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Risk Assessment for Water Supply Projects using Public Private Partnership (PPP) / Private Finance Initiative (PFI)

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Abstract
Public Private Partnership / Private Financial Initiative (PPP/PFI) water supply project typically involves a plethora of risks. While forming PFI is a promising technique, many PFI water services contracts experienced either early termination or early re-negotiation due to mismanaging risk-related issues. So for successful PFI projects such risks need to be identified, assessed, allocated and mitigated properly which otherwise may result in the increase of costs, project delays and services which fail to deliver value-for-money to the community. Although the experts have used several ways to manage and tackle risks, a high volume of risks during the PFI water supply projects still arose. The idea of using a systematic framework for risk assessment in PFI water supply contracts is seemed to be a proactive approach to achieve the project's objectives. Therefore, this study intends to propose a systematic risk assessment technique in order to optimise the allocation of the risks to the responsible parties. The research methodology applied includes literature review and questionnaires which are distributed to the private and public agencies that are involved in PPP/PFI projects. The main finding of this research comprises identifying four categories of risk allocation at the base of the prospect of both the main participants. The research concludes by recommending the application of the framework for risk assessment in the current PFI projects especially in the water supply context.

Keywords
Public Private Partnership, Private Financial Initiative, Water Supply Projects, Risk Assessment

1 Introduction

1.1 Background

Traditionally, water has been considered as a public goods in which the failure to effectively and efficiently manage this service may lead to crises which, if not properly addressed, could translate into social and political problems (Mohamed & Wibowo, 2008). Recently, the public have been dissatisfied with the quality and coverage of government-provided water services and the slowness with which the national and local governments extended infrastructure often pressured the public to seek for more private

sector participation. It is assumed that the private sectors can often manage the entire supply chain needed to provide and distribute water services more efficiently and effectively than government agencies. When they are properly designed and administered, PPP/PFI offers the government an important means of expanding service coverage and maintaining infrastructure and to the private sectors commercial opportunities to expand their businesses (Braadbaart, 2001; Ng & Loosemore, 2006; Hall & Lobina, 2006).

The use of PPP/PFI is not straightforward. There are many failed projects in this context in both rich and poor countries due to the poor designs and inadequate analysis. Risk is one of the main areas that experiences a lack of management in many PFI projects, and for successful PFI projects such risks need to be identified, assessed, allocated and mitigated properly (Idelovitch & Ringskog, 1995; Shirley & Walsh, 2000).

The aim of this study is to produce a tool that can conceptually identify, analyse, and properly allocate the water services-related risks to the party that is best able to control or manage them. In order to achieve the above aims, the research objectives comprise of identifying and assessing PPP/PFI water supply projects-related risks and proposing a tool for optimum risk allocation.

2 Literature Review

Technically, PPP is a long-term agreement between the public sector and private sector in which the public sector transfers most of the risks to the private sector and financially compensates it for bearing such risks. In other words, PPP is an effective approach to enhance project productivity by bringing in management efficiency and creative skills from the business practice, and reducing governmental involvement by using private sectors in the provision of public services (Shen et al., 2006). PFI is a type of PPP where project financing and capital investment rest mainly with the private sector.

The term ‘risk assessment’ refers to the determination of the rate of risk by multiplying the magnitude of its potential impact and the likelihood of an occurrence of such an impact. The determination of which party or parties should bear the consequences of events identified as project risks would be studied under ‘risk allocation’. An optimal risk allocation dictates that a particular risk be retained by the party who: a) is best able to assess, control, and manage the risk; or b) has the best access to hedging instruments; or c) has the greatest ability to diversify the risk; or d) assumes the risk at a lowest cost (Kerf et al., 1998).

Around fifty key risks inherent to water supply projects have been identified through reviewing the extensive literature. The identified risks were classified into five categories; namely, technical risks (T1-T10), logistical risks (L1-L10), construction risks (C1-C7), financial risks (F1-F12) and political risks (P1-P11) and also coded with the base of the first letter of their relevant categories. Figure 2-1 depicts the cause-effect diagram of the structured project risks. The contents of Figure 2-1 are used as the identified water supply project risks for the purpose of risk assessment and allocation.

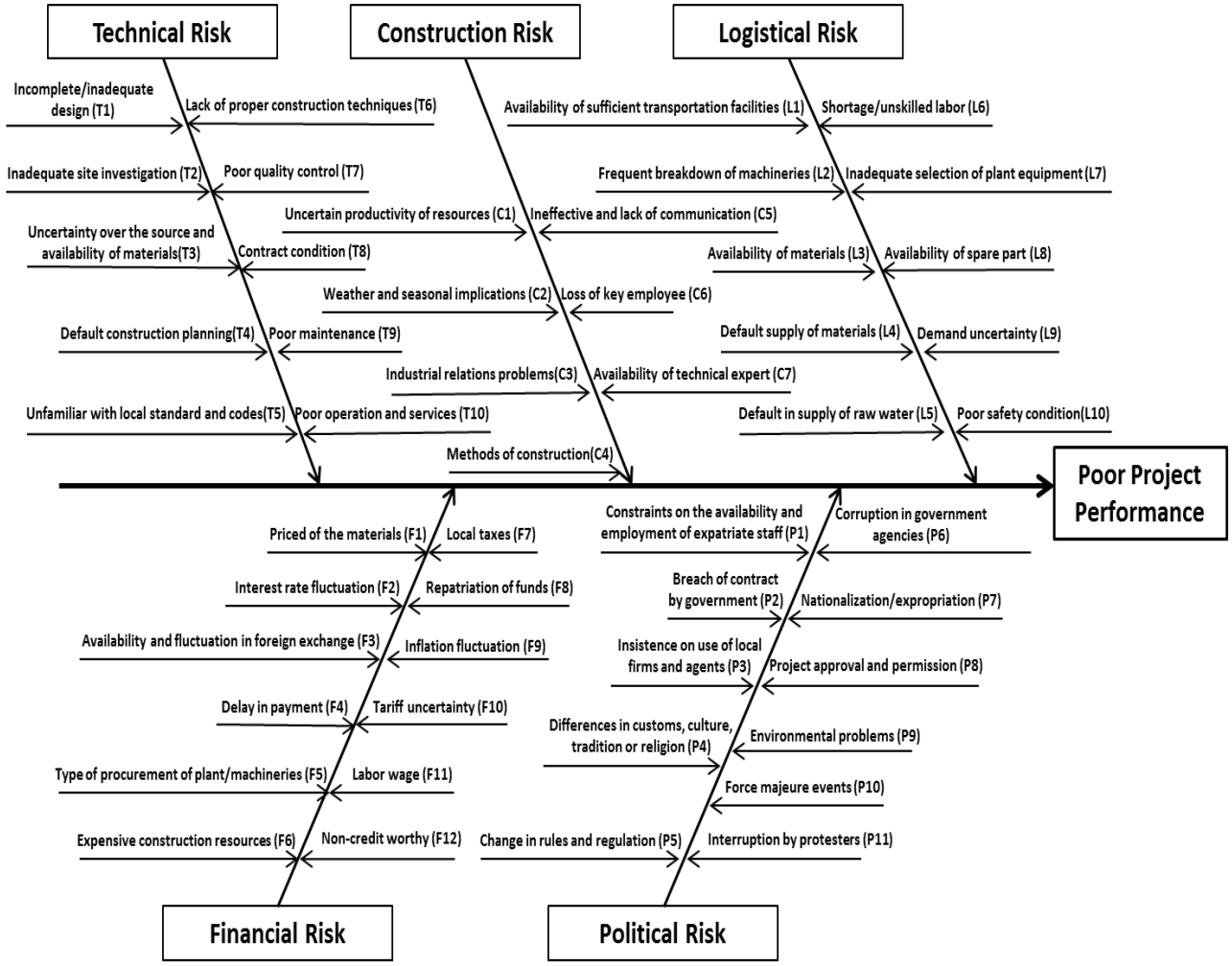

Figure 2-1- Cause-Effect Diagram of PFI Water Supply Project Risks (Source: Ishikawa & Loftus, 1990)

3 Research Methodology

The researcher conducted an industry survey via questionnaires that were manually distributed to selected respondents. For this study, the targeted respondents involved the professionals in both the public and private sectors who had at least one experience of a PFI project and familiar with water schemes. This is because there were no water or waste water projects which have been completed or done at the base of PFI in Selangor.

Out of the 64 distributed questionnaires, a total of 31 valid responses were returned, representing an acceptable response rate of around 48.5%. Out of the 31, around 15 of the returned questionnaires belonged to the respondents in the public sector and the rest belonged to the private sector. The analyses used in this study were correlation, descriptive analysis, percentages, mean and ranks. The results indicated that more than 52% of the respondents had industry experience of 10 and 15 years and majority of the respondents (48%) held managerial positions. These findings enhanced the validity of the responses concerning the issues raised in the questionnaire.

4 Project Risk Assessment

Ranking the risks and determining those risks as the most potential to impact the project's objectives were extracted from the first part of the questionnaire. To meet this, certain scores of '1', '2' and '3' were assigned to the certain levels of 'low', 'medium' and 'high' respectively for both likelihood and impact. The total score of each risk was obtained by considering the consensus percentages of both groups of respondents on its rating. To determine the level of the risks, certain levels of 'low', 'medium' and 'high' were assigned to the range of scores '1-4', '4-7' and '7-9' respectively. Project risks with the total scores of 8 and above were considered as 'critical risks'. Table 4-1 was developed at the base of the analysis of the questionnaire survey to meet the three targeted objectives of this study. This table presents the scores and levels of all the identified project risks as well as the best risk allocation and response plan to a specific risk from the prospective of the respondents in both the public and private sectors.

Table 4-1 - Risk Assessment, Allocation and Response Planning

Risk code	PUBLIC VIEW						PRIVATE VIEW						RAC
	RA		RRP *				RA		RRP*				
	RISK SCORE	RISK LEVEL	1 (%)	2 (%)	3 (%)	4 (%)	RISK SCORE	RISK LEVEL	1 (%)	2 (%)	3 (%)	4 (%)	
TECHNICAL RISKS													
T1	7.93	**High**	13.3	13.3	0	**73.4**	7.88	**High**	18.7	43.8	12.5	25	C2
T2	5.19	**Medium**	20	20	6.7	**53.3**	7.18	**High**	18.7	50	12.6	18.7	C2
T3	5.06	**Medium**	13.3	33.4	13.3	40	3.61	**Low**	18.7	37.6	18.7	25	C3
T4	8.27	**High (critical)**	6.7	13.3	6.7	**73.3**	6.37	**Medium**	12.5	56.3	18.7	12.5	C2
T5	3.00	**Low**	13.3	6.7	0	**80**	5.43	**Medium**	31.2	56.2	6.3	6.3	C2
T6	4.27	**Medium**	13.3	6.7	13.3	**66.7**	6.87	**Medium**	31.2	43.8	12.5	12.5	C2
T7	6.93	**Medium**	20	13.3	0	**66.7**	7.06	**High**	18.7	62.6	12.5	6.2	C2
T8	4.25	**Medium**	20	13.3	13.3	**53.4**	6.24	**Medium**	6.3	18.7	6.2	**68.8**	C4
T9	7.87	**High**	26.7	13.3	0	**60**	7.00	**Medium**	6.2	56.3	25	12.5	C2
T10	8.60	**High (critical)**	13.3	6.7	6.7	**73.3**	7.25	**High**	25	43.8	18.7	12.5	C2
LOGISTICAL RISKS													
L1	4.73	**Medium**	26.7	20	0	**53.3**	6.06	**Medium**	12.5	18.7	6.2	**62.6**	C4
L2	4.86	**Medium**	6.7	13.3	6.7	**73.3**	7.30	**High**	25	43.8	18.7	12.5	C2
L3	4.73	**Medium**	13.3	26.7	6.7	**53.3**	5.43	**Medium**	31.2	12.5	0	**56.3**	C4
L4	6.40	**Medium**	20	13.3	6.7	**60**	7.43	**High**	18.7	43.7	12.6	25	C2
L5	8.40	**High (critical)**	33.3	26.7	0	40	7.30	**High**	6.2	12.5	12.5	**68.8**	C1
L6	3.13	**Low**	20	20	6.7	**53.3**	6.18	**Medium**	12.5	18.7	6.2	**62.6**	C4
L7	3.60	**Low**	26.7	13.3	0	**60**	6.87	**Medium**	18.7	37.6	25	18.7	C2
L8	3.67	**Low**	26.7	20	40	13.3	2.44	**Low**	18.8	0	6.2	**75**	C1
L9	5.74	**Medium**	13.3	20	13.3	**53.4**	7.56	**High**	31.2	37.6	12.5	18.7	C2
L10	5.53	**Medium**	20	20	0	**60**	6.18	**Medium**	0	37.5	0	**62.5**	C4

Risk code	PUBLIC VIEW						PRIVATE VIEW						RAC
	RA		RRP *				RA		RRP*				
	RISK SCORE	RISK LEVEL	1 (%)	2 (%)	3 (%)	4 (%)	RISK SCORE	RISK LEVEL	1 (%)	2 (%)	3 (%)	4 (%)	
CONSTRUCTION RISKS													
C1	**6.00**	**Medium**	13.3	26.7	13.3	46.7	**3.75**	**Medium**	18.8	18.8	31.2	31.2	C3
C2	**2.67**	**Low**	6.7	20	26.6	46.7	**3.00**	**Low**	12.5	18.8	25	43.7	C3
C3	**3.33**	**Low**	13.3	26.7	20	40	**5.00**	**Medium**	12.5	25	31.3	31.2	C3
C4	**3.47**	**Low**	20	13.3	0	**66.7**	**6.24**	**Medium**	18.8	37.5	25	18.7	C2
C5	**4.27**	**Medium**	13.3	26.7	6.7	**53.3**	**5.87**	**Medium**	6.2	18.8	18.8	**56.2**	C4
C6	**2.27**	**Low**	20	13.4	13.3	**53.3**	**4.31**	**Medium**	12.5	18.8	12.5	**56.2**	C4
C7	**4.66**	**Medium**	13.3	20	6.7	**60**	**3.99**	**Low**	12.5	25	6.3	**56.2**	C4
FINANCIAL RISKS													
F1	**3.00**	**Low**	6.7	13.3	13.3	**66.7**	**4.62**	**Medium**	12.6	31.2	31.2	25	C2
F2	**6.87**	**Medium**	6.7	33.3	13.3	46.7	**5.50**	**Medium**	12.6	18.7	37.5	31.2	C3
F3	**4.73**	**Medium**	6.7	33.3	6.7	**53.3**	**6.12**	**Medium**	0	18.7	12.5	**68.8**	C4
F4	**4.86**	**Medium**	20	46.7	20	13.3	**7.18**	**High**	0	12.5	12.5	**75**	C1
F5	**3.53**	**Low**	6.7	20	13.3	**60**	**3.50**	**Low**	18.7	31.3	37.5	12.5	C2
F6	**4.33**	**Medium**	20	6.7	20	**53.3**	**6.87**	**Medium**	12.5	12.5	18.8	**56.2**	C4
F7	**3.53**	**Low**	13.3	13.4	13.3	**60**	**6.12**	**Medium**	18.8	12.5	12.5	**56.2**	C4
F8	**2.34**	**Low**	6.7	6.7	20	**66.6**	**7.37**	**High**	18.8	43.7	12.5	25	C2
F9	**2.86**	**Low**	6.7	13.3	26.7	**53.3**	**4.37**	**Medium**	6.2	18.8	50	25	C2
F10	**4.47**	**Medium**	6.7	13.3	20	**60**	**8.25**	**High (critical)**	6.2	31.4	6.2	**56.2**	C4
F11	**3.00**	**Low**	13.3	20	0	**66.7**	**7.18**	**High**	18.8	43.7	18.8	18.7	C2
F12	**2.94**	**Low**	26.7	13.3	6.7	**53.3**	**6.93**	**Medium**	25	50	12.5	12.5	C2
POLITICAL RISKS													
P1	**1.67**	**Low**	13.3	13.3	0	**73.4**	**2.81**	**Low**	25	25	37.5	12.5	C2
P2	**4.07**	**Medium**	6.7	26.7	53.3	13.3	**8.62**	**High (critical)**	6.2	0	6.2	**87.6**	C1
P3	**2.20**	**Low**	13.3	20	6.7	**60**	**5.06**	**Medium**	18.8	12.5	12.5	**56.2**	C4
P4	**1.80**	**Low**	13.3	6.7	13.3	**66.7**	**3.12**	**Low**	25	6.2	43.8	25	C2
P5	**2.80**	**Low**	13.3	6.7	46.7	33.3	**3.12**	**Low**	18.8	18.8	31.2	31.2	C3
P6	**5.27**	**Medium**	20	53.3	20	6.7	**7.12**	**High**	12.5	0	6.2	**81.3**	C1
P7	**3.40**	**Low**	20	13.3	20	46.7	**2.68**	**Low**	18.8	6.2	0	**75**	C1
P8	**4.73**	**Medium**	6.7	46.6	26.7	20	**3.50**	**Low**	25	0	6.2	**68.8**	C1
P9	**6.40**	**Medium**	13.3	20	6.7	**60**	**8.06**	**High (critical)**	25	56.3	12.5	6.2	C2
P10	**3.20**	**Low**	20	13.3	40	26.7	**4.25**	**Medium**	0	6.2	18.8	**75**	C1
P11	**2.80**	**Low**	6.7	20	26.7	46.6	**3.00**	**Low**	18.8	37.5	31.2	12.5	C3

RA: Risk Assessment, RRP: Risk Response Plan, RAC: Risk Allocation Category

*Note: 1=Elimination, 2= Reduction, 3= Absorption (Do Nothing), 4=Transference

The results from the risk assessment showed that from the perspective of the respondents in both the public and private sectors, the highest ranking belonged to the technical risk category at medium near to high level, followed by logistical risks at medium level and financial risks at low level from the public perspective and medium level from the private perspective. Construction risks and political risks ranked at the lowest risk level than other risk categories from the perspective of both groups. Generally, identified project risks were considered at the higher level by private sectors in comparison with the public sectors. The researcher argued that this was because of the nature of PFI schemes in which the greater duties and risks lied with the private party and as a consequence, caused the private sector to become more sensitive to the project risks.

From the perspective of the responding public sectors, the three highest ranked risks were: poor operation and services (T10), default supply of raw water (L5), and default construction planning (T4) respectively, whereas the responding private sectors identified breach of contract by government (P2), tariff uncertainty (F10), and environmental problems (P9) as the highest critical project risks respectively.

5 Proposed Risk Allocation Optimisation

Determination of the preferred party to retain a specific risk was extracted from the second section of the questionnaire. To meet this, the consensus percentage of the respondents on each four specified respond plan parameters was determined. Then a mode value or highest percentage was selected between the percentage of the 'transfer to other party' parameter and the sum of total percentage of other remained parameters (namely: elimination, reduction and absorption) for each risk. If the mode value for a specific project risk lied with the transference strategy, this meant that the risk should be allocated to the other party otherwise the risk should be retained by the party itself.

For interpretation, the researcher argued that each party would generally take one of the following actions to cope with each risk: Retention or Transfer. If the retention strategy was chosen, it meant that the party accepted to bear and take the responsibility of tackling the risk. Depending on the essence of the risk and business condition of the risk owner, three strategies (namely: elimination, reduction and absorption) were available to be taken by the risk owner in order to respond to the risk. Hence, the sum of the total consensus percentage of selecting elimination, reduction and absorption strategies to respond to a specific risk represented the willingness of the risk owner to retain such risk.

In some cases, the consensus percentage of selecting the transference strategy was approximately equal to the sum of total consensus percentage of the other remaining strategies (elimination, reduction and absorption) which referred to the high potential of sharing such risk between the parties.

The risk response plan (RRP) columns of Table 4-1 present the consensus percentages of the aforementioned risk response strategies.

5.1 Risk allocation categories (RAC)

The results from the risk allocation showed that there were four main categories in allocating project risks. Allocation of categories1 and 2 were classified at the base of a consensus among both groups of respondents to allocate the project risks, while allocation categories 3 and 4 were classified at the base of a disagreement between them.

The project risks included in the first allocation category were preferred to be retained by the public party, from the perspective of both respondent groups. Thus, these risks were most qualified to be retained by the public party. The critical risks L5 and P2 as well as most of the political project risks were classified into this category.

The project risks included in the second allocation category were preferred to be retained by the private party, from the perspective of both respondent groups. Thus, these risks were most qualified to be retained by the private party. This category comprised the majority of the project risks especially critical risks T4, T10 and P9.

Each of the two groups of respondents tended to retain those project risks comprised in the third allocation category by themselves. Although these project risks would finally be retained by the public party, the opposite view of the private sector respondents on the allocation practices may make these project risks less qualified to be retained by the public party. So, it seems there is a need for careful negotiations between the two parties before their allocation can be decided.

Each of the two groups of respondents tended to transfer those project risks comprised in the fourth allocation category to the other party. These project risks were initially transferred to the private sector by the public sector, but then they were retransferred to the public sector by the private sector. Negotiations between the two parties at this phase were inevitable to choose the proper party to retain these project risks. However, some of these project risks may be shared between the two main parties. The critical risk F10 was classified into this category. The last right column of Table 4-1 presents the allocation category for each of the identified project risks.

5.2 General risk allocation considered by main parties

The central tendency of the view of the respondents in the public sector demonstrated that the public party needed to retain a total of fifteen project risks (project risks specified in both categories 1 and 3) and transfer no more than thirty five risks to the private party (project risks specified in both categories 2 and 4).

However, most private sector respondents agreed that the public sector should transfer twenty nine project risks to the private party (project risks specified in both categories 2 and 3), while retaining the remaining twenty one project risks (project risks specified in both categories 1 and 4).

This finding verified the issues expressed in the literature review because it was presumed that the public sector would be tempted to transfer as many project risks as possible to the private sector, while the private sector tended to accept as fewer project risks as possible.

The results also showed that from the perspective of public sector respondents, although more numbers of the project risks were transferred to the private sector (around 70%), the magnitude of the project risks were equally distributed between the public and private parties. While the private sector respondents were in the believe that the public party transferred more project risks with higher ranking to them.

The researcher argued that the more conservative view of the private sector to those project risks which were transferred to it was because of its objective in participating in a PFI project to achieve a reasonable return on its investment. Hence, the private sector attempted to assign a high risk level to those project risks transferred to them by the public sector to make them available to translate as much as possible to monetary base in order to introduce it as much as possible to the bid price, whether through pricing the activities for eliminating or reducing the aforementioned project risks or through charging for risk premium in absorbing such project risks.

6 Summary

In this study, the researcher attempted to identify the risk factors related to the water supply PFI projects from the extensive literature. As a result, fifty project risks were identified and classified into five main categories, namely technical, logistical, construction, financial, and political.

A questionnaire survey was conducted by the researcher whereby all identified project risks were assessed from the perspective of both the public and private sectors. Thus, the highest ranking risk categories and also the critical project risks were revealed from the prospect of both main parties. The three project risks namely poor operation and services (T10), default supply of raw water (L5), and default construction planning (T4) were considered as critical risks from the prospect of the public respondents, while the private respondents considered the three project risks as their critical risks as namely breach of contract by government (P2), tariff uncertainty (F10), and environmental problems (P9).

The study on the second part of the questionnaire was implemented to determine optimum risk allocation. As a result, four categories for risk allocation were identified and all project risks were classified into them at the base of the prospect of both main parties. What the tendency was of each party to allocate a particular risk factor was also revealed and then the results were compared together.

7 Conclusion

In the common existing risk allocation tool for PFI projects, the client after assessing the risk, performs an initial risk allocation at the base of the strategy of as much as risk is transferred to the private party. Then, the private party takes various actions ranging from Elimination, Reduction and Absorption to transfer the whole or part of the risk to the client, in order to cope with each specific risk. Finally, the client decides on whether to accept to bear wholly or partly those risks transferred by the private party.

Although using such tool has been adopted between most of the clients, there are still some shortcomings due to the performance of this risk allocation tool. The first problem is that many clients come up with an increase in the total cost of their projects; however, they have never expected such cost to over-run since they have already transferred as much risk factors as possible to the private party! It is argued against the social perception that the private sectors prefer to bear as much of the risk factors transferred to them by the clients in order to claim for a higher premium than necessary to tackle such risks. Consequently, considerable cost rising occurs on the project. The other problem is losing the opportunity of allocating risks to the most qualified party, especially for those risks which are not transferred to the private party. It is argued that when a client decides to bear a specific risk through the initial risk allocation, indeed it destroys the opportunity of transferring such risk to the private party and taking action by it, which may more deserve to tackle the risk and better reduce it.

The new risk allocation tool for the PFI projects proposed in this study had the ability to bring some more benefits compared to the existing approach by overcoming the common challenges of cost overrun and misallocation of risks. The proposed tool considers the prospects of both the public and private parties on allocating all the risks with regards to optimal rather than a maximum risk transfer from the public to the private sector. Moreover, this tool offers four innovative risk allocation categories by analysing the opinions of both parties on allocating all the risks and then classifying each risk to only one category in order to find the most qualified party to bear a specific risk factor.

In this study, the application of the new proposed tool for optimum risk allocation was examined in the context of PFI water supply projects. By identifying the most common and critical risk factors in this area and classifying them into the risk allocation categories, this tool is strongly recommended to be applied as a template not only in the current practices of the PFI water supply projects, but in all other PFI projects as an effective risk allocation tool.

8 References

Braadbaart, O. (2001) Privatizing Water: The Jakarta Concession and the Limits of Contract. Paper presented at KITLV Jubilee Workshop on “Water as a Life-Giving and a Deadly Force”. Leiden, The Netherlands, 14-16 June 2001.

Hall, D. & Lobina, E. (2006) Pipe Dreams – The failure of the private sector to invest in water services in developing countries. PSIRU Reports, March 2006 (http://www.psiru.org/reports/2006-03-Winvestment. pdf).

Idelovitch, E. and Ringskog, K. (1995) Private Sector Participation in Water Supply and Sanitation in Latin America. Washington DC, World Bank

Ishikawa, K., & Loftus, J. H. (1990). Introduction to quality control. Tokyo: 3A Corporation.

Kerf, M. et al. (1998) "Concessions for infrastructure: a guide to their design and award", Paper No. 399, World Bank, Washington, D.C.

Mohamed, S. and Wibowo, A. (2008) Risk allocation in public-private-partnered water supply projects. Crawford School of Economics and Government, The Australian National University, 2008 (http://www.aigrp.anu.edu.au)

Butterworth-Heinemann.

Ng, A. and Loosemore, M. (2006) "Risk allocation in the private provision of public infrastructure", International Journal of Project Management, Vol. 25, 66-76.

Shen, L-Y. et al. (2006) "Role of public private partnerships to manage risks in public sector projects in Hong Kong", International Journal of Project Management, Vol. 24, 587-594.

Shirley, and Walsh, P. (2000) "Public Private Ownership: The Current State of the Debate." World Bank Working Paper No. 2420. The World Bank.