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Guidelines for deploying and implementing scheduling systems*

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1. Introduction

While the literature on scheduling models and solution procedures is extensive, very little has been written on how to bring these models and procedures into practice. This has given rise to the so-called "gap" between the theory and practice of scheduling (see McCarthy and Liu 1993), which has been widely documented in several studies, such as e.g. Ford et al. (1987). In order to close this gap between scheduling models and procedures, and their implementation in a real setting, the former should be translated into a piece of software supporting scheduling decisions in a company. This implies carrying out a software development process to obtain a final product, i.e. a scheduling system at work. As such a software development process, there are a number of technical, human and organisational issues which are critical and should be adequately managed to ensure a successful result.

Despite the importance of the process of developing such systems, scheduling research has often overlooked the topic, as there are hardly references providing guidance or recommendations to successfully accomplish the development of a manufacturing scheduling system, or at least case studies describing this development process for a particular application so lessons and insights for future developments can be learned.

Our paper is aimed towards these two important issues. To do so, we first review the existing literature on case studies regarding the application of scheduling systems. From this review, we derive and classify a number of conclusions that can be used for developing scheduling systems. To do so, we present guidelines for developing scheduling models for industrial practice based on our experience and on the analysis of the relevant literature. While we do not claim that the proposed architecture and guidelines are universally valid nor should be strictly followed, we hope that they will help orienting the design of scheduling models towards a greater applicability.

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In the extended version of the paper, we will present the results from the analysis in the literature, while in this abstract we briefly outline the guidelines, which we group in different topics in order to provide a comprehensive view of the different aspects treated in the literature. These are:

- **Model layout**. The focus should be kept on modelling relatively simple layouts. Even if the physical layout of the factory may be very complex, there are a number of reasons indicating the suitability of focusing onto simpler structures, at least on the initial stages of the life cycle of the scheduling system. These reasons include an incremental development of the scheduling system, the use of an A-B-C analysis, taking into account the dynamic nature of the business, and the need of preprocessing/what-if analysis.

- **Data acquisition and manipulation**. The analysis of literature on real cases implementation shows how hard is to collect and keep all the data needed by a complex scheduling system. At least the following issues must be addressed: Development of a database interface, Data maintenance, keeping interfaces as simple as possible, and addressing data performance issues.

- **Objectives**. It is difficult to overestimate the importance of coming to terms with the scheduling objectives. At the first glance, virtually all objectives that one may pose could be of interest for the decision maker, as single objective optimisation is controversial in practice. Nevertheless, our experience indicates that it is difficult to visualize and understand more than 2-3 objectives, as the decision maker can hardly make sense of the economic impact of more than 2-3 conflicting operational measures. Therefore, the main issue here is how to prioritize/select among these. There are several approaches to do it, including prioritisation of objectives, taking out non-conflicting objectives, Postponement of the decision on objectives, and transforming objectives into constraints (and vice versa).

- **Solution procedures**. A great effort in the scheduling field has been devoted to solution procedures, at least from the most theoretical side. A general problem is that most existing solution procedures have been tightly linked to the models, therefore generally resulting in algorithms with low performance outside the original models for which they were conceived, if applicable at all. Other issues to be regarded are the focus on feasibility, the need to provide a set of alternative solutions, and the understanding of solution procedures, among others.

- **Constraints**. While scheduling literature is rich in dealing with certain types of constraints, there are constraints that are so common in real environments that it is surprising that most existing models do not deal with them. A comprehensive list is to be provided in the final paper.

References

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