Affecting Factors for Implementing Performance-Based Maintenance Contracting: Perspective of Malaysian Road Contractors

Affecting Factors for Implementing Performance-Based Maintenance Contracting: Perspective of Malaysian Road Contractors

R Manogaran[1], R A Rahman[1,2], A Ismail[1], I S M Razelan[1] and P Mandiartha[1]

1 Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia
2 Earth Resources and Sustainability Centre, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan Pahang, Malaysia
E-mail: azlinai@ump.edu.my

Abstract. Traditionally, road maintenance is conducted either using road authorities' in-house resources or method-based contracting, where contractors do the work and are paid based on predefined volume and unit prices. Nowadays, Performance-based Maintenance Contracting (PBMC) is one of the most current approaches in road maintenance works. PBMC provides contractors with freedom in design, construction methods, materials, and innovation in performing the contract as long as the standard specified is fulfilled. While PBMC implementation is increasing around the world, it can be considered new in Malaysia. This research aims to investigate the viability and practicability of PBMC's implementation for road maintenance in Malaysia. Specifically, the research's objective is to identify factors that are affecting the adoption of PBMC for road maintenance works in Malaysia. To achieve that objective, interview data from industry practitioners that are involved in managing roads are analyzed. Factors affecting PBMC's implementation for road maintenance in Malaysia can be categorized into two groups: PBMC (ex. awareness on PBMC) and Non-PBMC (ex. contractor's integrity) related factors. The findings of this research would help policymakers, industry practitioners, and researchers improve the success of implementing PBMC in the facility management industry.

1. Introduction

Road networks play a significant role in both the economic and social development of Malaysia. Some of these include providing proper access to the public to various places for services like healthcare (to hospitals) and education (to schools) [1]. Deterioration is widespread in roads and is sure to happen over a certain time due to accumulated damage from vehicles, thermal cracking, or even oxidation. Road maintenance works include keeping pavement, shoulders, slopes, drainage facilities, and other road furniture closest to its original state [2]. An adequately maintained road gives comfort and safety to users and at the same time, enables users to travel from one place to another quickly without accidents occurring.

In Malaysia, road maintenance works are contracted out to the private sector to improve efficiency. The contracting method that is used is the conventional contracting method where quantities of works

completed are the measure used in determining unit rates for work items and payments [3]. The existing contracting method may have several problems (a) there is no direct communication between the contractor and consultant or in other words, no input and design planning by contractor; (b) the competitive tendering may be bias as low bidders get the project and; (c) this sequential process takes up more time for project completion which is why there is an urgency for an alternative method to be introduced[4].

Performance-Based Maintenance Contracting (PBMC) is a results-oriented contracting method that focuses on outputs, quality, or outcomes [5]. PBMC is cost-saving as techniques, technologies, materials, and quantities of materials to be used, together with the time during which the maintenance works should be executed is not specified by clients [6]. Although PBMC is widely practiced in many other countries like Brazil and Canada due to the many benefits it has brought [7], it is still very much not known among Malaysians.

The objective of this paper is to identify factors that are affecting the implementation of PBMC for road maintenance works in Malaysia. To achieve that objective, individual interviews with contractors that perform road maintenance works are analyzed. The findings provide an understanding of the thoughts of contractors towards this new method of contracting and to know what are the factors that should be considered before PBMC can be a contracting method in the future. Besides, the findings can help policymakers in developing action plans to overcome possibly arising challenges.

2. Background

2.1. Issues and Challenges Associated with PBMC

It is important to study the possible problems that could arise from implementing something new into practice so that proper precaution and preventive methods could be taken. Studies have been done in countries that have implemented PBMC as their main mode of contracting. The problems that arose will be discussed in this section. The challenges include (a) the need for performance specifications and standards to be set up by clients and (b) employee losing their jobs [7]. In the contract, the client is to state clearly the quantity, type, and location of the work outputs required [8]. This needed to be done by the client so that the contractors' quality of work can be measured before he receives his payment. With standards set, it will be a lot easier for the contractor to plan his work so that he can present the output as desired by the client. The problem here is that the specifications and the standards must be set very clearly so that no party is at a loss, be it the client or the contractor. A standardized road standard that all contractors should abide in must be set. This is to ensure fairness so that every contractor abides in one standard and not multiple standards. In 1999 in Estonia, after the road networks were contracted under PBMC, there was a decline in the workforce of the national and sub-national road agencies [9]. Under PBMC, there is very little need for staff to be on-site and supervise the condition on-site regularly. Also, not many people are required for administrative works. Since there is no need for supervision on the means and modes of which a project is carried out, supervision is only required at stages where final outcome is to be presented. So, to say, PBMC resulted in some staffs having to lose their jobs in Estonia, one of the countries that practiced PBMC.

2.2. PBMC in Malaysia

In order to secure long-term funding for road maintenance and to guarantee good road conditions, in 2001, PBMC was introduced for the entire federal road network (except areas managed under toll concessions) in Malaysia [10]. With each contract lasting for a term of 15 years, the type of maintenance works contracted using PBMC was either for periodic or routine works. In addition to maintenance works, the government practiced PBMC in works related to repair and overhaul of complex equipment [6]. Hence, it can be said that PBMC is no strange thing in Malaysia. However, this contracting method is still an uncommon practice among Malaysians. Before implementing something new and making that something new a common practice, it is important to first understand the acceptance and perception of people towards that something new. That is why hearing from experienced people in the field will help us understand why this so beneficial contracting method is yet to be made the main mode of contracting in Malaysia.

3. Methodology

The data was collected using a qualitative approach that is by conducting individual interviews and later on, analyzing data attained using thematic analysis method. Below shows a detailed explanation of the methods of data collection and data analysis.

3.1. Data collection

Interview sessions are conducted with relevant industry practitioners (contract managers and operation managers) as these groups of people will be the most suitable people, equipped with all the information that will ever be needed for this research. Interviews were conducted to answer all the research objectives. The data collection involved 20 interviewees who are contractors of class G7 performing road maintenance works in Malaysia, making findings reliable, and valid for this research. This approach was also used to collect data for identifying factors affecting highway construction projects [11] and design- building projects [12]. The type of questions asked were open-ended questions as these kinds of questions allow interviewees to answer their piece of thought freely without having to restrict their opinion with just limited options of choice for answers. The main question during the interview was "What is your opinion in implementations of PBMC in Malaysia?" Other questions included "Please brief the important factors in implementing PBMC in road maintenance," and "What do you consider to be issues or challenges in implementing PBMC in Malaysia?". After each interview session, the responses were summarized and emailed to the interviewee for verification or validation to avoid misinterpretation of data.

3.2. Data analysis

Analyzing the qualitative data using the thematic analysis method was done by identifying common repeated terms or patterns from the interview data. Prior studies were also done using the thematic analysis to identify themes in parameters for assessing construction readiness in highway construction projects [13] and attributes of changes agents in adopting technologies in construction projects [14]. There are six phases in the thematic analysis [15]. The first phase is familiarizing the data. At this phase, transcribing of data is done when needed. Data is read and reread, and from there, initial ideas are jotted down. The second phase is the generation of initial codes. Interesting features (potential themes and patterns) of the data are coded orderly. Data that is relevant to each other is being collated where any omitting or addition to the codes are done. The third phase is searching for themes. During this phase, codes are collated into potential themes. At this particular phase, codes from the second phase and the first phase are constantly revisited. The fourth phase is reviewing themes. This phase is done to check the themes application in relation to the coded extracts and entire data set to ensure saturation of data. During this phase too, a thematic map of analysis is generated. The fifth phase is defining and naming themes. More analysis is done to refine the specifics of each theme where clear definitions and names for each theme is generated. The last phase is producing the report, where the output of the analysis is done.

4. Results and Discussion

Figure 1 shows the affecting factors for implementing PBMC for road maintenance in Malaysia from analyzing the interview data using the thematic analysis method. Each of those factors are discussed in the subsequent subsections.

4.1. PBMC Related Factors

4.1.1. Acceptance of PBMC

Acceptance means a general agreement to which something is considered to be satisfactory or right and that it is all right in making that something a practice. To accept something is also an act of agreeing to an idea or proposal. In the context of this research, it is: (a) the favor shown by clients; and (b) the acceptance of the contractors towards the implementations of PBMC, which makes up the factors leading to challenges in the implementation of PBMC. Specifically, disputes between the client and contractor may arise as the client may not be willing to offer the price the contractor wants. Also, arguments may arise as the contractor gets to decide the type of materials as long as it complies with specifications. Clients may also not be in so much favor if they cannot maximize their profit as contractors decide the means and modes in PBMC.

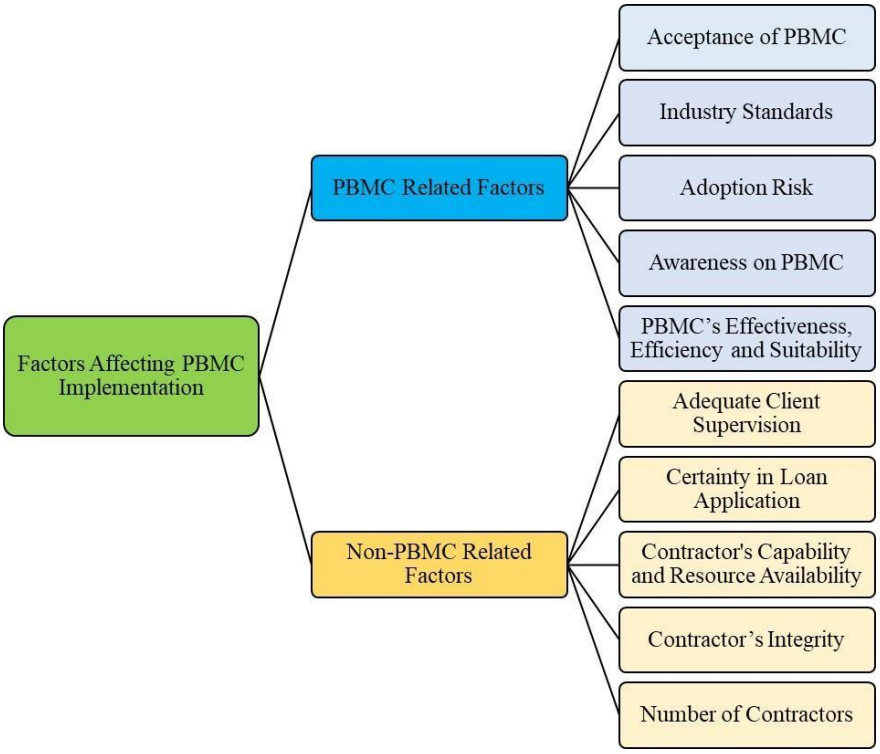

Figure 1. Factors affecting the implementation of PBMC for road maintenance works in Malaysia.

4.1.2. Industry Standards

An industry-standard is a basis of comparison, a rule, a principle, or a normal requirement that has to be followed by a contractor as he conducts a specific project awarded to him. From the results of this research, affecting factors related to industry standards are: (a) lack of safety; (b) all materials sold must follow standards; and (c) lack of transparency. Specifically, participants suggest that in some cases, under the practice of PBMC, safety factors may not be taken into top consideration. Since the client will not specify every detail of the road maintenance works, the contractor will now work according to the minimum requirement from the design given by the consultant without considering safety. In other words, before implementing PBMC into practice, further studies are required to identify any needs for additional specifications and standards.

Also, participants suggest that all materials should follow only one specification and requirements. Some suppliers may supply material at a lower price. The government has to ensure that the cheaper materials have an equivalent quality to the expensive ones. Whichever supplier who is supplying cheap materials that do not reach the industry standards should be charged legally.

Furthermore, the transparency of the contractor selection method should be examined. Since simply a low bidding will not assure a contractor a project awarded, but, also a good past record, the client may tend to award projects to contractors they favor whom they have dealt with previously. This will not give a chance to those contractors who are new and just starting to build a name in the industry. Even worse, an established contractor with internal connections is sure to have more favor from the client itself.

Therefore, the industry standards need to be revised not just to set guidelines for contractors to conduct their work but also for a cleaner contractor selection method. It may be a hard task when it comes to determining performance baselines as it may vary from projects and clients [6], which is why standardizationisvital.

4.1.3. Adoption Risk

Risk equals expected damage [16]. In terms of construction, the possible risks may be insufficient resources, disputes between clients and contractors, accidents at a site, or even bankruptcy. The analysis suggests that the risks for adopting PBMC for road maintenance work in Malaysia are: (a) higher allocation of risks to contractors; and (b) additional works for contractors.

Specifically, in PBMC, if upon completion, the defect liability period is not issued, there might be dissatisfaction for the contractor as the risk in case of any mis-happenings is for them to bear. Not being established nor having internal connections may result in getting no tender at all, which is not what any contractor wants. So, a contractor will have some extra work to do if he wants to outshine and stand out among other contractors. Contractors will have to study new innovative techniques and methods to complete a job that can leave the client in awe and immediately award the project to them.

4.1.4. Awareness on PBMC

Contractors' awareness of PBMC is also one of the factors that affect the implementation of PBMC in road maintenance work in Malaysia. Despite the numerous benefits of PBMC, some contractors still have yet to hear about this contracting method [6]. According to one of the interviewees:

"*The government should provide courses to contractors to explain how PBMC works, and all its whereabouts as some may not have even heard about it. Proper guidelines should be provided, aswell. Before any implementation is done, the government must find out if every contractor in the country understands PBMC*".

4.1.5. PBMC's Effectiveness, Efficiency, and Suitability

The affecting factors for this subsection include: (a) effectiveness and efficiency test; and (b) suitability with Malaysia. Below are some examples of the interviewees' responses related to this factor:

"*The government has to first conduct an effectiveness test on small volume projects for a certain period of years. Different aspects like the cost and the durability using PBMC should be tested. If growth and progress can be observed using PBMC compared to the traditional method, then maybe, the government may slowly start implementing PBMC on larger volumes*".

"*The benefits and problems should be observed. Also, action plans should be prepared ahead, especially for possible arising challenges*".

"*Before this method can be made into the main mode of contracting method, it is important for the government to first test its effectiveness on pilot projects. It would be better if implementations are done at a minimal stage first, not straightaway for all projects in the country. To compare the success of this method with other countries who have implemented, it will not be practical as different countries have different economic status and political status. The government has to do proper studies to see if the implementation of PBMC will help boost the current economic state or work otherwise*."

In a nutshell, that brings us to the suitability test. The economic status of the country must be studied. The government should work together with economists to see if this method is suitable for the current status of our economy. The government will first have to study the financial state of every contractor in Malaysia to see if or not they are capable and have enough resources to be part of the PBMC implementation. The government will have to test if PBMC is suitable for major road maintenance works to see if this method can be applied for both small and large-scale works.

Table 1. The total number of hits for factors affecting the implementation of PBMC for road maintenance works in Malaysia.

Total Num of Hits

Interviewee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
PBMC Related Factors																								
Acceptance of PBMC		√			√						√													3
Industry Standards							√												√					2
Adoption Risk			√				√	√				√	√											5
Awareness on PBMC							√																	1
PBMC's Effectiveness, Efficiency, and Suitability	√	√		√		√					√	√												6
Non- PBMC Related Factors																								
Adequate Client Supervision									√							√				√				3
Certainty in Load Application									√		√													2
Contractor's Capability and Resources Availability			√		√			√							√						√	√	√	7
Contractor's Integrity	√			√									√					√		√				5
Number of Contractors					√	√			√				√	√										5

4.2 Non-PBMC Related Factors

4.2.1. Adequate Client Supervision

The individual who will determine if a contractor is to be given either an incentive or a disincentive based on agreed performance standards will be the one conducting the supervision and inspection. This person is so important and plays a vital role in PBMC because if specific performance targets are achieved, only then, uniform installment will be released [6].

The two factors leading to challenges in the implementation of PBMC for road maintenance work in Malaysia related to adequate client supervision are: (a) availability of staff for supervision and inspection; and (b) the credibility of staff. Although in PBMC, site supervision is not done as regularly as in the conventional method, the government must first see if they have the needed people to do the supervision work. Otherwise, unnecessary costs will be required to hire staffs to do supervision work. Someone needs to be well versed in doing the job. Proper training must be given to the person inspecting to ensure the works done are perfect and really up to requirement so that no re-maintenance work will be required. Disputes between client and contractor may arise. If the client or the person who does inspection works is not just, he may on personal agendas, not do justice to the contractor. It is crucial for the one inspecting to be well trained to ensure a rightful evaluation. Only a credible person can hold this position of doing inspection and supervision work.

4.2.2. Certainty in Loan Applications

Loan eligibility is the topmost concern of all contractors who are seeking to carry out a certain project. Not all contractors have the ability to fund projects using private funding. Some will seek the help of local banks for financial aid. The one factor leading to challenges in the implementation of PBMC for road maintenance works in Malaysia related to certainty in the loan application is: (a) the eligibility for a loan application. Here is what the interviewees had to say in regards to loan applications:

"*With the current practice of contracting, the contractor is entitled to a loan application. However, it is still uncertain if, with PBMC, loans will still be given out to contractors. This might be a trouble for contractors who lack financially*".

"*If the contractor will have to look for his own resources in this new method of PBMC and loans are not going to be given, it will be hard for contractors to sustain their finance a few months after the project has been awarded to them. This because, usually claims from the government (for government projects) takes a very long time to process and that may be inconvenient if no loans are given*".

4.2.3. Contractor's Capability and Resources Availability

Capability is the ability of someone or something to perform a certain job. In this context, it will be the ability of contractors to perform road maintenance works. From the results of this research, the factors leading to challenges in the implementation of PBMC for road maintenance work in Malaysia related to contractor's capability and resource availability are: (a) ability to perform works; and (b) financial readiness.

The government must study the capability of contractors (main contractor and sub-contractor). The government must study the capability of local contractors in conducting road maintenance works. Like the East Coast Rail Link (ECRL) project, for instance, required the use of contractors from China to do the works. Although road maintenance works may not be as complex as a railway project, the capability of the contractors should first be studied so that there will not be a need to hire foreign contractors that will, in the end, require more money. The contractors must comply with the standards set by the clients. Hence, the quality of work is something needed to be considered in the selection of contractors, which is why it is important to know if or not the local contractors are skillful enough. Understanding their capabilities can help the government decide if there is a need for training for contractors within the country to be conducted.

Not only in terms of working must the contractors be capable, but, also in terms of finance. Studies should be done to see if the contractors in Malaysia have finance that is ready for any new system to be implemented.

4.2.4. Contractor's Integrity

For a contractor to execute their work as per specifications and requirements, a contractor must be honest and has strong moral principles. Based on the results of this research, the factors leading to challenges in the implementation of PBMC for road maintenance work in Malaysia related to contractor's integrity involves (a) the urge to earn more than supposed. Here is what the interviewee had to say:

"*Every contractor wants profit. Since now the contractor gets to decide the materials, technology, and techniques he wants to use in carrying out projects awarded to him, if there exists no integrity, the contractor may do some hanky-panky business here and there. The contractor is sure to cheat with the materials they use to complete a certain awarded project. They will seek for cheap, not so quality material if the client does not specify them in the requirements. Without milling depth specified, no contractor would go the extra mile. Instead, they will mill the least depth possible*".

4.2.5. Number of Contractors

Clients may face some loss since well-established contractors will stand a higher chance of getting projects due to the nature of PBMC. Conversely, small, new, local contractors may not have the capabilities to compete with established contractors. When only established companies take part in the bidding process, the range of price bid may not be a lot, causing the client to be satisfied with the few options they have. Therefore, the government has first to identify the exact number of contractors who are carrying out road construction and maintenance works before projects can be tendered out to ensure every contractor has an equal chance to carry out a project.

5. Conclusion

This paper intends to improve the status of the Malaysian road maintenance works industry through the implementation of PBMC. Specifically, through individual interviews, this research identifies factors that affect PBMC's implementation for road maintenance works in Malaysia. The significant results are the ten factors affecting the implementation of Performance-Based Maintenance Contracting (PBMC) for road maintenance works in Malaysia namely: 'Acceptance of PBMC', 'Industry Standards', 'Adoption Risk', 'Awareness on PBMC', 'PBMC's Effectiveness, Efficiency and Suitability', 'Adequate Client Supervision', 'Certainty in Loan Application', 'Contractor's Capability and Resources Availability, 'Contractor's Integrity' and lastly, 'Number of Contractors'. Also, these factors can be furthered grouped into two themes, PBMC Related Factors and Non-PBMC Related Factors.

More and more researches need to be carried out in close regards to PBMC to make great our roads and the industry itself. With the list of challenges obtained, policymakers can develop action plans to curb such problems discussed in the previous section in order to improve the road maintenance industry. With the list of factors of consideration from various angles, policymakers will have a close research with economist and relevant parties to study on many aspects that requires consideration before implementing any new policies.

6. References

[1] Cherepanov and Cherepanov 2018 Operational Guidance: Ethics for Global Mental Health 94-102
[2] PIARC (World Road Association) 1994 *International Road Maintenance Handbook: Practical Guidelines for Rural Road Maintenance* vol I of IV
[3] Walumoli N 2015 Performance Based Contracts as A Method of Improving Road Maintenance in Kenya 1
[4] 2007 *Alternative Project Delivery, Procurement, And Contracting Methods for Highways Molenaar* K R and Yakowenko G (Virginia, United States of America) p iv
[5] Practice P 2012 *Public Procurement Practice Performance Based Contracting Element 1.1: Developing Performance Based Contracts*
[6] Anwar et al 2016 Implementation of Performance Based Contracting in Malaysia *International Review of Management and Marketing* **6** 286-293
[7] Sultana, Rahman and Chowdhury 2012 An Overview of Issues to Consider Before Introducing Performance-Based Road Maintenance Contracting *World Academy of Science, Engineering and Technology* **62** 350-355
[8] Frost M and Lithgow C M 1996 *Improving Quality and Cutting Costs Through Performance Contracts-Australian Experience* (Washington DC: World Bank Road Management Training Seminar) December 17-18
[9] Stankevich N, Qureshi N and Queiroz C 2005 *Performance-based Contracting for Preservation and Improvement of Road Assets* (Washington DC: The World Bank)
[10] ADB CAREC 2018 Guide to Performance-Based Road Maintenance Contracts vol 1 (Philippines: Asian Development Bank) chapter 3 p 22
[11] Rahman, R. A., Radzi, A. R., Saad, M. S. H. and Doh, S. I., 2020. Factors affecting the success of highway construction projects: the case of Malaysia. In *IOP Conference Series: Materials Science and Engineering* (**Vol. 712**, No. 1, p. 012030). IOP Publishing.
[12] Lee, Z. P., Rahman, R. A. and Doh, S. I., 2020. Success Factors of Design-Build Public Sector Projects in Malaysia. In *IOP Conference Series: Materials Science and Engineering* (**Vol. 712**, No. 1, p. 012045). IOP Publishing.
[13] Radzi, A. R., Rahman, R. A., Doh, S. I. and Esa, M., 2020. Construction readiness parameters for highway projects. In *IOP Conference Series: Materials Science and Engineering* (**Vol. 712**, No. 1, p. 012029). IOP Publishing.
[14] Radzi, A. R., Bokhari, H. R., Rahman, R. A. and Ayer, S. K., 2019. Key Attributes of Change

Agents for Successful Technology Adoptions in Construction Companies: A Thematic Analysis. In *Computing in Civil Engineering 2019: Data, Sensing, and Analytics* (pp. 430-437). Reston, VA: American Society of Civil Engineers.

[15] Braun V and Clarke V 2006 Using Thematic Analysis in Psychology *Qualitative Research in Psychology* **3(2)** 77-101

[16] Campbell S 2005 Determining overall risk *Journal of Risk Research* **8** 569–581

Acknowledgment

The authors would like to thank Universiti Malaysia Pahang for supporting this research through financial grant RDU1703201 as well as the industry practitioners that agreed to participate in this work.