Application of Information and Communication Technology in Engineering for Effective Maintenance Management

Suleiman Abdulrahman, Saleh U.A., F. I Onuigbo

***Abstract*— This paper proposes an effective computerized maintenance management information system that offers proper maintenance management. It provides the Engineers with the timely information for sound decision making of the maintenance work, its application results in the reduction of response time, better accuracy of information, elimination of paper work, increase safety and centralization of the maintenance work, reduction in the annual maintenance cost, and detailed faults of each unit of the organization. The system was developed using Microsoft Visual Basic 2010 Microsoft office Access 2010.**

***Index Terms*— Computerized Maintenance Management, Preventive Maintenance, Corrective Maintenances, Visual Basic, Microsoft Access**

I. INTRODUCTION

Maintenance plays a very important role in proper functioning of an organisation. However it is the most neglected feature in most of the organisations in Nigeria, due to different reasons, the capacity utilization of equipments is less than 50%. Maintenance activity if neglected leads to frequent breakdowns and also bring about high cost of repairs and poor life of valuable equipment as well as incalculable loss of production [1]. Ineffective and poor maintenance in organisation leads to high financial losses to a firm. Maintenance contributes to efficient functioning during the life cycle of an equipment/machine. Maintenance must be properly coordinated [2]. It directly affects the operational costs of any organisation.

According to Pophaley [3]. Plants maintenance is an important activity in automobile industries, dedicated to translating requirements into activities, to develop new products and services. However there are several difficulties in its application, among them – interpreting the production needs, defining the correlations between the quality demanded and quality characteristics, difficulty in working in teams, and lack of knowledge about using the method, are major. These difficulties have depressed its effective use in making it a competitive advantage. The body of knowledge on maintenance performance is both quantitative and qualitative based. Quantitative approaches include economic and technical ratios, value-based and balanced scorecards, system audits, composite formulations, and statistical and partial maintenance productivity indices. Qualitative approaches include human factors, amongst others. Qualitative-based approaches are adopted because of the inherent limitations of effectively measuring a complex function such as maintenance through quantitative models. Maintenance decision makers often come to the best conclusion using heuristics, backed up by quantitative assessment, supported by quantitative measure [4]. According to [5] although university building maintenance practices are corrective and cyclical there is a lack of comprehensive maintenance management framework that guides the decision making processes. The processes surrounding decision making for equipment maintenance and replacement are complex and crucial to the success of a company, there are many small well known process-related changes that can benefit any company, such as reducing fire-fighting maintenance [6]. These changes are much easier that the right data is being collected for data-driven management. Without the collection and use of data about equipment, no decision can be made using quantifiable justification. The data collected also needs to be uniform and available on all equipment [7]. This work is expected to provide efficient and effective maintenance activities at the Centre for Atmospheric Research, Kogi State University Anyigba.

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II. CLASSIFICATION OF MAINTENANCE

Generally maintenance can be grouped into two broad categories as shown on the figure below

A. Preventive maintenance

B. Corrective maintenance

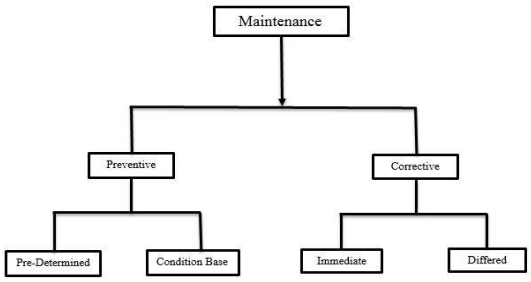

Figure 1.Maintenance Organogram

Preventive maintenance (PM) refers to regular, routine maintenance to help keep equipment up and running, preventing any unplanned downtime and expensive costs from unanticipated equipment failure [8]. It requires careful planning and scheduling of maintenance on equipment before there is an actual problem as well as keeping accurate records of past inspections and servicing reports.

Corrective maintenance (CM) refers to maintenance work which involves the repair or replacement of

components which have failed or broken down [8]; hence, it is usually more costly than preventive maintenance and often times require workmen of special skills and perhaps special tools.

Detecting a potential source of trouble before it happens or failure soon after it occurs can often prevent damage to other parts of the equipment and also may lessen the danger of plant unbalance [9]. Therefore a preventive maintenance program is of the utmost importance for the workmen at any plant.

III. MAINTENANCE MANAGEMENT

Maintenance management is the term used to describe the activities involves in ensuring that the equipment, facilities and appliances operate at the required state, this is performed in order to achieve continuous improvements in reliability and availability [10]. BS EN 13306.2010 defines maintenance management as: - all activities of the management that that determine the maintenance objectives, strategies and responsibilities, and Implementation of them by such means as maintenance planning, maintenance control, and the improvement of maintenance activities and economics. Maintenance management can be done in three different levels:

The first level is dealing with the formulation of the maintenance strategies so that is consistent with the other business strategies within the company.

The second level is planning and schedule maintenance in order to ensure efficient maintenance operations.

The third level is related to the execution and collection of data from the maintenance actions.

IV. REASON FOR MAINTENANCE MANAGEMENT

What is maintenance and why is it performed?

Maintenance in any organization means the practices or actions associated with equipment repair after itis broken or to keep the equipment in stable condition of operation [11]. The dictionary defines maintenance as follows: “to work of keeping something in proper condition; upkeep.” This would imply that maintenance should be actions taken to prevent a device or component from failing or to repair normal equipment degradation experienced with the operation of the device to keepit in proper working order. Unfortunately, data obtained in many studies over the past decade indicates that most private and government facilities do not expend the necessary resources to maintain equipment in proper working order. Rather, they wait for equipment failure to occur and then take whatever actions are necessary to repair or replace the equipment. Nothing last forever andall equipment has associated with it some predefined life expectancy operational life. For example, equipment may be designed to operate at full design load for 5,000 hours and may be designed to go through 15,000 starts and stop cycles.

The reason for maintenance is predicted on actual or impending failure ideally, maintenance is performed to keep equipment and systems running efficiently for at least design life of the component(s). As such, the practical operation of a component is time based function.

V. OBJECTIVES

The objective of the complaints management system is

1. To make complaints easier to coordinate, monitor, track and resolve,
2. To provide organisation with an effective tool to identify and target problem areas, monitor complaints handling performance
3. To make business improvements.
4. Prompt and specific retrieval of data.
5. Flexibility in the system according to the changing environment.
6. Controlling redundancy in storing the same data multiple times.
7. Accuracy, timeliness and comprehensiveness of the system output.
8. Stability and operability by people of average intelligence.
9. Enhancement in the completion of work within the constraints of time.

VI. PROPOSED MAINTENANCE SOFTWARE FOR THE CENTRE FOR ATMOSPHERIC RESEARCH, KOGI STATE UNIVERSITY CAMPUS ANYIGBA

The Centre has a core mandate which is dedicated to understanding the atmosphere-the air around us-and the interconnected processes that make up the Earth system, from the ocean floor through the ionosphere to the sun’s core, through the affirmation the Centre has different Atmospheric Research facilities separated across the entire country that operate on 24hrs basics which always need proper and accurate maintenances. And also the office appliances and laboratories would need proper maintenances. Others include procurement and maintenance of vehicles, plants and Machinery.

The Research facilities of the Centre are growing by the day and the maintenance demand is increasing daily, hence the needs to fashion out means for easy maintenance work. The design and development of maintenance software was conceived and carried out.

VII. PROBLEM STATEMENT

The maintenance of the Atmospheric and air quality facilities of the Centre has become one of the major sources of expenditure, this call for immediate action towards curbing the high cost of maintenance.

i. Maintenance process is cumbersome, considering its start process from complaints to the actual execution of the maintenance work from different part of the country.
ii. There is sometimes abnormality between fault reported and actual fault discovered
iii. There is sometimes disparity between materials required and actual materials used.

VIII. MAINTENANCE INFORMATION SYSTEM

Maintenance management information system (MMIS) is system that is used to schedule and record operation and preventive/planned maintenance activities associated with facility equipment. The MMIS can generate and prioritize work orders and schedules for staff to support "trouble" calls

and to perform periodic/planned equipment maintenance. Upon completion of a work order, performance information, such as the date work was performed, hours of the work, typically is loaded into the database for tracking, to support future operations/planning.

This system can provide reports used in managing the organization's resources, preparing facilities maintenance schedule and personnel decisions. In today's maintenance world, the MMIS is an essential tool for recording work requirements, tracking the status of the work, and analyzing the recorded data in order to manage the work, produce reports, and help control costs. Facility professionals use tools to manage the planning and day-to-day operations and maintenance activities required for a single facility or a large complex. These tools also provide all of the information required to manage the work, the work force, and the costs necessary to generate management reports and historical data [12].

The maintenance information system interface was developed using Visual Basic Software and Microsoft office Access 2010; the data base was compiled using Microsoft Office Access 2010 and visual basic software was used for the graphic user interface (GUI). The maintenance information system is designed with the aim of solving the problem mention above and operates as follows;

i. Complaints by staff or officer in charge of the research facility to be done via the internet
ii. Faults reported will now be checked by supervisor, confirm by head of maintenance unit and the head of division where necessary, thus ruling out to a large extend ambiguity.
iii. Materials required are confirmed by the staff, the supervisor, head of division and head of unit.
iv. Completion level of any maintenance work is certified by the officer, maintenance staff, head of division and the head of unit.

The maintenance information system can only be accessed through the user name and password as shown on the figure below

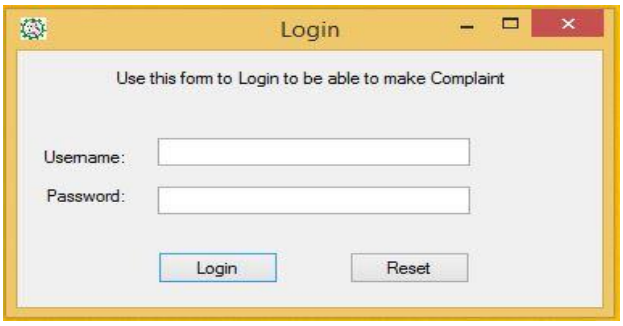

Figure 2. Logging platform

The complaint details shown in figure 3 would be on the database of the information system for easy access and control while the view report bottom can only appear when the head of unit (HOU) logging to the system . The thank you interface as shown in figure 4 is to acknowledge the recipient of the complaint by the system

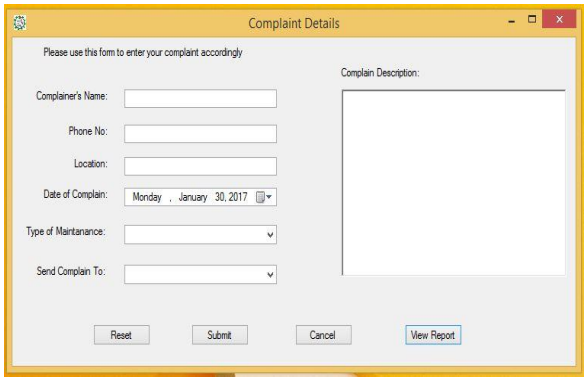

Figure 3. Complain details interface

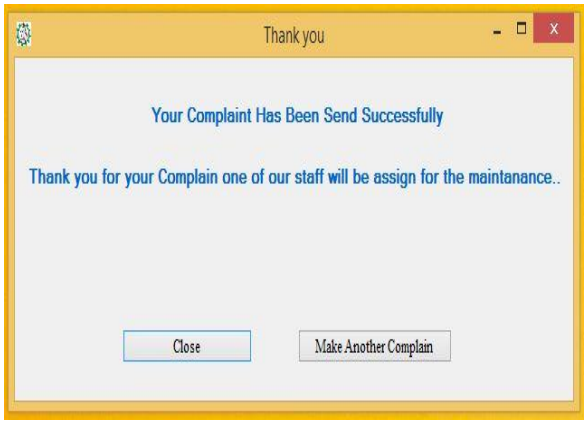

Figure 4. Thank you interface

The complain list which contained the whole complain in the system is shown on the figure below

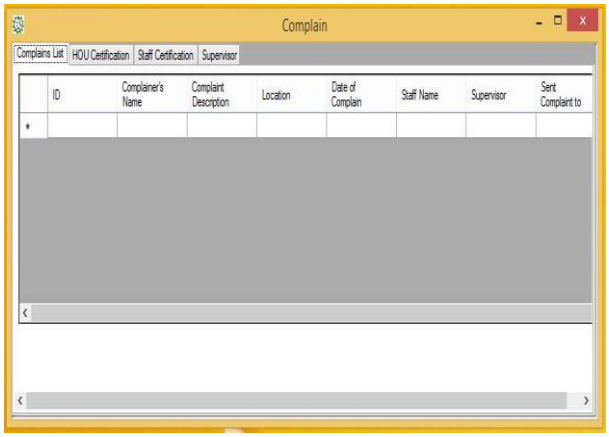

Figure 5. Complain list interface

The HOU assigned a staff and a supervisor to treat the complain as show on the figure below

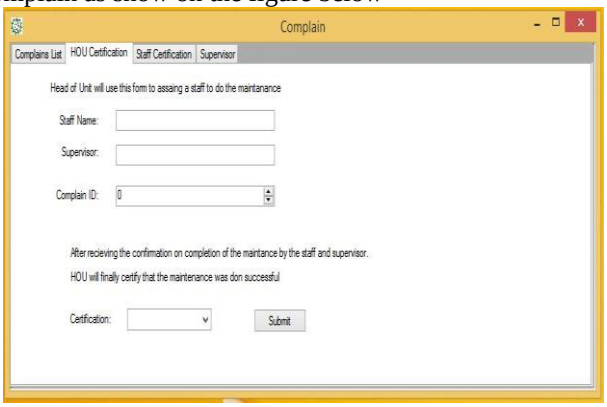

Figure 6. HOU Certification interface

The staff interface shows the report by the staff assigned to treat the complain while the supervisor interface shows the report by the supervisor as seen below

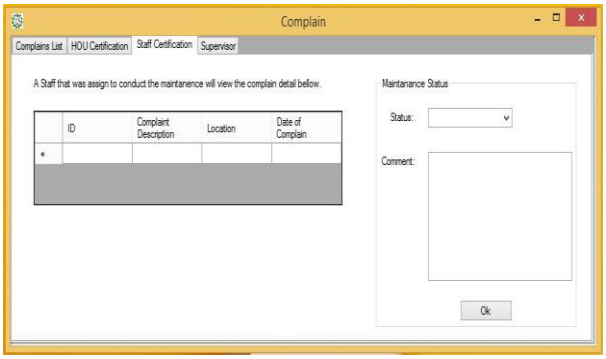

Figure 7. Staff interface

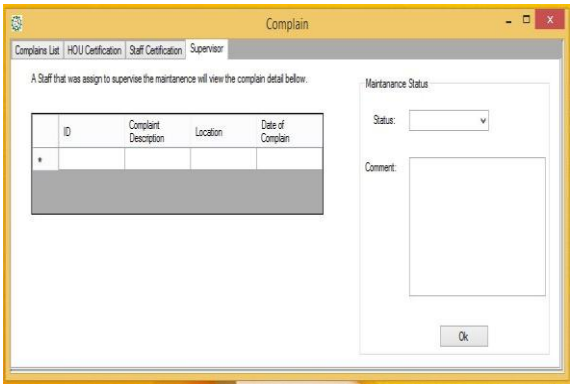

Figure 8. Supervisor interface

V. CONCLUSION

The maintenance information system is expected to ensure that there is ease in fault reporting by staff. The reported faults are properly logged in and only authorized staff can have access to reported faults. The location of the faults is easily accessed. Materials required for the work are outlined and the cost implication also calculated. The maintenance work after completion is certified by the complainant, the supervisor and the head of unit. If the procedures are followed professionally the materials required for the maintenance work properly accounted for and the work is carried out effectively. This information system provides a comprehensive maintenance solution for equipment performance prognosis and diagnosis.

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