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CHALLENGES OF MAINTENANCE MANAGEMENT SYSTEMS
DESAFIOS DOS SISTEMAS DE GERENCIAMENTO DE MANUTENÇÃO

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Abstract

Corporate focus ever more on profitability placing more emphasis on the revenue producing equipments. Correctly maintained and serviced equipment, well managed spare parts stocks as well as plant management decisions based on integrated information, are today's demands. The integration, not just the interconnection of information and knowledge from the process level, up to the enterprise management level, is tomorrow's challenge. The positioning of the computerized maintenance management system CMMS today and in the future and the method of selecting and assessing the optimal solution is described.

Keywords: *Maintenance Management System*

Resumo

As empresas hoje focam cada vez mais na rentabilidade, priorizando equipamentos que gerem lucros. Equipamentos bem mantidos, estoques de peças de reposição bem geridas, assim como tomadas de decisões na gestão da planta industrial baseadas em informações integradas são as demandas de hoje. A integração, não apenas a interligação de informações, e conhecimentos a partir do nível do processo até o nível de gestão empresarial, é o desafio de amanhã. O posicionamento dos CMMS – Sistema Informatizado de Gestão de Manutenção – hoje e no futuro, assim como o método de selecionar e avaliar a melhor solução é descrito neste artigo.

Palavras-chave: Sistema de Gerenciamento de Manutenção

1 INTRODUCTION

Today's competitive world with the main focus of most corporations on increase of profitability, lowering Total Cost of Ownership demands ever increasingly for appropriate asset, and computerized maintenance management system (CMMS) solutions. Globally, the focus is on corporate profitability. This focus is placing more emphasis on the revenue producing equipment. Well managed spare parts inventories, based on a history of usage, has proven to be a major factor in increasing profit margins, and correctly maintained and serviced equipment, especially planned shutdowns, keep plants operating at maximum efficiency. These aspects are magnified in the oil and gas and petrochemical industries where an unexpected shutdown can cost millions of dollars an hour (Tavares, 2005). On oil and gas and petrochemical industries, environmental and safety issues have and continue to have a significant impact. They include water and air quality and solid waste regulations. Government regulations, pose a challenge to industrial manufacturers to meet the stricter standards. Operational Safety & Health (OSH) regulations regarding process hazard analysis are yet another concern to process and power generation plants. They are causing manufacturers to establish and maintain equipment maintenance and repair histories. Many waste products, not considered hazardous today, could be classified as such in the near future. As regulations become more stringent, tighter controls will be required to ensure compliance. Computerized maintenance management systems are required to maximize the availability of this equipment at given rules (Lafraia, 2011).

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2 OBJECTIVE

The objective of this paper is to describe the positioning of the computerized maintenance management system CMMS today and in the future and the method of selecting and assessing the optimal solution.

3 THE SYSTEM PROPERTIES

The system properties can be defined following the grouping:

- functionality
- performance
- dependability
- operability
- safety
- non-task related properties

The properties can be extracted from the systems descriptions or System Specification Documents which are available. They describe the solution of how the tasks are being performed (see Figure 1). But to stay objective we have to focus on main properties. It is obvious that under these properties the functionality, operability, and performance may have more importance than the others. This has to be agreed upon before the assessment will be further continued and detailed. By assignment of the relative importance of properties to the tasks we can easily reduce the list.

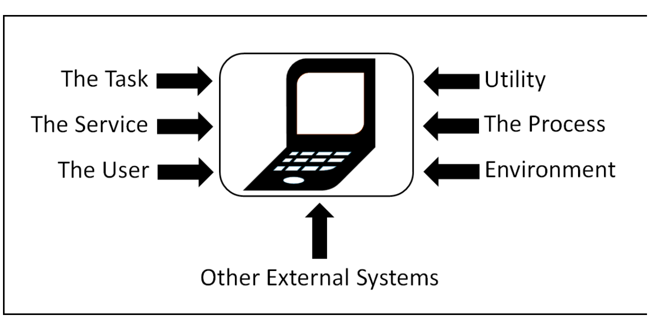

Figure 1. System performance

Source: The author (2014)

4 REQUIREMENTS IMPOSED TO THE CMMS

It is not necessary another piece of software but an essential function for our plant and a performance of a mission which has direct impact on the profit of the enterprise. Faced with the next millennium: Where do we come from and what is the situation? From the common "reactive maintenance" which in the 1970's was mostly unplanned we saw the swing to "preventive maintenance" which could turn out to be fully planned and thus be very costly. Preventive maintenance is often unnecessary. Components are replaced on schedule despite excellent condition with substantial lifetime remaining. In petrochemical plants where a break of a component can cause severe damage to plant or environment or injury to personnel this can only be justified for safety reasons. In addition by replacing components with new ones preventive maintenance can increase the exposure to infancy failures again (Pinto *et* Xavier, 1998).

The next step and compromise between the two extremes turned out to be the "predictive or condition based" maintenance where anomalies or defects in components are identified and traced to plan and thus initiate replacement well before the defect impacts production or safety. But even the predictive maintenance has its specific disadvantages especially in the justification of cost for sometimes expensive condition monitoring equipment against other methods and balance pay-off against possible consequences (Moubray, 1997).

In view of additional cost reduction programs in many companies resulting in loss of experience of older workers the need for a fundamental reconstruction of maintenance role and structure in the enterprise or plant is obvious. The ability to meet increased mission requirements at full capacity, efficiency, safety and quality is the challenging objective for the next time. We have to place maintenance into the integral equipment lifetime management (Tavares, 2005). According to Weir (2001), this situation calls for a proper and exhaustive definition and selection of the CMMS in an Enterprise wide Asset and Resource Management.

The 6 main functions of a CMMS, as show in figure 2, are: asset management, purchasing, cost controlling, analysis & reporting, operations data and stock controlling.

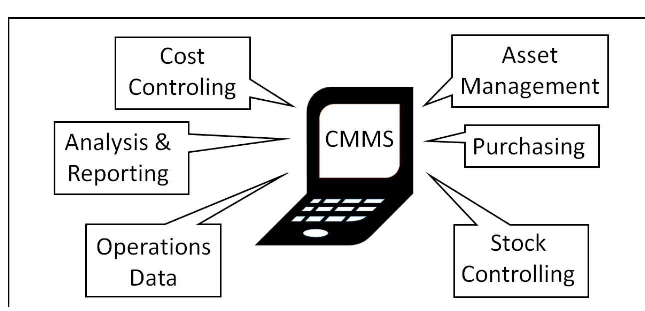

Figure 2. CMMS functions

Source: The author (2014).

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The objectives and consequences, the efforts and cost/time implications of the implementation of a CMMS demand a clear and structured methodology for the evaluation, assessment and selection. The fundamental question in the selection and application of a CMMS is the definition of the demand in system properties. Having decided to implement a CMMS the user runs through a line of actions to result in the proper selection and decision (Wireman, 1998).

According to Albertão (2001), the whole process will be started by forming a project team. This shall bring together maintenance and operations engineers as well as experts in information technology and from procurement and commercial departments. The work will result in the System Requirements Document:

- Work process and flows must be analyzed and described. This will lead to adjustment or reengineering in many cases;
- The groups of users which will be far beyond the maintenance staff itself must be defined;
- The functional and operational and structural requirements the potential user will impose must be known;
- The potential for better plant or cost performance has to be assessed;
- The need for interfaces to and integration into other management functions must be made clear;
- The economic performance of the solution has to be evaluated;
- The requirements for implementation and operation assistance must be made clear;
- Future development and requirements shall be defined as far as possible;
- The evaluation and assessment of systems will be performed;
- The decision for a certain product will be made;
- The implementation can start.

This is the general procedure in brief (see Figure 3).

- ❑ Setup project team
- ❑ Design requirements document
  - ✓ Maintenance process flow
  - ✓ Plant structure
  - ✓ Reporting and history
  - ✓ Interfaces
  - ✓ User interface
- ❑ Design specification document

Figure 3. System start-up
Source: The author (2014).

A major task at the start of the assessment and implementation of the system will be the definition of the requirements. This is typically driven by known functions and functionality, desired functions, best practice examples from other applications and many inputs from competing system descriptions on the market. So what can be selected? Making a difference between operational and structural requirements is a helpful approach. The operational requirements can be sorted from the very basic functionality up to high-end functions (Cato, 1999).

A List of operational requirements includes preventive maintenance, work order generation and tracking, including emergency work orders; job planning and scheduling; personnel and equipment resource planning; job cost calculation, failure analysis, equipment history, inventory control, purchase requisition, calculation and reporting of costs, generation of management reports and others (Palmer, 1999).

The more complex the functions become, the more structural requirements will evolve. A list of structural requirements includes CAD systems, document management system, energy optimization, facility management, financial, import of text documents, bar code reader and others. It is obvious that structural requirements are heavily depended on the interfacing functions between functions inside the system structure and to other system's functions on plant or enterprise level (Barella, 2000).

The support of a consultant for Maintenance and Asset Management and Information Technology can be a very valuable support at this time. The consultancy should be independent of the latter product choice and produce a feasible realistic but innovative solution concept.

5 PROCESS OF IMPLEMENTATION OF A CMMS

The plant and its components and sub-components will be framed, the number and formats of reports, displays and screen formats will be defined. The requirements in number of clients, local or portable users shall be defined. After placing the order the System Specification Document has to describe the prospected solution clearly. Implementation and integration tests will follow and proper function at least with dummy-data will be proven. In parallel the plant structure and plant data will be provided in detail, they will be imported or integrated into the system (Cato, 1999).

To augment the acceptance and initiate the best use of the system from the very beginning, the staff of users must be informed, trained and made responsible with and for the system and its functions as soon as possible, latest at the start of the pilot phase. After successful run of the pilot phase the system can be handed over to full commercial operation (Colangelo Filho, 2001).

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This implementation process – shown in figure 3 and 4 – can easily take several months, depending on the functionality and size of the system.

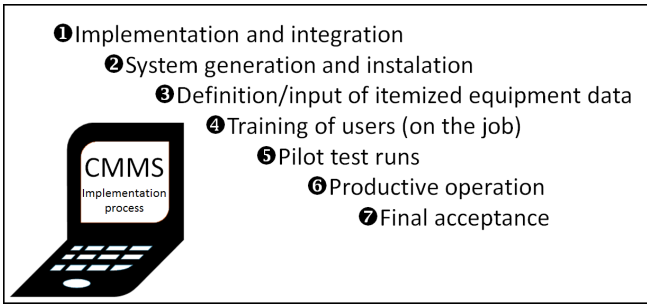

Figure 4. Implementation process.

Source: The author (2014).

6 EVALUATION AND ASSESSMENT PROCEDURE

After the implementation process, when an assessment of a CMMS has to be performed, three prerequisites are essential, according to Arese (2006): the definition of a System Mission, the requirements to the systems to be assessed as laid down in a Systems Requirements Document and the specification of the proposed system as laid down in a Systems Specification Document. If these are available and properly performed all aspects of selection, qualification and limitations, will end up in a sufficient and satisfactorily solution. The single steps of the evaluation and assessment are as follows:

1) The system mission is defined;

2) The mission is being detailed into single tasks;

3) The tasks identified have to be checked as to their importance to fulfill the mission.

This can be done by an A-B-C-analysis separating the tasks being (A – indispensable / B – essential / C – desirable).

7 THE INFLUENCING CONDITIONS

Influencing conditions can have a substantial impact on the system and its properties. They should be checked and be grouped as per this list (Hehn, 1999).

Checking the influencing conditions on the system we find:

- the task itself
- the user/operator
- the process
- the utility
- the environment
- the service
- other external systems

Here again through a simple A-B-C analysis we can identify and eliminate those influencing conditions which are of minor importance for the mission and the system. So we are arriving at the desired list for the assessment in which we describe to which extent the proposed system fulfils the defined tasks (See Figure 5). An appropriate way is to weigh the entries of the list according to their importance. This gives different groups of users the chance to stress their requirements more than other users would do. The results and findings of such an assessment shall be laid down in a report (Arese, 2001).

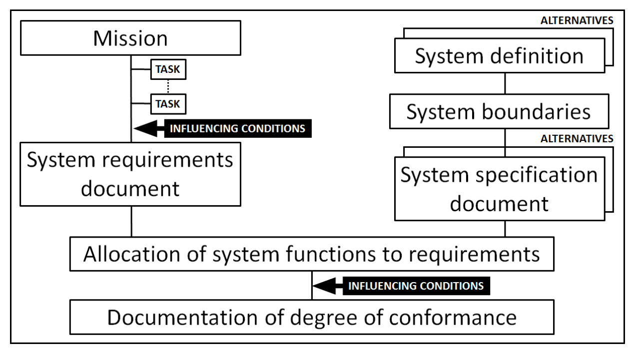

Figure 5. Influencing conditions location in the process

Source: The author (2014).

8 CONCLUSION: EXTENDED ASPECTS AND FUTURE TRENDS

The proliferation of microprocessor-based smart field devices, field communication protocols, and the increased price/performance of today's software have converged to enable sophisticated and integrated approaches to both plant and maintenance management. We see ever increasing the need for integration of data and information from two levels: the process and the enterprise level. The process level includes corrosion analysis, intelligent field device, condition monitoring, control valves, rotating equipment and distributed control system. Enterprise level includes enterprise asset management, purchasing accounting, human resource, energy optimization, advanced control, computerized design and enterprise data management.

It is not only importing data via interfaces into the CMMS (although even this can be a nightmare) but the transformation of data into information into knowledge and derived actions. This imposes continuous demand on innovation and development at the suppliers and many of them have progressed with integral solutions

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already. Whether the terms used are asset, equipment, or maintenance management, there is a new class of systems and applications emerging today that will change the way process control is perceived. These Plant and Maintenance Management Systems (PMMS) will unify condition data from field instrumentation, sensors, and plant equipment to create advanced preventive and predictive maintenance strategies within plant environments that optimize both maintenance costs and production process itself. These new solutions are the next big opportunity for plant management to improve plant financial performance. Information required for equipment management is optionally developed within specialist systems like those mentioned above.

Information at the interfaces must be ready available, easily exchanged and clearly understandable for everyone with requirements throughout the enterprise. For this open systems are the most flexible and effective method for information exchange. They offer greatest scalability and expandability at least cost. To make this possible the world wide Machinery Information Management Open Systems Alliance MIMOSA has been founded in 1994 (see www.mimosa.org). Today it has much more than 50 members world wide being progressive users, suppliers, consultants and institutes. The mission is: Provide open exchange conventions that assure vital information defining status and condition of process, manufacturing and production equipment is readily available and produces greatest value for users throughout the enterprise. The common convention is to:

- Establish a common ground for connectivity and interoperability of equipment control, condition and maintenance information
- Create a platform that allows innovators to produce highest value core competency components at least cost
- Greatly simplify mapping equipment information to other standards On the upper enterprise level we find the demand and solutions for interfacing of PMMS to:
    1. enterprise asset management (EAM)
    2. purchasing & accounting
    3. human resources planning
    4. energy optimization and
    5. advanced control systems
    6. computer aided design systems (CAD)
    7. electronic data management systems (EDMS)

This is at least performed by powerful and easy to handle import-export functions for data but increasingly through a full integration via the common database and routines. The best of breed Enterprise Asset Management/CMMS suppliers have developed software and programs that integrates, not just interconnects their software to Enterprise Resource Planning (ERP) packages like human resources planning, purchasing and accounting.

In industry, automation and related information can be found everywhere – from integrated business information systems at the corporate level, to planning, optimizing, scheduling, and controlling at the plant level. Automation can be seen as the catalyst for the information explosion from the plant floor to the board room. It is the best weapon that companies will have to compete into the next decade, and enterprise wide asset maintenance and management is playing an increasingly important role.

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