Preventive maintenance optimisation: towards a new model

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Abstract

In a competitive environment, the most successful companies are those that well manage their projects defining the right map to achieve their goals and optimizing the triptych "cost-quality-time limit".
Considering preventive maintenance as a lean project, we propose managing its steps through a lean model integrating a useful decisional algorithm to select the appropriate NDT (non-destructive testing) techniques in the step "Method" under the "optimisation" phase of our model.
The implantation of our proposed model allows the early prediction and prevention of equipment breakdowns and so the redaction of unnecessary costs.

Keywords
Preventive maintenance; NDT; Lean; optimisation; maintenance project.

1. Introduction

Industrial maintenance, having as the main objective ensuring the proper functioning and availability of industrial equipment, is a strategic function in companies. Closely linked to the continuous development of technology, to the emergence of new forms of management and the need to reduce production costs.

Repairing machines is no longer the only goal of maintenance today, but also anticipating and avoiding breakdowns and failures, because the least undesirable hazard can question the production or endanger the system itself. During its perpetual adaptation, the activity of maintenance personnel has also evolved, in order to combine technological, organizational and relational skills.
The actual maintenance needs, require a new model development taking into consideration technical and at the same time appropriate managerial aspects to implement preventive and predictive maintenance methods.

2. Preventive maintenance context

In a company "maintenance" function deserves more attention to maintain the production tool in operational conditions avoiding its breakdowns and inability to meet the deadlines causing direct and indirect costs of failure that the company is no longer able to support, the distribution of various costs are shown in Figure 1 [1]. It cannot wait for the failure to occur to rectify it, but it must make arrangements to perform the various operations that can avoid it. The design of equipment that is required for maximum operational availability cannot be achieved without proven methods or relevant maintainability and reliability data. This is the transition from "curative maintenance" to "preventive maintenance". Initially, the preventive actions were carried out periodically "systematic preventive maintenance" according to predefined schedules. Failures and breakdowns are actually anticipated by the replacement of some components in a degradation process, but at the cost of a significant increase of maintenance costs. Thanks to this "systematic maintenance", the risk of breakdowns has decreased compared to "curative maintenance", but the probability of breakage between two visits is still present, as well as the risk of bad restart conditions and sometimes the costs of visits are unnecessary. In order to avoid these disadvantages, we have moved towards a "new maintenance". This "new maintenance" is based on control and diagnostic techniques. This type of maintenance is called "predictive maintenance", it allows to replace the components just before their failure by relying on defaults prediction techniques.
Recent studies on the effectiveness of maintenance management have shown that more than a third of maintenance costs come from unnecessary or poorly performed operations [2] [3], and preventive maintenance only presents10% of all maintenance activities [4].
67% of companies indicated that logistics chain performance is seriously affected by infrastructure risks (equipment) [5], hence focusing on the interest of proposing a methodology for optimizing preventive maintenance by taking advantage of the benefits of Lean to build a model for determining the need for maintenance and therefore the appropriate method of preventive maintenance including that based on NDT which will be the subject of the next chapter.

3. Preventive maintenance optimisation

The actual maintenance context points out the main guideline objectives of a maintenance project [6]:

- Insuring equipment availability continuously to avoid production shutdown.
- Minimizing costs and looking for fast, sustainable benefits.
- Improving product quality as defined by the customer.
- Respecting time limits to win the costumer’s confidence.
- Maintenance optimization, in other words achieving goals with a minimum of costs.

Lean culture is growing from day to day to be recognized and practiced in every field or structure looking for higher performance and quality levels reducing extra-costs as much as possible .In fact lean thinking as Womack and Joes defined in the title of their book: "Banish Waste and Create Wealth in Your Corporation"[7].
In addition, most preventive maintenance programs and policies fail due to: lack of managerial tools [8] and the lack of realistic information to determine immediate repair or maintenance needs.

To determine the methodology of preventive maintenance optimization, we propose following the next steps to reach the desired objectives avoiding unnecessary costs within the lean culture framework dealing with the preventive maintenance as a lean maintenance project reducing main maintenance costs:

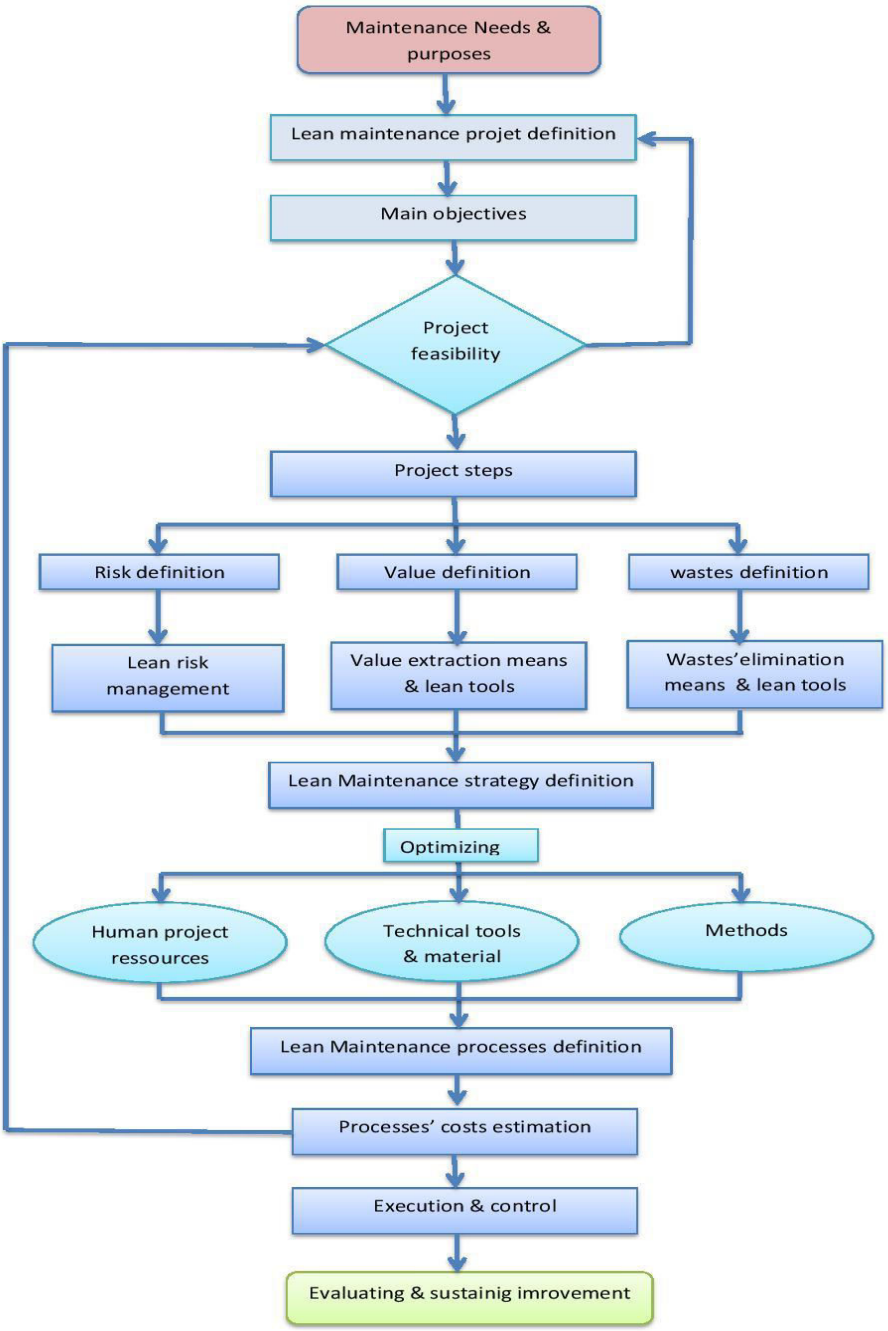

Figure 1. Lean maintenance project management model [6].

Regarding the "Methods" step under the "Optimizing" phase, it seemed appropriate to propose a general algorithm (figure.2) allowing the choice of the most suitable NDT technique.

Indeed, most research work in the field is focused on the development of supervision and diagnostic tools [9]. On the other hand, work dealing with the managerial aspect, particularly the implementation of preventive maintenance deploying NDTs, is rare [10].

Since a bad maintenance program can prevent the increase of production rates and hinder the development of companies, the maintenance program must move towards a predictive maintenance that contains many techniques such as: vibration analysis; thermography; ultrasound; radiography; penetrant; Magnetic.

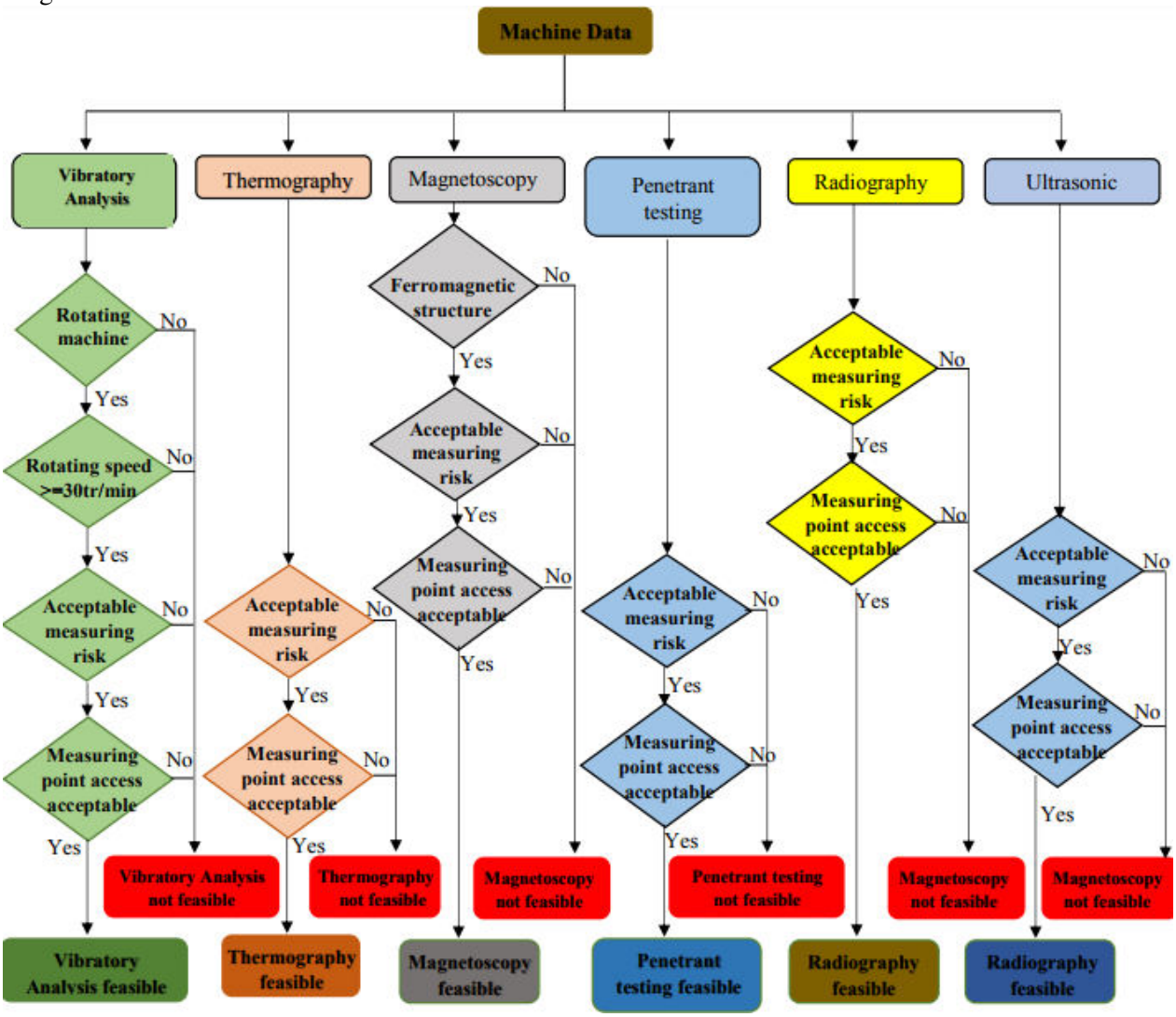

Figure 2. Decisional algorithm on measurement techniques choice

For automotive companies that have adopted vibration analysis and thermography in preventive maintenance, have managed to eliminate up to 70% with these two measurement techniques. In addition, it is expected after the deployment of the NDTs in the maintenance seen as being a Lean project would be more fruitful by reducing the wastes due to unforeseen breakdowns of the industrial equipment.

4. Conclusion

The majority of production systems are often penalized by the maintenance costs related to equipment failures and sudden breakdowns; this derives from the maintenance management strategies that are more oriented towards the curative strategies than the preventive ones. In order to deal with this issue and we have developed a generic Lean maintenance optimization model. In our approach, we discuss the deployment of a decision algorithm on NDT techniques in the "methods" step, which could reduce the number of unforeseen failures.

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Biographies

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