



# Comparative study of China and USA public private partnerships in public transportation

Zhijie Dong<sup>1</sup> · Meicheng Wang<sup>2</sup> · Xianfeng Yang<sup>3</sup>

Received: 8 January 2016/Revised: 26 March 2016/Accepted: 7 April 2016/Published online: 23 April 2016  
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**Abstract** As an effective alternative approach to provide goods and services for public infrastructure, the Public Private Partnership (PPP) has been studied extensively over the past few decades. On a global scale, China and the United States have developed cooperation on PPP projects in various areas. To perform a comparative study, this paper analyzes how PPP projects work in both countries for public transportation. The basic features, types, and phases of PPPs in public transportation are introduced first, followed by a thorough discussion on their advantages and challenges. This paper adopts a case study method to analyze the achievements and problems of PPP projects in both countries and then proposes important findings and suggestions for future research.

**Keywords** Public private partnership · Public transportation · China · USA

## 1 Introduction

Governments and the private sector deliver goods and services with different methods, where they share responsibilities and claim rights in various degrees. Samuelson [1] noted that public service provision does not necessarily imply that the government is also the producer of the services. In fact, the private sector has been involved in the service delivery for decades. In the early 1990s, Public Private Partnerships (PPP) projects were first launched in the U.K. on toll-road concessions. After these first experiments in the U.K., PPPs have been growing in popularity as an effective alternative instrument for the provision of goods and services by governments, especially in the infrastructure industry for both developed and developing countries, such as Greece [2], Poland [3], Indian [4], and Ghana [5].

In China, with markets opening up for public facilities and services at the end of 1980s, growth in the number of PPPs in infrastructure has increased fast. For example, since late 1990s, the number of expressways under PPP contracts, programmed in the Chinese National Expressway Network Plan (The 7918 Plan), has increased from 0 to 122 PPP contracts at present [6]. Such a rapid growth was the result of the gap between public funding and actual project costs. Governments were hoping to seek more funding from private sector and meanwhile reallocate responsibilities of design, construction, operation, and maintenance by means of PPPs. At the same time, the trend towards PPPs in the provision and maintenance of infrastructure projects in the United States has been increasing mildly due to the strengths of financial and institutional arrangements that support the traditional procurement across the country. However, as the U.S. infrastructure system matured, the needs for repairing and expanding urban networks of roads, bridges, and tunnels have escalated beyond the fiscal and managerial capabilities

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✉ Zhijie Dong  
zd57@cornell.edu

Meicheng Wang  
mw833@cornell.edu

Xianfeng Yang  
xyang@mail.sdsu.edu

<sup>1</sup> School of Civil and Environmental Engineering, Cornell University, Ithaca, NY 14853, USA

<sup>2</sup> Department of City and Regional Planning, Cornell University, Ithaca, NY 14853, USA

<sup>3</sup> Department of Civil, Construction, & Environmental Engineering, San Diego State University, San Diego, CA 92182, USA

of traditional procurement. This has led to an increasing willingness by infrastructure agencies at each government level to consider and in some cases apply alternative structures of public service delivery, including financing, contract delivery, and life-cycle preservation methods to leverage the scarce public resources.

As two of the world's largest economies, China and the United States have developed cooperation on many PPP projects in various industrial and technology fields, such as electricity production and transmission [7], and the project of building high-speed railway between China and US is currently being considered [8]. Although there is much literature on PPP practices in China (e.g., [9, 10]), and more researchers in the United State are paying attention to this delivery method, less work has been done to investigate how PPP works differently in these two countries. Since public transportation is a major contributor to the economy in both countries, a comparative study on relevant PPP projects will lead to potential benefits. This paper focuses to fill such a research gap.

## 2 Features of PPPs

### 2.1 Attributes of PPPs compared with public provision and privatization

Definitions of PPPs vary broadly in the literature depending on the specific backgrounds of countries and regions as well as different research interests. Most definitions highlight the unique features of PPPs that distinguish it from public provision, privatization, or both (e.g., [11–13]). As defined by Federal Highway Administration [14],

A public–private partnership is a contractual agreement formed between public and private sector partners, which allows more private sector participation than is traditional. The agreements usually involve a government agency contracting with a private company to renovate, construct, operate, maintain, and/or manage a facility or system. While the public sector usually retains ownership in the facility or system, the private party will be given additional decision rights in determining how the project or task will be completed.

This definition emphasizes that in a PPP structure the public and private sectors share responsibility for the delivery of the project and/or its life-cycle services.

PPPs usually incorporate a long-term contractual relationship between public and private sectors, as against to the short-term procurement in traditional public provision. Another essence of PPPs is the substantial role of government by either the eventual ownership or the life-cycle supervision, as against to the result of privatization. The

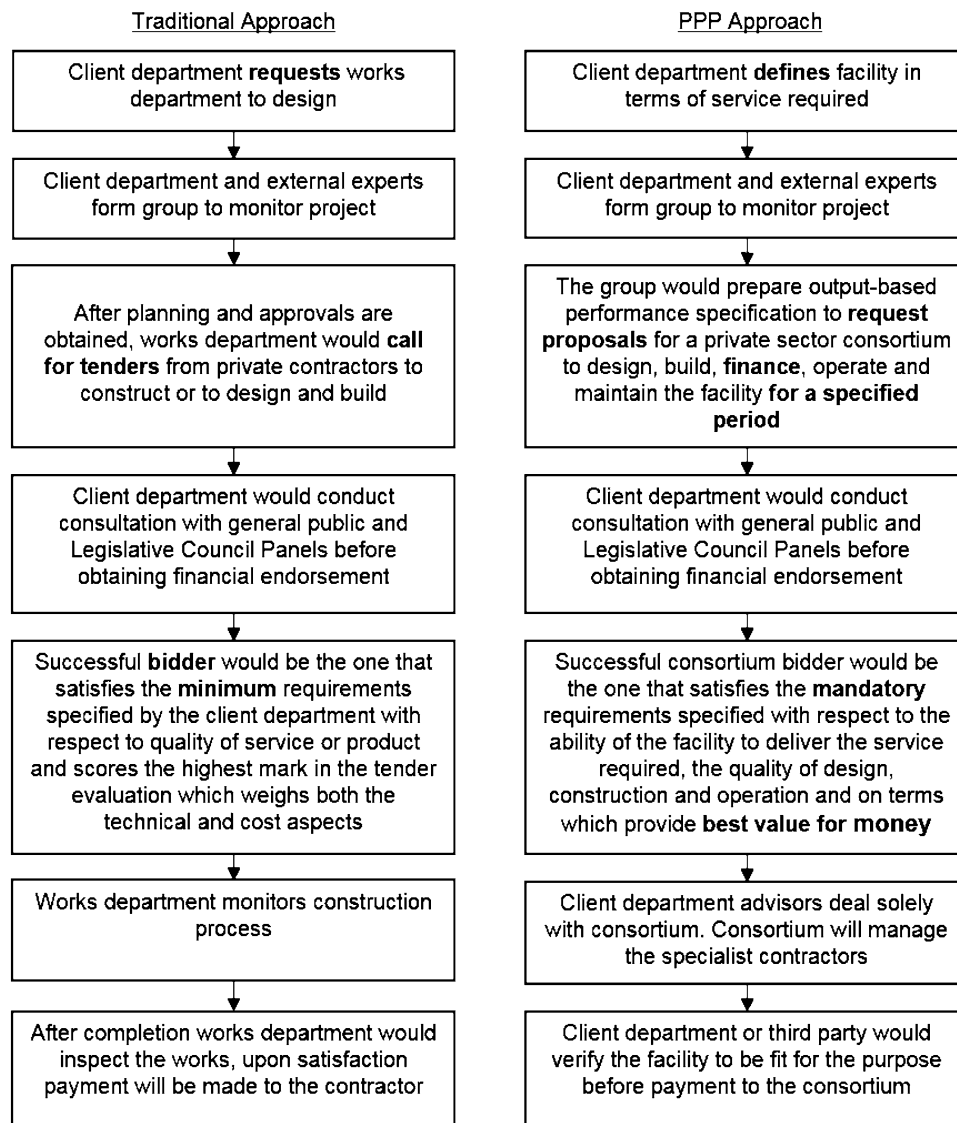
purpose of introducing PPPs in between public provision and privatization is to deliver public services with more competent resources aggregation and risk allocation.

Traditional public provision separates the construction phase from the sequent operation and maintenance (O&M) phase by only purchasing the construction service from the private firms. This procurement structure often leads to insufficient O&M and service deterioration in the long term. In addition, political pressure incentivizes governments to prefer introducing new projects to the O&M phase of existing projects. For these reasons, PPPs offer a viable alternative, in that the private sector is responsible for not only asset delivery but also overall project management and successful operation over the contract life [15]. Since returns of investment for private sector depend on long-term project performance than bundling the construction and O&M phases, service providers will seek efficient resource allocation to reduce life-cycle costs. Figure 1 summarizes key differences between PPPs and traditional procurement methods.

Privatization, referring to the shift of government functions from a public sector to the private agency, is also an alternative of service delivery [16]. In most cases privatization and contracting out are often used synonymously [17], but “contracting out” tends to indicate some parts of services being transferred to a number of private firms. Privatization has the potential to take more advantage of market competition. However, when certain services demonstrate increasing return and natural monopoly, or when they are not excludable and the society insists not to charge users, privatization does not work well for achieving users' welfare [13]. Transportation infrastructure projects demonstrate such features, thus require strong network planning and substantial roles government during the entire process. Meanwhile, the quality of transportation infrastructure is more contractible than that of education or health care, making it qualified for the application of PPPs.

### 2.2 Various types of PPPs

PPP projects can be structured either “vertical” or “horizontal” in nature [18], which are also referred to “contractual” and “institutional,” respectively. In a vertical partnership, a concession agreement or PPP contract assigns the responsibility of service delivery to the private sector over its entire life cycle (i.e., “design, build, finance and operate”), and transfers the service to public control at the end. In a horizontal partnership, both public and private sectors are responsible for providing infrastructure services as shareholders in a special purpose vehicle (SPV), in which public and private shares are jointly ventured for the project purpose. In contrast to the temporary and limited nature of vertical partnership, the horizontal partnership transfers ownership and operating function to the joint venture



**Fig. 1** Differences between PPP approaches and the traditional practice

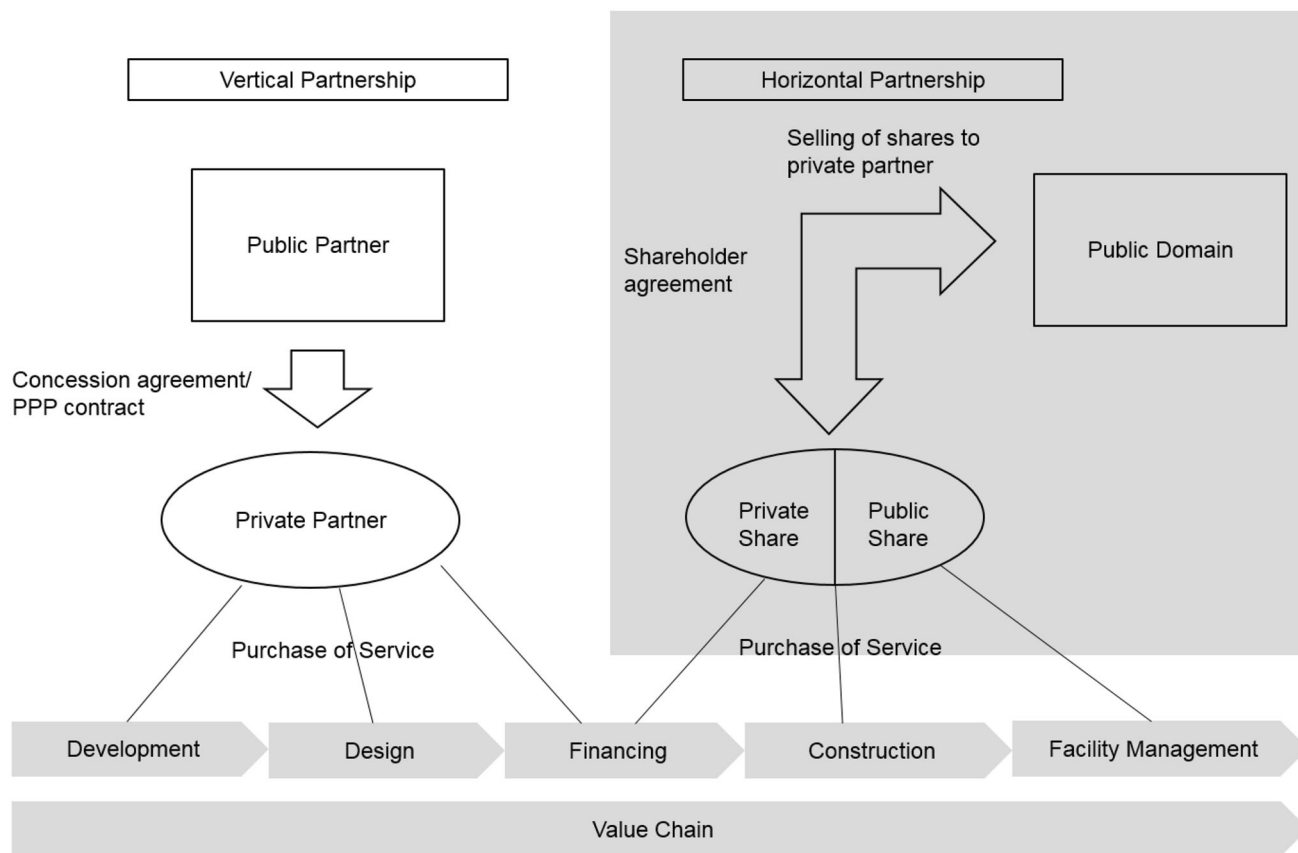
permanently. In extreme cases, government may hold no equity in the joint venture, but participate in the PPPs as a bond issuer or supervisor. Figure 2 demonstrates the different structures of vertical and horizontal partnerships.

In practice, PPPs take on many different forms that are typically known by acronyms. Most vertical PPPs are regarded as the variants of Build-Operate-Transfer (BOT), indicating that the private sector is responsible for building and operating specific facilities or services during a relatively long term, and eventually transfers the facility to the public sector. BOTs allow sufficient time for the private sector to internalize life-cycle cost and get returns on investment from fees charged to the government [19]. To mitigate the risk of overestimated demand, BOTs usually ask limited access to private capital, which means governments hold more financial responsibility and bears the equity risk.

A major variation of the BOT is build-own-operate-transfer (BOOT), also known as design-build-finance-operate (DBFO), involving significant finance from the private sector. In this structure, private firms maintain ownership until transfer it to the government, during which they are able to charge user fees and assume most equity risks. BOOTs are most suitable when the public sector faces a large financial gap or is not able to bear the financial risks [20].

### 3 Promises and challenges of PPPs in public infrastructure

The PPP gains the popularity in the infrastructure industry over recent years for its promises to allocate resources more efficiently and mitigate risk more effectively. The



**Fig. 2** Structures of horizontal & vertical partnerships

most highlighted advantage is the enhancement of “value for money” (VfM), meaning delivering specific facility or service with the same quality at a cost lower than conventional procurement or spending the same amount of money while gaining a better service quality [21]. Walker and Smith [22] argued that the private sector possesses better mobility than the public sector and is more capable to raise massive funds for the large-scale infrastructure projects. This is doubtful because the involvement of private firms does not intrinsically generate revenue or lower the cost of capital. The economic gains from PPP structure derive largely from the bundling of construction and O&M, minimizing the life-cycle cost and preventing government from obtrusively starting new projects rather than maintaining existing ones. Secondly, competition for the contract will lead to the pricing more economically viable than the inefficient user fees in public provision under political pressure. In addition, the private sector knows how to charge the premium that matches the risks they bear. Other reasons supporting PPPs include the innovation brought by private firms and the on-time service delivery incentivized by economic gains.

Ideally, most advantages mentioned above can also be realized in a competitive market, but considering the

increasing return to scale and thus the natural monopoly in most transportation infrastructures, a long-term public role to conduct network planning and regulation is indispensable. The urban railway network that will be discussed in the following section is one of the most salient examples. Since the quality of transportation service is relatively contractible, the public sector could partner with the private sector for enhancing completion but meanwhile retain long-term regulation and eventual ownership to avoid the loss of users’ welfare. For these reasons, whether the cost is covered by user fees or government transferring payment, PPPs in the arena of transportation win both complete privatization and traditional procurement.

Besides the promise of integrating resources more efficiently, the PPP becomes preferable because of its vision of allocating risks to the parties that are best able to manage them. Risk management is a dynamic process over the life cycle of the project, which can be broken down into the identification, assessment, and mitigation of risks through optimal allocation between public and private sectors. Comparing to traditional procurement, one of the major risks of public infrastructure, the unavailability risk, is borne by private firms instead of public users under PPPs. On the other hand, each sector will assume risks with

**Table 1** Typical categories of risk management

Risk categories	Stages of the project	Allocation of risk
Land acquisition	Development phase	Public/private party
Delays in project Development	Development phase	Private party
Design risk		
Planning risk		
Project completion risk	Construction phase	Private party
Project cost risk/cost overruns	Construction phase	Private party
Technology risk	Construction/operation Phase	Private party
Regulatory & administrative risk	Operation phase	Public/private party
Commercial risk	Operation phase	Private party
Operations & maintenance risk	Operation phase	Private party
Financial risk	Operation period	Private party
Interest rate risk		
Foreign exchange exposure risk		
Tax rate change risk		
Inflation risk		
Termination risk	Operations phase	Private party
Insolvency and outside editor risk	Throughout project life cycle	Private party
Environmental risk	Construction/operations Phase	Public/private party
Political & social risk	Throughout project life cycle	Public/private party
Events of wars		
Nationalization or revocation		
Social Risk		

corresponding benefit claim. For example, lenders will ask for higher risk premiums if the private sector need to bears demand risk (i.e., collecting availability payment rather than user fee). Table 1 lists typical categories of risk management.

It is worth noting that the advantages of PPP structure do not guarantee the promises of PPP projects. Instead, there are certain preconditions to apply PPPs and a number of shortcomings that often impede the success of PPPs. Given that competitive auction can only be achieved when real competition exists for the contract [23], any institutional or financial barriers that inhibit competitions could become challenging for PPPs, including but not limited to weak protection of property rights, incapable budgetary control and incompetent financial market.

The more intrinsic shortcoming of PPPs is the high transaction cost during long-term contractual relationship. A lengthy bidding process in PPPs could impose high contracting cost at the beginning, which is the reason why many countries impose a threshold or value to select projects qualified for PPPs. Moreover, since the contract is not likely to be perfectly detailed, there is room for opportunistic renegotiation, which could enable the public and private sectors to take advantages of each other's efforts. For example, Gomez-Ibanez and Meyer [24] noticed that

governments in the transportation sector often bail out concessionaires. Table 2 depicts typical steps of a vertical PPP project. If each sector is not bear the full responsibility of its own actions, such renegotiation is likely to cause inefficient lobbying and even corruption.

In sum, if the cost of renegotiation negates the efficient gain, or if the speculation by any partner could escape the penalty under an unsupportive institutional and financial environment, PPPs may not be the best option for transportation infrastructure projects.

#### 4 PPP applications of publication transportation in China and the USA

Growing demand for mobility has created serious traffic congestion and deteriorating air quality in urban areas. This has encouraged huge investments in the viable public transport infrastructure, such as subway systems, as alternatives to car travel. Many large transport infrastructure projects used to be financed by the government directly, but the financial burden far exceeds the availability of public funds. This section focuses on analyzing PPP public transportation projects in between both China and the United States using the method of case study.

**Table 2** Typical steps of a vertical PPP project

Phase I: Project Identification & Early Consideration	
↓	<ul style="list-style-type: none"> <li>• Assessment of need, economic &amp; financial feasibility</li> <li>• PPP test</li> </ul>
Phase II: Preparation & Project Approval	
↓	<ul style="list-style-type: none"> <li>• Development of PPP delivery method</li> <li>• Development of traditional delivery method</li> <li>• Efficiency comparison test (Value for Money test)</li> </ul>
Phase III: Project Delivery & Contract Award	
↓	<ul style="list-style-type: none"> <li>• Preparation and prequalification</li> <li>• Negotiation process</li> <li>• Selection based on criteria</li> <li>• Contract award and closing the deal</li> </ul>
Phase IV: Project Implementation & Contract Management	
↓	<ul style="list-style-type: none"> <li>• Construction and Operation</li> <li>• Performance control by the government</li> </ul>
Phase V: Contract Termination	
	<ul style="list-style-type: none"> <li>• Transfer</li> </ul>

#### 4.1 Beijing No. 4 subway line

Beijing No. 4 subway line is a 17.4-mile project, which runs through the north and south of the city passing by many central business districts and universities [25]. This is the first project adopting PPP delivery approach in Chinese metropolitan railway system. This line is regarded as the “Golden Line” by Beijing municipal government, and it was partially opened in time for the 2008 Beijing Olympics.

In 2004 after the proposal of allowing investments from outside Chinese mainland was approved by the State Development of Reform Commission, the Beijing municipal government opened up participation in the building and operation of Beijing No. 4 subway line to domestic and foreign companies. Three private players won the contract after a competitive process, in which only a small number of prequalified bidders were invited to take part. These three companies are Hong Kong Mass Transit Railway Corporation (MTR), Beijing Capital Group (BCG) and Beijing Infrastructure Investment Corporation Ltd (BIIC). The former one is a private company from Hong Kong and the others are state-owned.

The signed contract covers a period of 30 years, with the initial 4 years reserved for construction and the rest for operation. The project is divided into two parts (part A and B) according to the characteristics of construction missions. Part A involves civil engineering and physical infrastructure of the project (e.g., earthwork, tunnels and

stations), with an investment about USD 1.5 billion (70 % of the total expenses) paid by the Beijing municipal government (through the No. 4 Beijing Subway Line Investment Company). Part B covers the operational aspects (e.g., vehicles, ticket machines, signaling systems, air-conditioning, fire protection, escalators, elevators, control devices, and power supply facilities), and represents the 30 % of the total expenses [26]. It is privately funded and managed by a SPV, in which the shares of MTR, BCG, and BIIC are 49 %, 49 %, 2 %, respectively, functioning as partners in a regular BOT project [27, 28]. The No. 4 subway line will be transferred back to the Beijing government by 2039. Figure 3 illustrates the joint venture structure and investment agreement of the project.

There was also an asset lease agreement between the No. 4 Beijing Subway Line Investment Company and MTR-BCG allowing the latter to use the infrastructure. During the concession period, MTR-BCG would obtain revenues from ticket fares and the commercial operation of the subway stations. Besides monitoring assets, quality, and safety management, BIIC also plays a role in guaranteeing a certain level of profits for MTR-BCG. Besides subsidy on ticket fares, BIIC promised to make up the difference if the annual revenue is less than 70 % of the projected level, while if it is higher, the exceed part will be absorbed by the equity investors National Development and Reform Commission [26]. In reality, annual ridership of 4th subway has constantly exceeded the predicted level by more than 10 %, generating considerable profit for investors. Since there is no upper limit of revenue gains in the contract, 4th subway faces critics of leaving too much profit to the private sector.

There are many factors driving the operation of this project. First, it is a product under the investment system reform led by the central government. Second, it helps the Beijing municipal government to avoid raising large amount upfront cost in a short term. Last but not least, the intense interaction between different partners has resulted in an environment where mutual learning on technical, management, and economic aspects can flourish, leaving experiences on how to share risks and revenues among public and private stakeholders. In order to govern the PPP activity of Beijing’s 4th subway line, the municipal government had to issue several supplementary documents, including “Regulations on Developing Urban Infrastructure with PPPs Arrangement,” proving that certain institutional environment is necessary to promote PPPs. On the other hand, such amount of efforts led to 18-month negotiation preceding the final contract, which inevitably caused the high transaction costs. Although this cost of time is common in well-designed PPP projects, some government officials may not choose PPPs if they have to delivery public services faster.

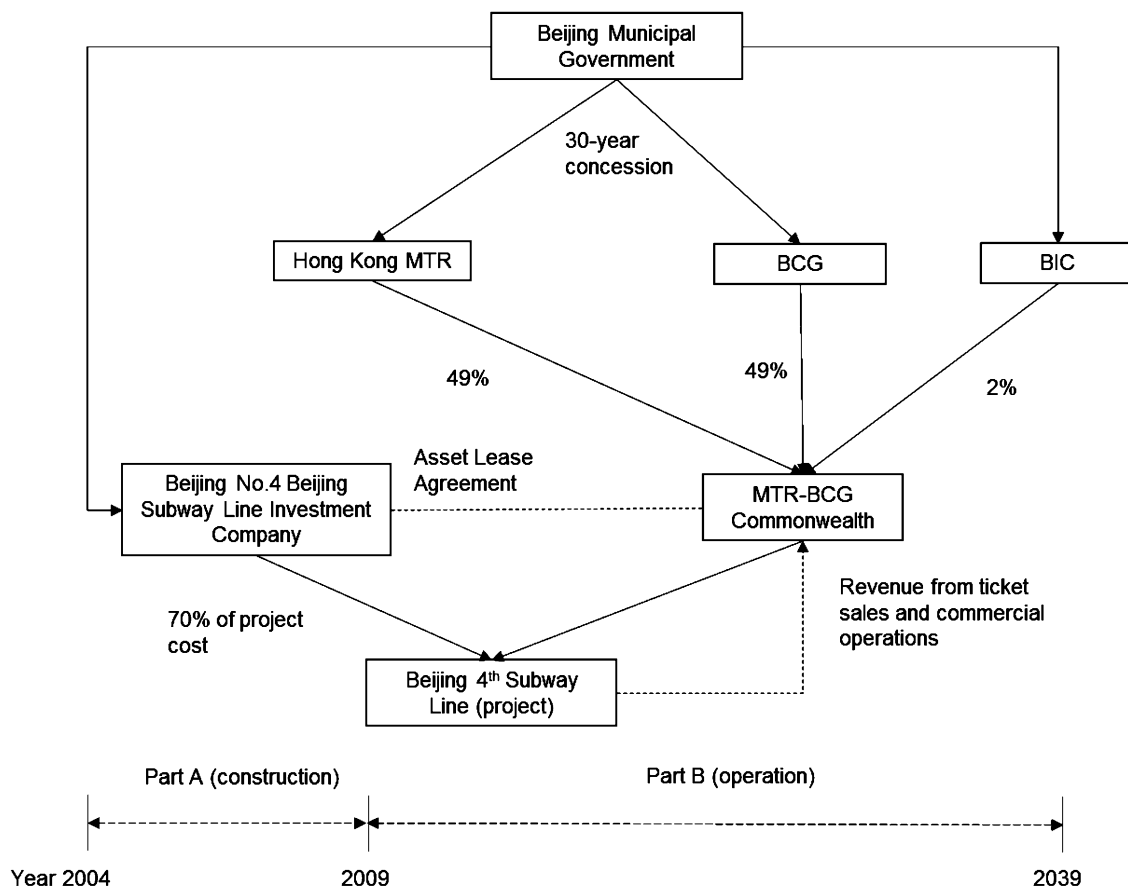


Fig. 3 Joint venture structure in Beijing No. 4 subway line

## 4.2 Las Vegas Monorail

The Las Vegas Monorail is a 3.9-mile rail transit system located in Clark County, Nevada, connecting major hotels and casinos along the world famous Las Vegas Strip. It was built on an existing free monorail jointly owned by MGM Grand and Bally's Monorail. LLC. The tourist growth stimulated the expansion from the original 1-mile system to the current Las Vegas Monorail to satisfy the increasing transportation demand.

In 1997 the State of Nevada passed legislation for the expansion plan to allow a private company to own, operate, and charge a fare as a public monorail system. Later the non-profit corporation, Las Vegas Monorail Company (LVMC), was formed in 2000. LVMC gained a 50-year contract with the original developer, and signed an agreement with Transit Systems Management LLC (BOO partner), for the construction, operation, and management of the project. Different from most public transportation PPPs, the government does not own a share in the venture, nor does the private sector transfer the project to the government. Instead, the public sector participating in this unconventional PPP by providing policy supports.

The primary funding resource of Las Vegas Monorail project is the tax-exempt revenue bonds issued by the State, with further user fares and advertisement to fulfill the debt service. Salomon Smith Barney and the Nevada Department of Business and Industry issued revenue bonds, and LVMC would pay the expenses of operations and maintenance after receiving the bonds. It is worth noting that the State of Nevada was only responsible for bond issuing, and most construction costs were funded by the private sector without government investment, guarantee, or subsidy [29]. As pointed out by the Federal Highway Administration [30], one major innovation in financing arrangement of this project is that the LVMC is the first and only privately owned public transportation systems in the U.S. and operates with no public subsidies. This innovative funding solution using PPP also promoted the development of monorail technology. For example, Las Vegas Monorail is the nation's first fully automated, line haul electric transit system with zero emissions. In 2009 only, tourists who rode the Monorail helped reduce emissions by more than 48 tons of carbon monoxide, volatile organic compounds and nitrogen oxides over the course of the year by saving about 2.7 million vehicle miles [31].

When this PPP project was being implemented, many difficulties have been overcome such as overruns, schedule delays, mechanical failures, and legislation. However, due to inaccurate ridership prediction, LVMC filed for bankruptcy protection in January 2010 when it became unable to pay debt service on the bonds and its other expenses [32]. Following by the recovery of the entire project, the ticket fee of Las Vegas Monorail is now at least double than most metropolitan cities in the U.S.

## 5 Discussion

Although public private partnerships have different development paths in China and the United States, valuable lessons learnt from these two typical cases in public transportation infrastructure will help understanding the contexts of conducting PPPs in these two countries.

First of all, how the government plays its role is crucial for implementing the PPPs. On the one hand, local governments should fully respect the agreements and give considerable freedom to private partners. One counterexample is that the second-largest shareholder of Beijing No. 4 subway line, Zhiqiang Ren, has recently complained about the government's arbitrary decision makings including pricing, investment, and line extension, which led his investment to be a "generous donation" [33]. On the other hand, the lack of the ability for the local government to conduct proper risk analysis and negotiate with private parties inhibits the development of PPPs. Las Vegas Monorail's filing bankruptcy demonstrates the challenges too limited involvement of the government (i.e., the State of Nevada) on the PPP project. The role of the public sector is typically defined by the PPP agreement; thus the core task is to keep the resource allocation and risk taking balanced so that both sectors are able to maximize their capacities [34]. From a financial point of view, before an attempt secure equity financing or debt, it is important for PPPs to have an equitable risk-sharing system.

Second, efficiency and innovation should be sought before funding PPPs. Up to now, most contributions from the private sector have been financed by short-term bank loans, often with the backup from the local governments. However, a bottleneck is caused by the lack of financing sources in future PPP infrastructure developments with the large scale of investment required and the limited guaranteeing capacity of local governments under new regulations. One important alternative is infrastructure bonds, which have been used for years in China and the United States. For example, Beijing recently raised \$1 billion bonds for the development of Beijing metro system in three-year and five-year notes [35]. Another possible alternative to enlarge the investing base is to create opportunities for pension funds

and insurance companies to invest in infrastructure funds on a long-term basis. The project of Las Vegas Monorail has made some innovative achievements by introducing the entirely private-owned public transportation systems. Besides bringing in innovation in project finance, patterning with the private party under a PPP agreement will also attract advanced technology, which make the services sustainable for public purposes [36].

Third, an effective evaluation and renegotiation system shall be developed. If a PPP is considered as an approach of accessing financing only, the chances of failure will be increased because of a high risk of choosing inappropriate projects (also known as "white elephants"). The core criterion while selecting and designing a project is whether it will bring value for money, which is termed VfM analysis. In the context of PPPs, such analysis is conducted to decide whether it would be eventually more beneficial to the public users [30, 37]. If a PPP project does not enhance social benefit, the public sector needs to consider renegotiation the contract or choose other delivery methods.

## 6 Conclusions

The public private partnership (PPP) model offers significant advantages over traditional public procurement in terms of efficiency, service quality, and value for money. The main factor that drives PPPs' prosperity in many countries is the long-term capacity of project finance brought by the private sector, which works along with government supervision and network planning.

Government agencies and companies in the U.S. and China have been collaborating on PPP projects in the area of energy and climate; however, few research studies have been conducted to analyze the difference of PPPs applications in both countries. Since transportation is the major application of PPP all over the world, China and the United States have huge potentials for exploring cooperation opportunities on transportation infrastructure projects.

Among the discussions about promises and challenges of PPPs, public transportation system, especially urban rail system, differs from other infrastructure such as bridges or highway in that: (1) it is more dependent on network planning and coordination at municipal level; (2) the upfront cost such projects takes a larger part of life-cycle cost; (3) to reach a socially optimal scale of service, government has to restrict the level of the user fee, which usually requires government support to sustain the cash flow.

Two typical PPP cases in China and the United States, the Beijing No. 4 subway line and Las Vegas Monorail respectively, are selected for discussion. With analysis of their different PPP structures, valuable suggestions are proposed from the case study that more attention should be



given to the roles of governments during the long-term partnership. Governments need to take discreet supporting and supervising steps of promoting diversity of finance, encouraging innovation of skills and technologies, and creating responsible evaluations. Future research could focus on more recent projects using PPP approach in China and the United State within the field of public transportation, comparing their financing mechanism and institutional systems.

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