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Operational Risks for Highway Projects in Malaysia

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Abstract**—**The Malaysia Highway Authority (MHA) was established by the Government in 1980 for the purpose of designing, constructing and maintaining toll highways in Malaysia that include the North-South Expressway and the Penang Bridge, which were procured using the publicly-funded traditional procurement. However following a recession in the mid 80's, the operations of these tolled-highways had been privatized to ensure that their operational services continue through private financing as a result of long-term concession agreement concurred between the Malaysian Government and private operators. The change in the contract strategy for highway projects in Malaysia would have a great tendency to dictate a significant risk exposure towards the key parties involved, particularly the Malaysian Government as project principal, unless operational risks are clearly identified and managed via appropriate mitigation measures prior to a contract signing.

This research identifies potential operational risks that have a possibility to occur in highway projects in Malaysia from the perspective of public sector clients. Since this research focuses on the operational risks for highway projects in Malaysia, the initial results acquired from literature review on the operational risks of highway projects in some Asian countries are then justified by a number of key individuals from the MHA through interviews. As a result, among key operational risks that have possibility to occur in the highway projects in Malaysia include initial toll-tariff decided by the Government, traffic congestion, change of road network and over-loaded freight transportation, which could cause damage to the road surface and hence affecting the operation of a particular highway.

Keywords**—**Malaysia, operating highway project, operational risk.

I. Introduction

OPERATIONAL risk refers to an event or incident that causes a negative consequence to the operation of a project after commissioned. In other words, operational risks have significant impact to the effectiveness and efficiency of the operational activities designed to enhance the operating system of a project if occur. There are several potential factors that may influence the occurrences of operational risks in construction projects like highways. Amongst them include an ineffective use of related tools and techniques to identify and predict possible risks and their potential cost impact should they occur in the actual construction project. Also poor risk management planning, low quality in design and poor supervision during construction are among other potential factors that may dictate the occurrences of operational risks in construction projects.

Usually if one or more of these factors takes place in the actual construction projects, there is a great possibility of one or more operational risks to occur. Among the operational risks that may occur in construction projects like highways include cost overrun in operation and maintenance, non-availability of services due to asset failure and poor quality of service delivery. Time and cost overrun during construction may also have a significant effect on the operation of a construction project if occur in the actual construction project. For example, time and cost overrun in construction would dictate a potential delay in project commissioning.

This research focuses on identifying operational risks that have great potential of occurring in highway projects in Malaysia. The outcomes of this research are purely developed based on initial findings acquired from extensive literature review on the operational risks of highway projects within some selected Asian countries. The operational risks identified are then justified by a number of key individuals from the MHA, which have a considerable level of experience working and managing highway projects in Malaysia, via interviews to verify their potential occurrences in highway projects in Malaysia. As a result of this research, several significant risks that may affect the operation of highway projects in Malaysia have been identified to ensure that appropriate mitigation measures can be carried out by the MHA as early as project initiation stage to minimize them from occurring in the actual project.

II. Methodology

There are two stages involved in this research project: First, the key operational risks for highway projects in Malaysia and some selected developing Asian countries were identified through literature review. This stage of research focuses on determining the types of operational risk that had been identified by previous researchers, which have great potential of occurring in the highway projects and causing significant impact to the project if occur.

Second, extensive interviews were conducted with a number of key personnel from the MHA in order to get their personal opinions and views about the possibility of the operational risks identified from literature review to occur in the highway projects in Malaysia. The selection of the personnel involved in the interviews was made based on a

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thorough background check in regards to their knowledge and experience working as well as managing highway projects in Malaysia. For example, the Regional Director of the MHA who used to manage and also currently managing the operational contracts of highway projects within its region. The personnel involved in the interviews then justified the possibility of the operational risks identified from literature review to occur in the highway projects Malaysia.

III. Findings

Operational risk in construction projects like bridges, highways and hospitals reflects activities or events that have significant impact towards the operation of the project if occur. Time and cost overrun in the operation and maintenance are among key operational risks that have the possibility to occur in a construction project during the operational stage. Reference [1] outlined several factors that may dictate the occurrences of these risks in construction projects, which include:

- breach of contract by either contractors or project clients;
- industrial action directed at the project;
- force majeure events;
- certain court and tribunal rulings; and
- additional works required to rectify defects.

The costs for operating and maintaining a construction project are usually considered as overrun when the allocated expenses are found insufficient to carry out the scheduled activities or works, after arising from unexpected escalation in the costs of equipment, labour, utilities and other supplies. Reference [2] identified other possible factors that can be associated with the occurrences of cost overrun in particular, during the operation and maintenance of a construction project. These include the operator's failure to meet the desired performance standard or produce the required capacity, output and efficiency from the procured assets and/or facilities as specified. However in order to achieve the aim of this research, only findings related to operational risk for highway projects in some selected developing Asian countries that had been identified by past researcher will be specified under this heading.

A study on the operational risk of Senai–Pasir Gudang–Desaru Expressway (SPGDE) [3] resulted in the identification of potential environmental pollution to the water quality of the surrounding area caused by spillage of dangerous and hazardous chemicals from the travelling heavy vehicle along the highway. This prospective environmental pollution was identified as part of the risks for this project due to the location of the SPGDE where some part of the 77 km expressway had been built across the Layang River catchment area, which situated between the Upper Layang Reservoir and Lower Layang Reservoir. The water quality from the Layang River water catchment, which acts as the main source of water supply for the Johor Bahru District, will be badly affected if this risk materialises during the operation of the SPDGE.

Inappropriate operation and maintenance of the procured assets was another type of potential operational risk identified for highway projects. A study conducted by past researcher [4] on the expressway in China determined about the importance of proper asset management to ensure that the procured highway projects are fully operational to the public. Generally the quality of road surface procured had been identified as part of the key assets towards a successful delivery of highway projects in China [4]. Thus there are two key risk sources identified that could affect the quality of road surface where the latter is also known as an expressway asset for highway projects in China; man-made risk and natural risk. The man-made risk refers to activity or event created by human being that could cause damage to the expressway asset either deliberately or not. Among the examples of man-made risks identified from the study on highway projects in China include over-loaded freight transportation and leakage of dangerous material/cargo on the road surface. The studies on the over-loaded freight issue for the highway projects in China had resulted in the identification of the fact that direct loss of highway assets caused by overloading freight transport in a year was equivalent to the total annual maintenance fee collected from highway projects nationwide [4]. The natural risks in the highway projects in China meanwhile are seen as events with negative consequences that occur beyond the control of human being such as flood and fog.

A study on concession-tolled roads in Indonesia by past researcher [5] was aimed at identifying risks and their potential impact within four project stages; project initiation, construction preparation (contract award stage), construction and operation. However only results related to the operational risks of concession-tolled road in Indonesia had been utilized to meet the aim of this research. Typically there were five key operational risks identified for concession-tolled roads in Indonesia [5], namely the initial toll-tariff decided by the government, sudden increase in toll-tariff, traffic congestion as well as change of road network and change of government policy. The initial toll-tariff decided by the government here reflects the actual rate agreed to be imposed to the end-user of the concession-tolled road by the ruling party prior to project commissioning. This risk would have significant impact towards the actual toll collection if the initial toll-tariff decided is beyond the affordability of the road user. Sudden increase of toll-tariff due to global economic crisis was also identified as risk that may have a significant impact to the operation of concession-tolled roads if occur in Indonesia. However none of these operational risks were found to have either high level of probability occurrence or cost impact in the concession-tolled roads in Indonesia but only moderate [5].

A study on highway projects in Thailand had also been conducted in the past [6] to determine their potential risks during operation. The study had resulted in the identification of several risks, which could affect the effectiveness and efficiency of highways' operation. Among the key operational risks identified from the highway projects in Thailand include poor road sign and delineator, road side hazard, inefficient road safety device and poor road surface. Several potential sub-risks that have great potential to occur in highway

projects in Thailand under each key operational risk were also identified by the researcher [6] as shown in Table I.

TABLE I
OPERATIONAL RISKS/ SUB-RISKS FOR HIGHWAY PROJECTS IN THAILAND

Risk	Sub-Risk
Poor road sign and delineator	Hidden signage
	Fade/ Defect/Inappropriate signage
	No proper marking/delineator for road side obstruction (warning sign)
Road side hazard	Improper existence of road side fix objects such as tree and lamp post
	Uncovered side drainage
	Poor condition of bridge pier/ pedestrian foot bridge
Inefficient road safety device	Defect device
	Poor visibility
	Improper installation
Poor road surface	Uneven surface
	Debris on surface

Hidden road sign, inappropriate/defect signage and improper warning sign by road side were identified as among major sub-risks under poor road sign and delineator for highway projects in Thailand. As for the road sign hazard, a number of sub-risks were identified including improper existence of fix objects at road side such as tree and lamp post that sometime may distract the focus/attention of road drivers and hence causing accidents as well as an uncovered road side drainage that may also lead to severe accidents. Defect device, poor visibility and improper installation of devices were among sub-risks identified under inefficient road safety device while uneven surface and regular debris on surface were classified under the poor road surface for highway projects in Thailand.

IV. RESULTS/ DISCUSSION

This section specifies the outcomes generated from the extensive interviews conducted with a number of key personnel from the MHA in order to get their personal opinions and views about the potential occurrence of operational risks identified from the literature review. The selection of the personnel involved in the interviews was made based on a thorough background check in regards to their knowledge and experience working as well as managing highway projects in Malaysia. The personnel involved in the interviews then justified on the possibility of operational risks identified from other highway projects in some developed Asian countries to occur in Malaysia.

There were thirteen risks identified from the highway projects in Malaysia and some selected developing Asian countries through the literature review. Table 2 indicates the types of risks identified from the highway projects in Malaysia and some selected developing Asian countries via the literature review and also consensus achieved from personnel involved in the interviews in regard to the probability occurrence of these risks in the highway projects in Malaysia. All the thirteen risks identified from the literature review were found to have the potential of occurring in the highway projects in Malaysia. Out of thirteen risks identified, only one was classified by the personnel involved as risk with high probability of occurrence in the highway projects in Malaysia; the initial toll-tariff decided by the government. According to the interviewed personnel from the MHA, the initial toll-tariff for a particular highway project is usually decided based on the capital cost of the project as well as its estimated operation and maintenance costs over the contractual duration agreed between Government and private contractors prior to commissioning. In other words, revenue of private operators in most of the highway projects in Malaysia is purely based upon the toll collection.

TABLE II
PROBABILITY OCCURRENCE OF OPERATIONAL RISKS IN HIGHWAY PROJECTS IN MALAYSIA

Risk	Probability (Low/Med/High)
1.Environmental pollution to water supply quality	Low
2.Over-loaded freight transportation	Medium
3.Leakage of dangerous material/cargo on road surface	Medium
4.Flood/ fog	Low
5.Initial toll-tariff decided by the government	High
6.Sudden increase in toll-tariff	Low
7.Traffic congestion	Medium
8.Change of road network	Medium
9.Change of government policy	Low
10.Poor road sign and delineator	Low
11.Road side hazard	Low
12.Inefficient road safety device	Low
13.Poor road surface	Low

However this type of pre-commissioning decision would somehow have an effect on the low-income user if the initial toll-tariff decided is expensive and hence preventing them from using the newly-procured highway project. Therefore there is a high possibility of this risk occurring in the highway projects in Malaysia. Unlike the highway projects in the UK where payments are made by the Government through "shadow toll" estimate via the government's popular choice Private Finance Initiative (PFI) procurement strategy, Basically, the shadow tolls reflect payments made by Government to the private operator based on an estimated number of vehicles using the road where drivers do not need to pay tolls directly, thus minimizes the toll collection costs [5].

Four other risks were classified by personnel involved in the interviews as risks with medium probability of occurrence in the highway projects in Malaysia; over-loaded freight transportation, leakage of dangerous material/cargo on road surface, traffic congestion and change of road network. According to the MHA personnel, most of lorry drivers in Malaysia have very poor attitude especially to abide by the rules and regulations set by the Government for heavy vehicles such as speed limit, type of carried material/cargo and also maximum loading limit.

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Although continuous actions have been taken by the responsible authority, over-loaded freight transportation and leakage/ spillage of dangerous material on road surface are still occurring in the highway projects in Malaysia. Hence these risks had been classified as risks with medium probability of occurrence by the personnel involved in the interviews. As for the risks of traffic congestion and change of road network, there is low probability of occurrence in the highway projects in Malaysia due to proper initial planning prior to project implementation between the Malaysian Government and other public sector agencies such as the MHA and Public Works Department Malaysia. However heavy traffic congestion usually occur in the highway projects in Malaysia during festive seasons and alternatively change of road network would be initiated by Malaysian Government and the MHA to overcome the problem temporarily. Thus the personnel involved in the interviews had classified these risks as risks with medium probability of occurrence.

V. Conclusion

Operational risks are events that would have an adverse impact towards a particular construction project like highway if occur once it is commissioned. Although different Asian countries explored in this research might have different type of operational risks due to geographical and cultural differences, still there is a great potential for each risk identified to occur in the highway projects in Malaysia except the level of probability occurrence could be different. Thus there is a huge likeliness for the thirteen key operational risks identified to also occur in other highway projects around the world. These operational risks ought to be carefully considered and mitigated to appropriate project parties as a result, to ensure highway projects can be delivered in the most effective and efficient manner around the world.

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