

## MMMS – A Microcomputer Based System for Maintenance Management

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**ABSTRACT.** The growing awareness of the critical importance of proper maintenance both at national and sectoral levels has led to the development of the concept of maintenance management systems. This paper outlines the main features of a microcomputer based maintenance management system, called MMMS. The system was developed using dBASE III<sup>+</sup> and is completely menu driven. The main features of the system include the generation of preventive maintenance schedules and work orders for both preventive and breakdown activities, maintenance of all preventive and breakdown activities and generation of practical management reports. It also tracks labor time, cost, and efficiency of various maintenance operations. The system has integrated both the personnel and the spare parts inventory systems with the maintenance system.

### 1. Introduction

It is well recognized that maintenance is growing both in volume of activities and in importance. This growth is primarily due to the increase in the size of economic infrastructure and to its increasing complexity. Increasing world-wide competitiveness of market economies makes it imperative that machines and equipment are used optimally. This preoccupation with efficiency entails continued maintenance of existing assets in order to ensure their proper operation and to increase their economic life.

In order for maintenance to best achieve its objectives, the maintenance activities have to be conducted at the right time, in the right way and of course at minimum cost. This requires a properly structured maintenance management system (MMS) capable of capturing, recording, storing, and processing vast amounts of data, updat-

ing maintenance history and providing various management reports on a regular basis<sup>[1]</sup>.

The MMS can be either manual or computerized. The enormous data which supports a MMS and the need for large amount of information generation from such a system makes the MMS an ideal choice for computer application<sup>[2]</sup>. Also, manual systems cannot be compared with the accuracy, efficiency, speed and sophistication of computerized systems.

Until recently, most systems were programmed for expensive and powerful main-frame computers and as a result, the use of MMS was restricted to big organizations only. Small organizations were deprived of the benefits of MMS. The availability of high speed micro-computers with large memory and storage capability at a reasonable cost has made them an obvious choice for operating maintenance management systems<sup>[3]</sup>. Now even the smaller organizations can afford to purchase a micro-computer and devote it solely for maintenance management.

The various aspects that were stressed during the MSS computerization process included not only developing specific programs for different components of MMS such as preventive maintenance<sup>[4]</sup>, but also features such as choice of a proper computer, development of broad specification of software<sup>[5]</sup>, and the creation of software packages<sup>[6]</sup>. A stage has now been reached when a number of software packages for MMS are commercially available. Sixty such packages were reported in a recent survey<sup>[7]</sup>. Most of the packages were either developed in COBOL or BASIC. Very few were developed using dBASE II, dBASE III, and Fox Base.

This paper presents the salient features of a microcomputer based system for maintenance management. The system, called MMMS<sup>[8]</sup>, was developed at the Industrial Engineering department of King Abdulaziz University, Jeddah, Saudi Arabia by the authors using dBASE III<sup>+</sup> and can be run on any IBM or IBM compatibles.

## 2. Overall System Structure of MMMS

There are two general approaches to MMS design, a structural approach and a functional approach. In the structural approach, the system is designed around the physical entities in a maintenance system, such as equipment, crafts, parts, reports, work orders ... etc. In the functional approach, the design revolves around the major functions performed by the system, such as Breakdown maintenance, Preventive maintenance, Management reporting, File management ... etc. The MMMS was developed using the functional approach.

The MMMS comprises three major modules. These are :

- i) Preventive maintenance (PM) module.
- ii) Breakdown maintenance (BD) module.
- iii) Documentation module.

In addition to above modules, there are two other modules in the system. These

are File Maintenance module and Query module.

The overall system structure is given in Fig. 1. The system is completely menu driven. The menu structure is shown in Fig. 2.

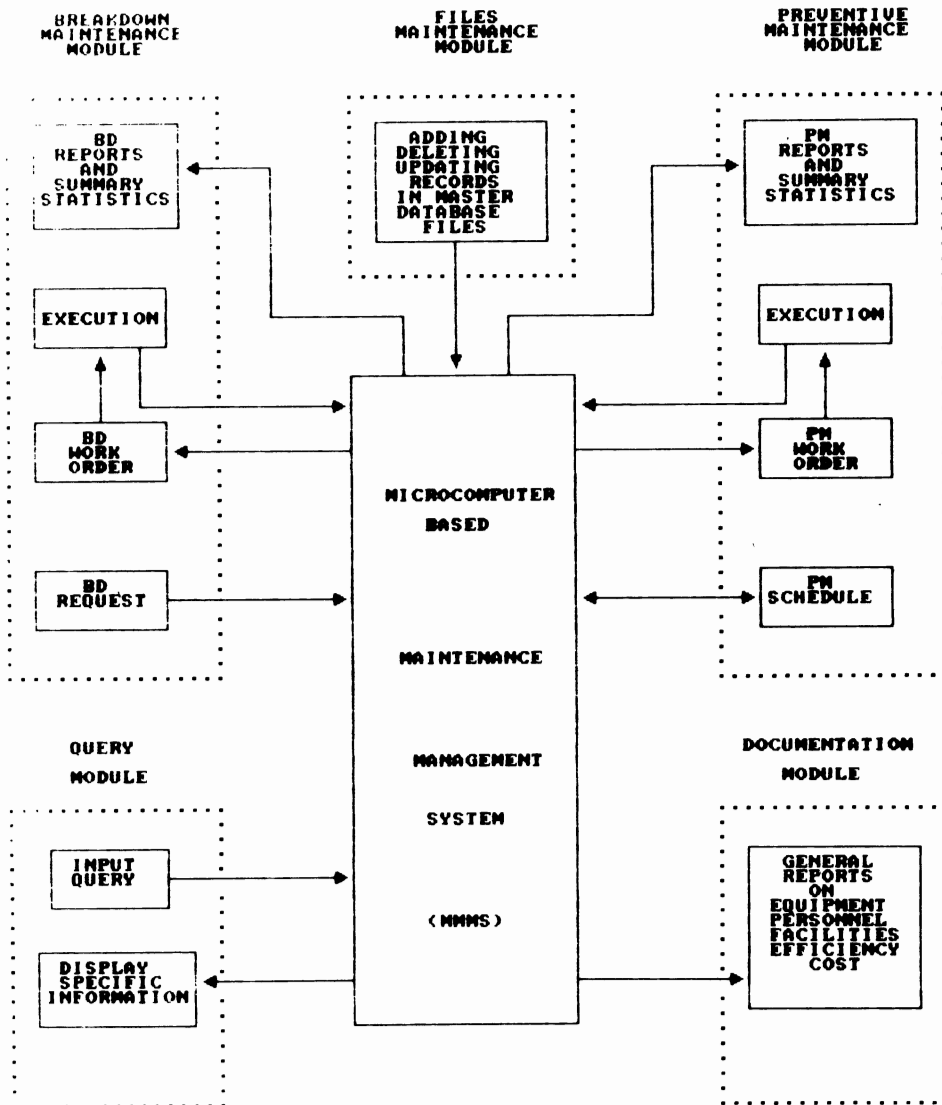


FIG. 1. Basic structure of MMMS.

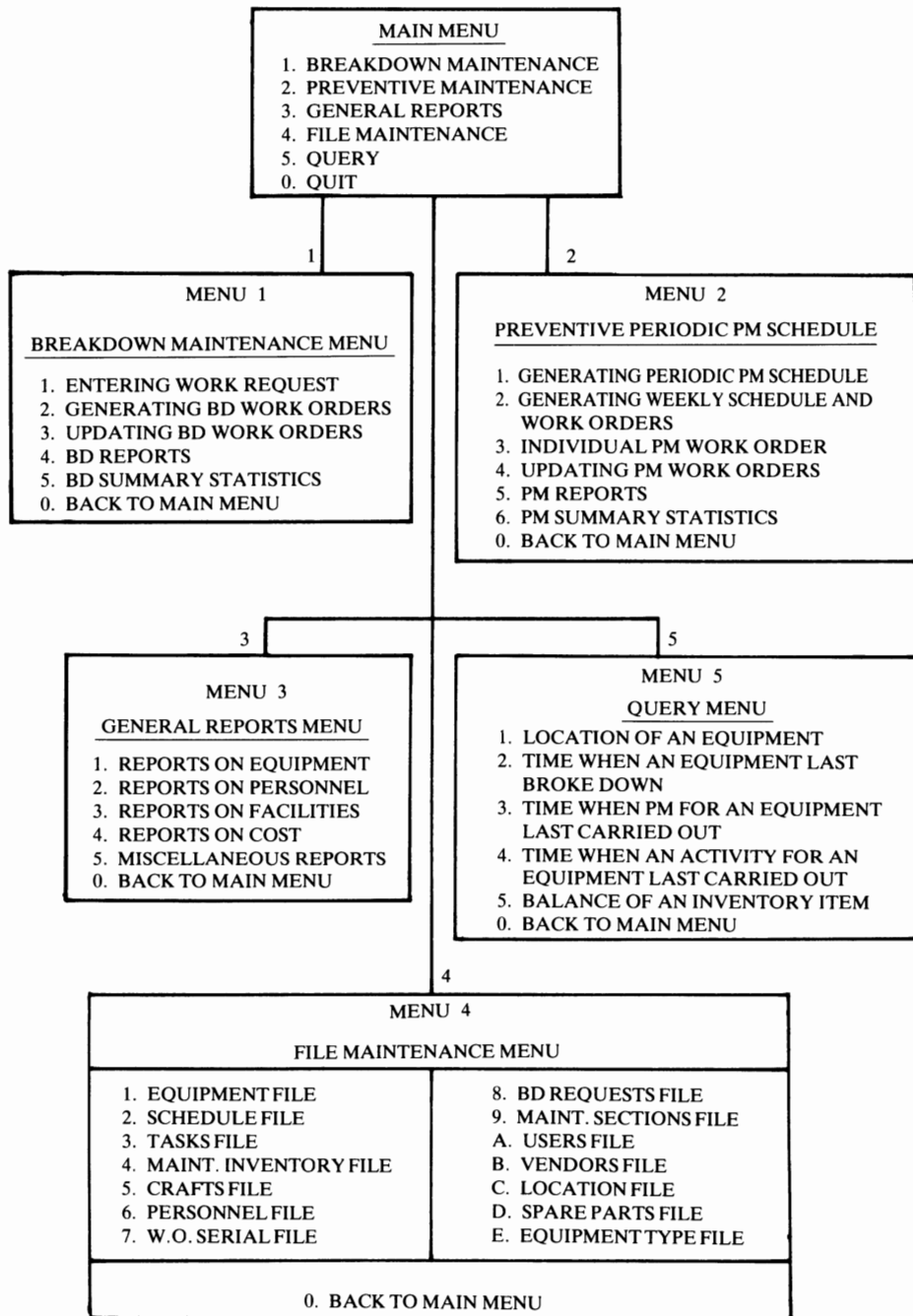


FIG. 2. The menu structure of MMMS.

**The PM Module**

The major functions carried out by the PM module are as follows :

- a) Keeping information on all PM activities by equipment along with their frequencies.
- b) Keeping information on all resources (crafts, spares ... etc.) needed for doing each individual activity.
- c) Generation of PM schedules for user-specified period.
- d) Generation of PM work orders.
- e) Tracking of work status by work order.
- f) Maintaining history on completed work orders.
- g) Tracking of performance and efficiency indicators.
- h) Detailed cost tracking.
- i) Generation of various statistical reports on PM activities.

**The BD Module**

The major functions carried out by the BD module of MMMS include :

- a) Entry and tracking of all Breakdown requests.
- b) Generation of BD work orders.
- c) Monitoring status of work orders.
- d) Maintaining history of BD repairs.
- e) Detailed cost tracking of BD repairs.
- f) Tracking of BD performance and efficiency.
- g) Generation of various statistical reports on BD activities.

**The Documentation Module**

The documentation module provides general reports on maintenance entities other than those specifically related to BD or PM activities. The module generates reports on equipment and its various status, personnel, facilities, total maintenance costs, efficiencies, ... , etc.

**The Query Module**

The query module is for getting some specific information about different entities of the maintenance system on the monitor. The queries which can currently be made through the system are listed in Menu 5 of the menu structure (Fig. 2).

**The File Maintenance Module**

The file maintenance module is for maintaining the data base files of MMMS. This includes adding, deleting and updating of records in various data base files. The files which are maintained by the system are listed in Menu 4 of the menu structure (Fig. 2).

**3. Major Features of the System**

The MMMS is an integrated system. It incorporates both personnel and spare-parts inventory systems with the maintenance system. The system is truly user

friendly. At every stage, starting from data entry to report generation, the system guides the user through a series of screen menus. A unified system of numbering menus and sub-menus ensures that the user knows the relation between the displayed menu and the rest of the menu structure. The system has well-designed, and uncluttered input screens. The system has the feature of displaying instant warning or error messages on the screen in case of any data handling error.

The system generates a wide range of reports. The reports are well designed both in terms of information contents and format.

The most important feature of MMMS is its modularity. The inbuilt flexibility in the system allows PM or the BD module to be implemented separately if needed.

#### **4. The System Operation**

The proper operation of MMMS requires the setting up of a Maintenance Management Cell (MMC) whose primary function is to plan, coordinate, and control the maintenance activities and also serve as an information center for the maintenance department.

The procedure for managing breakdown and preventive maintenance activities through MMMS is described below.

The steps involved in the execution of BD tasks starting from the receipt of a work request until the generation of reports are shown in Fig. 3 with the help of a flow chart.

Figure 4 shows the steps involved in the execution of PM tasks starting from the generation of PM schedule for any user specified period and ending with the generation of various PM related management reports. The PM schedule lists all equipment due for PM in the specified period arranged in order of due date. It also shows the due PM tasks for each equipment. It includes a further list of equipment due for PM with tasks infeasible due to lack of spare parts. A detailed list of spare parts in short supply for these equipment is also provided. The system automatically generates PM work orders for all equipment due for PM with feasible tasks.

#### **5. Management Reports**

The MMMS generates a large number of reports needed by management for proper planning of future maintenance activities and controlling maintenance works under progress. The reports provide accurate, up-to-date information on equipment, personnel, facilities, status of maintenance activities, maintenance history, maintenance cost and efficiency. For ease of management use, the reports are classified into three groups.

- i) BD reports.
- ii) PM reports.
- iii) Other reports.

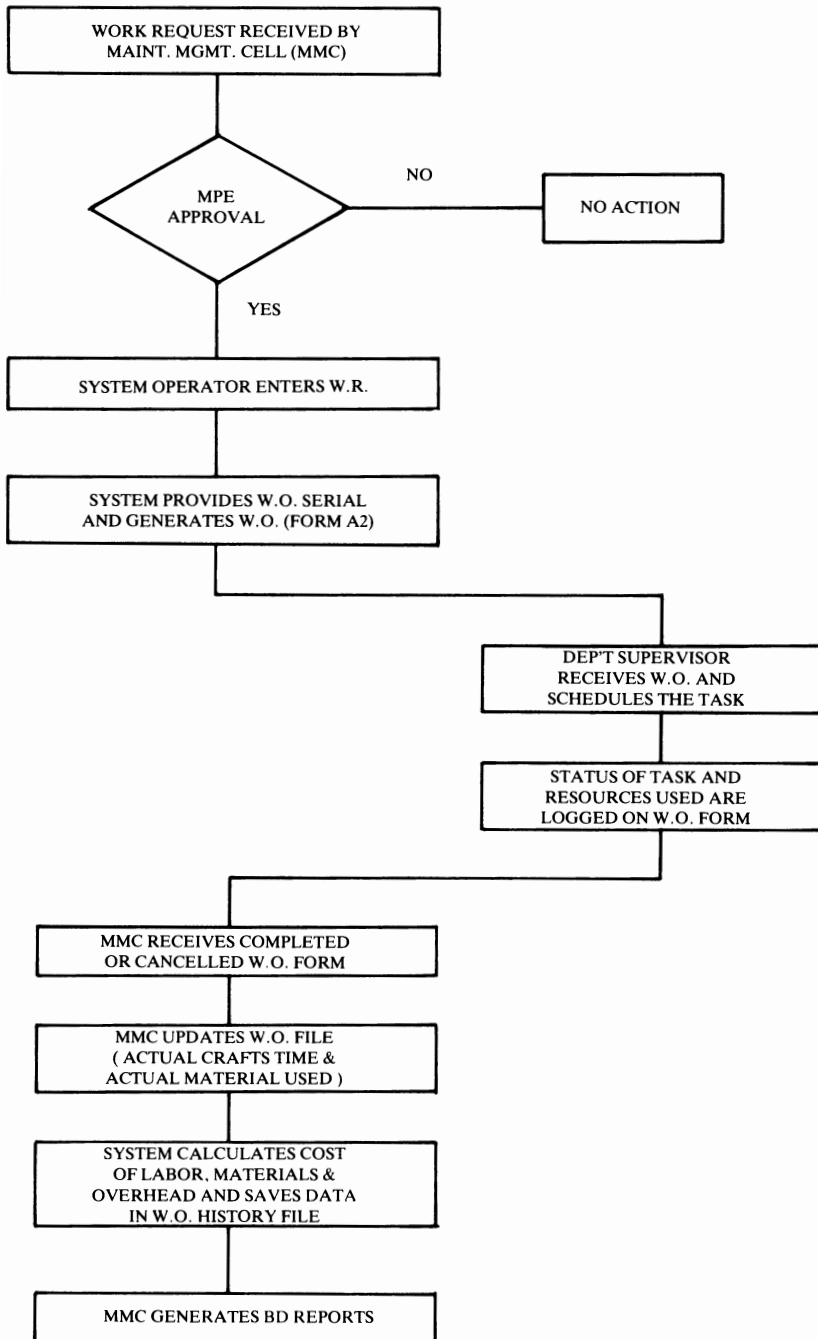


Fig. 3. Breakdown maintenance management plan.

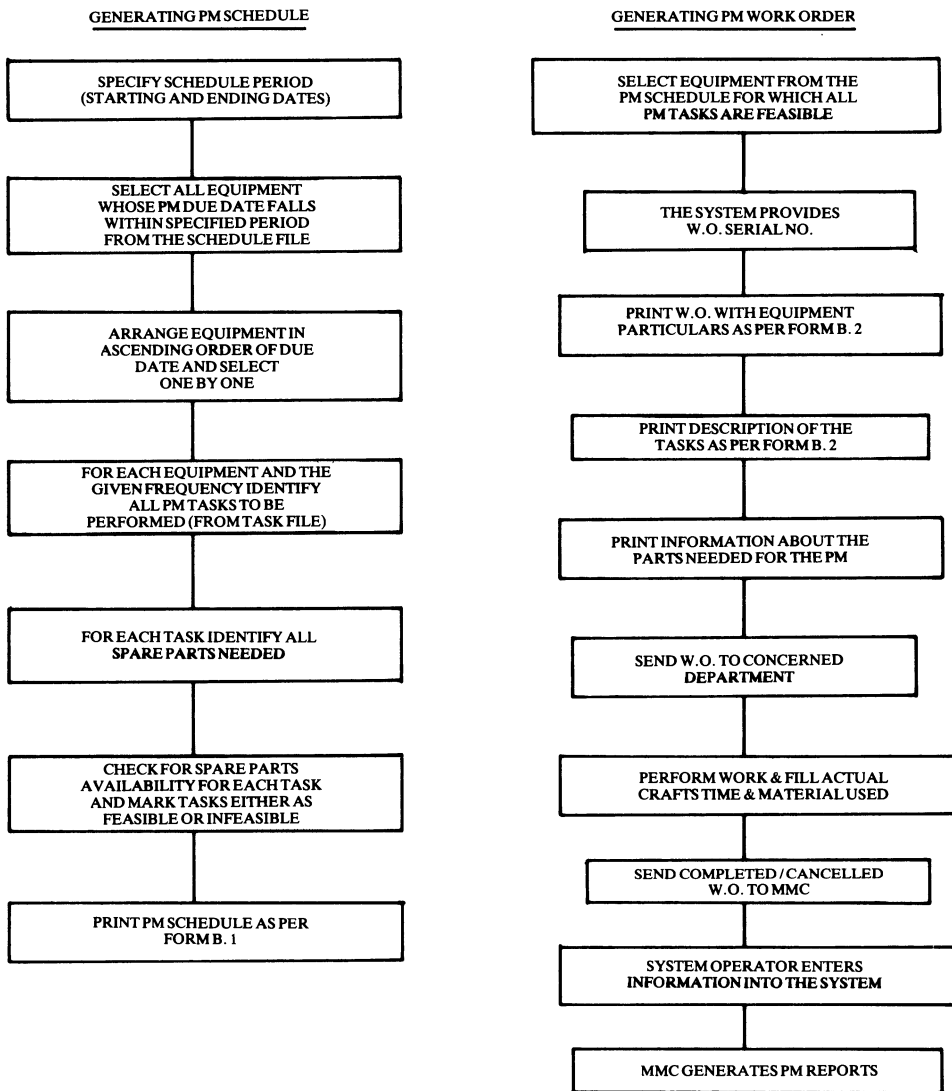


FIG. 4. Flowchart for PM management.

As mentioned earlier, all BD related reports are generated through the BD module and all PM related reports through PM module. All other reports are generated through the Documentation module. The system prints various summary reports by accessing up-to-date maintenance history data for all equipment units. The principal summary reports include reports showing labor, material, overhead and total costs of maintenance by equipment, by specific range of dates, by nature of maintenance (PM or BD). It also provides statistical reports regarding total maintenance cost by



month, monthly maintenance cost by equipment, maintenance cost by equipment and users over previous years and a list of equipment whose cost of maintenance over a specified period has exceeded a certain percentage of the equipment value and many more important reports needed by a maintenance organization for effective management.

## 6. Hardware Requirements

The MMMS has been designed to run on a stand-alone microcomputer system. The computer system requirements are as follows :

- a) An IBM AT or IBM AT compatible with minimum 640 KB RAM, two disc drives, 40 MB hard disc, CGA/EGA/VGA.
- b) Color monitor (medium or high resolution).
- c) 40 MB backup system.
- d) Printer (132 character width).

## 7. Conclusion

The MMMS presented in this paper is a management information system for the maintenance systems. The system was developed by using dBASE III<sup>+</sup> language which is very powerful in terms of its file handling capabilities. The system provides up-to-date information on Breakdown and Preventive maintenance. It generates PM schedules, both BD and PM work orders, maintains maintenance history, performs costing, calculates efficiency and provides practical management reports.

One important feature of MMMS lies in its inbuilt flexibility that allows PM or BD modules to be implemented separately if needed. The major feature of MMMS is its suitability for the small and medium-sized industrial and service organizations. This is because the system requires only one microcomputer which can easily be afforded by these organizations. As these kinds of organizations abound in the Kingdom of Saudi Arabia there is a great potential for application of MMMS.

## Acknowledgement

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## نظام معلومات لإدارة الصيانة باستخدام الحاسب الآلي الشخصي

أبو الكلام محمد عبد الحق ، محمد حسن إخوان ، فرحات علي بيرني و إبراهيم سليمان عبد الله  
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المستخلص . يزداد دور الصيانة في الاقتصاد ، ويزداد تبعاً لذلك الاهتمام بنظم المعلومات في إدارة الصيانة . وتعرض هذه الورقة لنظام معلومات لإدارة الصيانة باستخدام الحاسب الآلي الشخصي . وقد طور هذا النظام باستخدام لغة البرمجة dBASE III+ ، ويجري تشغيله بالكامل عن طريق شاشة العرض ، حيث يعرض النظام الخيارات المتاحة للمستخدم على الشاشة .

وأبرز وظائف النظام الآلي هي إصدار الجدول الدوري للصيانة الوقائية ، وإصدار أوامر الإصلاح ، وإصدار التقارير اللازمة لإدارة الصيانة ، والتي تشمل تقارير عن التكلفة والأعطال وعن كفاءة أداء الصيانة . كما يربط النظام بين احتياجات الصيانة الوقائية من قطع الغيار والمخزون المتوافر منها .