

**DMOSYS: DEFECT MONITORING SYSTEM FOR BUILDING MAINTENANCE
AT POLYTECHNIC**

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A thesis submitted in
fulfilment of the requirement for the award of the
Master of Science in Technology Management by research

Faculty of Technology Management and Business

Universiti Tun Hussein Onn Malaysia

NOVEMBER 2013

DEDICATION

Specially for,

My parents, Ismail B. Hashim and Hajah Hamidah Bt. Burok

and

Assoc. Prof Dr Narimah binti Kasim



PTTA UTHM
PERPUSTAKAAN TUN AMINAH

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim...

Alhamdulillah, thanks to Allah for allowing me to finalise and completed this research. I can't deny that a lot of new things and challenge I have discovered and learnt through this whole process. But with the spiritual help from my beloved parents, help from my supervisor, Assoc. Prof Dr Narimah Binti Kasim, facility management lecturer, Assoc. Prof Dr Rozilah Binti Kasim, software engineering lecturer, Assoc. Prof Dr Mohd Najib Bin Mohd Salleh, supportive family members and friends, Ahmad Ridhuan B. Abdul Rasid (Uniti Consultants Sdn. Bhd.) and Hasfahani Bt. Aspatah (DBKL), and the people not mentioned in this research, I've managed to go through those obstacles peacefully and hopefully successfully. Indescribable amount of appreciation for those who had helped me directly or indirectly, and not to forget, the cooperation from the very friendly members of Port Dickson Polytechnic such appreciation and gratitude to all of you.



ABSTRACT

Maintenance management could be a complex subject if implementation and planning issues of the building facility are not handled properly. In this context, the current maintenance management method has affected the efficiency of the building facility management at Polytechnics. Many issues such as poor service delivery, inadequate finance, poor maintenance planning and maintenance backlogs were emerged due to the usage of conventional method application (paper-based form and unsystematic database). Therefore, this research is to review existing maintenance management practices, and subsequently develop a prototype system based on the stated problems related to the conventional method in improving the maintenance management processes.

Literature review and semi-structured interview was carried out to achieve the objectives. Eight Polytechnics are selected based on major problems of using conventional method in the comparison to investigate the maintenance management practices in each Polytechnic. There are around 32 Polytechnics in Malaysia and almost are using conventional methods. The number is considered very big indicating that the use of modern Information and Communication Technology (ICT) is still very limited compared to other institutions of higher learning in Malaysia. The results revealed that the practice of maintenance management at Polytechnics needs to be improved and a computerised system was proposed based on the requirements of a maintenance management system identified through the case studies.

The framework was encapsulated in a computer-based prototype system based on Microsoft Visual Basic.Net as a graphical user-interface while for the database design, the Microsoft Access is used to deploy the information for maintenance management processes. The computerised system was developed using Data Flow Diagram (DFD) and

coding. Subsequently, the prototype system was tested by running it until the critical problems were fixed and its functional requirements work correctly. This system will help with the building diagnosis and decision making process approaches. It will assist staff in facilitating the maintenance identification, assessment, planning and execution in relation to building facility. In conclusion, the developed prototype system can improve the maintenance management practices effectiveness for building facility to provide high-quality building facility for safe and healthy environment.



ABSTRAK

Pengurusan penyelenggaraan merupakan satu subjek yang rumit jika isu perancangan dan pelaksanaan untuk fasiliti bangunan tidak ditangani dengan tepat. Dalam konteks ini, kaedah pengurusan penyelenggaraan memberi kesan pada keberkesanan pengurusan fasiliti bangunan di Politeknik. Isu seperti kelemahan penghantaran aduan, kekangan peruntukan kewangan, kelemahan pengurusan perancangan dan tunggakan penyelenggaraan timbul disebabkan oleh penggunaan kaedah secara konvensional (seperti borang berasaskan kertas dan pangkalan data yang tidak sistematik). Oleh itu, penyelidikan ini dijalankan adalah untuk menilai kaedah pengurusan penyelenggaraan sedia ada, dan seterusnya membangunkan sebuah prototaip sistem berdasarkan kenyataan masalah pada kaedah konvensional dalam menambahbaik proses-proses pengurusan penyelenggaraan. Kajian literatur dan temu bual semi-struktur telah dilaksanakan untuk mencapai objektif-objektif tersebut. Lapan buah Politeknik dipilih berdasarkan masalah major menggunakan kaedah konvensional dalam perbandingan untuk menyiasat amalan pengurusan penyelenggaraan di setiap Politeknik. Terdapat kira-kira 32 Politeknik di Malaysia dan hampir kesemuanya menggunakan kaedah konvensional. Bilangan ini dianggap sangat besar yang menunjukkan bahawa penggunaan Teknologi Maklumat dan Komunikasi (ICT) moden yang masih sangat terhad berbanding dengan institusi pengajian tinggi lain di Malaysia. Hasil kajian menunjukkan amalan pengurusan penyelenggaraan di Politeknik perlu dibaiki dan sistem berkomputer telah dicadangkan berdasarkan pada keperluan sistem pengurusan penyelenggaraan yang telah dikenal pasti melalui kajian kes. Rangka kerja terkandung dalam satu prototaip sistem berasaskan komputer berdasarkan Microsoft Visual Basic.Net sebagai pengantara muka grafik pengguna manakala bagi reka bentuk pangkalan data, Microsoft Access digunakan untuk

menempatkan maklumat untuk proses-proses pengurusan penyelenggaraan. Sistem berkomputer ini telah dibangunkan dengan Gambarajah Aliran Data (GAD) dan kod program perisian. Seterusnya, prototaip sistem telah diuji dengan menjalankan sistem tersebut sehingga masalah yang kritikal dapat diatasi dengan keperluan fungsi bekerja dengan betul. Sistem baru ini dapat meningkatkan teknik dalam pendekatan pemeriksaan diagnosis dan proses membuat keputusan. Ia dapat membantu staf dalam proses mengesan kerosakan, penilaian, perancangan dan pelaksanaan pengurusan penyelenggaraan dalam fasiliti bangunan. Kesimpulannya, pembangunan sistem prototaip ini dapat menambahbaik kerja pengurusan penyelenggaraan dengan lebih efektif untuk fasiliti bangunan dalam menyediakan fasiliti bangunan yang berkualiti untuk persekitaran yang lebih menjamin keselamatan dan kesihatan.



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LIST OF SYMBOLS AND ABBREVIATIONS

<i>AHP</i>	-	Analytic Hierarchy Process
<i>AS-IS</i>	-	Current Value Chain Model
<i>BIM</i>	-	Building Information Modelling
<i>BIMFM</i>	-	BIM-Based Facility Management
<i>BLK</i>	-	Borang Laporan Kerosakan
<i>BMS</i>	-	Building Management System
<i>CAD</i>	-	Computer-Aided Design
<i>CAFM</i>	-	Computer-Aided Facility Management
<i>CBM</i>	-	Condition Based Maintenance
<i>CBR</i>	-	Case-Based Reasoning
<i>CIMMS</i>	-	Centralised Information Maintenance Management System
<i>CM</i>	-	Corrective Maintenance
<i>CMMS</i>	-	Computerised Maintenance Management System
<i>COMOLOS</i>	-	Condition Monitoring of Low Speed Machinery
<i>CRM</i>	-	Customer Relationship Management
<i>C&S</i>	-	Civil and Structure
<i>CSP</i>	-	Condition Survey Protocol
<i>DFD</i>	-	Data Flow Diagram
<i>DLP</i>	-	Defect Liability Period
<i>DMOSYS</i>	-	Defect Monitoring System
<i>EAM</i>	-	Enterprise Asset Management
<i>E-FORM</i>	-	Electronic Form

<i>ERP</i>	-	Enterprise Resource Planning
<i>E-MRO</i>	-	Maintenance, Repair and Operating Materials
<i>FBM</i>	-	Failure-Based Maintenance
<i>FMECA</i>	-	Failures, Modes, Effects and Criticality Analysis
<i>FMIS</i>	-	Facility Management Information System
<i>GIS</i>	-	Geographical Information System
<i>GPS</i>	-	Global Positioning System
<i>GUI</i>	-	Graphical User Interfaces
<i>HVAC</i>	-	Heating, Ventilation and Air Conditioning
<i>ICT</i>	-	Information and Communication Technology
<i>IR</i>	-	Infrared
<i>IS</i>	-	Information System
<i>ITOBO</i>	-	Information and Communication Technology for Sustainable and Optimised Building Operation
<i>IWMS</i>	-	Integrated Workplace Management System
<i>KKR</i>	-	Ministry of Works Malaysia
<i>MAMPU</i>	-	Malaysian Administrative Modernisation and Management Planning Unit
<i>MANR</i>	-	Assessment Method for Building Rehabilitation Needs
<i>M&E</i>	-	Mechanical and Electrical
<i>MMS</i>	-	Maintenance Management System
<i>M-RFIDMM</i>	-	Mobile RFID-Based Instruments Maintenance Management
<i>MS Access</i>	-	Microsoft Access
<i>NDT</i>	-	Non-Destructive Testing
<i>OBS</i>	-	Organisational Breakdown Structure
<i>OCC</i>	-	Online Customer Complaint
<i>PBS</i>	-	Banting Polytechnic
<i>PDA</i>	-	Personal Digital Assistant
<i>PETRONAS</i>	-	Petroliam Nasional Berhad

<i>PIS</i>	-	Ibrahim Sultan Polytechnic
<i>PM</i>	-	Preventive Maintenance
<i>PMJ</i>	-	Mersing Polytechnic
<i>PMK</i>	-	Melaka Polytechnic
<i>PMM</i>	-	Merlimau Polytechnic
<i>PMMS</i>	-	PETRONAS Maintenance Management System
<i>PNS</i>	-	Nilai Polytechnic
<i>PPD</i>	-	Port Dickson Polytechnic
<i>PROMETHEE</i>	-	Preference Ranking Organisation Method for Enrichment Evaluation
<i>PS</i>	-	Prioritisation System
<i>PSA</i>	-	Sultan Salahudin Abdul Aziz Shah Polytechnic
<i>PWD</i>	-	Public Work Department
<i>RAD</i>	-	Rapid Application Development
<i>RCM</i>	-	Reliability Centered Maintenance
<i>ROIIM</i>	-	Return on Investment in Maintenance
<i>RFID</i>	-	Radio Frequency Identification
<i>RPI</i>	-	Rensselaer Polytechnic Institute
<i>SCADA</i>	-	Supervisory Control and Data Acquisition
<i>SDLC</i>	-	System Development Life Cycle
<i>SPSS</i>	-	Statistical Package for the Social Sciences
<i>SPSU</i>	-	Southern Polytechnic State University
<i>TO-BE</i>	-	Modified Value Chain Model
<i>TPM</i>	-	Total Productive Maintenance
<i>TQM</i>	-	Total Quality Management
<i>UPP</i>	-	Maintenance and Development Unit
<i>UPPF</i>	-	Facility Management and Development Unit
<i>VB.Net</i>	-	Visual Basic.Net
<i>3-D</i>	-	Three-Dimensional

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CHAPTER 1

INTRODUCTION

This chapter presents the context for this research. It starts with a brief background of the research, and then the need for the research is justified. It also states the aim and objectives of the research and the adopted methodology. Lastly, it describes the structure of the thesis.

1.1 Background of Research

Lately, Maintenance management is an essential issue in the construction industry. This issue is related to the disastrous defects as the roof collapsed at Stadium Terengganu (Wyn, 2010) and the collapsed building at Jaya Supermarket in Petaling Jaya (Sagayam, 2009). The reasons for those collapses are the deficiency of technical and administrative services in maintenance management. Ismail (2012) states that, the reasons for maintenance management deficiencies are delay of action taken, inefficient steps toward decision making processes and other related factors of staff weakness. Effective maintenance management has significant value on running cost of particular building and infrastructure throughout its operation. Another identified issue of maintenance management is lack of completed system that helps to plan, implement, control and measure the maintenance performance of the facilities (Chanter and Swallow, 2007).

Although there are many systems related to maintenance management, a system that can diagnose the real situation of building and infrastructure maintenance defect is still not available (Ahmad *et al.*, 2011). Therefore, there is a need to treat the defect for heritage or old building structure over 25 years age from being collapsed abruptly.

Presently, most organisations are still implementing conventional method rather than computerised systems to manage the maintenance of building facilities and infrastructure (Supramani, 2005). The conventional method such as using paper-based form and unsystematic database are apparently not able to capture long term business targets (Hassan, 2010). The problems emerged as a result of the need to manage huge and complicated data, for instance, data loss caused by unsuitable places for file storage, excessive retrieval time in the data files recovery and not supported with maintenance decision making.

The preservation of Polytechnic is another issue in maintenance management. Polytechnic has a department to coordinate maintenance and repair of equipment, buildings, infrastructure and facilities related work, including supporting services. However, the management system implemented by this department faced many problems of reporting the defect. All reports regarding facilities defect must use “Faulty Report Form”, where students and staff have to fill up the paper-based form and send it to the related department. Students and staff are not motivated to report defect due to many forms required. There is also a risk of report being lost before reaching the related department. Moreover, the student and staff have to resubmit the form in case of incomplete information and other related factors. As complainers, staff and students also have the difficulty to identify their complaint status whereby they have to call or send an email for action progress. In addition, the teaching and learning process cannot be carried out smoothly and bother the lecture sessions because of this ineffective complaint system (Lazim & Samad, 2011).

As a result of the inherent weaknesses in maintenance management at Polytechnic, an alternate maintenance management model is proposed, namely, Computerised Maintenance Management System (CMMS). This model is designed by integrating causes and reasons from shortcomings in the conventional process through the “constructability concept”. The CMMS model is engaged in the new system to

improve the characteristic element with the decision making process. The significant factor to select a CMMS is much more advantageous than just a way to schedule maintenance management processes and able to perform the task needed without stressing the budget (Kullolli, 2008). The CMMS does not make decision, rather it provides the maintenance manager with the best information which affects the operational efficiency of a facility (Sharma and Govindaraju, 2010). Therefore, this research focuses on the deployment of new system with the decision making process to improve maintenance identification, assessing and planning activity.

1.2 Problem Statement

The problems of paper-based and unsystematic database have occurred for a long time without effective action. According to the survey conducted by Wahab (2005), that problems cause the low quality in maintenance management and time gap of building repairs manpower in order to resolve the problems.

Port Dickson Polytechnic is among the Polytechnics in Malaysia which faced problems related to paper-based and unsystematic database. Port Dickson Polytechnic gradual increase of intakes every year indirectly contributes the building and infrastructure development with the conventional maintenance management system. The conventional processes are mainly corrective and cyclical. These approaches to maintenance have been criticised for various inadequacies. They lead to maintenance backlogs and poor user satisfaction (Ismail and Kasim, 2012). The inadequacies with the system maintenance also involved the Premiere Polytechnics such as Ungku Omar Polytechnic, Ibrahim Sultan Polytechnic and Sultan Salahuddin Abdul Aziz Shah Polytechnic (Yusof, 2010).

The application of paper-based form and unsystematic database are also included in preventive maintenance such as facilities services and disposed, supplier, contractor list and for statistical data. The maintenance management staff facing difficulty to update the instantly recorded data and contributed to the negligent of management such

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