

**China Planning Network (CPN)
CPN Urban Transport Congress
Beijing July 19, 2008**

**Current best practices in applying public-private
partnerships to metropolitan subways in China**

Martin de Jong
Xu Shanshan
Dominic Stead

Delft University of Technology, the Netherlands
Harbin Institute of Technology, People's Republic of China

Abstract

Rapidly growing motorization has led to problematical levels of traffic congestion and emissions urging large Chinese metropolitan areas to invest in subway development. The financial needs, however, far exceed the availability of available public funds. Since 2001, therefore, the Chinese government has allowed lower tiers of government to experiment with Public Private Partnership and private finance to supplement their funding needs and promote the generation of Value for Money in transport infrastructure investments. Analysts often claim that institutionally, countries have to fulfill certain institutional, macro-economic and other requirements before they can make effective use of PPP. In this article, China's record in meeting those requirements as discerned in the literature is investigated and conclusions drawn as to where the remaining weaknesses lie. Subsequently, seven PPP projects for subways in five large metropolitan areas in China (Shanghai, Beijing, Shenzhen, Chongqing and Harbin), just finished or currently under way, are investigated to find out China's empirical record. At the end, conclusions are drawn as to China's current status and its strengths and weaknesses into the future.

1. Introduction

The massive speed and scale with which economic changes are occurring in China far exceed those anywhere else around the world. China currently has over 40 cities whose population surpass 1 million, and 8 cities with more than 3 million inhabitants (Ai 2006). Because of large differences in the standards of living between urban and rural areas, the pressure of urbanisation is only bound to increase further in the coming years with huge implications for urban transport demand. Rising income among citizens and a decrease in restrictions imposed on car ownership by the Chinese government have already led to problematical levels of car congestion in most key metropolises (Ng & Schipper 2006). National, provincial and local governments around

the country have concluded that massive investments are urgently needed. Road capacity should be enhanced at the national, provincial and local levels and the larger cities are in need of Metro Rapid Transit (MRT) to provide viable alternatives to energy-intensive, space-consuming, contaminating and sometimes unsafe car use. However, public funds to achieve these objectives are limited. Subway systems, often considered the vital backbone of any metropolitan public transport system, require rapid extension in some of China's leading cities and development from scratch in others. Like other Asian countries such as India, Thailand and Malaysia, China is placing a high priority on construction and extension of subway network in metropolitan areas (Phang 2007). In its latest annual report, the Chinese National Development and Reform Committee (2007) estimated that there will be more than 30 cities with MRT construction projects underway in the next 15 years. The necessary investment will surpass 600 billion Yuan (approximately €60 billion). Table 1 presents the projected investments in urban railways in China in the coming decades and gives an impression of both the high ambition levels of the Chinese governments and the enormous efforts involved to implement these ambitions.

Table 1: Chinese metropolises and their subway projects

T1 Metropolitan areas already having a subway system				
Name	Date of Completion	Number of Lines	Length (km)	Estimated Costs (Billion Yuan)
Beijing	2010	11	270	93.6
	2015	15	561	268.2
Shanghai	2012	12	510	160
	2030	17	780	225.4
Shenzhen	2010	5	154.25	68.34
	2020	13	267.0	115.26
	2030	16	585.3	290.31
Guangzhou	2010	5	130	40.10
	2030	8	205.5	81.62
Tianjin	2015	9	234.7	104.1
Nanjing	2015	7	263.1	132.77
T2 Metropolitan areas with subway lines under construction				
Xi' an	2009	1	20	11
	2013	2		
Shenyang	2009	1	22.05	9.48
	2010	2	82.2	45
Harbin	2012	1	14.33	8.24
	2030	5	143	62.23
Chongqing	2013	1	37.7	20.74
T3 Metropolitan areas with subway lines in preparation				
Kunming	To be built in 2009			
Qingdao	To be built in 2010			
Hangzhou	To be built in 2009			

Note: Changchun, Dalian, Wuhan, Chongqing have light rail systems in place. These are not included in the table.

Sources: <http://www.ccmetro.com/>, <http://www.drc.gov.cn/>, <http://www.df8.cn/search.asp>, <http://www.urbanrail.net>, *The Future Layout of Subway*

Networks in Shenzhen, Governmental Issued Document, Subway Construction and Administrative Centre of the Municipal Government of Shenzhen, 2008 (in Chinese), *The Construction Layout of Urban Rail Transit System of Shenzhen*, Research Centre of Urban Rail Transit System of Shenzhen, 2006 (in Chinese), *The Review Report of Construction and Operational Models for Mass Rapid Transit Systems in Beijing*, Urban Rail Transit Committee of the Chinese Transportation Association, 2007 (in Chinese).

The large majority of all transport infrastructure projects in China to date has been primarily financed with national, provincial or local public funds and managed by means of State Owned Enterprises (SOEs). Many of these SOEs have also borrowed money from banks and ran into heavy debts (Hu 2008, Huang & Xia 2006). Since there would always be state guarantees for that money to be paid back, those SOEs could always borrow at low rates. They could also incur serious cost overruns without going bankrupt or experiencing great difficulties. Wise financial-economic standards often mattered less than political pressure and personal friendships. However, criticism of these practices has grown in recent years: SOEs are now often accused of running the complex, large and costly infrastructure projects slowly, and in wasteful, unprofessional ways (Wei 2004, Wang 2004a, 2004b, Xu 2008). It should not be forgotten, however, that 10 cities in China, including some of the largest cities (Beijing, Shanghai, Guangzhou and Shenzhen) have all used this 'traditional procurement model' for their first subway lines. Shanghai did so with additional foreign loans, and Guangzhou with additional land rent charges, which is common in nearby located Hong Kong (Tang & Lo 2008).

The concept of public-private partnerships (PPP), which was first adopted in the United Kingdom in 1992 (Hodge & Greve 2005) and has since been followed by several other Western countries, was officially embraced by the Chinese government in 2001, when the Chinese National Planning Committee issued the policy note entitled 'Suggestions to promote and guide private investments'. This policy note recommended the use of incentive mechanisms to attract private capital and extended the domains in which private investment was permitted (Chen 2004). The set of permitted finance channels was broadened, impartial tax policies were implemented and governmental monitoring and management were improved. In 2002, a follow-up report 'Suggestions to advance marketisation in civil infrastructure industries' was released, in which a concession system was introduced (Chen & Qiu 2005). Since then these beginnings have been supplemented by other statutes on public bidding, a political framework for BOT projects in which its reach is extended and legal provision have been refined (Chen 2005). PPP had incidentally already been applied to road projects before, but its application to subways was new.

Worldwide both positive and negative experiences with novel contracting practices and outsourcing arrangements have been reported (Koppenjan 2008a, Koppenjan & Enserink 2005, Phang 2007, Chang, Menon & Imura 2003). It is a good Asian tradition to systematically gather knowledge from foreign examples and good practices and, subsequently, to implement the most useful lessons at home. The adoption of PPP for transport infrastructure planning and funding by the People's Republic of China has been no exception to this rule. But international experts have made it clear that China still

has a long way to go for PPP. Compared to early adopter countries now seen as mature and having obtained 'executorial excellence' (e.g. UK and Australia) and transient ones working on 'effective governance' (e.g. Spain, South Korea and Japan), China is in a group of relative latecomers still working on 'long-term commitment' to PPP along with diverse countries such as Thailand, Brazil, India, Germany and the US (Guo 2007). Mature countries are now said to face issues related to perfecting their performance (producing robust business plans, generating an attractive and stable risk allocation, having a transparent and robust tendering process and an effective controlling framework in place). The middle group is working on a robust legal and institutional and regulatory framework, clear standards for PPP-models, project selection and evaluation and effective and capable government institutions. China, as a relative laggard, is still in the process of developing a clear vision for the role of PPP in infrastructure delivery, generating a robust and transparent pipeline of viable PPP projects and creating a positive PPP-image. According to Guo, China still has quite along way to go.

In this paper we examine exactly where China currently stands on the financing schemes of recent subway projects, what the Chinese experiences have been to date, and how PPP has been adopted to fit the specific Chinese circumstances in the case of subway schemes. More specifically, we address the following questions:

- What are the main motives for introducing Public Private Partnerships for transport infrastructure in the People's Republic of China (section 2)?
- Which forms of PPP have been distinguished in the academic literature on the subject, and which of those have been adopted in China for subway management (section 3)?
- What institutional, financial, practical and other requirements for effective PPPs engendering Value for Money (VFM) have been formulated in the academic literature? What is China's experience to date (section 4)?
- How has PPP been used in projects for subway infrastructure projects in China? Here we examine 7 large construction projects in 5 Chinese metropolises (Beijing, Shanghai, Shenzhen, Chongqing and Harbin), identify the procurement models that were chosen and evaluate their performance (section 5)
- What can we conclude about the state-of-the-art of PPP-application for subway infrastructure in China, and how has the approach been appropriated within the Chinese administrative system (section 6)?

By providing answers to the questions above, the authors hope to contribute to (1) growing knowledge regarding the transferability of institutional arrangements originating in a typically 'Western' or 'Anglo Saxon' legal, political and cultural environment to very dissimilar contexts, such as the Chinese one, and (2) effective and equitable implementation and further improvement of PPP in the world's most populous nation, where accommodating the skyrocketing mobilisation in a sustainable manner is in fact of global rather than just national importance.

We have based ourselves on relevant literature on management of public-private partnerships and its application to subway maintenance management, leading recent international and Chinese reports, relevant policy and project documentation in Mandarin, and a set of interviews with policy-makers, managers and experts working on subway infrastructure projects in Beijing, Shanghai, Shenzhen and Harbin.

2. Why introduce PPP for transport infrastructure in China?

Large transport infrastructure projects such as subway systems require huge amounts of capital. Although some Chinese cities, such as Guangzhou, have decided to continue to rely on traditional public procurement models, most other metropolitan city-governments have started to consider alternative forms of funding. This has happened because city governments do not have sufficient financial resources and do not consider SOEs as an attractive an option. In many cases, the belief within these city governments is that only funding from the private sector can fill the immense gap between the limited presence of public resources and rapidly growing sustainable urban infrastructure needs. This is often the dominant motive for PPP in developing countries: here China is no exception. A strong focus on Value for Money, although also often expressed in official policy documents, is often only a second motive after the urgent need for money in emerging economies (Phang 2007).

Another reason often echoed in policy documents and the media, both nationally and internationally, is the desire to introduce competitive pressures to the world of construction. In the past, large construction contracts were awarded over-the-counter to partners well-known to the authorities, but in often opaque ways to other parties and the wider public. In China, these long-standing practices led to growing criticism of ineffectiveness, low speed, lack of transparency and even widespread corruption (Mu 2008). Competition through open tendering in the field of transport infrastructure is seen as a way of dramatically improving performance (Xu 2008). Developing a legal framework with clear procedures regarding the phases of planning, tendering, design, construction, maintenance and operation of transport infrastructure projects or any public service amenable to PPP would drastically improve transparency and accountability. It could save tax-payer's money, create a level playing field among various suppliers and force large SOEs to operate at market prices by ending their de facto monopolies or cartels in the business (Yusuf, Nabeshima & Perkins 2006). In some countries, such as Spain, Italy and Chile, this has been done by enacting specific full- fledged and detailed PPP legislation, while other more pragmatic ones such as Britain, Ireland, Norway and Finland have eliminated legal inconsistencies between various pieces of legislation relevant to PPP without an explicit attempt to make encompassing PPP-legislation (Bruzelius 2005). In principle, China can still choose from both legislative options. The advantage of the first is its clarity and completeness, that of the second its flexibility of use. Using competition to discourage Chinese SOEs from borrowing even larger amounts of capital for yet other new projects and reducing their future debt levels seems a likely scenario. Demand for traffic is growing so fast that regardless of their cash income from toll, it will be sufficient in the coming years to safeguard the eventual payback to their creditors.

While SOEs tend to become more disciplined by these institutional changes, market opportunities for segments of the private sector are actually enhanced. Banking, construction, engineering and consultancy outside of established consortia can deploy more activities in the construction sector than before and acquire skills in new markets. Some observers even go so far as expressing the hope that the negotiations preceding good contracts between public and private players will provide strong incentives to both sides for more solid quantitative assessments of various project alternatives. More 'scientific relations' between governments and private organisations regarding priority-setting, risk allocation and the sharing of responsibilities, costs, benefits and possible losses and profits could be developed (Cui 2006, Wang 2004a). In other words, this would promote the use of cost benefit, cost effectiveness or multi criteria analyses leading to less politicised and more rigorous policy-making. It could also include the use of Public Sector Comparators (PSC) in which the likely costs and benefits of a PPP construction are compared with those likely to arise if the project were done in a fully public mode (Xu 2008). The realism of this expectation of 'enhanced rigour' strongly depends, however, on the institutional requirements set for the decision-making, tendering and selection procedures. If much emphasis is placed on the merits of analytical studies as basis for project selection and the countering of producing biased information, this effect might indeed occur. In such cases incentives (not guarantees) exist that most relevant decision-making aspects have been considered, and both public and private players will ensure that the costs, benefits and risks allocated to them will correspond with what they can realistically and wisely bear.

Last but not least, there is a strong macro-economic argument to pour substantial amounts of private funding in public projects. The reason for this is, as in several other countries in East Asia, they are coping with comparatively high saving surpluses leaving banks with the luxury problem how to spend this influx of money wisely and at a high profit. The growth in mobility and motorisation in China tend to make the economic prospects of investing in this industry markedly better than they would otherwise be. Consequently, if good prospects are offered free of excessive risks from unexpected political intervention or engineering calamities, putting funds into transport infrastructure may be an attractive option for private investors in China.

3. Different forms of Public-Private Partnerships

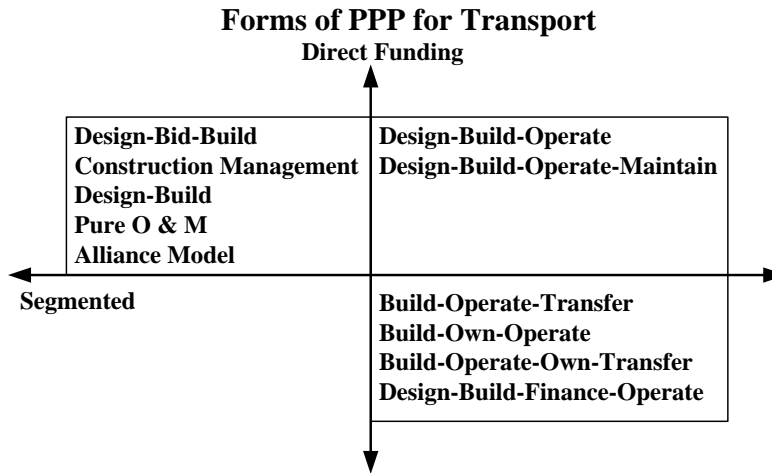
Authors have defined PPP in many different ways (see for example Koppenjan 2008b, Greve & Hodge 2005, Grimsey & Lewis 2002). Although all agree that PPP projects are projects in which private parties are involved in the design, construction, maintenance and operation of a public infrastructure on the basis of long-term contracts or arrangements, some focus mainly on the aspect of private finance, while others give it a more comprehensive interpretation in which the division, sharing and management of various tasks at hand are included (Miller & Lessard 2000, Li & Akintoye 2003, Devapriya 2006). In this article the second definition, which is common in China, is followed in developing a typology of PPPs used in the world of transport infrastructure. Li (2003) has defined it as a provision scheme for public goods or services through the establishment of a co-

operative partnership between the public and the private sector, based on the signing of contracts or agreements that explicitly reflect the rights and obligations of partners for each of them in advance. This cooperation can occur at any phase of the project, investment, design, construction, maintenance and operation. Miller & Lessard (2000) and Pakkala (2002) have identified two axes to distinguish different forms of PPP. The first one refers to the level of separation or integration of the various phases or activities required for the completion of a public project. Usually, the sequence in phases on which typologies are based are Design (D), Build (B), Maintain (M), Operate (O), Manage (also M) and Rehabilitate (R). Separating all of these phases in different contracts granted to different actors is considered 'old style', whereas combining them in one large-scale and long term contract allocated to a comprehensive consortium is seen as 'novel', because the longer time horizon, greater economies of scale and availability of a great variety of capacities and skills would allow for more cost saving and innovative technical and process solutions (Pakkala, de Jong and Aijo 2007). Thus Design-Build-Operate-Maintain-Rehabilitate (DBOMR) would be comprised of all relevant elements of project completion in one contract and offer the greatest likelihood of high VFM. In addition to the above, several aspects pertinent to contracting or construction not covered under the above terms have sometimes been incorporated in the wealth of procurement model acronyms. The main ones are Finance (F), Bid (also B), Develop (also D), Transfer (T), Lease (L), Upgrade (U), Purchase (P) and Own (also O). The rather traditional Design-Bid-Build would for instance be abbreviated to DBB, while a well-known more modern procurement model focusing more on the entire infrastructure life cycle reads as Build-Operate-Transfer (BOT). An arrangement where ownership permanently remains with the private sector would be Build-Operate-Own (BOO), and if it is transferred back to the state after a number of years, it would be Build-Operate-Own-Transfer (BOOT). One of the most progressive, but also risky arrangements could be Design-Build-Develop-Finance-Operate-Maintain (DBDFOM), which includes all functions and ample space for commercial development of areas around infrastructure links and nodes. Similarly, many more creative combinations can be thought up, as has been done by Wang Hao (2004b). We will come across some examples of them in section 5. Although the emphasis on integrated packages is tempting, in reality the desirability of applying them remains quite context-dependent. The costs for organising tenders and monitoring are often quite high, making integrated contracts for small projects or activities or deals with players whose reputation is unknown or doubtful highly unattractive.

Some of the well-known characters in this set of project management configuration acronyms (Finance, Lease, Purchase and Own) refer to the second axis, which is on the direct versus indirect sources of income for the project. Completely direct funding is assumed to involve exclusively or predominantly public sector funding, while indirect funding may include various forms of private investor funding, fees collected from infrastructure users, loans from even public banks or even full-fledged ownership of the infrastructure by one or more private players. The general belief is that indirect funding is more modern than direct finance coming from the public coffers. But again, this very much depends on the circumstances and involves high risks

too. In fact, some analysts claim that the origin of the funds is not the relevant factor for project success or failure, but rather the presence of incentives for responsible and reasonable conduct for the various players involved in a project (Tam 1999, Virtuosity Consulting 2005).

Figure 1: Forms of PPP for transport infrastructure



Source: Pakkala, de Jong & Aijo (2007).

Not all of the above mentioned procurement models are currently being applied in China. Most of the radically innovative ones have been eschewed until now, since gradualism is preferred to let policy-makers, managers and practitioners become acquainted with new processes before they are deployed in their full complexity. Overall, though, one can say that authorities and enterprises in the larger metropolises, the coastal areas and Southern China are less traditional and more forward-looking than in other parts of China, fully in line with general development of economic reform around the country.

An alternative typology developed by the World Bank, revised by Frank (2004) and Wang (2004a) distinguishes six different types of PPP that differ in terms of asset ownership, operation and management, investment, contract duration and division of commercial risk.

Table 2: Categories of PPP Schemes

Types	Assets Ownership	Operate & Manage	Investment	Contract Duration	Commercial Risk
<i>Service Contract</i>	Public Sector	Share	Public Sector	1-2 years	Public Sector
<i>Management Contract</i>	Public Sector	Private Sector	Public Sector	3-5 years	Public Sector
<i>Lease</i>	Public Sector	Private	Public Sector	8-15 years	Shared
<i>Joint Ventures</i>	Public Sector	Shared	Shared	20-30 years	Shared
<i>Build, Operate and Invest</i>	Public Sector	Private Sector	Private Sector	20-30 years	Private Sector
<i>Divestiture</i>	Private or Shared	Private Sector	Private Sector	Forever	Private Sector

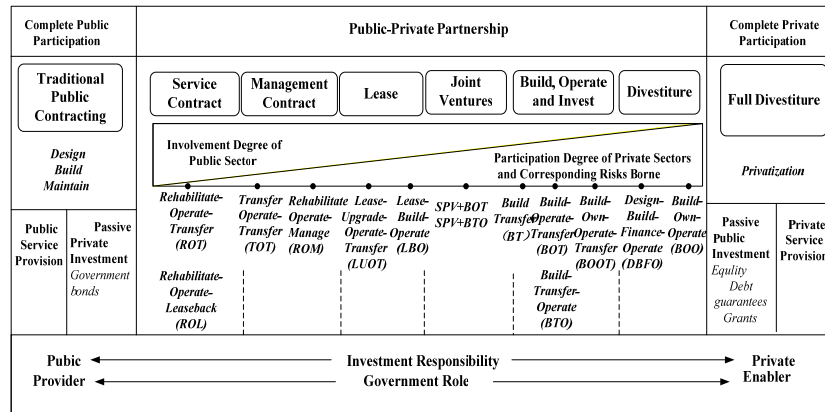
Adapted from Frank (2004) and Wang (2004a).

Financial profitability in operating subways is often problematical, because not all positive externalities are included in the price. Conversely, positive externalities are much higher and upfront specification of project requirements and risk transfer to private parties are far more difficult. Therefore, the comparatively more complex procurement models have been embraced in which a host of different players are involved in design, construction, maintenance, operation, funding and consultancy. The most popular forms in China were found to be Build-Transfer (BT) and Build-Operate-Transfer (BOT), which in the World Bank typology would all be subsumed under Build, Operate and Invest. These have been applied for the newer lines in Beijing and Shenzhen, partly based on management experiences transferred from Hong Kong. Railway construction and development corporations from Hong Kong are actively involved in subway line construction, funding and management in Beijing and Shenzhen and have added Build-Develop-Operate-Transfer (BDOT) to the collection. This procurement model is now considered state-of-the-art practice in both Hong Kong and China. It must be added that it can be put to use more easily in areas where land prices are high making condensed commercial land development attractive (e.g. Hong Kong, Shenzhen and Beijing) than in less densely populated parts of China.

Furthermore, in Beijing, a Joint-Venture scheme has been used for the newly constructed 4th line, where a so-called 'Special Purpose Vehicle' (SPV) has been set up to coordinate all relevant managerial issues. An SPV is a combined public-private-law body with representatives from the main parties on the board free from direct political interference. In Shanghai, something similar, an SPV Project Company, has been used for the construction of the most recent subway lines, but it differs from the one in Beijing in that it is a public organisation comprised of state companies yet free from direct governmental interference. It can actually be seen as a series of distinct management or service contracts rather than BOI.

In the table below, taken from Xu (2008), an attempt to combine the two typologies above has been made, and the dominant models as applied for subway infrastructure in China can be located. It should be added here that for reasons of space in the table BDOT here falls under the same heading as BOT (Kumaraswamy & Zhang 2001).

Figure 2: Forms of PPP and degrees of private involvement



Source: Xu (2008)

4. Institutional and other pre-conditions for effective PPPs

Flexibility, technical know-how, risk allocation to those players best able to carry them, market and marketing expertise, transparent book-keeping and fast decision-making are believed to be the main contribution the private sector can make to infrastructure development (OECD/ITF 2007). Most available public reports in which the international practice is evaluated explicitly indicate that efficiency in generating Value for Money should be the main target for using PPP for transport infrastructure projects. The actual use of private finance as such does not necessarily provide a positive contribution to this (Virtuosity Consulting 2005, Bruzelius 2005, OECD/ITF 2007, Clifton & Duffield 2006). In spite of this, most governments are simply driven towards applying the PPP concept once public funds have dried up as a short-term political necessity when demand for transport capacity remains high. This implies that the primary driver for introduction is not always the one allowing for maximum Value for Money, although a steep learning curve among the main participants can lead to learning curves where along the way questionable political desires are converted to wise long-term service-improvement in infrastructure provision.

The academic literature and a number of international reports specify a range of essential institutional conditions that should be met before PPPs can be fruitfully put in place (these have been collected in de Jong & Mu 2008). It is often in developing countries, which also have the worst record in overrated benefits and project cost overruns, that some of these conditions seem to be lacking (Flyvbjerg, Bruzelius & Rothengatter 2003). Among these conditions the presence of secure private property legislation, solid anti-collusion and anti-monopoly laws and legislation enabling authorities to coherently utilise PPP rank high. In addition, acts obliging both governments and private parties to only proceed to action after economic, technical and environmental assessments have been conducted, cross-checked and improved, are crucial to the quality of decision-making. Underlying these specific preconditions regarding economic legislation, there are general rule-of-law issues to be resolved. If the above laws and acts are not effectively enforced, if effective recourse by private players to the law is not possible, and/of verdicts reach by courts are not executed or followed by administrative bodies, the entire framework mentioned above will also falter (Cow 2003). In the case of the People’s Republic of China, the evidence regarding the above institutional

preconditions is mixed. New laws to protect private property and safeguard industrial competition have been enacted in recent years, and a review whether new legislation to structure Public-Private Partnerships is needed, is taking place. On the other hand, strong informal personal links between public bodies and representatives of some SOEs or private corporations make the existence of actual level playing fields in the market questionable. For instance, when invited rather than open tendering is used for the selection of contractors, or when the criteria or procedure for selection lack transparency, the odds are that weaker project proposals may be chosen. Allowing for only public book-keeping and official publication of both selection criteria and all bids made would be a big step to increase openness, reliability and accountability. Moreover, effective recourse to the law is sometimes questionable as long as all acting judges in courts have to be member of the Chinese Communist Party and such are subject to the party-line decided by the Legislative and Executive rather than the Judiciary. This makes both independent judgement and effective execution of court decisions problematical (Lieberthal 2006, Chow 2003). It is both individual citizens whose individual interests are harmed by projects and corporations who are unable to ward off unexpected and undesired interventions by governmental agencies in the management practices that could suffer.

Less often mentioned, but equally important is the presence of checks and balances among the various players in correcting cost and ridership estimates and the institutionalisation of counter-expertise against the initiators and beneficiaries of project when bids are evaluated and before contracts are signed. As some players can benefit from artificially low estimates, while the opposite goes for others, checks and balances are the only way to mitigate the presence of systematic bias. Relatedly, what is quite often noted as key to the quality of cost and benefit estimates is the allocation of various types of risks (market, capital market, political, project, technical, etc.) of those actors best able to estimate and deal with them. Since there is a very extensive literature on these issues, we do not have to go deeper into them here. Suffice it to say that the institutionalised use of counter-expertise and the keeping and sanctioning of each player to its estimates and promises made initially (within reasonable boundaries) would make a giant leap forward possible in the quality and reliability of decision-making and project management. China's record is meagre on these counts, but here it is in good company, because very few countries have such preconditions in place.

Apart from the formal institutional conditions for applying PPP fruitfully to transport infrastructure projects, additional informal behavioural relations among players should evolve as experience with the new procurement models grows. In case this lesson has not been picked up from experience gathered in other countries, most players will come to see the value of a life cycle view of transport infrastructure. Even though short contracts (say, from three to five years) add more to the competitive atmosphere among bidders, long term contracts (usually of twenty years and over) allow contractors to spend comparatively more resources on technical innovation and sustainable solutions. They can feel secure about their stream of resources over the years and can connect design, construction,

maintenance and operations with each other and generate economies of scale. Some claim that the benefits of long comprehensive contracts with reliable and knowledgeable contractors far exceed those of short specialised contracts (Pakkala, de Jong & Aijo 2007). The latter form of contract may lead to a narrow focus on cost-cutting and induce opportunistic behaviour in systematically overlooking relevant elements not explicitly mentioned in the contracts. More generally, lasting commitment and trust between partners is indispensable in realising the symbiosis expected from PPP. Otherwise, both public and private partners will be strongly driven by cost-saving and effort minimisation. The latter conduct often arises when doubtful actions or omissions, from a wider socio-economic perspective, are not illegal and can therefore pass with impunity. Here, China is still relatively at the beginning of the learning curve. Public agencies are sometimes still grappling with finding reliable partners, or even struggling to be reliable partners themselves refraining from infringement in detailed construction matters. On the other hand, the choice for many BOT-style projects as a careful start-up of the process of gathering more experience has probably been wise, given painful experiences with further reaching procurement models in other Asian cities, such as Kuala Lumpur and Bangkok (Phang 2007).

Another crucial requirement for successful use of PPP, one could say even prevention of project disaster, is the selection of credible, knowledgeable, experienced and reliable contractors. Intelligent tendering and smart contractor selection necessitate often drawing lessons from other cities/countries and gaining personal experience. The relevance of introducing financial incentives by public authorities in ways that push contractors to deliver fast and keep service quality high across time will then become readily apparent. It is normally considered unwise to start payments before the final infrastructure product has been delivered and available for passenger-use. Alternatively, payments can be made to contractors at regular time intervals based on their actual (and satisfactory) delivery of the required products and services. China's record on this count is extremely varied, and this will be reflected in section 5. More often than not, administering specific incentives in project management depends on individual projects rather than country policies.

In addition, it should be said that in most nations where innovative contracting has been tried for some time, explicit efforts were made to formulate definitions and lists of quality demands and requirements through which contractor performance can be better monitored and evaluated (Altamirano forthcoming). These indicators or requirements were formulated at higher aggregation-levels to prevent public agencies from mingling with technical specifications under the responsibility of contractors, while allowing them to maintain an eye on general quality of delivery. Only the most advanced countries worldwide, such as Britain and Finland, have begun this development.

Finally, two market-oriented considerations seen as state-of-the-art should be mentioned here. Firstly, in the more entrepreneurial countries and constituencies, commercial land exploitation around transport links to enhance private benefits and reduce public costs has grown in importance and is sometimes vital to making projects

financially viable. In China's immediate surroundings, Hong Kong is considered an extremely valuable breeding ground and source of inspiration for such practices, even a world leader (Shen, Platten & Deng 2006, Tang & Lo 2008). Similar ideas are currently being tried on a new subway line in Beijing. The value of lands along newly developed routes has been claimed to increase by 20% in China on average (Ma Zhong & Luo Xiao Min 2006). Secondly, private interest rates at the capital market should not far exceed public ones. Should that be the case, then public borrowing is so much cheaper than using private pre-finance, making private investment too unattractive. It would also open the door to starting up a new round of non-refundable loans (Yusuf, Nabeshima & Perkins 2006). In China, large amounts of capital are cheaper and easier to get for the government and SOEs than for private firms, because of public loan guarantees and substantial government and SOE pressure on banks to provide loans without rigorous financial-economic tests. Yet the need for additional capacity in transport infrastructure is so vast, extra private funding is still in high demand, in spite of higher interest rates to be paid by private debtors.

5. China's record in using PPP for subway infrastructure

In order to show an up-to-date account of the way in which Public Private Partnerships are applied for the subway management in China, we have collected evidence from 7 cities in 5 metropolitan areas, some of which encountered more hurdles than others. The cases are:

1. The 1st subway line in Chongqing (BDOT)
2. The 1st subway line in Harbin (BDOT)
3. The 5th subway line in Beijing (Joint Venture)
4. The Olympic Games subway lateral in Beijing (BT)
5. The 4th subway line in Shenzhen (BDOT)
6. The 4th subway line in Beijing (Joint Venture)
7. The 3rd subway line in Shanghai (Service and Management contract)

We will first give a brief account of the cases in which PPP was abandoned, and the reasons why this happened. Since these had little to do with the specific procurement model that was chosen, we will not pay much attention to these details. Subsequently, for each of the more fortunate cases, we will briefly present their chosen procurement model, their more specific institutional and contractual parameters and their strong and weak points.

1st subway line in Chongqing

For the 1st subway line of Chongqing, a Build-Develop-Operate-Transfer model was employed. The municipal government of Chongqing and the Hong Kong based Shen Hua Development Corporation Ltd (SHDCL) already signed an agreement in 1997, in which the latter would be made fully responsible for financing, construction and operation of the project, while the Chongqing city government remised land along the subway routes at preferential prices and tax rebates to carry out real-estate exploitation.

Unfortunately, the agreement was terminated in 1998 after SHDCL turned out to have serious liquidity problems. It had borrowed huge sums for land development and put a lot of effort on earning money in

this manner, but had neglected the infrastructure part leaving just an unfinished 800-metre tunnel to Chongqing. The lesson that selecting a reliable, non-opportunist contractor is key to successful PPP arrangement was learned the hard way by Chongqing policy-makers.

1st subway line in Harbin

Since 2005, the municipal government of Harbin had planned to sign a BDOT-style subway development agreement with Harbin Institute of Technology Group Ltd (HIT Group) for the construction of its 1st metro line. It had encountered some difficulties finding contractors meeting the necessary financial and competence requirements and only the HIT Group seemed to meet them after a process of public bids and official qualification tests. The chosen arrangement would allow HIT Group to develop land along the route commercially. The last step before signing was approval from central government, which the latter refused to grant because all Chinese national land used for commercial purposes must be acquired by public competitive bidding process under the existing legal system, making the situation too insecure and unprofitable for both partners to further proceed. Apparently, for metropolitan areas even the size of Chongqing and Harbin, without previous PPP and subway experience, it is difficult to find the critical mass of qualified and/or reliable construction consortiums together to make serious competitive bidding possible.

5th subway line in Beijing

The 12 billion Yuan 5th subway line, planned since the late 1990s, was to be co-funded by two private companies, domestic Capital Inaugurating Ltd (for Y 1.9 billion) and Canadian Infrastructure Investment Ltd (for Y 1.5 billion), and one public, Beijing Subway Operation Company (for Y 0.6 billion). Their combined effort would be managed by a newly set up SPV project company and the 4 billion (one third of the total investment required) met the conditions imposed by the Chinese National Planning Committee to proceed for a Joint Venture in which the SPV would finance, construct and operate the new line for 25 years. The Beijing municipal government promised to subsidise the SPV for the gap between the publicly imposed ticket fares and the actual costs needed to cover the SPV's investments. This safeguard was not deemed sufficient by the Canadian investors. They feared that the calculation mechanism would grow too complex and have uncertain outcomes, so they demanded subsidies to be provided to the SPV beforehand, during the construction-phase, which could be spent on constructing the earthwork (e.g. tunnel, track and stations). Central government demands competition in bids when land development is allowed in contracts. The feared the calculation mechanism would grow too complex and involved high uncertainty, and demanded that the subsidies be provided to the SPV during the construction-phase. In this way, the SPV could achieve returns of around 40% of its initial investment during the construction process. Although the Beijing municipal government agreed to this construction, hard-fought negotiations followed which stagnated in June 2002. Soon after, the entire co-operation was terminated. The bottleneck in this case was the Canadian insistence on legal guarantees for the subsidisation scheme, for which no appropriate legislation exists in China. The Beijing government, on the other hand, demanded a detailed scheme on maintenance and operation be submitted to

evaluate the feasibility of the subsidisation scheme. Eventually, the loss of trust among the partners gave the final blow to the project.

Olympic Games subway lateral in Beijing

Build-Transfer is a variant of BOT, I which contractors are only made responsible for preparation and construction, but not for operations. It shares features with a service contract too, mainly the short duration (here 5 years), except for the additional transfer of financial responsibilities. After the contract period, the completed works are to be transferred back to the public sector against an agreed sum. The Beijing municipal government made use of this procurement model for the building of the Olympic Games subway lateral. On April 29, after winning the bidding process, the State Investment Corporation Ltd was invited for to sign the contract, along with three private contractors, the Parent Company of the Chinese Railways, the Electrification Office of the Chinese Railway Group and the Third Office of the Chinese Railway Group. These four parties were to contribute 35% of all investments at the outset. The three private ones would take on the earthwork, rail construction and electromechanical systems of all Olympic stations and then deliver the result to the State Investment Corporation Ltd, which would pay for their services by means of purchasing their stocks for a sum of money agreed in the contract.

Compared to the arrangements in the six other projects, this one was comparatively low-risk and a safe way to start the innovative contracting learning curve. It allowed for the collection of private funds in an uncomplicated manner, the decision-making process ran rather smoothly and the preparation stage involved higher transaction costs than usual, but these lower than average in the implementation phase. As drawbacks compared to the other models should be noted the lack of incentives to private parties to optimise their performance and further develop and transfer their technical, financial and managerial knowledge. In other words, the project has progressed relatively smoothly without pushing contractors to do anything exceptional and excel.

Extension of Shenzhen's 4th subway line

Compared to Beijing's Olympic lateral, the procurement model chosen by Shenzhen for the extension of its 4th subway line was definitely more daring. It adopted a so-called BDOT arrangement, in which construction and operation were combined with land development. After a bidding process, the municipal government of Shenzhen selected the Hong Kong Subway Construction Corporation Ltd (HKSCCL) as the sole private contractor and allowed it a 5-year construction period, followed by a 30-year operation period. In addition, it provided 80 hectares of land around the 4th line for commercial development at only 60% of the market value to the SPV set up by HKSCCL (for usufruct, since public land cannot be sold in China). In exchange for this favourable condition, the contractor could not claim any public subsidies in the operations phase. The agreement on issues of investment, construction and operation of the extended 4th subway line was signed by Shenzhen's municipal government and HKSCCL was signed January 15, 2004. Although the negotiations had taken some time (mainly on land exploitation, ticket prices during the operations phase and monitoring issues), what gave the entire

enterprise higher credibility was the incorporation of this project in a whole set of subway construction projects completing the metro network to five lines altogether.

HKSCCL set up an SPV project company with at least 40% registered capital of the total required investments at the beginning. The rest of the amount should be secured through various financing sources from inside and outside China, and it is not permitted to mortgage construction lands of the project to borrow loans for the SPV. In addition, HKSCCL is to own at least 51% of the SPV stocks.

In this scheme, public responsibilities were restricted to the surveillance of the construction process and service levels during the operations phase. This is an absolute need, however, for two things must be emphasised. Although this arrangement is innovative and many risks have been transferred to the private operator, not too dissimilar packages faltered in Chongqing, because the constructor was neither financially solvable nor reliable, and in Harbin, because the central government held the opinion that private monopolists could grow too strong. It seems as if the contractor here is both stronger and more trustworthy than in Chongqing, which is favourable. Shenzhen's project was also lucky enough to be considered a special experiment, a favour not granted to Harbin. Nevertheless, enhanced innovativeness and risks effectively transferred to the private sector do involve future liabilities, making monitoring and surveillance crucial here.

4th subway line in Beijing

The arrangement agreed between the Beijing municipal government and three contractors, Beijing Infrastructure Investment Ltd, Capital Inaugurating Ltd and the Railroad Company of Hong Kong has all the features of an actual Joint Venture. Its contract covers a period of 30 years, of which the first few are reserved for construction and the remainder for operations. During the construction phase the hard infrastructures (earthwork, tunnels and stations) representing 70% would be paid from public funds, while smaller equipment (for instance vehicles, automatic ticket-sold machines, signalling and communication systems, air-conditioning, fire-protection, escalators, elevators, control devices and power supply facilities) representing the other 30% would be privately funded (mainly through bank loans and bonds). This remaining 30% part would be stationed in an SPV, the shares of which would be shared by Beijing Infrastructure Investment Ltd (2%), Capital Inaugurating Ltd (49%) and the Railroad Company of Hong Kong (49%), and operate as a regular BOT. Beijing Infrastructure Investment will be acting as the municipality's delegate for the public part of the project (the 70%), and would collaborative with the two others within the framework of the SPV for the private part (the remaining 30%). After construction and during operations, its active role within the SPV will be reduced to one of overseeing the larger administrative issues (disposing assets, safety standards) without retaining any financial stake or interest in daily matters. However, should excess profits be generated, it would cream them off from the other contractors as a balancing incentive. On the other hand, should the actual ticket prices be lower than the price stipulated by Beijing's municipal government in the contract, it should take compensatory measures for the SPV.

Overall, the model makes quite a balanced impression. It has not safeguarded the municipal government from high spending (70% of the funds for the construction process is still public), but the intense interaction between the various partners has led to an environment in which mutual learning on technical, economic and process aspects can flourish. The construction and operations risks have also been shared equitably leading to a solid balance. As weaknesses have been noted the high transaction costs caused by the protracted negotiations preceding the eventual contract and the extensive interaction within the SPV and the missing financial innovation. The latter aspect is the very hallmark of Shanghai's 3rd subway line.

3rd subway line in Shanghai

Compared to all other cities, Shanghai has adopted a very different approach. It has chosen for a so-called 'four detachments' policy, which essentially implies that investment, construction, operation and surveillance are separated from each other and done by different players to reinforce competition, clarity and transparency. It has therefore established the Shen Tong Corporation (State Investment Company for Mass Rapid Transit), which acts as a concessionaire (on behalf of the Shanghai municipal government) for the entire subway system collecting funds mainly through public finance, bank loans, issuing (tradable) stocks and bonds and reactivating existing assets.

One of its main projects was the nearly 25 km long 3rd subway line which was built in 2000 (Sun 2006). It established an SPV for this line, allocated all the necessary initial resources and gave it the function of further fund raising from domestic and foreign investors sources and issuing project shares at the stock market, leading to a great variety of shareholders for the SPV (first detachment). In these operations, it managed to save approximately 5% of the costs compared what the project would have cost had it been publicly funded (Song 2005). The second detachment was construction. After a bidding process, Shen Tong identified one corporation, the Chinese Railway Combined Construction Company for this task. For operations, the third detachment, it selected the bid of two private firms, the Shanghai based Modern Rail Transit Ltd and the Operations Company of the Shanghai Subway. However, since all assets and debts and income from operations tasks are owned by the SPV, these firms charge it the fees for their activities. The fourth and final detachment, monitoring and surveillance, is fulfilled by the municipal government of Shanghai, which thus acts as its regulator. It had performance-based pay mechanisms at its disposal to reward private contractors for good and punish them for disappointing performance, using evaluation criteria to promote higher efficiency and enhanced innovation.

The Shanghai four detachments arrangement is generally considered successful in China (Sun 2006). Especially the financial, management and technical innovation have flourished, since for all four detachments tasks were performed by organisations best equipped for and specialised in them. Also the incentives to push various players to maximum performance are admired. One could even claim that the assumption that innovation comes from an integrated package of activities or an alliance approach is belied here. On the other hand, problems have arisen in the communication between the various partners. Difficulties in reaching agreement and complication originating from overlapping functions between the detachments have

pushed up transactions costs to higher level than anywhere else. Consequently, preference for the Shanghai procurement model or any of the others is basically a matter of taste: which criterion does one bring to bear when choosing a 'best practice' in using PPP for subway infrastructure management in China?

Table 3: Summary of the empirical findings

Project	Beijing's Olympics Lateral	Shanghai's 3 rd Line	Beijing's 4 th Line	Shenzhen's 4 th Line
Procurement Model	BT	"Four-Detachment"	SPV+BOT	BDOT
World Bank Model	Build, Operate and Invest	Management Contract	Joint Venture	Build, Operate and Invest
Asset Ownership	Public	Public	Public	Public
Financial responsibility	Private	Public	Shared	Private
Construction	Private	Private	Shared	Private
Operations	Public	Private	Shared	Private
Contract duration	5 Years	3~5 Years	30 Years	35 Years
Public savings	Construction costs	5%	30%	Construction + operation costs
Type of innovation	Limited	Financial, managerial and technical	Learning curve through alliance	Limited
Type of payment	Fixed (lump sum)	Performance-based	Capital compensation mechanism	Resource compensation mechanism
Transaction Costs	Moderate	Highest	Much Higher	Higher
Monitoring and surveillance	No independent body	Independent body	Independent body	Independent body, potentially quite costly
Main advantage	Safely generating sufficient funding	Accessing multiple financing channels, enhanced competition and strong innovation	Reducing and sharing financial risks, continuous mutual knowledge transfer	Enhanced profit and saving through land development, spatially attractive stations
Main disadvantage	No incentives for improved performance	Very high transaction costs	Limited competition and high transaction costs	Limited competition and potentially very high risks

6. Conclusions

To give a nuanced answer to the question how far China has progressed with the adoption and further development of PPP for subway, it is important to realise that China is a country of enormous variety and operating at several speeds, depending on the region one speaks of. The metropolitan areas near the Eastern coast can easily be called 'developed' and their utilisation of PPP is advanced by any standard. Knowledge transfer and learning from Hong Kong and abroad has definitely had a role to play in the rapid progress made in generating required private funds and promoting Value for Money. But it is also an attitude of modesty, an active wish to learn from others, an agility of making policy transplants from elsewhere work

by adapting them to local needs that make a difference. If the BT model adopted for Beijing's Olympics Games Lateral is still on the conservative side, the other three chosen procurement models show all the relevant characteristics of advanced PPP (financial engineering, use of concessionaires, alliance approach, land development) that can be found in Britain, Australia, Spain and Hong Kong). In that sense, China (partly because of its size and variety) can be said to be serious test bed for various PPP approaches and models. A number of issues remain to be resolved, however. We have also seen that some underlying constitutional and institutional preconditions for good PPP are not met in China. Not all aspects of rule-of-law are yet in place, not all legal inconsistencies have been resolved yet, no effective way to weed out unreliable rent-seeking contractors has been found yet. The failure in three cases (Chongqing's 1st subway line, Harbin's 1st subway line, Beijing's 5th subway line) can to some extent at least be attributed to missing links in the legal and political precondition for effective PPP adoption in China. The experimentation and learning vis-a-vis PPP in China is likely to continue in the coming years; the mobility and motorisation conditions make this an absolute necessity. It is likely to take some time before legal safeguards against bad practices in PPP are fully in place, but these seem underway. It will probably also take even more time for public and private players to establish reliable partnerships guided by mutual trust and reasonableness in renegotiating contracts when this becomes necessary. *Guanxi* ('personal networks') can oil decision processes and have often benefited management and policy in China, but modernisation will tie them to certain norms of transparency and accountability. That is an intriguing challenge for the awaking giant.

References

- Ai, Ya (2006): The prospect for PPP: Feng Guiting and Zhao Xiaoyu, officials of the Ministry of Finance's answering the reporter from 'International Finance', People's Daily Newspaper, July 21 (in Chinese).
- Akintoye, N. and M. Beck (eds) (2003): Public private partnerships; Managing risks and opportunities, Blackwell publishers, London.
- Bruzelius, Nils (2005): The Impact of Legal/Regulatory Frameworks on Transaction Costs for Private Sector Involvement in Transport Infrastructure Funding, Report to the Joint OECD/CEMT Transport Research Centre, Paris.
- Cervero, Robert (2008): Suburbanization and transit oriented development, presentation given at the China Planning Network transport conference, Beijing 19 July 2008, <http://chinaplanningnetwork.org/transport2008/index.htm>
- Chang, M., M.A. Menon and H. Imura (2003): International experience of Public Private Partnership for Urban Environmental Infrastructure and its application to China, *International review for Environmental Strategies*, 4 (2), 223-248.

Cheng Qian (2004): A new thought for financing of public projects, the cooperative financing schemes of PPP, Sichuan Finance (in Chinese).

Chen Feng, Qiu Xujian (2005): Discussion on the prospect of applying Lease PPP scheme in Chinese subway systems [J], Transportation and Economy in Railroad Field (in Chinese).

Chen Liu Qin (2005): PPP-a new public and private cooperative scheme [J], Construction Economy, China (in Chinese).

Chinese National Development & Reformation Committee Website (2007): <http://www.drc.gov.cn/>

Chow, Daniel C.K. (2003): The legal system of the People's Republic of China, Thomson West, Columbus (Ohio).

Clifton, Chris and Colin Duffield (2006): Improved PFI/PPP service outcomes through the integration of Alliance principles, in: International Journal of Project Management, no 24, pages 573-586.

Cui, Zili (2006): Close to the PPP pattern in mass transit projects, South Weekend, no 5.

Devapriya, K.A.K. (2006): Governance issues in financing public-private partnership organisations in network infrastructure industries, in: International Journal of Project Management, 24: 557-565.

Flyvbjerg, Bent, Nils Bruzelius and Werner Rothengatter (2003): Mega-projects and Risk; An anatomy of ambition, Cambridge University Press.

Frank, Heiko (2004): Introduction to PPP and PPP in infrastructure development, presentation held at the workshop held by the United Nations Institute for Training and Research, 29 November, New York.

Grimsey, Darrin and Mervyn Lewis (2002): Evaluating the risks of public private partnerships for infrastructure projects, in: International Journal of Project Management, no 20, pages 107-118.

Guo, Evan (2007): Financing urban transportation and public private partnership in China, presentation given at the China Planning Network transport conference, Beijing, August 2007, <http://chinaplanningnetwork.org/english/publications.htm>

Hodge, G. and C. Greve (2005): The challenge of Public Private Partnerships. Learning from international experience, Edward Elgar, Cheltenham.

Hu, Chun Lei, (2008): Director of the Urban Rail Layout & Management Department of Shenzhen, interviewed by Xu Shanshan in April 2008.

Huang, Bin and Wangxia Chang (2006): Research on the funding pattern for urban mass transit projects, Urban Mass Rapid Transit Research (in Chinese).

Jong, Martin de and Mu Rui (2008): Improving the effectiveness of Public Private Partnerships in China, presentation held at the China Planning Network conference, Beijing July 19.

Koppenjan, J.F.M. and B. Enserink (2005): International Best Practices in Private Sector Participation and Community-building in Sustainable Urban Infrastructure. Report to the China Council for International Cooperation on Environment and Development, Delft/Stockholm/Beijing.

Koppenjan, J.F.M. (2008a): Public-Private Partnerships and mega-projects, in: H. Priemus, B. Flyvbjerg and B. van Wee: Decision-making on mega-projects; Cost-Benefit Analysis, planning and innovation, Edward Elgar Publishers, Cheltenham.

Koppenjan, Joop and Bert Enserink (2008b): Public Private Partnerships in Urban Infrastructures: Reconciling Private Sector Involvement and Sustainability, forthcoming in: Public Administration Review.

Kumaraswamy, M.M. and X.Q. Zhang (2001): The governmental role in BOT-led infrastructure development, in: International Journal of Project Management, 19 (4): 195-205.

Li B. (2003): Risk management of public/private partnership projects, unpublished PhD thesis, School of Built and Natural Environment, Glasgow Caledonian University. Glasgow, Scotland.

Ma Zhong and Luo Xiaomin (2006): The analysis of funding and income systems of the Hong Kong subways, Urban Rail Transit Research (in Chinese).

Lieberthal, Kenneth (2006): Governing China; From revolution through reform, W.W. Norton Press, New York.

Miller, Roger and Donald Lessard (2000): The strategic management of large engineering projects; Shaping institutions, risks and governance, MIT Press, Cambridge, USA.

Mu, Rui (2008): Public Private Partnerships and the management expressways in China; An agency theory approach, master thesis at Delft University of Technology, Delft.

Ng, Wei Shiuen and Lee Schipper (2006): China motorization trends; Policy options in a world of transport challenges, in: World Resources Institute: Growing the Greenhouse; Protecting the Climate by Putting Development First, Washington DC, Chapter 4, pages 49-61.

OECD/International Transport Forum (2007): Transport infrastructure investment; Options for efficiency, Paris.

- Pakkala, Pekka (2002): Innovative project delivery methods for infrastructure; An international perspective, Finnish Road Enterprise, Helsinki.
- Pakkala, Pekka, Martin de Jong and Juha Aijö (2007): International overview of innovative contracting practices for roads, Tiehallinto/TU-Delft/Ramboll, Helsinki/Delft.
- Phang, Sock-Yong (2007): Urban rail transit PPPs: Survey and risk assessment of recent strategies, in; Transport policy 14, pages 214-231.
- Shen, Li-Yin, Andrew Platten and X.P. Deng (2006): The role of public-private partnerships to manage risks in public sector projects in Hong Kong, in: International Journal of Project Management, no 24, pages 587-594.
- Song, Xiao (2005): Sustainable development for the rail transportation system in Shanghai; Research on the urban rail transportation system, Shanghai, government study report (in Chinese).
- Sun Jiping (2006): Research on the reform and development of the rail transportation system in Shanghai, Urban Mass Rail Transit Research (in Chinese).
- Tam, C.M. (1999): The Build-Operate-Transfer model for infrastructure development in Asia: reasons for success and failure, in: International Journal of Project Management, 17: 377-382.
- Tang, Siman and Hong K. Lo (2008): The impact of public transport policy on the viability and sustainability of mass rail transit; The Hong Kong experience, Transportation Research, Part A 42, pages 563-576.
- Virtuosity Consulting (2005): Successful examples of Public-Private Partnerships and Private Sector Involvement in transport infrastructure development, 28 May 2005, Ottawa, Ontario.
- Wang, Hao (2004a): Promoting the research and application of the PPP pattern, Macroeconomic research no 1, pages 46-48 (in Chinese).
- Wang, Hao (2004b): The discussion on the definition n classification of PPP, Urban Rapid Transit, no 12, pages 111-114 (in Chinese).
- Wei, Zhu (2004): The application of PPP in urban mass transit constructions, Integrative transportation, no 10, pages 16-18 (in Chinese).
- Xu, Shanshan (2008): Applying Public-Private-Partnership to Chinese Subway Infrastructures, Master thesis at Delft University of Technology, Delft
- Yusuf, Shahid, Kaoru Nabeshima and Dwight H. Perkins (2006): Under new ownership; Privatizing China's state-owned enterprises, World Bank/Stanford University Press, Washington/Palo Alto.

Zhu Wei (2004): The application of PPP in urban mass transit constructions, in: Integrated Transportation, no 10, pages 16-18 (in Chinese).