



MINES
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Faculté des Sciences et Techniques

Multi-Agent Programming

Supply Chain Management System in Manufacturing Industry

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Introduction –

The supply chain of a manufacturing enterprise can be regarded as a worldwide network of suppliers, factories, warehouses, distribution centers, and retailers through which raw materials are acquired, transformed, and delivered to customers.

Supply Chain Management (SCM) is the management of the flow of goods, data, and finances related to a product or service, from the procurement of raw materials to the delivery of the product at its final destination. Sales, Inventory Management, Manufacturing, Logistics Management, and Transportation of final goods are important faces of a supply chain system. So for effective implementation of the supply chain system required a good collaboration of members. But this task is not simple and cannot be efficiently performed using the conventional system of data exchange. In this scenario, introducing a multi-agent-based system into the supply chain market is an effective solution that solves many existing problems like complex decision making, proper negotiation between the members, information exchange, etc.

In the supply chain management system, the major problem that affects its function are lack of coordination between the participants, Data security issues, improper Data management, and interaction between the participants are major problem and miscommunication. And also the modern supply chain management is very complex in operation. So these problems will lead to economical issues. So in this situation, the solution is to replace the participants in the supply chain like retailers, distributors, etc with intelligent software agents who are capable of doing complex tasks and decision-making on their own. This project discussed the affection implementation of a multiagent-based supply chain management system.

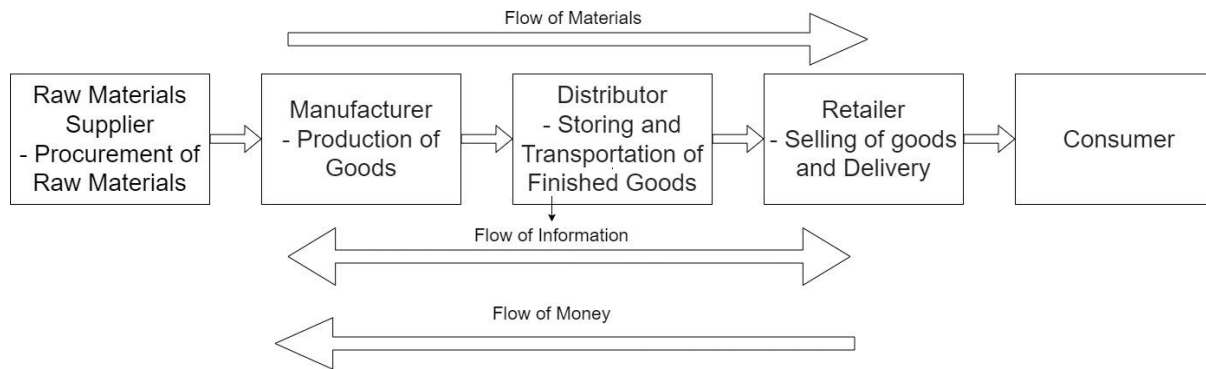
A multi agent system views the supply chain as composed of a set of intelligent (software) agents, each responsible for one or more activities in the supply chain and each interacting with other agents in planning and executing their responsibilities. An agent is an autonomous, goal-oriented software process that operates asynchronously, communicating and coordinating with other agents as needed

In a Multiagent system, agents are of two types, Cognitive and Reactive agents. Cognitive agents are self-learning agents which have well-defined goals and memory containing historical data and also these agents share information directly with other cognitive agents. But Reactive agents don't have a memory nor explicit goals and also these agents will not communicate directly with other agents. These agents will do responses according to the actions written. In this project the advantages of a multiagent-based Supply chain management system and also the reactive and cognitive model of this system.

Project Overview -

In this project describes the implementation of Supply Chain Management System for a manufacturing industry using the multiagent system.

Phases in a Supply Chain Mangement System -



The above diagram represents the basic architecture of supply chain Management system.

Here, there are four main phases in a SCMS.

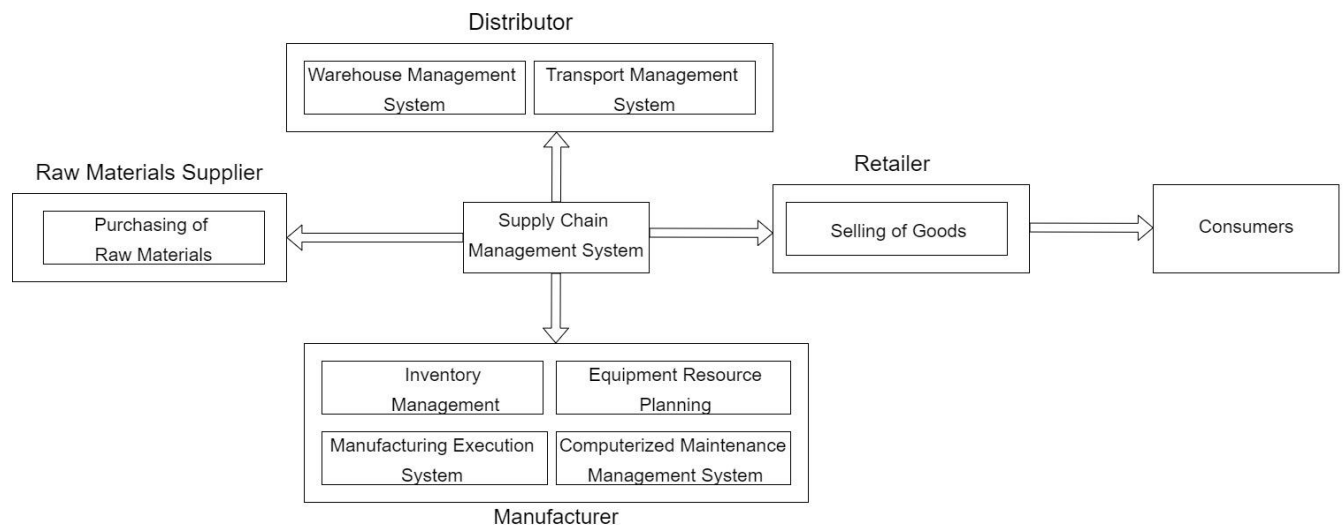
They are,

1. Procurement of Raw Materials – The purpose of this phase is to distribute all the raw materials required to produce a material to the manufacturing unit.
2. Production of Goods – Here, the Manufacturing unit will assemble the raw materials and make the finished products with the help of multiple machineries and labors. Inventory Management, Purchasing, Manufacturing, Maintenance of machineries, temporary storage of finished goods etc. are the different process in this phase
3. Distribution – Storing and transportation of finished goods are the main purpose of this phase
4. Selling of Finished goods to consumer – This phase is the job of a retailer. Selling of goods, financial negotiation with consumer, delivery of final product, temporary storing of goods are the main functions of this phase.

Process of Supply Chain Management System –

1. Customer will order the product of required quantity through online portal.
2. Here the retailer system will do the selling, payment process and delivery with the customer. Also, this system has a small storage unit for the goods
3. After getting the order, the retailer system will validate the order and give the proposal to customer containing the total price and first installment to be paid and approximate delivery date of the product by considering the current storage availability and certain other criteria.
4. Using the proposal customer can accept or reject the proposal. And also, here customer can do negotiation regarding payment, delivery time etc. with retailer.
5. After receiving the payment retailer will check stock and if the system has sufficient products in stock for supply, immediately it will be delivered to the customer.
6. If the stock is not available for delivery, retailer informs the distributor system to supply the good of required quantity.
7. Distributor system will store the finished good and periodically supply the good to retailer considering the demand of products for each retailer.
8. If the distributor system will receive the request from retailer in between the normal periods of transportation goods, then the distributor system will validate the request and send the products of required quantity to the retailer.

9. The manufacture plant production goods by assembling raw materials and send to the distributor
10. The raw materials supplier agent will monitor the raw materials quantity in manufacturing unit and send to manufacturing unit depends on quantity without being any production interruption.



Here many information systems are developed like Manufacturing Execution System, Equipment Resource Planning, Ware House Management System etc. for the better performance. But the capability of current information system for better collaboration and co-ordination in supply chain is limited due to complexity in the current business cycle. Also, the dynamics of the enterprise and market make the supply chain more difficult.

Problem and Multi-agent-based solution for Supply Chain Management System –

Problems in the Current Supply Chain Management System -

1. Delay of product due to late shipment – This problem is occurred due to improper communication with retailer and the distributor. This may occur due to the unavailability of stocks in retailer's hand or error occurred in the delivery of the order.
2. Shutdown of manufacturing unit for maintenance – The unplanned shutdown of manufacturing plant without considering the current market demand of the goods and available stocks in distributor. This problem is occurred due to the improper co-ordination with the retailer, distributor and manufacturer which will led to the incapability of order fulfillment to the customer.
3. Customer change or cancel the order - The current supply chain management system is not flexible enough for customers. Here the problem is, once the customer places the order but later request to cancel or the change the order due to the delivery delay or payment related issues. But the retailer may the possibility of not noticing the request due to some error or miscommunication. Because the retailer needs to handle more customers at the same time.

4. Data Management – Entire supply chain management system has to handle so many data points. Handling these data and providing security to this data is a big problem in supply chain.
5. Raw materials unavailability for manufacturing - This problem is mainly occurred due to the improper co-ordination with manufacturer and raw materials supplier.
6. Problem in identify the demand of products in each supplier

By monitoring the above, the common problems in supply chain management system are

1. Lack of co-ordination with the participants
2. Security and Privacy
3. Inability to handle multiple tasks paralleling at the same time
4. Communication issues in various phases

These problems can be solved by implementing a multiagent based system in Supply chain management system. In this system consists of multiple interacting intelligent agent that will co-ordinate each other to solve a complex problem which are the perfect solution to improve the performance of the supply chain management system.

Advantages of Agent in multi-agent system –

1. Presence of multiple Autonomous agents who do tasks responsible for them
2. Concurrency - Agents are capable for performing different tasks parallely
3. Security and Privacy
4. Adaptability
5. Scalability
6. Mobility – Software agents can easily migrate to any platform or environment
7. Distributed System – MAS operate on different host and are distributed over a network
8. Better Co-operation and Co-ordination between the agents
9. Reactivity
10. Goal orientation
11. Int

Advantages of Multi-agent-based Supply Chain Management System-

1. Introducing Intelligent agents in Supply Chain System increases performance of various tasks such as making decisions, solving various problems that normally require the human intelligence, such as problem diagnosis, data classification, production planning, customer negotiation and demand based distribution that normally required human intelligence.
2. It will help to reduce the overall cost of the system - Because here it is using intelligent agents which are faster than humans which will to save lot a time and also help to eliminate the human error.
3. Increases the supply chain efficiency - Integration and coordination of various systems and processes in the supply chain, facilitating the supply chains management in a dynamic environment.

4. Successful process of communication and negotiation between manufacturers and suppliers, creates good communication networks that allow the satisfaction of customer requirements. MAS are inexpensive standardized communication infrastructure, which includes separate agents that interact in an open and real-time environment and provide transaction security;
5. Increases the security of the system
6. These systems are always active and ready to respond
7. All information regarding the different process like sales, finance, inventory etc. are easily available to other agents using the database.

Definition of Multi-Agent System –

Agents:

In this multiagent agent system consist of five types of agents.
They are,

1. **Customer Agent** – A human agent who are placing the order according to their requirements. These agents interact with retailer agent using an interface for placing the order and know the pricing details.
2. **Retailer Agent** – A software agent which receive orders from customers and issue invoices to customers. Also, this agent also has a small storage unit for temporary storage, a delivery system for distributing good to customers and also a payment gateway for customer.
3. **Raw Material Supplier Agent** – A software agent which monitor the raw materials quantity needed for manufacturing plant for production and collect these materials from different sources and supply these to factory according to the demand of each. This software agent also has one purchasing system and a storage unit.
4. **Manufacturing Agent** – A software agent which control the whole manufacturing process. This Agent consists of an inventory management system, Maintenance planning system, Manufacturing planning system and a goods storage unit.
5. **Distributor Agent** -The software agent which store and deliver the finished goods to the retailers. It consists of transportation management system to deliver goods to the retailer and big storage system to store the finished goods. This agent will send product to the retailer periodically and also monitor the selling activity of every retailer. While sending the goods, the demand of particular goods and the storage limit of that particular retailer will be considered.

Interactions-

There are five types of agents in this system. here the system is modeled using reactive and cognitive approach. In reactive modeling there are no direct communication between the agents. But in cognitive model direct communication exists between the agents.

In reactive modeling, all the five agents interact with one common database which contains all the information like customer information, raw materials details, manufacturing details, transportation and delivery details, stocks availability in retailer and distributor etc.

In cognitive modeling, each agent will interact with each other. For example, a customer agent interacts with a retailer agent for buying a particular product.

Goals -

In this system, each agent has a different set of goals. That also depends on the type of agents. Here two types of modeling are there. For reactive agents, there are no predefined goals. These agents will act according to the instruction written on their core when a situation comes just like reflexes.

And for cognitive agents, each agent has predefined goals.

They are,

1. Customer Agent – Find best product with competitive prices and quality
2. Retailer Agent – Processing of customer order as soon as possible
3. Manufacturing Agent – Manufacturing of goods efficiently
4. Distributor Agent – Storage and distribution of goods
5. Raw Materials Agent – Supply raw materials to manufacturing plant

Motivation –

1. Line-up demand planning across the supply chain, so that all partners' advantages are not kept by unneeded stocks on hand.
2. Developing the intelligent supply chain management system to support several-level decision making which will help to understand the deficiencies and needs
3. Improved the supply chain network efficiency that will help in smooth flow of goods (from raw materials to finished goods) to customers
4. Improved data management and security of the system

Co-operation –

Organizations work on independent business activities towards a common (agreed-on) goal, either to improve performance or to solve conflicts which is achieved by the contribution of each supply chain member.

Cooperation entails communicating and working together to balance the tension between individual and common goals.

Process of working on independent business activities towards a common (agreed-on) goal in a long-term view where communication is relatively informal, resources are separated and risks are shared.

Co-ordination –

Supply chain actors such as manufacture,retailer etc. align, organize and manage their business activities like systems, processes, product flow, information and knowledge in accordance with their expertise and supply chain focus.

Component of integration where organizations work together on a specific business activity to solve a problem and to jointly create strategic competitive advantages.

Negotiation –

Negotiation is the core of many agent interactions .There are three steps in negotiation

1. Exchange of Information
2. Each agent will evaluate information from its own perspective
3. Final decision is taken by mutual agreement

Here there are two main types of negotiation techniques . They are Distributive Negotiation and Integrative Negotiation.

The distributive negotiation involves a decision-making process of solving a conflict between two or more parties over a single mutually exclusive goal.

The integrative negotiation involves a decision making process of solving a conflict between two or more parties over a multiple interdependent, but non-mutually exclusive goals.

Reactive Modeling of Supply Chain Management System –

In this section explain the reactive agent modeling of the multi-agent-based supply chain management system. Here Reactive agents select actions on the basis of the current situations ignoring the historical data because these agents have no memory. These agents have no explicit representation of environment and has no direct communication between agents. Also, they have no predefined goals and have reflex action-based behaviors. These types of agents are also called reflex agents.

For implementing an efficient Supply Chain Network, this type of model is not the perfect solution. Because the reactive agents don't have ability to store the past data and directly, they can't interact each other. They work depends on the action written on their profile. Also, here for every instance must be coded in advance and the system can't derived into conclusion using the past data.

In addition to this, there are some advantages of using this model, first one is easy to produce agents and also the responses are very fast from the agent side. But the operation of supply chain management system is very complex. So, this type of implementation is not a good choice for SCMS.

Reactive Agents –

There are five reactive agents in this system. They are Customer Agents, Retailer Agents, Distributor Agents, Manufacture Agents, Raw Material Supplier Agents. These all agents work

independently depends upon the action written on their profiles and they share some information via central database.

1. **Customer Agents** – These agents will place the order of required quantity in an online portal. The data of the customer containing the order information will stored in the central database.

Perceptions – Customer Agent

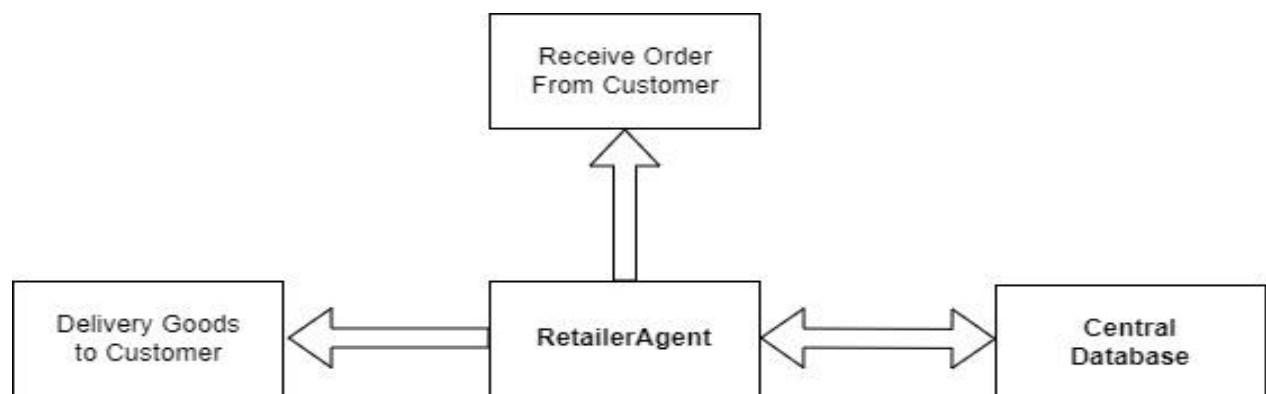
1. Receive Invoice of the order placed
2. Tracking of product delivery information

Decision Process –Customer Agent

1. Customer will accepts or reject order depends on approximate delivery time and cost
2. Customer select the nearest retailer

Actions – Customer Agent

1. Customer place order to one of the retailer
 2. Customer accepts or reject the proposal
2. **Retailer Agents** – The main job of the retailer agent is to receive orders and deliver the good to appropriate customer. Here the retailer agent checks the order summary about the customer in database. Each time the customer places the order the corresponding retailer agent get information via central database.



Perception – Retailer Agent

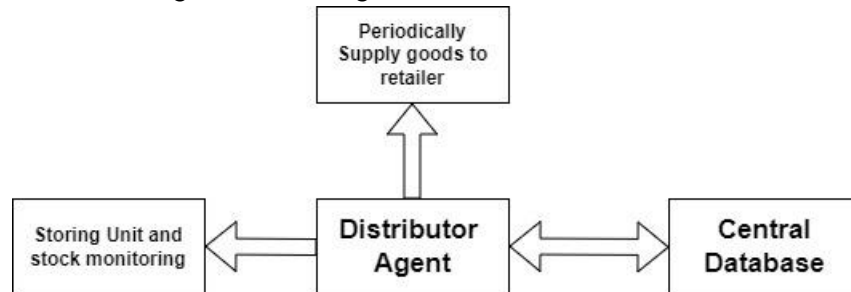
1. Order coming from customer

Decision Process – Retailer Agent

1. Check the current pricing of ordered goods and quantity
2. Validation of the customer location for delivery

Action – Retailer Agent

1. Send invoice order to customers when order came
 2. Delivery goods to customer
 3. Verify payment of the customer
3. **Distibutor Agents** – This agent recieve the finished goods from manufacturing unit and periodically supply this to the retailer in some interval.Also this agent has big storage unit for storing the finished goods.



Perceptions – Distributor Agent

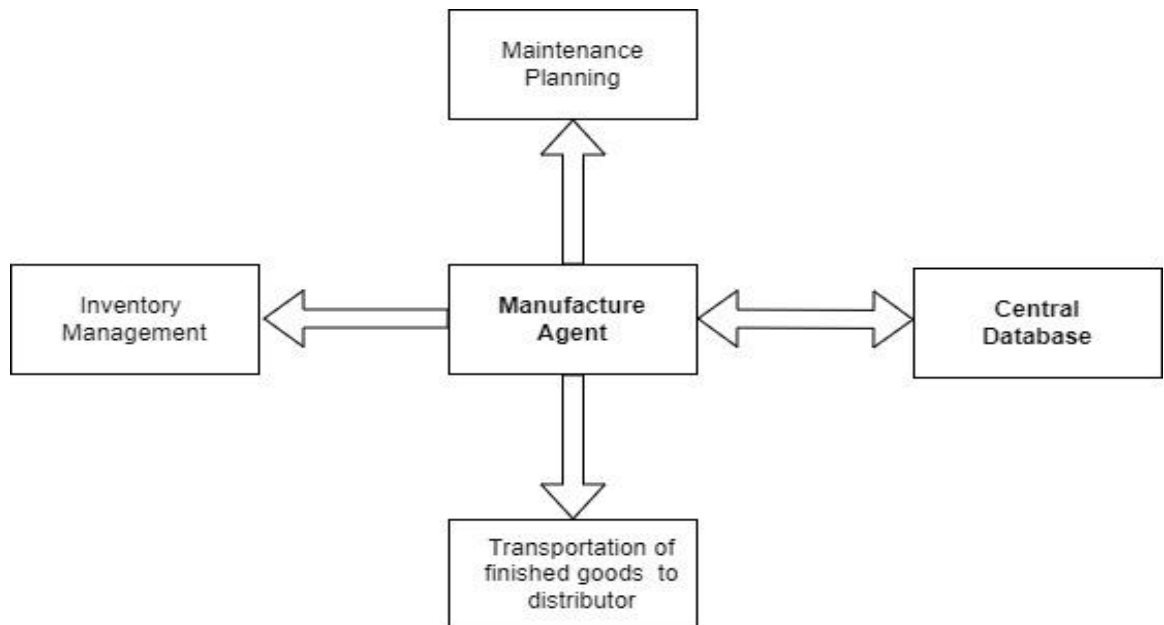
- 1.Handle the finished goods coming from the manufacture agent.
- 2.goods shortage request from retailer through central database in between the periodic delivery due to demand among customers

Decision Process – Distributor Agent

- 1.Validate the retailer ID and required quantity
- 2.Compare this with current stocks availability

Actions - Distributor Agent

- 1.Send goods to retailer in a definite interval of time
 - 2.Due to demand,when request came from retailer regarding the shoratge, then immdiately send the goods deppends upon availabale stock and priority.
4. **Manufactruing Agents** – This agent control the manufactruing process,Maintenance Planning and the inventory management.here for an efficient manufacturing of goods the agents need to continously monitor the raw materials availability and if it is going to some threshold limit ,immediately agent will update it in the database.Also here maintenance planning is not efficient.Because here only periodic maintenance is doing. But not considering the market demands and Current storage in distributor hand and also it is not a predetermined machine failure prediction system.



Perceptions – Manufactruing Agents

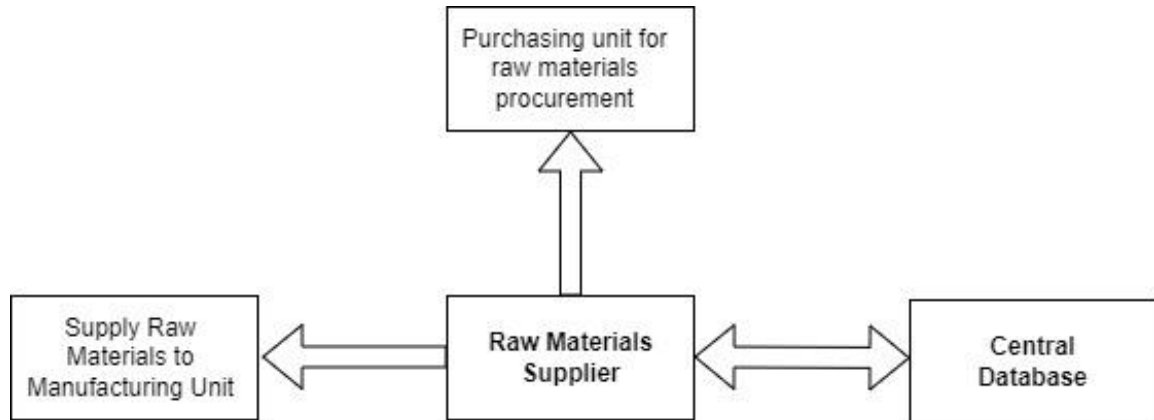
1. Receive Raw Materials from the supplier

Decision Process – Manufactruing Agents

1. Manufacturing goods based on target set by the management
2. Factory maintenance depends on machine current performance

Actions - Manufactruing Agents

1. Control the Manufacturing process.
2. Control the machinery maintenance operation
3. Inventory management
4. Management of Transporting goods to the distributor
5. **Raw Material Supplier Agent** – This agent will supply rawmaterials needed for manufacturing unit for the production. Also this agent has a purchasing unit to collect the raw materials from many sources and also monitor the raw material stock in manufacturing unit for continuous supply.



Perceptions – Raw Material Supplier Agent

1. Monitor the raw materials availability in the manufacturing unit

Decision Process – Raw Material Supplier Agent

1. Identify the raw material required for the production
2. Verify the raw materials quantity is sufficiently available for production in manufacturing unit

Actions - Raw Material Supplier Agent

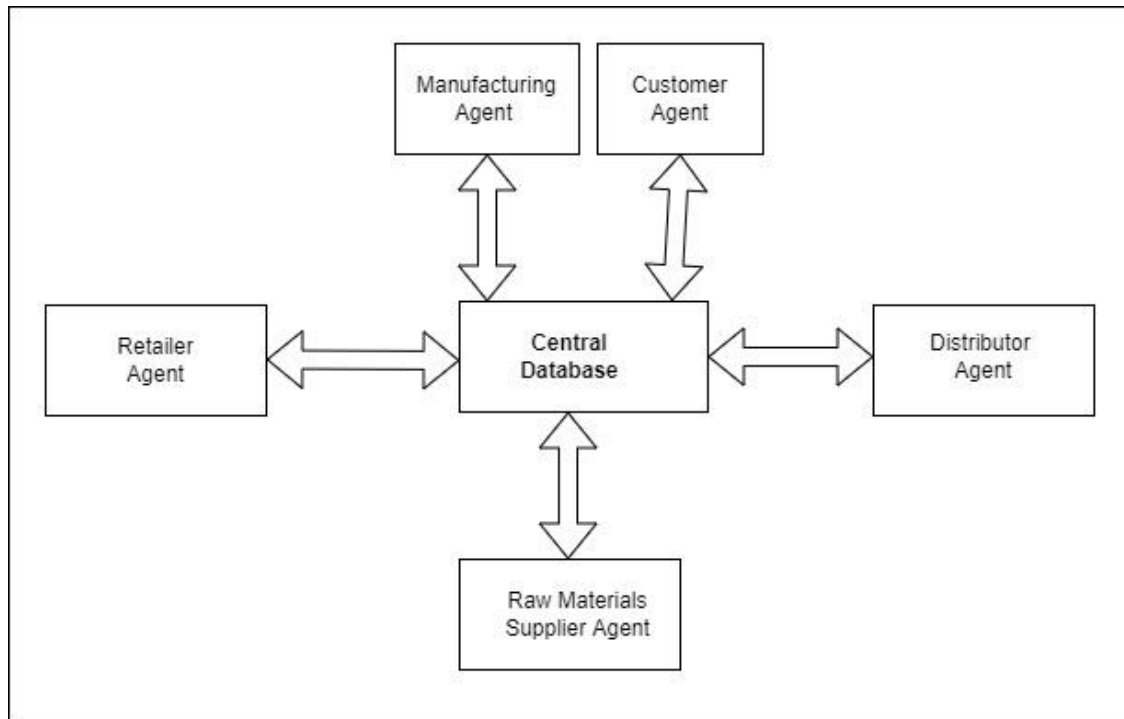
1. Send the raw materials to the manufacturing unit by considering the quantity of each
2. Purchase the raw materials from various resources .

Environment –

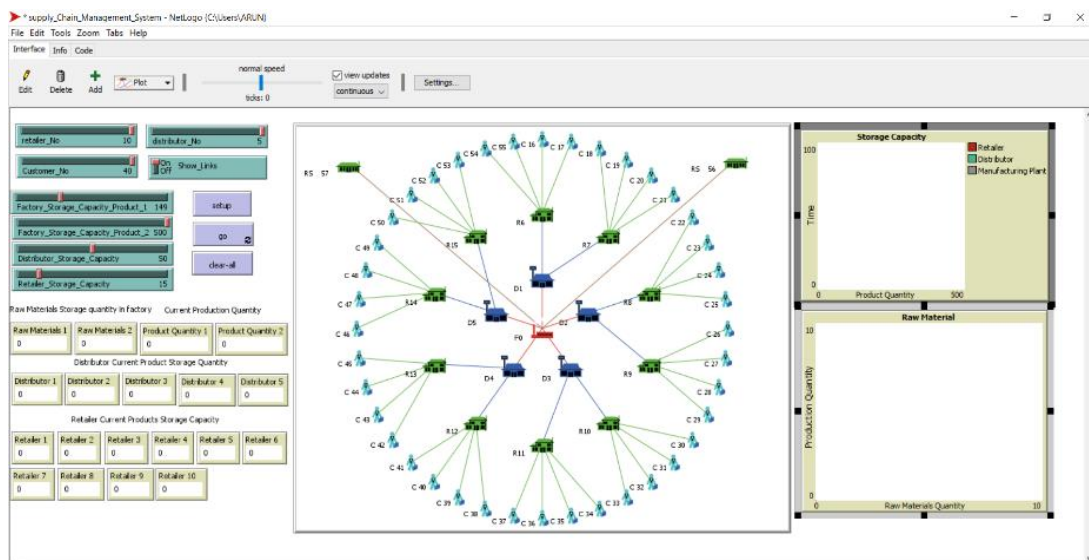
An environment is everything in the world which surrounds the agent, but it is not a part of an agent itself.

In this reactive model there are mainly two environments.

1. Centralised Database – Each agents will update the current work done by them in this database. These information is accessible to all agents in the system. Also here several sensors and devices are connected to monitor the system efficiently.



2. NetLogo – It is a programmable environment for multiagent system modeling and simulation.



The information shared in the environment can be certain features. They can either be observable or accessible information.

Observable Information - If an agent sensor can sense or access the complete state of an environment at each point of time

1. Customer order information including quantity and product type
2. Raw materials availability in manufacturer's hand

3. Inventory details which includes details about finished goods, work in progress goods and raw materials

Accessible Information - If an agent can obtain complete and accurate information about the state's environment

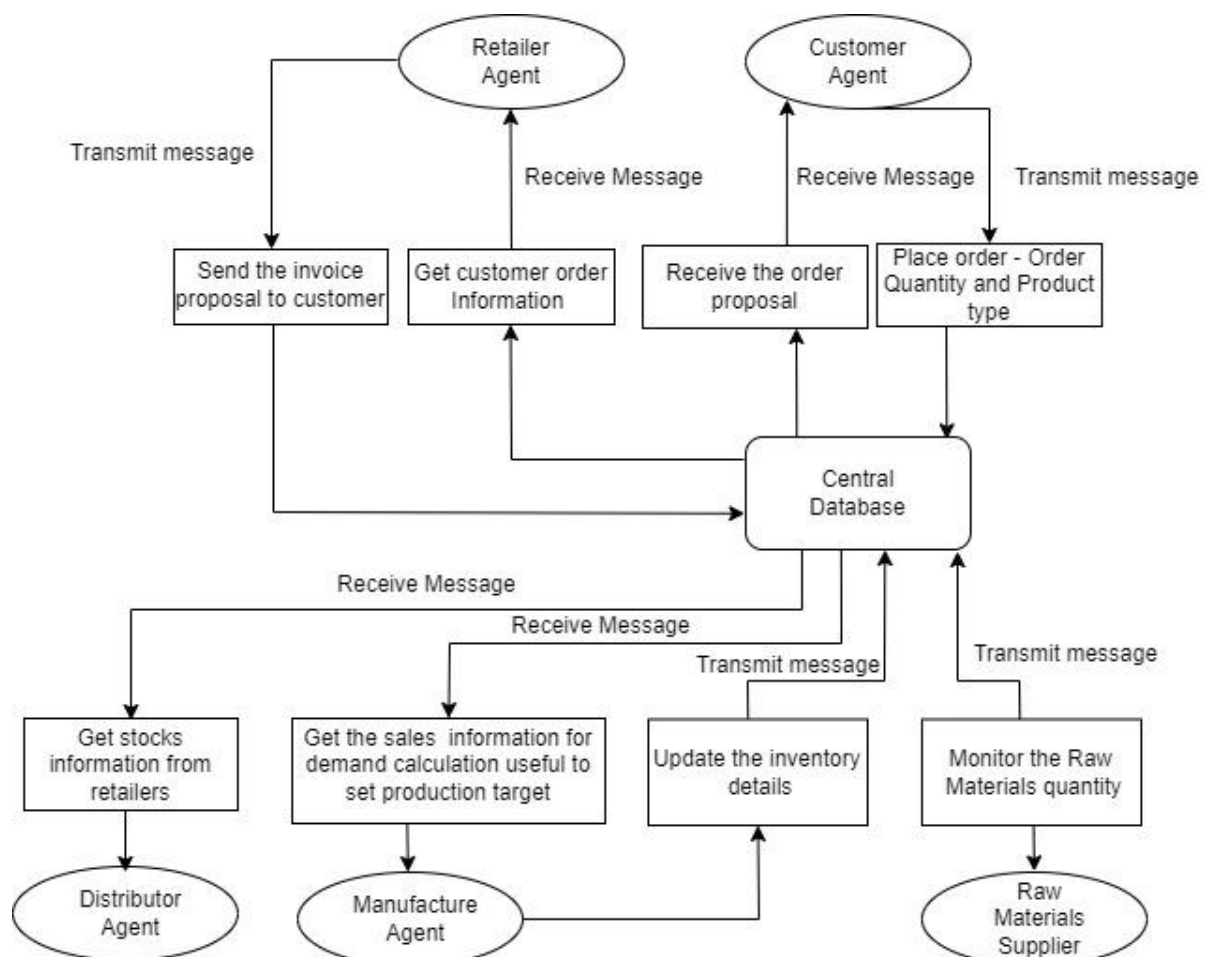
1. Stocks information in retailer and distributor
2. Production performance of machineries in manufacturing plant

Regulation Rules –

1. Guidelines of the periodic maintenance of machineries
2. Periodic distribution of good from manufacturing unit to distributor and distributor to retailer
3. Production target information from managerial side

Interactions –

In supply chain management system, certain information from each agent need be shared for better coordination and cooperation. But here it reactive modeling, so agents don't directly communicate with each other. Hence here use a central database, that each agent update the information need to be shared



Pros and cons of Reactive Based Supply Chain Management System–

Advantages –

1. Responses from each agent side is very fast
2. Easy to produce agents
3. Cost effective implementation

Disadvantages –

1. Here there is no demand-based distribution. Distributor periodically send goods to each retailer. So, the chances of dead storage in some retailers are high.
2. Customer can't track the order processing and delivery information. The Customer can only able to see the order summary details.
3. An additional database is required for data sharing between agents

Cognitive Modeling of Supply Chain Management System –

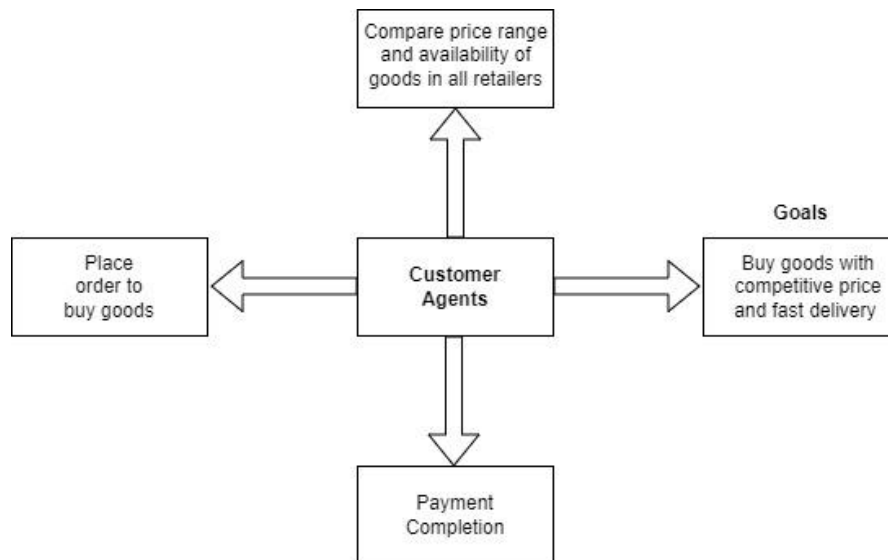
Cognitive approach is the efficient way for modeling multiagent based supply chain management system. These agents have goal-based approach means they choose their action in order to achieve goals. Also, these goals can be easily in future when necessary. These agents have a memory and direct communication exist between the agents. They have elaborated decision-making process guiding behavior.

Cognitive Agents –

Here the agents are similar as in reactive approach. But each agents have different set of goals and they work each other to achieve these goals. And also, these agents make certain decisions by analyzing past data.

Customer Agent –

The function of this agent is same as in reactive approach. But here this agent has a goal that is, to buy the product based on competitive prize and fast delivery. To achieve this, the agent needs to negotiate with multiple retailers and finally they buy the product.



Set of Perceptions –

1. Receive pricing and approximate delivery time for goods from retailer
2. Tracking of the product flow after order is placed

K : Knowledge about the world -

1. Customer knows the pricing of product and approximate delivery time needed for each retailer.

Ka : Knowledge about itself –

1. Ordered quantity and delivered location
2. Time required for delivery

Decision Process –

1. Order goods based on price of the goods and Delivery time

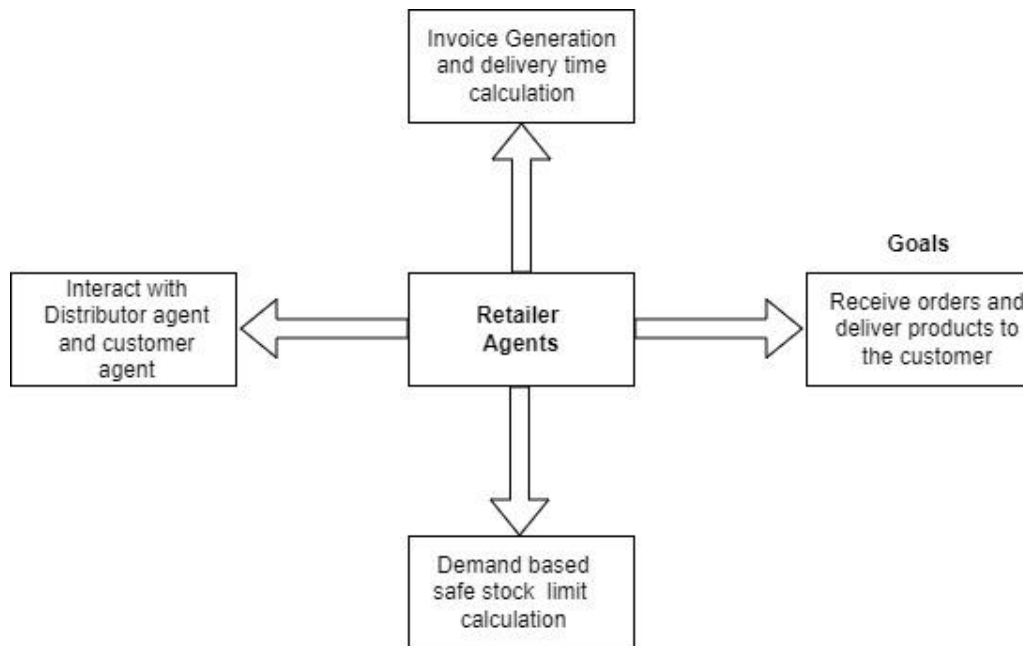
Action –

1. Order products on required quantity
2. Complete payment as per invoice
3. Order update due to some situations

Retailer Agent –

Retailer agent will control the sales and delivery activities of finished goods to the customer. Retailer agent also have the information about complete stocks.

This agent has a prediction system for demand calculation for each month based on the past sales activities and corresponding period of time. With respect of that, a safety stock quantity limit is calculated for each month for fast delivery of products.



Set of Perceptions –

1. Customer order information from customer agent via messages
2. Order accept or reject from customer agent
3. Payment status from customer agent
4. Order update request from customer agent

K : Knowledge about the world -

1. Knowledge about regular customer who purchased continuously with the same retailer for easier negotiations. Regular customers may get more discount in price and priority in delivery.

Ka : Knowledge about itself –

1. Entire stocks hold by the retailer
2. Estimated safety stocks limits details to meet the demand of each month

Decision Process –

1. Demand calculation based on the previous sales data on each month.
2. Approximate delivery time prediction based on the current stock's availability.
3. Invoice generation based on the prices and possible discount given for different customers. Each retailer has some regular customers. So, they have more discount and priority among others.

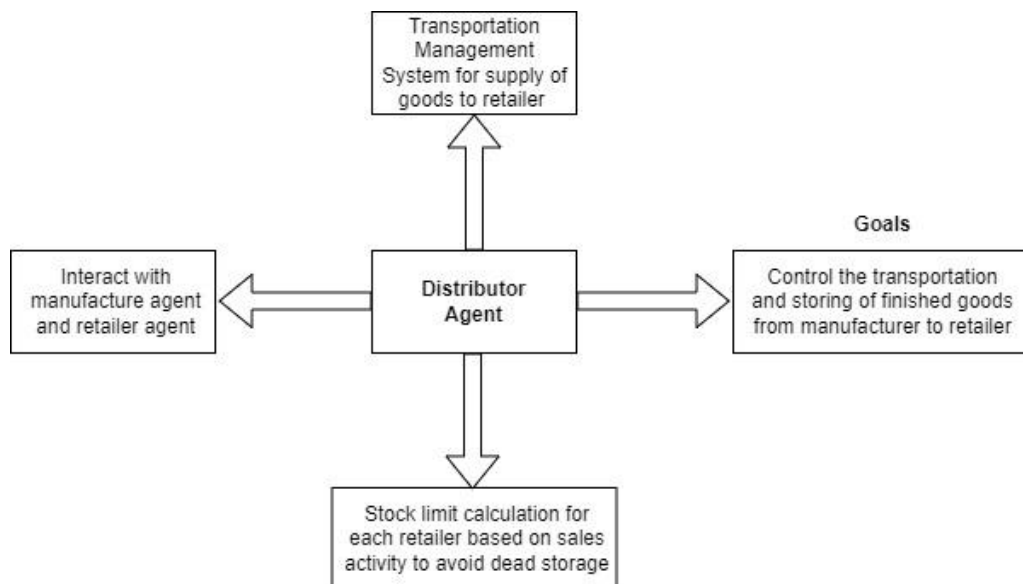
4. If a customer continuously buys from a particular retailer for more than 4 times for a continuous interval of time, then consider that customer as a regular customer

Action –

1. Send invoice to the customer
2. Send stock supply request to the distributor agent based on the demand calculation
3. Accept payment from customer side
4. Monitor the delivery process of products to customers

Distributor Agents –

The agent who controls the collection of finished goods from manufacturer, storing of these goods and supply them to the retailer. Here distributor supply the goods to retailers based on the sales activity in order to avoid dead storage in each retailer's stock.



Set of Perceptions –

1. Receive Sales information from retailers for stock limit calculation of each.
2. Get stock details of other distributor agents for collecting goods to meet emergency demand situations.

K : Knowledge about the world -

1. Stocks availability in other distributor agents.
2. Production rate from manufacture agent
- 3.

Ka : Knowledge about itself –

1. Individual distributor stock availability
2. Tracking of transportation of goods to retailer

Decision Process –

1. Distributor send the goods to retailer, here the required quantity is calculated based on the sales activity of that particular retailer at that time and the retailer current stock capacity
2. If production rate of manufacturing doesn't meet the demand of a distributor of a particular time period, then all distributor agents will co-ordinate each other and collect stocks from their stores.

Action –

1. Stock limit calculation for each retailer for particular time period.
2. Send products to each retailer demand on the safety limit

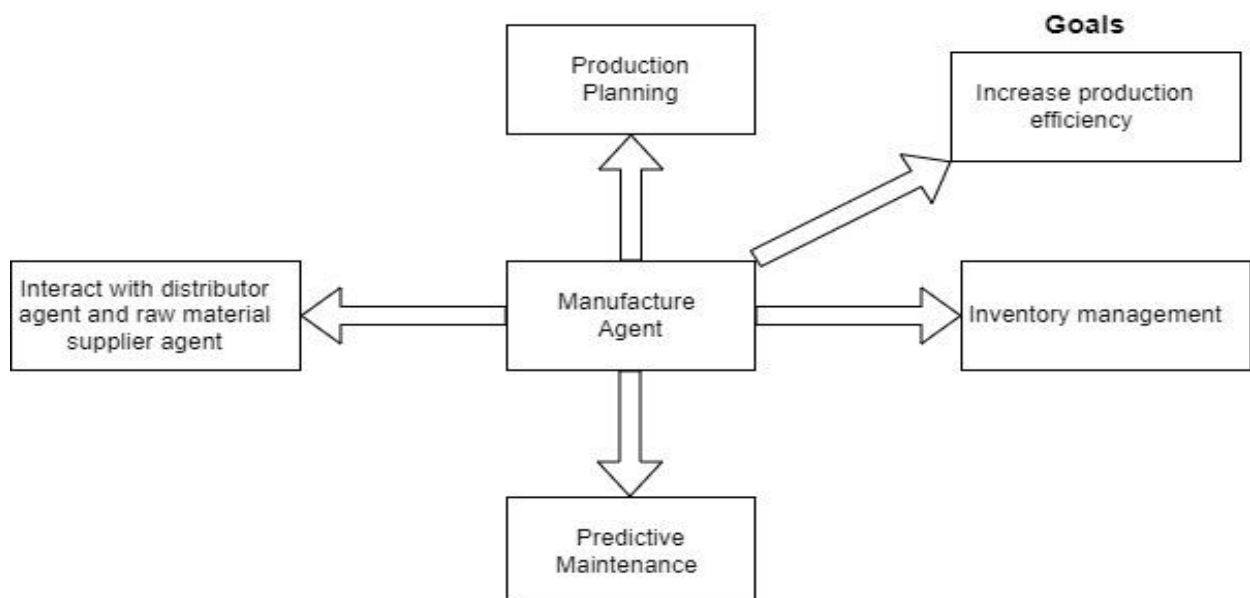
Manufacture Agent –

This agent controls the inventory management, Maintenance of machineries and production planning.

Inventory management include the raw materials details, information of finished goods and also the goods at the manufacturing stage.

Maintenance of machineries include the periodic maintenance and also predictive maintenance (continuously monitor the electrical and mechanical equipment in each machine and predict the approximate life of that particular part depends on many parameters like temperature, vibration etc.)

Production planning include the process of changing raw materials to finished products.



Set of Perceptions –

1. Machine performance details and individual machine efficiency
2. Machinery sensor feedback to monitor electrical and mechanical faults

K : Knowledge about the world -

1. Information regarding the current stock availability in distributor store for demand-based production planning

Ka : Knowledge about itself –

1. Inventory details
2. Production rate
3. Total manufacturing plant efficiency

Decision Process –

1. Predictive maintenance - fault prediction of particular device is based on the sensor feedback and analyzing past threshold limit of that particular parameter of that device.
2. Production planning depends on the raw materials availability, current market demand and also depends on the individual machine performance

Action –

1. Execute the production planning
2. Request raw materials to supplier agent
3. Predict the fault chances of equipment before failure to reduce plant shutdown
4. Fix periodic maintenance and suggestions to improve performance of the machines
5. Send the finished products to distributor

Raw Materials Suppliers –

This agent will procure raw materials needed for production and supply this to manufacturing unit depends on the quantity.

Set of Perceptions –

1. Information regarding raw materials availability in manufacturing unit

K : Knowledge about the world -

1. Know the current market demand of the product which help to find out the quantity of the raw materials need to stock on the supplier side.
2. Know production efficiency of manufacturing plant

Ka : Knowledge about itself –

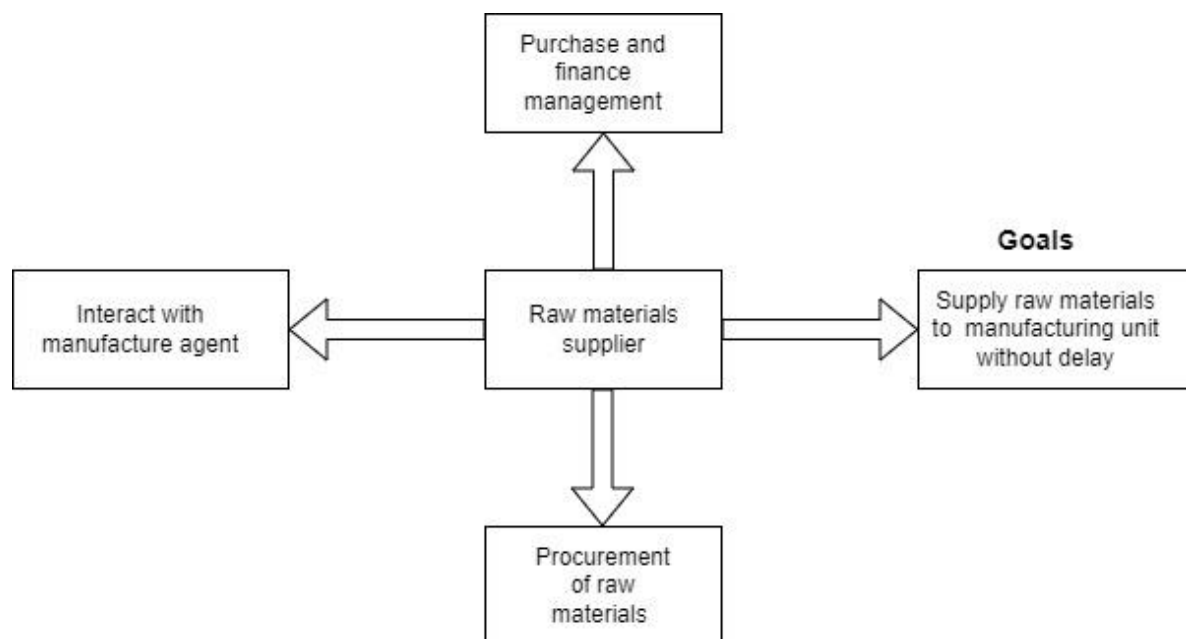
1. All raw materials stock availability information on supplier side

Decision Process –

1. Send the raw materials to manufacturing plant based on the availability of same on manufacture side and production speed

Action –

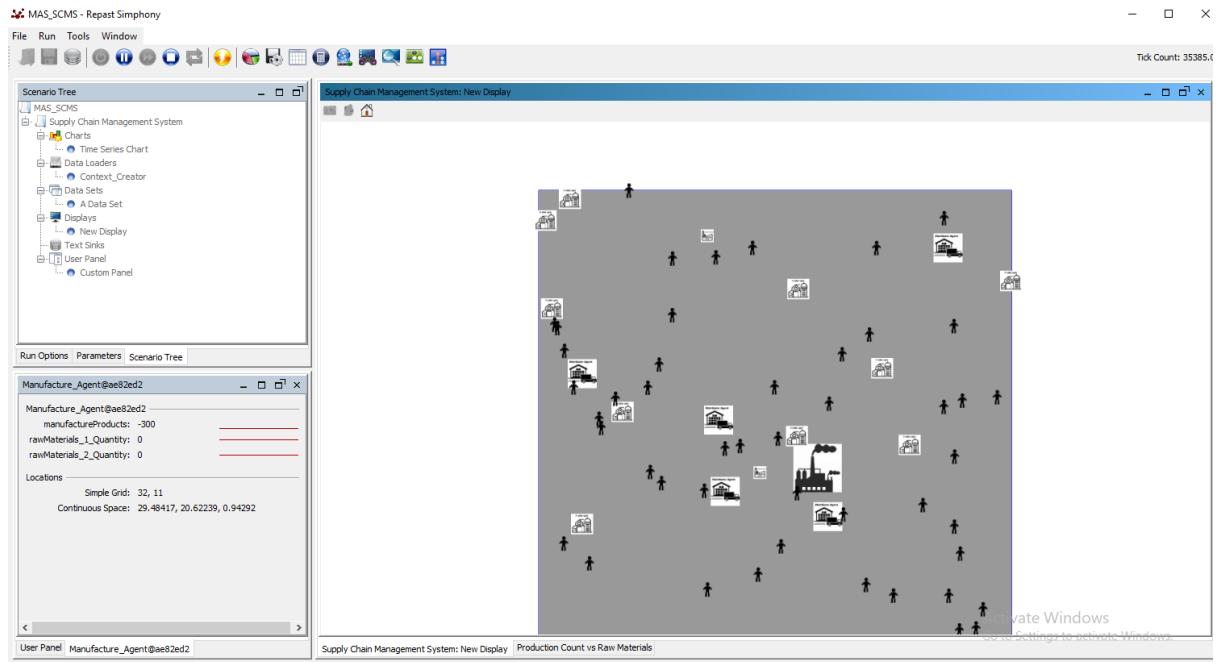
1. Send Raw materials to manufacturing plant
2. Procurement of raw materials from various resources
3. Do the payment process between supplier and different raw materials sources



Environment –

The environments in cognitive modeling are

- 1.Repast Symphony - The Recursive Porous Agent Simulation Toolkit (Repast) is open-source agent-based modeling and simulation toolkit.



2. Manufacturing Execution System – For production planning
3. Warehouse Management System on Distributor Side – For efficient storing of goods
4. Transportation Management System
5. Equipment resource Planning
6. Warehouse Management System on retailer side
7. Smart Delivery System
8. Different type sensor installed in manufacture plant to monitor electrical and mechanical fault

Interactions –

In the cognitive model, direct communication is existed between the agents. So, here the directly exchange information via messages. For this certain communication protocols like KQML and FIPA ACL are existing.

1. **Interaction between Raw Materials Supplier and Manufacture Agent** – Here raw materials supplier agent get the raw materials quantity information from manufacture agent. If the quantity less than a particular limit, then Raw Materials Supplier send the materials to manufacturing plant.

FIPA(Foundation of Intelligent physical agents) Message: -

(request-whenver

: sender (agent-identifier: name manufacture agent)

: receiver (set (name raw materials supplier agent))

: content

“((action (agent-identifier: name raw materials supplier agent)

(inform-ref

: sender (agent-identifier: name raw materials supplier agent)

: receiver (set (agent-identifier: name manufacture agent))

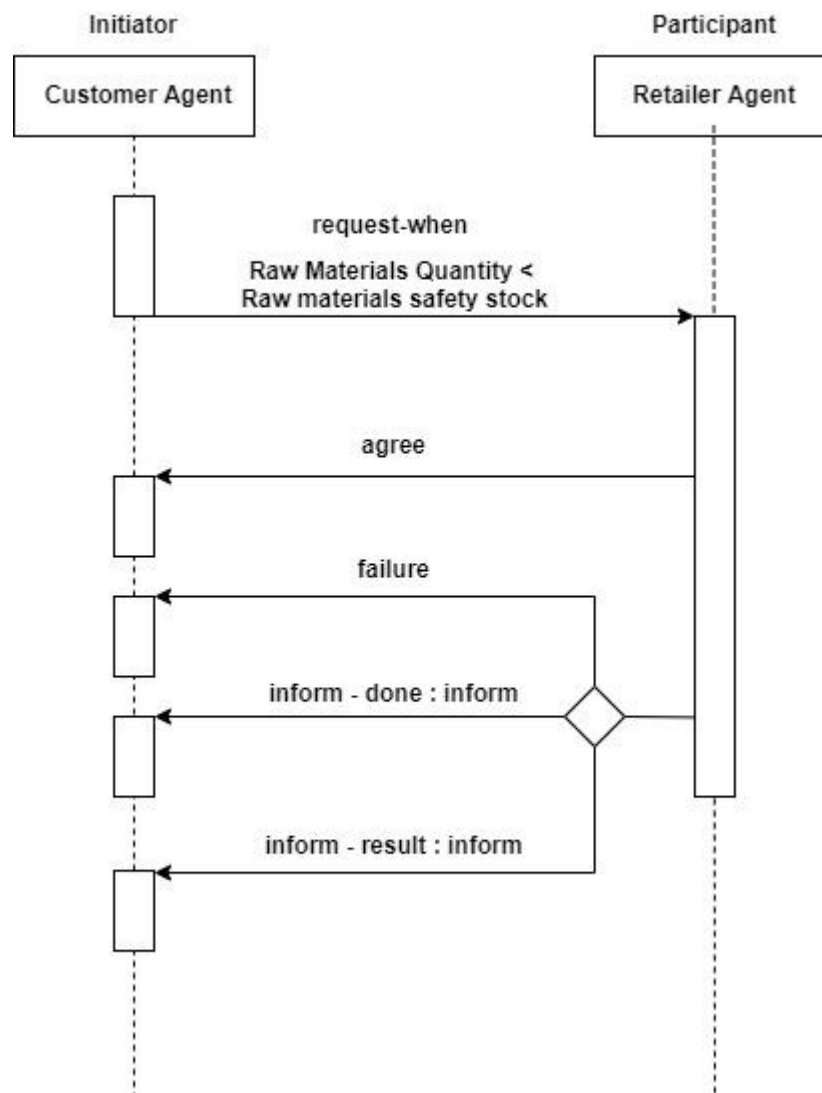
: content

\” ((iota? x (= (raw materials quantity)? x))) \”))

(< (raw materials quantity) raw materials safety stock)”

: protocol fipa-request

: language fipa -sl)



- Interaction between retailers and customer agent - Here the customer agent place order of required quantity with retailer agent. Retailer Agent validate this order issue the proposal. The Customer Agent may accept or reject the proposal depends upon of certain conditions.

Message for placing order –

(call for proposal

:sender (agent-identifier : name customer agent

:receiver (set (agent-identifier :name retailer agent)

:content

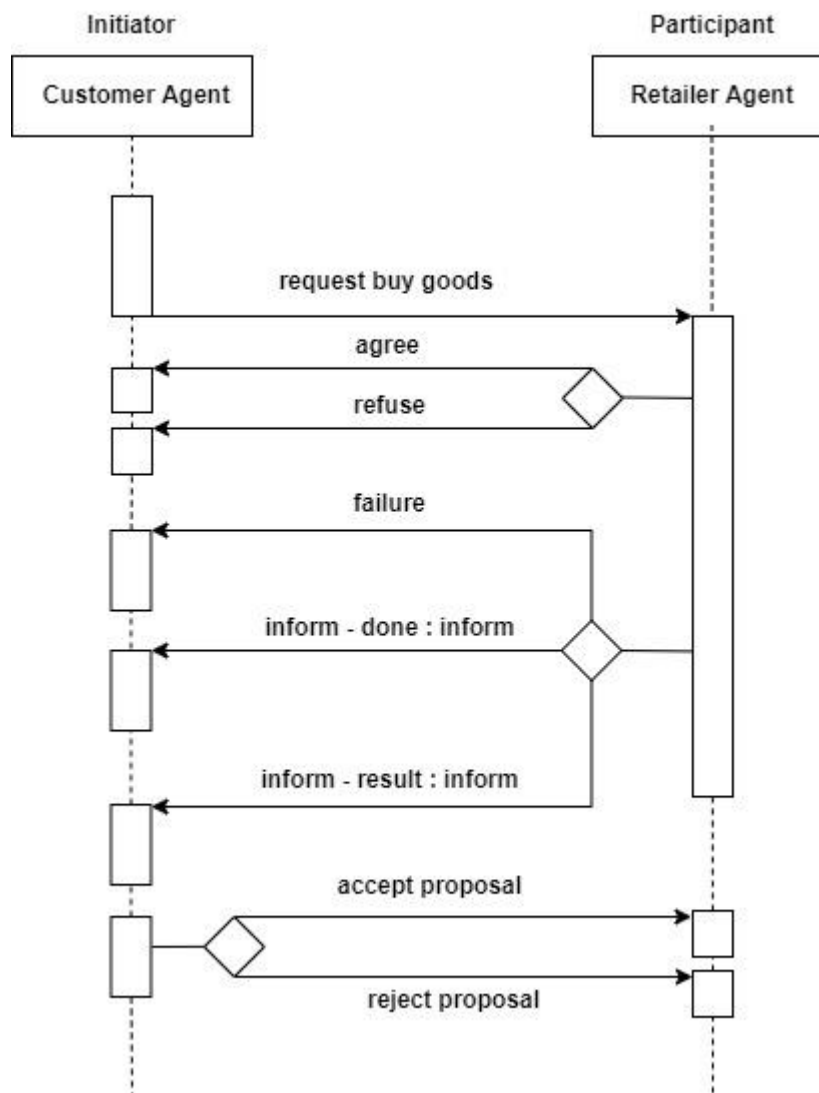
“((action (agent-identifier : name customer agent))

(buy goods quantity))

(any ?x (and (= (price goods) ?x))))”

:ontology supply chain management system

:language fipa-sl)



3. Interaction with Retailer Agent and Distributor Agent – Here retailer agent send the request to distributor agent when there is a stock shortage.

(request-when-ever

: sender (agent-identifier: name retailer agent)

: receiver (set (name distributor agent))

: content

“((action (agent-identifier: name distributor agent)

(inform-ref

: sender (agent-identifier: name distributor agent)

: receiver (set (agent-identifier: retailer agent

: content

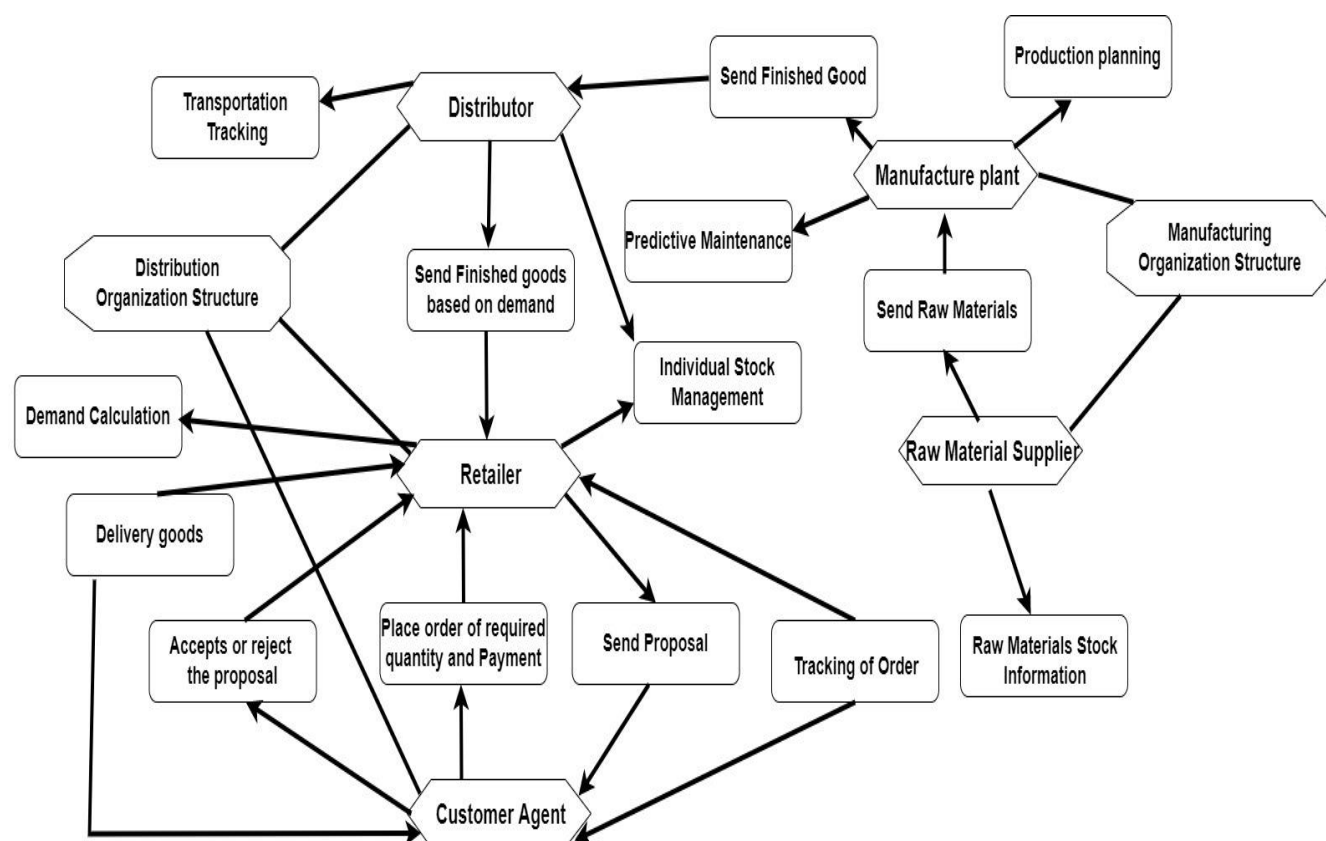
\” ((iota? x (= (retailer stocks)? x))) \”))

(< (retailer stocks) retailer safety stock)”

: protocol fipa-request

: language fipa -sl)

Organization :-



The above diagram explain the organization diagram for cognitive modeling

Conclusion –

Multi-agent system is a loosely coupled network of software agents that interact to solve problems that are beyond the individual capacities or knowledge of each problem solver. The general goal of MAS is to create systems that interconnect separately developed agents thus enabling the ensemble to function beyond the capabilities of any singular agent in the set-up in agent model. This research can demonstrate that agent technology is suitable to solve communication concerns for a distributed environment. Multi-agent systems try to solve the entire problem by collaboration with each other and result in preferable answer for complex problems. For further works, it is recommended for developing this model to have multi retailer and even multi distributor and apply the auction mechanism between them.

Supply Chain encompasses all those activities needed to design, manufacture and deliver a product or service needs a mechanism or frame work for information sharing. Agent-based manufacturing is a new way of thinking about and applying information. With this idea an attempt is made to provide a multi agent system model for the supply chain management. In the proposed model each agent performs a specific function of the organization and share the information with other agents. There by the most important requirement of effective supply chain i.e information sharing is achieved in the proposed model. At the same time this agent based approach provides reliable and agile systems, which will enable manufacturing organizations of the future to accommodate ever changing needs of its customers.

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