Multi-Objective Negotiation Mechanism in Manufacturing Enterprise Supply Chain Based on Multi-Agent

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ABSTRACT

In the operation of manufacturing enterprise supply chain, there are lots of conflicts and differences between the node enterprises because of the different demands on the price, quality, cost, and other factors. These conflicts and differences can be effectively solved by negotiation. In this paper, the authors will abstract different entities in manufacturing enterprise supply chain as agents, and present a negotiation mode, and then discuss the negotiation tactics and procedures between the purchasing agent and supplier agent. Next, a practical example will be discussed and simulated for validating the negotiation model. Application of negotiation tactics and models will be helpful for resolving differences and conflicts, and improving negotiation efficiency. That will be used for optimizing the supply chain management, maximizing the benefits, and improving the operational efficiency of manufacturing enterprise supply chain.

KEYWORDS

Negotiation Mechanism, Negotiation Model and Tactics, Supply Chain Management

1. INTRODUCTION

IT technology has been widely used in enterprise management practice (Ensslin et al., 2019; Peng et al., 2020). As an inevitable development result of artificial intelligence, agent and multi-agent have attracted attention and concern in the academic research, and are widely used in various fields (Morrar et al., 2019; Yang et al., 2019). In the multi-agent system of supply chain, the node enterprise is independent, the goal of each node enterprise is to maximize profits, and different cooperation strategies and trading mode will be adopted by each node enterprise based on interests, operation mode and product features (Charles, 2002; Hsu et al., 2016; Nader & Ala, 2020). Therefore, each

enterprise has different requirements on quality, product price, cost, quantity, delivery, service conditions, response time and other factors. All of these demands will develop a large number of conflicts between the manufacturing enterprise and cooperative partner. Negotiation is the frequently-used method for resolving the conflicts and is the main form of interaction between supply chain partners. Cooperative enterprise can realize bilateral or multi-joint tactics by means of negotiation in the manufacturing enterprise (Ji et al., 2017; Du, 2019; Chen et al., 2020). The application of multi-agent technology to manufacturing enterprise supply chain negotiation, will be helpful to realize the coordination and control between enterprises in manufacturing enterprise supply chain, to promote efficient, flexible and efficient cooperation among enterprises, improve negotiation efficiency and save negotiation time, to improve the operation efficiency of supply chain.

The authors mainly discuss the multi-objective multi-agent negotiation mechanism of manufacturing enterprise supply chain in this paper. At first, the main problems will be put forward after analyse relevant literature. And then, the negotiation model is built, and the negotiation process is analysed. Finally, an actual example is applied for validating the effect of the negotiation model and strategies.

2. LITERATURE REVIEW

The agent and multi-agent as well as the negotiation between them have been extensively researched. Soam and Franklin thought the agent is a system that perceives the environment and acts on the environment to achieve its plan (Franklin, 1996; Soam et al., 2017). Wooldridge considered the agent was a computer system designed to achieve the goal of pure packaged, can perform flexible behavior (Wooldridge, 1997). Shoham considered the agent was an entity with the mental state of beliefs, capabilities and commitments (Shoham, 1993). Lane believed the agent is a computing unit with control problem solving mechanism, which can be known as a solver, a module or an expert system (Lane et al., 1994). In solving complex problems, the ability of a sole agent is limited, so, lots of mutually independent agents can be formed a multi-agent system by coordinating their behavior. The different agent will coordinate their goals, accomplish some specific tasks or achieve some goals by collaboration, and share knowledge about solving problems and solving methods in the multi-agent system (Yang et al., 2018).

If the negotiation is conducted under complete information, the agent involving the negotiation will fully understand each other's information. It is not difficult to reach the Nash equilibrium, communication and negotiation time between negotiating agents will be reduced greatly. In fact, more negotiations are non-cooperation based on incomplete information, such as multi-objective negotiation. Both parties are involved in the negotiation for multiple target negotiation, after several rounds negotiation maybe achieve the possible solutions. Durfee and Lesser think, negotiation is the process of exchanging information between the parties to form a plan. Conflict is the starting point of the negotiation, through a series of mutual concessions, and consensus in the end, the negotiation is a process of bilateral or multi-joint decision-making and mutual compromise (Durfee & Lesser, 1989). In the multi-agent negotiation process of manufacturing enterprise supply chain, each agent representing the enterprise is to communicate with each other through the network, and interact with each other until the goal is reached (Sikora & Shaw, 1997). Huang and Sycara focused on the study of justice, is to use the negotiation model, analyze and improve negotiation strategies, choose the right way to negotiate, arrange a reasonable agenda for the negotiations, and maximize the interests of both parties (Huang & Sycara, 2002). Neumann and Morgenstern divided the negotiations into sole objective and multi-objective. Sole objective negotiation refers to the two sides to negotiate a goal. The goal is to achieve a consensus on negotiating success. Multi-objective negotiation means that the two sides will interact with each other. All the goals can be reached when the agreement is reached. In the negotiation process, it does exist to negotiate with a number of negotiating objectives, such as the price, quality, delivery time, supply quotas, etc. (Neumann & Morgenstern, 1994). Faratin studied from the perspective of negotiation tactics, thought negotiation can be divided into resource-

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