

Design, Development and Implementation of Computerized Maintenance Management Information System (CMMIS) for a Selected Medium Scale Industry

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Abstract— In this information age, data has become one of the most important resources to organizations. The effective and efficient management of large quantities of data is a common problem found in many industries. The study is carried out to design, development and implementation of a computerized maintenance management information system (CMMIS) according to the requirements of a medium scale industry, with an intention to assist the maintenance and other activities of the industry in an organized manner. The system is designed and developed by Asp.Net as front end and My SQL as back end it is one of the most powerful database management system by keeping in mind the user requirement as the primary concern.

This information and communications system is designed to assist management in controlling department like marketing, production, stores and purchase which are inter-linked for the better functioning of the organization. The system is capable of providing screen viewing and hard copy of specific reports on all activities in the organization such as equipment details, equipment spares details, preventive maintenance schedules, work order system etc. Finally, the computerized maintenance management information system (CMMIS) proposed is effectively used by the medium scale industry. Further, it is stressed at this stage that, there is an utmost need to train the employees, instigate them to take up challenging jobs and to get involved totally for the success of the industry.

Index Terms—Maintenance Management, Information System, Computerized, Medium Scale Industry.

I. INTRODUCTION

The reason for designing a computerized management information system is to give the best assistance to management for routine decisions in order to achieve minimized downtime and also extend useful life of equipment at minimum cost. The maintenance [01] activity can save costly machines and machine repairs necessitated by neglect of regular services, but the primary saving has to be gained in manpower by implementing a computerized

system, the detailed clerical tasks which are necessary for maintenance department are greatly simplified. Record keeping is also made easier because input data can be automatically updated and equipment record can be standardized and up to date.

Computers offers unmatched [02] speed, performing repetitive tasks, releasing us forms more critical, creative activities. It performs tasks repeatedly without error, avoiding the fatigue that affects humans. A computer can be efficiently used to store the data and supply the required information in the form of print outs at right time to management. Formulation of ideas of maintenance, ideas day to day standings, final monthly or yearly analysis etc., are the targets of the maintenance department. The different researchers have worked in Maintenance Management for different fields are as follows

Damilare T. Onawoga and Olasunkanmi O. Akinyemi [03] have presents the impact of maintenance as one of the competitive factors in an overall business strategy. Manufacturing industries and business organizations are set up primarily to meet the thirst or need for a particular commodity. Haron N S, Ariffin Mazeyanti Bt Mohd, Hasan Mohd H and Abdullah Siti N [04] have presents the requirements, design and prototype implementation of a system for managing Preventive Maintenance (PM) in an industrial plant.

Faremi Julius Olajide and Adenuga Olumide Afolarin [05] have focused on maintenance management practice in banking industry in Lagos state, Nigeria. It assessed the operational state of bank buildings, the factors affecting maintenance management of bank buildings, the maintenance management strategy used in maintaining bank buildings and the adequacy of funds available for maintenance management of bank buildings within the study area. Adenuga and Olumide Afolarin [06] have investigated in their study the maintenance management practice in public hospital buildings in South-west, Nigeria, and identified the essential skills for maintenance managers in a hospital built environment.

Li, Xiaoxia ; Zheng, Wei ; Liu, Qing and Cui, Hu [07] have discussed in order to improve the efficiency of enterprise maintenance management, on the basis of user

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needs analysis of the transportation enterprises and vehicle maintenance enterprises, taking three-tier C/S architecture, ADO database access technique, Visual Studio 2010 and SQL Server 2008, commercial vehicle maintenance management information system is developed.

II. OBJECTIVES OF THE PRESENT WORK

- To study thoroughly the existing system followed by the selected medium scale industry and problems faced by the employees while using existing system.
- To design and develop a computerized maintenance management information system with the help of any latest front end and back end software for the selected medium scale industry based on the requirement of the management to maintain the maintenance and other activities of the organization.
- To identify the problems faced in the implementation of developed computer maintenance management information system in the selected industry.

III. METHODOLOGY FOR THE PRESENT WORK

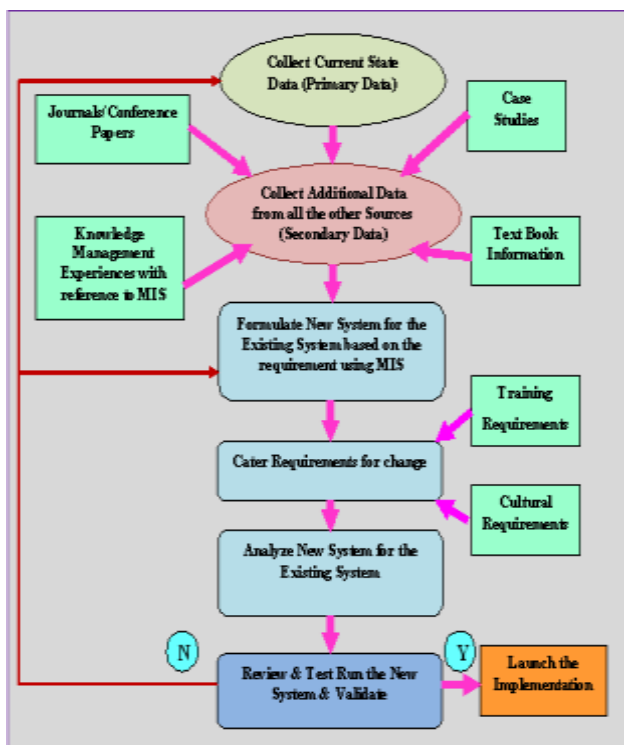


Figure 1. Methodology for the Present Work

The study proposes a computerized maintenance management information system specific to medium industries and a summary is discussed in Fig 1. The flow diagram shown shows the methodology adopted in carrying out the work and is used for improving the efficiency and effectiveness of the current system for better productivity and reduction of wastes in a medium scale industry.

The model gives a road map starting from an intention for Management Information System implementation with a

total commitment from top management on the spirit as well as the results that could be accrued from the Management Information System implementation and redesigning the existing system followed by the industry.

The methodology applied for the implementation of Management Information System can be executed using the following model proposed by the research scholar.

IV. SCOPE OF THE PRESENT WORK

The production target for every year is increasing. To achieve this target, machine to be always available for production. The priority is now to reduce the breakdown hours. Hence there is a need to develop a system which aims to minimize downtime while providing for the most effective use of facilities and man power in order to secure desired results at the lowest possible cost.

This work studies the existing system in the industry and proposes a computer based management information system. This computerized system should be able to assist management by reflecting the current state of maintenance department by providing quick access of information, generating reports helping management in planning routines to minimize downtime and extend the useful life cycle of equipment at minimum cost. Detailed critical tasks necessary for maintenance of equipment are greatly simplified when taken over by a computerize system. Record keeping is also made easier because input data's can be automatically edited and equipment records can be standardized. It also highlights how business can use information systems to gain a competitive advantage. This system will not only limited to inter-relationship among various activities of the company, but also is aimed at better understanding and co-operation among employees of the organizational hierarchy. Besides, it explores the relationships with customers and suppliers. The scope of this research work includes the following departments such as Maintenance Department, Production Department, Marketing Department, Stores Department, Purchase Department etc.

V. DRAWBACK OF THE PRESENT SYSTEM

At present the selected process industry is maintaining a centralized information flow and it has every freedom regarding the flow of information either from the top level of managers to the lower level managers or vice versa i.e., the company is practicing both Bottom Up and Top Down design of the information flow. Regarding the external factors such as purchase and supply, the customers and vendors have to come through the managing director. The information regarding the purchase of finished goods by the customers and the supply of raw materials to the company by the vendors will be sent to the respective departments through the managing director only. The heads of various departments will then take care of the further proceedings. There is a good communication and understanding between the same hierarchical level and all should be in writing only.

The existing system calls for more of managerial time spent on studying, analyzing and then to measure the

performance. Lot of time is unnecessarily spent on meeting. Delay in communication is now leading to unnecessary stock of both finished goods and raw materials and to a little extent planning of men, material and machine is very difficult with the existing system. The maintenance in the selected process industry is reasonably good, but as far as the record keeping is concerned, the department is facing difficulties in the existing methods. It is noticed that the records does not have the particulars about the cost of maintenance (Breakdown or Preventive) and cost of labor.

Presently, the maintenance department is keeping only the record of breakdown maintenance and preventive maintenance. But reports generation on maintenance cost, labor cost, periodic breakdown, preventive maintenance are not in routine work. Hence this is the major requirement of the maintenance department in the plant. These reports helps the department in analyzing the repetitive problems, mean time between failure(MTBF), material and labor cost, downtime of equipment, availability etc. Other than these, it is possible to analyze the maintenance budget for the year. Hence Maintenance Management Information System is used to overcome the above problems.

VI. DESIGN AND DEVELOPMENT OF PROPOSED SYSTEM

A. Overall Description

a) System Perspective: This developed CMMIS is independent. The system is expected to accomplish the said requirements. It should be able to assist the user to achieve a better level of work efficiency.

b) User Characteristics: The users of the system are the authorized employees of the different department of the organization. All the users should be registered by the authorized person before they sign in.

c) Assumptions and Dependencies: We assume that all users have basic knowledge of computer. We also assume that the users will be given software training documentation and reference material.

B. Specific Requirement

a) Functional Requirements: Functional requirement specify which outputs should be produced from the given inputs. They describe the relationship between the input and output of the system. For each functional requirement, a detailed description of all the data input and their source, the units of measure and the range of valid inputs are given.

b) Design Constraints: There are many design constraints in the user environment that may restrict the choices of a designer. Such factors include the resource limits, operating environment, reliability and security requirements, and policies that may have an impact on the design of the system.

C. External Interface Requirements

For the external interface requirements of the software with people, hardware and other software should be clearly specified.

a) User Interfaces: User interface is becoming increasingly important and must be given proper attention. A user manual should be created with all user commands, screen formats, an explanation of how the system will appear to the user, feedback and error messages. A window based user interface is provided so that the user can easily operate with minimum computer knowledge.

b) Hardware Specification

1. PC with minimum hard disk capacity 40 GB and 256 MB RAM
2. Local or network printer.
3. Key board and Microsoft Mouse.
4. Storage devices.

c) Software Specification

1. Front end- Asp Dot Net.
2. Back end- MySQL
3. Browser- Internet Explorer or Google Chrome
4. OS- Windows 2000/XP/98/7

d) Structured Query Language (SQL): MySQL is one of the most popular open source databases [08] available. With the release of version 5.0, MySQL adds new features, such as stored procedures, triggers, and user-defined functions, making it more comparable to commercial database server systems. Many Web hosting companies offer MySQL, and it is a compelling solution as well as a great way to learn SQL. SQL server is a relational Database Management System that can be used to store and manipulate large amount of information that runs as a server providing multi-user access to a number of databases.

e) Visual Basic 2005 (.NET Framework): Microsoft Visual Basic 2005 is an evolution of the Visual Basic language that is engineered for productively building type-safe and object-oriented applications. Visual Basic allows developers to target Windows, Web, and mobile devices. As with all languages targeting the Microsoft .NET [09] Framework, programs written in Visual Basic benefit from security and language interoperability.

f) Asp.Net (Active Server Pages): Asp.Net is a Web application framework developed and marketed by Microsoft [10] to allow programmers to build dynamic Web sites, Web applications and Web services.

D. System Analysis

a) Preliminary Investigation: Usually in the industries a separate staff is dedicated for this purpose of maintaining the maintenance and other activities of the organization. This task is tedious and complex. Once the initial investigation is done and the need for new or improved system is established, all possible alternate solutions are checked out.

b) Feasibility Study: The main objective of the feasibility study is to treat the technical, Operational and economic feasibility of developing the computerized system. All systems are feasible, given unlimited resources and infinite time. The feasibility study to be conducted for this work involves:

1. Technical Feasibility
2. Operational Feasibility
3. Economic Feasibility

VII. COMPUTERIZED MAINTENANCE MANAGEMENT INFORMATION SYSTEM (CMMIS)

This package is designed and developed using Asp Dot.Net as front end and My SQL as back end. The details of the different input formats, menus, output formats, options provided are explained in brief in this designed software package.

Home Page: This is the startup page which appears once the application is loaded. It displays all the different menus and options provided in the software.



Figure 2. Home Page Window

Register Menu: Before login to the software, the user has to register by entering the details shown in fig 2. It shows error message if entered in wrong format or left blank. This module registers users into CMMIS



Figure 3. Registration Menu

Log in Menu:

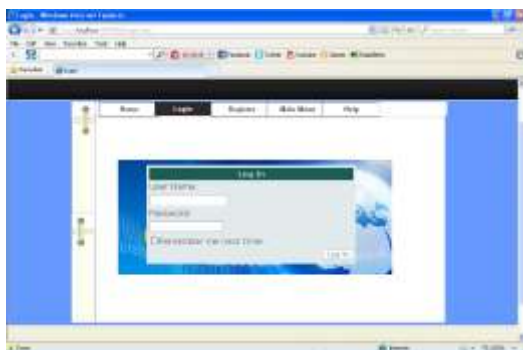


Figure 4. Log In Menu

After the registration the user can login to the software by entering Username and Password which he has selected at

the time of registration. Now the user can select any menu and can be used to fulfill his requirement.

Main Menu: This menu is divided into two sub menu, namely

- I. Maintenance Management Menu
- II. Management Information System Menu



Figure 5. Main Menu

I. Maintenance Management Menu: This menu is divided in to three sub menus, namely

1. Equipment Details Menu
2. Work Order Process Details Menu
3. Preventive Maintenance Details Menu
4. Spares Details Menu



Figure 6. Maintenance Management Menu

1. Equipment Details: This is like an identity card for a machine. It gives the information shown in fig 7.

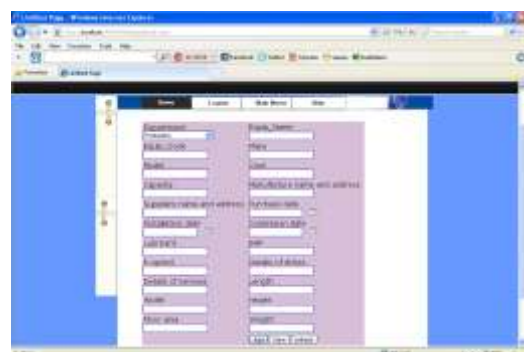


Figure 7. Equipment Details Menu

2. Work Order Process Details: It has been developed to enter the day to day breakdown details of all the machines. It has 3 sub menus, namely

- a) Work Order Input Menu
- b) Equipment History Record Menu
- c) Work Order Reports Menu



Figure 8. Work Order Process Menu

a) **Work Order Input Menu:** This is the basic input to the system. This menu has got the following sub menus.

- I. Work Order Maintenance
- II. Activities & Case Details



Figure 9. Work Order Menu

i. **Work Order Maintenance:** This gives the basic input data to the maintenance system.

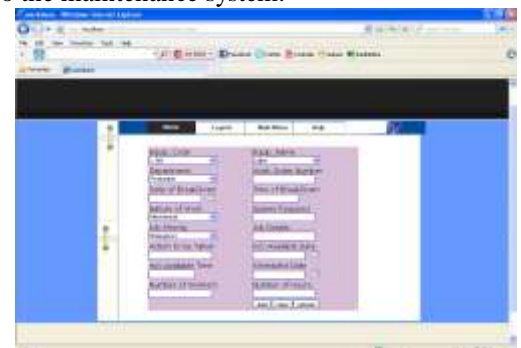


Figure 10. Work Order Maintenance Menu

ii. **Activities and Case Details:** This form gives the details of work carried out against the work order.

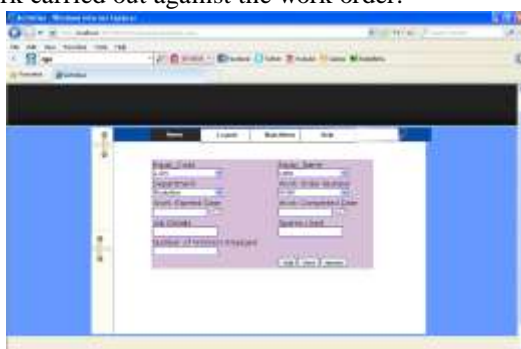


Figure 10. Activities and Case Details Menu

b) **Equipment History Record:** It contains all the information about the machines. This has got the following sub menus.

- i. Equipment History Card

- ii. Breakdown Report
- iii. Maintenance Cost Report



Figure 11. Equipment History Record Menu

i. **Equipment History Card:** All events pertaining to the particular machine is recorded in this card. Any work carried on machines is recorded in the card. This card serves as a history for future references.



Figure 12. Equipment History Card Menu

ii. **Break Down Report:** This report helps in determining the number of times a particular machine had failed during a given interval of time and it also helps in analyzing and taking corrective action on repetitive problems. This report displays the details of the breakdown of different machines.

iii. **Maintenance Cost Report:** It is generated from the equipment history card. It gives the maintenance cost involved for a machine during a particular interval of time.

c) **Work Order Report:** In this report all the work orders are recorded as and when it comes every day. Work Order status report is generated at the end of every day. It shows which are the pending breakdowns and the reasons.

3. **Preventive Maintenance Details:** This menu is divided into two sub menus

- a) Daily Lubrication List.
- b) P. M Inspection List.



Figure 13. Preventive Maintenance Details Menu

a) **Daily Lubrication List:** It indicates the different locations in a machine to be lubricated.



Figure 14. Daily Lubrication List

b) **P.M Inspection List:** Preventive Maintenance inspection has different schedules such as Daily, Weekly, Monthly, Half Yearly and Yearly.



Figure 15. P.M Inspection List

4. **Spare Details:** When there is a machine breakdown because of a failure of a machine part, this part has to be replaced with a spare. The proper control of spares is necessary to lessen the maintenance cost. Hence it is necessary to have required level of spares to keep machine running at lower inventory costs.



Figure 16. Spares Details Menu

II. Management Information System

This menu consists of 8 sub menus as shown in fig below



Figure 17. Management Information System Menu

1. **Company Details:** This is about the details of the company.

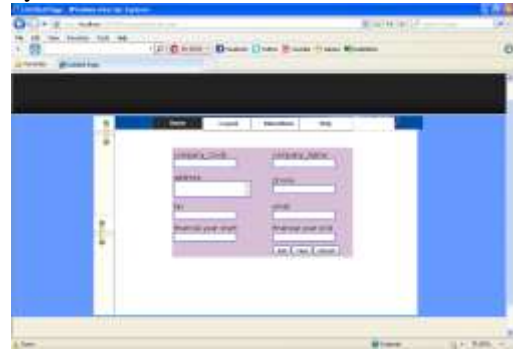


Figure 18. Company Details Menu

2. **Customer Details:** This is about the details of the customers.



Figure 19. Customer Details Menu

3. **Transporter Details:** This is about the details of the transporters.



Figure 20. Transporter Details Menu

4. **Vendor Details:** This is about the details of the vendors.



Figure 21. Vendor Details Menu

5. **Marketing:** The marketing department, it consists of following sub-menus namely,

- a) Sales
- b) Order Master
- c) Order Execution.



Figure 22. Marketing Menu



Figure 25. Order Master Menu

a) Sales: The sales menu has been divided into the following sub-menus namely,

- i. Daily Sales
- ii. Daily Sales Summary
- iii. Sales History



Figure 23. Sales Menu

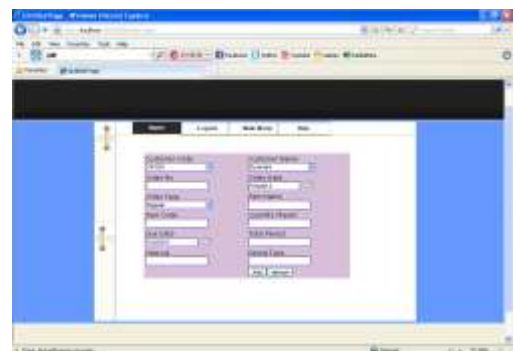


Figure 26. Orders Menu

i. Daily Sale: It gives the information about daily sales



Figure 24. Daily Sales Menu

ii. Daily Sales Summary: This is about the abstract of the daily sales. When the user presses this menu, a report will be automatically displayed on the screen

iii. Sales History: When this is operated, a format will be opened indicating the three choices of viewing the different charts.

b) Order Master: This menu has been divided into the following three sub-menus namely,

- i. Orders
- ii. Back Orders
- iii. Requisition

i. Orders: This input format is designed for the purpose of recording and storing the details about the orders placed by the different customers. The stored data after processing can be utilized for generating the reports such as the total quantity of a particular item placed by different customers.

ii. Back Orders: Depending on the orders executed, the quantity of the back orders will be automatically displayed in the orders execution input format.

c) Order Execution: This input format is designed for the purpose of executing the orders placed by the different customers.

6. Stores: This menu consists of the following sub-menus namely

- a) Inventory
- b) Order Execution



Figure 27. Stores Menu

a) Inventory: This is the input format for storing the details of inventory of both the raw materials as well as the finished goods.



Figure 28. Inventory Menu



Figure 31. Material Requirement Planning Menu

b) Order Execution: This input format is designed for the purpose of executing the orders placed by the different customers.



Figure 29. Order Execution Menu

c) Flow of Materials: This input format is divided into two divisions namely

- i. In Flow
- ii. Out Flow



Figure 32. Flow of Materials Menu

7. Production: It consists of following sub menus

- a) Product Priority
- b) Materials Requirement Planning
- c) Flow of Materials



Figure 30. Production Menu

a) Product Priority: Whenever a requisition is received from the marketing department, the production department will take care of prioritizing the items for production later.

b) Materials Requirement Planning: This input format is designed for the purpose of knowing the quantity of different raw materials to be purchased based on the quantity of different finished goods to be produced. This input format has two divisions namely

- i. Quantity Required Finished Goods
- ii. Quantity Required Raw materials

i. In Flow: This form is designed for the purpose of knowing and to have an acknowledgement of the different raw materials received from the stores.

ii. Out Flow: This form is designed for the purpose of knowing and to have an acknowledgement of the different finished goods supplied to the store.

8. Purchase: This consists of the following sub menus

- a) Purchase Order Suppliers
- b) Goods Receipt Note



Figure 33. Purchase Menu

a) Purchase Order Suppliers: This gives the information about order placed



Figure 34. Purchase Order Suppliers Menu

b) Goods Received Note (Raw Materials): This gives the information about goods received



Figure 35. Goods Received Note Menu

VIII. SYSTEM IMPLEMENTATION

Implementation plan is to be made before starting the actual implementation of the system. Implementation is the stage where the theoretical design is converted into a working system, the new system may be totally new, replacing an existing manual, or automated system or it may be a major modification to an existing system. The advantage and effectiveness of a proposed system depends to a large extent on the awareness of the user. It is necessary to review the system periodically and identify the improvements requirement.

It is the human tendency that they never switch over to another “New System” as they are in the false conclusion that they are far better than the computers and do well manually what is required by the top managers without taking into consideration the speed and accuracy of the computer systems. Sometimes they hesitate to work with the computers, as it is completely a new one to them. But, in reality, if they practice doing with the computer systems, gradually they can become used to it. For the sake of company’s efficiency, growth and welfare of the company and in turn overall development of the nation, the company should adopt MIS for adapting to the changing environment, without giving chance to second thought to neglect it.

To implementing the MIS to any industry it is necessary to study the existing system in the industry in detail, the roles played by the manager for better decisions making, to streamline the vast information system to improve the productivity of an industrial plant. Initially the training session has been planned for the employees for those who will use it. It is very difficult to give the training to all the employees at a time. As

the employees of different departments works in different shifts and moreover without affecting their regular work many groups have been formed. The computers are arranged in the different departments in respective places so that user can enter or access the relevant information which he need. All the computers are interconnected by Local Area Network even WiFi can be used. The training is given in many sessions consisting of a group of different department’s employees to make them familiar with the system. The registration is also done for the authorized users.

Management Information System is management oriented, the designing of Management Information System takes care of the managers who meet the information requirements. This developed system can be suitably changed as per the requirement of the management. Initially the system has been run on a test data and it can be implemented in a phased manner. First side by side with existing system to get familiarization and to get the staff used to it. Later once the advantages become obvious to the user, the new system alone can be maintained. This system is basically an information processing tool, it cannot make decision. One must use the information generated to help find ways to improve the operation.

IX. RESULTS AND DISCUSSIONS

The developed Computerized Maintenance Management Information System provides a user friendly interface. The main intention to develop this software is to help the medium scale industry where they can maintain the maintenance and other activities automatically, without having to do it manually, which creates a lot of frustration and consumes more time. Also provision is provided for future developments in the system. The system is designed and developed by Asp.Net as front end and My SQL as back end it is one of the most powerful database management system. Moreover it is user friendly any changes required by the management with minor modification in the source code, the changes can be done immediately based on the requirement.

This package can also be implemented on a network connecting all the department and make the system a completely an integrated one. Hence it is recommended that computerized information systems are utmost essential so that the efficiency of the company can further be enhanced to a greater extent. Besides, information regarding the inventory, sales figures, production and purchase for a period or on the day will be available on the spot. Planning of men, material and machine can be properly planned so as to economically manufacture the products. More important is that the “Demand and Supply” can be balanced. Finally, decisions can be taken at the earliest possible time for that matter concerned which was not possible immediately with the existing system.

MIS plays vital role of information generation, communication, problem identification and helps in the process of decision making for an effective management, administration and operations of an organization. In today’s world of ever increasing complexities of business as well as

management for every organization to survive and grow, must have an efficient and effective MIS which will improve the productivity of the industry. This enables the manager to accomplish his task successfully. In any organization, small or big a major portion of the time goes in data collection, processing, documenting and communicating it to the people. Hence a major portion of overheads goes into this kind of unproductive work in the organization. Every individual in an organization is continuously looking for some information which is needed to perform his/her task. Hence, the information is people oriented and it varies with the nature of the people in the organization. In management of almost all operational activity, the information forms a major input and as such for effective implementation of futuristic information system in overall system, it is essential to modify the existing management.

X. CONCLUSION

This work intended to design, develop and implementation of a computerized maintenance management information system according to the requirements of a medium scale industry, with an intention to assist the maintenance and other activities of the industry in an organized manner. The system is designed and developed by Asp.Net as front end and My SQL as back end it is one of the most powerful database management system..

The proposed computerized maintenance management information system has been designed by keeping in mind the user requirements as the primary concern, moreover the system has been designed in such a way that further modification to the system can be made with ease. This information and communications system is designed to assist management in controlling department like marketing, production, stores and purchase which are inter-linked for the better functioning of the organization. The advantage and effectiveness of a computerized management information system depends to a large extent on the awareness of the user. It is necessary to review the system periodically and identify the improvements required. In today's world of ever increasing complexities of business as well as management, every organization to survive and grow must have an efficient and effective MIS. An effective Management Information System supplies accurate, relevant and timely information to the manager of an organization.

ACKNOWLEDGMENT

We are thankful to the Management, Principal, Mechanical Department HOD and Staff of Srinivas Institute of Technology, Mangalore for their support and encouragement.

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