ABSTRACT

The Optimal Maintenance Policy for a Manufacturing
System with Age-Dependent Operating Costs. (December 1993)
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During the past three decades interest has grown in the area of optimal replacement of stochastically deteriorating systems. Surprisingly, little attention in the literature has been paid to the operating costs when minimal repair models are applied to manufacturing systems. However, in practice most systems incur increasingly expensive operational costs as they age.

In this research, we study a modified minimal repair/replacement problem that is formulated as a Markov decision process. The operating cost is assumed to be a nondecreasing function of the system's age. The lifetime distribution of the system is assumed to have an increasing failure rate. The specific maintenance actions to be considered for a manufacturing system are whether to replace the system, perform a minimal repair or keep it operating. It is shown that a control limit policy, or in particular a (t,T) policy, is optimal over the space of all possible policies under the discounted cost criterion. A (t,T) policy is defined as: minimal repair is used if the system's age is less than t at failure, and replacement is used if failure occurs between the system age t and T; if the system is still operating at age T, it is replaced. A computational procedure for the parameters of the optimal (t,T) policy is obtained based on the total expected discounted cost.

Another modified model is studied with the additional change that replacement with new technology is available instead of with one identical to the current operating system. The new "improved" system could be different in its lifetime distribution or associated costs for repair or replacement. The optimal policy for this problem is proven to have the same form as the previous results. A two-phase search procedure is developed that is applicable for solving the replacement problem with two types of technology.