Editorial

This issue devoted to "Modeling and optimization of manufacturing systems" is a compilation of a wide range of selected papers presented during the 9th IFAC Workshop on Intelligent Manufacturing Systems held in Szczecin, Poland in October 2008.

Optimization of manufacturing systems takes a variety of forms and uses different methods and techniques. The implemented methods offered by theories of operational research, stochastic processes, computer simulation and artificial intelligence provide versatile conceptual models of enterprise operation. Their usage is usually limited to some aspects of enterprise considered. Depending on requirements imposed on the solution of particular tasks, whose nature can be uncertain or deterministic, dynamic or static, etc., the different solution methods may be applied to the same problem. No methods, however, can guarantee an efficient solution adequate for all problems occurring in both technical and organizational aspects of enterprise production management.

In other words, the problems arising in manufacturing are as diverse as the techniques and tools used for solving them. Some problems can be solved with simple heuristics, others may require more sophisticated optimization approaches, while others need to be tackled with artificial intelligence tools. Therefore, in order to achieve successful management of traditionally organized and/or extended enterprises, the methods applied should take into account interconnections existing among a variety of money, energy, personnel, material and data flows, as well as the requirements imposed on reliable, cheap and on-line decision making regarding tasks allocation and scheduling, workflows planning, and so on. This means that the selection of the appropriate conceptual model aimed at the development of the model-based design and evaluation methods is of primary importance.

In the aforementioned context this issue covers various aspects of manufacturing management while providing the state-of-the-art in the field of modern computer science-based management engineering, particularly in such domains as: discrete event theory, scheduling, uncertain systems, simulated annealing, computer simulation and so on. The papers fall into three groups according to the kind of foundations, methods, and techniques for manufacturing systems optimization, ranging from a general modeling and designing framework to specific issues related to the implementation of information technology as well as the concepts of production flow planning.

The first four papers deal with general issues concerning the layout and product designing. Flexible organization of production space is considered by Owsinski. In particular, the machine-part grouping problem is discussed, as equivalent to partitioning sets of machines and operations into subsets, corresponding to block diagonalisation with constraints. The attempts to solve the problem with clustering methods are outlined. Martins and Tsuzuki propose a new simulated annealing based method with adaptive neighborhood heuristic to solve the problem of minimizing the waste of space that occurs on a rotational placement of a set of irregular bi-dimensional items inside a bi-dimensional container. The objective function is evaluated in a constructive approach, where the items are placed sequentially. The sensibility of each continuous parameter is associated to its probability distribution in the definition of the next candidate.The next paper written by Dolgui *et al.* deals with a decision support tool for preliminary design of transfer machines with rotary or mobile tables. In these transfer machines, the machining operations are grouped into blocks, where the operations of the same block are simultaneously performed by one multi-spindle head. The goal is to select the number of working positions and to decide which spindle heads will be installed minimizing the machine cost while respecting a given production rate. The math-

ematical and decision-support methods developed and implemented in a software for the optimization of preliminary design of such machining systems are presented. A new expression approximating the quasi-renewal function is proposed by Chelbi *et al.* for systems which times to first failure follow a Gamma distribution. The modeling of a preventive maintenance strategy applied to a single-unit system subject to random failures is considered. Mathematical models aimed at evaluation of the system stationary availability and determining of the optimal preventive maintenance period are developed. Simple deadlock avoidance policy is examined on a numerical example.

Production flow planning employing different methods ranging from genetic algorithms to computer simulation subject to uncertain and exact (precise) data is addressed in the second group of next four papers. Profound considerations and comprehensive results on multi-objective job-shop scheduling with the application to production processes are given by Witkowski *et al*. The authors describe the basic meta-heuristics applied for solving the resulting optimization problems and the approaches that use domination method, fuzzy method, and analytic hierarchy process (AHP) for comparing schedules in accordance with multiple objectives. The effectiveness of the corresponding scheduling algorithms is tested on several examples and the results are shown. Janiak *et al.* study problems of scheduling unit-time jobs on identical parallel processors, in which for each job a distinct due window is a priori given. The version is investigated when a job gains an earliness or tardiness cost if it is not completed within its due window. Properties of optimal solutions are set up for different scheduling criteria. An uncertain version of a production planning problem is addressed in the paper by Gąsior and Józefczyk. A total utility connected with the manufacturing is maximized while an amount of resources are not precisely known and the formalism of uncertain variables is employed to describe the uncertainty. The solution algorithms for two versions of the problem are presented. The selected job scheduling problem for unit and small batch production as well as its heuristic solution algorithms are presented by Matuszek and Mleczko. Results of exhaustive computer simulations and of tests on real data are given. The algorithms proposed can be applied to real-world production systems as the extension of ERP systems.

The last group of two papers comprises works on control issues stated within different frameworks of discrete event systems and Petri nets theory. The ontological concept to a mathematical model of a discrete event dynamic system is considered by Kulba *et al.* The problem considered concerns an approach allowing one to construct this model in an event-space, so as being conceptually based on the same idea, previously employed in differential system models given in the algebraic form of monoid in state-space. This note presents a control synthesis approach for discrete event systems modeled by marked graphs with uncontrollable transitions. The next paper, written by Sioud *et al.*, deals with discrete event systems modeled by marked graphs not necessarily bounded and not necessarily safe. It is shown that existing control synthesis approach does not consider the deadlock avoidance for closed loop systems. Using the structural proprieties of marked graph, the causes of deadlock situations are defined and a formal method to avoid them is proposed.

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Guest Editors