ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 5, MAY, 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)

DOI: 10.5958/2249-7137.2021.01496.8

SELECTION OF METHOD FOR OPTIMIZATION OF VEHICLE MAINTENANCE AND REPAIR SYSTEM TAKING INTO ACCOUNT OPERATING CONDITIONS

Soyib Ortikovich Narziev*

*PhD, Head of the Vehicles and Automotive Industry Department,
Tashkent State Transport University,
UZBEKISTAN
Email id: soyib_narziyev1984@mail.ru

ABSTRACT

In broad terms, maintenance optimization models includes the mathematical models focused on finding either the optimal balance between costs and benefits of maintenance or the most appropriate time to execute maintenance. Parameters often considered in this optimization are the cost of failure, the cost per time unit of downtime, the cost (per time unit) of corrective and preventive maintenance and the cost of repairable system replacement. The foundation of any maintenance optimization model relies on the underlying deterioration process and failure behavior of the component. Over the last decades, maintenance optimization models have received growing attention, and by now it is a well-established area of research. This paper presents a brief review of existing maintenance optimization models. Several reliable models and methods in this area are discussed and future prospects are investigated.

KEYWORDS: *Maintenance Optimization Model, Preventive Maintenance, Corrective Maintenance, Risk Based Optimization, Simulation*

INTRODUCTION

The importance of the maintenance functions and maintenance management has greatly grown in all sectors of manufacturing and service organizations. The principal reason is due to the continuous expansion in the capital inventory, the requirements for the functioning of systems and the outsourcing of maintenance. Maintenance management is gaining importance and support from science is needed to improve it. In theory, maintenance management could have benefited from the advent of a large area in operations research, called maintenance optimization

[1, 2]. According to Dekker [1] and Sandve and Aven [3] the interest in development and implementation of maintenance optimization started in the early 1960s by researchers like Barlow, Proschan, Jorgenson, McCall, Radner and Hunter. Well-known models originating from that period are the so-called age and the block replacement models. In the age-type models the timing of the maintenance action depends on the age of the system, however for the block type models the timing of the maintenance action is known in advance, it depends neither on the age nor on the state of the system [4]. A maintenance optimization model is a mathematical (stochastic) model which aims to quantify costs (in a wide sense) and to find the optimum balance between the cost of maintenance on one side, and the associated cost (benefit) on the other [3]. There has been extensive literature on models for maintenance optimization. Table 1 (Appendix A) represents some basic literature surveys is this area. Maintenance optimization is one of the most critical issues in production since the failure of a system during actual operation can be a costly and dangerous event. When a machine fails to operate in a system, it does not only delay the completion time of the operations assigned on it but also affect all the other planned operations in the system. Consequently, the jobs cannot be finished on time and it will induce penalty and bad reputation to the company [5]. This optimization process can utilize different methods. It can be made by adding features and conditions that make the maintenance policy more realistic, for example by taking into account working conditions, the production schedule of the industry, safety issues, perfect and imperfect actions. Generally maintenance optimization models are classified according to the way they describe and represent natural variability and uncertainty in parameter, model and scenario. The use of deterministic methods does not provide information about potential risk which results in non-optimal maintenance planning for process plants. However, Probabilistic models use probability distributions to describe and represent natural variability and uncertainty in different cases.

Among the different types of maintenance policy, the preventive maintenance (PM) is widely applied in large systems such as production systems, transport systems, etc. PM consists of a set of management, administrative and technical actions to reduce the components' ages in order to improve the availability and reliability of a system (i.e., reduction of probability failure or the degradation level of a system's component). These actions can be characterized by their effects on the component age: the component becomes "as good as new", the component age is reduced, or the state of the component is lightly affected only to ensure its necessary operating conditions, the component appears to be "as bad as old". The PM corresponds to the maintenance actions that come about when the system is operating. However, the actions that occur after the system breaks down are regrouped under the title of corrective maintenance (CM). Some of major expenses incurred by industry are related to the replacements and repairs of manufacturing machinery in production processes. The PM is a main approach adopted to reduce these costs [7]. Although CM has a direct influence on the components of a system, it was not sufficiently studied. Recently, studies begin to focus on the optimization of PM policies. Traditionally, optimal PM intervention schedules have been obtained using models which involves minimization of the costs incurred in relation to maintenance activities. For considering both PM and CM policies, in the following section several models for optimization of PM policies are reviewed and categorized based on their approach for taking into account CM effect. 2.1 Considering CM from the cost point of view Dedopoulos et al. [8] developed a model which determines the optimal number of PM activities to be scheduled within a time horizon of interest, the extent of the preventive maintenance by means of an age reduction of the unit (Figure 1) and the corresponding optimal value of the expected profit. A single unit working in a continuous mode of operation characterized by an increasing failure rate is considered. For the CM activities, only their corresponding costs are considered.

Under the title of PM optimization, Tsai et al. [9] presented periodic PM of a system with deteriorated components. Two activities, simple PM and preventive replacement, are simultaneously considered to arrange the PM schedule of a system. The optimal activities-combination standing for determination of the action(s) required for the PM components on each stage by using genetic algorithms and by pursuing system unit-cost life maximization. The CM effect is only taken into account from the cost point of view. The same issue is repeated with Park et al. [10] when the authors tried to minimize the cost of a periodic maintenance policy of a system subject to slow degradation. Each PM relieves stress temporarily and hence slows the rate of system degradation, while the hazard rate of the system remains monotonically increasing. The optimal number and period for the periodic PM that minimize the expected cost rate per unit time over an infinite time span are obtained. The case when the minimal repair cost varies with time is also considered and explicit solutions for the optimal periodic PM are given for the Weibull distribution case.

REFERENCES

1. Dekker, R., 1996, “Applications of maintenance optimization models: A review and analysis”, Reliability Engineering and System Safety, 51(3):229-240.

2. Dekker, R., Scarf, P.A., 1998, “On the impact of optimization models in maintenance decision making: the state of the art”, Reliability Engineering and System Safety, 60(2):111–119.

3. Sandve, K., Aven, T., 1999, “Cost optimal replacement of monotone, repairable systems”, European Journal of Operational Research, 116(2):235–248.

4. Boschian, V., Rezg, N., Chelbi, A., 2009, “Contribution of simulation to the optimization of maintenance strategies for a randomly failing production system”, European Journal of Operational Research, 197(3):1142–1149.

5. Chung, S.H., Lau, H.C.W., Ho, G.T.S., Ip, W.H., 2009, “Optimization of system reliability in multi-factory production networks by maintenance approach”, Expert Systems with Applications, 36(6):10188–10196.