A GENERAL FRAMEWORK OF COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM FOR AN AUTOMOBILE INDUSTRY

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ABSTRACT - *This paper deals with a general framework of Computerized Maintenance Management System (CMMS) for an Automobile Industry. Computerized Maintenance Management System offers the highest availability of production equipment and results in the effective planning. According to the fact that prevention is better than cure, network systems implementation culture should be promoted in organizations for reasons such as preventing equipment from idling and break-down and on-time, regular and programmed maintenance. In the present scenario, it is very difficult to maintain data and information manually and also it consumes a lot of time during retrieval. The purpose of this software is to efficient planning of maintenance aspects. CMMS leads to effective planning, controlling and scheduling of maintenance activities. The application software is to contain various modules such as Equipment, Work Order, Tools & Tackles, Spare Parts, Staff Details, Task Allotment and Safety Records. This CMMS aims to lower the effective downtime, frequency of failures and overall annual maintenance cost to improve maintenance policies and machine life.*

KEYWORDS: Computerized Maintenance Management System (CMMS), Computer Aided Maintenance Planning (CAMP), Computer Aided Maintenance Control (CAMC).

1. INTRODUCTION

A machine, equipment once designed and fabricated is bound to fail during course of its operation, which can be delayed or avoided by regular maintenance. Maintenance includes playacting routine actions that keep the device in operating order (known as scheduled maintenance) or stop bother from arising (preventive maintenance). Maintenance is also outlined as, "Maintenance may be a operate to stay the machines and system in operating order by commutation or repairing a number of its elements and parts". Maintenance involves keeping the work, its structures, equipment, machines, furniture and facilities in good repair and operating efficiently and safely. There are two main types of maintenance work. Routine/preventative maintenance is typically planned and includes scheduled inspections repairs and replacement to create certain everything continues to work. Corrective maintenance is needed when things go wrong or break downs occur demanding reactive action to be taken to get things up and running again. Regular maintenance is crucial to stay premises, equipment, machines and also the work setting safe and reliable.

CMMS stands for "Computerized Maintenance Management System". Computerized Maintenance Management System (CMMS) is not any new system of maintenance but it is simply application of computers for quickly and efficiently deciding, planning and organizing various jobs for effecting systematic plant maintenance. CMMS software package maintains a electronic database of knowledge regarding an organization's maintenance operations. Over all CMMS is the integration of Computer Aided Maintenance Planning (CAMP) and Computer Aided Maintenance Control (CAMC).

2. CRITICAL LITERATURE REVIEW

INTRODUCTION

In this section various factors of CMMS are identified from the previous research work carried out in this field and the brief literature review of CMMS is discussed from various articles published in literature. A detailed literature review has been carried out to understand about maintenance and the processes of maintenance strategy formulation, selection of maintenance strategies, maintenance practices and implementation of maintenance strategies in the operation intensive industries. CMMS aim to reduce downtime of system and machines maintenance cost. The conclusion of previous research papers from 2009 to 2019 are given below**:**

Fei-Hui H. and Sheue-Ling H. [2009] explained the Computerized Maintenance Management System for a Nuclear Power Plant. The system used a Computerized Procedures interface, integrating procedures etc. From the output we can explain that using computerized procedure interface improved operating performance than using the manual procedure interface. The team or employee performance could be increased by using Computerized Procedures, especially in terms of reducing downtime, reducing operation time, detecting errors, and improved in learning effect.

Ashayeri et al. [2009] reviewed the CMMS for CNC machines. They discussed that the Computer Aided Maintenance Planning (CAMP) was a main challenge because the maintenance operation's environment was usually traditional and unfavorable to change. The Computer Aided Planning system for a maintenance business unit served a number of manufacturing facilities, each consisting of the Corrective Maintenance activities of all CNC machines within the different manufacturing sites which helped in conducting different maintenance activities of manufacturing units in a more synchronized way, finishing well in time and lead to lower costs.

Halawani and Burhanuddinv [2010] identified a cost analysis showing a continuing challenge to maintenance management in all type of organization. Decision Making Grid model is used to implement maintenance strategies. In this paper, a model of failure-based problem was presented. The purpose of the proposed cost model was the flexibility and expandability obtained from using the same expression for several maintenance actions.

Ronald R.S. et al. [2010] stated the maintenance schedule and Root Cause Analysis based on CMMS for a Process Industry. The code has been developed in Microsoft Visual Studio NET. In this paper they collected information like detailed information of equipment, procedures of maintenance tasks, employees, work order and calendar facility etc. The qualitative analysis using Root Cause Analysis (RCA) helped to create a knowledge base to deal with the problem related to process/product unreliability by listing out all possible failure causes.

Kundu J. et al. [2011] designed a CMMS for a thermal power plant. The analysis gave the list of all root causes for the failure of Thermal Power Plant Unit. The software has been developed in Java Server Pages. The developed computer software had a number of modules like equipment's detail, Preventive Maintenance (PM) tasks. PM Tasks Schedule, Work Order, Employees, Overhaul Schedule, Critical Issue etc. They applied RCA with CMMS on unit no. 7 of the plant. It gave the list of all root causes for the failure of Thermal Power Plant Unit.

Gomez and Carnero [2011] developed a CMMS in a hospital. The model consisted of two differentiated stages: the selection of finalist companies and the selection of the most suitable CMMS. The multi-criteria technique ELECTRE II was used in both stages. The fact that the selection of the CMMS eventually purchased, since the restrictions and the standardization to which the organizations dependent on regional public administrations were subject steering the purchasing decision towards an alternative that was not even considered in the analysis of the previous alternatives.

Faud et al [2012] showcased a Computerized Maintenance Management System for medical devices in Royal Medical Services. Firstly, investigation of the existing CMMS in Royal Medical and then a list of its requirements was created. Such a system was conceptually designed and finally an object-oriented model was built based on the conceptual design. The conceptual design was divided into sections such as: System Access, creating of a work order, Work orders in progress, Look-Ups, Scheduler and Reporting.

Kumar et al. [2012] discussed the development of CMMIS for a fertilizer plant. Which was versatile, less complicated, less costly and less time-consuming computer software. CMMIS software aimed to an informational tool for maintenance and also reduced total downtime, overall annual maintenance cost and frequency of failure of the machines.

Ramachandra et al. [2013] implemented a CMMIS according to the requirements of a medium scale industry. The intention was to help the upkeep associate degreed alternative activities of the trade in an organized manner to help management in dominant department like promoting, production, stores and buy which are inter-linked for the better functioning of the organization.

Beni [2014] studied and established a management system for maintaining knowledge in the Iranian Ministry of Petroleum. The main function of the system included units and equipment reliability analysis, failure mode analysis and maintenance

benefit cost analysis. The paper presented the current status and the benefits of implementing the CMMS in Iranian Gas Industry.

J.D Claverley et al. [2014] explained that a proper utilization of CMMS can assure effective management of costly power plant equipment. A good CMMS can lead to increased efficiency, improved quality and better decision-making. They showcased the existing performance of CMMS to provide a way for companies to track equipment and inventory assets, details when and how work orders are to be performed in maintaining this equipment, and accumulate all of the associated costs for labor, material and tools.

Ralph W. Peters [2015] introduced the CMMS Benchmarking System as the most important benchmarking tool and the improvement process that the planner or others can take to gain better use of CMMS and information technology for maintenance. This benchmarking tool is introduced as a method to assist the planner/scheduler assess the effectiveness of their current CMMS, to define functional gaps, and to define how to enhance current use or to help upgrade functional gaps. It is additionally a technique to assist develop and justify a CMMS replacement strategy wherever several existing planners will play a vital role. It includes various evaluation criteria to help gain maximum value from an existing CMMS system.

Rastegari et al. [2016] investigated the need for CMMS decision analysis capability to achieve
world class status in maintenance management. They worked on problem that collect data in the system was not completely utilized. The aim of this paper was to provide and examine different decision-making techniques which could be linked to CMMS.

Daye et al. [2016] surveyed the use of Computerized Maintenance Management System (CMMS) by almost all organizations to manage the process of maintenance. Advances in Information and Communication Technologies (ICT) and in computers have resulted in the evolution of e-maintenance, where several maintenance activities are carried out electronically.
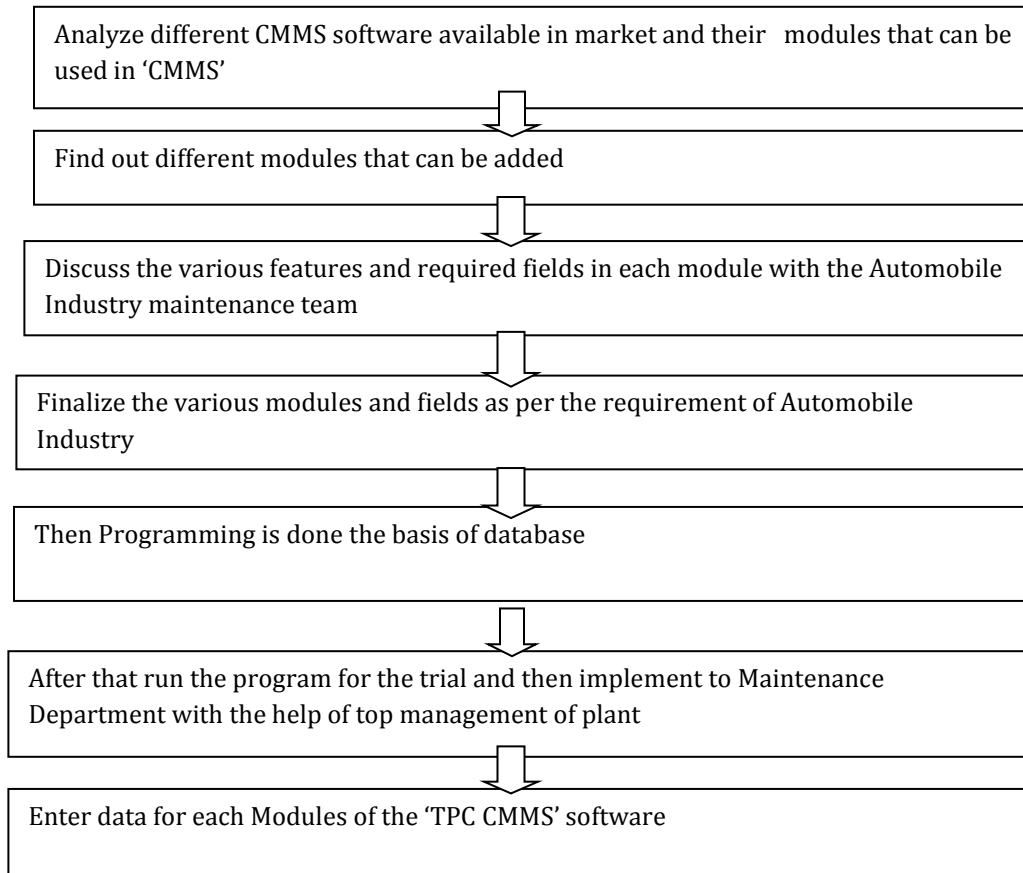
Saeid Saeid Ardekani [2017] applied CMMS in steel industry. They survey of the barriers and problems occurred in implementing CMMS in steel industry. This paper investigates the factors effective on CMMS implementation in Yazd County's Steel Rolling Industries. The results show that, to implement CMMS, Marshall Association's questionnaire, with a Cronbach's alpha equal to 0.8655, was distributed to 66 managers, experts and technicians in Yazd County's steel rolling mills and, next, taking advantage of descriptive and inferential statistics and by the use of SPSS t-test, five hypotheses were analyzed.

Zul-Atfi Ismail [2018] focused on the event of CMMS to enhance the knowledge storage of style and construction, diagnostic and defect risk assessments on IBS building through the mixing of Building Information Modeling (BIM).

Katrine Mahlamaki [2019] identified details of Technological, Organizational and People (TOP) factors affecting maintenance technicians use of CMMS in manual collection of asset data. The aim of this paper was to identify the factors that characterize sites that produce high quality data. This study has identified how the manual collection of asset data is affected by TOP factors: the technology used for data collection, the organization where data collection takes place and the people collecting the data.

3. METHODOLOGY

The flowchart given in Fig.1 shows the various steps involved in the development of CMMS for an Automobile Industry.

Analyze different CMMS software available in market and their modules that can be used in 'CMMS'

Find out different modules that can be added

Discuss the various features and required fields in each module with the Automobile Industry maintenance team

Finalize the various modules and fields as per the requirement of Automobile Industry

Then Programming is done the basis of database

After that run the program for the trial and then implement to Maintenance Department with the help of top management of plant

Enter data for each Modules of the 'TPC CMMS' software

Fig. 1 Flowchart for Developing a CMMS

4. FRAMEWORK OF COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM FOR AN AUTOMOBILE INDUSTRY

The CMMS facilitates the maintenance personnel by providing a Graphical User Interface consisting of various modules with different features by which feeding and retrieval of maintenance data and information fast and accurate.

4.1 LOGIN PAGE
This feature provides a provision of a user Id along with a unique password. The use of this module ensures a level of security by authentication of the maintenance personnel in authority for handling it.

4.2 HOME PAGE
It is a main page in which operator open the different modules by simply clicking on button and this provides a screen with various modules available in the application software.

4.3 EQUIPMENT DETAILS
This module provides details of equipment and information about the equipment of the maintenance department. Just by selecting the respective equipment Id the information about the respective equipment can be traced.

4.4 RESOURCES

The CMMS might embody a separate module to trace resources. Some CMMS will allow maintenance managers to also track skill levels and qualification for each resource to help in planning and scheduling work.

4.5 STAFF DETAILS

In this module all information like name, id, date of birth, address, date of joining, designation, shift, experience and contact etc. are consist. It maintains names of the staff and employees which are working in industry.

4.6 TOOLS

This module is required to store information regarding the tools that are required in various maintenance activities. The features are the tool name along with its actual location in the plant, the description of the tool along with the quantity available in the inventory.

4.7 SPARE PARTS DETAILS

This module gives the information regarding the spare parts stored and used in various maintenance activities. The various fields of this module are like Part name, part id, warranty, available stock etc.

4.8 TASK ALLOTMENT

The information about various maintenance tasks connected with different machines. This module stores information of all those maintenance tasks performed in Automobile Industry.

4.9 DAILY STATUS

This module provides the details regarding the daily status of an equipment. It is very helpful for industry to reduce damage cost.

4.10 WORK ORDER

This module stores all the information related to the work order and their current status. The details of the work order in the maintenance department are entered in this module.

4.11 QUICK REPORTING

The CMMS could provide an easy means for opening, reporting on, and closing work orders, and reporting work on small jobs after-the-fact. Downtime, failure, equipment life, materials etc. could all be reported.

4.12 UTILITIES

The CMMS could provide a rapid and easy means for opening, reporting on, and closing work order, and reporting work on small jobs after-the-fact. Labor, materials, failure codes, completion date, and period might all be reportable.

5. CONCLUDING REMARKS

This paper explains a general framework of Computerized Maintenance Management System (CMMS) for an Automobile Industry. CMMS gives many advantages like reduction in total down time, overall maintenance cost and frequency of failures of systems. It affects the work-force management and employee responsibilities in easing the retrieval of required maintenance data and information saving time resulting in reduction of mental fatigue of the maintenance personnel and fast accessibility to the required maintenance location. An effective practice of CMMS provides a proper maintenance management with increased industry efficiency. The use of different modules for specific maintenance field category gives the maintenance personnel a Graphical User Interface (GUI), making him more capable to ensure proper recording of data and information.

The CMMS also assists the maintenance work by ensuring proper technical data collection, reduced maintenance cost, streamlining of work order schedule and fast access of information. CMMS can also be useful to other process industries such as Fertilizer, Cement, Chemical, and Dairy processing industry, manufacturing industries. A good CMMS can be improved quality, better decision making and increased efficiency. This software will provide various information may be obtained regarding various modules such as Equipment Details, Task Maintenance List, Task Procedure List, Work Order List, Employee Details, Schedule of Maintenance Details, Overhaul Detail, Critical Issue etc.

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