

# **EcoProduction**

## Environmental Issues in Logistics and Manufacturing

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## **About the Series**

The EcoProduction Series is a forum for presenting emerging environmental issues in Logistics and Manufacturing. Its main objective is a multidisciplinary approach to link the scientific activities in various manufacturing and logistics fields with the sustainability research. It encompasses topical monographs and selected conference proceedings, authored or edited by leading experts as well as by promising young scientists. The Series aims to provide the impulse for new ideas by reporting on the state-of-the-art and motivating for the future development of sustainable manufacturing systems, environmentally conscious operations management and reverse or closed loop logistics.

It aims to bring together academic, industry and government personnel from various countries to present and discuss the challenges for implementation of sustainable policy in the field of production and logistics.

Pawel Pawlewski · Allen Greenwood  
Editors

# Process Simulation and Optimization in Sustainable Logistics and Manufacturing



Springer

*Editors*

Pawel Pawlewski  
Faculty of Engineering Management  
Poznan University of Technology  
Poznan, Wielkopolskie  
Poland

Allen Greenwood  
Industrial and Systems Engineering  
Mississippi State University  
Mississippi State, MS  
USA

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# Preface

In order to succeed in today's highly competitive business environment, organizations strive to effectively balance financial and social performance. Oftentimes, they do this by improving the design and operation of key processes in manufacturing, service, logistics, and basic business functions. These changes need to be evaluated based on both shareholder needs and those of society.

Making these change decisions involve understanding both the organization, which is a complex and dynamic system, and the environment in which the organization must function—also complex, dynamic, competitive, and oftentimes global. One means to help organizations cope with complexity, better understand their system, and make better decisions is through the use of models, such as simulation and optimization models. Model-based decision making enables the testing of ideas and alternatives virtually—this provides an understanding of the consequences of a decision before it is implemented. The use of models also expands the decision space, and is not disruptive to the real system.

Simulation involves developing a model or representation of a real system, using the model to conduct experiments and analyzing the impact of proposed changes on system performance. Simulation is oftentimes used to assess performance before the system actually exists. By its very nature the process of simulation is sustainable in that it conserves resources and reduces risks. However, simulation by itself, and when coupled with optimization, provides a powerful means to understand a system's behavior and performance, the interactions of its components, its dynamics, the influence of variability, and the effects of changes in system parameters, policies, and the environment.

This monograph brings together a cross-section of articles that present ideas and applications of how simulation and optimization effectively support the design, analysis, and management of sustainable manufacturing and logistics systems. It is composed of 12 reviewed chapters divided into four parts.

Part I includes six chapters that illustrate how simulation modeling supports the analysis of sustainability in manufacturing systems including: the design of a new production facility considering safety, environmental protection, and cost; the definition and evaluation of a variety of measures of production-logistics systems; a methodology that is validated and evaluated through simulation for analyzing alternative strategies in organizations that offer a wide variety of products and

employ diversified customer services; a study, through the use of simulation, of the effects of key parameters of an order-leveling technique (Heijunka, intending to reduce fluctuations in the production process); the analysis and assessment of stability and risk in production systems through modeling and simulation; and, the optimization, through simulation, of the operation of a production process with a focus on energy consumption.

Part II includes two chapters on other types of production systems. The first chapter illustrates how simulation can be used to address transportation concerns in the mining industry; the second chapter describes the formulation and use of an optimization model to aid with biomass co-firing decisions in coal plants considering emissions, plant efficiency, logistics costs, and capital investments.

Part III also includes two chapters—they describe how simulation and optimization can be used to address issues, including sustainability, beyond the enterprise—to the supply chain. The first chapter uses simulation to study the effect of the level of supplier flexibility on total order lead time and variability in total lead time; the second chapter assesses the effect of various types of disturbances or interferences (e.g., related to means of transport, route, driver) on the functionality and sustainability of supply chains.

The final part describes two cross-disciplinary methodologies that support the use of simulation to analyze and enhance production and logistics systems. The first chapter uses the IDEF0 methodology to enhance the general simulation modeling and analysis process; the approach is demonstrated through a healthcare application example. The second chapter describes an approach that has effectively been used to transform university-based student simulation projects in manufacturing and logistics into business projects.

We are indebted to our authors and reviewers for their outstanding contributions and assistance in preparing this work.

Pawel Pawlewski  
Allen Greenwood

# Contents

## Part I Manufacturing Operations

<b>Simulation Method for the Benefits of a Small Business in Sustainable World</b> . . . . .	3
Grzegorz Wróbel and Joanna Oleśków-Szłapka	
<b>Operational Measurements for Evaluating the Transformation of Production-Logistics System and Their Reflecting in Simulation Software</b> . . . . .	23
Piotr Cyplik, Lukasz Hadas and Pawel Pawlewski	
<b>Methodology of Assortment Analysis in Companies with a Wide Range of Products for Building the Flexibility of Customer Service</b> . . . . .	43
Lukasz Hadaś, Pawel Pawlewski, Karolina Werner-Lewandowska and Piotr Cyplik	
<b>Global Sensitivity Analysis of Heijunka Controlled Assembly Line</b> . . . . .	59
Przemyslaw Korytkowski	
<b>Stability Analysis of the Production System Using Simulation Models</b> . . . . .	69
Anna Burduk	
<b>Simulation Modeling of Acrylic Bathtubs Production Using Task-Oriented Approaches as a Tool to Improve Energy Efficiency of Thermoforming Process</b> . . . . .	85
Witold A. Cempel, Dawid Dąbal and Mateusz Nogły	

## Part II Production Operations

<b>Simulation Analysis of Traffic Congestion in Mineral Mining Transport</b> . . . . .	99
Sebastian Chęciński	

<b>An Optimization Model in Support of Biomass Co-firing Decisions in Coal Fired Power Plants. . . . .</b>	<b>111</b>
Sandra D. Eksioglu and Hadi Karimi	

### **Part III Supply Chain Management**

<b>Using Simulation Modeling and Analysis to Assess the Effect of Variability and Flexibility on Supply Chain Lead Time . . . . .</b>	<b>127</b>
Seratun Jannat and Allen Greenwood	

<b>Models of Organizing Transport Tasks Including Possible Disturbances and Impact of Them on the Sustainability of the Supply Chain . . . . .</b>	<b>141</b>
Patrycja Hoffa and Pawel Pawlewski	

### **Part IV Cross-Disciplinary Methodologies**

<b>IDEF0 as a Project Management Tool in the Simulation Modeling and Analysis Process in Emergency Evacuation from Hospital Facility: A Case Study . . . . .</b>	<b>155</b>
Witold A. Cempel and Dawid Dąbal	

<b>Transforming a Student Project into a Business Project: Case Study in Use of Simulation Tools . . . . .</b>	<b>167</b>
Pawel Pawlewski, Rafał Juraszek, Magdalena Kowalewska and Zbigniew Pasek	