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# Maintenance Management Practices for Building Maintenance: Case Studies

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## Abstract

Maintenance management in Malaysian Polytechnic faced many issues due to poor service delivery, inadequate finance, poor maintenance plan and maintenance backlogs. The purpose of this study is to improve the conventional method practices which tend to be ineffective in Malaysian Polytechnic. The case studies was conducted with eight Polytechnics in Malaysia. The selected Polytechnic is based on conventional method practices and its major problems, attempt to implement computerised technology and the willingness of staff to share their experiences. All feedbacks from respondents through semi-structured interview were recorded using video camera and transcribed verbatim. The overall findings of this research indicated; poor service delivery, inadequate financial, poor maintenance planning and maintenance backlogs. There is also need to overcome less man power competencies of maintenance management practices which existed with all eight Polytechnics. In addition, the study also found that the Polytechnics still use conventional maintenance management processes in managing building facility condition. As a result, the maintenance management staffs were not able to improve the maintenance management performance at the Polytechnics. The findings are intended to be used for maintenance management practices at Malaysian Polytechnics in order to provide high-quality of building facility with safe and healthy environments.

***Keywords:*** *Maintenance Management; Conventional Method; Maintenance Management System; Malaysian Polytechnic*

## Introduction

Maintenance is a continuous operation to keep building, infrastructure, and equipment in the best form for normal use (Akasah et al., 2009). It is also to ensure the facilities are in a good condition for a life time. In achieving the sustainability of facilities condition, maintenance management required the efficiency and effectiveness for strategic planning. There are many existing theories, models and framework related to maintenance management. According to Lateef et al. (2010), maintenance management system used conventional method in many university campuses in Malaysia. The system is using paper-based form to provide defect report from student and staff. Meanwhile, improper database such as Microsoft Excel and Microsoft Word contribute to the irregularities in the university's maintenance management system. The lack of comprehensive maintenance management also is due to not providing the decision making process to solve complicated problems of building and infrastructure defect. Therefore, a computerised maintenance management system (CMMS) is the suggested solution for that problem in Malaysian university.

According to Lazim and Samad (2010), the management system implemented by Polytechnic is also using the conventional method. Polytechnic has the department to coordinate maintenance and repair of equipment, buildings, infrastructure and facilities related work, including support services at Polytechnic. Hassan (2010) stated that, the application of telephone or mobile phone, paper-based form and email commonly used to report the defects of building facilities. The telephone or mobile phone application for defect reports depending on party involved in maintenance management. If one of the party is not available, the defect reports cannot be made and need to be reported again another time. Meanwhile, paper-based form requires the signature from the head of department before being submitted to the maintenance management staffs. This process would take a few days before the problem could be attended. Complaint via email sometimes causes problem to the recipient due to the difficulty to receive the defect complaint because the mailbox is occupied. In fact, the facility handling is uniformly practiced at most Malaysian Polytechnics (Lazim & Samad, 2011). The implementation of conventional method provides ineffective and poorly organised maintenance management (Ismail, 2012). The losses incurred by breakdowns or failures of operating system, for example, electrical and mechanical utilities. Besides, the ineffective maintenance management lets the unhanding of preventive maintenance (OôDonoghue & Prendergast, 2004). Therefore, maintenance management system is necessary to handle the facilities defect in a more appropriate, time saving and paperless manner.

## Issue of Maintenance Management at Polytechnic

Many buildings and infrastructures need to be refurbished to enhance the effectiveness in maintenance management processes (Awang et al., 2011). The conventional method has to be improved for better maintenance of building and infrastructure, and to provide good environments. The technical and managerial defects are the main problems in the conventional method in maintenance management. The technical defect is the lack of technical expert to operate and

monitor the facilities of building and infrastructure with new technology. This is related to the knowledge exposed to the Information and Communication Technology (ICT). Presently, CMMS application is widely used in maintenance management processes of building facility. CMMS can reduce the negligent management due to problems emerging as a result of the need to manage huge and complicated data. For instance, the causes of data loss through unsuitable places for file storage and excessive retrieval time in the recovery of data files (Ismail, 2012).

The managerial defect consists of project management, resource management defect and economical and financial defects (Saghatforoush et al., 2011). The project management defects at Polytechnic are related to improper planning of works, inefficient system to record data, failure to identify the potential defect causes, and specified the correct remedial work. Report of defects by using paper-based form is also haphazardly completed. As a matter of fact, the docket information like a daily report is not reliable and not all the works are implemented. Therefore, it is difficult to assess decision making for remedial works due to maintenance planning (Razali, Halim & Jusoff, 2011). The resource management defect is related to the poor workmanship. The technicians who involved in maintenance management should be trained with technical skills to complete tasks efficiently. The technicianôs competencies will ensure the quality of maintenance management provided at Polytechnic (Zulkarnain et al., 2011).

The economical and financial defects are an insufficient budget to conduct maintenance management in the organization. For instance, even if all the work is carried out correctively, it still requires more systematic system and cost-effective approaches than the conventional processes currently in use at Malaysian Polytechnics.

Maintenance management at Polytechnic revealed a number of shortcomings as it still use paper-based form and unsystematic database to manage a complex and huge amounts of data including data analysis and tracking of complaints. Thus, the new system is proposed in order to improve the conventional method that tends to be cumbersome at Polytechnics (Ismail, 2012). Essentially, the new system has the potential to transform maintenance management processes to foster the professionalism and excellent working culture for successful transformation agenda.

**Case Studies Project**

The case studies on eight Polytechnics were undertaken in order to identify the maintenance management problems, the current approaches to address the problems, the ICT implementation and the maintenance management system to obtain information relating to the maintenance identification, assessment, planning and execution processes. The interviews conducted were consisted of three types of Polytechnic, namely, ôNew Polytechnicô, ôOld Polytechnicô and ôPremier Polytechnicô. The case study was based on eight cases (Case A-Case H) of Malaysian Polytechnics. There were two case studies (Case A and B) on ôPremier Polytechnicô that under the transformation plan to become a University College by 2015 and three

case studies (Case C, D, and E) on óOld Polytechnicô due to older establishment and operation such as Melaka Polytechnic which was established in January 1999. In addition, three more case studies (Case F, G, and H) are classified as óNew Polytechnicô which manages the maintenance operation with fully equipped new amenities and facilities.

The justifications for the selected case studies were according to the following main criteria; (i) exposed to the conventional method use and major problems, (ii) attempted to implement computerised technology and (iii) the willingness of staff to share their experiences in improving the maintenance management processes at the polytechnic. The different types of Polytechnics was to provide the variations on the maintenance management practices classified as old, new and premier Polytechnic respectively. The professional staff were interviewed which included engineer or assistant engineer and had the experiences in the maintenance management practices. The summary on the eight case studies is presented in Table 1.1

Table 1.1: List of Case Studies

| Case | Name of Polytechnic | Type of Polytechnic | Person Interviewed | Maintenance Management System |
|---|---|---|---|---|
| A | Ibrahim Sultan Polytechnic, Johor | Premier | Engineer | Conventional |
| B | Sultan Salahuddin Abdul Aziz Shah Polytechnic, Selangor | Premier | Assistant Engineer | Conventional |
| C | Port Dickson Polytechnic, Negeri Sembilan | Old | Assistant Engineer | Conventional |
| D | Melaka Polytechnic, Melaka | Old | Assistant Engineer | Conventional |
| E | Merlimau Polytechnic, Melaka | Old | Engineer | Conventional |
| F | Mersing Polytechnic, Johor | New | Assistant Engineer | Conventional |
| G | Banting Polytechnic, Selangor | New | Assistant Engineer | Conventional |
| H | Nilai Polytechnic, Negeri Sembilan | New | Assistant Engineer | Conventional |

The semi-structured interviews were conducted with either the engineers or assistant engineers who were responsible for the maintenance management of the entire Polytechnic's building facility under Facility Management and Development Unit (UPPF) and Maintenance and Development Unit (UPS). The interviews sessions took around half an hour to accumulate the data on the maintenance processes including the demonstration of the current maintenance management system with the implementation of ICT tools by the engineer or assistant engineer. All of the data from the interviews were recorded using video camera and transcribed verbatim.

## Case Studies Findings

The eight case studies involved in this research were to identify the maintenance management problems, the approaches to address problems, ICT implementation and the maintenance management system at the selected Polytechnic. The findings from the case studies are summarised within four elements of analysis which is (1) Maintenance Management Problems, (2) Approaches to Address Problems, (3) ICT Implementation and (4) Maintenance Management System and presented in Table 1.2 below.

Table 1.2: Cross-Case Analysis

| Element of Analysis | Case A | Case B | Case C | Case D | Case E | Case F | Case G | Case H |
|---|---|---|---|---|---|---|---|---|
| Maintenance Management Problems | ð Nonspecific complaint<br>ð Time gap of building repairs<br>ð Limited budgets<br>ð Less competent manpower<br>ð Defect repetition<br>ð Student Vandalism | ð Less competent manpower<br>ð Defect repetition<br>ð Time gap of building repairs<br>ð Limited budgets | ðNonspecific complaint<br>ð Time gap of building repairs<br>ð Limited budgets<br>ð Less competent manpower<br>ð Defect repetition | ð Less competent manpower<br>ð Defect repetition<br>ð Time gap of building repairs<br>ð Student Vandalism | ð Limited budgets<br>ð Defect repetition<br>ð Student Vandalism | ð Less competent manpower<br>ð Defect repetition<br>ð Time gap of building repairs<br>ð Limited budgets | ð Verbal complaint<br>ðUnsystematic database<br>ð Defect repetition<br>ð Less competent manpower<br>ð Time gap of building repairs<br>ð Limited budgets<br>ð Poor quality contractor | ð Lack of motivation for reporting defect<br>ð Delayed delivery complaint<br>ð Unhanded complaint<br>ð Limited budgets<br>ðNonspecific complaint<br>ð Time gap of building repairs<br>ð Defect repetition<br>ð Poor quality contractor |
| Approaches to Addressing Problems | ð To replace the old material (e.g. timber) with strong material (e.g. heavy steel)<br>ð Allocated the budget and punishment for vandalism cases<br>ð Training courses for technician | ð Training courses for technician<br>ð To replace the old material (e.g. timber) with strong material (e.g. heavy steel) | ð To replace the old material (e.g. timber) with strong material (e.g. heavy steel)<br>ð Training courses for technician | ð Provide more frequent inspection and assessment in identifying the causes of defect<br>ð Training courses for technician<br>ð Installed signage to motivate student to | ð Priority on maintenance repairs<br>ð Installed signage to motivate student to conserve facility | ð Training courses for technician | ð Issued the notice to prevent verbal complaint for minor defect<br>ð Improve the maintenance assessment for the building maintenance works did by the contractor<br>ð Training courses for technician | ð Improve the maintenance assessment for the building maintenance works did by the contractor |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | conservefacility | | | | |
| ICT Implementation | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) Email System- for managing complaints | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) Email System- for managing complaints | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) E-Aduan System- for managing complaints | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) Email System- for managing complaints | MySPATA-Data inventory for immobile facilities (e.g. building) mySPA- Data inventory for mobile facilities (e.g. furniture) |
| Maintenance Management System | Conventional (e.g. paper-based form and unsystematic database) | Conventional (e.g. paper-based form and unsystematic database) | Conventional (e.g. paper-based form and unsystematic database) | Conventional (e.g. paper-based form and unsystematic database) | Conventional (e.g. paper-based form and unsystematic database) | Conventional (e.g. paper-based form and unsystematic database) and under DLP | Conventional (e.g. paper-based form and unsystematic database) and under DLP | Conventional (e.g. paper-based form and unsystematic database) and under DLP |

Note:

DLP: Defect Liability Period

*Maintenance Management Problems*

The findings from the case studies revealed that many customers (students and staff) had no motivation to report the defect in the paper-based form as in Case H. The customer found it difficult to spend the time to report the defect at the Polytechnic. Previous research highlighted the similar maintenance management problems such as many forms were needed for each report categories such as civil, mechanical and electrical engineering (Lazim & Samad, 2011). The delivery delay of defect complaint occurred when the maintenance management staff received the report late on the related facilities. In managing the maintenance processes, there were many departments and units involved including hostel facility and staff residential at the Polytechnic. The undelivered report due to management negligent was also the reason on the delay delivery of defect complaint by the maintenance management staff (Case H).

Previous research also indicated that the customer confronted the risk of stolen form and the form was not delivered to the relevant staff to conduct the maintenance repairs (Lazim & Samad, 2011). Case G encountered the problem of receiving complaint through verbal method for the facility defect. The verbal method especially on handling the uncritical defect gave the difficulties to record the defect explanations such as location, complainer, facility defect and inventory into the database. These were affecting the maintenance planning to complete the task of repairs in the particular duration at the Polytechnic.

The less competent of manpower among the technicianswas one of main problems at the Polytechnics (Case A, B, C, D, F and G). The technicians can be categorised into three major fields, namely, civil engineering, mechanical engineering and electrical engineering. The task involved in the maintenance management consisted of several stages particularly on the maintenance identification, inspection and defect diagnosis. However, the assistant engineer had found it difficult to describe the defect explanation based on the actual inspection by technician. Sometimes, the defect were caused by failure to identify the maintenance action.

Therefore, the time gap had increased to conduct the maintenance planning and execution in the particular duration (Case A, B, C, D, F, G, and H). The reason for the time gap of repair was also due to unspecific information in the complaint delivered from the customers (Case A, C, and H). For example, the report stated that the defect was pipe leaked. However, the maintenance management staff had found that the real defect was broken pipe valve. The maintenance budget for this particular facility increased and affected the regular maintenance processes (Case A, B, C, E, F, G, and H). More cost was required to repair the defects as external contractor was called through tender process. This led to more time required to repair the defects.

The repetition of defect happened at several Polytechnics, especially for the hostel facilities (Case A - Case H). Mostly, the building facility and infrastructure consisted of old structure and had long life span of services within 10 years (Case A - Case F). At the same time, the number of students increased progressively every year. Previous research emphasised the same problems that the repetition of defects became as a challenge to the maintenance management staff although the related defects had been repaired in the early stage (Yusof, 2010). Even beginning

September 2013, Case A and B would offer a new degree programme as a part of education transformation as the Premier Polytechnic.

However, the number of existing facilities such as the lecture hall were not improve to accommodate the increasing number of students at the Polytechnic. Besides, the poor quality of the main contractor also contributed to the repetition of defect in Case G and H that was under the defect liability period. The delay of repairs for facilities in the particular duration was the main problem faced by those Polytechnic. Besides, the main contractor had repaired the repetitive defect to gain more profits.

Student vandalism in Cases A, D and E also influenced the repetition of defect to become the critical issues. As an example, the students had damaged several smoke detectors at their hostel and this had affected to the allocated budget for the ad-hoc maintenance in every year at the Polytechnics. The maintenance management problems from the case studies are described as follows:

Table 1.3: Maintenance Management Problems from Case Studies

| Maintenance Management Problems | Case A | Case B | Case C | Case D | Case E | Case F | Case G | Case H |
|---|---|---|---|---|---|---|---|---|
| Unspecific information in the complaint delivery | * | | * | | | | | * |
| Time gap of repair | * | * | * | * | | * | * | * |
| Limited budgets | * | * | * | | * | * | * | * |
| Less competent man power | * | * | * | * | | * | * | |
| Defect repetition | * | * | * | * | * | * | * | * |
| Student vandalism | * | | | * | * | | | |
| The complaint was received through verbal method | | | | | | | * | |
| Unsystematic database | | | | | | | * | |
| Poor quality main contractor | | | | | | | * | * |
| No motivation to report defect in the paper-based form | | | | | | | | * |
| The delay delivery of defect complaint | | | | | | | | * |
| Undelivered report | | | | | | | | * |

*Approaches to Address Problems*

The problems in Case G stated that the majority of complaints werereceived verbally especially on the uncritical facility defect. The engineer had issued the notice of prevention using verbal method in the defect complaint exceptfor the emergency case in managing processes to record the data effectively in the specific database at this Polytechnic (Case G).

The repetition of defect such as cupboard, door and bed were the same category of defect materials which were made from plywood. The approach to reduce the repetition of defect problems was to replace the old material with stronger material. Case A, B and C had been planning to spend their budget to upgrade the facility material from being damaged by the students and to ensure the sustainability of the building facility and infrastructure provided at the Polytechnic. However, this approach needed significant justification due to the huge cost for replacing the particular facility. As an example, there were approximately 1500 students living in the hostel. The price for steel beds facility was estimated at RM500 each. Therefore, the total cost required to purchase the beds was almost RM750000.

Generally, new students had to take part in the óOrientation Weekô to expose them before becoming the official students at the Polytechnic. The bad attitude of several students increased the number of reports for the repetition of defect such as leaked piped and damaged air condition. The budget had been reserved to repair the same defects involved in every year due to student vandalism (Case A). At the same time, the engineer also installed the signage to remind the students on maintaining the facility (Case G and H). Case A approaches was to punish the students based on the degree of the severity for the damaged facilities.

Most Polytechnic faced the budget problems on maintaining the building facility and infrastructure. The priority of repairs in the maintenance planning was executed to revise the budget especially on the ad-hoc maintenance (Case E). The maintenance priority was measured through the risk of defect failure and losses effect to the facility itself. In addition, case D had decided to provide more frequent inspection at the site location to manage the defect in the particular duration. Besides, the maintenance management staff were sent to the training courses to improve the knowledge in the maintenance inspection and repairs (Case A, B, C, D, F, and G).

There were new approach to measure the main contractorôs performance during the under the defect liability period at the Polytechnic. The maintenance management staff had improved the maintenance assessment for facilities at the site location (Case H). The defect repairs by the main contractor had been supervised in strict condition for quality improvement toward the maintenance execution.

*ICT Implementation*

Presently, Polytechnic had been using advance technology system being developed by the Public Works Department (PWD) and Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) to improve the inventory management for the mobile and immobile facilities. These systems namely ómySPATAô and ómySPAô assisted the maintenance management staff to inspect and repair the facilities where the defect information such as location and facility type were described in detail in the database application (Case A, B, C, D, E, F, G, and H). Moreover, time taken due to inadequate explanation such as the location of defect was reduced with the use of the systems.
Besides those ICT application systems, Case B, C and G also had used the email system to improve the complaint management for the facility defect at the Polytechnic. The senior

technician would submit the information from the report received through the email to the relevant technician for further inspection. The maintenance status was then replied to the customer after the planning and executing processes had been completed. However, this email system was not equipped with an auto-reply report to handle the complaint email for reference action.

Case D had implemented ôE-Aduanô system as a tool to reduce the utilised time in managing the report without having to send the paper-based form personally at the maintenance management office. Normally, the lecture hall is accommodated with internet network where the students and lecturers are able to access the system using laptop, netbook or other portable devices where they can submit their defect complaint. ôE-Aduanô system also became a dedicated structure to manage the complaint in the entire day compared tothe conventional method and the maintenance management staff had found it was easy to compile the data and to record the complaints from 1000 customers per year.

*Maintenance Management System*

Maintenance management at the Polytechnic used the conventional method in all of the case studies (Case A, B, C, D, E, F, G and H). ôE-Aduanô system in Case D had enabled customers to report the defect via the internet network. Many respondents from the case studies mentioned the used to develop a systematic database on the defect category and location, including the types of facilities involved at thePolytechnic. Respondents from Case A and B suggested to use the paperless office where the maintenance management staff would be able directly send the information into the online system frequently.

In Case F, G and H, the maintenance management was conducted by the main contractor as the facilities were still under 2 year defect liability period.

## Conclusion

A total of eight case studies were used to analyse the key problems, approach to address problems, ICT implementation and maintenance management system at the Polytechnic. The factor of nonspecific complaint, defect repetition, limited budgets, time gap building repairs and less competent manpower were the main problems identified at the Polytechnics that utilised the conventional method in the maintenance management processes. The delay of repair was due to the inaccurate information in the customer complaint. Based on the findings, this research will concentrate on the development of a new system to integrate the maintenance identification, assessment and planning processes to improve the decision making process and maintenance management at polytechnic.

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