

An Approach to Schedule Production using the Reservation Tables

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Abstract. This paper deals with the problems of scheduling of manufacturing where specific requirements have to be considered like production of microwire and specialized products based on it. Scheduling of such production systems is very nontrivial because of some technological, human, and organizational issues. To tackle the respective issues some predictive and reactive scheduling schemes must be developed. The paper discusses the possibility to develop schedules based on the method of reservation tables, which is a well known method in the computer pipelines. The proposed approach it seems to be an acceptable one. In our opinion, the method of reservation tables may be successfully adapted and developed to schedule nontrivial production systems, especially when multi-mixed model lines work in small batches. Combining with other methods, the proposed approach may offer feasible schedules in computation times short enough to be accepted in real-life decision support systems.

Keywords: System engineering, optimization, scheduling, reservation table, assembly line.

1 Introduction

The reengineering and improvement of modern manufacturing enterprises is an extremely complex process because it involves a combination of technological, human, machine, and organizational issues. In order to solve such a problem, managers need models of the enterprise at the shop floor level, as well as at organizational and business levels.

Particularly, the problem of finding optimal schedules is the crucial one in real productions systems. Furthermore, research should even more focus on solving real-world scheduling problems. It is very important and necessary to provide models, methods and algorithmic tools which help managers of enterprises to construct and maintain (online!) optimal production lines. Users of the decision making support systems want to find the best suited solution. In order to achieve this goal a variety of supporting decision making algorithms are used to advice manager an optimal pro-

duction scheme. Decision making is related to the problem of selecting the optimal solution from all accessible schedules.

In this paper we focus on the problems of scheduling of production where specific requirements have to be considered like production of glass-coated microwire and products based on it. Scheduling of such production systems represents a complex problem because of many specific issues. The paper discusses the possibility to use the method of reservation tables, which is well known in the computer pipelining, in the area of production planning and control. The main purpose of the paper is to show that the method of reservation tables can be the way to develop feasible schedules in computation times short enough to be accepted in real-world decision support systems.

The paper is organized as follows. Firstly, a brief review of the problem domain is presented. This includes some basic knowledge related to joint balancing and scheduling problem (section 2). Secondly, we put in discussion the manufacturing process of microwire and products based on it. The first subsection of section 3 contains a brief introduction to the method of reservation tables. Next subsection describes the process of microwire production and resources involved. Some technological, human, and organizational issues are pointed out. After that, a possible tentative approach to solve the problems of optimal scheduling in a microwire production system is formulated. Finally, the conclusions are drawn in section 4.

2 Background

The requirements for optimal organization of the enterprise activity are actual and fit into the idea of reengineering. This idea is centered on all processes in the modern enterprise. Reengineering is a radical redesign of a business or production process to achieve a considerable improvement in performance indicators (cost, quality, productivity, etc.). The idea of reengineering is actual one as the information technology is constantly changing.

Production scheduling can be defined as the allocation of available production resources over time to best satisfy some set of criteria [1-3]. Generally speaking, the scheduling problems are NP-hard. It is probably impossible to secure optimal solutions using fast algorithms. However, some problems are in fact “easy”, in the sense that they are solvable to optimality by fast algorithms. It is well known, that for NP-hard problems an approximation is constructed for the whole problem. When building a specific approximation, different methods and techniques may be used together such as exact polynomial methods, iterative approaches, relaxation methods, genetic algorithms. Scheduling problems are found in a lot of different applications.

In general, scheduling deals with the temporal assignment of known activities to accessible and limited resources. Usually, in a production system a set of constraints has to be regarded. The generation of a normative schedule under the production constraints is a hard problem. However, in the real-world production system another seri-