# RISK ANALYSIS AND ALLOCATION IN PUBLIC PRIVATE PARTNERSHIP PROJECTS

**Bing Li, Akintola Akintoye and Cliff Hardcastle**

*Department of Building and Surveying, Glasgow Caledonian University, Glasgow G4 0BA, UK*

The application of Public Private Partnerships (PPPs) has become increasingly important in the development and delivery of public projects. Reviews of some completed PPP schemes in the UK and overseas indicate that not all PPP projects can claim to be successful, as a large number of uncertainties still affect this procurement approach. Conducting a comprehensive risk analysis, followed by appropriate positive action, are some of the critical factors contributing to the success of PPP projects. This research is thus aimed at developing a framework to evaluate and manage risk factors critical to PPPs, as they affect construction projects. Literature on risk assessment and management and PPP procurement has been, and is still being, reviewed. The risk associated with private provision of public infrastructure differs according to the nature of the service for which the facility is provided, and is also dependent on perspective. To enhance better understanding of project risks by all PPP participants, a three-tier structure of risks is proposed for the analysis of risk factors in PPP projects. This structure is made up of micro, macro and meso (level) risks. The micro level risks explore the uncertainty factors within a PPP organization. The macro level risks refer to the ecology variables, while the meso risk factors fall between the macro and micro levels, and are especially relevant to the entire project.

Keywords**:** public private partnership, risk, risk analysis, risk allocation.

## INTRODUCTION

Traditionally, most public facilities are developed by the public sector using public money. Thus, the ownership belongs to the public sector (Corry, 1997). Due to the growth in the demand for infrastructure, limited public funds to meet current and future needs, and acceptance of a greater role for the private sector in the provision of infrastructure, alternative methods of financing public facilities and services have been embraced by the public sector. One method of provision of public goods and services is the public private partnership.

However PPP popular is world-wide, it brings along with it some risks which both the public sector and the private sector, including the users of public goods and services, need to address and manage. Two obligations in the risk assessment and management of a PPP project come to mind. First, the requirement for a risk transfer mechanism in PPP arrangements; the risks to be transferred should be identified, analysed and probably priced (Hambros, 1999). Secondly, PPP procurement methods are associated with many pitfalls, uncertainties and risks (Reijniers, 1994) to the governments and the private sectors (Irwin, *et al.* 1997; Wang, *et al.* 2000).

Risk and risk management of construction PPP arrangements, notably of BOT and PFI, have been extensively discussed by many exponents including HM (1995); Zhang, *et al.* (1998); Lam and Chow (1999); Wang, *et al.* (2000) and Lu, *et al.* (2000). However, they have not been able to provide an integrated risk management

Li, B, Akintoye, A and Hardcastle, C (2001) Risk analysis and allocation in public private partnership projects. *In:* Akintoye, A (Ed.), *17th Annual ARCOM Conference*, 5-7 September 2001, University of Salford. Association of Researchers in Construction Management, Vol. 1, 895-904.

solution which combines risk analysis and allocation in a PPP project environment. The aim of this paper is to provide a conceptual framework for risk analysis which would help to determine the principle of risk allocation for PPP projects.

## PUBLIC SECTOR INFRASTRUCTURE PROCUREMENT

Governments pragmatically, or unintentionally, adopt alternative ways to procure public services to fulfil their responsibilities. Corry (1997) has identified some means as shown in Table 1. Public Private Partnership (PPP) has become a popular avenue in recent times for the provision of public sector services. It can be argued that PPP has developed from these alternative arrangements where the private and public sectors are in a closer co-operative relationship.

**Table 1:** Alternative Ways of Providing Public Services (*Source: Corry, 1997*)

| Arrangements | Examples |
|---|---|
| a. public provision, public payment | Water pre-privatization, the army |
| b. private provision, public payment | Contracted out swimming pool |
| c. private provision (including finance), public contract | PFI deal for a new bridge |
| d. private provision (including finance), public regulation | Water post-privatization in England and Wales |
| e. private provision | Most commercial products |

## CONSTRUCTION PUBLIC PRIVATE PARTNERSHIPS

The whole concept of Public Private Partnership is a government policy to tackle financial problems in facility provision, and an integrated private management skill to increase efficiency, effectiveness and quality (HM, 2000). The level of private sector involvement might range from a purely service provision, without recourse to public facilities, through service provision based on public facilities usage, up to "public facilities" ownership.

The UK government has identified eight types of PPPs as follows:

Asset Sales which relates to the sales of surplus public sector assets.

Wider Market which deals with introducing the skills and finance of the private sector to help with better use of the asset in the public sector.

Sales of Business, which deals with the sales of shares in state owned business by flotation or trade sale.

Partnership Companies, which is about introducing private sector ownership into state owned business, while still preserving public interest through legislation, regulations, etc.

Private Finance Initiative

Joint Ventures in which public and private sector partners pool their assets together under joint management.

Partnership Investments in which the public sector contributes to the funding of investment by private sector parties, to ensure that the public sector shares in the return generated.

Policy Partnerships in which the private sector individuals, or parties, are involved in the development, or implementation, of public sector policy.

What is obvious from the list is the fact that not all the eight models of PPP proposed by the UK government are useful for construction facilities and services provision. The construction PPP can be categorized as follows:

Service contracts - Purely service contracts in the construction industry are seen as those where the private sector alone contributes to the service, without further capital input. The contract arrangements are as operation and maintenance, design build, turnkey contract, or design, build and major maintenance.

Service contract based on public facilities - The second group is characteristic of the private sector operating the facilities. The procurement methods could be design, build and operate (DBO); and lease, develop, operate (LDO). There is some temperate "nominated" ownership, such as build, lease, operate, transfer (BLOT); build, operate, transfer (BOT); or build, transfer, operate (BTO); and build, own, operate transfer (BOOT).

Private sector permanent provision - The permanent privately ownership of public facilities arrangements are build, own, operate (BOO); buy, build, operate (BBO), or divestiture (privatization).

Special Vehicles – Joint Ventures (JVs) - Like business arrangements, there is another arrangement of both public and private sector participation together – joint venture, which includes equity JV, co-operate JV and consortium. The private and public sectors share the liability and return from the same JV Company.

The contractual structure of PPP procurement options is diverse in form and/or substance; some PPP procurement options might in fact resemble conventional procurement. The main features of PPP are characterized by three essential features: the public sector transferring a significant level of responsibility and risk to the private sector; contractual arrangements built around performance-based outcomes; a new type of relationship supported by a long-term contractual arrangement. (DETR, 1998; Hambros, 1999).

The overall objectives of PPP are to achieve value for money (VFM) for the taxpayer, while keeping the attraction of some profit to the private sector. Hambros (1999) listed three different perspectives need to evaluate a PPP procurement: financial (cash flow) analysis from the perspective of government; financial (cash flow) analysis from the perspective of the concessionaire for a PPP solution; and benefit-cost analysis from the perspective of society.

## RISKS IN PPP PROJECTS

There are various risks associated with PPPs projects. These risks vary with the PPP project development process (Reigjiners, 1994), from the planning stage through the design, construction, and operation stages. A checklist of risks associated with a PPP projects could be classified on the basis of three-levels of risk factors: macro level, meso level and micro level. These levels of PPP project risks are summarized as follow:

The macro level of PPP – these are risks at ecology level. This will focus on the PPP national or industry level variables. The risk at this level is often associated with political and legal conditions (Stager, 1996; Gupta and Sravat, 1998), economic conditions (Gupta and Sravat, 1998, Duffield, 1998), and social conditions (Kopp, 1997).

The meso level of PPP – these are risks at project level and represent the PPP implementation problem such as project demand/usage (Gallimore, *et al.* 1997), location (Kopp, 1997), design and construction and technology (Stager, 1996; Lam, 1999), etc.

The micro level of PPP – this will present risks between the contradictions in public and private sector in contract management. The most significant reason for generating this risk category rests on the fact that the public sector has social responsibility while the private sector is mostly profit driven (Reijniers, 1994; Brodie, 1995; Kopp, 1997).

A preliminary checklist of potential risks provides a starting point for identifying risk associated with construction projects (Al-Bahar and Crandall, 1990). Table 2 shows a checklist of risks involved in a PPP project which can be classified as macro, meso and micro level risks.

**Table 2:** Checklist of PPP Risk Factors

| Risk Level | Risk Factors | |
|---|---|---|
| Macro | Political and government policy | Legislation change |
| | unstable government | Change in tax regulation |
| | Expropriation and nationalization | Social |
| | Corruption | Social corruption |
| | Macroeconomic performance | Shortage of society voluntary |
| | Poor financial market | Traditional public opposition |
| | Inflation and interest rate fluctuation | Industrial Sector specified |
| | Exchange rate fluctuation | Industrial regulatory change |
| | Influential economic evens | Labour/material unavailable |
| | Legal | Natural |
| | Hard currency not transferability | Force majeure |
| | Currency exchange unavailable | |
| Meso | Project selection | Construction time delay |
| | Project demand | Delay material supply |
| | Land acquisition | Design alteration risk |
| | Residual risk | Poor quality |
| | Project finance | Technological |
| | Project investment attraction | Geographic conditions |
| | Finance cost | Operation |
| | Design | Operation cost overrun |
| | Design deficiency | Income under-performance |
| | Construction | Low productivity |
| | Construction cost overrun | Maintenance |
| Micro | Public risk | Both |
| | Higher project cost | Contract variation |
| | Private company capability | Organization and co-ordination risk |
| | Private monopoly risk | Little experience |
| | Private inefficiency risk | Inadequate distribution of |
| | Private Risk | responsibilities and authorities |
| | Approval and permit risks | Laborious political decision-making |
| | Tort liability risks | process |
| | Publicly accountability | Difference in working method and |
| | Staff Crisis | know-how |
| | Reliability and creditworthiness of | Power struggle |
| | government | No enough commitment |
| Sources: | Reijniers, 1994; HM, 1995; Wells and Gleason, 1995; Stager, 1996; Kopp, 1997; Smith, 1997; Duffield, 1998; Zhang, *et al.*1998; Lam and Chow, 1999; Wang, *et al.* 1999; Hutton, 2000; Lu, *et al.* 2000; | |

## FRAMEWORK FOR PPP PROJECT RISK ANALYSIS AND ALLOCATION

Risk analysis is the systematic assessment of decision variables which are subject to risk and uncertainty. According to Edwards and Bowen (1998) the risk analysis process comprises the establishment of probabilities of occurrences of adverse events; the setting of assumptive bounds to associated uncertainties; and the measurement of the potential impact of risk event outcomes. Risk analysis objectives are to capture all feasible options and to analyse the various outcomes of any decision (Flanagan and Norman, 1993). However, in a PPP arrangement, an additional option for risk allocation is important for PPP risk management. A risk allocation option enables parties to optimize the management of each risk factor associated with a PP project. In the allocation of PPP risk factors, the main issues that need to be considered are the nature and size of the risk and the impact of each risk on each of the participants in the project.

A framework for the risk analysis of PPP projects and the allocation process is shown in Figure 1. This process combines a systematic risk management approach for construction projects proposed by Al-Bahar and Crandall (1990), with the principle of risk sharing in PPP partners produced by Grant (1996) and HM (2000). In the proposed framework, the public sector is expected, in conjunction with the private sector participants, to identify potential risks which will arise throughout the life of PPP project. Thompson and Perry (1992) maintained that firstly the source of risk must be identified; and secondly its effect must be assessed or analysed. The risks must be capable of being divided into those to be managed by the private sector participants, those by the public sector and those by a third party to the PPP project. According to Lewis and Mody (1997), the government needs to be able to assess its own risk exposures. In addition the private sector should be able to model the risks and evaluate the company's ability to deal with these risks, using the two dimensions of severity and frequency to measure the risk impact. There is a tendency that the private sector will price the risk and pass this to the public sector in the form of a bid. If the cost of the risks is acceptable to the public sector, a contract will be easily awarded. If the private sector's charge is considered high, the public sector may need to go into a form of negotiation with the private sector, and consider whether to accept the higher risk cost, or share the risks, or retain the risk in the public sector. Bennett (1998) recognized that direct negotiation between a private company and the public sector must be designed to prohibit corruption and get the best value for the public. It is possible that the concerns with a higher risk will lead to the public sector deciding not to develop the project under a public-private partnership (Hambros, 1999). Once the risk allocation is agreed, both parties (private and public sectors) can go to the risk treatment stage.

In the above risk analysis, risk modelling is very important to both the public and private sector. Inputs to this risk modelling and consequent analysis, are based on experience and/or statistical data. Risk analysis techniques are used to determine the value of risk. These techniques can be classified as qualitative, semi-quantitative and quantitative (Al-Bahar and Crandall, 1990; Flangan and Norman, 1993). The research on risk management of a PFI project in the UK confirmed that qualitative and quantitative methods jointly, or (semi-quantitative), are as important as quantitative analysis (Akintoye, *et al.* 2000).

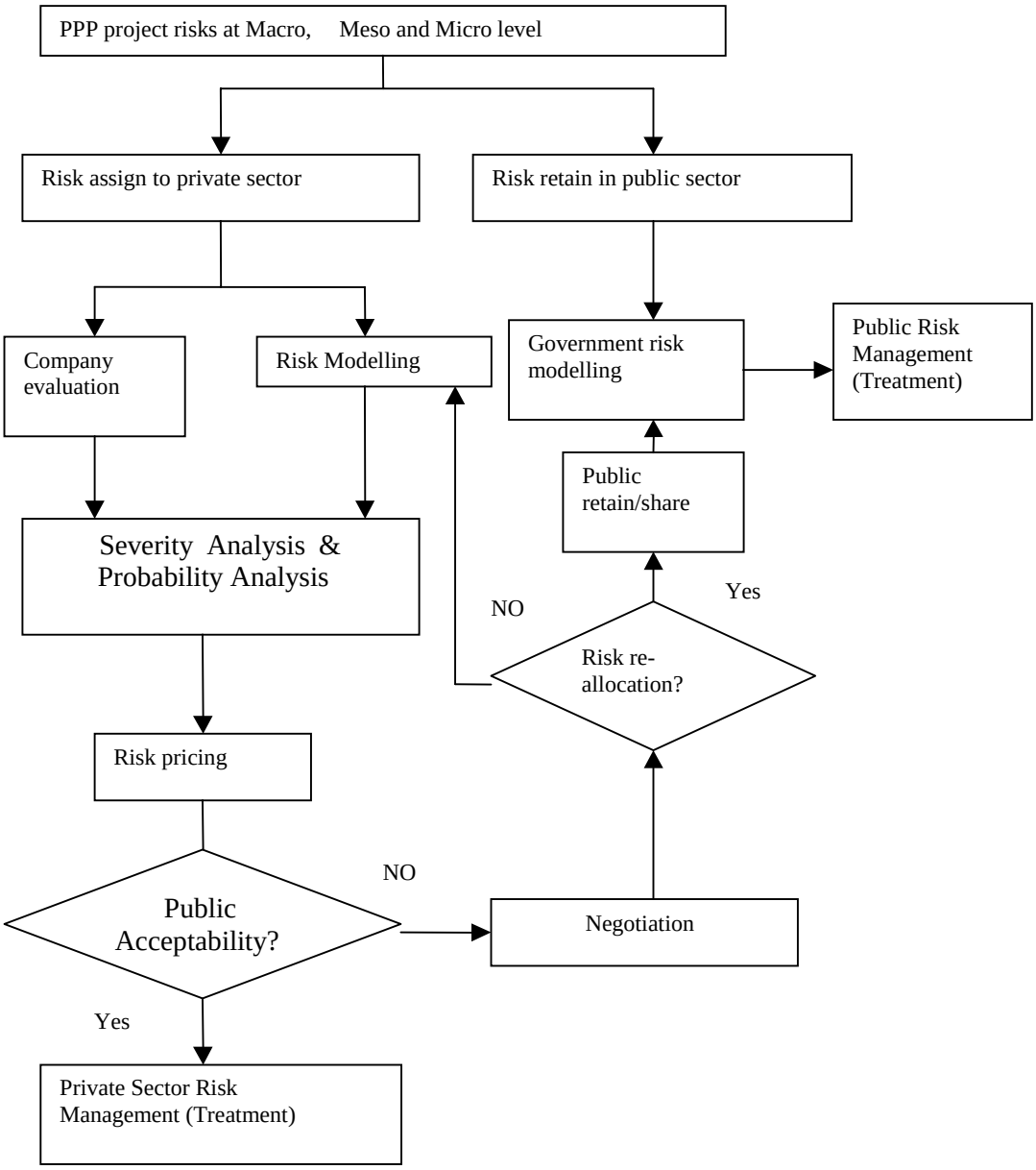


**Figure 1:** Risk Analysis in PPP Project

Some of the risks, like macro and micro level risks, are still very difficult to analyse and assess quantitatively (Hambros, 1999). These risks, identified for PPP projects, can be analysed using qualitative assessment of the likelihood of the risk ($F_I$) occurring, along with the likely impact of the risk ($D_I$) on the project (Hampton, 1993). The likelihood of the risk occurring is categorized as either very high, high, medium, low or very low on a ten-point scale. And the impact is similarly classified as severe or not severe, using a ten-point scale, or in relation to the monetary value of the associated value of risk (Flanagan and Norman, 1993). Both $F_I$ and $D_I$ are assumed in the range of 0 and 1. The degree of risk is near 0 if a risk factor has either little impact or little probability of occurrence. In contrast, if a risk factor has a high impact and a high probability of occurrence, its degree of risk is very high, near 1 (He, 1995). Using this method, Zhang, *et al.* (1998) and Wang, *et al.* (2000) in their studies of Chinese BOT projects have found out that the significant risks associated with

Chinese PPP projects are those related to political, economic and financial elements of the schemes.

The risks at meso level, such as finance, have been studied in the construction industry using quantitative analysis (Duffield, 1998; Pollio, 1999; Bollen, 2000). The quantitative analysis techniques most used include sensitivity analysis, scenario analysis, simulation analysis and correlation analysis (Flanagan and Norman, 1993). In addition risk analysis software is being used for evaluation; a popular type used on BOT projects is @Risk (Ranasignghe, 1999).

## RISK ALLOCATION IN THE PPP PROJECT ENVIRONMENT

A general principle for PPP project risks is that these are shared and allocated between the public sector, private firms and third parties. These agents can in turn redistribute the risks to other organizations. Critical factors in determining whether a party will be a able to bear the risk, include the degree to which the agent can influence or control the outcome that is risky and the actor's ability to bear the risk (cost of risk bearing). Risk can be allocated through a payment mechanism and specific contract terms (Owen and Merna, 1997).

Despite Vega's (1997) suggestion that there is no universal formula or solution to the risk-allocation problem, many principles have been proposed as to how risk should be allocated between the public sector, private sector and other third parties involved in a PPP project. Kopp (1997) considered that the risks of macroeconomic conditions and project risk bear directly on the public sector's decision to enter a PPP, and that this should be assumed by a government agency proposing the project. Such risks will include a stable macro environment for the project: stable macroeconomic policies reduce the likelihood of large changes in exchange and interest rates, thereby making it less necessary for governments to provide exchange rate guarantees or to discontinue currency convertibility or transferability (Thobani, 1999). According to He and Tiong (1996), it is this continued strength and stability of China's economy that is attracting foreign investors to Chinese PPP projects, despite the fact that China's political and legal risks ranked top among Asian countries. Expropriation, currency inconvertibility, and non-transferability are directly under the control of the government; thus, it makes sense for the government to assume these three risks.

On the other hand, it is generally recognized that design and construction risk, operation risk and financing risk are assigned to the private sector (Akintoye, *et al.* 1999). Thobani (1999) suggested that private investors should bear exchange and interest rate risks. Sharing the same view, Hambros (1999) noted that the key financial risks of a PPP project are interest-rate risk and exchange-risk and that these should be assumed by the private sector and mitigated through the use of financial hedging instruments. Maintenance risk can be integrated with design build aspects, and allocated to the private sector (Hambros, 1999).

Other risks which are relevant to a PPP project are demand, regulatory and residual risks. The demand risk can be retained by the government, transferred to the private sector, or shared between them. The survey of PFI in UK local governments by Akintoye, *et al.* (1999) indicates either of the three methods of risk allocated are possible, depending on the size and type of the PPP project. Hall (1998) argued that volume risk (an element of demand risk) transfer is unlikely to lead to value for money in transportation projects. According to Thobani (1999), regulatory risks are best handled on a case-by-case basis. Residue risk is strongly associated with the

project nature. In DCFM prison contracts, residual risk has been largely retained by the public sector (Hall, 1998).

## CONCLUSION

PPP is an arrangement whereby the private sector is able to take part in the government's responsibility for the provision of public facilities. A PPP project is associated with many levels of risks, including those related to ecological, project and the public-private sector relationship.

Risk analysis in a PPP project is a fundamental instrument to determine a risk allocation strategy and risk value. To achieve a value for money PPP project, associated risk should be allocated to the party who can best manage it and is not vulnerable to it. However in the early days of PPP implementation, there were no records of successful applications of this risk allocation principle, and lengthy negotiations are the norm rather than the exception in promoting BOT project (Tiong, *et al.* 1992); a use of risk negotiation technique as an integral part of the process of risk analysis should achieve a better risk allocation scheme. Experiences of PPP suggest that the public sector will still retain a large amount of risk, especially those at marco level; while meso level risks are assigned to the private sector.

It is expected that the risk analysis model proposed in this paper should provide a suitable framework for the risk analysis of PPP undertakings. The development of this framework is a subject of further research leading to a PhD degree.

## REFERENCES

Akintoye, A., Fitzgerald, E. and Hardcastle, C. (1999) Risk Management for Local Authorities' Private Finance Initiative Projects. RICS *Cobra 1999*. 81-91.

Akintoye, A., Beck, M., Hardcastle, C., Chinyio, E. and Asenova, D. (2000) Management of Risks within the PFI Project Environment. *Association of Researchers in Construction Management Sixteenth Annual Conference*. Glasgow Caledonian University, 261-270.

Al-Bahar, J. F. and Crandall, K. C. (1990) Systematic Risk Management Approach for Construction Projects. ASCE *Journal of Construction Engineering and Management.* **116**(3): 533-547.

Bennett, E. (1998) *Public-Private Co-operation in the Delivery of Urban Infrastructure Services (Water and Waste.* PPPUE Background Paper, UNDP/Yale Collaborative Programme, http://www.undp.org/pppue/.

Bollen, R. (2000) Applying Quantitative Techniques to Evaluate Residential Development Profitability. *Journal of Financial Management in Construction and Property*. **5**(1&2): 51-64.

Brodie, M. J. (1995) Public/Private Joint Ventures: The Government as Partner – Bane or Benefit? *Real Estate Issues*. Chicago. **20**(2): 33-39.

Corry, D. (1997) The Role of the Public Sector and Public Expenditure. *Public Expenditure: Effective Management and Control (ed Dan Corry).* London: Dryden. 15-40.

DETR (1998) *An Explanatory Note on PFI and Public/Private Partnerships in Local Government.* http://www/local-regions.detr.gov.uk/pfi/index.htm

Duffield, C. (1998) Commercial Viability of Privately Financed Heating Systems in Europe – A Case Study. *Engineering, Construction and Architectural Management*. UK: Blackwell. **5**(2): 3-8.

Edwards, P. J. and Bowen, P. A. (1998) Risk and Risk Management in Construction: A Review and Future Directions for Research. *Engineering, Construction and Architectural Management.* **5**(4): 339-349.

Flanagan, R. and Norman, G. (1993) *Risk Management and Construction.* London: Blackwell.

Gallimore, P., Williams, W. and Woodward, D. (1997) Perception of Risk in the Private Finance Initiative. *Journal of Property Finance.* **8**(2).

Grant, T. (1996) Keys to Successful Public-Private Partnerships. *Canadian Business Review*, Ottawa, **23**(3): 27-28.

Gupta, J. P. and Sravat, A. K. (1998) Development and Project Financing of Private Power Projects in Developing Countries: a Case Study of India. *International Journal of Project Management*. **16**(2): 99-105.

Hall, J. (1998) Private Opportunity, Public Benefit? *Fiscal Studies*. London, **19**(2): 121-140.

Hambros, SG (1999) *Public-Private Partnerships for Highways: Experience, Structure, Financing, Applicability and Comparative Assessment*. Canada.

Hampton, J. J. (1993) *Essentials of Risk Management and Insurance.* New York: ANACOM.

He, Z. (1995) Risk Management for Overseas Construction Projects. *International Journal of Project Management.* **13**(4): 231-237.

He, Z. and Tiong, R. (1996) *Development of Financial Risk Assessment Model for Overseas Project Investments*. Singapore: Nanyang Technological University.

HM, Treasury (1995) *Private Opportunity, Public Benefit: Progress the Private Finance Initiative*. London: the Stationery Office.

HM, Treasury (2000) Public Private Partnerships – The Government's Approach. London: the Stationery Office. http://www.hm-treasury.gov.uk/docs/2000/ppp.html

Hutton, W. (2000) *London Underground Review Project*. the Industrial Society, http://indsoc.co.uk/tube/press.htm

Irwinm T., Klein, M., Perry, G. E. and Thobani, M. (1997) Dealing with Public Risk in Private Infrastructure: An Overview, *World Bank Latin American and Carribean Studies Viewpoints: Dealing with Public Risk in Private Infrastructure (eds. Timothy Irwin et al.).* Washington, 1-19.

Kopp, J. C. (1997) *Private Capital for Public Works: Designing the Next-Generation Franchise for Public-Private Partnerships in Transportation Infrastructure*, Master Thesis, Department of Civil Engineering, Northwestern University, USA. http://iti.acns.nwu.edu/clear/infr/kopp/index.htm.

Lam, K. C. and Chow, W. S. (1999) The Significance of Finance Risks in BOT Procurement. *Building Research and Information*. **27**(2): 84-95.

Lewis, C. M. and Mody, A. (1997) The management of Contingent Liabilities: A Risk Management Framework for National Government. *World Bank Latin American and Carribean Studies Viewpoints: Dealing with Public Risk in Private Infrastructure (eds. Timothy Irwin et al.).* Washington, 131-153.

Lu, Y. C., Wu, S., Chen, D. S. and Lin, Y. Y. (2000) BOT Projects in Taiwan: Financial Modelling Risk, Term Structure of Net Cash Flows, and Project at Risk Analysis. *Journal of Project Finance.* New York, **5**(4): 53-63.

Owen, G. and Merna, A. (1997) The Private Finance Initiative. *Engineering, Construction and Architectural Management*. **4**(3): 163-177.

Pollio, G. (1999) *International Project Analysis and Financing*. London: MacMillan.

Ranasinghe, M. (1999) Private Sector Participation in Infrastructure Projects: a Methodology to Analyse Viability of BOT. *Construction Management and Economics*. **17**: 613-623.

Reijniers, J. J. A. M. (1994) Organization of Public-Private Partnership Projects: The Timely Prevention of Pitfalls. *International Journal of Project Management*. Butterworth-Heinemann, **12**(3): 137-142.

Smith, W. (1997) Covering Political and Regulatory Risks: Issues and Options for Private Infrastructure Arrangements. *World Bank Latin American and Carribean Studies Viewpoints: Dealing with Public Risk in Private Infrastructure* (*eds. Timothy Irwin et al.)*. Washington, 45-85.

Stager, D. K. (1996) Organizing and Managing a Finance-Design-Build Project in Turkey: Fourth Roebling Lecture, 1995[a]. ASCE *Journal of Construction Engineering and Management*. **122**(3): 199-204.

Thobani, M. (1999) Private Infrastructure, Public Risk. *The Newsletter of the International Project Finance Association*. **1**(1): 5-7.

Thompson, P. A. and Perry, J. G. (1992) *Engineering Construction Risk: A Guide to Project Risk Analysis and Assessment: Implication for Project Clients and Project Managers*. London: Telford.

Tiong, R. L. K., Yeo, K. T. and McCarthy, S. C. (1992) Critical Success Factors in Winning BOT Contracts. ASCE *Journal of Construction Engineering and Management*. **118**(2): 217-228.

Vega, A. O. (1997) Risk Allocation in Infrastructure Financing. *The Journal of Project Finance*. **3**(2): 38-42.

Wang, S. Q., Tiong, R. L. K., Ting, S. K. and Ashley, D. (1999) Risk Management Framework for BOT Power Projects in China. *Journal of Project Finance*. New York, **4**(4): 56-67.

Wang, S. Q., Tiong, R. L. K., Ting, S. K. and Ashley, D. (2000) Evaluation and Management of Political Risks in China's BOT Projects. ASCE *Journal of Construction Engineering and Management*. **126**(3): 242-250.

Wells, L. T. and Gleason, E. S. (1995) Is Foreign Infrastructure Investment still Risky? *Harvard Business Review*. (Sept-Oct): 44-55.

Zhang, W. R., Wang, S. Q., Tiong, R. L. K., Ting, S. K. and Ashley, (1998) Risk Management of Shanghai's Privately Financed Yan'an Donglu Tunnels, *Engineering, Construction and Architectural Management*. Blackwell, **5**(4): 399-409.