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Editorial

Project management and scheduling

The EURO Working Group on Project Management and Scheduling (WG-PMS) was established in 1986, with the aim of assessing the state-of-the-art and stimulating progress in both theory and practice within the area. To achieve these goals, the decision was made to organize workshops every two years. The Eighth International Workshop on Project Management and Scheduling was held in Valencia (Spain), April 3–5, 2002, and was hosted by the Department of Financial and Mathematical Economics and the Department of Statistics and Operational Research of the University of Valencia. The proceedings book contains extended abstracts of all 94 papers accepted by the program committee. These papers were clustered for presentation into 26 sessions scheduled in three parallel streams. Broadly speaking, the streams correspond to Project Management, Machine Scheduling, and Applications.

This feature issue contains 20 papers that were presented at the Workshop, and accepted for publication after a careful reviewing process. We would like to express our gratitude to all the reviewers for their invaluable efforts allowing us to select a set of high-quality contributions.

The first three papers address the issue of scheduling under uncertainty. The project scheduling literature largely concentrates on the generation of an optimal (or near optimal) schedule for problems arising in project planning and control that assume complete information and a static deterministic environment within which the precomputed baseline schedule will be executed. However, uncertainty lies at the very heart of real-life project management, and thus the literature on project scheduling under risk and uncertainty is witnessing a recent explosion.

Herroelen and Leus in their invited review overview fundamental approaches for scheduling under uncertainty—many of which have been mainly or solely studied in a machine scheduling environment—and discuss the potentials of these approaches for scheduling under uncertainty projects with deterministic network evolution structure.

Elmaghraby delivers a stimulating and insightful discussion on the issue of uncertainty in project management, especially when dealing with the risk inherent in the estimates relative to cost and time. Based on a project scheduling problem with stochastic activity work contents, the paper exemplifies the prejudicial consequences that are incurred in project control when random variables are substituted into their expected values.

Introducing flexibility in the schedule determination phase is an approach proposed by Artigues, Billaut, and Esswein to cope with uncertainty in a general shop floor scheduling setting with release dates and deadlines. The flexibility is provided by generating a family of schedules instead of a unique one, so that the decision-maker can switch from one solution to another in case of disruptions. A family of schedules is represented by defining for each machine a sequence of groups of operations, where the operations within a group are totally permutable. The generation and evaluation of families of schedules, the maximization of flexibility criteria and the impact of grouping operations on the makespan value are some of the issues dealt with in the paper.

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The next four papers are devoted to project management. In medium to large-scale projects, it is quite common for the project owner, lacking the technical skills in a number of areas that the project execution may call for, to subcontract some or all of the project activities to one or more specialists. Under these circumstances, a bidding mechanism is often the preferred price-setting mechanism. Paul and Gutierrez approach, from the point of view of the project owner, the process of price setting using sealed bids. They use a parsimonious stochastic model to compare the expected price fetched by three commonly used contract forms: *Fixed Price, Cost Plus* and an intermediate type of contract that they call a *Menu* contract. The impact of risk aversion and collusion on the average winning bid price is also analysed.

In project management, the project duration can often be compressed by accelerating some of its activities at an additional expense. This is the so-called time-cost trade-off problem (TCTP). Next two papers consider different versions of this problem.

The paper by Akkan, Drexl, and Kimms provides lower and upper bounds for the discrete version of the problem (DTCTP) using column generation techniques based on network decomposition. A computational study is provided to demonstrate that the presented bounds are tight and that large and hard instances can be solved in short run-time.

Recently, time-switch constraints have been introduced into the discrete time/cost trade-off problem in order to cope with day, night and weekend shifts. Basically, these constraints impose a specified starting time on the project activities and force them to be inactive during specified time periods. Vanhoucke proposes a new branch-and-bound algorithm for the DTCTP with time-switch constraints that outperforms previous results.

In the context of the resource-constrained project scheduling problem (RCPSP), Valls, Ballestín, and Quintanilla propose the double justification as a technique able to improve the quality of solutions obtained by other methods. By incorporating double justification into 22 diverse heuristic algorithms, they show that justification is a simple technique that can be incorporated easily into diverse algorithms and produces notable improvements in the quality of the schedules with a small, and generally favourable, change in computing time. Their main conclusion is that double justification should always be considered when designing an algorithm for the RCPSP.

A group of five papers are clustered around the study of the computational complexity of different machine scheduling problems. Sevastianov proposes a novel complexity analysis of discrete problems, multi-parameter complexity analysis, which consists in establishing the complexity of the various sub-problems of a given problem whose intractability has been determined. The sub-problems are specified by combinations of constraints on key problem parameters. Since the number of sub-problems may be infinite, the author introduces and studies the concept of a basis system of sub-problems, a minimum cardinality set of sub-problems such that the determination of their complexities would be sufficient to determine the complexity of any other sub-problem.

The new ideas and theoretical results presented in the paper are illustrated with the application of multi-parameter complexity analysis to two discrete problems: the open shop scheduling problem and the connected list colouring problem. This final problem allows a natural interpretation as a scheduling problem on parallel machines.

Flow-shop problems with a single server are generalizations of classical flow-shop problems where setup times are assumed to be separable from the processing times and all setups have to be done by a single server. Brucker and Knust derive new complexity results for special cases where restrictions on processing and or setup times are specified.

Blazewicz, Pesch, Sterna, and Werner consider another version of the flow-shop scheduling problem—the two-machine non-preemptive flow-shop scheduling problem with the total weighted late work criterion and a common due date. This criterion takes into account the duration of task late parts while ignoring the quantity of this delay. They have proved the binary NP-hardness of the problem mentioned and propose a dynamic programming approach of pseudo-polynomial time complexity proving in this way the ordinary NP-hardness of this problem.

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