

Research Article

Scheduling Mixed-Model Production on Multiple Assembly Lines with Shared Resources Using Genetic Algorithms: The Case Study of a Motorbike Company

Francesco Costantino,¹ Alberto Felice De Toni,² Giulio Di Gravio,¹ and Fabio Nonino³

¹ Department of Mechanical and Aerospace Engineering, University of Rome “La Sapienza”, Via Eudossiana 18, 00184 Rome, Italy

² Department of Electrical, Management and Mechanical Engineering, University of Udine, Via Delle Scienze 206, 33100 Udine, Italy

³ Department of Computer, Control and Management Engineering “Antonio Ruberti”, University of Rome “La Sapienza”, Via Ariosto 25, 00186 Rome, Italy

Correspondence should be addressed to Fabio Nonino; fabio.nonino@uniroma1.it

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The authors deal with the topic of the final assembly scheduling realized by the use of genetic algorithms (GAs). The objective of the research was to study in depth the use of GA for scheduling mixed-model assembly lines and to propose a model able to produce feasible solutions also according to the particular requirements of an important Italian motorbike company, as well as to capture the results of this change in terms of better operational performances. The “chessboard shifting” of work teams among the mixed-model assembly lines of the selected company makes the scheduling problem more complex. Therefore, a complex model for scheduling is required. We propose an application of the GAs in order to test their effectiveness to real scheduling problems. The high quality of the final assembly plans with high adherence to the delivery date, obtained in a short elaboration time, confirms that the choice was right and suggests the use of GAs in other complex manufacturing systems.

1. Introduction

Simulating the natural evolutionary process of human beings results in stochastic optimization techniques, called evolutionary algorithms, which can often outperform conventional methods when applied to complex real-world problems. Scheduling problems of manufacturing planning are a common example of complex problems where the interest in these groundbreaking techniques is growing among both scholars and practitioners.

The paper examines a case study of a scheduling system for a mixed-model assembly lines [1], also referred to as the permutation flowshop scheduling problem. In such a production system, the managers want to sequence different products, thus obtaining a high service level (product mix) without delays in products delivery while respecting the constraints of capacity. The focus of the present work is

the application of the genetic algorithms (GAs) as a technique for the resolution of such a complex problem.

The paper is structured as follows. Section 2 depicts the principles and the successful characteristics of these techniques, providing an applicative model for their use in combinatorial problems, in particular in the scheduling of final assembly phase of mixed-model assembly lines. We use the case study of an important Italian motorbike company as the outset of the study. Section 3 describes the company's production system and the demand management logics. Afterwards, in Section 4, we propose a scheduling approach consisting of two stages, a macrostep and a microstep. The two steps, respectively, carry out a “macroscheduling” and a “microscheduling” of the assembly operations; in particular, the genetic algorithms are applied in the microstep. We focus on the development of a scheduling model and provide the algorithms to implement in the scheduler. The paper ends