LOGISTIC OPTIMIZATION OF THE COMPLEX MANUFACTURING SYSTEM WITH PARALLEL PRODUCTION LINES

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Abstract:

The paper highlights the problem of mathematical modeling of a complex manufacturing system which is a potential synthetic representation of a real production environment. Production lines are parallel. Each production line consists of work stations which are placed serially along the predetermined trajectory. Each work station is equipped with the predefined tool used to manufacture the dedicated product. The system is controlled by means of heuristic algorithms to meet the manufacturing criteria. Equations of state illustrate the behavior of the system at every stage.

The paper shows basic characteristics of current manufacturing systems emphasizing models for further optimization and simulation processing. First of all, the general background related to this topic is given. The second part of the paper focuses on the specific manufacturing system and suggests the ways of optimizing it to meet the given criteria with the use of heuristic algorithms.

Keywords: manufacturing system, model, logistics, mathematical modelling, optimization, simulation, heuristic algorithms, manufacturing criteria.

JEL Classification: C20, C61, C63

1. Introduction

Manufacturing companies in the 21st century face unpredictable, high-frequency market changes driven by global competition. To stay competitive, companies must possess new types of manufacturing systems that are cost-effective and very responsive to all these market changes. In this context, increasing emphasis is put on the so called reconfigurable manufacturing systems (RMS) whose components are reconfigurable machines and reconfigurable controllers as well as methodologies for their systematic design and rapid ramp-up. They are the cornerstones of this new manufacturing paradigm (Koren, 1999). New manufacturing and production systems and requirements placed on them implement new approaches for their development, optimization and, in general, management. It is always necessary to take into account the purpose of the system to define its type and architecture. Other indispensable modeling elements to be considered are monitoring operations, optimization and simulation. The primary component of each model is, of course, its mathematical description enabling and facilitating the system optimization. In connection with the above, the main objective of the article is to present a concrete example of the optimization of the manufacturing system which consists of production lines which are arranged in a parallel way.

Conclusions

In fact, each manufacturing system must be modelled in an independent way based on autonomous assumptions. Software engineering is responsible for delivering the ready product in the form of a simulator imitating the discussed production activity. The specification is the first step and cannot fail the needs of the synthetic environment representing the real system. The following step is to carry out the modeling process. These two steps are mutually connected and lead to creating the software which, after a successful testing process, can be used to train operators of the potential manufacturing system.

The manufacturing system presented hereby requires the control approach which is based on heuristic algorithms to meet the stated criterion or criteria. The result of this publication is to lead to creating fully functional software which could ease a training process for operators of manufacturing systems similar in nature and minimize the period of time devoted to preparing the staff responsible for introducing a new set of products in a similar manufacturing environment.

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