Manufacturing Scheduling Systems

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An Integrated View on Models, Methods and Tools

Springer

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To Carmen, Julio, and Daniel

Jose M. Framinan

To Karin, Steven, and Annemarie

Rainer Leisten

To Gema and Diego

Rubén Ruiz García

Preface

Obtaining economic and reliable schedules constitutes the core of excellence in customer service and of efficiency in manufacturing operations. While few areas have been more productive in decision sciences than scheduling, only a fraction of the vast amount of scheduling research has been translated into practice. On one hand, the inherent complexity of most scheduling problems has led to an excessively fragmented and specialised field in which different facets and issues are treated in an independent manner as goals themselves, lacking a unifying view of the scheduling problem. Aside, scientific brilliance and mathematical elegance has been sometimes prevalent to practical, hands-on approaches, producing specific procedures of narrow application. Finally, the nearly non-existence of research on implementation issues in scheduling as well as the scarcity of case studies has not helped in translating valuable research findings into industry.

In this book we attempt to overcome these limitations by presenting an integrated framework for formulating, developing and implementing systems that can be effectively used for supporting manufacturing scheduling decisions. To do so, we have intentionally avoided the traditional taxonomy style of many scheduling approaches and focused on the explanation and integration of the different issues into a (hopefully) coherent framework for modeling, solving and implementing scheduling decisions. Therefore, the book does not contain a detailed description of specific models and/or procedures, but rather will present a general overview of the scheduling field in order to provide the tools to conduct an up-to-date scheduling research and practice. To compensate this, we include a generous compilation and discussion of related literature for further reading, so the reader can easily track the main contributions of particular interest.

The book is intended for an ample audience who wish to get an overview of actual scheduling topics. It may constitute a starting point for researchers in the scheduling field. Also, post-graduate students with a focus on operations management can be attracted by the content of the book. Practitioners in the field would feel comfortable with many of the models and systems presented in the book as well, as they can easily see in them real-life cases. As a result, the book is not intended to be read sequentially, but is designed to support different itineraries, providing comprehensive introductory chapters/sections before detailed explanation of specific topics.

There are few but important prerequisites for this book. Knowledge of the most basic concepts of production management is required, although an effort is done in Chap. 2 to place scheduling into context. Maths will appear profusely in some parts of the book, mostly in the chapters devoted to scheduling models.

Organisation of the book

The book is structured into five parts. In the first part, we introduce the main definitions and notation, and present the framework that we will use throughout the book. In this framework, a scheduling system is defined as a collection of models (representations of scheduling problems), methods (procedures to obtain efficient solutions out of scheduling models), and tools (software devices to embed models and procedures in order to support the scheduling decision problem), together with the human elements operating the system. Models, procedures, and tools will constitute the next three parts of the book. A final part on scheduling systems is devoted to assemble all these elements together in a roadmap to guide the development of a scheduling system. The structure of the book is summarised in Fig. 1.

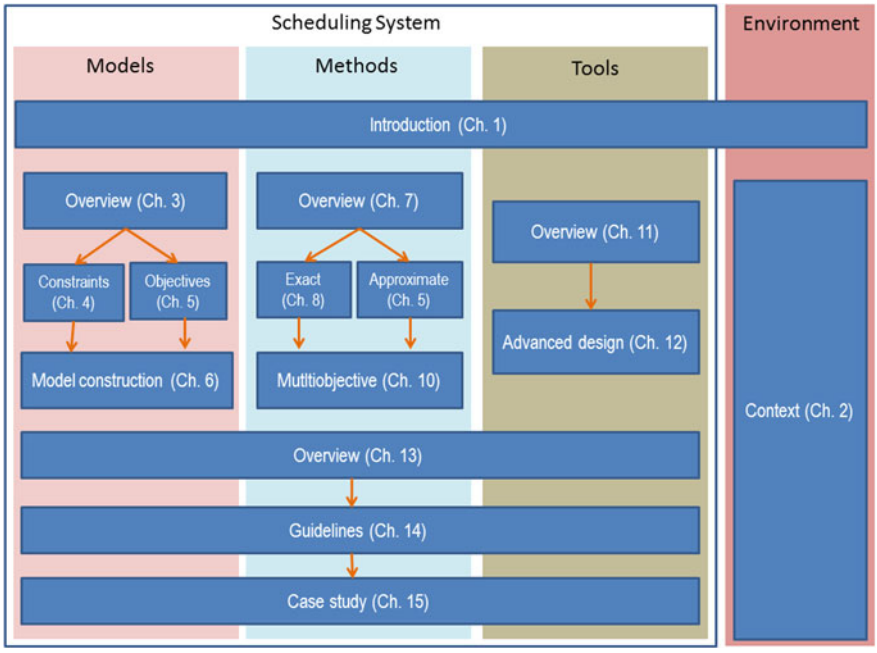

Fig. 1 Structure of the book

As mentioned before, the book does not have to be read comprehensively and sequentially. Manufacturing scheduling constitutes a topic of interest for different professional (including managers and top/intermediate staff in charge of operations management) and academic profiles (including production/manufacturing engineers, computer scientists, and different bachelors in operations research and management science). When used as a textbook, the instructors would have a clear idea about the content, sequence, and depth in which the different topics contained in the book should be learnt. Therefore, the subsequent lines are mainly intended as a rough advice whenever such supervision is not present.

We believe that a rather basic knowledge of the scheduling field can be gained by reading the introductory chapters of each part, i.e. Chaps. 1, 3, 7, 11, and 13. A more classical (although, in our opinion, also more theoretical) itinerary for the scheduling field would exclude Chap. 11 to Chap. 15, and would stress issues related to modeling and solution procedures. Modeling would be reinforced by adding Chaps. 4, 5, and 6. These three chapters are heavily interdependent and therefore should be read together, although readers with some scheduling background may skip some parts of Chaps. 4 and 5, and focus instead on the discussions in Chap. 6. A rather comprehensive understanding of solution procedures is provided in Chaps. 8 and 9, whereas multiobjective scheduling issues are treated in Chap. 10. Since multiobjective scheduling is a hot topic with practical and theoretical interest, we would favor its inclusion even at a basic level course. Nevertheless, most of it could be skipped if the reader adopts a more classical/basic view of the topic.

We think that Chaps. 11 and 12 would be of particular value for an audience interested in the design and implementation of scheduling tools. Chapter 11 would serve to grasp a general view on the topic, whereas Chap. 12 is intended for readers with some background and experience on business information systems, and –in our opinion– should be spared for basic scheduling courses, unless they are heavily geared toward information systems/computer science.

We hope that users and consultants of manufacturing scheduling systems would find interesting Chaps. 13 to 14, as the practical issues treated there are not usually subject of classical scheduling books. Despite the verbosity and apparent simplicity of some of the ideas contained in these chapters, they are mainly intended for an experienced reader who may better grasp the inherent complexity of the deployment of manufacturing scheduling systems and their integration with the human schedulers. We are not sure that many of the ideas contained there could be fully appreciated at a more basic level, although we think that at least a glimpse of those in Chap. 13 should be given in order to avoid an excessively technical approach to the field, which in our opinion is and has been a rather common flaw in scheduling teaching and research.

Finally, Chap. 15 may be used in many different itineraries, ranging from a basic level in which modeling and solution procedures issues are seen into

practice, to a more advanced discussion case in which success factors, shortcomings, lost opportunities, and learnt lessons can be debated.

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