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# A Cost-Effective Simulation Algorithm for Inspection Interval Optimization: An Application to Mining Equipment

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## Abstract

In machinery maintenance policies, regular inspection intervals should be specified in such a way that the cumulative of direct and indirect financial consequences of maintenance activities should be minimized while supporting the functional health of system components. This study aims to develop a simulation algorithm, called the time-counter, to optimize inspection intervals. In the algorithm, uptime and downtime behaviors of the system components and production losses in the corrective repairs are considered random values. Delay time concept is regarded when estimating failure detection periods and deciding on the required maintenance type. In addition, the developed model is applied to two active draglines and their inspection intervals are optimized for 232 and 184 hours for Dragline-1 and Dragline-2, respectively. The optimized values are observed to decrease the total maintenance cost by 5.9 and 6.2 percent compared to the current interval of 160 hours. The main novelties of the study are that i) the proposed concept which allows for the simultaneous assessment of system components in an incremental time span has not been proposed in the literature when deciding on optimal inspection intervals, ii) it is the first initiative in inspection optimization of a mining machinery system, and iii) it uses real datasets on lifetime, repair time, and financial values that are rarely observed in the maintenance studies.

**Keywords:** Inspection interval; optimization; delay time; production systems; maintenance cost.

## 1 Introduction

Inspections are the integral parts of maintenance policies, especially in machine-based production cycles. These activities are generally performed in regular intervals to identify, examine, and recover potential abnormalities in working machinery systems. An inspection may entail various work packages such as: i) visual inspection of system elements, ii) preventive or corrective rectification of defects via repair or replacement activities, iii) preventive replacement of predefined components in deterioration period, iv)

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