Chapter 25
Bi-Criteria Optimization for Finding the Optimal Replacement Interval for Maintaining the Performance of the Process Industries

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ABSTRACT

The optimization of the maintenance decision making can be defined as an attempt to resolve the conflicts of decision situation in such a way that variable under the control of the decision maker take their best possible value. One of the most important controllable parameters is the time interval between maintenance. Most of the researchers have kept the fact that whenever the suitable maintenance interval is reached, the system is replaced with the original one. However the improvement of a system life not only depends on the replacement of deteriorated components, but also on the effectiveness of the maintenance. Taking care about this fact, the effects of maintenance of a multi-component system by combining the three main different PM actions, namely (1a), (1b) and (2p)-maintenance actions. Thus, the main purpose of an effective maintenance program is to present a technique for finding the optimal maintenance interval for the system by considering the multiple goals of the organization viz. maximum availability, minimum maintenance cost.

1. INTRODUCTION

With the advance in technology, a designer always wants to manufacture the equipment and systems of greater capital cost, complexity and capacity which results in increasing the reliability of the system. Also at the same time the unfortunate penalty of low availability and high maintenance cost need to be improved for their survival. To achieve this end, availability and reliability of equipment in the process must be maintained at the higher order. Thus, reliability and maintainability concepts are mainly applicable at the design stage of a machinery or plant layout, while the availability concept is mostly applicable after

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commissioning the plant or after a steady state of production is reached. Modern technology has developed a tendency to design and manufacture equipment and systems of greater capital cost, sophistication, complexity, and capacity. The disastrous consequences of low availability and high maintenance cost of such systems led to the desire for high reliability, high maintainability, and low mean time to support. Due to design problems and poor product support, manufacturer equipment and systems are not able to meet these requirements. However, to improve the quality and quantity of a manufactured associated prospectus, there is a need to accentuate more on operational management and the proper consideration of reliability, availability and maintainability (RAM) in the design, manufacturing and installation phase will could be reduced the number of failures and their consequences minimized (Saraswat and Yadava, 2008). Thus, for this reason and to reduce the number of likelihood failures, there is a great interest in dealing with the main feature of the reliability parameters which affects the system performance directly i.e. reliability, availability and maintainability. In that direction, various researchers have addressed the issue of RAM analysis by adapting the suitable maintenance strategies for increasing the performance of the system (Saraswat & Yadava, 2008; DuJulio & Leet, 1988; Wood, 1989; Madu & Kuci, 1994; Hwang, 1996; Zerwick, 1996). To improve the system reliability and availability, implementation of appropriate maintenance strategies play an important role. The high performance of these units can be achieved with highly reliable subunits and perfect maintenance. To this effect the knowledge of behavior of system, their component(s) is customary in order to plan and adapt suitable maintenance strategies. Thus, maintainability is also to be a key index to enhance the performance of these systems.

In a system where a certain amount of failures is allowed, the efficient repair and/or replacement of these failures is critical to the continued usefulness of the system. This repair and replacement of failures are called maintenance. Maintenance has a definite influence on operating costs, either through its own (maintenance) labor or through its effect of system downtime and efficiency. In reliability, maintainability can also be used to increase the probability that a system will continue to operate efficiently, given that it is allowed a certain amount of downtime of repairs. The purpose of maintainability is to return a failed or deteriorating system to a satisfactory operating state. To do this, there are two extreme maintenance policies that can be applied. The first is to unplanned (corrective) maintenance while the second one is planned (preventive) maintenance. In unplanned, corrective strategy, no maintenance action is carried out until the component or structure breaks down or when its cost of operation becomes creeping or wear-out failures. This is called corrective maintenance (CM) or emergency repair. A study on the effect of CM in maintenance policies was done by Samrout et al. (2009). CM activities are categorized into minimal repair (1C). 1C-maintenance makes no change in system time and restores the system reliability to it when it had failed. Upon failure, the associated repair time is large and thus leading to large downtimes and high costs. In this approach, efforts are undertaken to achieve small mean times to repair (MTTRs). To avoid failures at occasions that have high cost consequences preventive maintenance is normally chosen. This allows that inspections and upgrading can be planned for periods, which have the lowest impact on production or availability of the systems. The main function of planned maintenance is to restore equipment to the "as good as new" condition; periodical inspections must control equipment condition and both actions will ensure equipment availability. PM, by its nature, can be scheduled and controlled for a minimum cost; corrective action cannot. PM includes such things as inspecting, tuning and major overhauls. In some types of system (especially mechanical systems such as automobiles), PM can also include painting, waxing, chemical solution monitoring, and water treatment. PM strategy involves preventive tasks such as repair, replacement or inspection at a pre-determined interval