Historical Development of Expressway in China

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The opening of China's first expressway – the Shanghai-Jiading Expressway in 1988 – marked the beginning of the creation of today's largest expressway network in the world, with a total length of 131,000 kilometers at the end of 2016. The achievement is attributed to the development of infrastructure systems. Infrastructure systems can be defined as systems including physical facilities and such social systems as legislative, financial, organizational, and technical systems to deliver infrastructure service.

This paper reviews the historical development of expressways in China over the past 30 years in terms of the expressway system. New trends such as the utilization of Public-Private Partnership in the expressway sector under the background of current challenges faced by China's developmental strategy are introduced. Future prospects are discussed in order to provide suggestions for achieving the sustainable development of the expressway sector in China.

Key Words: *expressway, historical development, Public-Private Partnership, sustainability*

1. INTRODUCTION

The growth of China's national expressways, from zero kilometers to the world's longest expressway system, is an outstanding national achievement accomplished over the past 3 decades. The improvement of transportation infrastructure significantly enhances the efficiency and effectiveness of inter-regional connectivity in China, yields significant social returns, and provides a firm foundation for China's economic growth, as shown in **Fig. 1**, which indicates how the expressway network in China has generally expanded in conjunction with national economic development.

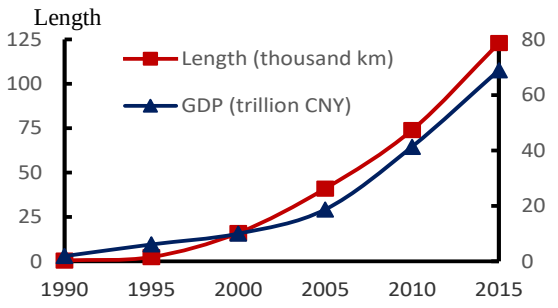

Fig.1 Expressway development and GDP[1)]

This paper focuses on several fundamental factors associated with expressway development. It identifies and explores the development of regulations, institutions, technical, and financial issues from a historical perspective, including a brief assessment of their impacts, successes, and challenges. Problems and future prospects toward a sustainable expressway network are discussed, and policy recommendations are provided.

2. HISTORICAL DEVELOPMENT

China's transportation infrastructure has undergone historic changes. Expressway development has been significantly affected by China's overall economic development level, as well as by the country's legislative and administrative system. Changes have also been influenced by the division of responsibilities among various levels of government, technical planning, and the national road financing policies.

(1) Developmental stages

To summarize briefly, historical development pf Chinese expressways can be divided into 3 stages,

based on annual mileage increase.

Table 1 Development stages of expressway in China

Stage	Period	Annual mileage (km/year)	Events
Start	1988-1994	0-1000	Expressway Law launched
Speed up	1995-2007	1000-5000	Toll Road Regulation launched
Mature	Since 2008	5000 more	Comprehensive planning for 2030

Back in the 1980s, in response to a growing backlog of road expansion needs arising from fast-paced socioeconomic development, China initiated efforts to construct a national expressway network.

Since the beginning of the 21st century, the Chinese government has continued development, built a comprehensive network system, improved the management system, and modernized management capacity in the sector. These various reforms are bringing China's expressway to a new stage that incorporates multiple functions and promotes coordinated development.

(2) Legislative system and Regulations

The development of expressways is closely related to regulatory policies from the central government. Serial regulations on financing, constructing, and maintaining expressways have been launched[2]. Among these, the two most important regulations are the Expressway Law of the People's Republic of China, and the Regulation on the Administration of Toll Roads.

a) Expressway law of the People's Republic of China (Expressway law)

The law was issued by the authority of Standing Committee of the National People's Congress in 1998, for the planning, construction, maintenance, operation, and management of expressways.

The significance of the Expressway Law is the regulation on expressway finance. Under the Expressway Law, funding of the expressway sector may come from the following sources:

- Appropriations made by government;
- Loans from banks or foreign governments;
- Investment made by economic organizations; and
- Funds raised from enterprises and individuals to build expressways.

Currently, bank loans represent the largest share of funding[3], with a proportion of around 40%, followed by economic organizations' investment, at 30%.

b) Regulation on the Administration of Toll Roads (Toll Roads Regulation)

This regulation was issued by the authority of State Council in 2004, with the purpose of strengthening the administration of toll roads, regulating toll collection acts, maintaining lawful rights and interests of toll road users and business operators, and promoting the development of the road industry.

In 1984, China established a toll road and bridge policy that authorized provincial and local governments to construct toll roads and finance them with toll-backed debt. The regulation covered two kinds of investment facilities: government loan repayment toll roads (GLRTRs) and commercially operated toll roads (COTRs).

GLRTRs refer to roads that are built and financed by the applicable public institution with the objective of meeting loan repayment and road maintenance needs. Whereas, COTRs refer to commercially operated toll roads that are built and managed by economic entities with the objective of covering facility maintenance costs and receiving a reasonable return on investment.

These facilities were regulated before expressway construction began in China, and has since retained and incorporated Toll Roads Regulation. Road tolls have been widely used to help contribute to or recover financing costs. As a result, virtually all expressways (98%) are tolled[4].

The laws and regulations mentioned above provide a complete legal framework for the development of expressways.

(3) Institutions

In accordance with the Expressway Law and the Toll Roads Regulation, the administration of expressways in China is highly decentralized.

The Ministry of Transport (MOT) and Provincial Transport Departments (PTDs) are the main entities that carry out planning, construction, maintenance, and management of expressway networks. **Table 2** outlines the administrative and executive entities of the expressway sector in China.

Table 2 Administration and executive entities

Administration level	Function	Executive entities
National	Planning	MOT, State Council
	Construction, maintenance and management	PTDs
Provincial	Planning	PTDs and MOT
	Construction, maintenance and management	PTDs

At the level of the central government, the MOT is the authority for transportation under the State Council. The MOT is responsible for mid- and long-term national road system planning, in conjunction with the relevant departments under the State Council and provinces. The MOT is also responsible for issuing technical standards, specifications, and relevant guidelines.

At the level of the provincial government, PTDs are responsible for drawing up provincial road development plans, which are submitted to their respective provincial governments for approval. PTDs have the responsibility to manage routine maintenance work in their jurisdictional areas. They issue performance targets, establish evaluation criteria, and conduct annual inspections of maintenance work.

(4) Technical Issues

There are 3 types of technical plans for expressways in China, considering different time-spans and priority issues.

a) Mid- and Long-Term Plan. The MOT, in conjunction with other agencies, usually prepares mid- and long-term development programs that consider up to the next 10 years. Examples include the National Expressway Network Plan that based on the central government's long-term socioeconomic development strategy.

b) Five-Year Plan. Based on the mid- and long-term plans described above, the MOT works jointly with relevant departments under the State Council to develop five-year plans, which are submitted to the State Council for approval. The five-year plans identify key projects and associated investment costs, and provide criteria for identification of construction projects and funding approaches in each province.

c) Annual Plan. At the beginning of every year, for each province, the MOT issues an annual investment plan and the Ministry of Finance (MOF) issues an annual budget after the investment plan has been approved by the National People's Congress. Each province then submits an accomplished funding application form to the MOT and the MOF based on the yearly progress of the projects.

The "National Main Road Network" was the country's first road plan and was launched in 1981. The most recent plan is the "National Road Network Planning 2013-2030", approved by the MOT in 2013. The expressway plan seeks to connect provincial capitals and all of the large and medium-sized cities with a population of more than 200,000.

(5) Financial Issues

a) Expressway investment

The expansion of the Chinese expressway network is only possible through high levels of capital investments. Since the late 1990s, investments in road infrastructure in China have exceeded 3.5% of GDP[3]. In recent years, under the economic stimulation policies of the central government, investment in expressway sector has surged, as shown in **Fig. 2**.

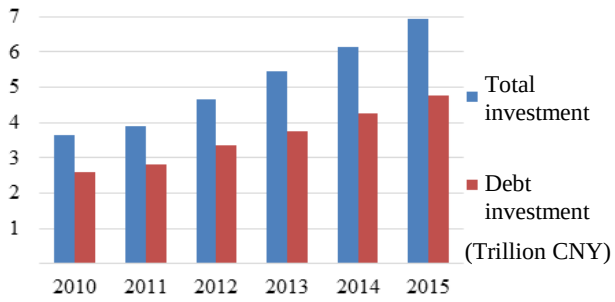

Fig.2 accumulated construction investment on toll roads

At the end of 2015, accumulated construction investment on toll roads reached 6.95 trillion[1], of which 2.18 trillion is made up of equity and 4.77 trillion is debt (making the equity-debt ratio 31.4: 68.6). High debt ratios and surging investments[5] are likely triggering over-investment in expressway infrastructure.

b) Public-Private Partnerships (PPP)

PPP refers to a long-term contract between governments and the private sector that aims to provide public assets or services, with the private sector taking on significant risk and management responsibility in delivery.

Concerns of high government debt initiated a trend of PPP implementation ever since 2014, along with the legislation of relevant regulations and establishment of corresponding institutions. In the early days of private investment in China, the investors reduced risk by creating joint ventures with local PTDs, thereby often ensuring preferential treatment and high-level official support. As the process moves toward increased competition and transparency, the private sector will likely seek a level of profitability lower than what has been the case to date, but with a corresponding level of risk.

The lack of legal frameworks and unexperienced government bodies with insufficient capacity to properly conduct project feasibility assessments, demand and financial analyses are major challenges that impeding PPP implementation in China[6].

3. PROBLEMS AND FUTURE PROSPECTS

(1) Decentralized system

As mentioned previously, China's decentralized institutional and funding mechanisms for delivery of the expressway network have been instrumental to its growth. However, the decentralized system has caused considerable variability between regions as well.

The eastern portion of China's expressway network enjoys high traffic flows and possesses sufficient income to attract debt and even private equity for further expansion. On the other hand, the central and western portions will have insufficient revenue to cover debt servicing and on-going maintenance costs[7]. In recent years, the central government has stressed balanced development strategies, providing preferential policies to the economically under developed central and western regions. Despite these efforts, disparities still exist in terms of network density, road system facilities, and road conditions. While it is understandable and arguably appropriate that different regions have different road density levels and types of facilities, the road systems in rural areas are clearly underdeveloped. A more balanced network density and coordinated system performance are necessary.

(2) Future Prospects

Based on a historical review and a consideration of the identified problems facing China's expressway development, future prospects for the sustainable development of the expressway network in China can be suggested.

The existence of both over-investments in the expressway infrastructure and under-developed expressways network in China's rural areas calls into question the effectiveness of current investment policies. Optimization of investment needs a comprehensive consideration of total social welfare and regional disparity. Investment level should be consistent with demand level as well as regional economic condition. Future plans should tailor investment timetables and designs to projected economic development, improved demand estimation, and the consideration of general social welfare.

A cross-subsidization of revenue from mature roads to lower traffic roads or to new roads is a solution for the decentralized system issue[8]. This would suggest the establishment of a national polling mechanism in China, making proper provision to meet balanced long-term network development.

Establishment of a legal framework and accumulation of implementation experience are important for taking advantage of PPP. New contract forms of PPP, such as governmental guarantees or net present value methods have been developed and implemented to cope with different risk situations.

4. CONCLUSION

By reviewing 30 years of Chinese expressway development, essential characteristics of China's rapid expressway network are identified across three phases: start, speed up, and maturity. These characteristics include:

- Legislation and regulation that constitute a complete legal framework;
- Continuously investment from central and provincial government; and
- Clear and effective planning and simultaneous implementation effort by provinces.

Recently, China is challenged with expressway investment issues such as over-investment, regional disparity, and proper implementation of PPP. Optimization of expressway investments considering total social welfare and regional disparity should be emphasized in the future.

Challenges reveal themselves over time. By learning from valuable experiences of the development process, with the persistent effort from the whole nation, it is hoped that in the long run, sustainable expressway infrastructure can be achieved in China.

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