

Chapter 79

An Integrated Approach to Supply Chain Simulation

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ABSTRACT

Simulation can be a valuable tool for supply chain analysis, planning, optimization, evaluation, and risk management. Computer simulation and simulation models can be used to model intricate supply chains close to real systems, execute those models, and observe system behavior. This chapter deals with supply chain modeling and simulation. It starts with a rationale for supply chain simulation, its advantages and benefits. The chapter gives a systematic background research and literature overview related to supply chain simulation with insights into the main simulation approaches and methods. Next, supply chain modeling and simulation methodology are described. It introduces a supply chain metamodel that enables modeling of both supply chain structure and dynamics. The main components like model database, process library, knowledge base, and execution engine are also described. The examples of various simulation scenarios are presented. Finally, the chapter gives the main future research directions and concludes with a brief discussion of supply chain simulation importance and applications.

INTRODUCTION

Simulation can be a valuable tool for supply chain analysis, planning, optimization, evaluation, and risk management. Computer simulation and simulation models can be used to model intricate supply chains close to real systems, execute those models, and observe system behavior. The goal of simulation is to evaluate existing supply chain configurations, as well as to aid in design of the new supply chains. Supply chain simulation matters both supply chain design and supply chain control. In other words, it helps resolve different supply chain management (SCM) problems which can be grouped into the following categories:

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- Infrastructure configuration that implies defining of the manufacturers, distribution centers, wholesalers, retailers and their locations (nodes).
- Planning and design of supply networks.
- Defining strategy related to processes at the nodes.
- Coordination between processes and activities with the purpose of their alignment and fulfillment of performance goals on global supply chain level.
- Information integration so that processes can exchange all necessary information.
- Risk mitigation in supply chain implementation both at the strategic and process levels.
- Supply chain validation through performance measurement which involves defining metrics at different supply chain levels.
- Validation through performance monitoring which involves defining metrics at different supply chain levels.
- Optimization by means of what-if analysis and application of best practices for improvement.

Modeling and simulation approach is the only practical option for exploring performance of the complex business networks such as supply chains. Furthermore, the modeling and simulation approach facilitates the design of the new supply chain configuration and policies, as well as the redesign of existing systems (Thierry et al., 2010). There are different supply chain modeling methods and types of simulation. Supply chain simulation can be performed with different goals. This can be analysis of supply chain dynamics, structure, or cash flow, risk mitigation, design, learning, etc.

In this chapter, the modelling approach and the simulation software which has integrative features capable to unify these various needs for different user groups are presented.

The background section gives definitions and explanations of key terms and concepts, as well as literature review with main contributions related to supply chain simulation. Simulation software integrates different models, entities and modules that function cooperatively. Its construction and functioning principles are described and examples of supply chain simulations are given. The key contributions and benefits of the presented simulation solution are presented. Finally, the main future research directions and opportunities are examined.

BACKGROUND

By examining well designed simulation models, organizations can reinforce their decisions regarding supply chain processes. They can study and analyze effects of different supply chain initiatives and improvement programs through sensitivity analysis (such as what-if or goal seek) before investing huge amount of money or disrupting their operations.

Computer simulation and simulation models can be used to model intricate supply networks close to real systems, execute those models, and observe system behavior.

The main advantages of the supply network computer simulation are (Stefanovic et al., 2009):

- The simulation is relatively clear and flexible.
- It can be used for analysis of the complex real systems such as supply networks.
- With the simulation, it is possible to include real-world influences, for example uncertainty factor in demand or lead time.

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