

Chapter 25

A Game-Based Approach for Simulation and Design of Supply Chains

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ABSTRACT

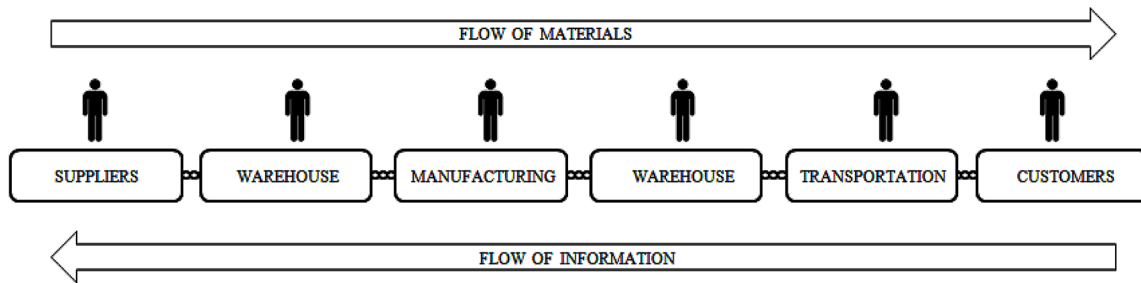
This chapter reviews the potential benefits and challenges of knowledge-based computer game simulation as means of understanding the dynamics of global procurement and manufacturing supply chains. In particular the chapter focuses on the use of software agents to assist decision making across the supply chain, for example in raw material procurement. The chapter describes a framework for supply chain scenarios in multi-agent based simulation games. The agents' behaviour is governed by business rules, based on the concept of normative knowledge representation and its reasoning mechanism (known as rule-based reasoning, RBR) and that also come closer to the task that confronts the supply chain operational manager – the analysis of current case in hand in terms of previously decided business problem solutions, known as case-based reasoning (CBR). The aim is to introduce more realistic behavior of the supply chain actors and improve understanding in operational management of supply chains.

INTRODUCTION

Supply chains are important part of every economy and every business (Pal & Karakostas, 2014). In a typical supply chain, raw materials are purchased from different vendors and products are manufactured at one or more manufacturing plants, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. All supply chains share the following characteristics: (i) the supply chain comprises all business activities in order to supply a product or service to its end customers; (ii) any number of supply chain partner organizations can be linked in the supply chain; (iii) a customer can be

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Figure 1. A schematic diagram of supply chain



a supplier to another customer within the supply chain, which means that the total network of activities can consist of a number of supplier/customer relationships; (iv) the path from supplier to customer, depending on the products and markets, can include a number of intermediaries (distributors) such as wholesalers, warehouses, and retailers. Product or service flows from supplier to customer are called downstream flows while demand information from customer to supplier is called upstream flows. Figure 1 shows a simple diagrammatic representation of a supply chain.

In this way, a supply chain creates a complex set of business processes, which need to be optimized for a profit making company. Consequently, to reduce production cost and enhance service levels, effective supply chain strategies must take into consideration the interactions at the various levels in the supply chain. Traditionally, researchers and practitioners have been concerned with the various processes within supply chain individually, without much attention to their interactions.

Rapid globalization in recent decades and the subsequent requirements make it essential for supply chain managers to consider complex supply chain process inter-dependencies to successfully compete and emerge as market leaders. As a result of liberalization and the globalization of international trade, the manufacturing industries procurement and fabrication business processes are taking place around the globe in order to provide significant cost reduction by using efficient global supply chain operations. In today's global environment, companies recognize the strategic importance of well-managed supply chains. For example, companies such as Dell, Nokia, Intel, Toyota, Wal-Mart, Zara, and Li & Fun have based their corporate strategy around achieving supply chain superiority over competitors (Copacino & Anderson, 2003). These multi-national corporations have gained competitive advantages by effectively managing the complex web of supply chain process interactions that extend across continents and across enterprises in product procurement, manufacturing and distribution. In essence, the requirements of modern supply chains are:

- **Connectivity:** With emphasis on the ability to make and maintain connection between business partners. It characterizes the ability to exchange information within supply chain partners in a way which provides inter-organizational collaboration.
- **Integration:** The ability to connect and coordinate business processes in a seamless way. It improves supply chain business processes performance by establishing collaborative connections among supply chain partners. For example, seamless integration increases information transparency among partners and allows pooling of inventories and sharing resources.
- **Visibility:** Visibility refers to the capability to access or view data or information related to logistics and the supply chains. For example, visibility is the ability of knowing where raw materials

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