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Continuous improvement on information and on-line maintenance technologies for increased cost-effectiveness

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Abstract

Industries are increasingly paying attention to maintenance services, due to the relevance that maintenance is taking as a business and profit centre within the companies. Many of the improvements could be obtained using new technologies and strategies to maximize service level and to reduce the maintenance costs. Predictive maintenance (PdM) technologies, whether on-line or inspection, are key in this change as they provide supervision and control over assets condition.

However, it is important to avoid risky upgrades that may have no positive effect on maintenance operations cost-benefits, and hence may serve to underestimate the potential of PdM and finally stop maintenance progress. Here is important to pay attention to several aspects of the proposed upgrades, such as the maturity of the proposed technologies. Also, the culture and organization of the company should be taken into account, and in particular is very important to understand the existing level of information management at the company, where bottlenecks at information acquisition, transmission or processing concerning reliability and maintenance operations can be expected.

This paper presents a methodology that provides a continuous assessment of PdM technologies with respect to specific business scenarios. The methodology integrates existing reliability and maintenance business analysis techniques and standards, always having in mind the positive impact that may have the implementation of these technologies. A critical simulation tool is also developed in order to compare different PdM strategies. The paper finally explains how this methodology has a positive impact not only on the cost-effectiveness of maintenance processes, but also on the maintenance information available.

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Keywords: Predictive Maintenance, Information systems, Cost-effectiveness, Continuous improvement, Indicators.

1. Introduction

Performance improvements in maintenance activities are usually measured by availability and operational reliability indicators. They should be obtained preserving maximum quality and safety levels and minimizing the costs. In the current scenario of competitiveness, improvement efforts are essential to reach high levels of effectiveness and efficiency in every company’s production or operational department. The purpose is to achieve competitive advantage (in products or offered services) based on different hard-to-copy aspects, i.e. know-how.

To obtain maximum performance, the organizations must be prepared for changes and there are three interconnected areas [1]:

- Processes, work fluxes to achieve the improvements (e.g. doing more preventive work instead of corrective work).
- Technologies to facilitate or enable some processes.
- The organization -and people within the organization- must validate any change, so tools that ease changes are truly understood and accepted.

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One of the approaches for improvement is to identify and to apply predictive maintenance (PdM) techniques which would help to identify potential anomalies in advance. In this context, PdM is still an important area of improvement for Original Equipment Manufacturers (OEMs), maximizing the value of their products through extended lifetime services -not just within warranty periods- as well as for end users, that can maximize the availability and performance of their assets with optimum maintenance costs.

Habitual PdM systems are mainly focused in just *condition monitoring*. That is, the identification of anomalies in order to mitigate critical system failures before time-based replacement (or repair) is completed. This is the usual approach at systems that require extra safety approaches (e.g. nuclear, aerospace). However, PdM true potential is related to the extension (or cancellation) of repair and replacement periods, helping companies in their shift from 'fail and fix' policies to 'predict and prevent' [2]

There are different ways to achieve cost-effective PdM. One vector of improvement is the use of high-tech elements which can serve to help maintenance specialists in rapid on-site inspections, or even to perform an on-line remote assessment of the asset conditions. Another vector is to rely on third party services that can perform specialized analysis, diagnostics and audits over specific areas (e.g. the lubrication process)

1.1. The maintenance information gap

The positive effect of PdM approaches in the improvement of operation and maintenance processes may be mitigated by different reasons. The lack of adequate information concerning the maintenance process is one of them. Lack of information can be due to different causes. Several examples follow:

- The signal is acquired (e.g.: vibrations) but stored just locally due to difficulties/cost in data transmission (e.g.: aero-generators)
- Too often the failures and work order handled by maintenance personnel does not reaches the OEM and then cannot understand its machinery reliability – Different departments and even different companies
- Lack of information transmission between operation and maintenance processes, apart from scheduled plans for preventive maintenance and inspection. No information on machinery performance, nor on short/medium term operational schedule
- Condition signal acquired by third party services (e.g. vibration, lubrication, and thermography) and handled in isolation, with a single 'condition monitoring' purpose.

At the end there is a lack of proper acquisition, transmission and storage of vital data that needs to be shared and communicated with the appropriate areas of the company (management, operation, maintenance, OEM). It may be argued that this lack of the information systems is because of the organizational culture and of the business processes. However, in many cases the lack of adequate information channels is motivating a certain culture of isolation.

This is critical and has at minimum two different effects on the development of any strategy for continuous improvement: At the starting point of any improvement, the quantity and quality of the maintenance and reliability information needs may appear discouraging. Simulation tools can help identifying how a new PdM approach may help -or hinder- in the cost-benefit of the life cycle of the product, or in the global productivity of the plant. But most tools rely on several types of data not available at the beginning. Second, during the whole process, there is a need for metrics. The identification of true improvements is also difficult if only partial information is available. The Key Performance Indicators (KPIs) initially planned can become unfeasible.

This paper illustrates a methodology to overcome this information gap, which helps in starting to take decisions with a small amount of information that is typically available at the beginning, and allows a progressive increase in confidence on how to improve maintenance operation.

2. Improvement model

Maintenance should be a constantly improving activity, which enhances the quality of service and optimizes operating costs. Condition-based maintenance and predictive strategies based on cutting-edge technologies are arriving to the market and their continuous cost reduction opens wide opportunities, helping the operation and maintenance personnel to perform tasks more effectively.

There are cost-effectiveness studies of different types of strategies, but it is normally difficult to measure with the existing tools the impact of predictive strategies [3,4,5,6].

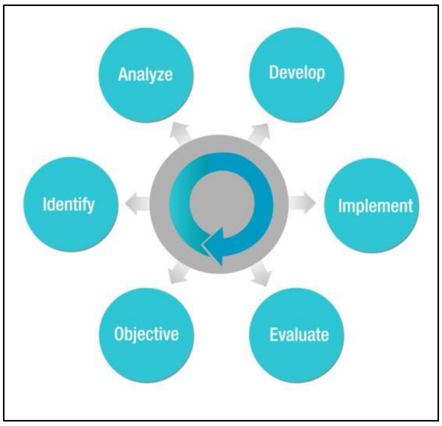

Fig. 1. Deming cycle.

To overcome this gap, a simple model is developed to guide a cost-effective application of predictive maintenance technologies. This model is based on the application of existing technologies (Balance Scorecard, Failure Modes Effects and Cause Analysis - FMECA, Preliminary Hazard Analysis - PHA,…) and follows a six-step structure based on a Deming cycle that gradually improves each process or service by means of a better adaptation of technologies to maintenance needs.