



# Editorial: Simulation optimization in manufacturing and services

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Accepted: 26 October 2020 / Published online: 6 November 2020  
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## 1 Introduction

Simulation Optimization is an active field of research and is also increasingly being used in practical simulation applications and incorporated into both simulation and optimization software packages. This Special Issue of Flexible Services and Manufacturing (FSM) journal is devoted to report the recent advancements in Simulation Optimization techniques for manufacturing and services systems and how they are applied in practice. Indeed, many systems in several areas of manufacturing and service management are too complex to be studied analytically, and computer simulation has long been a useful tool for evaluating the performance of such systems. However, a simple evaluation of performance is often insufficient. To this aim, a deeper exploratory process may be provided by Simulation Optimization, which is the process of finding the combination of decision variables corresponding to the best performance of a system, evaluated through the output of a suitable simulation model. There has been a great deal of work on Simulation Optimization in the research literature, and optimization (simulation) procedures have been recently incorporated into several commercial simulation (optimization) software tools. Methods for Simulation Optimization vary greatly depending on the problem setting and how the possible uncertainties are considered. There also appears to be a

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significant gap between those techniques that have been extensively studied in the research literature and those that are commonly used in practice. Indeed, this difference is widely recognized, and this Special Issue of FSM aims to help bridging this gap. Papers included in the Special Issue provide a substantial novel contribution with regard to the relevant scientific literature. They address research issues linked to Simulation Optimization, and how it can contribute to solve real/realistic problems. Topics cover methods and applications of Simulation Optimization to manufacturing and services systems. Application oriented articles also bring a scientific contribution, highlighting the underlying theoretical issues, and explaining the concrete benefits obtained in the application.

The reviewing process involved a number of experts in various fields. Strict evaluation criteria respecting the high standards of the journal were applied. The papers accepted for publication address different currently challenging application areas and new concepts in modeling and solution approaches. As a result of the rigorous editorial process, 6 articles were accepted out of the 34 received submissions for publication in this Special Issue.

The following Sect. 2 contains an analysis of the accepted papers, including a short description of each of them.

## 2 Papers in the special issue

The papers included in this Special Issue of FSM refer to the theory and the applications of Simulation Optimization in various areas, and each article investigates on modeling or methodological issues giving a relevant contribution.

The article *Population-based simulation optimization for urban mass rapid transit networks* by Schmaranzer et al. (2019) presents a simulation-based optimization study for urban mass rapid transit networks. The underlying discrete event simulation model contains several realistic and detailed stochastic elements, whereas the overall optimization problem involves both cost reduction and service level improvement. The overall approach has been tested on the subway network data of Vienna.

The successive paper titled *Impact of travel time uncertainties on the solution cost of a two-echelon vehicle routing problem with synchronization* is authored by Anderluh et al. (2019), and analyzes the performance of an innovative city distribution scheme for a two-echelon vehicle routing problem with synchronization issues between vans and cargo bikes, in a realistic context where travel time uncertainties are also considered. The paper presents a re-optimization method for the deterministic solution of the problem, using a simulation model, which significantly improves the quality of the overall solution in real-life scenarios.

Gao et al. propose the article *Capacity allocation and revenue sharing in health-care alliances* (Gao et al. 2019) studying the operations of such alliance, where two types of independent units collaborate to improve both efficiency and revenue. They propose a two-stage game-theoretic approach to determine the optimal incentive and coordination mechanisms of the alliance. The equilibrium decisions obtained

through simulation provide suggestions of significant practical value for healthcare alliances.

The fourth article in the Special Issue is *Integrated preventive maintenance and flow shop scheduling under uncertainty* by Seif et al. (2019) dealing with stochastic scheduling of production and maintenance activities in a permutation flow shop environment. It proposes a two-stage stochastic mixed-integer program, extending the classic permutation flow shop scheduling problem to consider preventive maintenance activities. The authors apply Simulation Optimization to solve large-scale instances of the problem, and to validate their mathematical model.

Lidberg et al. authored the paper *Optimizing real-world factory flows using aggregated discrete event simulation modelling* (Lidberg et al. 2019). This article considers the combination of discrete event simulation, aggregated models, multi-objective optimization, and data-mining to address complex factory problems. A real industrial case study is reported, showing the potential of the proposed approach.

The paper *Scheduling approach for on-site jobs of service providers* by Holczinger et al. (2019) addresses scheduling problems arising in communication service providers operations. In the considered problems, mobile groups of workers have to deliver services at different locations. The orders have various time constraints, some of which can be violated at the cost of incurring penalties. The proposed approach relies on the S-graph framework, which is extended to handle the special aspects of the problem, and it is illustrated through a case study of an Hungarian service provider.

### 3 Concluding remarks

As Guest Editors, we would like to express our gratitude to everyone who contributed to the success of this editorial project.

We thank the FSM Editor in Chief Andrea Matta, and the members of the Editorial Board, for providing us with the opportunity to edit this Special Issue. We would like to thank the referees involved in the different revisions for their efforts, and for sharing their expertise and opinions in order to have a set of high-quality articles.

Finally, we are grateful to all the authors who made this Special Issue possible.

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