A life-cycle risk management framework for PPP infrastructure projects

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Abstract
Purpose – The purpose of this paper is to develop a life cycle risk management framework for public private partnership (PPP) infrastructure projects that lead to the realization of value for money and balance of interests between different partners including the public and end users.

Design/methodology/approach – This paper draws on extensive theoretical research and literature reviews, coupled with case study methodologies. A comprehensive review of current literature in the field was first carried out. Then three PPP infrastructure projects, two from Australia and one from China, are studied to scrutinize reasons leading to their dilemma and articulate the valuable lessons learnt in relation to risk analysis and mitigation.

Findings – The paper found that properly assessing risks (financial, government’s political and public’s acceptance/rejection risks), ensuring value for money and protecting the public (and end users’) interests are essential in PPP infrastructure projects and this can only be achieved through optimal risk identification, assessment, allocation and management from a life cycle perspective and balanced interests between the Government/public and private partners as well as product end users.

Research limitations/implications – The paper was limited to proposing the framework; therefore the next step should be testing the framework.

Practical implications – The framework proposed in this paper should be practical and useful for professionals in managing the risks associated with the procurement of PPP infrastructure projects.

Originality/value – The PPP method has been increasingly used to procure large-scale infrastructures such as freeways, railways, tunnels and bridges worldwide. While there have been many successful PPP projects, unsuccessful cases abound and studying them can help people better manage the risks in future PPP infrastructure projects. To ensure the success of PPP infrastructure projects, it is important for all partners to manage the risks from a project life cycle perspective, in which risks are identified and assessed in the earliest possible project stage and are allocated to the parties who are in the best position to control them. Furthermore, it is also important to continuously monitor the risks and develop proactive risk response strategies throughout the project life cycle. To this end, this paper provides a life-cycle risk management framework for PPP infrastructure projects.

Keywords Risk management, Australia, China, Partnership, Public sector organizations, Private sector organizations

Paper type Research paper

Introduction
Public private partnership (PPP) arrangements have been used in different sectors such as transport, technology, water, prisons, health, welfare, and urban regeneration. It may be as extensive as privatizing facilities and services, or may be simply obtaining management or financing techniques from the private sector (McDonough, 1998, cited in Li and Akintoye, 2003). The basic PPP format is that the state or federal government departments are transformed from being owners and operators of infrastructures and public assets into the purchasers of services from the private sector, with the private sector becoming the long-term provider of services by taking the responsibility for the financing, feasibility study, design, construction, and the operation of the infrastructure and facilities (Ahadzi and Bowles, 2004). The Canadian Council for Public Private Partnerships defined PPP as “a
cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards’ (CCPPP, 2001). As PPP arrangements are project specific and dependant on many factors such as public and private partners’ skills, capabilities, limitations, projects’ characteristics and also the environment in which the project is going to proceed, the partners’ assumption of responsibility may differ and the partnership may take different forms such as Build Operate Transfer (BOT), Build Own Operate Transfer (BOOT), Leasing, Joint Ventures or Operation and Management contracts, etc. Regardless of the names, there are common characteristics among all types of PPPs (Grimsey and Lewis, 2004; and Peters, 1998 cited in Li and Akintoye, 2003). All PPPs involve two or more actors, at least one from the public and another from the private sector: Each participant is capable of bargaining on his own behalf; The partnership is establishing an enduring and stable relationship among actors; Each participant brings something of value to the partnership; Sharing of risks and responsibilities for the outcomes or activities between parties involved, is essential; A framework contract underpins the partnership and provides the partners with some degree of certainty.

**Benefits and limitations of PPP projects**

As any other types of procurement, PPP projects have many benefits and limitations as summarized in Table I.

Different types of PPP applications have been used around the world (Zhang, 2005). For example, in Australia, the Governments have increasingly used PPP in its projects, such as the Mitcham Frankston toll road in Melbourne ($2.5 billion) and Darwin’s City Waterfront Redevelopment ($600 million), to provide public infrastructures and services (Mallesons, 2005), the Water Treatment Facility project in Scotland, the Faisalabad Urban Transport Society in Pakistan, Sydney Harbour Tunnel and the City Link project in Melbourne (Grimsey and Lewis, 2002). Furthermore, the New South Wales State Government has proposed to build nine schools (spending over $100 million in total) in the State using PPP strategies (Briefing, 2005) and the Queensland State Government will also use a PPP approach for its future infrastructure (including bridges and free/highways) development totalling $1.2 billion (Newman, 2005). Similar situations exist in China where many infrastructures will be procured using PPP. For example, Beijing Olympic stadium, Beijing underground railway lines 4, 9 and 10. These figures are clear indications of the increased faith being placed in PPP procurement as a mechanism to provide capital intensive infrastructure for the future. However, not all the PPP projects have been successful and Port Macquarie Hospital in NSW State of Australia, the Sydney Airport Railway Link (Centennial Consultancy, 2005) and the Sydney Cross City Tunnel (Davies and Moore, 2005), the Malaysian Privatized National Sewerage project, Parkeerschap Den Bosch and the Betuwe Railway in The Netherlands (Reijniers, 1994; Zhang, 2005) are some examples of controversial projects which have been espoused by many commentators as failures. The failure of these projects, by and large were attributed to improper risk identification, analysis and mitigation. The following sections hence will discuss common major risk factors contributing to success or failure of PPP projects.

**Major risk factors contributing to success or failure of PPP projects**

It is necessary to investigate the major risk factors that make PPP projects successful or otherwise. Apart from the factors which create an enabling environment for private involvement such as transparency of the process, competitiveness of the bids, developers’ return commensurate with their risks, and credit enhancements (Malhotra, 1997), critical risk factors for successful PPP projects have also been probed and investigated (Wang et al., 2000, Jefferies et al., 2002, Lane et al., 2003; Parker and Hartley, 2003; Robinson et al., 2004, Li et al., 2005; Grimsey and Lewis, 2005; Zhang, 2005; Australian Government Department of Finance and Administration, 2005, Ng and Loosemore, 2006). On the other hand, Reijniers (1994), the World Bank (Asian Business, 1996), identified a few reasons why many partnered infrastructural projects have been held up. A summary of these positive and negative risk factors is presented in Table II.
The paper first studied three cases, namely Sydney Cross City Tunnel, Sydney Airport Railway Link and China Fu-De Highway projects, then discussed the important risk factors and issues governing the success of PPP projects and finally develops a life cycle risk allocation and management framework for PPP infrastructure projects.

Case study 1 – Sydney Cross City Tunnel PPP Project, Sydney Australia

Project brief
The Sydney Cross City Tunnel is 2.1 km long running east-west between Darling Harbour and Rushcutters Bay, and is a build own operate transfer (BOOT) type of public private partnership (PPP) between the New South Wales (NSW) Government and the Cross City Motorway Consortium (CCMC) with a 30-year concession period after completion of construction. The tunnel consists of two separate east and westbound tunnels with two lanes in each direction. It is Sydney’s first full electronic tolling motorway. The private company, CCMC, consists of Cheung Kong Infrastructure Holdings Ltd (headquartered in Hong Kong.

Table I: Benefits and limitations of PPP projects

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>Reducing the cost to implement the project (Li and Akintoye, 2003)</td>
<td>Being negotiated for a longer term (30 years or more), PPP planning is more complicated (Transport Quebec, 2006)</td>
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<td>A favoured form of financial engineering or off-balance sheet financing which have been devised to avoid treating financing arrangements as debt (Centennial Consultancy, 2005)</td>
<td>Complexity of the contractual structure, which in turn results in longer negotiation periods (ECI, 2003)</td>
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<td>Potentially best practice of risk sharing to improve productivity and performance (Li and Akintoye, 2003)</td>
<td>The up-front cost of PPP projects is much greater than the preparation and negotiation costs of conventional procurement methods (ECI, 2003)</td>
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<td>Transferring risks from government to competent private partners (Grimsey and Lewis, 2004)</td>
<td>Although through PPP, governments try to remove the capital expenditure for the asset from their capital accounts, possibility of expenditure realization in the capital accounts due to the Government liability in case of partnership failure should not be disregarded</td>
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<td>Superior value-for-money (regarded as the sole reason for adopting a PPP type of project procurement method by the New South Wales Treasury Office (2002))</td>
<td>May “lock in” governments to existing modes of service delivery and lead to a loss of public sector skills (Centennial Consultancy, 2005)</td>
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<td>Shorter construction period (Department of Transport and Regional Services, 2005)</td>
<td>Lead to a loss of services to the community (Centennial Consultancy, 2005)</td>
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<td>Attracting larger, potentially more competent and productive bidders to the project (Li and Akintoye, 2003)</td>
<td>Distort spending and urban planning priorities, since priority may be given to projects that are readily packaged as PPPs, instead of those producing greatest benefit to the community (Centennial Consultancy, 2005)</td>
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<td>Streamlined contracts and simplified procurement (Department of Transport and Regional Services, 2005)</td>
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<td>Facilitation of innovation, bringing diverse interests together and enabling public authorities to cohere around common objectives (Jacobs, 1997)</td>
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<td>Getting away from the bureaucratic and political processes involved in publicly procured projects (Grimsey and Lewis, 2004)</td>
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<td>An Effective manner in introducing new technologies and encouraging technology transfer (Blaiklock, 2003)</td>
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<td>Effective vehicle of bringing about environmentally efficient buildings resulted from the whole-of-life view of the project (Grimsey and Lewis, 2004)</td>
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<td>Access to skills, experience and technology of the private sector (Li and Akintoye, 2003)</td>
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Part of NSW Government’s 1998 Action for Transport 2010, was the creation of a road tunnel crossing under the heart of Sydney Central Business District. Following that in 1998, the Road and Traffic Authority (RTA) started preparation of a conceptual design for the tunnel. In August 2000, an Environmental Impact Statement of the project was released and on public exhibition for two months. In August 2001, the Minister of Planning approved the modifications in response to representations and further studies. In September 2001, the RTA invited private sector organizations to tender and in February 2002, CCMC was announced as the preferred private company. The CCMC’s proposal included some changes to the approved activities, which were considered as appropriate by the Government and as a result of those changes, a Supplementary Environmental Impact Statement (SEIS) was prepared and put on public display in July 2002. In response to SEIS and additional studies done, further alteration to the project was proposed. In December 2002, the Minister gave his approval to the revised conditions for the approved activities and the contract between RTA of NSW State Government and CCMC was signed (Cross City Tunnel, 2005). The cross section of the tunnel together with an exit is shown in Figure 1.
Design and construction of the project was contracted to Baulderstone Hornibrook as a Design and Construct (D&C) contract (BH is owned by the Bilfinger Berger AG which also owns Abigroup) (Abigroup, 2006; Baulderstone Hornibrook, 2006; Road and Traffic Authority, 2006). In January 2003, construction of the project started and the tunnel was officially opened on 28 August, 2005 (Cross City Tunnel, 2006a), almost one and a half months ahead of the schedule. The cost of the project was approximately $680 million (Davies and Moore, 2005; Wikipedia, 2006).

**Risk analysis**

**Financial risk**

The tunnel was considered to be effective in reducing the travel time from up to 20 minutes to average of two minutes with a free-floating traffic in the tunnel (Cross City Tunnel, 2005). The original predictions of initial uptake of the tunnel were 35,000 vehicles per day and increasing to 90,000 by the end of the first year of operation. However, the project was not well received by motorists and was utilized by only 20,000 per day, one month after the opening (Goodsir, 2005; Wikipedia, 2006). To overcome the low usage of the tunnel, a three-week toll free period was announced which was then extended by another two and a half weeks. During the free period, the tunnel usage increased to 53,000 vehicles per day. However, the usage dropped by almost half when the toll was reinstated (Smith, 2005; Wikipedia, 2006). There are a number of major risk factors leading to the low usage of the tunnel.

The Cross City Tunnel is Sydney’s most expensive tollway on a per km basis (NRMA, 2005). Cost for using the tunnel is $3.56 apart from vehicles longer than 12.5 metres and higher than 2.8 metres which will pay $7.12. An administration fee of at least $1.6 will also be added to the mentioned figures if a one to seven day pass is purchased. Travellers without e-tag will pay $5.16 for a one-way trip to the city, which will be $10.32 for using the tunnel both ways (Cross City Tunnel, 2006b). This price will also increase quarterly by the Customer Price Index (CPI) (Wikipedia, 2006). It is found that the expensive toll for using the tunnel is the result of a 16 per cent return on investment budgeted by the private sector over the next 30 years and also the $105 million construction permission cost (50 cents of each toll) imposed by the Government on the project (Wikipedia, 2006).

It is interesting to point out that Twiney’s report shows that by cutting more than 66 cents off the toll, the operator’s revenue would not change. Reducing the toll price will result in an increase in the tunnel usage and 66 cents reduction in tolls will result in the second balance point, which will produce the same income for the private company. However, the number of vehicles using the tunnel is not so much important to the private sector as it is to the public sector. This is a financial risk requiring analysis at feasibility study stage and a risk management mechanism should be developed to monitor this risk and adjustment be made at the operation stage if the actual usage was less than the predicted.

**Public acceptance/rejection risk**

In this project the Government transferred all the financial risks (such as return on investment) to the private party. The CCMC’s solution, in dealing with the risk of people not using the tunnel, was to mitigate the risk by funnelling the traffic into the tunnel through changing the existing road configuration and traffic directions and therefore, guaranteeing its usage. As a requirement of the private operator, the Government had agreed to make certain changes, such as closing, changing number of lanes and traffic directions to some streets to guarantee minimum revenue to the private sector (Sheehan, 2005). However, closing off the existing free routes angered the public and affected the public inclination towards using the tunnel. Opening of the tunnel resulted in more congested streets and more confused drivers as a result of road alteration and changes made to the above ground streets. These changes resulted in congested roads and confused and angry drivers (Davies and Moore, 2005) who became more resistant to using the tunnel and gave the public the perception that the Government is obliging them to pay for a service which was previously free (travelling to the city). Nevertheless, the Government eventually got the point, as the Richmond's (Moore, 2005) report later articulated by saying that as a ‘‘general rule’',
the authorities should minimise alteration and changes to the existing roads. Yet, the issue was not appropriately attended to at the time and the immediate public perception of the tunnel opening was not the provision of a service, but worsening the current traffic situation. This situation attracted much media attention, which might have heightened the public’s negative perception on the project. The risk described above should have been dealt with at the design stage where minimum alterations and changes of the existing roads and traffic conditions should be maintained if not improved.

**Government’s political risks**

The tunnel was also used as a medium to generate income for the Government, which in turn had its effect on the toll price. In this project the private provider was charged $105m to obtain the government’s permission to build the tunnel which was subsequently converted by the private provider into an extra 50 cents per use which was then added to toll payments (Wikipedia, 2006). Grimsey and Lewis (2004) regarded purchasing a service as the essence of PPPs. Although one of the roles of government is to redistribute income and wealth, reconcile private and social costs and implement its political program using whatever means suitable, imposing an extra 50 cents to the toll price, somehow contradicts with the fundamental of providing a service to the society.

Other issues included no cash payment facilities, higher price for drivers without e-tag, concerns about exhaust fumes from the tunnel, secrecy of the contract conditions and misleading signage (Wikipedia, 2006).

**Case study 2 – Sydney Airport Railway Link**

**Project brief**

In October 1990, the private sector was asked for an expression of interest to construct a 10 km underground railway between Sydney Central Business District and Sydney’s Kingsford Smith airport (see Figure 2). On 10 February 1995 a contract between French-Australian Bouygues Transfield Joint Venture and State of New South Wales (NSW) State Rail Authority was signed (Kerr, 2004). According to the BOOT type contract with a 30-year concession period, the Airport Link Corporation (ALC) was to construct, own and run the stations and the Government was to design, build, and maintain tunnels, tracks and signalling for the duration of the contract (Kerr, 2004 and Morris, 1995). The consortium included Paris based Bouygues and Sydney based Transfield Services each with a 50 per cent holding. Bouygues Travaux Publics was the contractor for the project. Construction started in August 1995 and ALC was responsible for building and operating the four stations at Green Square, Mascot, Domestic Airport and International Airport along the 10 km railway link. The project was completed in May 2000. Maintenance of the Airport link stations was the ALC’s responsibility and tracks and tunnel, RailCorp’s responsibility. However, both maintenances were carried out by Transfield Services.

**Risk analysis**

**Financial risk**

The project was financed 14 per cent through equity and 86 per cent by debt. The project was constructed by Bouygues Travaux Publics and opened in May 2000, four months before the Sydney 2000 Olympics, but ran into financial trouble six months after opening. The project went into receivership in November 2000, after defaulting on a $10 million bank payment of a $200 million loan from National Australia Bank and receivers called on a State Government guarantee (Centennial Consultancy, 2005). Finally, in October 2005 the Government accepted a $106 million plan. Thereafter, the private party will receive 85 per cent of all train fare revenue from passengers travelling to and from the four stations on the line, which should see the $106 million paid by 2012. In return, the owner of the Railway Link agreed to drop future claims and legal actions against the NSW government. This deal took the sum for Sydney Railway Link project to be over $800 million (Davies and Moore, 2005).
The project was expected to be built for $600 million, of which $470 million was supposed to be provided by the Government, but the extra cost for pedestrian facilities at the domestic terminal, route changes and tunnelling problems increased the project cost to $716 million, $74 million of the $116 million extra born by the Government (Morris, 1996). By May 1996, the taxpayers’ contributions had grown to $570 million. The project cost also increased as a result of construction of the North Arncliffe Interchange including Wolli Creek station. It connected the Illawarra line with the airport link and was considered to be crucial in the project’s success. However, it was not included in the original deal and it resulted to an extra $130 million to the Government increasing the total cost to the public to $700 million.

In 1994, it was projected that by project completion, the railway would be used by 48,000 per day but averaged just 12,500 passengers per day and the patronage was expected to increase to 68,000 in ten years. However, using the train, it will take ten minutes to travel to central station and 15 minutes to travel to Circular Quay (Frequently asked questions, 2006). A one way trip from the city to the international airport will cost $12.80, as such the actual usage of the railway was far less than the projected usage.

The Airport Link’s main reason for failure could be considered to be its low patronage (i.e. financial or return on investment risk). Amongst the reasons resulting in railway low


Note: The green line is the Sydney Airport Link line
patronage, excessive ticket price has been the most important one. The expensive ticket price, almost three times as expensive as other lines, has also been equally effective in the line’s unpopularity. The high ticket price was a result of high expectation of return on investment by the private company. The fare is very expensive compared to a taxi, especially if a few people are travelling together.

According to Centennial Consultancy (2005), the revenue sharing between the private sector and the Government included the following four steps. In step 1, 100 per cent of the revenues go to the private sector, until the private sector has recovered all of its initial investment; in step 2, 80 per cent goes to the private sector and 20 per cent to the Government. Step 2 lasts until the private sector has earned a cumulative real rate of return of 15 per cent (presumably, before tax) on its initial, already re-paid investment. In step 3 the consortium would get 20 per cent of any additional surplus cash until it has earned a cumulative real rate of return of 22 per cent on its initial, repaid investment. Thereafter, the consortium would get 10 per cent of any excess revenues. On the basis of projected traffic volumes, the NSW Government would recover its investment after at least 23 years and the private sector consortium would break even in less than four years. The NSW Government’s internal “real” rate of return would be 2 per cent, while the private sector consortium’s internal rate of return would be 21-25 per cent (in “real” terms before inflation) over the 30 years life of the project (Walker, 1994, cited in Centennial Consultancy, 2005). Excessive expectation of return on investment as can be seen in the negotiated terms of the contract clarifies the high ticket price of the line.

Another mistake was the ticketing problem and poor marketing. Scarcity of passengers was related to ticketing problems and poor marketing when the project was first opened.

### Public acceptance/rejection risks

Since the return on investment is dependent on the toll and therefore the public acceptance of the project is very important. They will not use it unless they accept it. Over crowded carriages at peak times, and lack of luggage space in the trains were also the problems (Spoehr, 2002). Furthermore, to reach the airport, the passengers need to use suburban railway stations, the majority of which have lots of stairs (leading to discomfort of carrying luggage up and down the stairs), which makes using the train inconvenient. The underlying reason for building the Airport Railway Link was to facilitate travelling to the airport. However, it is essential to look beyond the Line itself to assess its suitability and comfort. What has been missed in the process was looking beyond the Railway Link itself and paying attention to the origins from which the passengers will be travelling to the airport. Owing to the fact that many passengers need to use suburban stations, usually with many stairs, to get to the airport, exacerbated with the inconvenience of bringing the luggage to the stations itself, severely affects travellers’ choice. This risk could have been reduced if proper risk identification and analysis was conducted in design stage.

### Government’s political risks

Governmental political risk is another issue in this project. In this case there are no obvious reasons why the NSW Government needed to involve the private sector. The government itself was responsible for the designing, building and maintenance of the tunnel, tracks and signalling. The government is a major financier of the project by contributing $700 million to the project. The government is also taking all the risks by being responsible for bailing out the corporation if it fails. Under such circumstances the Government would have been better off building the stations itself as well as running the line as a part of its own network.

### Case study 3 – Fu-De Highway Project in Hengshui City He Bei Province, China

#### Project brief

Hengshui city is located in the Southeast of He Bei province. It is in a good position only 250 km away from the capital city Beijing and an important trading seaport city, Tianjin city. To the south, it connects the coal and iron base of Xing Tai and Han Dan city and about
100 km from the provincial capital city Shijiazhuang to the west and 180 km away from the Huang Ye and Bin Zhou Bo Hai ports on its east. It is an important exploring and opening zone that rings Bohai, Beijing and Tianjin. It administers 11 counties with the total area of 8,815km² and 4.14 million populations. The Fu-De highway locates within the Hengshui area and is the shortest provincial main road that leads from South and North of China to Beijing. The road, starting from the Fu town in Heng Shui and reaching at De Zhou city in Shan Dong province, is an important line that connects two national arteries 104 and 106 roads. Its total length is 66.5 km. It is the 2nd class motorcar road, having 12m wide roadbed and 9m wide pathway. Its designed speed limit is 80 km per hour and the design loads was for motorcar-20, trailer-120.

According to the Provincial Transportation Authority's approval, the road will be constructed under "owner responsibility system". A BOOT (build-own-operate-transfer) project financing model was employed to realize this cooperation. The project company was called Heng Shui Jin Fu Road Development Center, which was formed jointly by Heng Shui Road Development Center and Hong Kong Mei Jia Group Limited Company. The joint venture was established under the PRC Enterprise Law of Sino-Foreign Cooperative Operation and relative codes and statutes. The total investment for the project is 0?110 million, with 0?38 millions invested by the Hengshui Road Development Center raised from the Governments along the line and the other 0?72 millions by Hong Kong company mainly consisted of the sponsor's own capital and overseas financing. The concession period is 18 years from 1996-2014. It would be transferred over to the local government after the concession period was over.

Risk analysis

Financial risk

To estimate the traffic volume, the project company organised a four day-and-night continuous on-site traffic survey in 1995. The results showed that the traffic was 2,474 vehicles/day, of which 23 per cent was local vehicles while the other 77 per cent was from outside the city. Considering the traffic volume may be reduced by the introduction of the toll-fee when the new road is built, the basic traffic in 1996 was set as 3,000/day, with an increase of 6 per cent each year.

A comprehensive project economic evaluation was carried out which was based on the relevant government guidelines and methodologies. The evaluation took seven parameters into account, which is construction costs, maintenance and major repair cost, management cost, sale tax, income tax, depreciation, and accumulative and public welfare funds. A detailed calculation can be found in the Appendix.

Based on the project evaluation, it was proposed that two tollgates would be set up on the whole line. The average charge of each vehicle would be RMB?15. The traffic in 1996 was estimated 3,000 vehicles. Considering exempting some local motorcars, the actual charging motorcars would be 80 per cent of the total. Thus, the annual income= traffic/day × 15 × 2 × 0.8 × 365. For example, the estimated annual income for 1996 would be 3,000 × 15 × 2 × 0.8 × 365 = RMB26.28 million.

According to the agreement between the two parties of the project company, from the first charging day, the distributed plan of the assignable profit was: the first two years, it would be used to repay the capital of Hong Kong company; from the third year, it would be divided at 3:7 between the Chinese company and the Hong Kong company till the Hong Kong company repay all its invested capital; from then, the all assignable profit would be repaid the Chinese company's capital till it repay all the invested capital; the rest of period, it would be divided at 3:7 between the two parties...

One component of financial risk is the possibility of insufficient traffic volume and competition from the road in adjacent area might affect the income of the project. The project company and the local government had reached agreement on these. Some conditions in the concession agreement were not clear. This resulted in operational problems, for
example, there were just oral commitment on how to limit the appearance of other competitive roads in adjacent area instead of detailed clauses in words included in the agreement, the oral ones having no legal validity. For example, in 2003, the completion of another competitive Heng De (Hengde-Dezhou) Road that cross through Fu De Road have resulted in a lot of traffic loss which took away almost RMB760,000/day income based on preliminary survey and calculation. However, this loss was prevented through the concession agreement.

Another component of financial risk is the foreign currency exchange risk, which includes the risk of foreign currency exchanging and exchange rate variation. Because the project itself only generates Chinese Renminbi (RMB) not foreign currency, the project company could only buy foreign currencies from Bank of China to repay the foreign loans according to China policies. This risk would be eventually taken by the users transferred by the project company.

Despite the above-mentioned risks, the project has run well since the first day of its operation and hence was successful in terms of financial return (return on investment). It has paid a large amount of tax to the local government, for example, RMB20.576 million in 2003, and returned all the invested capital by the 8th year of operation.

Public acceptance/rejection risk
As described previously, it is vital to ensure that the public accept the toll highway project. They will not use it unless they accept it. During the operation period, it would be inevitable for the project company to have connections with all parties of local society, from which conflicts and disputes might arise. Given China’s political and social system and structures and the extremely high population densities in every city, it is unlikely that the public will act aggressively against to the project as what have happened in the Sydney to the Sydney Cross City Tunnel. However, the local government promised to coordinate such things if they happen.

Political risk
Generally speaking, China’s stable macro-political-economic development environment provides good external conditions; Heng Shui municipal government and local county government gave strong supports to this project. The governmental officers’ concern of the project at all times and promise of the stability of relative policies reduced the political risk greatly. However, the uncertainty of local government policies and change of governmental officials poses political risks. The project company takes a big policy risk because of the uncertainty, instability and discontinuity of Chinese local governmental policies. During the 18 years operation, the local government would alternate four times at least. Because the administrative creed of each newly elected government officials would not be the same, the project company is undertaking huge political risks.

Construction risk
This refers to the income risk when the project could not be finished on time or could not reach the prospective quality standard. The project company transferred the completion risk to the construction contractor by delivering the project with design and build method.

Corruption risk
It is worthwhile to point out that there were some risks which were not identified / anticipated during project feasibility study. Through interviews with the key personnel in the project company, the authors have noted some risks which were not identified as risks in the original risk identification processes – that is corruption risk – The cost for coordinating with local government was far too much because the corruptive ethos that appeared as serious phenomena of “eating, fetching, blocking and demanding” in the Chinese lower local government officials and some functional departments officials. The general manager of the project company said frankly that two-third of his time each year had been spent on dealing
with building and maintaining different relationships with government or functional departments and the expenditure on these public relationships was shocking.

**Discussions**

One of the main areas where PPP has extensively been used is transportation infrastructures (e.g. railways, roads). These types of projects allow for financing through tickets sold or tolls paid. Toll financing is a direct financing method through which the specific users of the service pay for its capital, operating and maintenance costs. At the same time, one of the unfavourable features of toll roads is, their great uncertainty regarding costs and revenue (Ababutain, 2002, p. 29) compared to other infrastructural sectors (e.g. power or water projects).

**Correct and precise diagnosis of a need is a fundamental step in the search and prescription of the solution**

It is important to pay attention to the need’s life span and the periods in which the need might slow down or increase. For example, it would be illogical to build the railway to the airport if it is just for the purpose of peak periodic needs (such as the Olympics Games) when it would have been possible to satisfy that need through a different medium. The complication of the issue after the identification of a need and an appropriate solution is to identify the future equilibrium point which will define the feasibility of the project from the private sector’s perspective. Conducting risk management at this stage would be useful in identifying the short-term and long-term demand risk and develop responses strategies.

**Optimum ticket or toll price is the only way to ensure the usage of the PPP infrastructure and hence return on investment**

For infrastructure road and rail projects, return on investment are mainly dependents on toll (ticket price). High toll prices for both the Sydney Airport Railway Link and the Sydney Cross City Tunnel are significant in their unpopularity. In both cases the return on investment expected by the private partner has been relatively high, 21-25 per cent (in “real” terms before inflation) for Sydney Airport Railway link case and 16 per cent for Cross City Tunnel case. Richmond (in Moore, 2005) believes that the provision of Sydney’s road network without private involvement would be impossible because both the financial and political risks are too high. However, the “no cost to the Government” approach of the NSW Government can defeat the purpose of higher value for the taxpayers’ money if alternative methods of provision of the service by the Government are going to be ruled out.

At feasibility stage, all risks related to return on investment should be identified and simulation analysis carried out to achieve optimal toll versus traffic volume. This optimised model should be monitored in the operation stage and changes made if the actual performance of return on investment is different from the predicted ones.

**Achieving value for money and Public Sector Comparator (PSC)**

Value for money is the core concept for PPP projects (NSW Department of Finance and Administration, 2005). The “value for money” aspect of a project and the comparison between PPP projects and the conventional alternatives in procuring public assets are the essential elements of government decision-making on PPPs. Value for money, defined as the effective use of public funds on a capital project, can come from the private sector innovation and skills in asset design, construction techniques and operational practices, and also from transferring key risks in design, construction delays, cost overruns and finance and insurance to private sector entities (Grimsey and Lewis, 2002). Value for money was proposed to be examined by the comparison between partnership proposal and the “Public Sector Comparator” (PSC) (Blaklock, 2003). PSC is a model of cost incurred by the Government through conventional publicly financed and managed approaches, which also allows for the risks that may realize during the lifecycle of the project as costs.

The Australian Department of Transport and Regional Services (2005) considers achieving long term value for money to be dependant on how well the private party manages the risks
transferred to it and how the public sector manages the contract over its usually long duration. The emphasis on the risk transfer can be misleading as value for money requires equitable allocation of risk between the public and private sector partners, and there may be an inherent conflict between the public sector’s need to demonstrate the value for money versus the private sector’s need for robust revenue streams to support the financing arrangement.

**Determining suitable and fair concession period**

For Fu-De Highway project, because the design and construction period was not included in the concession period, the local government lost the control on the construction period, resulting in concession period being extended. In the concession agreement, the Government should have included the period of design and build to avoid such situation to occur. The economic evaluation of the project based on no strict survey and calculation was unscientific, having inaccurate income forecasting. During the operation, the actual profitability was so strong that it was far much more than the forecasting one. The project company recovered all its investment in just eight years, which was half of the concession period. However, the public will be charged for another 22 years for using the highway as the concession period was set to be 30 years in the contract. As such the public interests are compromised.

**Ensuring balance of interests for different project partners and stakeholders, including protecting public interests**

Usually, the public sectors are more concerned with the realization of a social goal, which is strongly correlated with their political standing and to maintain their influence, while private sectors are more interested in achieving returns on the invested funds and realizing a corporate goal. Under these incentives, the public sector tends to minimize the risks on its shoulder whereas the private sector is willing to take reasonable business risks. The balance of the different interests is the core issue in PPPs (Reijniers, 1994). Therefore, having checks and balances in place to ensure the bearing capacity in toll fee or rental fee and the long term quality of the facilities, are very important from the public perspective, while these are the limitations posted to the private investors. On the other hand, the Governments’ guarantee on minimum facility usage volume and/or minimum return on investments, are crucial for the private sector. Hence, balancing the interests of the public and private sectors is essential for the successful implementation of PPP projects.

For the Fu-De highway project, from the perspective of return on investment, the project may be seen as successful but this is only for the investment company. However, from the broader perspectives of the Government and the public, it is another un-successful story, as discussed previously. Therefore, the Government should pay more attention to protecting public interests and be smarter in time, cost and quality issues in PPP projects. Only by balancing the interests between the public, government and the private investors, PPP can be a good method of procurement for public infrastructure projects.

The balance of interest is a dynamic and integrated synergy. A PPP project needs to be structured well to achieve balance of interests in order to attain value for money for both the public and private sectors.

**Proper risk allocation/sharing is of absolute importance to ensure success of PPP projects**

From the three case studies, it is very important that both parties, public and private, share the risks if the project is going to proceed. If the Government is going to accept or share in a project usage risk, then proper attention should be paid so that the private sector contribute to the project by taking some other risks or to make sure that the private sector is actually sharing the risks. For example, if the Government decides to share the project usage (financial) risk with the private sector and guarantees a minimum level of patronage as in the cases of Sydney Airport Railway Link and Cross City Tunnel projects, then it should be careful that the private partner does not set the ticket price too high, thereby mitigating all its financial risk by making sure it will recover all its cost through the minimum level set.
Research found that unless the risks in terms of financial, technical, managerial, environmental and social, are properly analysed, allocated and managed, the goals of a true value for money and a win-win PPP is hardly attainable. In a PPP-type of arrangement, the Government's role in the delivery of infrastructural and public services changes from owners/managers to overseers, where the investors undertake far more responsibilities and assumes more complicated risks than a mere contractor (Reijniers, 1994). Using PPP schemes, public sectors try to transfer as many risks as possible to the private enterprises and thus, shed their responsibilities. However, every entrepreneur will require a risk surcharge for each risk conveyed. How to fairly share the responsibilities of risks and the potential benefits between public and private sector bodies, or to achieve optimum risk transfer as against maximum risk transfer when dealing with risk in PPP projects, deserves further consideration in PPP research (Grimsey and Lewis, 2002). In addition to the typical risks related to technical, political, environmental issues, the financial risk factors, such as changing interest rates, fluctuating inflation and unpredictable revenue variables (e.g. toll fee per passenger and amount of usage in bridge and road projects), is of the most concern among private sectors (Spackman, 2002). Furthermore, Grimsey and Lewis (2004) pointed out that “the PPP programme has raised awareness of project risks in ways that public procurement has to date not been able to do. The result is that the identification, allocation and management of risks have grown to become an essential part of PPP processes”. Due to the lack of PPP experience and expertise in many countries and regions, identifying and managing the risks are decisive to the success of PPPs (Zhang, 2005) and the application of risk management techniques can make enormous contributions in identifying risks and minimizing their negative impacts, and also in optimizing the overall construction project performance (Loosemore and Zou, 2005).

The common practice regarding the risk is to first identify the risks in a structured or ad hoc method through analysis of the previous projects, use of standard checklists, interviewing involved parties and end users, or brainstorming and workshop sessions. The common risks associated with PPP projects may include:

- legal risks;
- political risks;

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**Figure 3** PPP procurement mode and extent of participation and risk-taking by the public and private parties

<table>
<thead>
<tr>
<th>Government Funded</th>
<th>Project Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Government Funded</td>
<td>Build-Operate-Transfer</td>
</tr>
<tr>
<td>Traditional Construction</td>
<td>Build-Operate-Transfer</td>
</tr>
<tr>
<td>D-B (Turnkey) Contract</td>
<td>Build-Operate-Transfer</td>
</tr>
<tr>
<td>Lease/Service contract</td>
<td>Build-Operate-Transfer</td>
</tr>
<tr>
<td>Jv Build-Operate-Transfer</td>
<td>Build-Operate-Transfer</td>
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<tr>
<td>Build-Operate-Transfer</td>
<td>Build-Operate-Transfer</td>
</tr>
<tr>
<td>Build-Own-Operate-Transfer</td>
<td>Build-Operate-Transfer</td>
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<tr>
<td>Build-Own-Operate-Transfer</td>
<td>Build-Operate-Transfer</td>
</tr>
</tbody>
</table>

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financial/market risks: project cost, interest rate, exchange rates, currency inflation, traffic volume, toll fee level and adjustment;
- economical risks;
- social and public acceptance risks;
- construction and geological risks;
- technical risks;
- technology risks;
- health risks;
- safety risks; and
- management risks.

When the risks are identified and risk matrix is prepared, the public sector can take four different approaches regarding identified risks:

1. Retain certain risks.
2. Insure against them.
3. Transfer risk to the project company (Lane et al., 2003).
4. Try to mitigate those risks.

Figure 4 shows the relationship of proper risk allocation versus project efficiency and project cost.

Giving proper attention to contractual conditions and consideration of the possibility of upholding them, is essential for both parties. Incapability of the public sector in complying with some of the contractual conditions in the case of the Airport Railway Link has been the foundation of the Government's loss in following up legal actions. Providing a certain number of trains per hour by CityRail (Kerr, 2004) is part of the Airport Railway Link Project contract. Yet, the airport line has been one of the CityRail's worst lines in 2004 with an average of only one in three trains on time during the afternoon peak hours (Kerr, 2004). It seems that the Government's optimistic view of its future performance has been the source of claims by the private partner and the Government's loss in the Sydney Airport Railway case. Furthermore, the division of responsibilities was very unusual because the Government acted as the main financier and also took the construction responsibility. If the Government was going to build

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**Figure 4** Risk allocation versus project efficiency and total cost
the whole tunnel and then also maintain it, the question arises why the straightforward task of building the stations are to be transferred to the private sector and why the private sector should not also build the tunnel and be responsible for its maintenance if they are more capable in construction.

The risk allocation structure in the Sydney Airport Railway Link is amusingly inappropriate because after finishing the construction of the station, there was almost no risk threatening the private partner. The New South Wales State Government was responsible for bailing out the corporation if it failed. According to the contract, if ALC defaulted on the loan repayment then the Government is obliged to buy the four stations at a cost of around $200 million and if the rail authority is found to have defaulted on the agreement, then it is the public sector’s responsibility not only to pay the entire debt to National Australia Bank, but also the $30 million investment made by ALC.

In the Cross City Tunnel case the Government tried to transfer the financial risk to the private sector, however; CCMC tried to mitigate the transferred financial risk through imposition of above ground road changes to the contract, in order to funnel the traffic into the tunnel. This way of addressing risk resulted in another problem, which was the public resistance in using the tunnel and resentment. It should not be forgotten that the PPP project was to provide a service and not to detract from a service. If the project does not have any justification without affecting the current status of the roads and obliging the traffic to use it then its necessity should be questioned in the first place. Another issue is the Government’s generation of income through the Sydney Cross City Tunnel which its consequent effect on the toll price, affected the public’s usage of the tunnel.

A proposed life-cycle risk management

Based on the issues discussed in previous sections, it is clear risk identification and assessment should be conducted from a life-cycle perspective starting at the feasibility study stage and carried out right through the operation and transfer stages with continuous monitoring. Hence, the paper provides a risk allocation framework for PPP projects, which is from a perspective of project life cycle (from feasibility study to operation stages) as shown in Figure 5. This framework shows the dynamic process for allocating and monitoring risks and its aim is to achieve balance of interests between different parties involved and ultimately realise the value for money for all partners of the project including the public interests.

Conclusions

Whatever strategies a government adopts for procurement of infrastructure and public assets, the quality of services (that is the public interests) should not be undermined. This should be a prerequisite when both the public and private sectors aim at value for money in their PPP practice. However, due to different benefits explored in PPP projects and different attitudes towards risk and different skills in risk management, the resources of PPP projects are often poorly collocated to achieve balance of interests as well as optimal risk allocation and management. As a result, the value for money objective is unattainable. Grounded on a thorough literature review, this paper identified positive and negative risk factors in implementing PPP projects and particularly examined three key issues: balance of interest, value for money and risk allocation and management. Three projects (The Sydney Cross City Tunnel project, Sydney Airport Rail Link project and Hebei Road project) were referenced, to investigate the root reasons leading to their unsuccessful circumstances. It is found from these case studies that optimal risk allocation according to the capability in controlling particular risks is vital in PPP projects. Based on the literature review and studies of the three cases, a life cycle risk allocation and management framework is proposed. The paper concluded that the importance of putting efforts on a continuous life-cycle risk identification and allocation is never overstated; protecting the public interests and allowing the private partners to gain reasonable return on their investments are essential for achieving value for money in PPP projects, which can only be viable through optimal risk allocation and balance of interests between the public and private sectors.
References


Further reading


Appendix

Project economic evaluation

Evaluative basis – The evaluation was executed according to the terms and conditions set in the document No. 539 Construction Project Economic Evaluative Methodologies and Parameters issued jointly by National Planning Committee and Construction Ministry in 1993 and the document No. 500 Transportation Plan Economic Evaluative Methodologies of Road Construction Projects issued by National Transportation Ministry in 1988.

Calculation parameters – A number of parameters were used in the economic viability of the project as described in the following sections.

Parameter 1. Construction cost – According to relative prescriptions in Editing Details of Feasibility Study of Road and Water Transportation Projects issued by Transportation Ministry, the total investment estimation was assumed as financial investment cost, which was RMB110 million.

Parameter 2. Maintenance and major repair cost – by referring to the cost standard of same class local roads and incorporating the actual situation of the Fu De Road project, a major repair was arranged in the tenth year of operation. The maintenance cost schedule was set as following:

- The first five years of operation: RMB20,000/km.
- The 5th-10th year: RMB50,000/km.
- The 10th year (major repair): RMB600,000/km.
- The 11th-16th year: RMB20,000/km.
- The 17th-18th year: RMB60,000/km.

Parameter 3. Managerial cost of toll-system – Two toll-gates would be set up on the whole line, 50 people for each, totally 100 people. The estimated managerial cost of each person was RMB15,000 in 1996, with 10 per cent increasing each year for the following years.

Parameter 4. Sales tax – According to national relative prescriptions, the sale tax was calculated in 3 per cent based on the total fee collected.

Parameter 5. Income tax – According to the prescriptions on Sino-foreign cooperative projects, central governmental income tax was 15 per cent and local government 3 per cent, which would be exempted at the first two years and deducted in the following three years.

Parameter 6. Depreciation – The depreciated period was 18 years and the depreciated cost of each year being RMB6.11 million counted as a cost.

Parameter 7. Accumulative funds and public welfare fund – According to relative prescriptions in the country, reserve at the rate of 10 per cent of the profit after tax would be saved until it reached the 50 per cent of registered capital; the award and welfare fund to employees at the rate of 5 per cent.
Financial evaluation and decision making

1. Basic discount rate – The investment of this Sino-foreign cooperative project is proportional, so does the income. According to the relative prescriptions on discount rate of different industry in EEMPCP, it was decided as 8 per cent.

2. Profit dividing – According to the agreement between the two parties of the project company, from the first charging day, the distributed plan of the assignable profit was: the first two years, it would be used to repay the capital of Hong Kong company; from the third year, it would be divided at 3:7 between the Chinese company and the Hong Kong company till the Hong Kong company repay all its invested capital; from then, the all assignable profit would be repaid the Chinese company's capital till it repay all the invested capital; the rest of period, it would be divided at 3:7 between the two parties.

According to above forecasting, this project would produce RMB25.13 million tax, RMB504.33 million profit during the 18 years operation period. After paying income tax, the project company could distribute RMB361.84 million assignable profit during the 18 years period. After the economical evaluation, the inner rate of return after paying income tax was 16 per cent, the capital pay-off time is 12.2 years. Based on these data, the project was feasible.

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