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Study of Production Scheduling Problem for Reconfigurable Manufacturing System (RMS)

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Abstract

In the present competitive manufacturing environment, handling changes and uncertainties in the production scheduling is a major challenge. Reconfigurable Manufacturing system (RMS) provides an effective and promising solution for this challenge. This paper provides a novel approach of production scheduling considering the reconfigurable machine tools. In Dedicated Manufacturing lines (DML) and flexible manufacturing systems (FMS) do not meet the challenges up to expected level because of short comings in their implementation procedures like lack of support for product variation, scalable production capacity and high production cost, RMS provides the solution in designing a new manufacturing system with scalable flexibility and functionality which is needed in the manufacturing industry. This paper studies the problem of scheduling of different operations in for the selected product in reconfigurable manufacturing systems (RMS). The objective is to minimize the make span of the product by segregating and scheduling the similar operations of product. To solve the existing problem in the production scheduling different metaheuristic approaches are developed for simulation, models are evaluated for the performance.

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Keywords: Reconfigurable Manufacturing System (RMS), Production Scheduling, Dedicated Manufacturing Lines (DML), Flexible Manufacturing Systems (FMS).

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1. Introduction

Manufacturing processes is value addition to the raw material which converts low value input parts into high value finished products using available resources such as machines, tools, and energy and manpower. In manufacturing systems, some machines are dedicated for some common machine operations like drilling, boring, milling and treading. This type of manufacturing systems is called dedicated manufacturing lines. For medium scale production this DML systems gives satisfactory profits, to enhance the revenues the flexible manufacturing systems (FMS) are into the manufacturing sector. But, FMS is still not satisfactory due to high cost of production and it also not provide generalized flexibility in the manufacturing setup. In the present scenario the main goal of any organization is to earn profit. If the set goal wants to be reached, meeting customer demands completely and in time and offering them high-quality products is must. Production scheduling plays a major key role to achieve the necessary competitiveness and fulfil the given task. But the production scheduling issues are very complex because of the continuous changing needs of customers and the existing constraints in different metal manufacturing industry. Therefore, researchers have been aimed at finding the solutions to production scheduling problems using reconfigurable manufacturing systems. In the literature special attention has been given to production scheduling problems ever since the fifties of the last century. Number of researchers has been published, following the appearance of Gantt chart that discusses the models and methods for solving production scheduling problems. In the literature on production scheduling various models and methods are used: mathematical programming and artificial intelligence. The models mentioned in the literature can be classified as deterministic and stochastic, and as static and dynamic. The published papers treating the production scheduling problem deal with different types of production. Erel et al. and He et al. studied a single machine batch scheduling problem, and the objective of established model is to minimize the maximum lateness. In the paper the authors compare various methods for the flow-shop scheduling problem with the late work objective function. Blazewicz et al. have studied the problem of scheduling a multiprocessor task model with parallel work on several processors that is often used in modern manufacturing system is discussed and they have applied scheduling in time windows for the objective function of maximum lateness and schedule length. Golenko-Ginzburg et al. have discusses the job shop scheduling problem doe flexible manufacturing system. To solve the job-shop scheduling problem a new time and memory efficient representation of the disjunctive graph is given in the paper. T’ Kindt et al. discuss the optimization of multiple confictions criteria for flow shop scheduling problem. In the literature researchers are elaborated the activities scheduling problem aiming at minimizing the project duration with the possibility to perform the activities in several variants. The project scheduling problem classification is also given. Allahverdi et al. have studied the scheduling problem with the setup time included, in contrast to most models that disregard the machine setup time or consider it as part of the processing time and also studied the family scheduling model which includes the setup times when there are family setup times aimed at minimizing total earliness and total tardiness. Leung et al. have studied the problem of scheduling orders with various priority rules. EIMaraghy made an attempt to compare RMS and FMS, concluded that the detailed customized flexibility in RMS is possible. Galan have studied to group the products into families and to schedule the families using RMS. Meng made an attempt to proposes a model for the RMS by applying colour timed object-oriented Petri nets. Abbasie have studied to propose a mixed integer nonlinear programming model to determine. They have used a genetic algorithm-based procedure is developed to solve the model. Azabet al. have developed and integer model, they have considered operations sequencing in RMS to minimize changeover time. While satisfying a number of precedence constraints in their model.

2.1 Problem definition

This paper deals with production scheduling issues in machining shop. The machining of engine blocks (Milling, Drilling, Boring, Threading and honing) is a combined continuous discrete production with processes: loading and unloading the job, changing tools, shifting job into different machines measuring and checking the features generated. Fig.1 gives a scheme of production lines in the machining shop. The production process consists of five production lines with ten different machines for production of engine blocks.
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