

## HIGHWAY MAINTENANCE MANAGEMENT: A REVIEW OF SOME PRACTICES IN MALAYSIA

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### ABSTRACT

*Highway maintenance is becoming a very popular topic in recent years. The relationship between the growth of the nation and welfare of the society has highlighted the importance of the subject. Without the proper maintenance system, highways can rapidly tumble into depreciation which in the end will affect the highways patron in term of vehicle operation, time, reliability and safety. With the alarming number of accidents happened due to highway condition, the effectiveness of the highway maintenance management system in Malaysia has raised a concerned. A study conducted to address this issue with related government agencies, highway operators and highway personnel using qualitative approach.*

**Keywords:** *Highway maintenance management, qualitative approach*

### INTRODUCTION

Practical and effective highways have known to enhance the movement of people as well as products to boost the economy of the country. Maw, Nakamura, & Okamura (2007) stated that highway is the foundation of the transport system to a country. Due to that, ensuring the safety of the highway patrons and the wellbeing of the nation via the top notch of highway maintenance practice should be one of the main priorities for the Malaysian government. In Malaysia, the highway operators are responsible for maintaining over 2,232 kilometers of highways. The highway operators are not there just to provide good and safe road for transportation purpose, they are also required to maintain all the roadside and highway assets in functioning condition. These roadside fixings include signs, barriers, drainage structures, traffic lights, illumination fixtures, and rest areas (PLUS, 2014). The effectiveness of the implementation of the highway maintenance management system (MMS) is a major concerned. Currently 19 people died on Malaysian road on daily basis and 45,000 of accidents happened between 2007 – 2011 on the highways were caused by the highway's condition (Ministry of Transport, 2014). That is why the maintenance management has become an important issue for parties involved.

## **LITERATURE REVIEW**

### **History of maintenance management**

Maintenance probably was first defined in 1964 by the British Standard in 1964 or known as BS 3811:1964 as “work undertaken in order to keep or restore every facility to an acceptable standard”. Geraerds (1985), Dekker (1996), Dhillon (2002), Pintelon & Parodi-Herz (2008) concluded that maintenance as the required actions performed in keeping or restoring a system or part or equipment to its original functionality state. In general, the maintenance management is equivalent to terms for example: maintenance models; maintenance methods; maintenance techniques; maintenance systems; maintenance types; maintenance philosophies; and maintenance strategies regularly used by many scholars to describe the same concept of maintenance (Fraser, Hvolby, & Tseng, 2015). Performing an appropriate maintenance require techniques, technical skills, methods to use assets such as equipment, vehicles, equipment, machinery, materials, plants and systems in the right way (Velmurugan & Dhingra, 2015). The main objectives for maintenance is to ensure system function, system life and system safety (Khaira & Jain, 2012; Velmurugan & Dhingra, 2015). In the highway perspective, according to Al-Mansour, Sinha, & Thomas, (1993); Gandhare & Akarte, (2012) and Velmurugan & Dhingra, (2015), the two main approaches of maintenance were Corrective Maintenance (CM) and Preventive Maintenance (PM). CM and PM are classified as Planned Maintenance whereas Unplanned Maintenance is classified for Emergency Maintenance only (Institute of Maintenance Management Education, 2013). CM, also known as breakdown maintenance is regarded as the earliest model in the industry by the researchers where the maintenance is done after system failure meanwhile the PM is performed before system failure (Zaim, Turkyılmaz, Acar, Al-Turki, & Demirel, 2013). Wang, Chu, & Wu (2007) further explained that PM in practice is subdivided into periodic maintenance and predictive maintenance.

Periodic maintenance, also known as “time-based maintenance” is performed periodically to prevent sudden breakdown (Wang, Chu, & Wu, 2007). Whereas in predictive maintenance, also known as “condition-based maintenance”, maintenance activities performed grounded on inputs obtained from dedicated measurement instruments such as ultrasonic testing, techniques of monitoring, sensor systems and vibration monitoring (Wang, Chu, & Wu, 2007). Conversely, the current practices of most highway operators in Malaysia gives more focus on the corrective maintenance, while preventive maintenance has been given a minor attention due to the lack of awareness and also regulation enforcement (Harun, 2009).

### **Maintenance optimization and strategy**

The best maintenance strategy to be selected is actually depends on several factors such as maintenance approach chosen must be able to resolve the problem, delivering within a budget and lastly minimal disruption to the public (Ansell, Holmes, Evans, Pasquire, & Price, 2009). General maintenance management models such as Total Productive Maintenance (TPM), Condition-Based Maintenance (CBM), Corrective Maintenance (CM), Preventive Maintenance (PM) and Predictive Maintenance (PDM) were evaluated to suite a particular asset/system in any organization as well as any industry. Many models proposed to improve operational performance and optimize the

cost such as maintenance decision support system (DSS) (Lin, Ambani, & Jun, 2009; Mahdi, Hossein, & Taha, 2010); Expert systems (Chang Albitres, Krugler, & Smith, 2005); Analytical modeling (Gendreau & Soriano, 1998); and System Dynamics (SD) (Fallah, Rahmandad, Triantis, & De-la-garza, 2010).

The critical issues in discussing the optimization of maintenance model are related to the identified key indicators for measuring the efficiency of maintenance, which are viability, reliability, accessibility, safety, and maintainability (Qingfeng, L.Wenbin, Z.Xin, Y.Jianfeng, & Y.Quingbin, 2011). Apart from the mentioned models, many other models are being develop and practice all over the world as the optimization models are originally being introduced to assist managers and practitioners in production related industry. Therefore, further research needed in covering this area and identifying the best method in Malaysia context.

The central aim of maintenance management is “total asset life cycle optimization” i.e., maximization of availability and the reliability of assets in attaining the operational or business goals. On that note, the maintenance is not only need to deal with the issues of technology but a mix of issues pertaining technology, management, business and operation strategies (Pintelon & Parodi-Herz, 2008). According to Schokry (2010), maximizing the productivity at the lowest cost possible without compromising the quality and the safety standard is the main objective of maintenance. Therefore, the maintenance commitment is constantly about optimizing productivity, minimizing cost and maximizing quality and safety of product, system or infrastructure.

### **Maintenance management problems**

The highway operators are the parties responsible for maintaining of highways. These infrastructure providers always has limitation in term of the available resources. As a result, highway operators or more precise, the highway maintenance department face problems in their efforts to optimize the allocation of resources between different competing objectives in terms of increasing capacity, maintain and improve highway safety (Chassiakos, Panagolia, & Theodorakopoulos, 2005). Lack of effective maintenance management can be seen through financial performance of the company and lead to safety hazard and loss of human lives (Sinha, 2015).

Miles and Syagga (1987) concluded that there are three main problem associated with maintenance management, insufficient financial; poor design; and bad management. The first problem of maintenance management is always being associated with financial. The lower appreciation for maintenance, coupled with increasing maintenance cost has made the maintenance task becomes increasing difficult. (Sharaf & Youssef, 2001). Highway need for maintenance keep increasing every year due to the assets deterioration factor and at the same time the fund allocated for this function are not adequate to satisfy all activity. Generally, the money increase for maintenance function, is related to the increase of maintenance activity cost and not for the betterment of maintenance works (Sharaf & Youssef, 2001).

The second drawback correlated to highway maintenance is poor design (Miles & Syagga, 1987). Each year many accidents happened as a result of improper maintained highway and poor design roads (The World Bank, 2013). According to The Levin

Firm (2014), some of the more common accident-causing conditions that result from negligent road maintenance or design including potholes; lack of signage; poor road drainage system; faulty traffic signals; faded or missing lane markers; burned-out streetlights; uneven pavement; debris on road; poorly maintained bridges; and lack of warning regarding hazards.

The last problematic issues with regard for highway maintenance is relates to bad management (Miles & Syagga, 1987). Highway maintenance has undergo many aspect of changes such as computerized highway maintenance system (PLUS, 2014), electronic reporting and communication (Lingkaran Trans Kota Sdn Bhd, 2014). However, the decision made for highway maintenance function is still at heart and this has not change by any mean (The Chartered Institution of Highways & Transportation, 2012). The effectiveness of maintenance management is relates to the highway maintenance manager and the ability of the maintenance personnel / workers (Mohamed, 2010).

## METHODOLOGY

The objective of this study is to investigate the effectiveness of implementation of highway maintenance management system in Malaysia. The general research design and justification engaged as an outlines for the current study. It features an argument of the primary research design, data collection, sample selection and method of management, reliability and validity issues, principled considerations and data analysis strategy. The study understand the need for involvement of qualitative methods in the highway maintenance area as its will involve the collection of data and analysis from the related parties such as government agencies and highway operators. The qualitative research will explore issues and uncover major research arguments with regard to the highway maintenance management practice, before analyzing the data to measure the effectiveness of highway management system practices in Malaysia.

The research aims to address the concerns of parties involved in this problematic highway maintenance system area and in cooperation with the members of the system in transforming the system into a desired state. These objectives are deemed to suit the goal of an action research (AR) for the study. AR processes enable practitioners to justify and improved their practice (French, 2009). This principle of understanding a phenomenon are generally normal to the paradigm of qualitative research (O'Brien, 2001). Qualitatively based approaches effectively measuring a complex function such as maintenance compared to quantitative models (Cresswell, 2007; Kumar, Galar, Parida, Stenstro'm, & Berges, 2013).

The study will employ interview method to obtain understanding of the maintenance personnel and will focus on will focus on unstructured interview which intended to put the interviewees at ease and unassessed and at the same time set the tone for the rest of the interview sessions as the researcher do not know in advance all the questions related (Douglas, 1985; Fontana & Frey, 1994; Hannabuss, 1996; Qu & Dumay, 2011). The interview conducted with standard procedure aims to ensure that all information data are consistent and reliable with the objective of the research studies (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). The data gathered from the

interview will be reviewed and coded for emergent themes or categories, which then will form the basis of the research findings (Rowley, 2012).

The quality and the finding trustworthiness of qualitative study depends on the credibility of data gathered, the accuracy of the analyses conducted and research design employed (Margaret & Paul, 2015). According to Bhattacharjee (2012), disregarding of the research design utilized, the objective of researchers is to collect as many and as varied as possible data that can help you get the best view possible of the phenomenon of interest. In addition, the strength of qualitative research methods were located on their utility in understanding the meaning and context of the phenomenon being studied, and certain events that occurred and the procedures that make up this phenomenon from time to time, in real life and natural settings (Maxwell, 1996; Kaplan & Maxwell, 2006). The analysis strive for depth of understanding (Merriam, 2002).

### **Sample selection**

The credible of qualitative research depends on adequate sample size (Marshall, Cardon, Poddar, & Fontenot, 2013). Accept generalization from logical reasoning enable the study as credential research due to the relevant respondents were selected for the study instead of statistical drawn samples (Yin, 1989). Interviews will be conducted with selected maintenance personnel in the Maintenance Management Department from government agencies and highway operators.

### **Data analysis**

The qualitative research is represented by the search for meaning and agreement, researchers considered a major tool for data collection and analysis of data, an inductive strategy and the investigation and the final product rich descriptive (Merriam, 2002) . Dodge (2011) explained that the data analysis for qualitative study gives a meaning for first impression and final compilation. The data analysis will be presented in these three categories; the work process flow of maintenance department involving the maintenance work planning, the weaknesses in the implementing of maintenance management during the maintenance monitoring activities and the details of the report requirements needed by the top management. These three classifications will attempt to discover all the details that can be utilized to accomplish the objective of the research

## **CONCLUSION**

This research seek to uncover the phenomenon in maintenance management system in Malaysia with the application of maintenance management, the strategy and practices, critical success factors, problems with the application of maintenance management. Irrespective of all issues recorded in the past, there is scope for maintenance management system, as a consequence of few fundamental explanations; the technological push, the economic necessity and safety aspect. MMS included in the decision support system allows quantitative and objective decision making. Firstly, the decision made is a decision that can be defended enable it to be very suitable for group

decision-making, mainly it allows parties responsible / operators to assess from an economic standpoint, satisfaction and safety resulted from the decision made.

The importance of highway maintenance needs to be raised at the broadest level of planning and prioritizing within a sector perspective, including the role of maintenance and its benefits to highway operators, users, and beneficiaries. At the same time, it is necessary to build a broader understanding of highway maintenance objectives and benefits, planning and prioritization processes, and an ability to explain these issues when necessary (Penang Monthly, 2014).

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