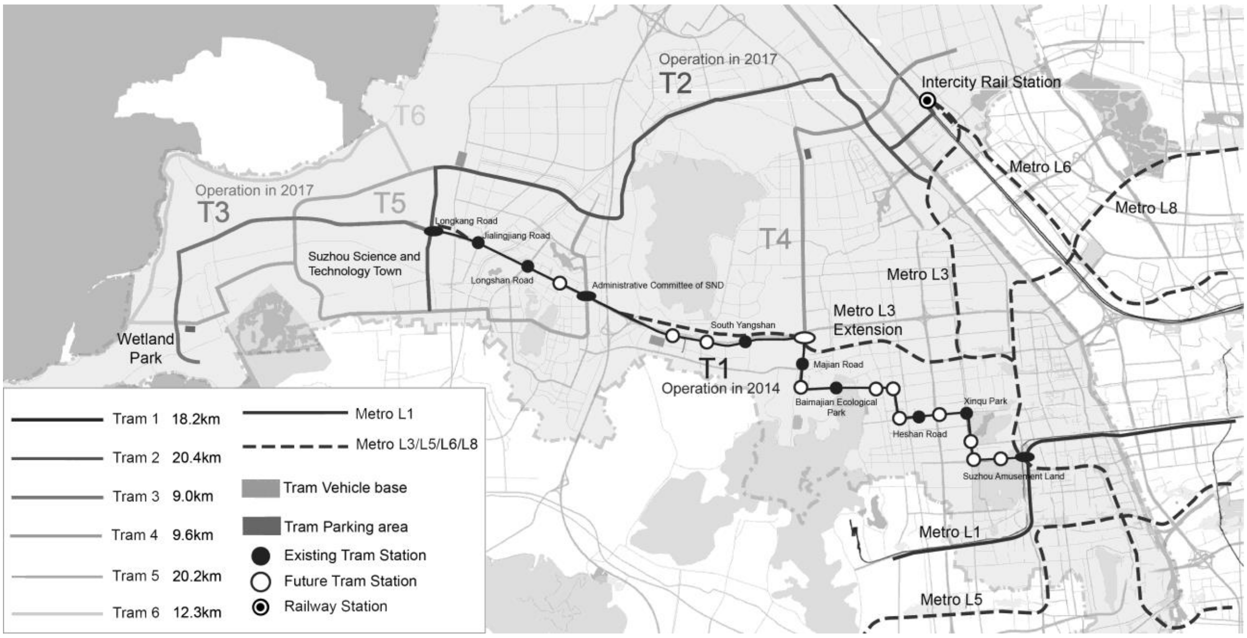
Station	From Shanghai	To Shanghai
Suzhou station	117	118
Suzhou North station	54	58
Suzhou Yuanqu station	16	18
Suzhou Xinqu station	2	2

Source: www.12306.com (accessed 23 March 2017)

Network planning and motivations for the SND tram

Figure 11 shows the SND tram network plan which was developed by SND tram company and approved by Suzhou Municipality in December 2010. In total, six lines are planned, amounting to 80 km (The SND tram company, 2012). The two transport interchanges (Figure 10) in SND are located in the east of SND, namely one in the Inter-city Rail station where Tram Line 2 and Metro Lines 3 and 6 interchange; and the other one is Highway Passenger Interchange West Station, where Tram Line 1 and Metro Lines 1 and 8 interchange at Suzhou Amusement Land for long-haul regional coaches, airport shuttle buses, car parking, and a commercial complex. The first tram line of 18.2 km came into service in October 2014. In total 22 stops were planned for Tram Line 1, yet only 10 stops are in operation at the moment. The rest of stops will be installed gradually based on the future land development. Both Tram Line 1 extension (shown in Figure 11 as T3) and Tram Line 2 are expected to start operation sometime in the second half of 2017.

Figure 11. **The SND tram network plan 2030**



Source: Open-street map & modified from SUCDRI (2012)

The SND Tram aims primarily to foster urban development in the west of SND. It is designed to exploit its scenery and landscape value, which is fundamentally different from using trams to relieve traffic congestion that takes place in dense central areas. Meanwhile, in order to ensure good connections with other urban districts in Suzhou, the SND Tram Line 1 was designed to serve as an extension of metro system in the short-to-medium term. Years later, once the planned Metro Line 3 is eventually completed ready for operation, it will be converted to be a supplementary line.

There was a hope that the SND tram would increase public transport modal share. Before it started its operation, the two highest shares of transport mode in SND in 2010 were e-bike (29.5%)[2] and private car (21.9%). Bus only accounted for 9.6% (SUCDRI, 2012). The SND tramway planning document shows that the planning and design capacity was based on an assumption that the modal share by public transport in SND will reach 30% in 2020. By 2020, the tram is expected to take passengers of 175 000 per day, or approximately 4 100 people per km day (SUCDRI, 2012).

According to planning documents (SUCDRI, 2012) and an interview conducted with the Deputy Manager of the SND tram company, the motivation for choosing a modern tram system in SND rather than other modes lies in five major concerns, namely construction plan approval procedure, population density, cost and time, capacity, comfort and image (Shi, 2014):

- Construction plan approval procedure – in line with national policy, constructing metro lines requires approvals from the national government, which generally rules out approval of metro lines in low density and undeveloped areas even if city-size thresholds are met. By contrast, tram construction plans do not require national approval and can be approved by either the municipal or provincial level of Development and Reform Commission (DRC), which is easier, quicker, and more supportive of local developments.

- Population density – since the population is dispersed in SND and the west part is still under development, high-capacity rail schemes may not have been considered viable. The tram network was proposed when the Metro L3 extension was approved. The Deputy Manager of the SND tram company revealed that, although the initially proposed Metro L3 did not get approval straight away, the idea of proposing an alternative metro backbone line running in SND still holds.

- Cost and time – tram is regarded as a good mode because the construction cost is generally 1/6-1/4 that of metro, which is about CNY 100 million per km. Moreover, trams have a much shorter construction period. A tram line will need about two years for construction before operation, compared to 5-6 years (NDRC, 2015, No.49) for constructing a metro line in Chinese cities (Zi et al., 2009; Xue et al., 2008).

- Capacity – trams that can serve 6 000-15 000 passengers per hour are argued to have a higher passenger capacity than Bus Rapid Transit (Qin, Miao, & Zhang, 2013). This also explains why tram replaced BRT which was initially proposed in Suzhou Comprehensive Transport Plan (2007-2020) (Suzhou Urban Planning Bureau, 2008)

- Comfort and image – according to the tram network planning document (SUCDRI, 2012), tram is regarded as a preferred mode with a number of key figures such as environmental friendliness, low energy consumption, and better accessibility with low-floor design. Moreover, it was argued to be vested with a safe, smart, comfort and modern image, so it fits well with the future vision SND is trying to achieve and promote.

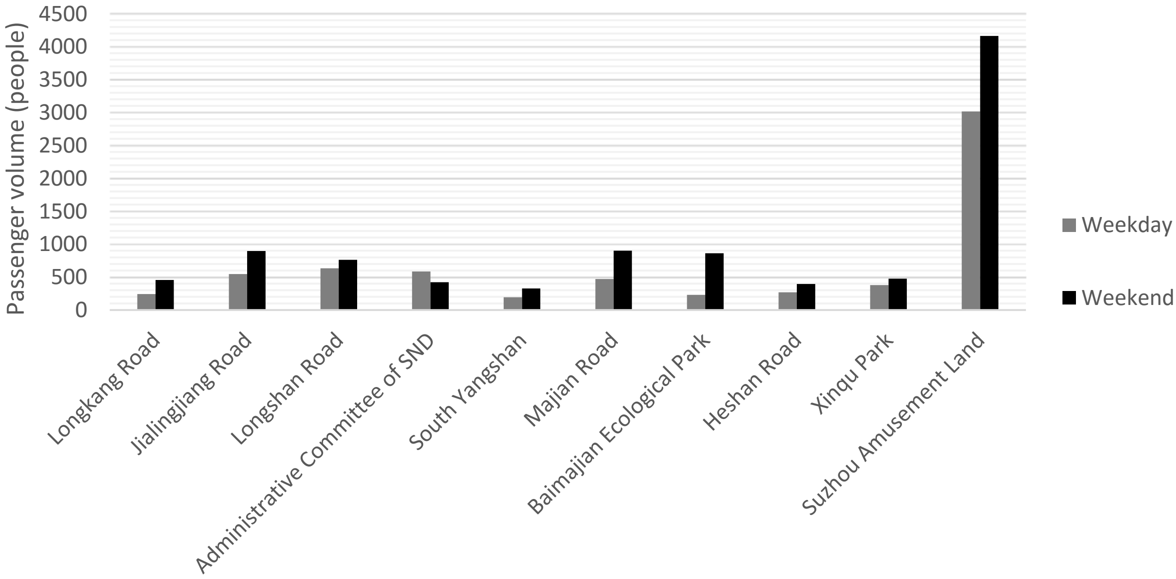
Use of the SND tram

In order to understand how the SND tram has been used, apart from patronage figures collected from the SND tram company, a questionnaire survey was conducted on three half days i.e. 22 (Wednesday afternoon), 26 (Sunday), 27 (Monday morning) February 2017. A total of 126 valid samples was obtained to reflect the user experiences more evenly for peak/off-peak time and weekdays/weekend settings.

Two and half years after its inauguration, the SND tram attracts few passengers. The patronage as of early 2017 of approximately 7 000 people per day, is much lower than the system was designed for and expected to carry (28 200 passengers per day) in the early period and 92 300 passengers per day by 2020 (Wang, 2013, p.41). The questionnaire survey findings showed that the tram passengers are not frequent users: 30% are seldom users and 25% are once-a-week users. Only 23% are in the category of “Multiple times a day”.

This survey shows that the tram attracts more passengers during weekend than weekdays, suggesting leisure travel is the dominant use (Figure 12). The Administrative Committee of SND stop is an exception to this overall picture, since this could be expected to serve trips for work and commute purposes, though this stop is lightly used, with only 500 total boardings and alightings.

Figure 12. **Tram daily passenger volumes by stop, 2017**

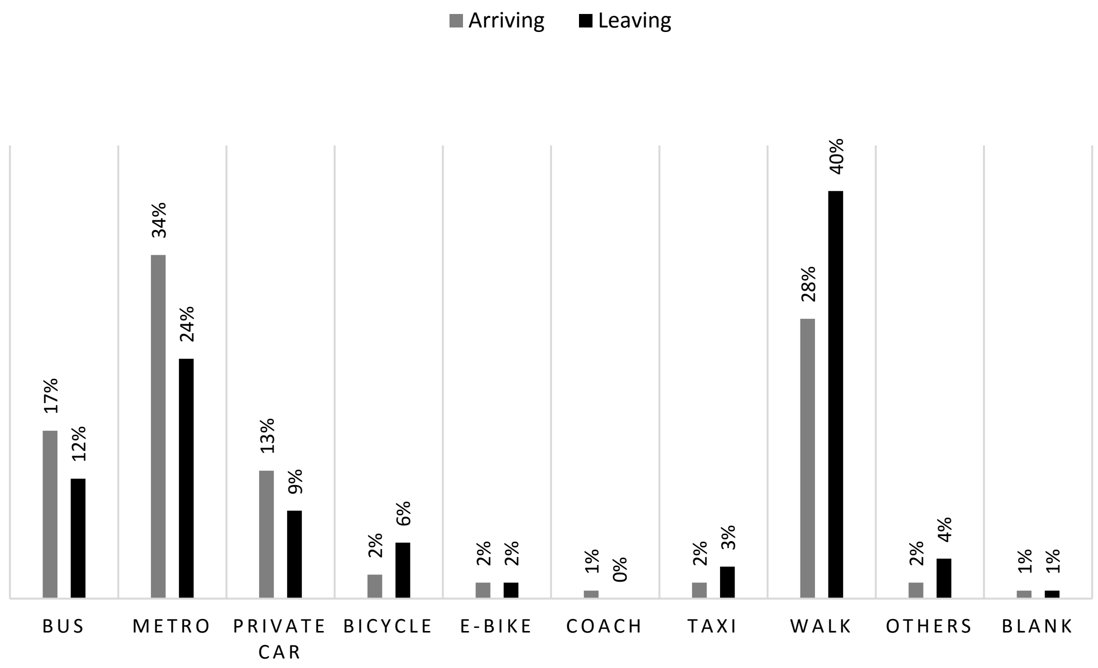


Source: The SND tram company (data collected for 26 and 27 Feb 2017)

The development-driven model requires time to grow the number of tram passengers. There are clear indications of improvement in tram patronage since 2015. Average daily passengers were just about 4 000 in 2015. In a recent random sunny weekend in early 2017, the passenger number was 9 661 (nearly ten thousand) and although the figure dropped to two thirds (6 563) during the weekdays, it is a significant growth since the system opened. However, the challenges to the tram being a competitive alternative to private car remain difficult.

Figure 13 suggests the majority of tram users at the moment are coming from two groups of people i.e. (a) those who live not too far (1.5 km in the case earlier of Xinfuweilai Huayuan) from the tram stops so walk to and from tram and (b) those who take tram to and from Metro Line 1. Bus transfer users are the third most common, perhaps reflecting groups that do not own a car. In spite of bike parking provision, the survey shows that only 2% and 6% of tram passengers took bikes when entering and leaving tram stations. On the other hand, the survey shows that 13% and 9% of tram passengers drive to and leave tram stations, even though there are no formal car parks at most stops. This suggests that many tram users may be getting dropped off (and picked up) by family members or friends.

Figure 13. **Transport modes for tram users to arrive and leave for interchange**



Source: SND Tram Survey (data collected on 22, 26, and 27 Feb 2017)

Current approaches to integration and its impacts

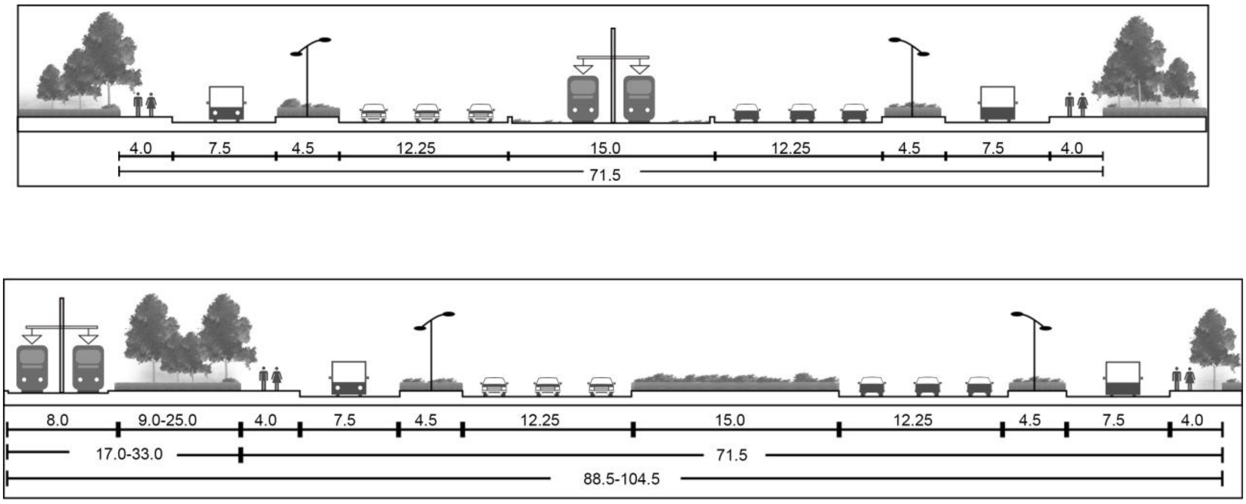
The previous section indicates how passengers respond to the current tram practice and its integration with public transport. In order to understand the causes underlying the revealed patterns, the condition of integration will be discussed in four aspects including the wider context for planning and design, service operation, management, and user experience. Data presented here involved five major research methods, namely statistical data collection/analysis, literature review, expert interviews, site visits, and the questionnaire survey/analysis.

Planning and design of the SND tram

The wider context of transport development in China (see the previous section on rapid urbanisation and rail development) and Suzhou has significantly shaped tram planning and design. It is only since the early 2000s that planning has shifted from car-centric to active promotion of rail. Therefore, rail public transport systems have been laid upon the territory expanded in the car-based era.

"Suzhou science and technology town" in the west of SND was designated in 2006. Taihu Lake Aveune was planned to be the gateway to this newly designated west area and a high-speed freeway from Suzhou city centre to Taihu Lake in 15 minutes. The construction started in 2008 and completed in 2010 before a tram network was initiated. The two road sections in Figure 14 show how the tramway is situated in the either centre or roadside within the main artery, Taihu Avenue, a 6-lane freeway prioritised for cars. In this situation, it is doubtful how tram can be time competitive with cars along the same route.

Figure 14. **Two types of road sections for tram and other transport modes in Taihu Avenue**

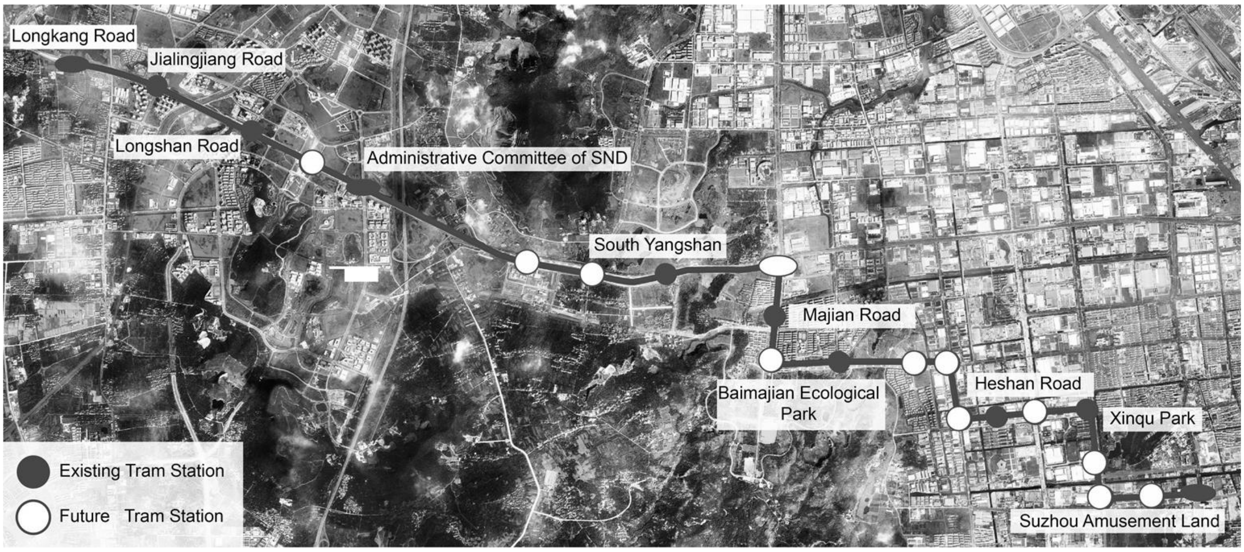


Source: redrawn based on the road sections in SUCDRI (2012)

The SND tram route avoids existing dense areas. The route runs through wide routes which can minimise confrontation and conflicts with other transport modes, reflecting a concern for "control and management" as a means to prevent social unrest. Broadly speaking, there are three kinds of right of way for tram operation, namely independent right of way, high-independent right of way, and mixed right of way. The whole SND tram line 1 adopts the second kind, half-independent right of way (prioritised for trams to pass at the road junction) and will consider to convert to a mixed right of way in the long term (Wang, 2013).

Figure 15 is a satellite picture which explicitly shows that SND Tram Line 1 runs through thinly populated areas such as Majian Road, Baimajian Ecological Park, South Yanshan and Longkang Road. Places around Heshan Road and Xinqu Park are mostly industrial. Further westbound, the newly created Administrative Committee of SND is a local government showcase for Science and Technology Town with newly developed culture facilities (library, museum, office tower blocks and governmental buildings). Both Jialingjian Road and Longshan Road stations are not too far from newly developed large-scale housing blocks and employment sites in the Science and Technology Town.

Figure 15. **The SND tram line 1 and its surrounding area**



Source: Modified from Baidu Map

As the tram is designed as a main artery for connecting west and east parts of SND and is anticipated that buses can take passengers to use trams, a critical question arises: to what extent will people prefer to travel a long way to take the tram instead of taking buses that are much closer to their homes and work places? Moreover, the challenge not only relates to integration issues between Tram and Bus but also a competition between private and public modes. For instance, if one wants to travel 17 km to Suzhou Amusement Park from a new housing development (Xinfuweilai Huayuan) 1.5 km walking distance to a SND tram station, in terms of time spent, interchange, and walking distance (Table 9), driving takes just 22 minutes, but tram takes 1 hour 22 minutes. For bus passengers, it would take at least one and a half hours, including one bus interchange. It implies that people who cannot afford cars will be disadvantaged in terms of more time spent on public transport. Neither buses nor bus/tram interchange is competitive against car.

Table 9. **Alternative routes and modes from Xinfuweilai Huayuan to Suzhou Amusement Park**

Mode choices	Travel time	Interchanges	Walking distance (m) (ingress +interchange+egress)
Car	31 mins	0	
Tram	1 hour 22 mins	0	1400+110
Bus (Route 353)	1 hour 37 mins	0	250+300
Bus (Route 353) + Tram	1 hour 22 mins	1	250+280+110
Bus (Route 44 +337 or 357)	1 hour 44 mins	1	1500+310

Source: Baidu map

Access to the tram is inconvenient and not close to where most people live since tram stops do not serve densely populated areas. Access might involve either an underground tunnel or an overpass bridge to cross the wide road. In Figure 16 the left and right pictures illustrate examples of overpass and underpass access, respectively. Thus, walking distance is increased and there are more obstacles for people with mobility impairments (some stops are not fitted with lifts).

Figure 16. **Access to the SND tram: overbridge and underpass**

Source: Author (left) and Huahui Ai (right)

Facilities planned and designed in each tram station reveal how the SND envisages its role to serve the territory and population. Public bike stations are provided near every tram station exit, but there are no Park and Ride facilities (P+R) for car users in the SND tram network except at the big highway passenger west station interchange complex. This indicates that no consideration was made to serve some passengers who live in rather rural areas and might want to drive to a tram station and park there to access the city centre. This might be seen a normal practice in Europe; yet, a lack of serious congestion in SND reduces the appeal of P+R which could be potentially exploited to assist territorial development and guide the transport planning.

Service operation

Integrating service operation among various public transport modes is examined in four aspects, namely timetabling connecting, bus rerouting, travel cards, and fare integration.

Firstly, Suzhou public transport modes operate in line with service intervals rather than pre-arranged timetables: tram (8-10 minute headways), bus (10-20 minutes), and metro (5-7 minutes). Considering the headways of Tram Line 1 and Metro Line 1 are not identical and there will be some time spent on interchange, it does not seem necessary to integrate timetabling among them. What was considered instead is timetabling integration between the lastest tram service in the end of the tram line 1 and the availability of connecting bus services for accessibility to wider territories. For instance, the bus services should be available 30 minutes after the last tram arrives. The deputy manager of the SND tram company explained that this was attempted in the beginning but was cancelled later on because of low demand as the surrounding residential areas are not well developed.

Secondly, existing bus route modification was also made after the arrival of Tram Line 1 to avoid competition along the same routes and provide better interchanges between tram and bus services. In practice, depending on the road condition, bus services tend to have the least regular services. Moreover, as discussed earlier in terms of issues related to planning and design aspects of integration (convenience, walking distance, time saving), the integration service between bus and tram is less effective.

Third, passengers have the option to use Suzhou citizen cards for fare payments, although the SND tram has its own travel cards. Suzhou citizen cards have multiple functions including transport (metro, tram, bus, public-bike), social functions, tourism, civic cultural facilities (library, gardens, etc.), dinning, shopping etc., which is similar, albeit less wide-ranging, to OCTOPUS cards prevailingly used in Hong Kong. For public transport, varied discount rates apply; therefore, it encourages users to take public transport. Moreover, for wider territorial integration, some citizen cards in Chinese cities could be used across different urban transport systems in other cities. Shanghai citizen cards can be used to pay for transport in Suzhou and vice versa. However, some technological obstacles might occur due to different generations (versions) of cards. Alternative payment methods include payments through traditional ways such as paying with cashes or coins on board or in station (such ways are less available now), or some latest popular e-wallet platforms such as WeChat Pay, Ali Pay etc..

Lastly, what has not yet widely implemented is fare integration among various public transport modes. For instance, if one takes metro and then interchanges to other modes such as bus or tram or public bike etc. then the fares paid are not always integrated (e.g. by distance). Instead, costs for the next transport modes are sometimes paid at full cost, free or discounted. The fare when interchanging between modes depends on the deal negotiated between different transport operators. However, greater fare integration could possibly encourage mode shift towards public transport by not penalising users for completing a trip with multiple modes.

Tram operation/management and public transit governance

Depending on the local contexts and existing resources, there are three operation and management models of tram systems in China, namely Tram company, Bus group and Metro company (Table 10). With some guidance received from Suzhou Metro Company, the SND tram company was created to operate and manage the service, so is an example of the first model – stand-alone tram company. How and where tramways share road space with buses, coordination of rerouting and management with the bus operator will be critical for service integration. Therefore, the second model (Bus group) would be more useful for bus and tram service coordination and integration than the first model.

Table 10. **Tram operation and management models in China**

	Tram company	**Bus group**	**Metro company**
Character	Tram operated by a tram company. In charge of operation and management. Other external business is also developed, such as tram construction, design and investment.	Tram managed and operated by bus group. Tram line is also included in public bus line network. Some external business is also developed by bus group, including tram construction.	Tram managed by a branch company of a metro company
Examples	Shanghai, Shenyang, Nanjing, Suzhou, Huai'an	Changchun, Dalian, Qingdao, Tianjin	Guangzhou

Note: Shanghai tram is operated by Shanghai Pudong Modern Tram Transport in partnership with Bus group; Shenyang is co-financed and managed by French Metro company (51%) and Chinese tram company (49%).
Source: Modified on Dong et al. (2013) and Suzhou Municipal Government (2014)

In addition to the tram operation and management, public transport governance in Suzhou also involves a wide range of institutions and remits, covering urban planning, construction, operation, and management (Figure 17 and Table 11). In this framework, integration of public transport services is difficult. In most cases, the coordination does not exist. The only exception is the public intervention under the extraordinary condition (Hu, 2013), such as the interventions to reduce air pollution in Beijing for the 2014 APEC meeting.

Figure 17. **Institutional structure of public transport governance in Suzhou**

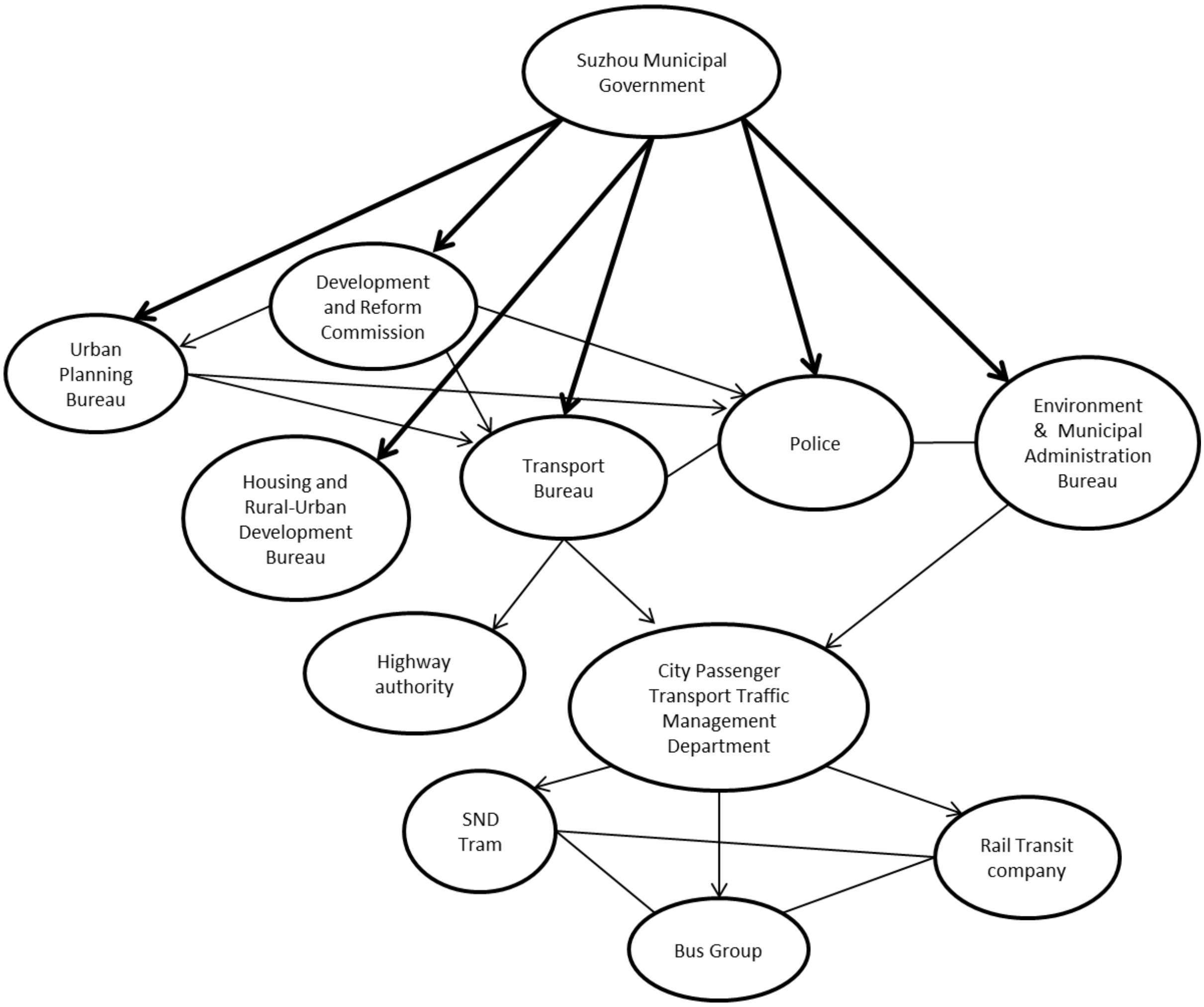


Table 11. **Institutional remits involved transport management in Suzhou**

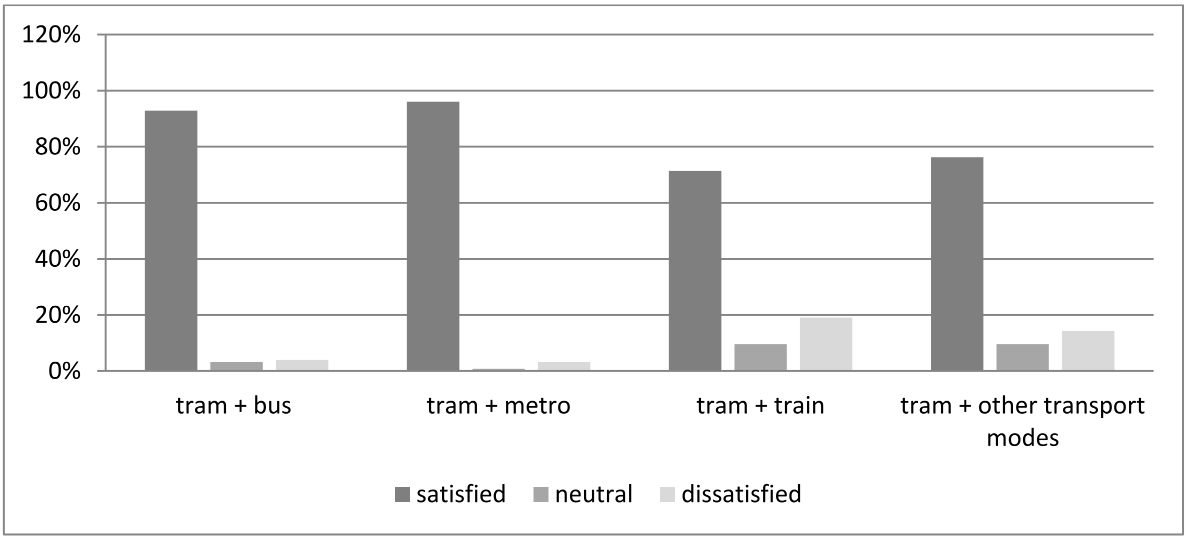
Institution	**Remits**
1. Development and Reform Commission	• Coordinate transport planning strategy • Approve transport projects
2. Planning Bureau	• Formulate transport planning and urban transport strategy
3. Housing and Urban–Rural Bureau	• Transport project construction management
4. Transport Bureau	• Formulate transport policy and guidelines • Implementing transport strategy, including comprehensive transport planning • Participate in road, port, regional railway, public transport, rail transit construction planning
4.1. City Passenger Transport Traffic Management Department	• Passenger transport management in Suzhou urban area • Transport industries management for road, metro, taxi, coach rent and logistics
4.2. Highway authority	• Formulate transport policy and transport infrastructure construction guidelines • Passenger and cargo transport management
5. Traffic police	• Road traffic management and accidents • Security promotion on public street • Driver administration and vehicle and non-motor vehicle management
6. Environment & Municipal Administration Bureau	• Infrastructure management (road, bridge etc.) • Environment and lighting facility management • Roadside parking management (public bike stations, non-motorised modes)

Source: Author (information from the municipal official website)

User experience

In addition to understanding the use of tram services, the questionnaire survey conducted also attempted to discern the effectiveness of the SND tram integration with existing public transport services. User satisfaction with tram integration is generally quite high across all four combinations: tram and bus, metro, train, and other transport modes (such as car, walking, cycling, etc.) (Figure 18). While still high, tram integration with train has the lowest satisfaction because there will be no direct link between tram and Suzhou Xinqu train station until Tram line 2 is completed by the end of 2017. Even though Tram line 2 will be completed, Xinqu station might not be very useful if the train frequencies remain low (see Table 8). That implies that the majority of people would prefer to taking trains from Suzhou station because passengers from SND need to take tram to interchange with Metro line 1 and interchange again to Metro line 2. The next lowest satisfaction is related to integration between tram and other transport modes such as car and walking. Several survey participants commented on long walking distances to the tramway and the lack of car parking provision.

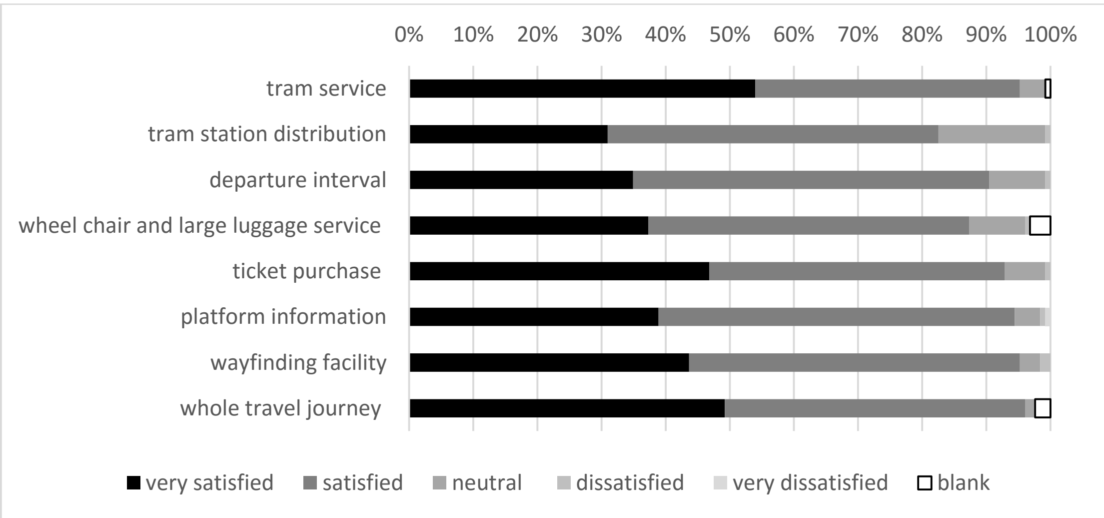
Figure 18. **Satisfaction with tram integration**



Source: SND Tram Survey (conducted on 22, 26, and 27 February 2017)

The overall satisfaction (including "very satisfied" and "satisfied") with SND tram services is very high (see Figure 19). The majority of tram users commented that the tram is clean, modern, high-quality, and comfortable. The two lowest "very satisfied" aspects are tram station distribution and departure intervals, which is closely associated with the tram route avoiding dense areas and the question of time-saving competitiveness while compared with private cars.

Figure 19. **Satisfaction with SND tram services**



Source: SND Tram Survey (conducted on 22, 26, and 27 February 2017)

The high satisfaction described above is drawn from tram users who are just a small portion of people in a large population pool. It is therefore likely to see a marked self-selection bias e.g. travellers who live close to stops or those who do not mind having to transfer from one mode to another are likely to become tram users and hence will rate the service relatively highly. Moreover, the perception of a service tends to be associated with individual experiences and local contexts. If users do not have comparable experiences elsewhere, it is difficult for them to make objective judgements.

In summary, the "development-driven" and "control and management" ideology towarads tram development instead of an "efficient and people-oriented" approach, arguably has not ensured that public transport is competitive with private cars in this corridor. The research findings above suggest whether and to what extent the SND tram will increase public transport modal share is a big challenge.

Conclusions and future implications

Over the past decade, Chinese cities have experienced rapid urbanisation and have invested massively in urban rail systems. National policies closely shape and influence urban rail development in China. Since tram systems can be approved at the local level, they are widely regarded as a good alternative if a case for constructing urban rail systems does not appear justified at the national level. Although there are relatively few tram systems in operation, a further 2 000 km tram network is expected to come into service in the near future. Therefore, a close examination of the current tram practice and public transport integration is pivotal to identify emerging issues and provide valuable implications for the future. This paper focuses on a case study of the SND tram in Suzhou which is a typical tram project in China i.e. a tram system serves a newly developed urban district and interchanges with metro and other urban rail to access city centres. The research shows that, based on a "development-driven" and "control and managment" ideology, key characteristics of tram practice include tram systems laid upon an widely expanded territory inherited from the car-based era, avoiding dense areas, inconvenient large-scale non-street crossing through either overpass or underpass, insufficient integration of service operation among various modes of public transport, a lack of facilities in tram stops that cater for other modes, fragmented governance of public transport integration etc. As a result, although an increase in public mode share is recognised as one of the key objectives, all lead to an incompetive provision of public transport and a lack of people-focused approaches.

Lessons learnt from this study for policy implication can be illustrated in the following five aspects.

Firstly, there should be a clear awareness that priorities should be given to public transport and its competitiveness against private cars. Public transport route planning should balance land (real estate) development and transport efficiency and provide sufficient room for non-motorised transport. It does not necessarily imply that car routes should be constrained but the challenges of adopting a tram system should be addressed rather than compromised. A good decision takes time to reach consensus, which involves more negotiation and participation for a better outcome. The Suzhou case study clearly demonstrates the disadvantage of public transport in terms of travel time saving – tram takes more than doubling the driving time and the journal experiences (inconvenience and disintegration).

Secondly, different transport technologies have their own key functions – such as non-motorised, tram, metro, regional express rail, high-speed rail, and air from low-speed to high-speed and from local to multiple higher levels. They should be collectively exploited and integrated to gain the best effects for a wider polycentric territory with key hubs that are accessible effectively by hinterlands. For instance, Beijing's second administration centre is being developed based on a strategic spatial planning approach that emphasises decentralisation and poly-centricity. However, this approach requres a strategic and efficient transport system beyond massive and indifferent metro networks to enable connections among key centres.

The current Chinese practice shows that although various public transport investments are made, the effectiveness of the transport provision is not necessarily ensured. Regardless of quantity, decision-making of locations, frequencies, stopping patterns, long-term strategies, and time saving for a door-to-door journey with quality of life are vital to determine a better investment. In many cases, the orientation to real estate development results in long public transport journey time, which are not competitive with private modes.

Thirdly, strategic planning/design and supportive regulations both play key roles in changing courses away from car-based mobility. The current Chinese regulatory framework does not have effective measures to suppress the increase of private cars, e.g. expensive parking charges, high petrol prices, congestion charges, or carbon emission charges. A wide range of transport policies should aim to work collectively for a better public transport service than what private modes can offer.

Fourthly, large-scale public transport investments tend to be financed by state-owned monopoly companies and assume that "users will come once being built". Such approaches are not necessarily concerned about whether a good financial return is achieved or not. More competition in finance and operation may facilitate performance improvement with incentives that can emphasise the value of a people-centred approach to future public transport services.

Fifth, a comprehensive and inclusive governance is necessary but not sufficient condition for better integration. If integration initiatives are institutionalised without a good leader, these initiatives might appear bureaucratic and bring about disastrous effects. Therefore, it is critical to ensure the quality of good leaders who can adjust to real situations, have the tenacity to overcome obstacles, and achieve what is envisaged for a more sustainable urbanisation for the future.

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Notes

1 The city-regional express rail system, although potentially a similar concept to the Regional Express Rail (RER) system in Paris, is different as it does not appear to serve centres and connect to large transport hubs. Instead, city-regional express rail in Suzhou which is planned to extend from the edge of city and seems to play a transition role between two neighbouring cities' metro systems such as Suzhou and

Shanghai. Take Kunshan (a county-level city within Suzhou prefecture-level city but not part of Suzhou Urban Districts) for example, S1 is actually planned as a metro system with frequent stopping patterns between Shanghai and Suzhou, which significantly undermines the strategic role a city-reginal express rail can potentially play. This issue is also raised in Zhou (2013). A local transport expert, Director of Transport Unit in Suzhou Planning and Design Research Institute Co. LTD argued that the role of city-regional rail (S1-S3) is not clearly defined yet and the plan could be altered later on. There was no space reserved for this kind of rail integration in city centre in this plan. More discussion is needed regarding the role of city-regional rail lines and how they should be integrated with urban rail systems to serve the Suzhou city-region.

2 Although e-bikes are pervasive in Chinese cities, there is a lack of regulations in managing them because the definition is not clear and many e-bikes are not registered. E-bikes are supposed to be non-motorised and not operated by a particular sector. Therefore, figures of e-bikes are not available in the statistics of motor vehicle and passenger traffic. The number of e-bikes registered in the government statistical dataset could not reflect the real situation.

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