Chapter 9
Modeling and Simulation of Partnership Network for an Intelligent Supply Chain

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ABSTRACT

Contrary to actual logistics networks in which chains are frozen, in the proposed partnership network, a dynamic chain is only built each time an order is requested; nothing is planned ahead of time. An isoarchic control model based on the holonic paradigm is proposed. The control of the partnership network can be seen through a simultaneous analysis of the holon views. The proposed control is based on a multicriteria analysis method by complete aggregation (Analytic Hierarchy Process (AHP)). The assignment of orders is based on the search for the best response to a Call For Proposals submitted by a customer. The solution that appears to be the most efficient in terms of the evaluation criteria will be adopted. For validation purposes, a simulation of the proposed approach was implemented using a distributed simulation environment HLA (High Level Architecture). A set of realistic tests were used to evaluate the proposed approach.

INTRODUCTION

The evolution of the economic world leads to a new type of competitiveness in industry. Companies try to achieve the goal of satisfying customers' needs through partnership. Consequently, changes appear in customer-supplier relationships: a strong partner relationship evolution has occurred since a few years in order to obtain better internal management of each partner and improved overall performance. Partnership

DOI: 10.4018/978-1-60566-808-6.ch009

control involves all the actions developed together to achieve common objectives and to timely react to any failure of any partner. Negotiation between partners is thus required involving management and production organization of each partner. This situation makes difficult obtaining the best response with respect to the need of each customer. For that, a new approach is proposed for customer-supplier relationship control, in which partnership is considered in the context of an association of potential suppliers within a network. In the large majority, logistics networks connect a set of frozen supply chains. Each customer places orders with identified suppliers chosen to work with on a regular basis, and suppliers are well aware of their customers and of orders they may place. This way of building the supply chain is referred to as 'static supply chain'. However a number of issues may arise in such chains; relationships between chain partners are fragile and mainly driven by opportunistic behaviours. In our work, we proposed a supply chain organization based on a partnership network able to address important dynamics and environment uncertainty. We have shown that this organization allows for better internal management of each partner and improved general performance in satisfying customers needs. In this organization, each partner is a node of a meshed network in which links represent potential relationships between one customer and his suppliers and in which logistics flows are dynamic and re-negotiated at each instance. Each partner of the network may belong to one or several supply chains, depending on his actual work load. Partners contribute to a common objective which is to collectively ensure the dispatching of orders coming from various customers while keeping in mind each customer and supplier interest.

In the proposed partnership network - contrary to actual logistics networks in which chains are frozen - nothing is planned ahead of time and a dynamic chain is built each time an order is made. Meshing allows defining several paths to implement the supply chain; the possibility of several potential paths avoids supply shortage occurring when a mesh of the supply chain is deficient. The proposed approach is efficient only if control decisions are performed in real time without forecasting. We call 'dynamic supply chain' a supply chain progressively built within the logistics network. We proposed an isoarchic control model for supply chain networks based on the holonic paradigm. Each partner is a Resource Holon that can contribute to the achievement of different Product Holons related to a series of Order Holons. Each of these three types of holonic entities has its own objectives and constraints, and partnership network control can be seen only through a simultaneous analysis of the three holon views. This behavior is modeled by using operational research methods such as multicriteria analysis and complete aggregation, and more specifically, methods based on priority theory. Orders assignment is based on the search for the best response to a Call For Proposals (CFP) submitted by a customer. The solution which appears to be the most efficient with respect to evaluation criteria will be selected. A multicriteria method is used by companies to choose, among several CFPs, the one that will ensure the best performance for the company. This approach allows a partner to become an intelligent production unit able to operate in self-organization with other companies. Each supplier organizes and controls his own activities by proposing his best conditions for the CFPs it has retained.

Migrating from a set of static supply chains to a dynamic logistics network leads to significant transformation of customer-suppliers relationships. Implementing such an approach amongst partners requires of course organizational adjustments, senior management commitment and technology realignment. It implies rethinking tasks and related activities. So, our approach must be supported by demonstration and change management tools. We have implemented, for validation purpose, a simulation of such a system using the distributed simulation environment HLA (High Level Architecture). HLA is a simulation architecture which facilitates interoperability of all types of models and several simulations. HLA capability to perform simulations in parallel to real operations makes possible comparisons and