

Research on Workshop Production Scheduling

Xiaohao Li^{1,*}

¹Business School, Sichuan University, Chengdu 610065, China.

Abstract

With the development of the economy and demand, competition between manufacturing enterprises is becoming increasingly fierce. In order to survive effectively in the market competition, manufacturing enterprises urgently need to find effective ways to improve the overall competitiveness. In manufacturing enterprises, production management is the focus of enterprise management, and production scheduling is the core of production management. Workshop production scheduling is the basis of the manufacturing system, and optimization of production scheduling is the core of advanced manufacturing technology and modern management technology. This paper studies the workshop production scheduling problem, analyzes the classification and methods of the workshop scheduling problem, and points out the future development of the workshop production scheduling.

Keywords

Workshop Scheduling; Manufacturing; Modern Management; Scheduling Method.

1. Introduction

Manufacturing is an important pillar of national development, the level of manufacturing in a country reflects the country's level of productivity and science and technology. With the development of science and technology and the intensification of market competition, enterprises need to respond quickly to market demand. Enterprise manufacturing is shifting to personalized, multi-variety, and small-batch production methods [1]. Therefore, the production scheduling problem of the manufacturing workshop has gradually become a research focus in the manufacturing industry.

Workshop scheduling is the core content of production management [2]. Workshop scheduling is the core of advanced manufacturing systems and modern workshop management technology, and is the basis for achieving advanced manufacturing and improving production efficiency [3]. As an important problem in the field of optimal combination, the production scheduling problem is a resource allocation problem that meets process constraints and task configuration requirements. The task of workshop production scheduling is to determine the processing sequence and processing time of workpieces on the equipment under the constraints of limited resources in the enterprise workshop to achieve the predetermined production goals. The scientific and effective formulation of production scheduling schemes plays an important role in controlling the inventory of work in progress in the production workshop, shortening the product supply cycle, and improving productivity. Therefore, the research on workshop scheduling has important theoretical value and practical significance [4].

2. Overview of Workshop Scheduling

The workshop production scheduling problem is to plan the workshop production process. As one of the important components of enterprise production operation, the production scheduling problem has been receiving widespread attention. Many scholars have explored and

studied the production scheduling problem from different perspectives. However, the production scheduling problem has not formed a unified definition so far.

Rodammer F A & White K P [5] believe that the definition of production scheduling is "the allocation of labor, raw materials and machine resources involved in the manufacturing process within a certain period of time to produce a variety of products". McKay K N and Wiers V C S [6] believe that "production scheduling is to complete a certain work task, and under the premise of meeting various constraints, allocate each task to specific resources, so that the processing time or cost is optimal." Reklaitis G V [7] believes that the definition of production scheduling is "a decision process about what, when, where, how in order to complete a given set of products within the planning cycle, and to meet the premise of each product processing technology constraint", among them:

What means the variety and quantity of products to be processed during the planning period;

When refers to the planned start time and planned end time of each specific operation;

Where refers to which machine or machining center each specific operation is performed on;

How refers to how the product enters the production system, priority rules for order production, and selection rules for processing machines, etc.

Generally speaking, the problem of workshop production scheduling is a reasonable allocation of limited resources in the system, thereby avoiding resource conflicts and meeting specific target requirements. A typical workshop scheduling problem includes a set of parts to be processed. Each part contains a set of operations. Each process requires production resources such as equipment, and must be processed according to a certain process route. Different workpiece processing procedures can be different. The purpose of scheduling is to rationally allocate resources such as machines for parts and reasonably arrange the processing time. While satisfying the constraints, some indicators are optimized. These indicators are generally delivery time or cost. The quality of the production shop scheduling results is directly related to the production efficiency of the enterprise.

3. Scheduling Research Status

In the original 1950s, workshop production scheduling problems were studied as purely mathematical problems to obtain mathematically optimal solutions. Johnson [8] published the first paper on scheduling research in 1954, solving the flow shop scheduling problem of two machines with the maximum process time as the goal. In the more than 50 years since then, many scholars in abroad have conducted a lot of research on production scheduling and achieved relatively large results. A large number of intelligent scheduling methods have been generated, including simulation scheduling, heuristic search, simulated annealing, tabu search, and neural network, etc.

The core content of workshop production scheduling research is scheduling method. Although the scheduling methods are diverse and complex, they can basically be classified into four categories: heuristic-based methods, operations research-based methods, simulation-based methods, and artificial intelligence-based methods.

The operations research-based methods are mainly used to study more traditional problems, including linear programming, dynamic programming, branch and bound methods, etc., which are characterized by seeking optimal scheduling time or near optimal.

The heuristic-based scheduling method is easy to implement, has low computational complexity, and can be used in dynamic scheduling systems. Therefore, it has been widely concerned by scholars for many years, and many new scheduling rules have continuously emerged. Panwalkar S [9] proposed more than a hundred types of tuning rules. Generally speaking, there are three types: simple rules, compound rules, and heuristic rules.

The simulation-based method collects data by running a simulation model, and uses the data to analyze the actual system, thereby adopting a suitable control scheduling method for the system. However, there are still some problems with pure simulation methods. For example, the simulation-based methods lack theoretical significance and are limited by human simulation capabilities.

Artificial intelligence took planning and scheduling issues as one of its application areas in the 1960s. The symbol of artificial intelligence(AI) applied to scheduling systems was M Fox [10] of Carnegie Mellon University in 1983 studied constraint-based in his doctoral dissertation Intelligent dispatch. The artificial intelligence scheduling method is a general term for modeling and solving scheduling problems based on artificial intelligence technology and human scheduling expert experience. It mainly includes the following branches: intelligent scheduling expert system, constraint planning, and cooperative solution method based on Multi-Agent system.

4. Scheduling Classification

Currently, according to different research objects, there are different classification methods for workshop production scheduling problems.

According to the type and number of resource constraints, the workshop production scheduling problem can be divided into single-resource workshop production scheduling, dual-resource workshop production scheduling, and multi-resource workshop production scheduling. According to the composition of parts and workshop, the workshop production scheduling problem can be divided into flow-shop scheduling, job-shop scheduling, single-shop scheduling, and open-shop scheduling. According to job processing characteristics, workshop production scheduling problems can be divided into static workshop scheduling and dynamic workshop scheduling.

The actual scheduling problem is often a combination of several basic scheduling types, and the scheduling is often random and dynamic.

5. Scheduling Development

More than half a century of production scheduling research has basically focused on general scheduling problems, and most workshop production scheduling problems have NP difficulty characteristics. In order to reduce the difficulty of research, the production scheduling research basically undergoes a series of simplifications, which is far from the actual production. Moreover, the production scheduling problem has not formed a systematic method and theory, and there is still a large gap between theoretical research and practical application. Until today, the application of production scheduling problem research results in production practice is not ideal, and there are still many limitations, mainly in the following aspects: (1) the model is too simplified; (2) the method is too single; (3) the scope of application is narrow [11]. Therefore, how to study a more effective scheduling method based on the classic scheduling theory has been a hot issue that academia and business have paid close attention to for many years.

With the in-depth study of workshop production scheduling problems, production scheduling research will inevitably be further combined with production practices, and will develop in an integrated, dynamic, efficient, intelligent, and practical direction.

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