

Defect Monitoring System (DMOSYS) for Building Maintenance

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Abstract—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 have emerged due to the usage of conventional method application (paper-based form and unsystematic database) [1]. Therefore, the proposed system development is 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. The prototype system was deployed and tested at Port Dickson Polytechnic and Public Works Department, Malaysia. This new system is expected to become the successful technology in assisting the maintenance contractors, clients and developer for effective management of maintenance defects at Polytechnic.

Keywords-Maintenance Management; Conventional Method; Maintenance Management System; Malaysian Polytechnic

I. INTRODUCTION

There were many problems related to the conventional method at the Polytechnic such as nonspecific complaint through paper-based form, limited budgets and time gap of maintenance repairs. The paper-based form wasted a lot of time, effort and materials. The number of students and the long life span of services required an efficient management to maintain the building facility at the Polytechnic [2]. Therefore, the transformation of the conventional process into the new system is important to improve the maintenance management in the works of inspection and to reduce the budget that allocated for maintenance repairs especially on the ad-hoc and preventive maintenance [3].

In the case studies, the engineers and assistant engineers revealed a number of shortcomings in the conventional method. The building defect information was insufficient to facilitate the maintenance management staff to handle the data analysis and track the complaints. The data were also inaccurate in order to assess the size of the work done and other decision making information.

The repetition of defect was frequently at Polytechnic [2]. The maintenance inspection and assessment was not able to address the building defect problems at the particular location due to the less competent manpower. Furthermore, the maintenance backlogs management caused the budget to be expanded to prevent the deterioration of the building facility.

In this research, the development of the system was intended to improve the maintenance management problems and processes at the Polytechnic. Figure 1.1 shows the components of a maintenance management system which comprises; (1) Defect Complaint; (2) Defect Diagnosis and Assessment; (3) Preventive Maintenance; and Report Protection.

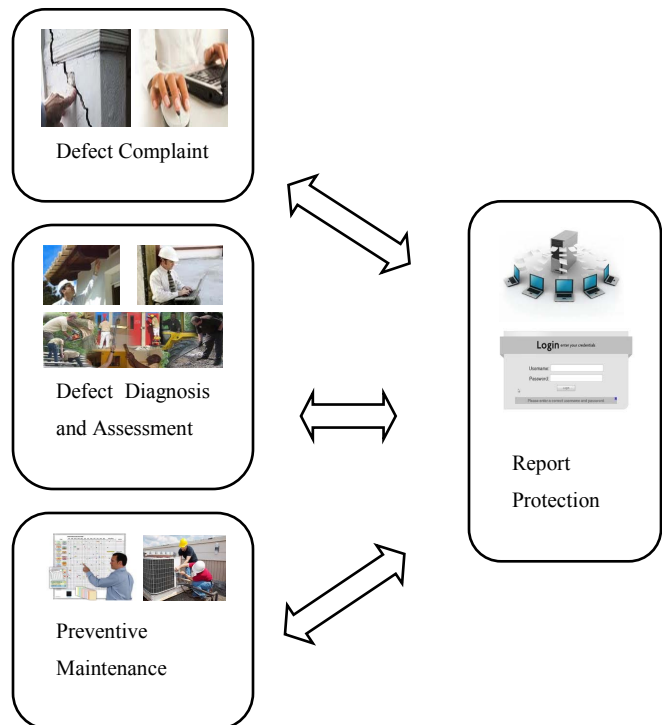


Figure 1.1: Components of Maintenance Management System

The components of the maintenance management processes are briefly described as follows:

- **Defect Complaint:** The customer will provide the password to login into the complaint form (VB.Net). The password is confidential in order to provide restricted access from hackers. In the complaint form, the customer can

choose the data from the list of the facility types, defect and location in details. The database system (MS Access) provides the complete information in reporting defects in the complaint form. The status of the complaint can be examined by using the same password and the status is classified as 'not repaired', 'being repaired' and 'repaired' in the system.

- **Defect Diagnosis and Assessment:** The technician will monitor the complaint received from customers. The inspection form (VB.Net) is used by the technician to update certain data based on the building defect inspection and assessment that will be categorised into four types, namely, 'immediate repair', 'need a spare part', 'need external contractor/supplier' and 'not economical to repair'. The provided database system is to assist the technician to complete the information accurately in managing the maintenance planning. Besides, the statistics of the ad-hoc maintenance can be analysed to examine the association between the allocations relative to total maintenance budget. The building performance also can be measured through the risk of failure classification factor such as good and moderate at the Polytechnic.

- **Preventive Maintenance:** At this stage, the technician finds out the required information of the building facility for planning the preventive maintenance. The system is equipped with the decision making process to present the alert sign colour in the form (VB.Net) when the particular equipment is near to the date of services. The alert signs are sorted into two colours. The white colour indicated the uncritical date of service while the red colour specified the critical date of services that requires immediate action to prepare the maintenance execution.

- **Report Protection:** All information of the maintenance management is sent to the database system (MS Access) with a restricted access to the personal files and documentation of the members of senior management at the Polytechnic.

This structure of the paper presents the introduction to the components of maintenance management processes including 'defect complaint', 'defect diagnosis and assessment', 'preventive maintenance' and 'report protection'. It then describes the key features of the process for maintenance management and discusses the development of the prototype system, 'DMOSYS-Defect Monitoring', which is based on the integration of maintenance management processes and information system. Next it examines the choice of the system development environment, system architecture and the development process of the maintenance management system. Lastly, this paper demonstrates the operation of the prototype system and concludes by showing the test of the prototype system.

II. SYSTEM ARCHITECTURE

The system architecture focuses on the collection of the facility defect information and assessment as well as

maintenance planning and analyse the data for the execution reference. The mobile devices such as notebook enable staff to compare and adapt the data at any facility location with the customer's complaint recorded in the prototype system user-interface (MS Visual Basic.NET). The staff will be able to capture the evidence of the facility defect, update about the detailing defect, and record the relevant aspect of the defect attribution in the inspection form of the prototype system. This information is stored in a computer database central (MS Access) at the office for further process. The information about the defect is analysed for the maintenance planning and execution using the decision making process. The workflow is illustrated in Figure 5.2.

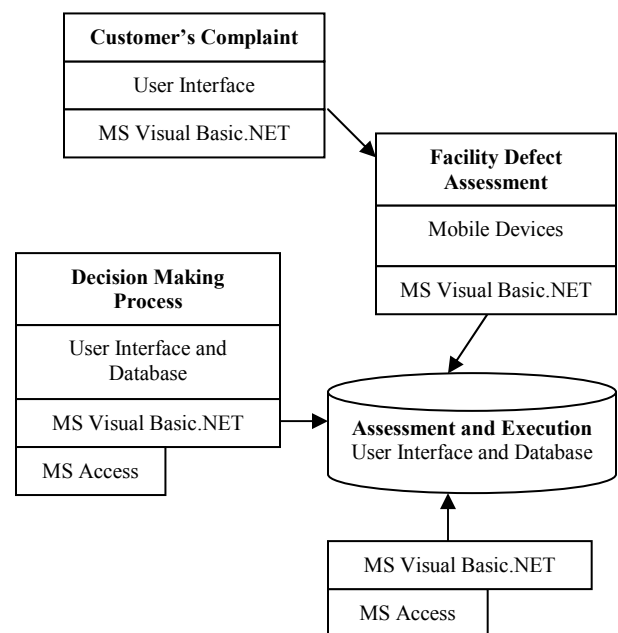


Figure 5.2: System Architecture of the Maintenance Management System (MMS) Prototype

III. OPERATION OF THE PROTOTYPE SYSTEM

This section describes the interactive portion of the system including input data validation and updates of system database in the information system prototype. The prototype system has four main functions and graphical user interfaces:

- System Login;
- Defect Complaint and Status;
- Defect Diagnosis and Assessment; and
- Preventive Maintenance.

System Login

The prototype system starts when the main interface, namely, “DMOSYS: Defect Monitoring System for Building” is displayed (see Figure 5.6). The login menu in the form is operated via ID and password input in allowing customer such as students and Polytechnic staff to enter the prototype system.

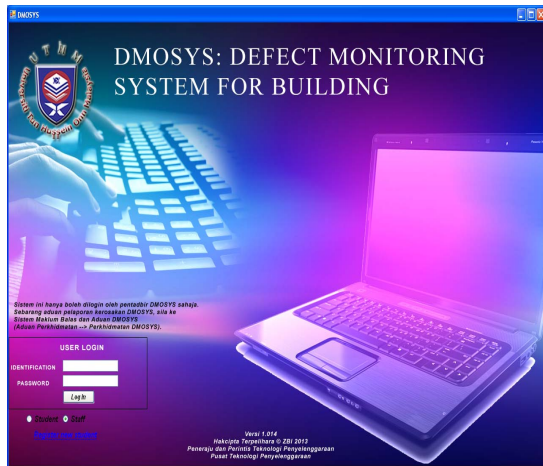


Figure 5.6: “DMOSYS: Defect Monitoring System for Building” Main Screen

The customers have to register their profile in order to report their complaint and check the status of the concerned building maintenance.

Defect Complaint and Status

After clicking the Log on button, the customer is entering the ‘Profile’ form as shown in Figure 5.7.



Figure 5.7: Student/Polytechnic Staff-Complaint Registration

In this application form, the customer is provided with two buttons, namely, complaint and report status to access other forms in the application in reporting defects for building facility.

Defect Diagnosis and Assessment

Figure 5.8 shows the ‘Received Complaint’ form, which provides the additional data such as ‘maintenance status’ option list of not repaired, being repaired and repaired as well as the ‘print’ button for staff reference that based on the standard paper report.

Choosing on the ‘being repaired’ and ‘repaired’ in the list box display to diagnose the building defects into three categories which are the critical, risk and good performance level.

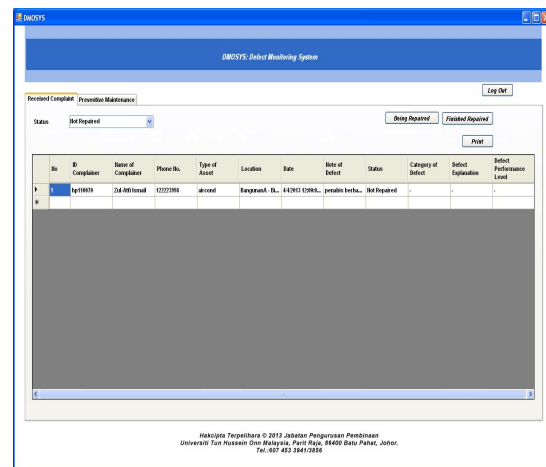


Figure 5.8: ‘Received Complaint’ Form

Preventive Maintenance

Figure 5.9 shows the ‘preventive maintenance’ form. This form also provides the staff with the additional data on ‘Facility Registration’ and ‘Inventory Registration’ button.

The red and white colour functions in the ‘preventive maintenance’ forms allow the alert sign and needed duration for the maintenance services. The concerned facility is identified based on the schedule setting and the data only being extracted from the displayed red colour after clicking the ‘maintenance update’ button at the row right-side of the table. Thus, the staff could ensure the real-time information on the services of maintenance facility which is undertaken at the site location effectively.

No	Facility	Building Location	Level	Room	Daily	Monthly	Yearly	Maintenance Units
1	Binaan Sptm...	FIS/TH	2	A1	0.0001 (0.0001)	0.0003 (0.0003)	0.0009 (0.0009)	0.0009 (0.0009)
2	Koridor...	FIS/TH	3	A2	0.0001 (0.0001)	0.0003 (0.0003)	0.0009 (0.0009)	0.0009 (0.0009)
3	Dapur...	FIS/TH	1	A1	0.0001 (0.0001)	0.0003 (0.0003)	0.0009 (0.0009)	0.0009 (0.0009)
4	Sukan...	FIS/TH	5	C2	0.0001 (0.0001)	0.0003 (0.0003)	0.0009 (0.0009)	0.0009 (0.0009)
5	Koridor...	FIS/TH	5	D4	0.0001 (0.0001)	0.0003 (0.0003)	0.0009 (0.0009)	0.0009 (0.0009)
6	Fos Kologan...	FIS/TH	2	B2	0.0001 (0.0001)	0.0003 (0.0003)	0.0009 (0.0009)	0.0009 (0.0009)

Figure 5.19: 'Preventive Maintenance' Form

IV. SYSTEM TESTING

In the final development of the prototype system, two test plans are needed at this stage of the research. The test plans involved are module testing and integration testing [4]. The module testing is commenced to ensure the prototype system follows the requirements of the data flow in the maintenance management processes through iterating approach. The prototype system consists of four main functions for the building maintenance, namely, 'system login', 'defect complaint and status', 'defect diagnosis and assessment' and 'preventive maintenance' operation. These functions were scrutinised to be compliant with the appropriate technical design as needed from client.

Besides, the assessment on user environment was implemented to improve the control range, extend of the scope and precision steps of the maintenance processes into the prototype system. The other criteria in the module testing were determined through performance at the provided boundaries and interfaces including the measurement for coverage of software and hardware reliability as well as maintainability [4].

The integration testing involved all of the procedures described in the above module testing where the concerned software and hardware were tested to produce the integration of both of these elements in the entire system. This testing focuses on the technical system design and is typically concerned with the reliability, integrity and safety of the system; such methods range from formal mathematical work (theorem proving, model checking) to informal procedures such as code walkthrough for the particular programming language in order to evaluate conformance without errors and defects (bugs) of the implemented system to its integration elements [5].

The prototype system is frequently tested by running it until the critical problems are fixed and the staff is confident with its functional requirements work correctly. The aim of testing of the prototype system in this research is to form the several phases of the current value chain model (AS-IS) as

well as constructing a modified value chain model (TO-BE) with the improvements in a prototype system. It provides the current structured system tools within an organisational context and the process-modelling technique as the final refinement to install a real system for application in improving the maintenance management practices at the Polytechnic.

V. CONCLUSION

This paper further explores the potentials of information system for building maintenance management. The key features of the maintenance management components of the prototype system were discussed at the beginning of the research. This paper also described the system architecture and the conceptual process model that defines the structure and more views of a system development. It then presented the operation of the prototype system, which consists of the 'system login', 'defect complaint and status', 'defect diagnosis and assessment' and 'preventive maintenance'. The system testing was concluded in the final section to determine the 'DMOSYS: Defect Monitoring' prototype system is in compliance with the user needs.

The integration of the information database and maintenance management processes is able to improve the building diagnosis approach and decision making process for managing building maintenance. In addition, this prototype system has the potential in allowing the budget certainty for the staff advantages including the reduction of maintenance duration. This new system is expected to become the successful technology in assisting the maintenance contractors, clients and developer for effective management of maintenance defects at Polytechnic.

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