

A review of integrated production and preventive maintenance planning models for multi state systems

G. Ettaye^{#1}, A. El Barkany^{#2} and A. El Khalfi^{#3}

[#] *Mechanical Engineering Laboratory, Department of Mechanical Engineering, Faculty of Sciences and Techniques, Sidi Mohamed Ben Abdellah University
Road Imouzzer, PO Box 2202, Fez, Morocco*

1. *ettaye@gmail.com*

2. *a_elbarkany2002@yahoo.fr*

3. *aelkhalfi@gmail.com*

Abstract: This article aims to present the main published works on multi states degradable systems, maintenance and production planning and optimization methods. The first part focuses on the characterization of binary systems and multi-state systems based on the work published in the literature and the presentation of optimization models that ensure continuity of service for repairable systems that can operate in degraded mode. In the second part we review the main models and optimization of maintenance strategies as well as those concerning the planning and optimization of production. We review the work that has focused only on planning models separated, then we introduce the approach to integrated production and maintenance planning for binary systems and ultimately for degradable multi-state systems.

Keywords: optimization, model, multi-state system, degradable, integrated planning.

Extended abstract

In the area of reliability, study the functioning of technological systems was undertaken based on the binary model where two states are considered: the operation Status and the state of complete failure [6]. However, more works in the scientific literature take into account many situations that may occur over the lifetime of some systems. Such systems are called multi-state systems (MSS). The MSS are generally subjected to various failure modes with different effects on there performance. One of these failure modes, degradation, allows MSS to continue to provide their service despite the occurrence of a failure causes partial reduction of their performance nominales. An extensive literature has been devoted to binary systems, however, little work has been published on the MSS.

On the other hand, production is located in the heart of the company; with the increasing complexity of production systems the organization of this activity has become very important. In parallel with the increased use of machines that replaced the human being, the problem of maintaining these machines and keep them in good working condition has become a major preoccupation of the company. Therefore researchers

have focused on the issue of maintenance planning and production scheduling which are among the most important and influential problems in industrial systems. Planning breach for preventive maintenance by the scheduling service can cause the failure of production equipment and therefore the interruption of production and non-satisfaction of the customer's request. Despite their interdependence, these two activities are usually planned and executed separately in manufacturing systems. So that, we will propose a classification into two categories: the first deals with the subject of planning production to meet the commands in time requiring maximum availability of equipment, while the second category includes models that address the maintenance planning requires production downtime to perform preventive maintenance actions.

Given that, the execution of maintenance activities frequently causes conflicts between maintenance managers and production because they act as elements coming to disturb a production program predetermined, for this reason we looked for studies on integrated planning of maintenance and production that aim to minimize the total cost of the two activities. The work we will present will be divided into two research axes to generate a plane containing simultaneously operations of maintenance and those of production: first research axis focuses on the effect of a maintenance policy determined in advance of production policies and storage ignoring the maintenance costs and the second research axis which included the costs of maintenance and repair in models of production planning for an integrated approach offering optimal policies maintenance / repair and production / storage. The first work that offers a truly integrated planning is that of Aghezzaf [1] [2] [5] then we found work of Machani [4].

At the end we will analyze a literature review covering the integrated maintenance planning and production for binary systems and for multistate degradable [3] systems.

References

- [1] E. Aghezzaf, M. Jamali., D. Ait-Kadi (2007). An integrated production and preventive maintenance planning model. *European Journal of Operational Research*, 181 (2), 679-685.
- [2] E. Aghezzaf, C. Sitompul, N. Najid (2008b). Integrated production planning and preventive maintenance in deteriorating production systems. *Information Sciences*, 178 (17), 3382-3392.
- [3] M. C. Fitouhi. *Optimisation de la planification intégrée de la maintenance préventive et de la production des systèmes multi-états*; (Thèse présentée à la Faculté des études supérieures et postdoctorales de l'Université Laval dans le cadre du programme de doctorat en Génie Mécanique, 2011).
- [4] M. MACHANI. *Heuristiques Efficaces Pour La Planification Intégrée De La Maintenance Préventive Et De La Production d'un Système Multi-États*; (Mémoire présenté à la Faculté des études supérieures de l'Université Laval dans le cadre du programme de maîtrise en Génie Mécanique, 2009).
- [5] C. Sitompul, E. Aghezzaf, (2011). An integrated hierarchical production and maintenance-planning model. *Journal of Quality in Maintenance Engineering*, 17 (3).
- [6] I. S. Wassy. *Modélisation et optimisation des performances et de la maintenance des systèmes multi-états*; (Thèse présentée à la Faculté des études supérieures de l'Université Laval dans le cadre du programme de doctorat en génie mécanique, 2011).