Preface for Flexible Services and Manufacturing

Jim Macgregor Smith, Horst Tempelmeier, Maria Di Mascolo, Tullio Tolio

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J. MacGregor Smith
*email:jmsmith@ecs.umass.edu

Horst Tempelmeier
†email:tempelmeier@wiso uni-koeln.de

Maria Di-Mascolo
‡email:maria di-mascolo@g-scop.grenoble-inp.fr

Tullio Tolio §
email:tullio.tolio@polimi.it

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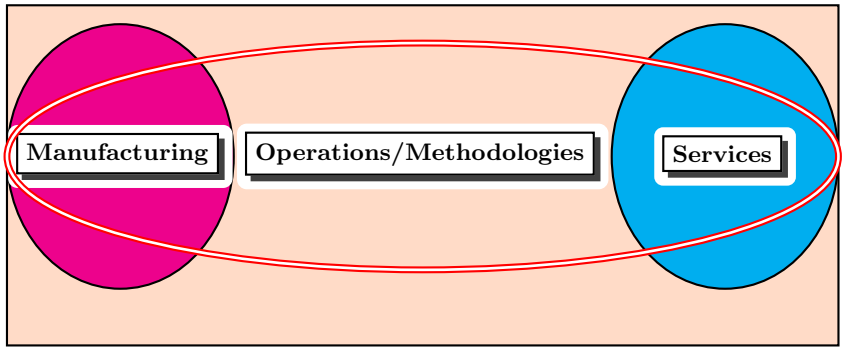
1 Introduction

This special issue of **Flexible Services and Manufacturing** is an outgrowth of the 11th International Conference held in Acaya, Italy sponsored by the organization **Stochastic Models of Manufacturing and Service Operations (SMMSO)**. These international conferences gather together knowledgeable individuals from all over the world every two years to communicate and share ideas. The conferences have been ongoing since 1997.

The main purpose of this special issue is to present innovative results of stochastic models of Manufacturing and Service System operations united by common methodologies and problems. Service systems (non-manufacturing) papers in this volume demonstrate that their operations are strongly related to manufacturing system operations and methodologies. This Special issue is subdivided into two parts: I. Manufacturing Systems, and II. Service Systems. This Special Issue examines Manufacturing and Service Systems, their operations and shared methodologies. **Operations** include (but are not limited to): *Supply-Chains, Maintenance, Scheduling, Flow Lines, Queueing, Material Handling, Inventory & Quality Control, and Buffer Allocation.* **Methodologies** include (but again are not limited to): *Decomposition, Markov Chains and Markov Processes, Stochastic Networks, Linear, Nonlinear, Integer Programming, and Simulation.*



Operations & shared methodologies as link between Manufacturing and Service Systems.

*Department of Mechanical and Industrial Engineering, University of Massachusetts, Amherst Massachusetts 01003
†Seminar für Supply Chain Management und Produktion, Universitat zu Köln, Köln, Germany 50923
‡University Grenoble Alpes, CNRS, Grenoble INP, G-SCOP, 38000 Grenoble, France
§Director ITIA-CNR, Politecnico di Milano, via La Masa 1, 20156, Milano Italy

2 Acknowledgements

We thank the many anonymous reviewers for their contributions in the objective analysis and eventual improvements of the compiled papers. There were twenty-two papers submitted to the special issue. After a thorough review by the reviewers, the following seven papers were accepted for publication.

3 Manufacturing System Papers

There are a total of five papers in this section concerned specifically with the operations and methodologies of maintenance, decomposition, discrete time Markov chains, and nonlinear optimization approaches.

1. The paper of Magnanini and Tolio (2020) is about Preventive Maintenance in a two-machine line, for which the machines are subject to random failures, the upstream machine is supposed to be the fastest one, and the intermediate buffer has finite capacity. The authors propose an optimal control policy, relying on the degradation condition of machines. The authors prove the existence of a threshold based control policy including a combination of switching points (defining the buffer level and machine states for which the preventing maintenance should be activated) and hedging points (defining the buffer level and the machine state for which the production rate of the fastest machine is controlled and reduced). Computational experiments analyze the impact of system parameters on the cost function and show the usefulness of the proposed method in order to evaluate when one should focus on improvement actions regarding maintenance, or focus on the production control.

2. The paper of Tancrez (2020) proposes an approach to evaluate the performance of flow line production systems assuming general characteristics, i.e., assembly/disassembly structures, general processing time distributions, finite storage spaces, and a potentially large number of stations. To model these systems, he applies probability mass fitting to fit general distributions to discrete phase-type distributions of each assembly/disassembly station. The entire system is decomposed into two station subsystems and the processing time distributions of the virtual stations are iteratively modified to approximate the impact of the rest of the network, adding estimations of the blocking and starving distributions. Computational experiments show that the approach provides accurate estimations.

3. The paper by Liberopouos (2020) studies the optimal buffer allocation of a manufacturing flow line with intermediate finite-capacity buffers. He compares the performance of three different production control policies, namely: Installation Buffer (IB), CONWIP (CV), and Echelon Buffer (EB), through the maximization of the average gross profit, minus the average cost, subject to a minimum average throughput constraint. The constrained optimization problem is solved numerically for numerous instances of a 20-machine and an 8-machine line. The author sets up and carries out an extensive numerical study, leading to some expected results, and to some less obvious ones. They especially show that EB policy generally outperforms the other two.

4. The paper by Lehman and Kuhn (2020) explores the question of whether or not high volume production sites for automobiles can be transformed to stabilized production. Stabilized production is an important concept in manufacturing systems especially in automobile production and the development of measurable indicators for quantifying the stability of a production sequence is critical compared to the initial planned sequence. The authors employ discrete-event digital simulation to determine stability levels in production lines. In the end, they carry out a detailed empirical study and show that a high volume plant with several production lines cannot achieve stabilized production without additional measures and research activities (*e.g.* improved scheduling methods).

5. Urlu and Erkip (2020) study the problem of positioning safety stock in a serial production system following a period review base stock system. Demand per period is known but supply is uncertain (available or unavailable). The system is modeled as a Discrete Time Markov Chain. For single- and two-stage systems an exact analysis is proposed while for multi-stage systems an approximation is presented and tested numerically.

4 Service System Papers

There are two papers in this section. These Non-manufacturing systems share many of the operations and methodologies with Manufacturing Systems. The first paper is concerned with a Maritime Shipping Birthing Allocation Problem (MBAP) and the latter paper with policies and analysis of influenza vaccine supply-chain intervention programs. Both of these papers rely on nonlinear programming methodologies for their analysis.

6. The paper by Liu, Xiang, and Zheng (2020) examines the Maritime Berthing Allocation Problem (MBAP) under uncertainty including the arrival and operation times of the vessels. They utilize a two-stage robust optimization procedure with uncertainty (RO-MBAP) where total cost is minimized (including the baseline cost and recovery cost). They employ CPLEX to solve small scale problems and a rolling horizon heuristic to solve large scale problems. Three separate models are generated and compared together and the demonstrate that all three models are robust tools for the MBAP.

7. The paper by Demicri and Erkip (2020) studies the problem of designing an intervention strategy for an influenza vaccine supply chain where there is uncertainty in demand and availability. They formulate the problem as a budget allocation problem and model it with a bi-level programming model. Demand and availability are assumed to follow bivariate lognormal distributions. Several mathematical properties are derived within the paper. In the end, coordinating intervention strategies is shown to be an effective approach for increasing the coverage of vaccination in the United States.