Chapter 3 Urban Transport Planning In China: A Case Study Of Wuhan *

3.1 Introduction

According to their functional uses, transport data can be categorised into the four groups of supply, demand, performance and impact. From the perspective of information science, transport data can be classified as spatial and non-spatial types. These data are complex in terms of sources and scales of spatial and temporal changes. An important aspect is that these data are collected and managed by different transport agencies. Understanding the context for transport planning may facilitate the studies on transport data integration.

This chapter introduces the development of urban transport planning in China in general and in Wuhan in particular. The history, characteristics and institutions of modern transport development in Chinese cities are introduced in the first section. This is followed by a detailed study of Wuhan, including a description of transport development and the findings of a survey of the main stakeholders in transport planning and management in the city.

3.2 Urban transport growth and transport planning in China

3.2.1 The evolution of urban transport development in China

Before the 1980s

Before the 1980s, transport development in China was not a major concern. After several decades of political, social and economic turmoil, the challenge facing the new China founded in 1949 was to provide basic needs for living. In addition to nationwide rural restructuring to foster agricultural production, much effort went into industrial development in the cities (Wong & Han, 1999). Large-scale infrastructure was constructed in large cities to facilitate this industrial development. Goods transport was considered very important for agricultural and industrial products, while passenger transport was basically neglected because of the low demand for travel in that period.

* Based on Huang, Masser & Hu (2001).

For practical reasons, little effort was spent on transport planning, development and management in this period. Firstly, under the planned economy, roads and road facilities were considered as "non-productive" and given low development priority. The planning of road networks was included in urban planning blueprints. Secondly, urban land was allocated to work units (*Dan Wei* in Chinese), such as governmental agencies, hospitals, universities and factories (Rose, 1999). There were no comprehensive housing development programmes. Each work unit had to develop its own offices and housing on the same piece of allocated land. This land use structure reduced the demand for travel to a minimum, because most activities happened within enclosed compounds. Finally, urban roads had a low level of service, which was disguised by the low traffic volumes of this period. There was inadequate recognition of speed, volume, and their implications for urban transport.

Economic growth inevitably put the inefficient transport system under pressure. By the late 1970s some big cities had already begun to experience such pressures, which stimulated serious thinking on transport problems among researchers and administrators. Some preliminary transport research was carried out, for example, surveys on traffic volume were implemented in several metropolitan areas, and Origin-Destination (O-D) investigations were used to predict traffic flow (Xu, 1992). However, these studies were generally primitive in nature.

Urban transport under the economic reform

After more than 10 years of economic and social stagnation during the 1960s and 1970s, economic reform and the open-door policy of the 1980s brought about drastic changes in both rural and urban areas. As a result, the demand for travel and the number of motor vehicles rapidly increased in this decade, generating much pressure on the insufficient road infrastructure, particularly in the large cities.

Over the years planners and administrative officers in China gained a deeper awareness of the urban transport issue (Xu, 1992). For example, urban transport was not non-productive but could bring great social and economic benefits. They also recognised that traffic management was indispensable for improving transport efficiency and that priority should be given to public transport.

Institutions were set up to promote the exchange of ideas and research activities (Xu, 1992). In 1979, the Academic Group for Metropolitan Transport Planning was founded in Beijing. The group worked under the Urban Planning Committee, a branch of the Society of Chinese Architects. Annual meetings, each with one main discussion topic, were organised by the group. These meetings played an important role in spreading transport concepts, experience, technologies and policies, and attracted participants from governmental agencies, such as the State Commission of Science and Technology, the Ministry of Public Security, the Ministry of Construction, the Ministry of Communications and the Ministry of Railways. Due to its successful work, in 1985 the group became the Chinese Academic Committee for Urban Transport Planning. At the local municipal level, some institutes for transport planning were set up under the administrative bureaus of urban planning and management.

Despite this progress, however, there were two dominant problems throughout this decade. Firstly, there was a marked emphasis on traffic engineering, without a broader view on the whole urban transport system and long-term transport planning. Secondly, insufficient infrastructure remained the bottleneck constraining development in large cities. The total amount of road space was far from sufficient. Nor were road networks developed in a systematic way.

The unprecedented challenge since 1990s

Since the 1990s, the Chinese economy has been growing very fast, accompanied by a corresponding increase in travel demand. As a result of the economic boom, urban development has taken place at an unprecedented speed, including the expansion of built-up areas into suburbs and redevelopment within historical central areas. Urban economic development has attracted a lot of surplus manpower from rural areas, giving rise to a dramatic population increase in most cities. Apart from population increase and economic growth, the increase in travel demand is also a result of several other factors. Urban expansion and land use reconfiguration have broken the traditional balance between jobs and housing, i.e. the *Dan Wei* system, where people live near their work places (Shen, 1997). Encouragement of the auto industry by central and local government has provided further impetus to the travel increase, and the number of automobiles has been mounting dramatically in urban areas.

On the supply side the shortage of road infrastructure has continued. The increasing travel demand brought about by economic and social development has placed great pressure on the already inadequate road infrastructure. Most of the newly built roads are in the fringe areas around the city and little has been done within the city centre. Another problem is the decline in public transport. Due to such factors as the implementation of the market economy and the shortage of funding and management skills, public transport has continued to operate inefficiently and has become a financial burden on local municipalities. In 1994, for example, 70 percent of the urban public transport enterprises were in the red, necessitating compensation from central and local government (Zhou, 1996).

Large-scale construction has taken place in every large city in China. It was realised that these types of developments would generate an increase in traffic on the road networks nearby. Consequently, traffic impact analysis of large-scale construction became necessary. In 1995, the Urban Planning Bureau under the Ministry of Construction issued a meeting synopsis advocating that traffic impact analysis should be carried out. Environmental problems caused by motor vehicles were not a real concern until the second half of the decade, when the atmospheric pollution in several of the largest cities became serious. In 1997, Beijing issued a traffic management regulation stipulating that all vehicles should install equipment for purifying exhaust gas. As a result environmental impact research became an important task.

At the national level, the bottleneck in transport development in Chinese cities during the 1990s was still the insufficiency of road infrastructure, and transport policies were in favour of road construction. The major task of transport planning was quite similar to that of Western cities about 30 to 40 years ago. It was increasingly recognised that physical extension and improvement of road infrastructures would never fully meet the growing transport demand. With this in mind and more information on the experiences of developed cities, transport professionals introduced some policy measures such as the demand management.

3.2.2 Characteristics of urban transport in China

Urban transport in China revolves around the imbalance between demand and supply, i.e. the supply of transport services falls behind the increasing demand for travel. The challenge facing transport supply is not simply the shortage of transport infrastructures, but the inadequacy of the whole framework of transport services, ranging from policy, planning and implementation to management. While the modes of transport in Chinese cities are basically the same as those in Western cities, the composition and characteristics of these modes are very different. This section gives a concise description of some of the important components of urban transport in China.

Passenger travel modes

A short list of the structure of several selected cities reveals some of the trip characteristics in China (Table 3.1). All the cities in the list have more than one million people. Although a direct comparison of the cities is less practical because of the different years of survey, it is still realistic to extract some basic features from this list. One such feature is that the bicycle plays an important role in passenger travel, accounting for more than 30 percent of all trips and over 60 percent of trips in some cities. In most cities walking is a popular mode, with a trip rate of over 30 percent in some cities. Public transport is also quite important in some cities, with trip rates of over 20 percent in some of the larger ones. Another interesting characteristic is that, due to a low ownership, there is no indication of the use of private cars. However, it has been estimated that, as the car industry is envisaged to be the industrial backbone of the country, private cars will become more and more important in urban transport (Stares & Liu, 1996).

One important mode of transport that is not reflected in Table 3.1 is the use of corporate vehicles. The word “corporation” here refers to any kind of employer (work unit or *Dan Wei* in Chinese terms) that has employment activities. Corporate vehicles may include cars, coaches, and trucks. Of these vehicles, only the use of the corporate bus was counted during the travel surveys. Actually, vehicles from these public or private corporations constitute a large proportion of urban vehicles. Unfortunately, there has been no detailed research on the use of corporate vehicles for the purpose of transport planning.

Table 3.1 Trip patterns in selected cities

City (year)	Public transit	Bicycle	Walk	Corpo-rate bus	Taxi	Motor-cycle	Other
Beijing (1986)	24.3	54.0	13.8	4.4	0.3		3.2
Shanghai (1986)	24.0	34.2	38.2	2.2	0.2	0.2	1.0
Tianjin (1993)	4.1	60.5	28.0	3.1		2.0	2.3
Guangzhou (1984)	21.7	33.8	30.6		6.1	6.4	1.4
Chengdu (1987)	5.8	54.6	36.0				3.6
Jinan (1988)	6.7	63.8	23.3	3.8		0.8	1.6
Wuhan (1993)	24.5	32.6	32.6	4.7	0.1	0.2	5.3

(Source: Li, Y., 1997)

Bicycles

The bicycle is one of the major modes of transport in Chinese cities. Bicycles are widely used when trip distance is within six kilometres of the house. Bicycle utilisation also depends on the scale of the city. Several studies have shown a difference in bicycle trip rates between three groups of cities, i.e. smaller cities have higher bicycle trip rates than larger cities (Table 3.2). Bicycles are affordable, flexible, energy saving, pollution-free, and beneficial to health. However, too many bicycles may also have a negative impact on urban traffic, including the influence on motor vehicles at crossroads, the lack of parking facilities, the safety aspect, and challenges to public transport. In response to both the advantages and disadvantages, there have been advocates for maintaining a moderate rate of bicycle trips in large cities (Miao & Zhao, 1995). One measure towards achieving this end is to build transfer points to link bicycle and public transport.

Table 3.2 Characteristics of bicycle trip in three city groups

Cities (population in millions)	Range of bicycle trip ratio	Average bicycle trip ratio	Trip ratio between public transport and bicycle
> 2	25%~55%	36.21	38 : 62
1 ~ 2	23%~63%	42.40	28 : 72
< 1	40%~75%	55.04	7 : 93
Average	-	44.55	24 : 76

(Source: Xu, 1997)

Walking

Walking is a “primitive” transport mode. Statistics in the second half of the 1980s in China showed that the walking trip rate in large cities was around 40 percent, in mediumsized cities about 45 percent, and in small cities more than 50 percent (Xu, 1997). There have been very few researches on the walking mode, and no standard for designing and constructing pedestrian roads. Pedestrian road systems in most cities are not complete, which has led to many traffic problems. It is difficult to cross a busy street, and sidewalks are often occupied by commercial uses. These factors have created an unfavourable walking environment on Chinese urban streets.

Public transport

According to the classification standard for the national economy and trade, urban public transport in China belongs to the social services industry rather than to the communications and transport industry. Similar to such trades as sewage and water supply, roads and bridges, and gas and heat supply, public transport has been regarded as one component of municipal public utilities. Financial support for public transport comes from local government, and a major part of this has been collected as a tax on urban construction and maintenance.

Table 3.3 shows the percentage shares of total passenger transport by various public transport modes at the 1994 national level. It is clear that buses are the dominating mode, carrying more than 75 percent of all passengers. However, it should be noted that the total number of passengers transported by buses has fluctuated since 1988, although the number of buses has been increasing. In fact, the shrinkage of bus transport has been very clear in large cities (e.g. Zhou, 1990, 1996, 1997; Zhao & Kong, 1999). Li (1997) also declared that bus transport in Shanghai had been in constant decline between 1988 and 1995. Actually, the trend continued until 1998, when a slight rebound occurred (*http://www.scctpi.gov.cn/*).

Table 3.3 Share of public transport modes in 1994

	Number of passenger trips (100 million)	Percentage
Bus	235.16	75.89
Tram	29.50	9.52
Trolley bus	2.30	0.74
Subway	5.42	1.75
Taxi	29.48	9.51
Ferry	8.01	2.59
Total	309.87	100.00

(Source: Wang *et al*, 1997)

Reasons for the shrinkage of bus transport include the low-price policy, inadequate finance, inefficient operations management, road congestion, the increase in motor vehicles, and the increase in other public transport modes. Despite the intractable situation, public transport has been identified as the critical means to meet the travel demand of urban passengers in China. With economic development, conventional buses and trolley buses can no longer cope with the rapid increase in transport demand, and alternative ways have to be explored. As early as 1985, the State Council concluded that rapid rail transport had to be developed gradually in the large cities, and that multi-dimensional transport systems had to be created (Wang *et al*, 1997).

Rapid rail transport in China can be classified into two categories, i.e. the mass subway or metro system (large capacity) and the light rail system (medium capacity). To alleviate the ongoing trend of transport deterioration, more than 20 cities have made plans for urban rapid rail systems (Allport, 1996). Currently, only four cities (Beijing, Shanghai, Guangzhou and Tianjin) have completed some subway lines. A light rail has been under construction since 2000 in Wuhan.

The taxi is a mode that has to be mentioned in regard to Chinese cities. During the last two decades the number of taxis has been increasing at a faster pace than that of buses (Figure 3.1). This phenomenon can be explained by factors such as the increase in income, business activity demand, and the door-to-door service. The problem with too many taxis is that they transport relatively few passengers but account for a large share of road traffic.

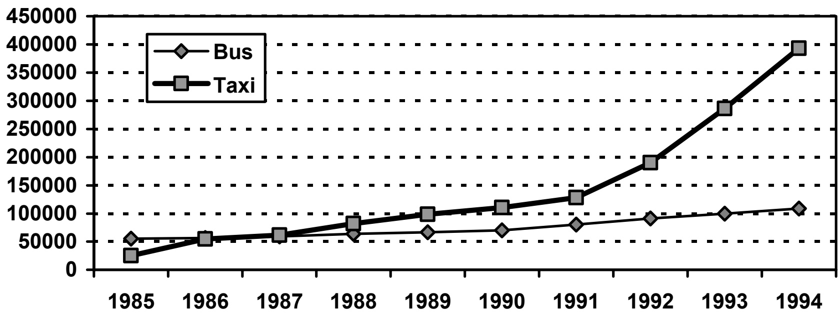


Figure 3.1 Increase in number of taxis and buses in cities of China
(source: Zhou, 1997)

Goods transport

Before the economic reform of the 1980s, goods transport dominated road traffic due to the low demand for passenger transport. Economic development brought about the expansion of goods transport, yet the proportion of goods vehicles has been reduced due to the increase in other types of vehicles. According to the statistical yearbooks of Wuhan, for example, in 1980 Wuhan had about 35,000 motor vehicles, of which 49 percent were goods vehicles; in 1998, with a total number of nearly 284,000 motor vehicles, the proportion of goods vehicles was only 20 percent (Wuhan Statistical Bureau, 1999b).

The expansion of goods transport has been accompanied by the internal restructuring of the sector since the 1980s. While state-owned transport enterprises were the only means of goods transport for several decades, these enterprises have become economically inefficient under the market economy. In the meantime, private goods transport has mushroomed and dominated the goods transport market.

3.2.3 Transport planning and management

Administration

Urban transport planning and management concerns aspects of infrastructure planning and construction, traffic management, safety, public transport and license registration. The administrative system for planning and management in Chinese cities has been set up according to these operational functions (Figure 3.2). Administrative agencies exist at three levels of government, i.e. central, provincial and municipal.

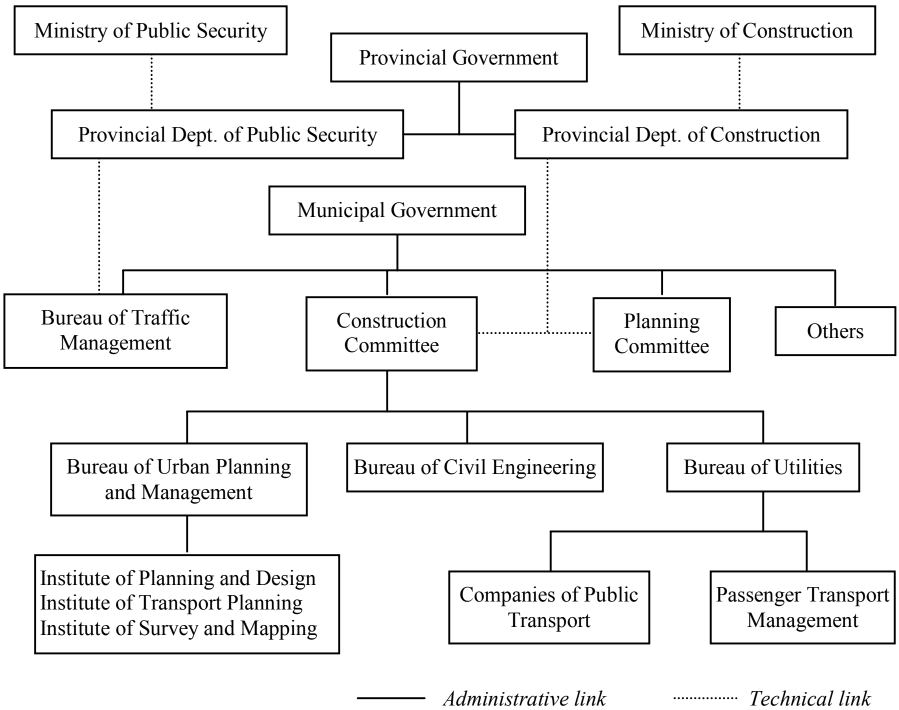


Figure 3.2 Urban transport administrative structure in China
(based on Wu *et al*, 1997)

These agencies are streamlined into two groups, i.e. the urban construction group and the public security group. In addition, other governmental agencies, such as the Financial Department and Planning Committee, also play a role in urban transport in terms of taxes, price policies, examining and approving large construction projects, and so on. Details of these institutions will be examined later with respect to Wuhan.

The transport planning framework

The Urban Planning Act became effective in 1990. According to the Act, urban transport planning is one of the components of master planning. However, the planning of transport systems places emphasis only on road networks and the location of transport facilities, and therefore represents only a part of the general meaning of transport planning (Li & Yu, 1997). This situation has improved as experiences from overseas have been acquired. Lam and Huang (1992) observed that, by absorbing successful experiences from more advanced countries, China had tried to make more effective transport planning and traffic management interventions. Techniques adopted for this purpose include land use and transport planning, travel demand forecasting, signalised junction design, and area traffic control systems.

It has been argued that transport planning should have hierarchies and time limits. Yang (1989) proposed three types of transport planning in terms of content and time range. Table 3.4 shows the three levels of transport planning, their ranges, and the corresponding stages of urban planning. In general, comprehensive transport planning involves a similar process to that presented in Figure 2.1, including stages of data collection, diagnosis, analysis and forecasting, scenario generation, evaluation, system planning and designing (Li & Yu, 1997).

Table 3.4 Transport planning and urban planning

Level of transport planning	Range (years)	Level of urban planning
Strategic transport planning	Far (20-30)	Master planning
Comprehensive transport and road networks planning	Long (10-15)	Zoning / control planning
Detailed improvement programme	Short (0-5)	Design / detailed planning

Comprehensive transport planning efforts have been made in some of the large cities (e.g. Chen, 1990; Chen, 1993; Pan *et al*, 1995; Li & Yu, 1997). Among these cities, Shanghai has played a leading role in transport research. In 1985, Shanghai initiated comprehensive transport planning (SICUTP, 1994). Five years later, the Institute of Comprehensive Urban Transport Planning was set up. This institute is responsible for mid- and long-term transport planning, for predicting future transport development, and for providing research results to policy makers. Transport strategies that have been identified as important to

Chinese cities include linking land use and transport development, improving road system and capacity, giving priority to public transport, controlling vehicle increase and use, and improving traffic management (*http://www.scctpi.gov.cn/*).

One of the major problems in transport planning has been data collection. By 1995, about 40 cities in China had conducted large-scale comprehensive passenger transport surveys (Wang, 1997). Such surveys usually require a large budget as well as close cooperation among various municipal departments. The advantages of these surveys have not been fully exploited owing to several limitations. Firstly, the lack of standard forms and definitions for transport surveys makes the comparison of cities difficult or impossible. Secondly, in many cases, comprehensive database systems have not been constructed for the surveys, which results in an inefficient utilisation of the data generated. Many data were lost after the research projects had finished, leaving nothing for the next planning effort or other uses. Also, there is a lack of standards for database structures. Finally, in addition to the data problem itself, there has been a shortage of qualified professionals to make full use of the findings of the surveys.

3.3 Transport development in Wuhan

3.3.1 Wuhan

Richly endowed by nature, Wuhan has been an important hub connecting the north and south, and the east and west of China for more than 400 years (Figure 3.3a). The Yangtze River, the third longest river in the world, which converges with the Han River in the city, has served as a thoroughfare from the east to the west in historical and modern ages. Railways and state highways have made the city a busy place for passenger and goods transfer, which also contributes much to the local traffic problems.

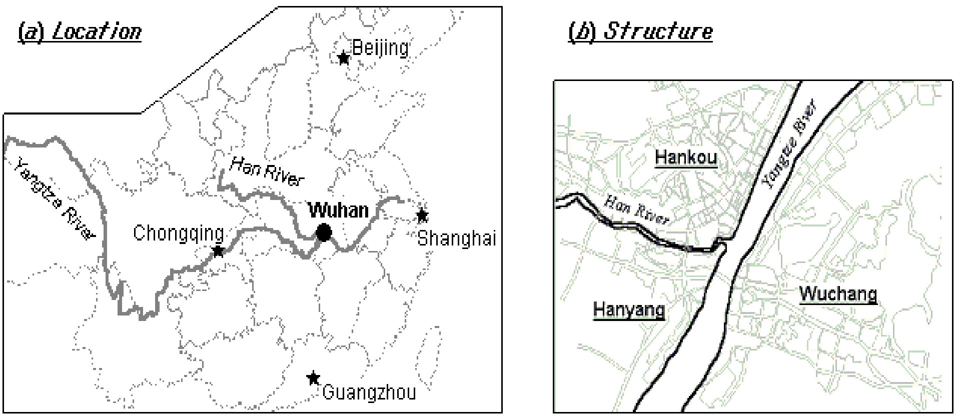
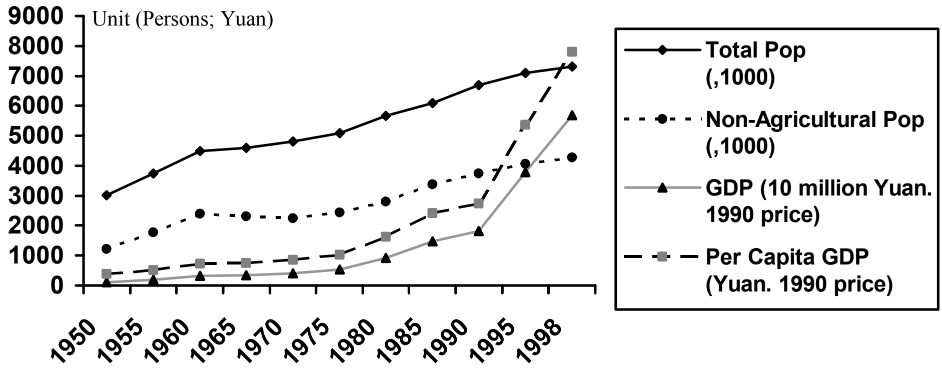


Figure 3.3 Location of Wuhan in China and its structure

The two rivers divide the city into three parts, generally known as the "three towns", i.e. Hankou, Wuchang and Hangyang (Figure 3.3b). Hankou is historically one of the "four well-known towns in China", and is now attracting a lot of commercial activities. The Hubei provincial government and many academic institutions reside in Wuchang. These three "towns" form the "core" of the city, with seven urban districts. Wuhan is administratively larger, with another five rural districts, in total covering more than 8,400 km^2. Restricted by many lakes and flood-prone areas, the city could not expand evenly in all directions. The built-up area in 1998 was 204 km^2 (Wuhan Statistical Bureau, 1999a).

Population in Wuhan has been increasing steadily. In 1998 the total population reached 7.32 million, with 4.28 million of non-agricultural population (Figure 3.4). Economic growth before 1980 was slow. In the early 1980s, the "open door" policy was introduced and the economic structure reform took place. Since 1990, the economy has been soaring.



(Note: the values are adjusted to have the same scale on the Y-axis – see the legend)

Figure 3.4 Changing population and GDP of Wuhan since 1950
(source: Wuhan Statistical Bureau, 1999b)

3.3.2 Transport development

In Wuhan, the physical structure as presented in Figure 3.3b indicates that the two rivers form a bottleneck for urban traffic. During the last two decades, enormous efforts have been made on restructuring and widening existing streets. Road density has changed little, from 6.10 km/km^2 in 1987 to 6.46 km/km^2 in 1997 (Wuhan Statistical Bureau, 1999b). Pressures on the Wuhan transport system have been caused by rapidly increasing travel and freight demands as a result of the economic boom since the 1980s, as well as by a failure to respond to these demands.

The increases in the number of motor vehicles may explain the challenges facing Wuhan. During the last two decades, the total number of vehicles has grown fourfold, i.e. from

35,000 in 1980 to 284,000 in 1998 (Wuhan Statistical Bureau, 1999b). While buses and trolley buses have been expanding gradually, taxis have grown dramatically from almost nothing in 1980 to 12,290 in 1998 (Figure 3.5). Surprisingly, the expansion of public transport in terms of the number of vehicles has not always been accompanied by an increase in passenger trips. Apart from the two exceptional years of 1991 and 1994, the general trend in passenger volume from 1988 to 1998 has been a steady decline (Figure 3.6). Many travellers have shifted to such modes as private cars, company coaches, informal transport, walking and bicycling.

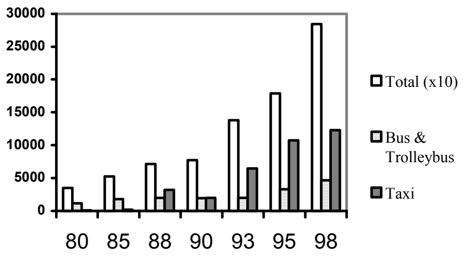


Figure 3.5 Increases in motor vehicles

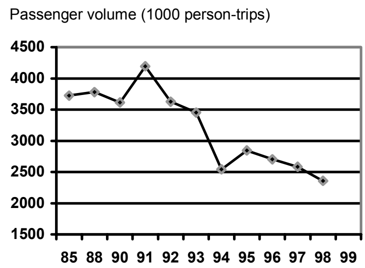


Figure 3.6 Public transport service

To ease the traffic pressure in the central built-up area, a comprehensive highway network has been proposed by the Institute of Urban Planning and Design (IUPD). The plan takes advantage of the national motorway scheme in which Wuhan is considered as a junction for distributing transport between the north-south (Beijing-Guangzhou/Zhuhai) and east-west (Shanghai-Chengdu/Chongqing) transport lines. As depicted in Figure 3.7, the two lines meet in the southwestern part of the region. A ring-road system has been proposed for making the connections. This will require two more bridges and two tunnels across the rivers. According to the IUPD, the four rings will have the following functionalities respectively:

- First inner ring: business, shopping and historical
- Second inner ring: 54 km, residential
- Third inner ring: 88 km, connecting economic development zones and bypass, and collecting traffic into the city
- Outer ring: 188 km, regional traffic bypass

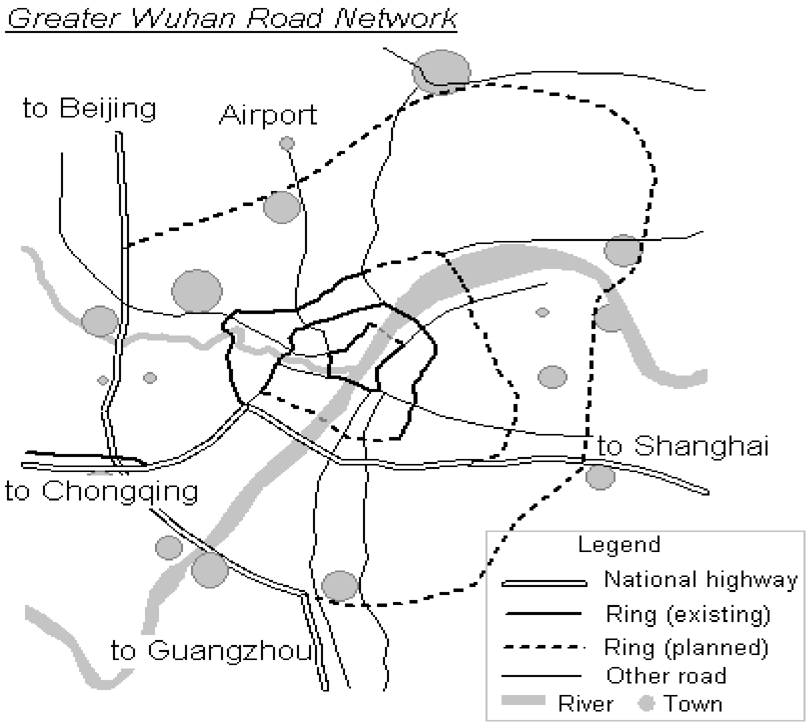


Figure 3.7 The planned road network of Wuhan

3.4 Institutional context for transport planning and management in Wuhan

3.4.1 An overview of institutional structure in Wuhan

Several groups of transport agencies play important roles in shaping urban transport in Wuhan (Figure 3.8). The municipal government administers and coordinates municipal committees and bureaus. The Construction Committee is responsible for infrastructure and the transport service. The Bureau of Public Security (BPS) is in charge of traffic management within the urban area and may provide data on social activities. The Transport Committee handles regional transport, including long-distance bus, railway, water and air transport. The Planning Committee exerts strategic influence on the transport system. The Statistical Bureau provides information necessary for planning and decision making.

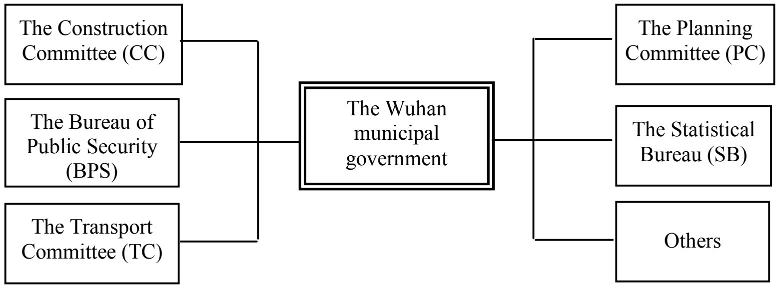


Figure 3.8 Groups shaping the urban transport system of Wuhan

3.4.2 Missions of transport institutions

The Construction Committee (CC)

Under the Chinese municipal system, all physical developments are directed and coordinated by the Construction Committee (CC). The Construction Committee of Wuhan is responsible for making strategic policies relating to urban expansion and for coordinating the work of its bureau. The major agencies within the committee are shown in Figure 3.9. The committee is technically directed by the provincial Department of Construction, above which is the Ministry of Construction in the central government (Figure 3.2).

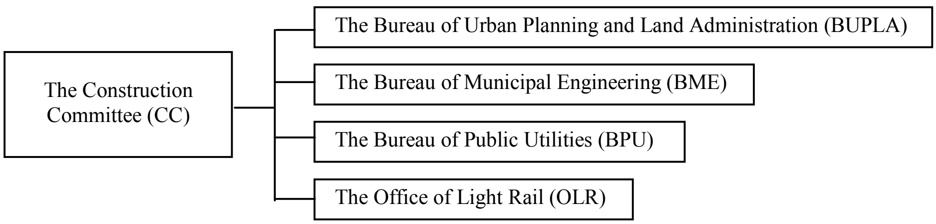


Figure 3.9 Agencies under the Construction Committee, Wuhan

The Bureau of Urban Planning and Land Administration (BUPLA) controls the physical development of the city, from the strategic to the operational levels and by administering land use changes and land registration. Apart from the management of physical development, the BUPLA has several technical institutes and an information centre that serve the purposes of data collection, data management, planning and design. A functional description of these technical units is listed in Table 3.5.

Table 3.5 Technical units under BUPLA and their functions

Unit	Functions
Institute of Urban Transport Planning (IUTP)	Comprehensive transport survey Strategic transport planning Road network planning Local transport improvement Road design
Information Centre (IC)	Management system for construction application Database development System development and maintenance
Institute of Urban Planning and Design (IUPD)	Master planning District planning Detailed planning / urban designing
Institute of Survey and Design (ISD)	Urban map surveying Urban remote sensing Engineering surveying

The Institute of Urban Transport Planning (IUTP) was founded in 1993 in response to the growing mobility since the 1980s. Traditionally urban road and transport facilities were regarded as "non-productive" and the municipality failed to react effectively to the requirements of transport. Since its foundation, the IUTP has been in a difficult situation. It has inadequate finance for developing travel and freight demand models, and has evolved like a consulting unit working on a less strategic level. In 1998 a comprehensive transport survey was carried out. Coordinated by the municipal government, the project involved agencies from public security, public utilities, traffic management, research institutes and universities. The survey covered a wide range of aspects needed for transport research, including:

- Resident trip survey
- Vehicle trip survey
- Vehicle trips to and from Wuhan
- Vehicle parking survey
- Traffic flow survey
- Traffic attraction point survey
- Public transport survey
- Outward traffic survey (passenger and freight flows)
- Socio-economic, land use and employment survey

Actually, prior to the foundation of the IUTP, similar transport surveys were carried out in 1982 and 1986. Due to changes in social, economic and political circumstances, parts of the survey (particularly the resident trip survey) in 1998 could not be carried out as effectively as in the two previous surveys.

The Institute of Urban Planning and Design (IUPD) is a technical agency that has information on the outcomes from various levels of planning, as well as some city design products. During the planning process, the institute collects data on urban land use, population, economy, geology, history, landscape and so on. The results are presented on the basis of the following three levels:

- Strategic master planning products (blueprints, reports), which are made or revised every 5 to 20 years. The major road network plan is one of the blueprints.
- District plans that designate land use, plot ratio, population density and so on. The boundaries and engineering parameters of main and secondary roads are identified, as well as crossroads, parking places and squares.
- Detailed planning blueprints which serve as engineering guidance for land (re-) development. Access roads are included in the drawings.

The Institute of Survey and Design (ISD) carries out surveying (including remote sensing) and exploration of engineering geology. It keeps geographically precise data, including topographical maps at different scales, land uses, road networks, aerial photographs and images.

The Information Centre of the BUPLA is formally responsible for maintaining the digital version of all data available at the bureau. As these data have different scales and formats, and are stored on different media, much work is needed to integrate them into an effective integrated information system.

The Bureau of Municipal Engineering (BME) makes and implements plans for road construction and road improvements. Information on every road segment of the city is collected and kept by the bureau, and a yearly statistical report is presented. It holds detailed records on urban road conditions, construction and maintenance. The bureau also has an institute for technical issues.

The Bureau of Public Utilities (BPU) is mainly concerned with public transport and gas supply. Policies and plans for public transport are made by its managerial office and implemented by corresponding companies. The bureau administers the Bus Company, the Trolley Bus Company, the Taxi Company, the Ferry Company and a research institute.

The Office of Light Rail (OLR) is a new agency specifically set up for the planning and management of light rail in Wuhan. Recent years have seen the initiation of mass public passenger transport. The OLR is responsible for initiating, coordinating and managing projects related to light rail development programmes.

The Bureau of Public Security (BPS)

The Bureau of Public Security (BPS) administers traffic operations, domicile registration, social security, passports and fire prevention. The first two functions are related to urban transport. The Bureau of Traffic Management (BTM) is functionally independent and administratively supervised by the BPS. The BTM is responsible for traffic development policies, traffic rules and regulations, motor vehicle registration, designing and implementing traffic signs, traffic operation control, driving licences, as well as monitoring and recording traffic flows.

The major objective of the BTM is to provide a safe and efficient traffic environment for travellers. Although it is a big organisation, it still lacks staff resources to respond to traffic incidents. This is due partly to the inefficient traffic control mechanism, and partly to the negative behaviour of travellers and drivers. It has been felt that advanced technologies have to be applied to improve management efficiency, and the BTM has already initiated a traffic management information system project.

The Section of Domicile Administration (SDA) of the BPS is responsible for registering urban residents and allocating street addresses. The Chinese domicile registration system is very strict and contains detailed data about individuals, households and work units. This information is quite useful for trip surveys and address geo-coding. The agency structure of the SDA follows the administrative structure down to the lowest unit – the residents committee. An enormous team (about 18,000 staff) works on the household registration and population statistics. Many social investigations are the responsibility of this team, such as the national census and the comprehensive transport survey. In addition to household registration, the section is also entitled to assign street numbers to spatial entities, i.e. houses legally owned by households and pieces of land used by work units. Due to these huge efforts, the domicile records represent the most complete and accessible social data among those of governmental agencies. However, the section has not yet employed a geographical system to geo-reference the registration data. Also, it is very difficult to update registration data in areas with fast development or areas with large amounts of floating population.

The Transport Committee (TC)

The Transport Committee (TC) deals with all modes of transport, post and telecommunications. The committee can be viewed as the counterpart of the Construction Committee (CC) in that the TC manages outward transport while the CC confines its extent to built-up districts. Thus the TC is regionally oriented. In the Chinese urban planning system, there are two types of transport: city transport and outward transport. Facilities such as railway stations, centres for regional passenger and goods transport, harbours and airports are classified as outward transport. Apart from these outward transport facilities, the TC also administrates road and water transport in the rural areas of Wuhan, which indicates a functional overlap with both the CC and the BTM. The TC maintains a traffic police team to ensure the control of transport operations. With regard to road transport, the TC is responsible for policies and regulations for regional transport, regional transport planning, administering outward transport within the city, administering road and water transport in rural districts, initiating and supervising road and transport facility projects, and administering toll roads and toll bridges.

Other agencies

The Planning Committee (PC) is a powerful agency within the planned economy of China. Its major role has been to make strategic plans for social, economic and infrastructural development, and to allocate financial resources to different sectors of the government. The strategic plans have been made in accordance with the series of national five-year plans. In recent years the main focus has been the 10th five-year plan, covering the period 2001 to 2005 (*http://www.whjw.gov.cn/*). The introduction of the market economy in the mid-1980s, triggered a decentralisation process that has somewhat weakened the role of the PC, particularly in the economic sectors. In spite of this shift, the committee continues to be the key agency for strategic urban development. Its function has not changed much. The work of the PC includes making strategic plans for land development and conservation, initiating large construction projects, and making five-year plans for social, economic and physical development.

The Statistical Bureau (SB) is the major source of information on the status and development of the population, economy, built environment and science. Information is collected periodically from organisations such as the Bureau of Public Security, the Bureau of Municipal Engineering, enterprises and commerce. In Chinese statistical terms, urban transport means the regional transport, i.e. the carrying of passengers and goods to and from the city, as well as the facilities used for this purpose. no information on travel demand or travel choice is collected routinely in the statistical system. The geographical basis for socio-economic statistics is the administrative hierarchy, including the municipality, the districts, the streets and the residents committee. In transport research, the Transport Analysis Zones (TAZs) are generally delineated along the boundaries of these units, which ensures cross-referencing between TAZs and statistical units.

Some other governmental institutions are also important to urban transport planning. For example, the Bureau of Commodity Price regulates the ticket prices for public transport, the Environment Protection Bureau keeps regular records on noise and emissions from motor vehicles, and the Commerce Committee holds data on large-scale commercial activity sites that attract a large amount of traffic flow. Besides the municipal government, the provincial government is also located inside the city and has some influence on strategic transport development.

3.4.3 Relationships among transport institutions

All institutions discussed above contribute to the development of the transport system in Wuhan. Several factors characterise the existing practice in these transport-related agencies.

Firstly, these institutions are independent in terms of mission and goal. For a transport system to operate properly, the administrative structure has to identify clearly the functional scope of each unit. In Wuhan, municipal institutions are respectively responsible for transport planning, traffic management, regional transport, transport infrastructure and transport facilities. Each sector has its own set of rules, regulations and laws as the basis for administration. Figure 3.10 shows the major business of each transport agency and their relationships. Based on the degree of influence on the urban transport system, the agencies can be divided into two general groups, i.e. those having direct impact, and those having less immediate impact. Institutions under the Bureau of Public Security (BTM) and the Construction Committee (BUPLA, BPU and BME) have direct and immediate impact on the transport system. They have close relationships and more frequently cooperate in terms of urban transport planning and management.

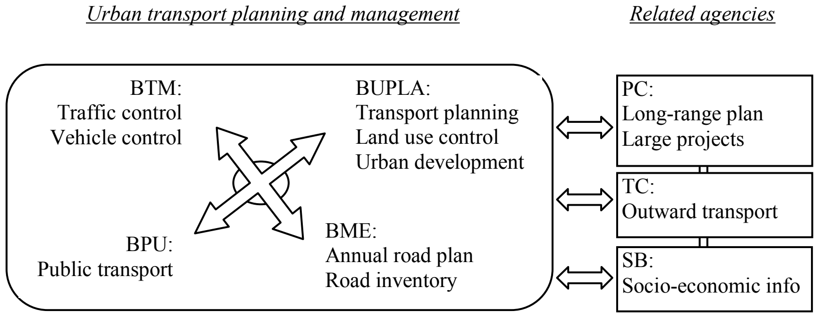


Figure 3.10 Institutional relationships on transport

Secondly, inter-institutional cooperation exists. On many occasions the organisations have to rely on one another in finding solutions to transport planning and management problems. For example, the comprehensive transport survey initiated by the Institute of Urban Transport Planning (IUTP) cannot be carried out without the assistance of the Bureau of Traffic Management (BTM), the Bureau of Public Security (BPS) and the Bureau of Municipal Engineering (BME). Also, traffic management schemes proposed by the BTM necessitate concerted efforts – by the BME as regards road administration, by the BPU as regards public transport administration, and by others. For purposes of transport planning and system performance evaluation, data from different agencies have to be integrated in such a way as to be referenced by common transport spatial entities (e.g. road, TAZ).

Wang *et al* (1999) have illustrated the items of travel demand forecast in Chinese cities, in which passenger travel is composed of resident travel, floating population travel, and outward or through passenger travel. By considering the general data requirements of passenger travel demand models, as well as the institutional structure of Wuhan, a data flow diagram can be made showing the possible contributions that various agencies could make (Figure 3.11). Basically the figure consists of three columns. The left column shows some procedures for travel modelling, the central column is a set of classified data necessary for the modelling process, and the right column indicates those agencies of Wuhan that may contribute to the data requirements. The arrows between the columns suggest which kinds of data are needed for the modelling purpose and which agencies may possibly provide these data. This diagram demonstrates both the importance of and the possibilities for data sharing and integration among these agencies.

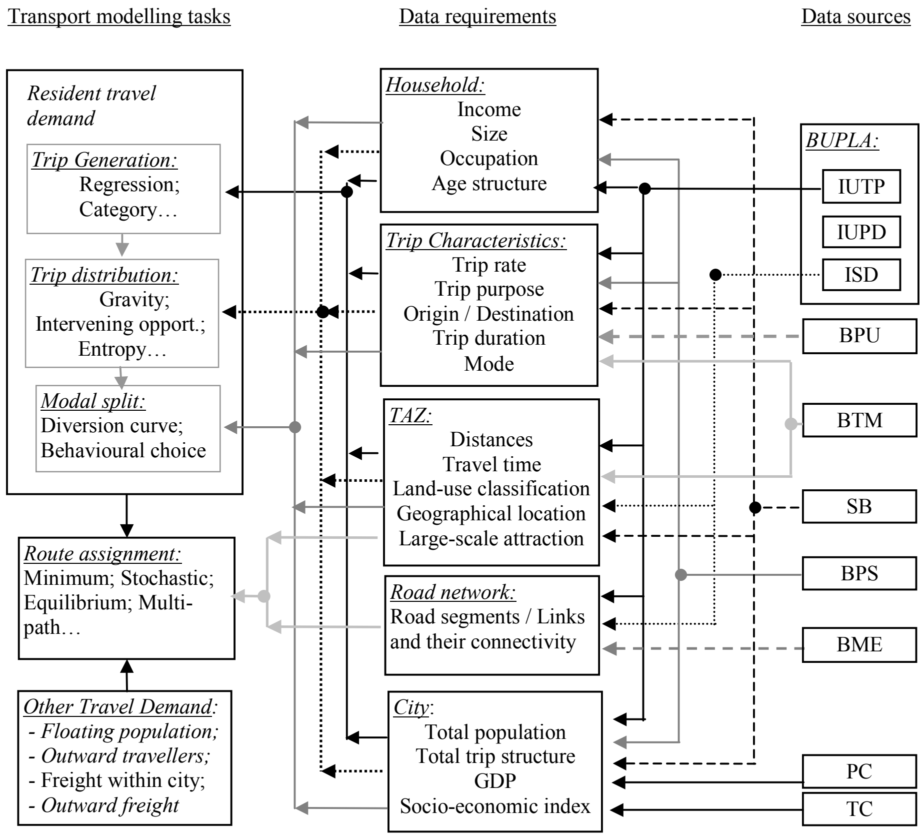


Figure 3.11 Institutional contributions to resident travel modelling

The third factor relates to the functional overlaps, conflicts and gaps among these institutions. One example of an overlap comes from road administration, which is to ensure the proper usage of road space. Both the BME and the BTM are responsible for curbing the violations of road usage, which may cause either avoidance (gaps) or duplicated pressure (conflicts) if there is no coordination. Although this factor is not a major problem area in institutional relationships, careful consideration is necessary.

Another example is the functional overlaps in strategic transport infrastructure planning. Firstly, the PC in Wuhan may launch transport consulting projects for the long term or for the five-year plan for socio-economic development. Project outcomes also serve as a basis for allocating financial investment during the relevant years. Secondly, the BUPLA has to include transport planning as an important aspect in its master planning. The IUPD under the BUPLA is responsible for the master planning, while the IUTP can hardly find a place in the process. Planning efforts by the PC and UPLA consider transport development inside and outside the built-up area. On the other hand, the TC is largely concerned with outward and regional transport planning. Overlaps happen especially in the fringe areas of the city.

Due to the above situation, negotiation is necessary among the agencies. Generally there are three types of coordination: involving upper agencies, involving the municipal government, and arising from joint projects. As each agency belongs to a hierarchy, from the national and the provincial down to the municipal level, many notifications, rules and regulations are jointly issued by the upper agencies. The joint guidance from the upper agencies also requires a united effort from municipal agencies, which is normally accomplished under the supervision of the municipal government. In most cases, a comprehensive improvement in urban road transport, e.g. the 1998 comprehensive transport survey, has also to be coordinated by local government. Apart from the two levels of coordination, some agencies also develop joint projects on road planning and traffic management. According to the Ordinance of Urban Road Administration, an urban road development plan should be formulated together by the departments of municipal engineering, urban planning and traffic management, under the supervision of the municipality (Ministry of Construction, 1997). The process of cooperation among the municipal agencies requires the sharing of, among other things, information.

3.5 Evaluation

At the Chinese national level there are no recommended general transport planning methods and models. Techniques of travel forecasting and planning evaluation have to be developed or adapted to fit the specific situation. One of the challenges for such techniques is the lack of integrated data. Although many cities have carried out comprehensive transport surveys, the exploitation of the survey results has been inadequate and slow. Also, the institutional study in Wuhan indicates that data for transport planning are spread over many transport-related agencies, and that these institutional data sets are not yet fully utilised. An important reason for this phenomenon is the lack of a data sharing framework among transport institutions, as well as the shortage of techniques for data processing and data integration.

An early investigation of urban transport management in 12 developed cities showed that the institutional context was an important factor in the successful formulation and implementation of transport policies (OECD, 1979). It was observed that the fragmentation of authority complicated and hindered the coordination of planning and implementation, that the consolidation of the authorities might achieve more efficient management, and that ad hoc coordination existed in the absence of any formal procedures. Compared with these findings, the investigation in this research shows a similar institutional context between Wuhan and Western cities in the 1970s, which implies ample space for improving the institutional relationships. To improve the situation, the diffusion of technology to the organisations is a necessary step (Ottens, 1993; Masser & Craglia, 1996). Another important aspect is the development of a data sharing policy among governmental agencies.

Obstacles to information sharing exist in every cultural context. For example, research on British local government has shown that only half of these organisations are in favour of cooperative information sharing (Masser & Campbell, 1995). Institutional aspects are regarded as the most difficult factor in data sharing among governmental agencies, which is especially true in the Third World (Batty, 1992). In Wuhan (and other cities in China), transport-related agencies have been separated and supervised by different provincial and national sectors, which encourages data exchange vertically rather than horizontally. Although the situation has been much improved by the widespread use of information technology, information exchanges among municipal units remain difficult. Given this institutional context, a point has to be found to balance the benefits to the agencies and the requirements of information technology, which, as Alfelor (1995) has pointed out, is a challenge to make every one better off as a result of adjustment brought about by information sharing.

The discussion of institutional missions in Wuhan helps to identify data needs or data availability within organisations. Assessment of institutional data needs may make use of methodologies from information science. Early information systems design methodologies concentrated either on data analysis or on process analysis, or on a combination of the two (Olle, 1982). The methodologies evolved into a system approach called information engineering, which involves an integrated and evolving set of tasks and techniques for business planning, data modelling, process modelling, systems design and systems implementation (Finkelstein, 1989; Martin, 1990). Using information engineering models, the data needs of an organisation may be acquired by identifying its mission, goals and objectives (Reeve & Petch, 1999). In this regard, the detailed description of institutional structure and missions in this chapter provides a starting point for further institutional data assessment.

The distinct characteristics of Wuhan, as well as other cities in China, must be taken into account when compared with the rest of the world, especially with the Western cities. These characteristics, as presented in this chapter, include a less organised urban structure, huge population size, high-density, mixed land uses, heavy dependence on the bicycle and public transport, and limited use of information technology for transport planning and management, as well as a mismatch between fast-growing travel demand and inadequate transport supply. These features provide a local context that has reference to the search for general methodologies for urban transport data integration.

Wuhan municipality implemented an institutional reform in the year 2001, which indicates a change in the organisational structure introduced in this chapter. As the fieldwork had already been carried out in 2000, there was no chance to get back to Wuhan and discover the details of this restructuring. However, it looks as though the fundamental functionalities for transport planning, construction, and operations management will not change as a result of the institutional reform. Rather, restructuring will most probably remove some of the old institutional barriers and achieve higher efficiency. Therefore, the underlying missions of transport agencies discussed here still give a good indication of the context for transport data sharing and integration in Wuhan.

3.6 Conclusions

To cope with the enormous increase in travel demand, urban transport planning in China is in the process of seeking appropriate technologies for evaluation and decision making. As demonstrated in the last chapter, manipulating a sustainable transport system involves huge amounts of data from a variety of sources. Without exception, transport planners in Chinese cities have also to face this data challenge.

The detailed investigation in Wuhan indicates that an entire institutional structure exists and that generally transport organisations are implementing their duties efficiently within their own administrative scope. To achieve greater efficiency, most organisations are attempting to build their own information systems. Given the complexity of the urban transport system, there is a growing awareness among these organisations of the importance of cooperation, which includes the exchange and sharing of institutional data.

While the functional categorisation of transport data contributes to studies of data integration from an institutional perspective, using information science techniques to classify these data may benefit the studies from a technical perspective. A major obstacle in the acquisition and sharing of transport data is the incongruence among different data sets. Integrating these data presents a series of technical barriers that have to be overcome during the building of an applicable transport information system. Breaking these barriers requires agreed standards for data representation as well as methodologies for linking and merging these data. The coming chapters will address the major methodological issues of transport data integration in the sequence presented in Table 2.9.