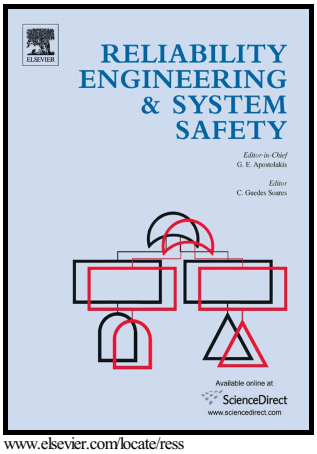

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Joint optimisation of inspection maintenance and spare parts provisioning: a comparative study of inventory policies using simulation and survey data

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Abstract

The demand for industrial plant spare parts is driven, at least in part, by maintenance requirements. It is therefore important to jointly optimise planned maintenance and the associated spare parts inventory using the most appropriate maintenance and replenishment policies. In this simulation-based study, we address this challenge in the context of the random failure of parts in service and the replacement of defective parts at inspections of period T. Inspections are modelled using the delay-time concept. A number of simultaneous periodic review and continuous review replenishment policies are compared. A paper making plant provides a real context for the presentation of our ideas. We survey practitioners working with such plant to collect real data that inform the values of parameters in the models. Our simulation results indicate that a periodic review policy with ordering that is twice as frequent as inspection is cost optimal in the context of the plant that we study. For the purpose of comparison, we also present and discuss the characteristics of the various policies considered.

Keywords: maintenance; spare parts; delay-time; simulation; joint optimisation.

1. Introduction

The demand for spare parts for industrial plant is predicated on the operation and maintenance of the plant. Therefore, the planning of spare parts inventory should be driven by operational and maintenance requirements rather than the observation of demand. This is because operation and maintenance schedules provide partial information about the demand for spare parts in advance, and the forecasting of spare parts demand based on historical usage is sub-optimal (Ghobbar and Friend, 2003; Boylan and Syntetos, 2010). Furthermore, maintenance planning that assumes 100% availability of spare parts is also sub-optimal (Sharma and Yadava, 2011). Thus, it is important to coordinate the planning of operation, maintenance and spare parts inventory (Wang and Syntetos, 2011). Many researchers have tackled this coordination of maintenance and inventory separately or sequentially (de Almeida, 2001; Marseguerra et al., 2005; Cheng and Tsao, 2010, de Almeida et al., 2015). However, it has been demonstrated that joint optimisation is superior (in a cost sense) to separately or sequentially optimised policies (Sarker and Haque, 2000).

Therefore, it is important not only to coordinate operation and maintenance planning and spare parts inventory control but also to carry out optimisation jointly. We do just this in this paper, whilst setting aside the question of coordination with operation by supposing that a plant is continuously or regularly operated. We focus on the joint cost-optimisation of planned, periodic inspection maintenance and each of several periodic and continuous review replenishment policies. We use the