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A Multi-level Approach for Scheduling and Capacity Management with Alternative Resources *

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Abstract

This paper deals with the assignment and scheduling problem in a context of a make-to-order environment. A two-level approach based on a time-aggregation is proposed. The upper level (macro-scheduling) roughly schedules production orders over a discretized mid-term horizon and helps the decision-maker to elaborate its plan considering the managerial policy that has been chosen (overtime, subcontracting, tardiness, etc.). The problem is formulated through a mixed-integer programming model (macro-scheduling model). The lower level (scheduling) refines the macro-schedule and accurately places operations on the resources that can be used (time is considered as a continuous parameter at this level). The study focuses on the upper level modeling in a context in which any operation can be performed by one resource of a pool of "alternative resources". The assignment model relies on an aggregate view of each pool in order to reduce complexity. Finally the paper focuses as well on both bottom-up interactions (aggregation mechanisms) and top-down interactions (guidance mechanisms and robustness property) between levels.

Key words: Scheduling, Macro-scheduling, Multilevel scheduling, Robustness, Time aggregation, robustness, alternative resources, mixed-integer programming.

1 Introduction

In the context of a make-to-order production environment, decisions of various natures must be taken to organize manufacture as well as possible and to minimize costs. Scheduling is a decision-making process that plays an important role in most manufacturing and production systems. Classically, the role of a production scheduling module is to precisely locate in time the manufacturing operations (or tasks) on resources. In order to satisfy the need for taking into account future predicted data, such a module is often run on a medium-term horizon basis. Additionally, it is important to carry out capacity adjustments (load smoothing, overtime and subcontracting management, etc). Few tools in this field are proposed to decision makers. The traditional scheduling software is well adapted for short-term or real-time scheduling problems but they do not allow a medium-term capacity management. Moreover, given the quantity and the granularity of handled information, they are not able to make an overall optimized scheduling and are rather based on local priority rules. The advanced planning tools (APS)

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