

Advancement of Rail Transportation System and Its Operation in China

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Abstract

Rail transit refers to a kind of vehicle or transportation system that operating vehicles need to run on a specific track. The most typical rail transit is the railway system composed of traditional trains and standard railways. With the diversified development of train and railway technology, rail transit presents more and more types, which are not only widely used in long-distance land transportation, but also widely used in medium and short-distance urban public transportation. Common rail transit includes traditional railway, e.g., national railway, intercity railway and Municipal Railway, subway, light rail and tram. New rail transit includes maglev track system, monorail system such as straddle track system and suspension track system, and passenger automatic rapid transit system. In the Chinese national standard common terms and terms of urban public transport, urban rail transit is defined as "the general name of fast and large volume public transport usually powered by electric energy and operated by wheel rail." According to the difference of service scope, rail transit is generally divided into three categories: national railway system, intercity rail transit and urban rail transit. Rail transit generally has the advantages of large traffic volume, fast speed, dense shifts, safety and comfort, high punctuality rate, all-weather, low freight, energy conservation and environmental protection, but it is often accompanied by high initial investment, technical requirements and maintenance costs, and the occupied space is often large. This paper presented a comprehensive study on these aspects and the operation system in China.

Keywords

Progress; Rail Vehicle; New Rail Transit

1 Introduction

In a broad sense, rail transit refers to various road transportation tools composed of trains, railways, stations and dispatching systems (including dispatching equipment and dispatching personnel), including all traditional railway systems and new rail systems. The main body of generalized rail transit is traditional railway, including high-speed railway. In a narrow sense, rail transit generally refers to urban rail, that is, intercity rail transit and urban rail transit, such as Pearl River Delta Intercity Rapid

Rail Transit, Dongguan rail transit, and so on, in China. Generally speaking, rail transit [1-4] is often used to refer to various medium and short-distance passenger railway systems newly built in economically developed areas.

Some local governments or mass media in the early stage did not know that many intercity rail transits were built in the national railway system, that is, intercity railway, referred to as intercity railway for short. So, many factual intercity railways were habitually referred to as intercity rail, referred to as urban rail for short, such as Guangzhou Zhuhai rail, Dongguan Huizhou rail. In fact, accurately speaking, they belong to the category of Intercity Railway in Intercity Rail Transit and are an integral part of the branch road network in the national railway.

Rail transit is most often referred to as modern urban rail transit. With the acceleration of China's urbanization, many cities began to build various light railway systems serving the city, such as underground railway, light rail railway, monorail railway, maglev railway, etc. Due to the variety of track forms, the local Municipal Railway Company will establish an urban rail transit company based on the overview of "rail transit", such as Chongqing rail transit group.

Subway system is the most widely used type of railway system in urban rail transit [5-9], and the main body of rail transit in most cities is also subway system. Therefore, the rail transit of some cities set up a municipal subway company based on the overview of "subway", such as Guangzhou subway. However, the "subway" here is not limited to the subway system, but also includes other types of rail transit in the city. For example, "Guangzhou subway" includes the Automated People Mover System, APM, which is different from the subway system.

There are three major categories of rail transit. **Traditional railway** is the most primitive rail transit, which is divided into ordinary speed railway and high-speed railway. It is mainly responsible for large-scale and long-distance passenger and freight transportation, which is usually carried by large locomotives pulling multiple carriages or wagons. Traditional railway is the core member of rail transit, which is related to the national economic and military lifeline. Traditional railways are also widely used in medium and short distance municipal railways. For example, the municipal railways in Beijing and Wenzhou adopt traditional railway technology.

Intercity rail transit is a new type of rail transit with comprehensive attributes between traditional railway and urban rail transit. It is mainly responsible for high-speed and medium-distance passenger transportation. Usually, large EMUs carry passengers to realize rapid contact between adjacent cities and meet the communication between urban agglomerations. Intercity rail generally adopts traditional railway technology, so it is also called intercity railway [10-14]. Some intercity rail adopts subway system technology, such as Guangzhou-Foshan subway.



Figure 1 Chongqing Rail Transit line 2 scenic spots Liziba Station using light rail monorail system.

Urban rail transit is a large volume rapid public transport system with electric energy as the main power energy and wheel rail operation system. It is mainly responsible for barrier free and short-distance passenger transportation. Usually, light EMU or tram is used as the transportation carrier to effectively alleviate the traffic pressure of dense passenger flow in the city. The system technology and appearance forms of urban rail transit are various and complex.

Many cities called all kinds of public rail transit in the territory of non-national railway as "rail transit", and establish local rail transit companies, such as Chongqing Rail Transit (Group) company (as shown in Figure 1). As the subway system accounts for the largest proportion of public rail transit in most cities, all urban rail transit systems in some cities are summarized by the word "subway", and local subway companies, such as Guangzhou Metro Corporation, are established. Guangzhou Metro includes not only subway system, but also automatic passenger transportation system and tram system.

2 Railway Transportation System

Rail transit is a complex system integrating multiple disciplines and types of work. It is usually composed of rail route, station, vehicle, maintenance base, power supply and transformation, communication signal, command and control center, etc. The transportation organization, function realization and safety guarantee of urban rail transit should follow the objective law of rail transit. In transportation organization, centralized dispatching, unified command, and organization of driving according to operation diagram should be carried out. In terms of function realization, various disciplines such as lines, stations, tunnels, vehicles, power supply, communication, signals, electromechanical equipment and fire protection system shall be in good condition and operate normally. In terms of safety assurance, it mainly depends on the

Urban rail transit is a transportation system [20-24] in which vehicles run on fixed guide rails and are mainly used for urban passenger transport. In the Chinese national standard common terms and terms of urban public transport, urban rail transit is defined as "the general name of fast and large volume public transport usually powered by electric energy and adopting wheel rail transportation".

Urban rail transit refers to public transport facilities with fixed lines, fixed tracks, transport vehicles and service facilities. "Urban rail transit" is a concept with a wide range, and there is no unified definition in the world. Generally speaking, urban rail transit in a broad sense refers to the rail transit system with medium or above traffic volume in the urban public passenger transport system (different from road traffic) with rail transport as the main technical feature, which mainly serves public passenger transport in the city (different from intercity railway, but can cover suburbs and urban circle), It is a modern three-dimensional transportation system that plays a backbone role in urban public passenger transport.

2.2 Railway classification

Rail transit can be classified according to a variety of criteria. According to rail weight: heavy rail, light rail. Traditional railway, modern subway and high-grade light rail all use heavy rail, because of high load requirements.

According to track form, it could be: double track railway, monorail railway and grooved railway. Double track railway is adopted for traditional railway, modern Metro light rail and tram systems; In addition to the traditional monorail railway, the normally conducting maglev track and permanent magnet maglev track also belong to monorail railway; Air suspension track and superconducting magnetic suspension track belong to grooved railway.

Operating speed, it could be high speed track and medium and low speed track. High speed rail system can generally allow the maximum running speed of trains in this section to reach more than 200km/h.

3 Advancement of Rail Transportation in China

3.1 From status role to technological development

Urban rail transit is the main line of urban public transport, the main artery of passenger transport and the lifeline project of the city. After completion and operation, it will directly affect the travel, work, shopping and life of urban residents. It had the following advantages.

(1) Urban rail transit is a world recognized "green transportation" with low energy consumption and less pollution. It is a golden key to solve the "urban disease". It is of great significance to realize the sustainable development of the city.

(2) Urban rail transit is the largest public welfare infrastructure in the history of urban construction, which will have a far-reaching impact on the overall situation and development mode of the city. In order to build an ecological city, it is suitable to change the pie shaped urban development model into an extended palm shaped model, and the skeleton of palm like urban development is urban rail transit. The construction of urban rail transit can drive the development of the city along the rail transit corridor, promote urban prosperity, and form suburban satellite cities and multiple sub centers,

so as to alleviate the common urban problems such as dense population, tight housing, small green area and serious air pollution in the urban center.

(3) The construction and development of urban rail transit is conducive to improving the travel efficiency of citizens, saving time and improving the quality of life. Due to the well-developed and convenient rail transit, people in internationally famous metropolises rarely travel by private vehicles and mainly rely on rail transit such as subway and light rail. The traffic in the old city is in good order, and the travel of citizens is convenient and time-saving.

Rail transit technologies such as Germany's bullet train technology series, Canada's bullet train technology series and France's bullet train technology series represent the world's advanced level. China's rail transit technology has basically reached the world's advanced level through the introduction and development in recent years, but the key traction control technology is still dominated by foreign products.

Since the construction of Shanghai line 1 and Guangzhou Line 1 subway in the 1990s, China's urban rail transit construction has widely adopted the latest technical equipment of various countries, and has built an urban rail transit system with world-class technical level, but the rail transit technology is still in the stage of introduction, digestion, absorption and innovation.

Before the 1990s, countries all over the world adopted the step-by-step speed regulation DC motor system with switching resistance or the step-less chopper voltage regulation DC motor system controlled by power electronics. In 1990, after the emergence of turn off thyristor and insulated gate transistor elements, the AC drive system of DC-AC frequency conversion and variable voltage speed regulation AC motor began to be adopted in Metro in developed countries. Since the 1990s, except for Shanghai Metro Line 1, all new metro lines, monorail lines and light rail lines have adopted the AC drive system of IGBT module. Compared with DC motor car, the power consumption of AC motor car can be reduced by 40%. Due to the use of regenerative braking, the amount of brake shoe is reduced by more than half; the wheel wear is small and the wheel replacement cycle is prolonged; the maintenance workload of AC motor is very small.

Type A metro vehicles (3m/3.2m wide) and type B metro vehicles (2.8m wide) are fully equipped with bolster free bogies widely used in the world. The bogie has the advantages of simple structure, few parts, light weight and less maintenance workload. The bogie adopts two-system suspension damping structure, one is metal rubber laminated structure, the other is air spring, and is equipped with automatic height adjustment valve to automatically adjust the height of vehicle floor through exhaust and air supply to match with the platform surface. The bogies of all different types of vehicles such as Metro type a vehicle, type B vehicle, linear electric vehicle, monorail vehicle and low floor light rail vehicle are produced in China.

3.2 Technical features

Urban rail transit has large transportation capacity due to high-density operation, short train running time interval, high running speed and large number of train marshalling vehicles. The maximum hourly transportation capacity of one-way peak can reach 60000~80000 person times (suburban railway). The subway has reached 30000~60000 person times, even 80000 person times. There are 10000-30000 light

rail trips and 10000 tram trips. The transportation capacity of urban rail transit is much higher than that of buses. According to literature statistics, the annual passenger volume of subway lines per kilo-meter can reach more than 1 million person times, up to 12 million person times, such as Moscow subway, Tokyo subway, Beijing subway, etc. Urban rail transit can transport large passenger flow in a short time. According to statistics, the subway can pass 17% ~ 20% of the whole day passenger flow in 1h and 31% in 3h at the morning peak. There are the following technical features.

- Punctuality

Urban rail transit is an all-weather means of transportation because it operates on the special carriageway, is not disturbed by other means of transportation, does not produce line congestion, and is not affected by climate. The train can run according to the train diagram and has reliable punctuality.

- Rapidity

Compared with conventional public transport, urban rail transit operates on the dedicated carriageway and is not disturbed by other means of transport. The vehicles have higher running speed and higher starting and braking acceleration. Most of them use high platforms. The train stops for a short time, gets on and off quickly and conveniently, and transfers easily, so that passengers can reach their destination faster, Reduced travel time.

- Comfort

Compared with conventional public transport, urban rail transit has better operation characteristics because it operates on the line that is not disturbed by other means of transport. Vehicles and stations are equipped with air conditioning, guiding devices, automatic ticketing and other equipment that directly serve passengers. Urban rail transit has better riding conditions and its comfort is better than that of public trams and buses.

- Security

Because urban rail transit operates on a special track, there is no level crossing, is not disturbed by other means of transportation, and has advanced communication signal equipment, traffic accidents rarely occur.

- Space utilization

The ground in big cities is crowded and the cost of land is expensive. Because urban rail transit makes full use of the development of underground and aboveground space and does not occupy ground streets, it can effectively alleviate the road congestion and congestion caused by the massive development of cars, which is conducive to the rational use of urban space, especially to alleviate the overcrowding in the central area of big cities, improve the land use value and improve the urban landscape.

- Low cost

Urban rail transit mainly adopts electric traction, and the wheel rail friction resistance is small. Compared with public trams and buses, it saves energy and has low operation cost.

- Low pollution

Due to the use of electric traction, urban rail transit does not produce waste gas pollution compared with buses. Due to the development of urban rail transit, it can also reduce the number of buses and further reduce the exhaust pollution of vehicles. Due to the adoption of various noise reduction measures on lines and vehicles, it generally will not cause serious noise pollution to the urban environment. The main Technical grades were listed seen in Table 1.

Table 1 Technical grade of Urban Rail Transit.

Grade		I	II	III	IV	V
System type		High volume	Large	Medium	Less-medium	Low
Vehicle type		A	B	C-I, C-II	C-II	Modern tram
Maximum passenger volume (One way 10000 person/h)		4.5~7.5	3.0~5.5	1.0~3.0	0.8~2.5	0.6~1.0
Line	Line form	Mainly Tunnel	Mainly Tunnel	Ground or overpass	Mainly Ground	Ground
Road	Road type	Special	Special	Special	Isolated or mixed	mixed
Item\level		I	II	III	IV	V
Platform	Average distance	800~1500	800~1200	600~1000	600~1000	600~800
	Platform length	200	200	120		
	Platform height	High	High	High	Low	Low
Vehicle	Vehicle width	3.0	2.8	2.6	2.6	2.6
	Vehicle capacity (person)	310	240	220	220	104~202
	Maximum axle load	16	14	11	10	9
	Maximum speed	80~160	80	80	70	45~60
	Average speed	60	60	55	50	45
	Gauge	1435	1435	1435	1435	1435
Power supply	Rated voltage	DC1500	DC750	DC750	DC750	DC750
	Power receiving mode	Overhead line/ third rail	Overhead line/ third rail	Overhead line/ third rail	Overhead line/ third rail	Overhead

3.3 Basic types and characteristics

There are many kinds of urban rail transit, with great differences in technical indicators. There are different evaluation standards all over the world, and there is no strict classification. Due to the rapid development of urban rail transit in the world,

different regions, countries and cities, and different service objects, urban rail transit has developed into various types. There is no clear unified classification standard, and different classification methods can distinguish different results.

According to the capacity (transportation capacity), it can be divided into high capacity, large capacity, medium capacity and small capacity.

According to the guidance mode, it can be divided into wheel rail guidance and guide rail guidance.

According to the line erection mode, it can be divided into underground, elevated and ground.

According to the isolation degree of the line, it can be divided into full isolation, semi isolation and non-isolation.

According to the track material, it can be divided into steel wheel rail system and rubber wheel concrete track beam system.

According to the traction mode, it can be divided into rotating DC, AC motor traction and linear motor traction.

According to the operation organization mode, it can be divided into traditional urban rail transit, regional rapid rail transit and urban (suburban) railway.

According to the scope of transport capacity, vehicle types and main technical characteristics, urban rail transit can be divided into seven categories: Tram, subway, light rail transit, suburban railway, single rail transit, new type transportation and maglev transportation.

- Tram

Modern tram (TRAM or streetcar) is a low volume rail transit system that uses tram traction, light rail guidance and 1~3 car formation to operate on urban road lines. Tram is one of the earliest developed urban rail transit. It is generally located in the city center and runs through the streets. It has the characteristics of convenient getting on and off.

Tram originated from urban public carriage. In order to carry more passengers, people put the carriage on the railway track. With the invention of electric motor and the emergence of traction power network, the world's first tram line was opened in Richmond, Virginia in May 1888. By the 1920s, the total length of tram in the United States was 25000 km. By the 1930s, trams in Europe, Japan, India and China had developed greatly. In 1906, China's first tram line was completed and opened to traffic from Beidaguan to Laolongtou railway station (now Tianjin Station) in Tianjin. Then, tram or electric train were built in Shanghai, Dalian, Changchun, Anshan, Beijing, Nanjing and other cities, which played an important role in urban public transport at that time.

The one-way transportation capacity of the old tram is generally less than 10000 person times / hour. It usually adopts the ground route and runs in combination with other vehicles. The running speed is generally about 45km / h. Due to the problems of transport capacity, road occupation and noise, old tram lines were demolished in major cities all over the world in the 1950s and 1960s, and the subway or light rail transit with large traffic volume was reconstructed. At the end of 1950s, there were

few trams left in China, only Dalian and Changchun remained. Dalian has also transformed the tram to make it a business card of the city.

The old tram has stopped its development and basically completed its historical mission. The reconstructed modern tram is very close to the light rail transit with poor performance, but the vehicle size is slightly smaller, the operation speed is close to 20km/h, and the one-way transportation capacity can reach 20,000 person per hour.

● Metro

Subway (Metro or underground railway or subway or tube) is the pioneer of urban rapid rail transit. Metro is driven by electric traction, wheel rail guidance, with a certain scale of traffic volume and driving according to the train diagram. The transport capacity of the subway is 30000 person times/hour in one direction, up to 60000~80000 person times/hour. The maximum speed can reach 120km/h and the travel speed can reach more than 60km/h. It can be composed of 3~8 cars, and the minimum operation interval of vehicles can be less than 1.5min. The driving modes include DC motor, AC motor, linear motor, etc. The subway is expensive, with an investment of 300-600 million Yuan per kilometer. Subway has the disadvantages of high construction cost and long construction cycle, but it also has the advantages of large traffic volume, fast construction, safety, punctuality, energy saving, no environmental pollution and urban land saving. Metro is suitable for urban central areas with long travel distance and large passenger demand. The state stipulates that Metro can be built in large cities with a permanent resident population of more than 2 million. The main technical parameters of metro are shown in Table 2.

Table 2 Main technical parameters of Metro.

Item	Technical parameter	Item	Technical parameter
One way transportation capacity in peak hours	30000~70000	Safety and reliability	Good
Train units	4~8	Minimum curve radius	300
Train capacity (person)	3000	Minimum vertical curve radius	3000
Vehicle construction speed	80~120	Comfort	Good
Average running speed	60	Urban landscape	No effect
Average station distance	600~2000	Air and noise pollution	Low
Maximum carrying capacity (pair/h)	30	Platform height	High platform
Isolation rate from ground traffic	95%		

● Light rail transit (LRT)

Another name for light rail, overhead, comes from the Liverpool overhead opened in 1893, which means "the railway system overhead". Unfortunately, the light rail system stopped operation and was demolished in 1956.

Light rail is a relatively broad concept. In the interpretation document of the International Federation of public transport on light rail operation system, it is mentioned that light rail is a rail transit system using electric traction and between standard tram and express transportation system (including subway and urban railway) for urban passenger transportation.

Light rail is generally constructed by the combination of ground and elevated, and the route can lead from the urban area to the suburbs. The train formation adopts 2 ~ 6 vehicles or single section, articulated car body. As the light rail adopts measures such as line isolation, automatic signal, dispatching command system and high-tech vehicles, the maximum speed can reach 60km/h, which overcomes the problems of low transportation capacity and high noise of tram.

Because light rail has the advantages of low investment (the cost per kilometer is 60 million~180 million Yuan), short construction cycle, high transportation capacity and flexibility, it has developed rapidly. Light rail is in the ascendant in both developed and developing countries. Countries have formulated corresponding light rail development strategies and models according to their own national conditions. Looking at the situation of various countries, there are roughly three types of development modes: first, transform the old tram into a modern light rail. This model is represented by Germany, the former Soviet Union and Eastern European countries. Second, the abandoned railway line is reconstructed into a light rail line. This method is represented by the light rail in San Diego, the United States, and there are similar situations in Europe, such as Gothenburg in Sweden and Karl Marx in Germany. China's Shanghai line 5 and Wuhan Rail Transit Line 1 phase I project also belong to this mode. The third is the way to build new light rail lines. For some cities, building light rail is more economical than building subway. Therefore, cities such as Manila, Rotterdam and Hong Kong have built light rail lines one after another.

After more than 100 years of development, light rail has formed three main types: steel wheel rail system, linear motor traction system and rubber wheel light rail system. The steel wheel and rail system, that is, the new tram, is the result of the transformation of the old tram by using the advanced subway technology. Linear motor car is a medium volume rail transit system with curvilinear motor traction, wheel rail guidance and vehicle marshaling running on small section tunnels and ground and elevated special lines. In the 1980s, Canada successfully developed a new type of rail transit vehicle driven by linear motor. It adopts high and new technologies such as linear motor traction, radial bogie and automatic control, and the comprehensive cost is saved by nearly 20%.



Figure 3 A first rail-line modern as a new public transport called Yunba in Bishan, Chongqing.

It is compatible with wheel rail system, convenient for maintenance and rescue, and has great climbing ability. Linear motor technology has achieved great success in Canada, Japan and the United States, and the developed linear motor train has also been put into use. Linear motor trains are also used in Guangzhou and Beijing, China. Because the linear motor train has the advantages of low body, light weight, low noise, passing through small radius curves and strong climbing ability, it can easily drill into the underground and climb up the elevated. It is an ideal model for underground and elevated connection. The significance of using linear motor as power is that it has caused the change of traction power of rail vehicles. The rubber wheel light rail system adopts full elevated operation and does not occupy the ground road. It has the advantages of low vibration, low noise, strong climbing ability, small turning radius and less investment.

- Magnetic levitation

Magnetic levitation for transportation is applied in Shanghai and Changsha in China. It is a non-wheel rail adhesive transmission, suspended on the ground transportation system. Maglev train is a new generation of transportation tool with high speed, safety, comfort, energy conservation, environmental protection, simple maintenance and less land occupation by using the suction or repulsion force generated by normal conducting magnet or superconducting magnet to float the vehicle, using the above composite technology to generate guiding force and linear motor to generate traction power.

- New transportation system

Automated Guide-way transit (AGT) is a vague concept. Different countries and cities have different understanding of it, and there is no unified and strict definition. In a broad sense, AGT is the general name of all modern new public transport modes (as shown in Figure 3). In a narrow sense, the new transportation system is defined as a medium and small volume rail transportation system with electric traction, rubber tyred vehicles with special guidance, operation and steering modes, and single vehicle or several vehicle groups running on special rail beams.

In the new transportation system, the vehicles can run automatically without driver on the line, and the station is unattended. It is completely controlled by the computer in the central control room, with a high level of automation. There are many similarities between the new transportation system and the single rail transit. The biggest difference is that the system has not only running rails, but also guide rails. Therefore, the new transportation system is also called automatic guide rail transit. The guidance system of the new transportation system can be divided into central guidance mode and side guidance mode, and each mode can be divided into single use type and dual-use type. The so-called single use type refers to that the vehicle can only run on the guide rail, and the dual-use type refers to that the vehicle can not only run on the guide rail, but also drive on the general road.

3.4 Project financing types in rail transportation system

Investment and financing mode refers to the operation mechanism and management system of investment and financing activities, including investment and financing management subjects, investment and financing organization forms, etc. Based on the fact that urban rail transit has both social welfare and market economy characteristics, its construction and operation can be provided directly by the government or by private enterprises through the market with the support of the government. The investment and financing of urban rail transit construction at home and abroad can be divided into government led investment and financing mode and market-oriented competitive investment and financing mode.

- Government led investment and financing model

Government led investment and financing mode, that is, the government is responsible for all construction investment and operation subsidies, and appoints an institution to be responsible for the specific implementation of investment, construction and operation of urban rail transit projects. The government investment and financing mode has two financing ways: government financial contribution and government debt financing.

The advantages of the government led investment and financing model are simple relationship, high efficiency of government decision-making, implementation and coordination, good government credit and fast financing speed. It can concentrate financial, material and human resources in a short period of time to speed up the construction process of urban rail transit projects.

The disadvantages of the government led investment and financing model are: first, the government has great financial pressure. Due to the limited financial resources and credit degree provided by the government, the financing capacity is insufficient and cannot meet the large amount of funds required for the construction and operation of urban rail transit. Secondly, the inefficient use of funds may breed corruption, and the division of responsibilities is not clear. Although the contradiction between construction and operation is covered up, it is not conducive to improving investment efficiency. It is not conducive to the transformation of enterprise management mechanism and the diversified joint-stock system reform of investment subjects, and it is impossible to establish a cost incentive and restraint mechanism for builders and managers.

- Market oriented investment

The market-oriented investment and financing mode means that the government is no longer the main body of investment and financing of urban rail transit projects, but that enterprises are responsible for the financing, construction, development and operation of urban rail transit projects by using commercial loans, issuing stocks, bonds, industrial investment funds and other commercial financing means under the market-oriented rules. In order to make urban rail transit projects have certain profitability and attract social capital to participate, the government usually gives urban rail transit projects many preferential policies, including commercial and property development of land along urban rail transit lines, so as to improve the capital operation status of the project and create an attractive project financing environment, And reduce the financing cost of urban rail transit projects.

The advantage of the market-oriented investment and financing mode of urban rail transit is that it can reduce the financial pressure of the local government by attracting a wide range of social funds. It is also conducive to the completion of market-oriented restructuring of urban rail transit operation enterprises, the transformation of enterprise operation mechanism, the improvement of enterprise operation efficiency, and the elimination of bureaucracy and corruption caused by the indiscriminate separation of government and enterprises.

The most typical of this model is the construction and operation of the Hong Kong Metro. Its main feature is that the government allocates several planned plots along the Metro to the metro company, and the Hong Kong Metro company carries out the real estate, commercial and property development of these plots together. The funds obtained subsidize the construction and operation expenses of the Hong Kong Metro to a great extent. In addition, in order to ensure that the external benefits of urban rail transit construction can be fully internalized and return the external benefits to urban rail transit construction, the Hong Kong government has granted some land and property franchise rights to the project company, and given certain preferential tax benefits.

4 Development Prospect

China's urbanization process is fast. The national urbanization rate was 51.27% in 2011, 52.57% in 2012 and 53.73% in 2013. It is predicted that by 2020, the national urbanization rate will exceed 60%, and the huge influx of people into cities will mean that public transport needs to bear more traffic volume. With the gradual transition of urban rail transit construction into operation, urban rail transit will still be in a situation of supply less than demand in the next few years. Summarizing the development of China's urban rail transit in the past 20 years, it could be believed that the development of China's urban rail transit has gone through 100 years of development in developed countries in 15 years, and the technology and equipment of rail transit have also changed from relying on imports to independent and domestic development. This makes the market prospect of track equipment huge. It has developed to build and improve the industrial chain. Many enterprises hope to enter the field of equipment production and supply. It is not just the potential of the urban rail market. With the deepening of the reform of the railway investment and financing system, the management right and ownership of the branch railway and intercity railway will be gradually delegated to the local government, which is expected to drive the development of the branch railway and intercity railway.

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