

# 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 productions 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.

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