



**INVESTIGATION OF HIGHWAY MAINTENANCE
MANAGEMENT AND ITS PERFORMANCE AT KUALA
LUMPUR – KARAK HIGHWAY**

BY

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ABSTRACT

Highway Maintenance involved maintaining the road structure and facilities to be in good functional condition at all time by the highway operator in order to ensure safe and comfort of the road users while travelling on the highway. Highway operators seem to face problems in setting up the performance indicators and in identifying the effective measurement method to be used which serve to confirm that their commitment in carrying out the maintenance and operations of highways are being done according to standard and public satisfaction. It is very important that the highway operator and relevant authority department has a systematic and effective performance monitoring system to observe and control the maintenance work quality carried out by the highway operator. The aim of the research is to study the current practice of highway maintenance management and its performance at Kuala Lumpur. Karak highway. This research looks into a case study involving Kuala Lumpur – Karak highway under Alloy Maintenance Engineering concession that responsible for the highway maintenance and operations. The study approach is focusing on content analysis extracted from the reports produced in the highway monitoring maintenance system known as Highway Asset Quality System (HAQS) and interviews session with the key personnel that are involved directly in the highway maintenance for Kuala – Lumpur Karak Highway. The data used for this study was based on the reports recorded in year 2014 where the system was fully implemented. The findings results showed in the content analysis that road furniture is the highest numbers of NCR compared to other maintenance categories issued by Malaysian Highway Authority to the responsible highway operator recorded during the first year of HAQS enforcement. Findings obtained from the interview session held with respective personnel has shown current problems on the highway maintenance works involving delays in work update, lack of site commitment, inefficient maintenance program and system used for monitoring and uncontrollable factors that affected the performance of highway maintenance works. Further to the above, it will be a great opportunities to further investigate on the findings of the highway maintenance work performance.

خلاصة البحث

إن صيانة الطرق السريعة المعنية تحافظ على هيكل ومرافق الطرق، لتكون في حالة جيدة وحيوية في كل الأوقات من قبل العاملين في الطريق السريع، من أجل ضمان أمن وراحة مستخدمي الطريق أثناء السفر عليه. ويبدو لنا في الدراسة أن العاملين في الطرق السريعة يواجهون مشاكل عدة في إعداد مؤشرات الأداء، وتحديد طريقة القياس الفعلي لاستخدامها التي تعمل على تأكيد هذا الالتزام في تنفيذ عمليات الصيانة والطرق، ويجري القيام بها وفقاً للمقاييس وتقبل الناس لها. إنه من المهم جداً أن يكون لدى العاملين في الطرق السريعة والسلطات المختصة بها الشأن، نظام مراقبة وأداء منتظم وفعال للمراقبة والتحكم في جودة أعمال الصيانة التي يقوم بها العاملون في الطريق السريع. يهدف هذا البحث إلى دراسة الممارسة الحالية لإدارة صيانة الطرق وأدائها في الطريق السريع (كرك-كوالالمبور). ويدرس البحث القضية التي تتعلق بالطريق السريع (كرك-كوالالمبور)، تحت امتياز هندسة الصيانة (للسبائك) المسؤولة عن صيانة الطرق والعمليات، ويركز منهج الدراسة على تحليل المحتوى المستخرج من التقارير الصادرة من نظام صيانة ومراقبة الطريق السريع المعروف باسم طريق نظام أصول الجودة (HAQS) ومن المقابلات وجلسات العمل مع الموظفين الرئيسيين الذين يشاركون مباشرة في صيانة الطريق السريع (كرك-كوالالمبور). جاءت البيانات المستخدمة في هذه الدراسة بناءً على تقارير سجلت في عام 2014م؛ حيث تم تنفيذ النظام بالكامل. أظهرت النتائج في تحليل المحتوى أن أدوات الطرق المحتاج إليها كانت أكبر عدداً في منطقة العاصمة الوطنية (NCR) مقارنة بفئات الصيانة الأخرى الصادرة عن هيئة الطرق السريعة الماليزية المسؤولة عن العاملين في الطرق السريعة، وقد سجلت خلال السنة الأولى من تطبيق نظام أصول الجودة (HAQS) نتائج تم الحصول عليها من الدورة التي تم إجراؤها بمقابلة الموظفين المعنيين. وقد أظهرت المشاكل الحالية لأعمال صيانة الطرق السريعة بعض التأخير في تحديث العمل، وعدم الالتزام في الموقع، والنقص في برنامج صيانة فعالة ونظام يستخدم عوامل الرصد التي لا يمكن السيطرة عليها؛ حيث أثرت في أداء أعمال صيانة الطرق السريعة، وفضلاً عما ذكر أعلاه، فإنه سيكون هناك فرصة كبيرة لمزيد من التحقق من نتائج أداء عمل صيانة الطرق.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a Dissertation for the degree of Master in Business Administration (Construction Business)

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LIST OF ABBREVIATIONS

AME	Alloy Maintenance Engineering Sdn Bhd
BOT	Build, Operate and Transfer
HAQS	Highway Assets Quality System
KPI	Key Performance Indicator
LLM	Lembaga Lebuhraya Malaysia
MHA	Malaysian Highway Authority
NCR	Non.compliance report
SOP	Standard Operating Procedures
LCC	Life Cycle Cost

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

Highway maintenance has always been an important and crucial aspect for highway operator in running the highway day to day operations. Several method and approach are used by the highway operators and authorities in monitoring the highway maintenance in order to ensure that it is carried out according to the schedule, requirements and standards.

Road maintenance is an integral part of highway maintenance work and is vital in ensuring road safety and customer satisfaction. Definition of highway maintenance according to the Malaysian Highway Authority (MHA also referred to as Lembaga Lebuhraya Malaysia (LLM) in Bahasa Malaysia) is a program to preserve, repair and restore the expressway's asset condition as well as to enhance the performance of the assets (Expressway's Maintenance Manual Guideline, 2008).

The guideline book also in general has defined that highway maintenance is to preserve road functions and structural characteristics to provide a safe, comfortable and reliable passage for all traffic. Apart from that, other maintenance works such as routine maintenance works which involve cyclical period of maintenance and other infrastructures and facilities along the highway are to be maintained in good functional condition at all time according to the requirements and standards.

Regular and appropriate maintenance works are crucial to preserve road functions and its structural integrity. A proper maintenance, inspection and reporting system will ensure effective highway management in regards to future planning, manpower and

budgeting. Therefore, to have a good highway maintenance management system is by having a comprehensive and an effective maintenance program that indicates the performance of each maintenance activities. The organization shall then measure their performance in order to know the efficiency of their works and to identify the opportunities for improvement. An effective maintenance system will reduce the rate of deterioration of the highway assets and at the same time contribute to a less maintenance expenditure that signify higher business revenues and profits to the highway operator.

Performance in highway maintenance has been the subject for studies for many years in meeting the increasing expectation of clients and users especially from the perspective of concession companies who runs and operates the highway (Otto and Ariaratnam 1999), (Zietlow 2004), (Fallah-Fini and Garza 2009). The performance measurement management system is unique for each application, however they all share common characteristics (Otto and Ariaratnam 1999) and (Batchelor 2009). Among the common characteristics of performance measurement management system are:-

1. A combination of quantitative and qualitative measures
2. An emphasis on outputs and outcomes that reflect strategic goals of the organization
3. Benchmarking against past performance of others
4. A feedback mechanism to improve the management process and influence policy and budgets

Maintenance standards and asset performance targets will vary across the highway network in line with relevant risk factors such as the nature and volume of traffic using the highway, operating speed, the susceptibility of assets to deterioration, the cost effectiveness of repairs and the competing priorities for funding (Batchelor 2009). Due

to that, there are always challenges and difficulties faced by the highway operator in establishing their maintenance performance.

Despite from the own performance measurement system used by the highway concessionaire to measure their company's performance, a standard quality control has been established by Malaysian Highway Authority in year 2014 to ascertain the effectiveness of the maintenance works carried out by the highway operator. It is also a tool created to monitor and ensure that all defective works identified within the highway boundaries during their regular inspection are being rectified according to requirement and specification.

This study looks into one of the monitoring method used by the highway operator together with the authorities whom responsible in regulating and monitoring the performance of the highway operator in maintaining their designated highway according to requirements. It will give the researcher an opportunity to assess the performance of highway maintenances works in Kuala Lumpur – Karak highway and at the same time analyzing the problem areas for improvement.

1.2 PRIVATIZATION OF KUALA LUMPUR- KARAK HIGHWAY

All Malaysian toll expressways are managed in the Build-Operate-Transfer (BOT) system. It was built by private companies under the supervision of the government highway authority, Malaysian Highway Authority (MHA). The Kuala Lumpur–Karak Highway is a 60km controlled-access highway or motorway in Malaysia connecting the capital city of Kuala Lumpur to the town of Karak in Pahang. It incorporates a twin

tunnel at Genting Sempah, near one of Malaysia's famous highland resorts, Genting Highlands. Originally, the highway was used to be a two-lane toll highway before being upgraded to a full expressway in 1997.

Anih Berhad has been awarded by the Malaysian Federal Government as the highway concessionaire and to ensure smooth flows of maintenance operations, Anih Berhad has appointed Alloy Maintenance Engineering Sdn Bhd (AME) to be responsible in carrying out the operation and maintenance works for Kuala Lumpur- Karak highway. AME roles are to ensure the maintenance works are carried out according to the requirement set by MHA and their performance of works will be monitored based on the MHA checklist.

In order to organize a standard checklist on the maintenance works for highway operators, MHA has prepared the checklist by breaking down the maintenance works into several categories with a systematic web approach. This has eased the highway operators' functions in updating all maintenance works progress without any delay into the web system. The same process also happen where MHA could make a complaint of a Non Compliance Report (NCR) into the web system instantly for the highways operator's action to rectify and make good whatever problem reported.

1.3 PROBLEM STATEMENT

Since AME did not prepared own resources, workforce and own equipment in performing the maintenance works, they have engaged their sub-contractors to carry out all the maintenance works according to work requirements and AME only involves in monitoring and managing the highway maintenance works. It is very crucial and

important for them to ensure that the maintenance works carried out by their sub-contractors will fulfill their work requirement and standards.

Problems arise on meeting the performance criteria as set by MHA in the maintenance checklist due to the lack of efficiency and effectiveness of the maintenance program and poor sub-contractors performance. Ensuring best performance practices has always been the most crucial aspect on highway maintenance works.

Although there are methods and approaches been used in implementing performance measures, however the performance should meet the requirement set by MHA in order to receive good rating during the MHA evaluations. The performance for each sub-contractors will actually reflect the overall performance of the highway operator, therefore it should be carefully organize, follow a prepared plan for periodically review to ensure that the performance is still meeting its standard requirement and the backup plan should there be any weaknesses in the performance of the sub-contractors.

Therefore, as for the case of AME who is the highway operator for Kuala Lumpur-Karak Highway, it is crucial for them get to know actual and right information in order to ascertain the performances of their sub-contractors, However, previously without the web monitoring system prepared by MHA, AME faced certain difficulties and problem with regards to confirming their work performance and also their sub-contractors performance due to below factors:-

1. Highway operators seem to face problems in setting up the performance indicators and in identifying the effective measurement method to be used which serve to

confirm that given tasks are being done according to standard and public satisfaction (Smith, Stivers, Hoener & Romine 1997).

2. Problems and difficulties faced by highway operators and the authorities in measuring and setting the performance measurement system for the highway maintenance works since each highway will have several factors affecting their work progress and performance.
3. There were insufficient information and issues established in monitoring the work performance for the highway operator.
4. AME's performance through the output of their sub-contractors does not really reflect the satisfaction that required by their client and authority, this has result to difficulties in evaluating the sub-contractors actual performance.
5. No establishment and further study on the common complaints received from MHA that can be made for a comparison and future improvement.
6. Finally, the contract awarded to the sub-contractors on the maintenance works are merely based on lump sum contract which does not indicate rates for quantity or area which makes it difficult for them to measure their sub- contractors' work performance.

With all the above factors, it has resulted to an inconsistent performance achievement for AME with lack of identification of weaknesses or strategy for improvement. The

new web based monitoring system called ‘Highway Assets Quality System (HAQS) introduced by MHA during end of 2013 and fully implemented starting in January 2014 to obtain better performance. The new monitoring method proved that previous conventional monitoring method does not reflects good indicators and impression especially from MHA views and perspective.

1.4 RESEARCH AIM AND OBJECTIVES

The aim of the research is to study the current practice of performance monitoring in Highway Maintenance of Kuala Lumpur – Karak Highway.

The research objectives are:-

1. To identify the non-compliance report (NCR) for Kuala Lumpur - Karak Highway issued by MHA to AME.
2. To identify the frequency of repetitive non-compliance report issued to AME.
3. To identify the level of performance of Kuala Lumpur – Karak Highway maintenance works.
4. To identify areas of improvement in respect of highway maintenance performance for Kuala Lumpur - Karak Highway.

1.5 RESEARCH METHOD

The process of identifying the highway maintenance trend for AME involve records analysis and comparison made on the data compiled for year 2014. The records that was used for the case study are the data recorded for year 2014 in the MHA maintenance web system. Therefore, the focus of the research through a case study is to identify and to analyze the trend highway maintenance works including frequency recorded by the authority department during their regular inspection in order to identify the most common maintenance works, it's root problem and to suggest the solutions to minimize the non-compliance report and enhance the achievement of the maintenance performance for better.

A summary of overall maintenance on monthly basis was prepared to tabulate the type of maintenance works and it's frequency that were recorded in term of the work complaint and NCR issued to AME by MHA. From the summary and detail records of NCR issued, it was segregated based on maintenance category to identify the highest NCR issued between all the maintenance categories. It gave the clues on which maintenance category that have got the highest NCR issuance and the detail of works involves. Trend analysis was then prepared to analyze the common weaknesses in the maintenance works carried out by AME and works that has high reoccurrence frequency in their maintenance works. Interviews with the related parties were conducted in obtaining all necessary information and opinions.

1.6 STRUCTURE OF DISSERTATION

The research have five (5) chapters where it covers from the background study, research methodology, objectives of the study, problem statement, data analysis and conclusion of the study based on the outcome of the research.

1. **Chapter One** – it looks into the background of the study done on the related topic from previous years and introduction of the research made in this study.
2. **Chapter Two** - Literature Review reviewed on related write ups and related researches that has been made todate with regards to the existing research topic that helps to focus on the scope of the research.
3. **Chapter Three** - Research Methodology explained on the method of study used for the research which is data collection from generated report and interviews with relevant personnel responsible from highway operator and the authority.
4. **Chapter Four** – Content analysis presented in this chapter where the actual report recorded along year 2014 which shown its trends. Interview findings also presented the observations and improvements that can be considered to enhance the performance of highway maintenance works.
5. **Chapter Five** – finally conclusion derived from the findings were discussed in this chapter in revealing the condition and performance of the highway maintenance for further study and references.

The summary of the study were made according to the analysis of the findings and how are objectives of the study achieved and how are they related to each other. Finally,

proposing the improvement that can be made based from the outcome of the study for better improvement in the future.

1.7 SUMMARY

The research took a case study based on the current highway maintenance monitoring practices introduced by MHA and implemented together with AME as the organization who is responsible for the highway maintenance and operation works. The purpose of the study is to look into the maintenance trend occurred within Kuala Lumpur – Karak highway and to identify their common problems in order to provide suggestion for better improvement in their maintenance works.

The content analysis could only be made through record in year 2014 since it was the first year the web monitoring system called HAQS was introduced to the highway operator. Therefore, based on the first year records, the researcher tried to identify the maintenance trends for Kuala Lumpur – Karak highway which are being maintained by AME.

Finally, through this research study, a benchmark can be set objectively by either MHA or AME in term of the Key Performance Indicator (KPI) and standard requirements for both parties where it will allow improvement to be made progressively by all to achieve better work performance effectively and efficiently. Next chapter discussed on studies that has been carried out related to highway maintenance and its outcome which lead to this study.

CHAPTER TWO

HIGHWAY MAINTENANCE PERFORMANCE

2.1 INTRODUCTION

This chapter will review the literature on study of highway maintenance to date. The literature review in this chapter on Highway Maintenance includes its definition, the importance of highway maintenance, criteria, work processes and other related matter on this research project.

2.2 CATEGORY OF ROADS IN MALAYSIA

In Malaysia, there are few types of roads gazetted by the Federal Government of Malaysia. The roads are categorized for the purposes of administration, planning and design of the roads based on the volume of traffic, speed limit and maintenance requirements. As for the maintenance purpose, the segregation will also involve different Government agency or authority department handling the responsibility on the maintenance and operation of the roads.

There are three (3) types of roads in Malaysia as below:-

1. Highway and expressway (with or without toll)
2. Federal Roads
3. State Roads

Highway or expressway are built for efficient huge traffic flows between cities and state. It has limited access and interconnected with interchanges.

2.3 DEFINITIONS OF HIGHWAY MAINTENANCE

According to the 'Highway Maintenance Handbook' (Ken Atkinson, 1997) the definitions of highway maintenance from the engineering aspects described the processes of sustaining construction elements in a safe and usable condition. This is mainly because of the construction elements will be depreciated over the time due to weathering, use and changes occurring in physical and chemical conditions.

The aim of maintenance is to carry out protective and repair measures designed to prolong the life cycle of the construction components. The effectiveness of the maintenance is improved if proper action taken before major defector deterioration takes place with good preplan works. 'A comprehensive assessment in the life cycle cost of the assets should be executed as part of facility management approaches to ensure buildings and facilities can be operated with optimum maintenance and replacement cost, which can therefore facilitate the highway operator to attain the best value of money' Mohd Fairullazi and Khairuddin (2011).

A general performance measurement framework must consider all types of perspective with different critical success factor for each perspective ie: customer, internal business, financial and innovation and learning perspectives. To define the "right" performance indicators is a rather challenging task and to avoid ambiguity, performance indicators have to be clearly defined and objectively measurable.