

IDENTIFYING CRITICAL RISKS IN PUBLIC PRIVATE PARTNERSHIP PROJECTS IN SINGAPORE

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ABSTRACT: Public private partnership (PPP) procurement was introduced into Singapore in 2003, and 10 PPP projects were successfully completed and have been in operation. The objective of this study is to identify the critical risk factors and risk allocation preferences for PPP projects in Singapore. To achieve this objective, a comprehensive literature review was carried out and 42 risks were identified and grouped into three meta levels, i.e. macro, meso and micro levels. The questionnaire survey produced 48 completed questionnaires from 48 different contractors. The survey results indicated that 23 risk factors had significantly high criticalities and that four macro-level risks, four meso-level risks and two micro-level risks were among the top 10 risk ranking. “Lack of support from government”, “availability of finance” and “construction time delay” were perceived as the top three critical risks. Also, the result implied that micro-level risks had a higher criticality mean score than macro-level and meso-level risks. The findings of this study help both public and private sectors to better understand the risks and their allocation in PPP projects, providing valuable information for organizations that intend to participate in PPP projects in Singapore.

Keywords: Public private partnership; Risk identification; Singapore

1. INTRODUCTION

A Public-Private Partnership (PPP) is collaboration between the public and private sectors for the purpose of delivering a project or a service traditionally provided by the public sector [1]. Some countries have adopted PPP due to fiscal deficit, budgetary pressure, demand–supply gap, and inefficient public services to infrastructure, while other countries choose PPP for operational efficiency, innovative technological and management skills, and more active involvement of private players in public services [2]. In Singapore, the Ministry of Finance (MOF) has embarked on a promotion of PPP projects since its first project in 2003. In October 2004, the MOF issued the first version of the Public-Private Partnership Handout with guidelines and provisions for adopting PPP projects in Singapore. Thus, the government outsourced projects worth S\$1.3 billion (S\$1.00≈US\$0.79) to the private sector for the next three to five years [3].

The aim of moving towards PPP projects in Singapore is to allow the public sector achieve better value for money in delivery public services. In addition, the government hopes to create a better and beneficial outcome for both the private and public sector by tapping on the skills, knowledge, resources and capability of the private sector [4]. Nevertheless, despite the efforts made by the government, only 10 PPP projects were successfully completed and are in operation now, while three projects were terminated or on hold [5, 6]. Hence,

there are issues that need to be addressed and obstacles to be overcome if PPP projects are to have a widespread success in Singapore [3].

The complexity nature of PPP projects may result in more management effort for contract transaction, lengthy delays in negotiation and high participation cost [1, 7, 8]. Also, most PPP projects are associated with risks that are difficult to control and analyze [1]. Hence, risk management is critical for both public and private parties in PPP projects to attain their objectives. In the risk management process, risk identification is the pre-condition of the follow-up steps, i.e. risk evaluation, response and control. Also, risk identification is the foundation of risk allocation between the parties involved in PPP projects. The objective of this study is to identify the critical risk factors in PPP projects in Singapore. The findings of this study help both public and private sectors to better understand the risk profile in PPP projects, provide valuable information for organizations that intend to participate in PPP projects in Singapore, and ultimately enhance the efficiency of risk mitigation and allocation strategies to be developed for such projects.

2. BACKGROUND

2.1 Status Quo of PPP in Singapore

According to the MOF [4], performing PPP projects enables the public sector to get better value for money in delivering public services, provides the private sector

with more business opportunities to innovate and offer efficient solutions for public services, and combines the expertise of the government and the private sector to meet the public needs effectively and efficiently. Hence, all government infrastructure projects worth over S\$50 million need to be considered for suitability as PPP projects. A number of sectors in Singapore have been identified by the MOF as suitable for PPPs. These includes sports facilities, incineration plants, water and

sewerage treatment works, large IT infrastructure deals, education and healthcare facilities, expressways and government buildings. In addition, the government ensures that the private sector can meet the public needs effectively; there is clear accountability when services are delivered by the private sector and the public knows who to approach for service queries and feedback; public security, health and safety is not compromised in PPP projects; and confidentiality of information is observed.

Table 1. Risks in PPP projects

No.	Risks	References												Total
		A	B	C	D	E	F	G	H	I	J	K	L	
R01	Lack of support from government		*		*				*		*	*	*	6
R02	Unstable government					*					*			2
R03	Strong political interference			*		*	*	*		*			*	6
R04	Corruption and bribery			*		*					*		*	4
R05	Nationalization/expropriation			*		*		*	*	*			*	6
R06	Poor financial market					*					*			2
R07	Inflation		*	*		*	*		*		*		*	7
R08	Interest rate			*		*		*	*	*	*		*	7
R09	Lack of legal/regulatory framework						*				*		*	3
R10	Inconsistent legal/regulatory framework	*		*	*	*	*	*	*				*	8
R11	Change in tax regulation	*		*		*		*	*	*			*	7
R12	Level of public opposition to project		*		*	*			*		*		*	6
R13	Environment	*	*		*	*							*	5
R14	Force majeure		*	*	*	*		*	*				*	7
R15	Weather					*		*					*	3
R16	Geological conditions					*		*					*	3
R17	Construction time delay	*				*		*	*			*	*	6
R18	Site safety and security					*					*			2
R19	Poor quality workmanship					*								1
R20	Construction cost overrun					*						*		2
R21	Excessive contract variation					*								1
R22	Material availability			*		*	*	*	*				*	6
R23	Availability of finance	*	*			*	*				*	*	*	7
R24	High finance cost					*				*				2
R25	Financial attraction of project to investors					*								1
R26	Delay in approval and permits	*				*	*	*					*	5
R27	Design deficiency					*	*			*	*			4
R28	Scope variation				*		*						*	3
R29	Unproven engineering techniques					*		*	*				*	4
R30	Level of demand for project			*	*	*			*	*	*	*	*	8
R31	Site availability	*				*			*			*	*	5
R32	Operation cost overrun	*	*		*	*		*	*				*	7
R33	Low operation productivity					*								1
R34	Maintenance cost higher than expected					*								1
R35	Maintenance more frequent than expected					*								1
R36	Residual assets risk					*		*					*	3
R37	Inadequate experience in PPP					*	*							2
R38	Organizational and communication risk					*	*	*					*	4
R39	Inadequate distribution of responsibilities					*	*	*		*				4
R40	Inadequate distribution of authority					*	*							2
R41	Lack of commitment of between parties					*		*						2
R42	Differences in working method					*								1

References: A=Gallimore et al. [9]; B=Salzmann and Mohamed [10]; C=Kumaraswamy and Zhang [11]; D=Grimsey and Lewis [12]; E=Li et al. [7]; F=Shen et al. [13]; G=Ng and Loosemore [14]; H=Estache et al. [15]; I=Medda [16]; J=Zou et al. [17]; K=Thomas et al. [18]; L=Xu et al. [19]

2.2 Risk Identification in PPP Projects

Risk identification is a critical phase in a project risk management process. It is desirable to identify the risks as early as possible [20], and a simple but valid method is to develop a risk checklist [21]. As an integrative part of risk identification, risk categorization structures the diverse risks associated with a project [22].

Based on the comprehensive literature review and content analysis, this study identified risks for PPP projects. Content analysis can help classify textual material, and reduce it to more relevant and manageable bits of data [23]. This method is often adopted to determine the major facets of a set of data, by simply counting how many times an activity occurs, or a topic is described [24]. In this study, risks identified in each literature were first marked down, and then similar risks were assembled. Thus, a total of 42 risks were finally identified from the analyzed literature, as Table 1 shows.

Moreover, Li et al. [7] proposed a three-level meta-classification approach by considering the relationship between risk factors and projects. The macro-level risks are mainly external to the project itself and beyond the system boundaries of projects, such as political, social, macroeconomic and natural risks; the meso-level risks occur within the system boundaries of projects and may include risks associated with project selection, finance, design, construction, operation and residual assets; and the micro-level risks are associated with the stakeholders relationships set up in the procurement process. This classification approach is adopted in this study because it can provide a comprehensive overview of risks associated with PPP projects.

3. METHODOLOGY AND DATA PRESENTATION

Based on the comprehensive literature review, a survey questionnaire was developed. The questionnaire consisted of three main sections. The first section included questions meant to profile the respondents and their companies. In the second section, the respondents were asked to rate the successful factors as well as positive and negative factors for PPP projects in Singapore. The results of this section are not included in this paper. The third section investigated the risk criticality in PPP projects in Singapore. The risk criticality is determined by the likelihood of occurrence and the magnitude of impact of a risk. The risks identified from the literature review were presented in this section. A risk matrix was also provided in order to make it easier for the respondents to rate risk criticality. A five-point Likert scale (1= lowest; 2= low; 3= moderate; 4= high; 5= extreme) was adopted to assess the risk criticality because the assessment inevitably involves complex and vague qualitative linguistic terms.

A list of the contractors registered with the Building and Construction Authority (BCA) was used as the sampling frame. The sample was stratified according to contractors' grade, and consisted of 120 contractors with

grades of A1, A2, B1 and B2 because they had higher tender limits and resources to tender for PPP projects that involved high capital costs. The target respondents included middle and top management, who were responsible for risk management of projects. The data collection effort produced 48 completed questionnaires from 48 different contractors, which represented a response rate of 40%.

Table 2 indicates a profile of the contractors and respondents. 77.1% of the respondents were from A1 contractors. Since all government infrastructure projects worth over S\$50 million are actively considered for suitability of adopting PPP procurement [4], large contractors (A1 and A2) would be more appropriate for PPP projects. Also, 54.2% of them had more than 10 years of working experience in the construction industry, and 66.7% held positions at middle and top levels. This ensured that the data collected were trustworthy and represented the opinions of experienced industry practitioners.

Table 2. Profile of Respondents

Profiles	Categorization	N	%
Registry grades of contractors*	A1	37	77.10%
	A2	8	16.70%
	B1	1	2.10%
	B2	2	4.20%
Years of experience	0-5	5	10.40%
	6-10	17	35.40%
	11-15	15	31.30%
	16-20	7	14.60%
	Above 20	4	8.30%
Job title	Directors	4	8.30%
	Senior manager	3	6.30%
	Project manager	25	52.10%
	Quantity Surveyor	12	25.00%
	Others	4	8.30%

*BCA grading system: A1-unlimited tendering limit; A2-up to S\$85 million; B1-up to S\$40 million; B2-up to S\$13 million.

4. DATA ANALYSIS AND DISCUSSIONS

The 42 risk factors were categorized into three meta-levels: macro, meso and micro levels. As Table 3 shows, risks R01-R16 are at the macro level; risks R17-R36 are at the meso level; and risks R37-R42 are at the micro level. All the risks were ranked based on their risk criticality mean scores within and across the risk levels, respectively. The criticality mean scores, standard deviation as well as ranks of these risks are presented in Table 3.

The results of the one-sample t-test (test value=3.00; confidence level=95%) indicated that 23 risk factors had significantly high criticalities (mean>3.00; p-value<0.05) while nine risk factors had significantly low criticalities (mean<3.00; p-value<0.05) in PPP projects in Singapore. Also, a total of 10 risks got high criticality mean scores above 4.00.

Table 3. Risk Criticalities and Ranks in PPP Projects in Singapore

Meta-level	No.	Risk	Mean	Std. Deviation	p-value (2-tailed)	Intra-level rank	Overall rank
Macro (Mean=3.37)	R01	Lack of support from government	4.46	1.05	0.000*	1	1
	R02	Unstable government	4.15	1.30	0.000*	2	5
	R03	Strong political interference	4.04	1.32	0.000*	4	9
	R04	Corruption and bribery	3.79	1.41	0.000*	7	13
	R05	Nationalization/expropriation	3.19	1.23	0.297	10	27
	R06	Poor financial market	3.42	1.08	0.018*	9	19
	R07	Inflation	3.98	1.28	0.000*	5	11
	R08	Interest rate	3.85	1.24	0.000*	6	12
	R09	Lack of legal/regulatory framework	4.13	1.02	0.000*	3	6
	R10	Inconsistent legal/regulatory framework	3.60	1.27	0.002*	8	16
	R11	Change in tax regulation	3.10	1.24	0.564	11	31
	R12	Level of public opposition to project	2.54	1.17	0.009*	12	34
	R13	Environment	2.50	1.19	0.005*	13	36
	R14	Force majeure	2.46	1.32	0.007*	14	39
	R15	Weather	2.42	1.22	0.002*	15	40
	Meso (Mean=3.25)	R16	Geological conditions	2.23	1.21	0.000*	16
R17		Construction time delay	4.21	1.07	0.000*	2	3
R18		Site safety and security	4.08	1.32	0.000*	3	7
R19		Poor quality workmanship	3.15	1.15	0.383	13	29
R20		Construction cost overrun	4.02	1.31	0.000*	4	10
R21		Excessive contract variation	3.38	1.02	0.015*	6	22
R22		Material availability	3.27	1.18	0.119	10	25
R23		Availability of finance	4.25	1.18	0.000*	1	2
R24		High finance cost	3.02	1.02	0.888	15	32
R25		Financial attraction of project to investors	3.38	1.20	0.035*	6	22
R26		Delay in approval and permits	3.65	1.26	0.001*	5	15
R27		Design deficiency	3.17	1.02	0.262	12	28
R28		Scope variation	3.13	1.21	0.479	14	30
R29		Unproven engineering techniques	2.69	1.26	0.092	16	33
R30		Level of demand for project	3.33	0.97	0.022*	8	23
R31		Site availability	2.50	1.19	0.005*	17	36
R32		Operation cost overrun	3.29	1.09	0.070	9	24
R33		Low operation productivity	3.23	1.13	0.168	11	26
R34		Maintenance cost higher than expected	2.48	1.05	0.001*	18	38
R35		Maintenance more frequent than expected	2.40	1.01	0.000*	20	41
R36		Residual assets risk	2.48	1.20	0.004*	18	38
Micro (Mean=3.75)	R37	Inadequate experience in PPP	4.17	1.00	0.000*	1	4
	R38	Organizational and communication risk	4.06	1.26	0.000*	2	8
	R39	Inadequate distribution of responsibilities	3.77	1.40	0.000*	3	14
	R40	Inadequate distribution of authority	3.56	1.27	0.004*	4	17
	R41	Lack of commitment of between parties	3.54	1.27	0.005*	5	18
	R42	Differences in working method	3.40	1.20	0.027*	6	20

*Significant at the 95% level (2-tailed), test value=3.00, degree of freedom=47.

4.1 Critical Risks at the Macro-level

At the macro-level, four political risks, i.e. “lack of support from government” (mean=4.46), “unstable

government” (mean=4.15), “lack of legal/regulatory framework” (mean=4.13) and “strong political interference” (mean=4.04) were recognized as the top four risks. These four risks were also among the top 10 overall risk ranking.

“Lack of support from government” was also the most critical risk of all the 42 risks, implying that the government support for PPP projects in Singapore was perceived inadequate. This was probably because the Singapore government had sufficient funds to improve its social and other infrastructures [25]. The introduction of PPP into Singapore is mainly focused on the need to achieve value for money in the delivery of public services [4]. A centralized agency within the MOF or outside of the MOF to champion the cause of PPP is still required because it could act as the “one stop shop” between public and private sector entities to facilitate PPPs [6]. Hence, just a PPP Handbook published by the MOF was not an adequate support from the government. More efforts had to be made to ensure the government support for PPP procurements and such efforts should be visible for the private sectors.

In addition, it appeared strange that “unstable government” was seen as the second most critical macro-level risk and got the fifth overall position. Singapore was famous for its long span of political stability. However, given the long concession period involved in PPP projects, any change in the regime or government policies would directly impose additional risks and increase cost. The likelihood of this risk may be very low due to the political stability in Singapore, while its magnitude of impact can be extremely high. This can explain the high criticality mean score and rank of this risk.

Moreover, although Singapore had a mature legal and regulatory system, the survey result indicated that “lack of legal/regulatory framework” was still perceived as very critical and got a high overall rank of 6. Thus, it can be inferred that Singapore lacked the legal framework that can deal with the disputes and conflicts arising from PPP procurements and that can adequately guarantee the interest of the private sector.

Furthermore, “strong political interference” (mean=4.04) was also seen as very critical, with an overall rank of 9. This result indicated that the political interference over PPP projects was seen as strong in Singapore. It can be inferred that such interference may be due to the fact that the public sector or the government needs to guarantee the public interest involved in the PPP projects through more or less interference. Actually, this risk was common in PPP projects. Xu et al. [19] found that the government intervention was perceived as the most impactful risk in PPP projects in Mainland China.

In addition to these four risks, “poor financial market”, “inflation”, “interest rate”, “inconsistent legal/regulatory framework” as well as “corruption and bribery” were also considered as critical macro-level risks for PPP projects in Singapore. However, all the risks associated with the nature and environment, i.e. “environment”, “force majeure”, “weather” and “geological conditions”, were not seen as critical. For one thing, it can be inferred that contractors were very familiar with these risks and

understand how to mitigate them because these risks were very common in any kind of construction projects. For another thing, as Singapore has experienced few natural disasters or extreme weather conditions, contractors tended to believe risks related to natural environment, such as “environment”, “force majeure”, and “weather”, less critical. Since few completed PPP projects in Singapore involved much underground works and tough underground conditions, “geological conditions” was perceived as the least critical one among the 42 risks.

4.2 Critical Risks at the Meso-level

At the meso-level, “availability of finance” (mean=4.25), “construction time delay” (mean=4.21), “site safety and security” (mean=4.08), and “construction cost overrun” (mean=4.02) were perceived as the top four risks and among the top 10 overall risk ranking.

“Availability of finance” occupied the top position among the meso-level risks and the second position in the overall ranking. Since the private sector is not paid until the start of project operation, unavailability of financial instrument may result in the difficulty in financing and would engender project termination as well as loss of the funds invested. This risk appeared to be a common risk as it was also ranked high in PPP projects based in Mainland China [19].

In addition, “construction time delay”, “site safety and security”, and “construction cost overrun” were also among the top 10 overall risk ranking with a rank of 3, 7 and 10, respectively. These risks are common in most construction projects regardless of delivery methods, and the high ranks of them in this study indicated that they were also recognized as critical to PPP projects in Singapore.

“Construction time delay” and “construction cost overrun” can be linked to schedule performance and budget performance, respectively, while “site safety and security” is associated with owner and public satisfaction. According to Ling et al. [26], safety management can be included in the scope of quality performance. Ling et al. [26] also believed that schedule, budget, and quality performance were the key components of project success. In the context of PPP projects, delay in construction may result in delay in project completion, and thus postpone the start of operation, when the revenue of PPP projects is gained in most cases. Thus, construction delays can be associated with project cost overruns [27, 28], which can explain the high rank of “construction cost overrun”.

In addition, “site safety and security” is always a pressing issue in construction projects. According to Teo et al. [29], the safety status of the Singapore construction industry was not satisfactory although the government had made great efforts to address this problem. Hence, it is not surprising that this common risk was perceived within the list of the most critical risks.

Besides these four risks, no other risks at the meso-level were among the top 10 overall ranking. Nonetheless, risks associated with contract variation, financial attraction, delay in approval and permits as well as demand for project were also recognized as critical risks because these risks also got significantly high criticalities.

Four meso-level risks, i.e. “site availability”, “maintenance cost higher than expected”, “maintenance more frequent than expected”, and “residual assets risk”, were with significantly low criticality mean scores. The Singapore Land Authority (SLA) has enacted the “Land Acquisition Act” to provide the legal framework for private sectors in order to ensure that land acquisitions can be properly justified through close scrutiny. Thus, “site availability” was seen not critical for contractors. In addition, the low score and rank of “maintenance more frequent than expected” and “maintenance cost higher than expected” implied that maintenance frequency and cost was well under control in PPP projects in Singapore. Further, “residual assets risk” was perceived not critical to PPP projects in Singapore. This result echoed the finding of Xu et al. [19] that residual risk was ranked bottom for PPP projects performed in Mainland China.

4.3 Critical Risks at the Micro-level

At the micro-level, “inadequate experience in PPP” (mean=4.17) and “organizational and communication risk” (mean=4.06) were the top two risks, which were also ranked fourth and eighth in the overall ranking.

The high value and rank of “inadequate experience in PPP” implied that contractors in Singapore still lacked experience in PPP arrangement even though 10 projects had been successfully completed since 2003. The large-scale and complex nature of PPP projects may render the inexperienced contractors more likely to suffer losses. Also, the lack of initiatives to parachute PPP experts into government agencies raised concerns among the private sectors. Thus, the lack of PPP experience made the respondents expect high risk exposure.

In addition, organization and communication tend to be associated with everyday operational requirements of projects. In most cases, operation responsibility in PPP projects is owned by the private sector. As this study focused on the perspectives of contractors, namely the private sector, this risk got a relatively high risk criticality mean score.

Furthermore, it should be noted that other four micro-level risks were also perceived as significantly critical to PPP projects. This result implied that the relationship among the stakeholders involved in PPP projects should attract great attention from the contractors that would like to participate in PPP projects. However, these risks may not be dealt with solely by contractors because they are concerned with the relationships between contractors and other parties, and that these risks need to be addressed

4.4 Comparison across Meta Levels

Table 3 also indicates the criticality mean scores of each risk meta-level. Risks at the micro-level obtained a mean score of 3.75, followed by the macro-level risks (mean=3.37) and meso-level risks (mean=3.25). This result confirmed the finding that all the micro-level risks were significantly critical to PPP projects (mean>3.00; p-value<0.05).

The relatively low criticality mean score of the meso-level risks tended to be attributed to the significantly low mean scores (mean<3.00; p-value<0.05) of four risks

(R31, R34, R35, and R36) as well as the eight risks (R19, R22, R24, R27, R28, R29, R32, and R33) without statistical significance (p-value>0.05).

Although five risks at the macro level (R12, R13, R14, R15, and R16) got significantly low criticality mean scores (mean<3.00; p-value<0.05), nine were significant critical (mean>3.00; p-value<0.05) and only two were (R05 and R11) without statistical significance (p-value>0.05). This can explain why the macro-level risks got a slightly higher criticality mean score than the meso-level ones.

5. CONCLUSIONS AND RECOMMENDATIONS

This study identified the critical risks in PPP projects using the inputs from contractors in Singapore. 42 risk factors identified from the comprehensive literature review were ranked based on their criticalities, and 23 of them were found to be significantly critical (mean>3.00; p-value<0.05) with the criticality mean scores ranging from 4.46 to 3.33.

The results implied that “lack of support from government”, “availability of finance”, “construction time delay”, “inadequate experience in PPP”, “unstable government”, “lack of legal/regulatory framework”, “site safety and security”, “organizational and communication risk”, “strong political interference”, and “construction cost overrun” were the top 10 critical risks in PPP projects in Singapore. Also, the micro-level risks, which are associated with the relationships among stakeholders involved in PPP projects, got a higher criticality mean score than the risks at the macro and meso levels. Thus, contractors should attach more importance to the stakeholder relations formed in the procurement process.

The findings of this study provide a profile of critical risks for the practitioners, who intend to participate in or are performing PPP projects in Singapore. Practitioners should seriously consider all the significantly critical risks before deciding to participate in PPP projects. In addition, such a list of critical risks helps them to develop risk mitigation and allocation measures as early as possible. The findings also enable the public sector to understand the main concerns of the contractors, which can help reduce the misunderstandings between the public and private sectors and thus improve their partnership.

Although the objectives of this study are achieved, there are some limitations to conclusions that may be drawn from the results. First, risk criticalities were evaluated based on the experience and subjective judgments of the respondents. In addition, this study only focused on the opinions of the contractors and did not involve third parties such as financial banks, legal firms and insurance companies who may have different views on the risk factors in PPP projects.

Further studies can be focused on risk mitigation and allocation strategies used in PPP projects. Case studies of the PPP projects that have been successfully completed in Singapore may provide a comprehensive view of how risks are managed and allocated in these projects. Based on the lessons learned from these case studies, the best

practices of risk management in PPP projects can be identified and validated, and thus can serve as the benchmark of risk management in PPP projects.

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