

Implementation of Computerized Maintenance Management System in National Iranian Gas Company and sub-companies

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Abstract

Nowadays, in the large-scale industries such as oil and gas industry, maintenance activities and planning are at the heart of industrial occupations. Operation and its maintenance require controls and strategies to reduce costs and yield loss. Optimal maintenance planning aims to increase the operation reliability and minimize downtime, meanwhile effective computerized systems can secure the desired results at the lowest possible costs. In this process the new methods for developing maintenance strategies are used and managed by the Computerized Maintenance Management System (CMMS). The developing system provides an executive summary of information and keeps them updated based on on-line status of their maintenance efforts. The objective of this study was to establish a management system for maintaining knowledge in the Iranian ministry of petroleum. The main functions of the system include units and equipments reliability analysis, failure mode analysis and maintenance benefit cost analysis. Taking into account that for the oil and gas industry, the safety, and environment effects caused by equipment malfunction is more essential than the other industries. If the executive team be able to manage critical points effectively and make decisions properly according to a Key Performance Indicators (KPI), the global risks of safety and environment, which are result from equipment malfunction, defiantly decrease. This paper presents the current status and the benefits of implementing the CMMS in Iranian gas industry. The major components of this plan are identified and a pilot system is implemented in some sector of Iranian Ministry of Petroleum (MOP). The case study is shown the current status of this program and the effectiveness of the CMMS solution in optimizing maintenance over the traditional approaches in National Iranian Gas Company and related sub-companies.

Keywords

Reliability Centered Maintenance (RCM), Computerized Maintenance Management System (CMMS), Maintenance management, Reliability, Key Performance Index (KPI)

1. Introduction

Nowadays using correct strategies of maintenance management systems into the infrastructures are beneficial not only for reducing maintenance cost but also for increasing productivity of limited resources. These strategies follow win-win policy for both governmental and non-governmental firms.

At the beginning of 1960s, the Reliability Centered Maintenance (RCM) developed by the North American Civil Aviation Industry. RCM was planned to determine the most optimized maintenance essential of any physical capital for continues operation. Typically the oil and gas industries have adopted RCM system to solve many maintenance problems.

RCM can be considered as an effective tool that incorporates sound guidance for executive managers to attain high standards of maintenance. This includes identifying critical equipments and developing optimal maintenance policy based on reliability data. RCM can be used to formulate maintenance strategies for discrete manufacturing and to perform the failure analysis function, which includes environmental aspects and human factors.

But in some cases, this system did not work properly for some reasons:

- a) RCM process is a time, effort consuming process and needs high amount of resources, especially in complex plants such as gas plants or gas compression stations.
- b) Lack of required data for decision making about the optimal cost of maintenance and strategy and operation sector is isolated from design and maintenance engineering systems;

- c) Some critical non-engineering elements involved in the maintenance issues (such as management and human factors.)

For solving above maintenance issues an integrated RCM-CMMS system is proposed in MOP which is dynamically change the maintenance strategies based on the operating conditions and other factors affecting the life cycle (aging factor) of the using assets. In 2010 a program is launched in Iranian Ministry of Petroleum (MOP) aimed to optimize the maintenance activities in oil and gas industry for minimizing equipment downtimes and maximizing the reliability of operational processes and equipment.

This paper purpose to study this program for implementing Iranian Petroleum Computerized Maintenance Management System (IPCMMMS) in Iranian petroleum ministry and all sub-companies maintenance activities. First of all a managing working group is formed in this ministry for this purpose; including CEOs related to the maintenance activities of oil and gas industry. The work scope of this committee is policy making for maintenance activities over all MOP all sub-companies regarding optimal usage of limited resources, minimizing maintenance costs, increasing safety and environmental concerns.

1.1. Objectives and Goals:

Regarding above definitions, the objectives of this system is defined as below statements:

- Strategic policy making for development of maintenance management in vision of 2020 of I.R of IRAN
- Applying maintenance International Standards in domestic maintenance activities
- Standardization of automation in maintenance management system in oil and gas industry
- Preparing infrastructure mechanisms for data gathering and implementation
- Maintenance management training
- Preparing the audit mechanisms, evaluation and benchmarking maintenance management based on standards
- Supervision over the implementation of integrated maintenance management

1.2. Duties and Authorities:

Based on above objectives the duties, responsibilities and authorities are as below:

- Preparation and presenting of executive summary reports including progress report, committees turnover and maintenance activities changing program for top management
- Integration, Corporation and networking with the other related sectors (governmental and private sectors) in related sectors
- Budget forecasting and obtaining financial resources and assignment for reaching the predefined goals and objectives
- Strategic policy making for maintenance activities
- Defining strategies for systematic approach, requirements, infrastructures of CMMS in every sectors of MOP
- Defining periodic and non-periodic auditing mechanisms and reporting
- Supervision of maintenance data gathering and implementation and executive action plan of system usage
- Granting of incentive mechanisms to encourage individuals and sectored premium maintenance companies

2. Maintenance strategies

It is vital to recognize the different maintenance strategies that can be used to maintenance activities, which will be configured within maintenance management system (in this case: CMMS) as well as in RCM system. Each maintenance strategy could be implemented into the several production facilities throughout its lifecycle. Each maintenance strategy can be used for operating condition associated with each plant facilities. The association between RCM and CMMS may cause dynamically defining the proper maintenance strategy along with the needed factors for each maintenance activity.

Figure 1 illustrates the various maintenance strategies, which is parted into two major types: proactive and default actions. Proactive maintenance is related to do the proper maintenance before failure occurrence; meanwhile default action involves in all other maintenance tasks. The maintenance strategy diagram is the core of the RCM decision making.

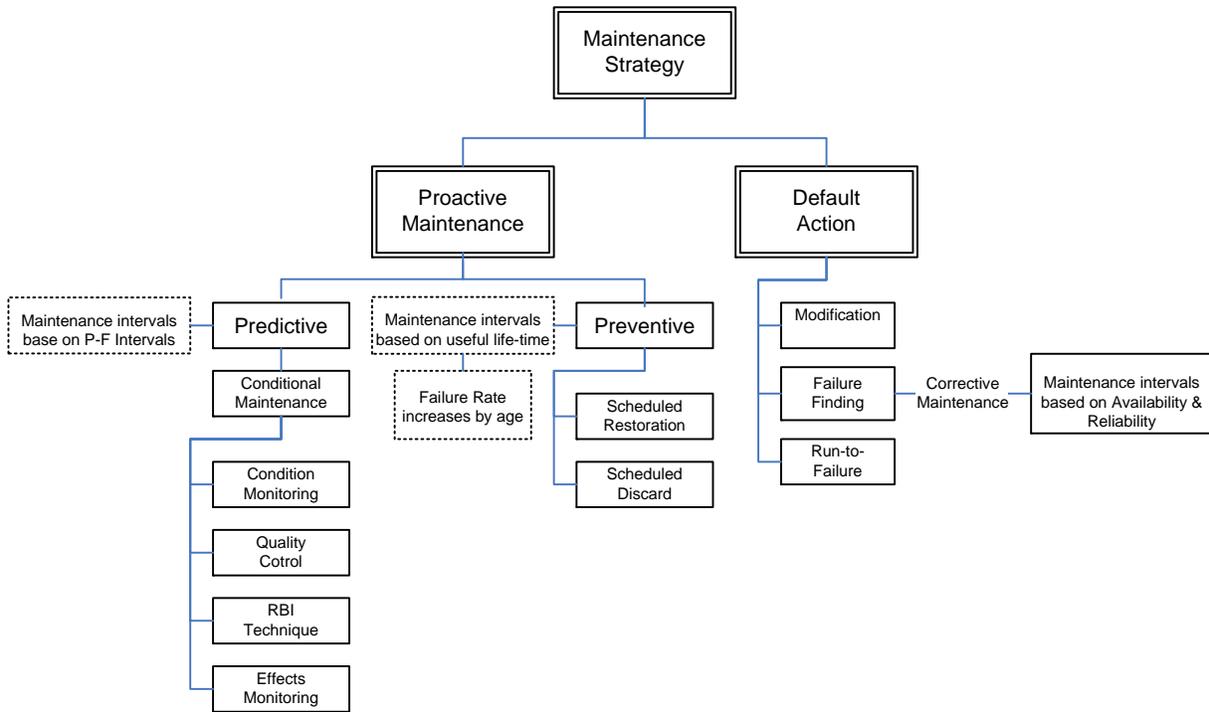


Figure 1. Maintenance Strategies

3. CMMS Design Criteria

The system must be designed for balancing the maintenance activities based on two below approaches:

- The most conservative view which is designing robust system, progressive preventive maintenance, and rapid response to warnings.
- On the other hand, operation strategies are driven by maximizing production annually, single-string system designs, and minimizing inspection and maintenance activities to obtain minimum downtime.

The difference occurs in the immediate costs and the results including system failure risk level (Baron & Cornell, 1999). In this paper we propose a CMMS for Iranian Petroleum industry (IPCMMS) methodology (See Figure 2) for using the synergy provided by the simultaneous adoption in oil and gas industry of reliability management methods, enables vital changes to be made with a view to the production that results increasing in reliability level by the lowest cost.

3.1. Development Methodology

The developing CMMS procedures and the application are implemented in four specific stages in the maintenance activities of different maintenance sectors of MOP were carried out by a panel of experts. A panel of experts was formed in for holding integrated meetings where the operation CEOs could share their knowledge and information about the processes. The panel was made up academic stuffs, whose research studies are mainly focused on maintenance integrated management systems, technical and managerial operation experts and maintenance planners and technical inspectors involved in the maintenance processes.

The re-engineering of maintenance activities are planned based on the Delphi technique. The technical committee work period was around 4 weeks, and the meetings were planned on three-round Delphi techniques.

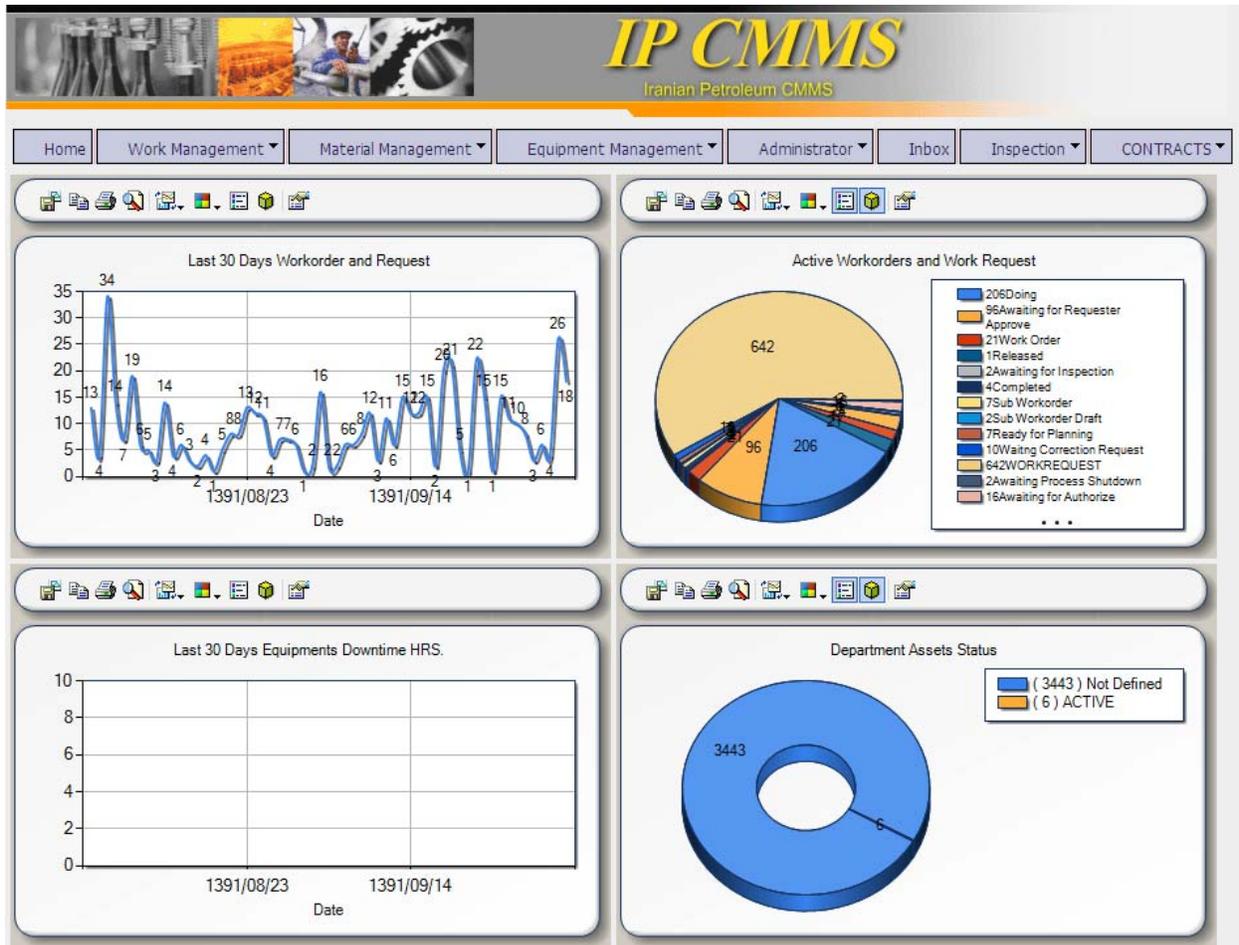


Figure 2. A view of Iranian Petroleum CMMS Software

3.2. Work orders management

This work proposes aims to define an adequate strategy for the management of ‘work orders’ which design by the Maintenance Engineering sector. The term ‘work orders’ refers to all of activities such as inspection and replacing the useless equipment, plant servicing, indenting and purchase orders for new components, failure mode analysis, etc. The responsibilities for correct functioning of the procedure including operation components and Maintenance Engineering (ME) are done by technical inspection department.

The conceptual procedure is based on the identification the cause and effects and corrective action, the undesired events analysis leads to introduction of a continuous improvement (Deming Cycle). Based on such this analysis the maintenance department could develop typical predictive and preventive maintenance plans and optimize the procedures and maintenance techniques to be adopted.

The work order management system for starts with a comparison of all work orders inserted in the CMMS collects also the design and feature of all items (equipment, units, etc.) to manage (Figure 3).

For decision making about the priorities for thorough investigation the work orders must go through a comparison process which is divided into several steps:

- The provided CMMS work orders must be selected by comparing them with the list of all the available items in the company warehouse.
- After selecting well-identified items, the 2nd selecting step implemented for only those tasks which pass at least one of the below conditions:
 - A. Critical items relation
 - B. High maintenance costs
 - C. Cause and effect of operation downtime

D. Emergency or urgent situation problems

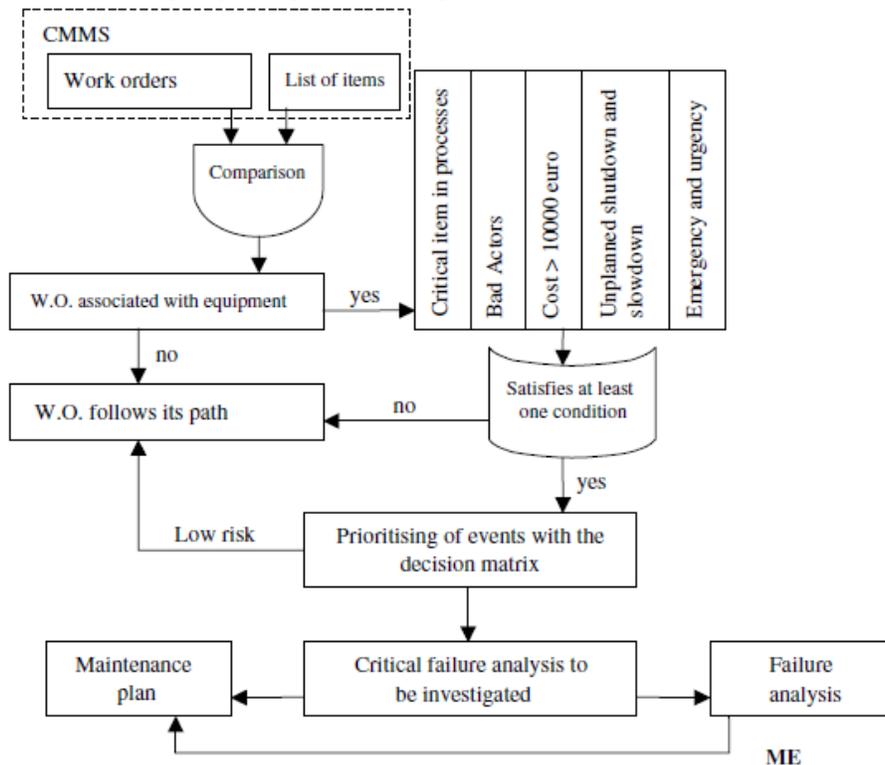


Figure 3. Work orders management Flowchart

3.3. Computer-aided RCM (CMMS) solution

The nature of the proposed solution is to have the RCM engine as associated by adopted CMMS within plant engineering circumstances. Both systems must be launched from the beginning of the unit/equipments lifecycle. The implementation concerns of how to make linkage the different sectors involved in the plant lifecycle has been discussed by executive committee. The presented solution is formulated based on the current activities and maintenance strategies of purposed companies.

3.4. Case Study: CMMS implementation in N.I.G.C. and sub-companies

- A. Regarding about definition and suggested system, first of all the executive committee has been formed in National Iranian Gas Company (NIGC) head office by the oil minister conferment and has full authority to implement this system in all NIGC; The road-map is defined to reach the goals in limited period of time.
- B. The technical committees are defined and formed in each sectors for following up the defined procedures and the contract is signed by the 3rd party CMMS contractor.
- C. The kicks of meetings are held in each sub-company by scheduled program and the maintenance processes/ strategies/data are introduced to CMMS contractor.
- D. The maintenance scenarios are introduce to the contractor
- E. Based on the defined scenarios and available data the system is programmed in C++ and installed on the purposed companies
- F. The data entry of CMMS is started and going on.
- G. The data-base is formed and will be completed in near future at the 1st phase (Class 1).
- H. The maintenance strategy for each maintenance process will be assigned in near future.
- I. At the 2nd phase (Class 2) the material / equipment management will be implemented and above procedure will be restarted for these modules
- J. At the 3rd phase (Class 3) the inspection module will be implemented which is included Risk-Based Inspection (RBI) which is a power tool of decreasing the rate of maintenance activities/processes.

- K. In each phase the feed-backs, issues and missing items are reported to CMMS contractor for developing project

Conclusion and Discussion

The CMMS is used to optimize maintenance for complex plants. The developed process and functional models are useful to analyzing other plants with small modifications saving time. The design modifications proposed to the adopted CMMS can be realized within IPCMMS in oil and gas industry of Iran. While CMMS engine can be developed as a shell integrated with the different modules of other maintenance-oriented activities (i.e. inspection). The association with the plant design and operational systems is vital to share and utilize detail design and operational information. The introduced solution can be further genetic algorithm modules to optimize the various parameters of the maintenance jobs. The regular transition from traditional maintenance strategy toward computer-oriented model is the critical step toward the strategic goals in 2020 vision of I.R. of Iran and sustainable operation growth. In order to effective usage of limited plant resources, such these projects must be launched and create the effective linkage between operation data and maintenance activities. Human Resource training for oil and gas industry in field of maintenance is a KPI of such these projects

For further study it is suggested to do the survey about effectiveness of this model on plant life-cycle. Every time defined the critical strategy of an item or event, reliability unit has to decide the best maintenance activity and work orders to carry out. The final target of this program is identifying the essential events, items and work orders in terms of HSE, unit availability, reliability, QC and maintenance costs, processing in a systematic way, with failure analysis and with the performance of related corrective action. The decision-making assessment matrix of CMMS must suggest a tool which quantifies the risk and can justify selecting items in terms of “action/event risk – associated risks – possible improvements – resources used – result”. As a result, IPCMMS must not be perceived as a static system to be implemented only once. And similar to the other management systems it should be a dynamic process, which must be continuously improved.

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Biography

Saied Salimi Beni is the Mechanical Supervisor of Inspection and Technical Control In National Iranian Gas Company, Tehran- I.R. of IRAN. He earned his B.Sc. Mechanical Engineer from AIT (Ahvaz Petroleum Institute). **Schlumberger Vice President Awards**, Due to Increase of MTBF's down hole tools & Equipment. **Inventions:** Make four inventions, 1) Safety Apparatus for Meat Grinder 2) Semi Automatic Map Ringer 3) Lifting Handy Aid 4) Eyes Protection Device.