

ANALYSIS OF TWO-MACHINE LINES WITH OPERATION-DEPENDENT AND TIME-DEPENDENT FAILURE MODES

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Abstract:

In this paper an analytical model for evaluating the throughput of two-machine lines, characterized by finite capacity of the intermediate buffer, deterministic processing times and two failure modes of the machines is presented. Unlike the existing analytical models that only deal with unreliable machines affected by either operation-dependent failures or time-dependent failures, in this paper the different nature behind the failure mode is caught in a unique model. Each machine can fail according to two disruption types, one failure is operation-dependent and the other one is time-dependent. For each failure mode, geometrically distributed times to failure and times to repair are assumed as well. The method evaluates the steady-state probabilities of the states of the system with a computational effort that depends only on the number of failure modes and not on the buffer capacity. A performance comparison of the proposed model with existing techniques is also reported.

Keywords:

Stochastic models of manufacturing systems, two-machine lines, time-dependent and operation-dependent failures.

1. INTRODUCTION

Nowadays, especially in long transfer lines working 24 hours per day, the presence of electronics such as PLC, control systems, data acquisition systems and, more in general, devices whose failure probabilities are independent of the workload of the machine, is assuming such an importance that it cannot be no longer neglected in the system model. In order to derive more and more accurate system performance estimations, it becomes important to explicitly consider the nature that rules the disruption of these devices. Most of modern manufacturing lines are in fact affected not only by operation-dependent failures (ODFs)¹, but also by time-dependent failures (TDFs)² which are influenced by how long a machine is turned on. Thus TDFs can occur whether or not the machine is producing a part. Even if this situation is quite common in practice, existing analytical models for throughput

¹ Operation Dependent Failures (ODFs) are failure types occurring only if the machine is processing a part, for instance a tool breakage.

² Time Dependent Failures (TDFs) are failure types occurring whether or not the machine is processing a part, for instance electronic failures.