

Manage Supply Chain Management Using Multi-Agent System for Multi-brand Retail

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Abstract This paper describes an ongoing effort in developing a Multi-agent System (MAS) for supply chain management for Multi-brand retail. In our framework, several suppliers, dealers and retailers are involved in transportation of raw materials and goods from dealers to various stores. Agents must have the knowledge of various warehouses where goods are stored. Warehouses must be selected close to the store so that logistic and transports involved in the process get reduced. The ontology defines the domain area and set of rules to understand the mechanism and get the knowledge of information flow between agents.

Keywords – Multi-agent system, supply chain, agents, ontology

I. INTRODUCTION

This paper explains the use of multi-agent system to manage supply chain management for multi brand retail.

A multi-agent system (MAS) is a network of software agents that interacts to solve the problems that are beyond the human capability or knowledge of each problem solver. A software agent is a piece of software that functions as an agent for a user or another program, working autonomously and continuously in a particular environment. It is inhibited by other processes and agents, but is also able to learn from its experience in functioning in an environment over a long period of time [1].

A supply chain is a network of suppliers, factories, warehouses, distribution centers and retailers, through which raw materials are acquired, transformed, produced and delivered to the customer. A supply chain management system (SCMS) manages the cooperation of these system components. In the computational world, roles of individual entities in a supply chain are implemented as distinct agents. Correspondingly, a SCMS transforms to a MAS, in which functional agents cooperate with each other in order to implement system functionality. Most of the previous research work in this field sets MAS in a closed environment, that is, the system consists of a fixed number of entities/components and they have a common target [2]. Supply chain management involves the following stages: planning, procurement, production, delivery and return. It has its own processes, problems and solutions at each stage [4].

The procurement and inventory management roles are to analyze residues in storage, and analyze sales by customer

group, sales in the previous period and the seasonality in the past, order placement, matching the quantity and terms with suppliers, the implementation of movement of goods between warehouses, and distribution of flows of goods in warehouses. It provides timely and sufficient saturation of commodities in stock in order to avoid situations of overstock (excess inventory), and out-of-stock (lack of goods in warehouses).

II. LITERATURE REVIEW

MAS in Supply chain management:

Earlier, object-oriented (OO) system design was the method of choice for SCM systems. This is gradually being replaced by agent-oriented (AO) system design, which could be considered as an extension of OO, to enable a higher level of integration and better effectiveness of the SCM system. The merging of MAS and SCMS results in multi-agent based supply chain management. The agent-oriented approach is considered for supply chain management in [6]. The carried out supply chain activities are distributed among agents, thereby improving the quality of supply chain management.

A multi-agent system is a set of intelligent software agents where each agent is responsible for one or more actions in the supply chain.

MAS Models:

Limitations of supply chain management:

Due to the many competitors and complexity of supply chains, a problem in one link can have increasingly negative effects on the whole chain. There are many areas in which incidents, preventable or not, can affect production.

Even though many systems are able to predict the quantity and types of resources or inputs necessary for production, improper forecasting (over- or under-stocking) remains a problem for supply chain management, especially in response to unpredictable market changes. For example, if there is an unexpected flow in demand due to an unpredictable trend and one of a firm's suppliers is out of stock of a particular part necessary to complete a product, there will be negative effect on the firm.

By using intelligent software agents which communicate with each other to share the information, we can avoid such complications.

A. MAS Vs. IT system:

In MAS, agents are involved so this system is highly intelligent and learns with time but in IT systems, there is no intelligent system which learns with time. In MAS, an agent is an autonomous entity that exists in an environment and acts in a rational way. But in IT systems, a program on the other hand is not as autonomous and cannot act rationally; the program relies more highly on the user of it. An agent may work for a number of principals at the same time but a program works as a servant which serves only one master. An agent is not subject to the direct control or supervision of the principal. As such, he has greater discretion in his actions. A principal has the right to direct what the agent has to do but the master has also the right to say how it is to be done whereas a program acts under the direct control and supervision of its user, and is bound to carry out all reasonable orders given to him in the course of his work. There is too much similarity between agent and program as both are used to act for and on behalf of a person.

B. Multi-brand Retail:

In a multi-brand retail, a single retailer comes up with the number of brands in the market to capture the market such as Tesco have their own brands of everything. If it comes to India with these brands then Indian brands have to suffer and also those companies suffer which are having single brand in India [3]. In single brand retailing, a single brand is sold across all outlets such as Nike, puma etc. In multi-brand retailing, so many brands are sold under a single roof. For e.g., Wal-Mart, Big bazaar, Vishal mega mart etc.

Multi-brand retailing in Big bazaar is started in 2001. Its headquarters are in jogeshwari and Mumbai. Punch line of big bazaar is "Isse sasta aur accha kahin nahi". Currently, it is having 106 outlets. It is India's first hypermarket retail outlet. Such companies choose different celebrities to promote their marketing like Big bazaar chooses Vidya balan for its price challenge exercise.

The concept of multi-branding helps the customer in a great manner. They need not to visit multiple locations to do comparison shopping and those dealers (and their staff) have "all their eggs in a single basket" to catch the customer attraction.

III. PROPOSED MODELS

AGENTS:

In Software we can define the agent that it is an entity which consists of various attributes defines a particular domain. Exp: An agent deals with warehousing consist its local attribute as well as the details which will be coordinated with other entity (Agents). So agents emulate the mental process or simulate the rational behaviour [7].

Multi-agents are the software agents with capabilities of autonomy, social ability, reactivity and the ability to be proactive.

A typical example of multi-agent system is taken with the help of sandwich and tea. Let a person wants the sandwich as the tea is ready, means the coordination between tea maker and sandwich maker is essential. Otherwise many situation may be raised like tea is ready but sandwich is not prepared and it comes after some time or the sandwich is ready and the tea is not prepared.

1. Agents are problem solvers.
2. Agents are pro-active.
3. Agents are goal-oriented.
4. Agents are context-ware.
5. Agents are autonomous

Supply chain is composed of set of intelligent agents, each responsible for one or more tasks in the supply chain and each interacting with other agents with the help of Agent Communication Language (ACL). The coordination among several agents is necessary to get better performance.

There are number of agents involved in the multi-brand retailing which communicate in such a manner to reduce the cost and complexity of the system and thereby, increase the intelligence of the system. In our framework, there are no centralized super-agents or any distributed mediators to handle the agent coordination. All these activities occur through ACL.

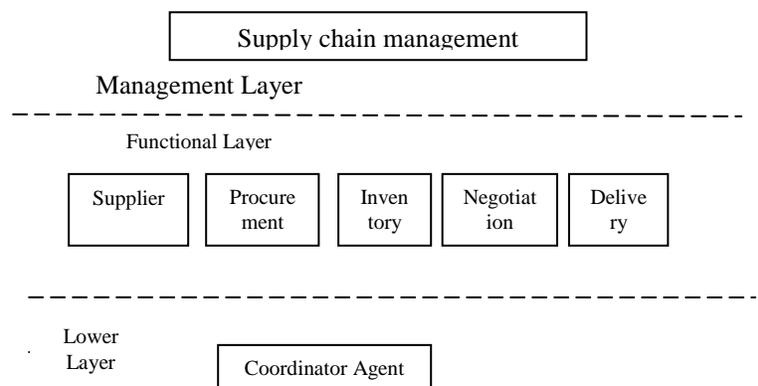


Fig. 1 Multi-agent system architecture

In the fig.2, D1, D2, D3 and D4 are the dealers which communicate with the Multi-brand store to supply the goods from the manufacturers to the owner of the store. When the item purchased is in bulk or for future use then it is transported to one of the warehouse of the store. W1, W2 and W3 are the warehouses of the store. A multi-brand store has number of warehouses to store the extra goods which are not being used presently. A warehouse must be close to the store to minimize the cost of transportation.

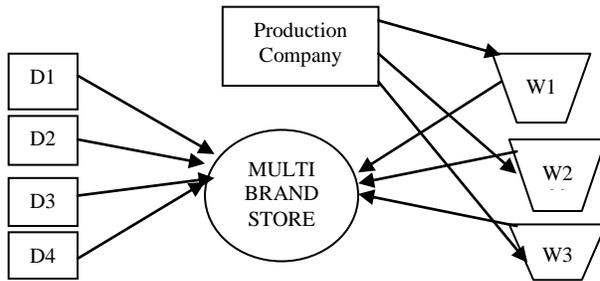


Fig.2 Multi-brand store architecture

Agents involved are:

1. Suppliers-

A supplier basically coordinates the exchange of goods between manufacturers and owner of the multi-brand store. He has the knowledge of every warehouse so to relocate the goods at appropriate warehouse with least logistic and transport cost.

| Supplier |
|--------------|
| a. Designing |
| b. Labelling |
| c. Marking |
| d. Packaging |

- a) Designing- Suppliers design the plan of the process how to import and export the goods.
- b) Labelling- They label the authenticity of the product.
- c) Marking- Certification of the product is done by this agent.
- d) Packaging- Packaging is done with proper care so to ensure its safety.

2. Procurement agents-

A procurement agent manages the acquisition of goods, services or work from an external source. Whenever there is scarcity of some widely used good, then this agent does the proper coordination from the external sources. It maintains that the goods are procured at the best cost to meet the needs of the buyer in terms of quality, quantity, time and location.

| Procurement agents |
|---|
| a. Develop integrated business strategies |
| b. Support operational requirements |
| c. Manage the procurement process |

- a) Develop integrated business strategies- Communicate with the other sources to improve the business plans and maintain the integrity of the system.
- b) Support operational requirements- This agent maintains the requirements needed during its operation.
- c) Manage the procurement process- This agent manages the whole process of coordination from the external sources.

3. Inventory agents-

Inventory management involves a retailer seeking to acquire and maintain a proper merchandise assortment while ordering, shipping, handling, and related costs are kept in check. It also involves systems and processes that identify inventory requirements, set targets, provide replenishment techniques, report actual and projected inventory status and handle all functions related to the tracking and management of material.

| Inventory agents |
|--------------------------------|
| a. Marketing and production |
| b. Improving efficiency |
| c. Establishing a safety stock |
| d. Balancing supply and demand |

- a) Marketing and production- this agent focuses on marketing and production strategies of the system.
- b) Improving efficiency- With the proper identification of goals, targets and techniques, this agent help in improving the overall efficiency of the system.
- c) Establishing a safety stock- Stock maintenance is mandatory but it is also mandatory to keep the safe and secure stock. Otherwise the hazardous products will destroy the fresh and safe product also.
- d) Balancing supply and demand- This agent balances the supply and demand of the product.

4. Negotiating agents-

Negotiation is the process in which two or more agents discuss on the same topic in order to find an agreement about it. This process of reaching an agreement is important in automating intelligent system that behaves on behalf of

humans. The agents involved in the negotiation process are negotiating agents.

| Negotiating agents | |
|---------------------------|---|
| a. | Supply analysis |
| b. | Exchange arguments |
| c. | Negotiate to gain profit as much as possible |

- a) Supply analysis- These agents keep check on the supply and demand of the product. When the demand goes high, it automatically increases the supply of the product to compensate the ratio of supply to demand.
- b) Exchange arguments- They exchange arguments with the several distributors to negotiate on costing.
- c) Negotiate to gain profit as much as possible- Negotiate with the manufacturers to gain maximum profit by reducing the cost of logistics and transportation.

4. Delivery agents-

In context to multi-brand retailing, delivery agents are those who deliver the goods from the main outlet to several outlets. Distributing the goods or products to its various franchisees is the main role of the delivery agents.

| Delivery agents | |
|------------------------|---|
| a. | Maintaining previous delivery records. |
| b. | Maintaining updated record of frequent customer. |
| c. | Filtering the cheapest mode of transportation. |
| d. | Look after the product safety during its packaging |

- a) Maintaining previous delivery records- With the previous records, it become easier to set the frequent customers on the higher priority. This feature catches more and more customer attention.
- b) Maintaining updated record of frequent customers- With the frequent customers list, we can provide extra discounts to them.
- c) Filtering the cheapest mode of transportation- Opting the cheapest mode of transporting of goods will ultimately results in the overall cost reduction.
- d) Look after the product safety during its packaging- The product safety is the major role done by this

agent. If the handling is not done properly, there is no use of the negotiation and cost reduction.

5. Coordinator agents-

This agent coordinates with every above stated agent through Agent Communication Language (ACL) to maintain the integrity of the whole system. This is the utmost required agent because if this agent doesn't work properly then it will result in the unbalancing of the system.

| Coordinator agents | |
|---------------------------|---|
| a. | Coordinates the functionality of other agents. |
| b. | Request handling. |

- a) Coordinates the functionality of other agents- It coordinates with all other agents to keep track of the system.
- b) Request handling- All the responses to the request are handled properly by this agent.

IV. CONCLUSION

The multi-agent system was constructed using the above explained architecture and agent structure. In this paper, we have worked on multi-brand retailing using multi-agent system. This review paper finally concludes that multi-agent system work more efficiently over the earlier IT system. With the use of an intelligent system i.e. agent, MAS enhances the performance of the system. It provides more accuracy, coordination and decision making power. It reduces the overall cost due to negotiation with the several distributors.

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Authors Profile

Prof. Ritu Sindhu is a B.Tech(CSE) from Ajay Kumar Garg Engineering College affiliated to UPTU Lucknow,UP in 2004 and M.Tech and Ph.D (CSE) from Banasthali University, Rajasthan in 2006 and 2012 respectively. I was an honours student throughout my Academic Career. Although my research career has just begun from year 2008, She have accumulated a strong background in several research fields and have developed a strong research foundation that will help to ensure my future success as a Researcher/Academician. Over the last 5 years, she have gained research experience in three main areas like Agent Technology, Data Mining and Computer Networks. She have guided more than 30 M.Tech +B.Tech students for their Thesis/Dissertation work. She have published more than 40 research papers in reputed National/ International Journals /Conferences. She have attended various Short Term Courses, Workshops, and Training etc and enriched my research experience from time to time. She have contributed in academics through organization of various refreshers courses/conferences/workshop/training and also through leadership at different levels at mine various reputed University/Institute worked places. To sharpen my research skills and attitude she is associated with various Technical Societies like, IACSIT, Computer Science Teacher Association (CSTA), International Association of Engineers (IAENG) etc. I am editorial member of various International/National Journals/Conferences. I have also served as Technical Program Committee (TPC) member of many International conferences worldwide.
