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The overlapping production planning: A new approach of bounded capacity management

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Abstract

This paper presents a new load adjustment approach by overlapping, guaranteeing the existence of a limited capacity schedule without scheduling under the assumption of preemptive tasks. The new method exploits the order's margins and tries to respect the just-in-time principles. First, we introduce the overlapping production planning. Second, we present the application of this approach to the case of manufacturing-to-order companies and to the seasonal industrial activities. Finally, we show how we can use this approach in the case of pure and generalized flow-shop.

Keywords: Bounded capacity planning; Overlapping production planning; Margins management; Flow-shop

1. Introduction

Traditionally, the production planning is made in a hierarchical way. First, one decides what products to supply, in which quantities taking into account the delays and then schedules the tasks for the production resources.

This approach involves many problems [1]:

- the net calculation requirement is made without considering capacity constraints. So, margins are necessarily introduced which leads to anticipation and lengthening of the horizon planning;
- the load calculation system considers the capacity constraints (Fig. 1) by comparing period per period or cumulatively the available with the required capacities. It does not exploit the order's margins;
- the material grouping process, according to the MRP technique, induces the creation of another unexploited margins.

Let us consider the following example of a production plan composed of 7 jobs which will be treated on a single processor with ready and due dates as shown in Table 1.

The required capacities corresponding to a back scheduling and a forward scheduling from this set of jobs are, respectively, the following: None of these charts proves the feasibility or the infeasibility

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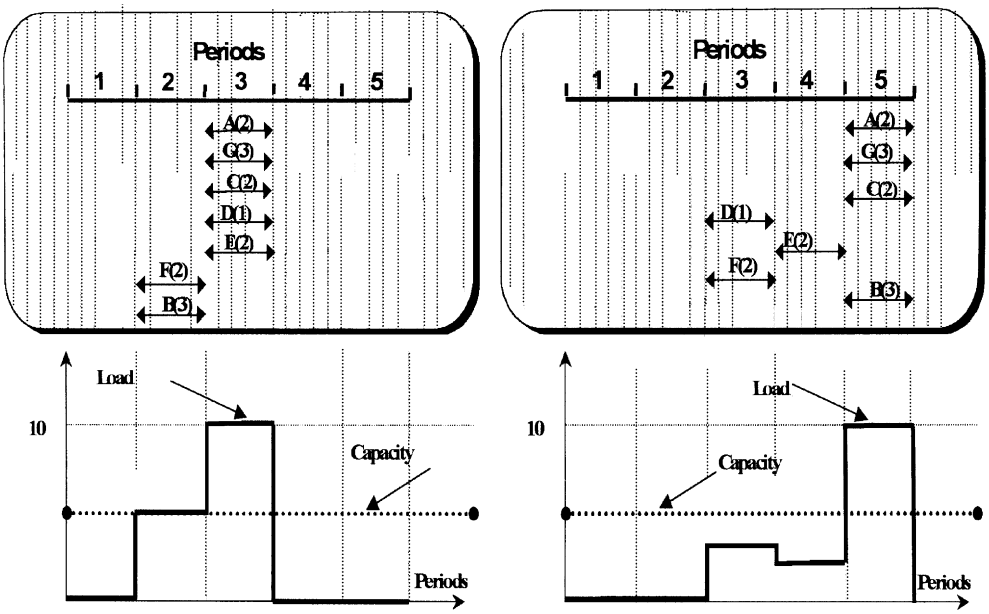

Fig. 1. Capacity and load by period for an earliest and a latest loading.

Table 1
Example 1

Job	Process time	Ready date (period)	Due date (period)
A	2	3	5
B	3	2	5
C	2	3	5
D	1	3	3
E	2	3	4
F	2	2	3
G	3	3	5

of this set of jobs considering their ready and due dates. The charts showing the load by period proves only the infeasibility of an earliest loading and a latest one. We cannot conclude also about the feasibility if we only consider the cumulative load chart (Fig. 2).

In comparison with this classical approach, the advantage of the overlapping production planning developed in this paper is to guarantee the feasibility of a limited capacity planning without scheduling (under the assumption of preemptive tasks). It works by exploiting and distributing the order's margins between tasks. It leads to allocation of a time scheduling segment for each task respecting capacity constraints and ensuring a delivery date for each product.

Bai [2] has developed a real-time scheduling approach for flow-shop organized firms. He tries with heuristics and a non-linear program to produce what is demanded and at the same time control the work-in-process inventory. Hillion [3] has studied the problem of a finite capacity flow control in a multi-stage/multi-product environment. He has modelled his problem in a non-linear program and has solved it with the dynamic programming. Gunther [4] and Arosio [5] also developed two heuristics for the lot sizing in the context of finite capacity. They can be used only for the context of a single stage production system. The problem of load modeling has also been studied by Adenzo-Diaz [6].

Another approach for finite capacity planning has been developed based on mathematical programming approaches, linear programming, mixed integer programming, and dynamic programming or on theory of constraints [7–9,12–17].