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RISK IDENTIFICATION AND ASSESSMENT OF INFRASTRUCTURE DEVELOPMENT FOR PROJECTS' VALUATION

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ABSTRACT

Public capital investment in infrastructure development holds the key for national economic growth. It includes the development of roads, power plant, ports, railways and other public facilities. The developments are important to provide better condition and services for the people and economic activities. Investment in public infrastructures demand high spending, long term commitment and involves with numbers of risks. In order to reduce government financial liabilities, many countries adopted built-operate-transfer (BOT) scheme. BOT is an agreement between the public and private sectors where the private sector required to finance, design, build, operate and maintain the facility. In return, private sector can collect profit from users whom benefited the facility for a certain period called concession period. However, the development of public infrastructures with BOT are tangled with numbers of risk. Without systematic risk management, the project will fail and disrupt huge monetary impact. The objective of this study is to identify risk anticipated in public infrastructure development in Malaysia. Risks are identified from previous studies done in Malaysia and other countries. The identified risks are assessed to determine severity impact of the risks on projects' valuation.

Keywords: Public capital investment; infrastructure development; risk factors; risk groups.

1. INTRODUCTION

Public capital investment requires high spending, long term commitment and involve with numbers of risk. The investment must be spent in the most systematic and economical way. Due to limited fund resources, many countries adopted Public-Private Partnership (PPP) under built-operate-transfer (BOT) scheme to fund the infrastructure development. BOT scheme fulfilled the demand for these infrastructure facilities at better condition and services. In this scheme, private sector is responsible to finance, built, operate and maintain the facility for a specified concession period. In return, the private sectors are awarded concession period to collect benefit from users whom benefited from the facilities [1]–[3]. The development of these infrastructures holds the key for national economic acceleration and elevated public services and social activities.

Public capital investment categorized under the long-term instrument for economic boost. The positive economic impact of the investment can be seen by the growth of Gross Domestic Product (GDP). A sample of 25 developing countries including Thailand and India stated that, these countries had an increment of USD10-USD15 country's real per capita GDP with systematic public investment [4], [5]. In East Asia and Pacific Region, there were more than 1000 public infrastructure projects that has been developed since 1980. Total amount spent was USD28,2804 million and more than USD30,000 million expensed in roads [2]. A report by Public Works Financing in 2007, the world had spent approximately USD1,197,279,000 on PPP project and 48% from this amount was invested in roads development [6]. In 2007, there were more than 20 BOT projects executed in Iran including power plants in power industry, transportations and many more [3]. In China, the high increment in population from 2007 to 2015 force the republic to adopt private public partnership. The project was expected to support 12.2% of their population. The implementation of infrastructure's project helped to support the restructuring unorganized urban growth in the republic [7]. In Malaysia, total of 18 tolled highways have been developed in 1985-2005. Total revenue from tolled highway as recorded to be MYR884.5 million in 1985 and increased to MYR3518.16 million ten years later [6].

Despite the widespread of BOT adoption, this scheme subjected to various risks anticipated at every phase of the project. Long term operations and complexities to determine future event increase the BOT projects' uncertainties. Systematic identification and assessment is highly important to estimate the value of the project.

The quantification of related risks need to be managed wisely to mitigate the downturn of revenue estimated from the project. The cash flows that spread in longer duration are exposed to unexpected changes which decision makers has little control. Thus, the planning stage of BOT project requires systematic risk management to ensure the success of the projects [3], [8].

According to Cooper et al. (2005), risk arise due to future uncertainties on economic, financial, social loss or gain from the respective project. In large scale project procurement, risk must be accountable at the earliest stage of projects' planning and must be managed throughout the project. Systematic risk management will give insight knowledge and help in decision making to estimate future possibilities. Risk identification is highly essential process to bring out associated risks in BOT projects. Risk identification is done to analyse what are the risk that commonly happen during the project. The identification is significant to give early monitory of what and how the risk can happen [10].

Xu, Sun et al. (2012) considered risks to determine concession price for PPP project in China. The proposed concession price model was highlighted to the risks involve in highway projects. This study divided risks into system and non-system risk. Two risks were listed for system risk; law risk and economic risk. These two risks affected by imperfect supervision, imperfect legislative, interest rate and foreign exchange. Non-system risk comprised risks of bidding, construction and operation phase. Non-system risk factors listed were competitive price, financing, project change, project completion, market, whether and geotechnical conditions, operation risks and etc. The concession price given was believed a fair value for the firm to win bidding price and able to receive decent profit from the operation of the project.

Ebrahimnejad et al. (2010) put risks into two categories. Endogenous and exogenous factors. Endogenous factors include initiating process risks, financing and operation process risks. On the other hand, exogenous factors are classified under political, regulatory and economical risks. This study identified and rank the risk engaged in BOT projects in power plant in Iran. Risk identification is done to assess the risks in the most systematic way for the particular projects. The result from this study indicate that initiation process has higher impact to the success of BOT projects execution.

Xu et al. (2010) identified 37 risk factors anticipated in PPP projects in China. This study then selected 17 most critical risks factors (CRF) and classified into 6 critical risk groups (CRG) via comprehensive literature review and Delphi questionnaire survey. The critical risk groups namely macroeconomic, construction and operation risk, government

maturity, market, economic viability and government intervention risks. This study showed that risk level of identified risk is between moderate and high. This study also claimed that government intervention and corruption hold the key success of PPP project in China.

Wibowo, Asce & Kochendörfer (2005) listed five major financial risks in toll roads development in Indonesia. The listed risks are construction cost, construction schedule, initial and future tolls, traffic volume and macroeconomic factors. This simulation of risk analysis applied to observe the financial impact of anticipated risks to the creditors. This study propose to identify and assess the risk involve in infrastructure development in Malaysia. Risk identification will comprise common risk occurred in most infrastructure project in Malaysia and other countries. Risk assessment will quantify identified risk to determine severity risk impact to the project. The findings will illustrate the relation of each risk group to the projects' valuation. Highly impact risk will cost more on the valuation.

2. RISK IDENTIFICATION OF PUBLIC INFRASTRUCTURE DEVELOPMENT VIA PPP IN MALAYSIA

BOT scheme has been implemented in various sector in Malaysia. Since then, studies concerning risks associated with BOT projects actively been done. In this section, the risk listed from other studies are gathered.

From comprehensive literature, this study initially identified 51 risks factors listed from the previous PPP projects done in Malaysia and other countries. The listed risks are thoroughly identified from the construction phase to operation and maintenance of the project. For futher analysis, 12 risk factors were selected based on high occurrence of the risk in each project. These risk factors are grouped into seven category called critical risk groups, namely construction, macroeconomic, natural, political, staff, operation and maintenance and market risk.

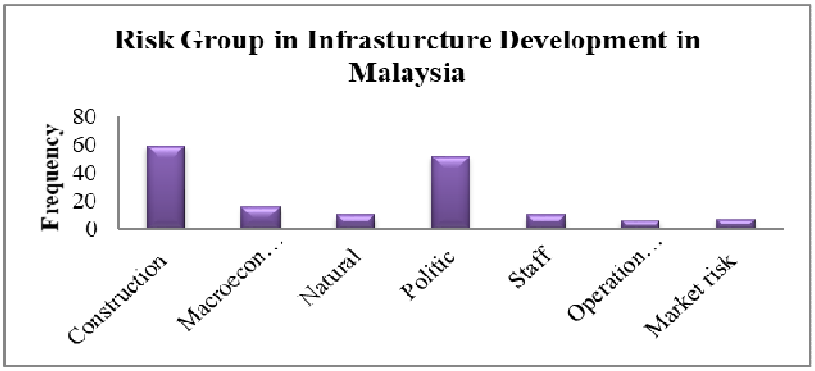


Fig.1. Number of responses of each risk group in PPP project from literature review

the above bar chart depicted number of responses for each risk group. This comprises the previous studies to reckon the risk that the most likely to happen in infrastructure project. Higher number of responses described higher occurrence of the risks in the project. Here, construction risk represents the highest number of Reponses. Likewise, political risk also shows high number of responses among other risks identified in the project. High number of responses for both risks are supported by high number of consolidated risk factors of each group. Overall, figure 1 depicted that, other risks received less than 20 responses for the occurrence in the project.

Table 1 presented risk description of each risk group considered in this study. The description met common criteria considered in other studies.

Table 1. Risk description for critical risk group.

Risk Description	Previous Studies
Construction risk Construction risk colligated to delay in completion, abandonment, problems in land acquisition and compensation, environmental risk, cost overruns, failure to achieve stipulated performance levels and faulty construction techniques. Construction risk may escalate cost of construction.	Alireza et al., (2014), Yong & Nur Emma Mustaffa, (2012), Sarvani et. al. (2014), Adnan et al., (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Alfan & Zakaria, (2012), Ruzian Markom & Engku Rabiah Adawiah Engku Ali, (2012), Bakri, Saidan Khaderi, & Abd. Shukor, (2009), Bokharey et al., (2010)
Macroeconomic risk This risk also known as financial risk. Macroeconomic risk has 4 risk factors, interest rates, inflation, influential economic events and poor financial market. The risks may impinge on long term loan payment.	Alireza et al., (2014), Yong & Nur Emma Mustaffa, (2012), Sarvani et. al. (2014), Miroslaw et. al. (2012), Raja Khairul Anuar Bin Raja Abd Karim, (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Bakri, Saidan Khaderi, & Abd. Shukor, (2009), Bokharey et al., (2010)
Natural risk Natural risk associated to war or acts of God. Natural risk includes force majeure, weather and environment risk factors.	Alireza et al., (2014), Sarvani et. al. (2014), Adnan et al., (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Bakri, Saidan Khaderi, & Abd. Shukor, (2009)
Political risk Political risk consist of the highest number of risk factors. Political risk pertained to government authorization and support to the project. The developed projects require special legislative, specific governmental approvals and government partly may act as financing guarantor.	Alireza et al., (2014), Yong & Nur Emma Mustaffa, (2012), Sarvani et. al. (2014), Adnan et al., (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Ruzian Markom & Engku Rabiah Adawiah Engku Ali, (2012), Bakri, Saidan Khaderi, & Abd. Shukor, (2009), Bokharey et al., (2010)

Staffing risk	
Staffing risk related to lack of coordination and commitment and inadequate experience in PPP project.	Alireza et al., (2014), Yong & Nur Emma Mustaffa, (2012), Sarvani et. al. (2014), Adnan et al., (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Bakri, Saidan Khaderi, & Abd. Shukor, (2009), Bokharey et al., (2010),
Operation and maintenance risk	
Operation risk involves the possibility that the operation expenditure elevated beyond allocated budget. Over expenditure on operation cost will affect the projected revenue of the entire project.	Alireza et al., (2014), Sarvani et. al. (2014), Adnan et al., (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Bakri, Saidan Khaderi, & Abd. Shukor, (2009), Bokharey et al., (2010)
Market risk	
Market risk driven by toll charges.	Sarvani et. al. (2014), Adnan et al., (2012), Miroslaw et. al. (2012), Raja Khairul Anuar Bin Raja Abd Karim, (2012), Ismail Abdul Rahman, Memon, & Nora Sheda Mohd Zulkiffli, (2014), Bakri, Saidan Khaderi, & Abd. Shukor, (2009), Bokharey et al., (2010)

Table 2 listed 12 risk factors commonly occurred in BOT project in Malaysia under 7 risk groups. Construction risk constitute with 3 risk factors namely availability of project finance, construction cst overrun and design default. In political factor, the most concern risk is strong political opposition and interference. This risk may restrained toll increment if there exist public pressure which will distort profit margin from toll revenue [14]. According to Xu, Miroslaw et al. (2012), microeconomic factors correlatively affect other risk factors. The fluctuation of inflation and interest rate will strike the cost of construction and operation activities throughout the project. As well as the natural risk, the occurrence of unexpected force majeure disrupts the road operation activities. Thus, it will coherent toll collection until it is fully recovered.

Table 2. Risk Identification of risk factors and in each risk group.

No	Risk groups	Risk factors
1	Construction risk	Availability of project finance
		Construction cost overrun
		Design default
2	Macroeconomic risk	Interest rates
		Inflation
3	Natural risk	Force majeure
4	Political risk	Strong political opposition & interference
		Third party delays
5	Staffing risk	Lack of coordination & commitment
		Inadequate experience in PPP/PFI
6	Operation and maintenance risk	Higher maintenance cost
7	Market risk	Market demand

3. RISK ASSESSMENT OF IDENTIFIED RISK IN INFRASTRUCTURE DEVELOPMENT

Risk assessment is extremely important to the success implementation of BOT project. The purpose of risk assessment is to quantify the common risks occurred. Risk assessment will help to determine the severity impact and compose the most significant factor that affect the project [12]. Based on the identified risk presented in table 2, the risk assessed according to the risk group. In order to obtain standard measurement of each risk from different results (refer table 1), this study adopted Ebrahimnejad et al. (2010) method to determine the weightage of each risk group. By using this method, the existing results from different studies were normalized [0,1] to provide better judgement of severity impact of the respective risks. Based on this method, higher weightage (close to 1) signifies high severity impact of risks to the project. According Ebrahimnejad et al. (2010), the weightage of risk groups can be determined using the following formula:

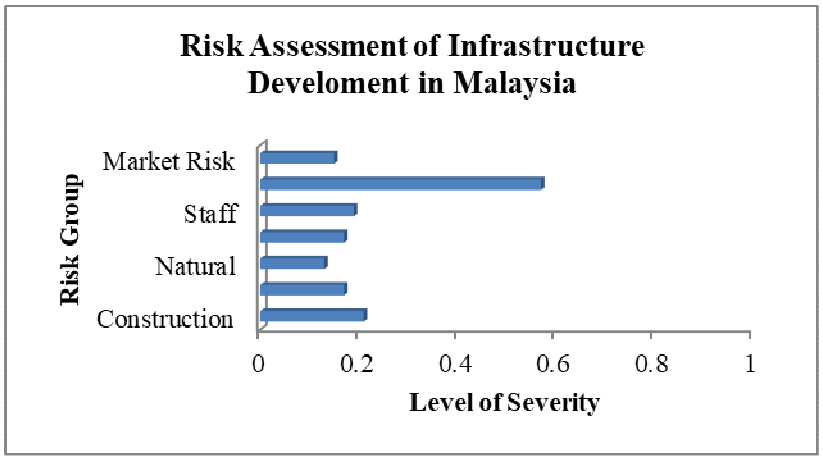
$$W_i = \frac{M_i}{\sum_{i=1}^{7} M_i} \quad \text{[1]}$$

where

W_i weightage of each risk group

M_i mean of particular risk group

$\sum_{i=1}^{7} M_i$ summation of mean of all risks groups



Risk groups	Weightage
Construction	0.21
Macroeconomic	0.17
Natural	0.13
Political	0.17
Staffing	0.19
Operation & maintenance	0.57
Market risk	0.15

Fig.2. Risk group assessment based on level of severity

Figure 2 above represents severity impact of seven risk groups. Operation and maintenance risks depicted to be the most severed risk in the project. The respective risk incurs high affect from the maintenance risk factor. According to [16], there are few factors contributed to higher maintenance in BOT project in Malaysia particularly in highways, namely, over-loaded freight transportation, change of road networks, traffic congestion and many others. Other risk that may not be overlooked is construction and political risks. Based on figure 1 presented in the previous section, these two risks received high responses from the literatures, however, the severity impact showed that the risks are less severed from the operation and maintenance risk. Microeconomic risk considered risky due to fluctuation of interest and inflation rate in the market. Thus, the interest of financing and inflation in purchasing goods and materials become uncertain.

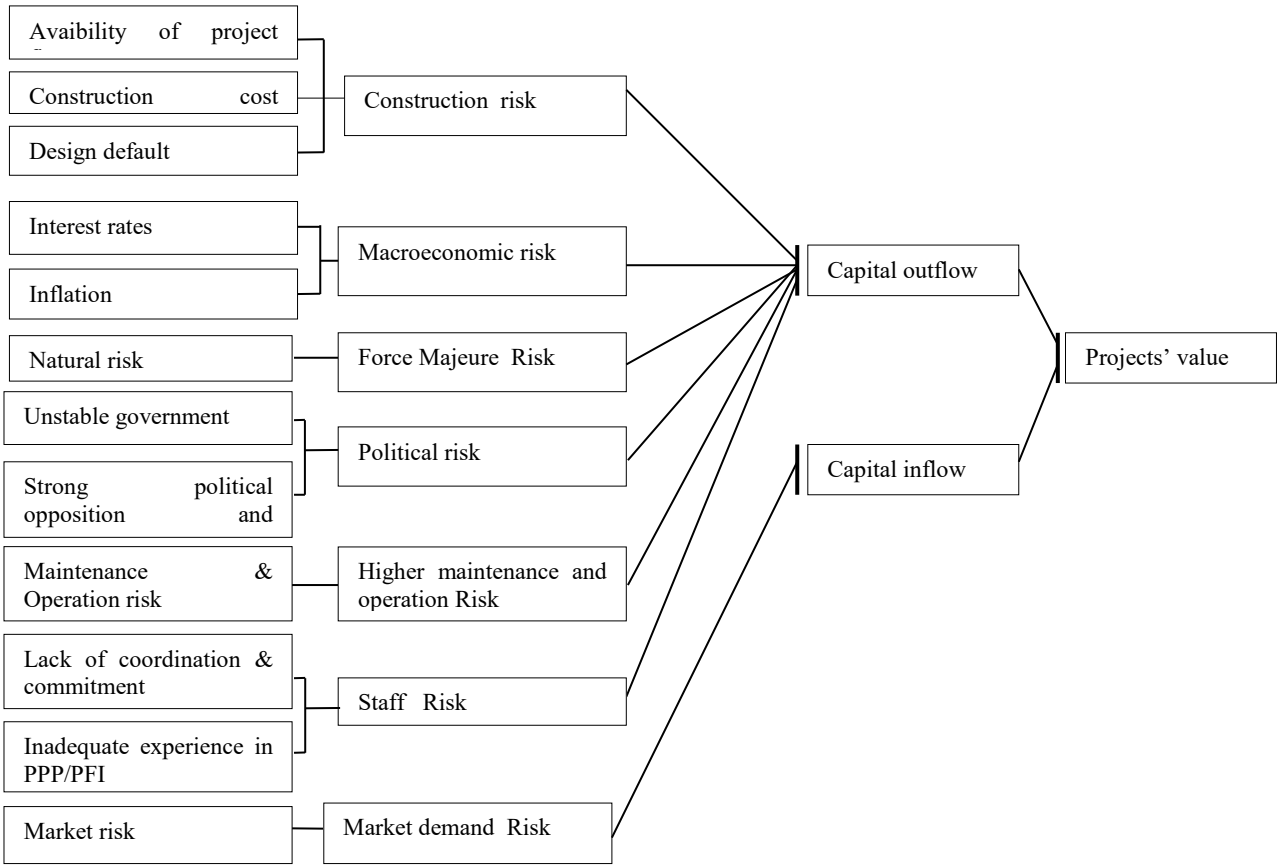


Fig.3. Risk factors anticipation in projects' present valuation

The flowchart presented in figure 3 described the relation of each risk group to the projects' valuation. The valuation depends on cash inflows and outflows of the project. For example, construction risk affects cash outflows at the beginning of the development. The risk factors

in construction risk such as construction cost overrun and project's design may differ from the amount determined at early stage of the project. Result in figure 2 also highlighted operation and maintenance risk to be primary concern of the project. The risk cannot be neglected due to high impact of projects' cash outflow. The revenue of the project depends on the market risk. Higher demand from users means the project is worth to be built. The investors need to ensure market demand risk is high to compensate other risks. Thus, identified and assessed risk process is extremely important in every infrastructure development. This will help the investors to monitor unlikely event to happen at every phase of the project.

4. CONCLUSION

Infrastructure development has to be built in the most systematic and efficient way for healthy growth of other economic activities. It is the backbone of the private development that literally bring great fortune to the country. Good development of infrastructure project is very important to the elevation of national economy. However, infrastructure development is high risk project, exposed to numbers risks at every phase of the project. The identification and assessment of risk is very important for the decision maker to mitigate the risk at planning phase to ensure the project is successfully executed. This study comprised common risk factors happened in the infrastructure development. The risk factors are categorized into 7 risk groups namely construction, microeconomic, natural, political, staffing, operation and maintenance and market risk. The risk groups are assessed using weightage method to determine severity impact of each risk group to the project. Operation and maintenance risk presented to be highly severed compare to other risk groups. The findings of this study believe to be beneficial to the infrastructure development project. It comprised most of risk factors commonly happen in Malaysia and other countries. Thus, it enables the investors to be more alert of the investment in infrastructure development.

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