Development of Computerized Maintenance Management Information System for Rico Industries, Gurgaon

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The expansion of industries both in terms of volume and variety creates the need to understand the importance of maintenance besides production. It is always difficult to manage a large and cumbersome amount of maintenance and technical data in any industry. To deal with it, a computer-aided tool is required to make the system reliable, precise and fast. The paper deals with the development of Computerized Maintenance Management Information System (CMMIS) for Rico Industries, Gurgaon. The system is designed and developed by C# (C Sharp) as front end and SQL Server as back end. The system includes modules and their reports such as equipment details, tools and spares, preventive maintenance schedules, maintenance staff and safety records, condition monitoring techniques and calibration, Root Cause Analysis (RCA) and feedback.

Keywords: Computerized Maintenance Management Information System (CMMIS), Condition Monitoring Techniques, Root Cause Analysis (RCA)

Introduction

Maintenance is a low priority when it comes to attention from data processing. Work on maintenance systems is not usually viewed as mission criteria. Maintenance refers to keeping equipment fit for use. The maintenance function in an organization is confronted with the challenging task of affecting significant reductions in cycle time, setup time, cost, facilitating quality improvements, capacity expansions and affecting improvements in organizational working environment. Thus, an effective maintenance program can make significant contributions towards enhancing production efficiency, plant availability, reliability and organizational profitability. In every organization,

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two factors are primarily responsible for its survival and growth, i.e., cost and quality. Manufacturing industries have no option other than maximizing the plant productivity, reliability of plant equipment and the full capacity utilization of plant. The primary saving has to be gained in manpower by implementing a computerized system, to ensure that the detailed clerical tasks necessary for maintenance department are greatly simplified. The purpose of developing the Computerized Maintenance Management Information System (CMMIS) lies in the best utilization of the available resources at the least cost. Record keeping, updating and modifying details are made easier. The computer is a tool that maintenance managers think will allow them to predict, affect, analyze and control the maintenance tasks easily. Computerization is done to avoid costs, improve quality, control costs, ensure uptime, improve service, etc. A CMMIS provides historic information for various types of work—availability of materials, costs by job, facility or type of work, etc. It can increase the effectiveness of planning, scheduling and cost tracking. The effectiveness of a CMMIS depends on how well the software accomplishes this integration, the acceptance of the user community and the quality of the maintenance data loaded into the CMMIS. Maintenance engineers, planners, analysts and managers have to adopt all the new changes, challenges and culture in technology. Successful implementation of CMMIS, selection of right vendor and right package are the challenges faced by maintenance systems, no matter how much they are computerized. CMMIS techniques have become more necessary than ever to ensure productivity, quality, timely delivery, availability, low cost and safety, particularly in lean manufacturing.

2. Literature Review

Gupta and Tewari (2007) dealt with the characteristics of CMMS to highlight the need for them in industry and identify their current deficiencies. CMMS had been designed, developed, customized and implemented for a sugar industry. The developed CMMS reduced total downtime, overall annual maintenance cost and frequency failures of the machines, and produced day-to-day maintenance schedule and predicted maintenance budget and maintenance policy. Tumiran (2008) investigated the CMMS in Yogyakarta Electric Power Distribution Company to support strategic maintenance. The CMMS was developed by digitalizing the distribution line networks, customer connection, inventory of the assets and manpower. He concluded that CMMS has the capability to provide all information about particular equipment as a monitoring parameter and the possibility of altering the equipment's component/spare parts, but implementing the CMMS still needs effort and a change in the mindset of management and personnel.

Huanga and Hwang (2009) examined the computerized teamwork system for the nuclear power plant. The system used a computerized procedures interface, integrating procedures, etc. The output shows that using computerized procedure interface resulted in a higher operating performance than using the paper procedure interface.

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And also, the team performance of two or three-person teams could be significantly increased by using computerized procedures, especially in terms of reducing operation time, detecting occasional system errors in the interface and improved learning effect. Ronald *et al*. (2010) developed the maintenance schedule and Root Cause Analysis (RCA) based on the CMMS for a process industry. It consists of a number of modules like detailed information of equipment, procedures of maintenance tasks, employees, work order, calendar facility, etc. The software was developed in Microsoft Visual Studio .NET. The qualitative analysis using 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 *et al*. (2011) designed a CMMS for a thermal power plant. They analyzed all the causes for the failure of thermal power plant unit and developed computer software which had a number of modules like equipment details, Preventive Maintenance (PM) tasks, PM task schedule, employees, overhaul schedule, critical issue, etc. CMMS software was developed in Java Server Page which increased the plant effectiveness and reduced the downtime in the plant. Ramachandra *et al*. (2012) dealt with a CMMIS for a process industry. They investigated whether the information system was designated to assist management in monitoring and controlling maintenance activities, and found that CMMIS results in proper recording of data/information, generation of reports, which help in day-to-day decision making and in long-term planning, reduction in down time, reduction in maintenance cost, increased productivity, reduced inventory costs, etc.

Kumar and Tewari (2013) dealt with a framework of CMMIS for JCB India Limited, Ballabgarh Plant. They developed computer software which includes modules like equipment detail, work order, monitoring, financial, hot-spot, safety record, calendar, maintenance staff detail, etc. At present, the developed JCB CMMIS aims at lowering the total downtime, overall annual maintenance cost, and frequency of failure of machines, to improve maintenance policy, raise the quality and spare part control, and prolong the machines' life, leading to minimum inventory. Lee (2013) developed a CMMS based on integration of Reliability Centered Maintenance (RCM) and automated data gathering using Multi-Agent Technology. The objective of the proposed system was to support decision making of maintenance managers by providing up-to-date reliability assessment of facilities in automated manner. A web-based application was also developed, which analyzed the failure patterns in order to provide reliability risk assessment such as expected remaining life of facilities, expected failure rates and risk of parts to fail.

Bankosz and Kerins (2014) developed prototype "mobile technology-enhanced asset maintenance in an SME", to demonstrate the potential benefits of deploying mobile technology to enhance asset maintenance processes in a small food manufacturing plant. The development of system supporting user interaction via mobile phone

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demonstrates the potential benefits of more flexible data capture and improved information management, which offer clear advantages over the limitations imposed by a stand-alone terminal. Issues concerning data security and questions surrounding a suitable deployment platform would need to be addressed in deploying this technology.

3. Methodology

The flowchart showing the various steps for the development of Rico Industries CMMIS is shown in Figure 1.

Figure 1: Steps for Developing Rico Industries CMMIS

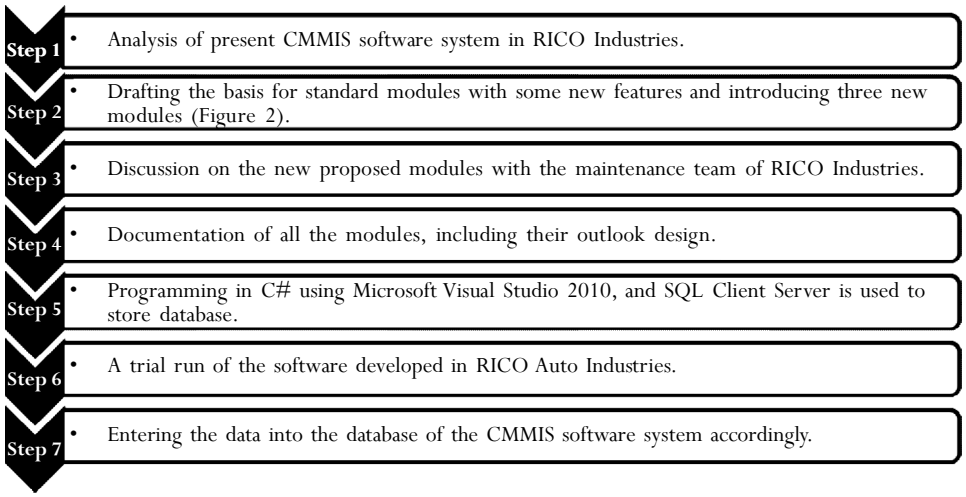
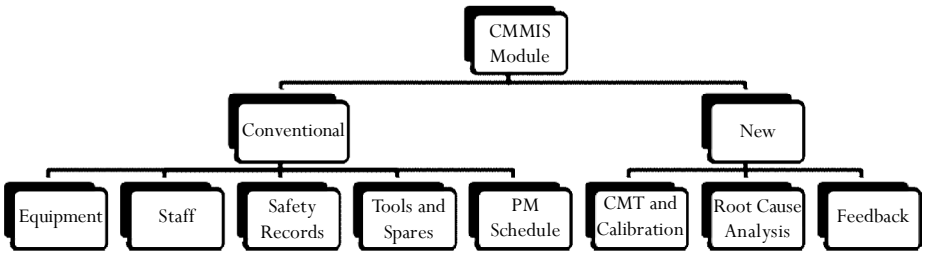


Figure 2: Modules of Rico CMMIS



4. Features in Developed Rico Industries CMMIS

Login Page: Login id and password are provided to the user for the data security of the plant. This is the first screen which is seen on the execution of the program. The screen for this page is shown in Figure 3.

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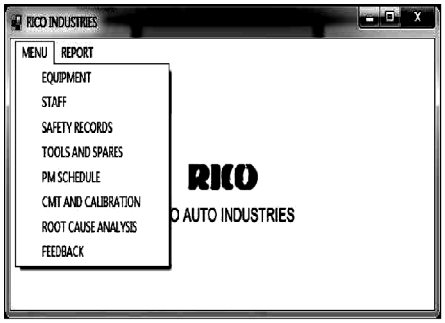
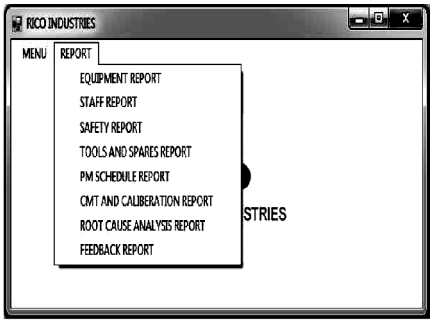
Home Page: Home page shows different menu options and reports available in the software, as shown in Figure 4. This screen gives the direction of proceeding to the user, i.e., which module or report to be entered in (Figure 4a). All the menu options or modules are discussed as follows:

Figure 3: Login Page

Figure 4: Home Page

Figure 4a: Menu and Report Options in Home Page





Module 1: Equipment

This module stores information of all the equipment, i.e., machineries, etc. used in the RICO Industries. The details provided by this module are shown in Figure 5.

Module 2: Staff

In the staff module, information related to different maintenance staff in the plant is saved. The details provided by this module are shown in Figure 6.

Module 3: Safety Records

Safety record module is used to keep record of safety, injuries and losses concerned with maintenance department of RICO Industries. The details of various fields provided in this module are shown in Figure 7.

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Figure 5: Equipment

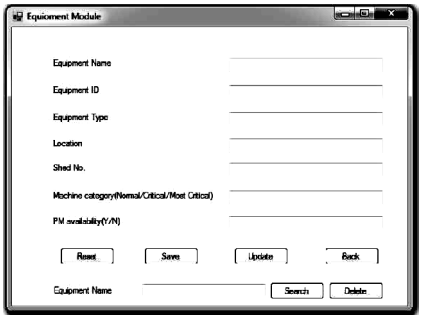
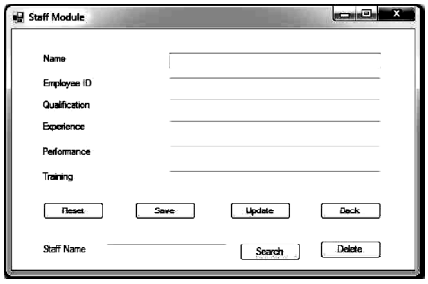


Figure 6: Staff



Module 4: Tools and Spares

Many different types of tools and spares are used in the plant for maintenance activities. This module intakes and stores information regarding these tools and spares. The details provided by this module are shown in Figure 8.

Figure 7: Safety Records

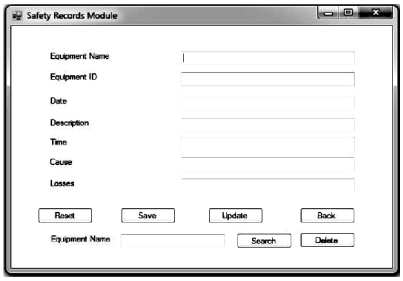
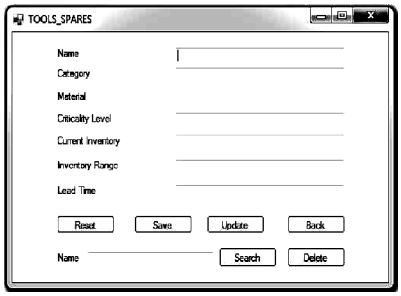


Figure 8: Tools and Spares



Module 5: PM Schedule

In PM schedule module, information for PM schedule for facilities (equipment, etc.) used in the plant is stored. The details provided by this module are shown in Figure 9.

Module 6: CMT and Calibration

It stores information for all the condition monitoring techniques used and about the calibration instruments involved. The details provided by this module are shown in Figure 10.

Module 7: Root Cause Analysis (RCA)

RCA module stores information about the previous failure modes and their root cause with their time of occurrence and present status. The particulars of this module are shown in Figure 11.

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Figure 9: PM Schedule

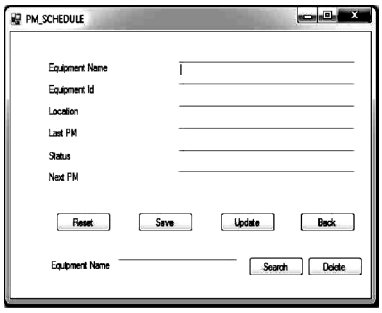
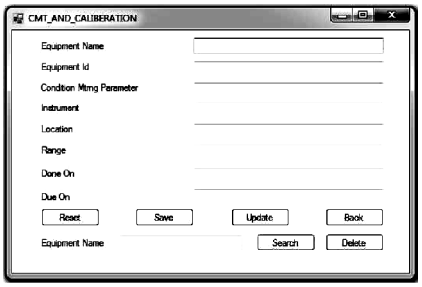


Figure 10: CMT and Calibration



Module 8: Feedback

This module gives the feedback regarding maintenance staff, their previous jobs and present status. The particulars provided by this module are shown in Figure 12.

Figure 11: Root Cause Analysis

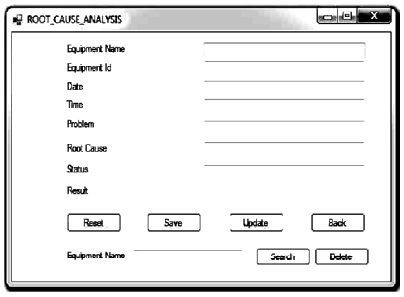
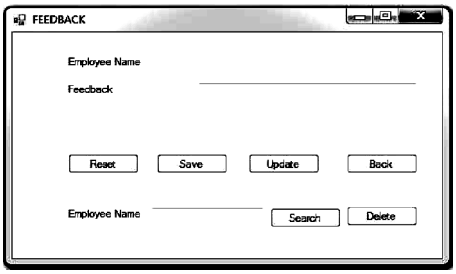


Figure 12: Feedback



Reports

Reports section generally works as history sheets. This section provides the records that were entered in the past. A sample report card is shown in Figure 13.

5. Merits of CMMIS

The merits that can be achieved after the implementation of the software are as follows:

- Efficient data integrity;
- Smooth and speedy information flow;
- Improved maintenance-related updates;
- Minimum repair and service costs;
- Minimum purchase of spare parts;
- Minimum physical hard work in activities;

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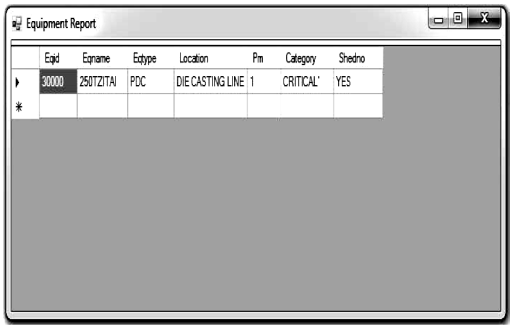
Figure 13: Equipment Report



- Maximum safety and minimum risk;
- Facilitating desired information display quickly; and
- Optimum use of space and practice of modern technologies.

Conclusion

The paper focuses on the fundamentals of maintenance procedures and the practices of Indian auto industries, because of their growing solicitude over equipment, machines or system utilization. CMMS is an advanced methodology utilized by maintenance management to be vigilant about maintenance efficiency and effectiveness. It is therefore imperative for RICO Industries to device this advanced system. CMMIS is an impressive and powerful tool for futuristic maintenance planning and control which is speedy, simple, effective, and also rationalizes the whole monitoring of information and data about the equipment and maintenance of the whole system. The latest modules added to the software are condition monitoring techniques and calibration, root cause analysis and feedback, apart from the traditional modules, i.e., equipment, staff, safety, PM schedule, tools and spares. CMMIS assists the maintenance work by ensuring proper technical and maintenance data collection, reduced maintenance and inventory costs, less paperwork and swift access to information. This software is very precisely designed in compliance with the modern manufacturing system which generally handles bulk of technical and maintenance data.

In future, this software may be used as an integral part of the machine or equipment being maintained, i.e., information might be shown on their digital displays and can also be utilized as mobile application, so that the maintenance work on the equipment or machine can be directly completed without any delay which can cause severe losses.

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