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Analytical Contributions to the Joint Optimization of Maintenance, Production and Subcontracting^{*}

Gilles Cormier^{a*}, Nidhal Rezg^b

^aFaculté d'ingénierie, Université de Moncton
Avenue de l'Université, Moncton, Nouveau-Brunswick, E1A 3E9, Canada

^bLaboratoire de Génie Industriel et de Production de Metz (LGIPM)
Université Paul-Verlaine de Metz, 57045 Metz Cedex 1, France

Abstract

This article develops analytical models for the purpose of comparing three alternative policies encompassing maintenance, production and subcontracting. It is assumed that the output of the owned (contractor) machine (M_1) must be supplemented by that of the subcontractor machine (M_2) in order to satisfy a constant single-item demand. Both M_1 and M_2 are subject to random breakdowns. The former, having an increasing failure rate, undergoes age-dependent preventive maintenance actions which return M_1 to the "as-good-as-new" condition, while the latter, being outside the purview of the contractor, is assumed to have a lifetime characterized by an exponential distribution. The three operational policies that are analyzed are: i) Simple Policy (SP), in which no coordination takes place between the contractor and the subcontractor; ii) Coordinated Policy (CP), where the preventive maintenance program of the contractor takes into account the known (constant) failure rate of the subcontractor machine; and iii) Coordinated Policy with Inventory (CPI), which extends the CP to allow the contractor to accumulate inventory so as to reduce shortages during downtimes.

Keywords: Maintenance; Production; Subcontracting; Mathematical Modelling

1 Introduction

This paper analyzes three operating policies in a manufacturing environment made up of a contractor and a subcontractor, which are henceforth referred to as machines M_1 and M_2 . The combined production capacities of machines M_1 and M_2 are able to fulfill the constant demand for a single product, but neither can accomplish this on its own. Mathematical models are formulated in order to compare the cost performance of the three operating policies, namely: i) Simple Policy (SP), in which no coordination takes place between the contractor and the subcontractor; ii) Coordinated Policy (CP), where the preventive maintenance program of the contractor takes into account the known (constant) failure rate of the subcontractor machine; and iii) Coordinated Policy with

^{*} This paper was not presented in any other journal. Corresponding author: Tel +1.506.858.4387; fax +1.506.858.4082.

Email addresses: gilles.cormier@umoncton.ca (G. Cormier), rezg@univ-metz.fr (N. Rezg)