

CHAPTER 3

AGENT BASED DISASSEMBLY OF E-O-L PRODUCTS

Supply chain management flow can formulate as the routing problem, and inventory routing of goods to disassembly in reverse logistics is a highly concentrated process in manufacturing industries. Thus, it is expressed using the JADE, the multi-agent system used for solving the inventory routing problem. JADE based multi-operator framework offers an extensive variety of applications in supply chain management. In Particular, sharing and recovery of data inside the specialist and between operators in dismantling sequencing and arranging in reverse logistic framework. In this chapter a study has been made of executing Multi-agent system for process planning and scheduling in dismantling and to solving the inventory routing problem in reverse logistics.

All the more clearly, reverse logistics is the way toward moving products originating from an end client with the ultimate goal of recovering qualities and appropriate transfer. The objective of every reverse logistic is to boost the qualities and limit condition hazardous of E-O-L Products. Taken a toll funds framework mostly for the purpose of reusing E-O-L products or potentially their subassemblies and additionally the reused materials. RL begins with the gathering of E-O-L Products to use, reuse and remanufacture (Chang Ouk Kim et al. 2010).

Item recovery expects to limit the measure the end user, product and acquire reusable components from old or obsolete items by a method for reusing and remanufacturing (H.J. Kim et al. 2003). The main pivotal stride of item recovery is dismantling. Dismantling is a procedure of extricating the necessary parts/subassemblies and materials from E-O-L Products through a progression of operations. The strategy of item recovery cycles for E-O-L Products is as appeared in Fig 3.1.

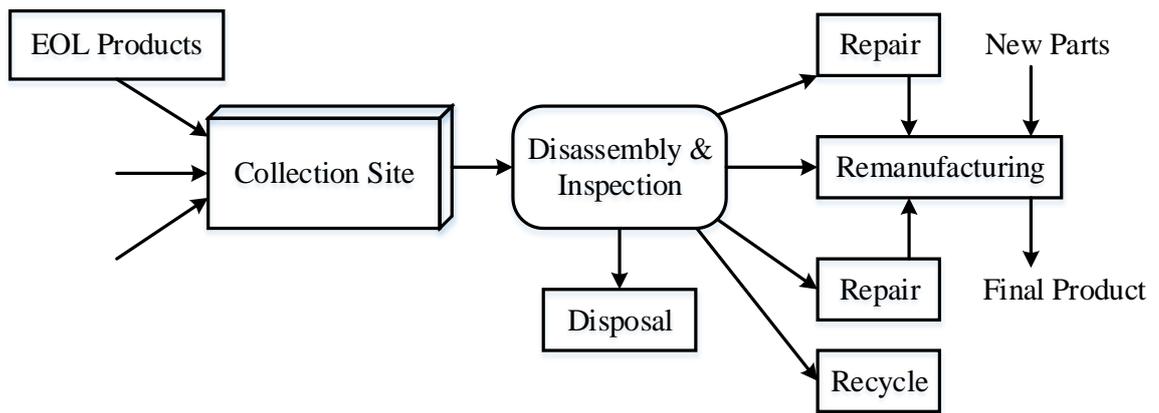


Figure 3.1. End-of-Life Product recovery cycle

Different request sources may likewise prompt to difficulties in dismantling sequencing and arranging and dismantling the line adjusting. Dismantling sequencing is basic in limiting the utilization of valuable assets, put resources into dismantling and augmenting the level of robotization of the dismantling procedure and the nature of the parts recouped. One crucial part of dismantling procedure arranging is to locate an ideal close ideal dismantle that gets the best cost/advantageous proportion for dismantling.

Multi-operator frameworks are frameworks in which different connecting specialists associate to take care of issues. Specialists in MAS know when and how to cooperate with whom. Regular attributes of Multi-operator frameworks are their inborn conveyance and multifaceted nature. Conveyed and adaptable nature of Multi-specialist frameworks prompts to expanded speed, heartiness, adaptability and reusability. In MAS, every operator has insufficient data, control and information are decentralized, and its calculation is unusual.

In the planning of MAS, the fashioner has a few issues like when and how operators ought to collaborate, participate and contend, to effectively meet their outline destinations. Here and their operators need to tackle a sub-issue all in all and such case specialists ought to comprehend other specialist's capacities, step by step instructions to empower specialists to break down their errands and blend fractional outcomes. The most efficient method to empower operators to convey, what dialects

and conventions to utilize, the powerful method to empower operators to speak to and reason about the condition of their cooperation.

As the interest for all the greater, proficient and adaptable specialists develop, so too does the weight on engineers. In the meantime, making operator perform excessively numerous undertakings would prompt to the many-sided quality of improvement and increment of support specialists are outlined in light of a particular reason. If operators must perform more assignments, either can expand their unpredictability (which builds the improvement exertion), or make them work co-operatively. The participation of operators is completely vital and to succeed, successful correspondence is required. The dialect and correspondence medium is basic for collaboration amongst operators and it ought to be normal.

Ahmed Elsayed et al. (2012) tended to the issue of making savvy, green and monetarily helpful dismantling groupings of E-O-L Products utilizing transformative calculation. Hung-DA Wan has presented the utilization of radio-recurrence distinguishing proof innovation to bolster dismantling choices with the enhanced data, a fluffy based dismantling arranging as well as a sequencing mode (Hung-DA Wan and Venkata Krishna Gonnuru, 2013). Jinmo Sung has improved the effectiveness of dismantling arranging remanufacturing condition (Jinmo Sung and Bongju Jeong, 2014). They developed a heuristic strategy for dismantling with the presence of dismantling part/subassembly requests.

Amre Z. Massoud and Surendra M. Gupta, (2008) acquainted Disassembly-with request issue where an assortment of returning items dismantle keeping in mind the end goal to satisfy the interest for indicating parts to decide the ideal number of reclaiming of E-O-L Products for the DTO framework that augments the benefit. Promote (Elif kangaroo and Surendra M. Gupta, 2001) utilised objective model to take care of the DTO issue in a multi-period constrain. In (Yuan-JyeTseng et al. 2012) portrayed another model to simultaneously assess the outline as well as plan the gathering and dismantling with limiting the aggregate of both get together and the dismantling charge. Smith has built up a decommissioning grouping structure chart

display (Smith.S, et al. 2012) for explaining a multi-target specific dismantling succession arranging issue by utilizing a hereditary calculation to acquire ideal arrangements. Li has outlined a particular dismantling arranging strategy to tackle a dismantling arranging issue by utilizing a new imperative taking care of the calculation on the fluid precious stone show (LCD) TVs (Li, W Mehnen, 2013).

Mukul Tripathi et al. (2009) have proposed a fluffy dismantling improved display, deciding the ideal dismantling succession and also the perfect profundity of dismantling to boost the net income to the finish-of-life (EOL) transfer of the item in this present reality circumstance. A fluffy shaded Petri net model and a heuristic arrangement strategy were proposed by (Turowski M et al. 2005) presented EOL item's condition and human components. Michael E. Ketzenberg et al. (2003) have proposed the issue of planning a blended gathering and dismantling for remanufacturing can be utilised to assemble the new item. Beatriz has exhibited disseminate look metaheuristic search to manage the ideal dismantling succession issue for the instance of multiple items with arrangement low dismantling costs, and expecting that just a single segment can discharge at every time (Beatriz González and Belarmino Adenso-Díaz, 2006).

Taleb has enhanced the approach to incorporate the materials shared trait and also the dismantling of numerous item structures (Taleb et al. 1997). Veerakamolmal and Gupta connected arranging and sequencing procedures which limit the aggregate handling time and dismantling costs (Veerakamolmal, and Gupta, 1998). Isaacs and Gupta examined the effect of the vehicle outline on transfer strategies by utilizing objective programming to tackle the issue (Isaacs, and Gupta, 1997). Multi-agent based dismantling sequencing and arranging strategy is unique about the past work. Jayaprakash has proposed reenactment investigation of executing multi-specialist in the stock steering issue (Jayaprakash J, et al. 2014).

Johan Holmgren et al. (2012) have displayed transportation and creation specialist based simulator that operate based model for a recreation of the transport link or path.

Georgios Andreadis et al. (2014) have introduced a profound overview of the different orders of Multi-Agents Systems in the production module of an organisation. Kamalendu Pal and Bill Karakostas, (2014) have displayed multi-operator, and web benefit structure for cooperative material obtainment framework in a logistics. Yang Li, and Shuo Liu, (2014) have presented the strong control of institutional financial specialist's infringing conduct in securities exchange. They centered the possible and reasonable significance of the impact of the self-versatile direction, methodology for the little and medium-sized financial specialist insurance.

Luca Greco et al. (2013) have proposed a multi-specialist framework for supply chain dynamic design. N. Mishra et al. (2012) have proposed a multi-operator engineering for dealing with race as well as the issues in reverse logistics. They tended to the unique parts of reusing, for example, squander characterization and reuse of items. They have called attention to, how the specialist conveys and acts self-sufficient to encourage the production logistics of materials.

3.1 Inventory routing problem

As of late, (T. Le et al. 2011) proposed a section era based heuristic to comprehend the model. They demonstrated noteworthy funds when utilizing their model. Then again, (Z. Shen et al. 2003) exhibited a common area stock model for the blood circulation framework. Therefore, they amplified these models and coordinate area, stock, and directing segments into one model.

Supply chains with perishable items have examined in various lines of research. A few scientists augmented the monetary request amount approach for stock models which incorporate perishable items. In (B. Giri and K. Chaudhuri, 1998) proposed a stock model for a perishable item where the request rate is a component of the close by stock, and the expense is nonlinear. Also, (G. Padmanabhan and P. Vrat, 1995) proposed stock-subordinate offering rate display where the multiplying capacity was thought to be subject to the measure of interest accumulated. In (C. Dye and L. Ouyang, 2005) presented a time comparable multiplying rate.

The inventory routing problem (IRP) is worried about the reshaped dissemination of a solitary/multi item, from single/multi providers to an arrangement of n clients over a given arranging skyline with length L , potentially unendingness. Clients devour the question at the rate D_i as well as have the capacity to keep up a nearby stock of the item. An armada of V_i homogeneous/heterogeneous vehicles, with limit Q , is accessible for the dissemination of the parts. The goal is to limit the normal dispersion costs amid the arranging time frame without bringing about stock outs at any of the clients.

Three choices must make:

- At the point when to serve a customer.
- The amount to convey to a client when it served.
- Which conveyance courses to utilize.

The ideal arrangement of any IRP relies on upon the target work picked. The minimization of the transportation cost just is an appropriate objective for a chief who is in charge of the transportation or in a circumstance where the stock expenses are not significant when contrasted with the transportation costs. The minimization of the stock expenses is the objective in circumstances where the attention is on stock management.

3.2 Multi-Agent System for Inventory Routing problem

Multi-operator frameworks have as of now been produced for various application area particularly mechanical control frameworks. In applying the multi-specialist way to deal with the IRP, see the enhancement issue as a competitive procedure of different substances with various intrigues. An IRP arrangement setup comprises of a set of sequences with each course comprising of a succession of management to various clients along the sequence. Proportionally, an IRP can view set of customer management, one for every buyer. Each arrangement comprises of the grouping of managements, to the client which are adjusted by various courses

after some time. Consequently, for the IPR the substances are the vehicle drivers, customers and managements.

Three central compartments in these dispersion frameworks which are expressly showroom, industrial facility, and distribution center as appeared in Fig 3.2. Demonstrate room holder has n number of client operators CA. Client Agent needs to gather the quantity of " m " things required time " T " by the " n " no. of clients.

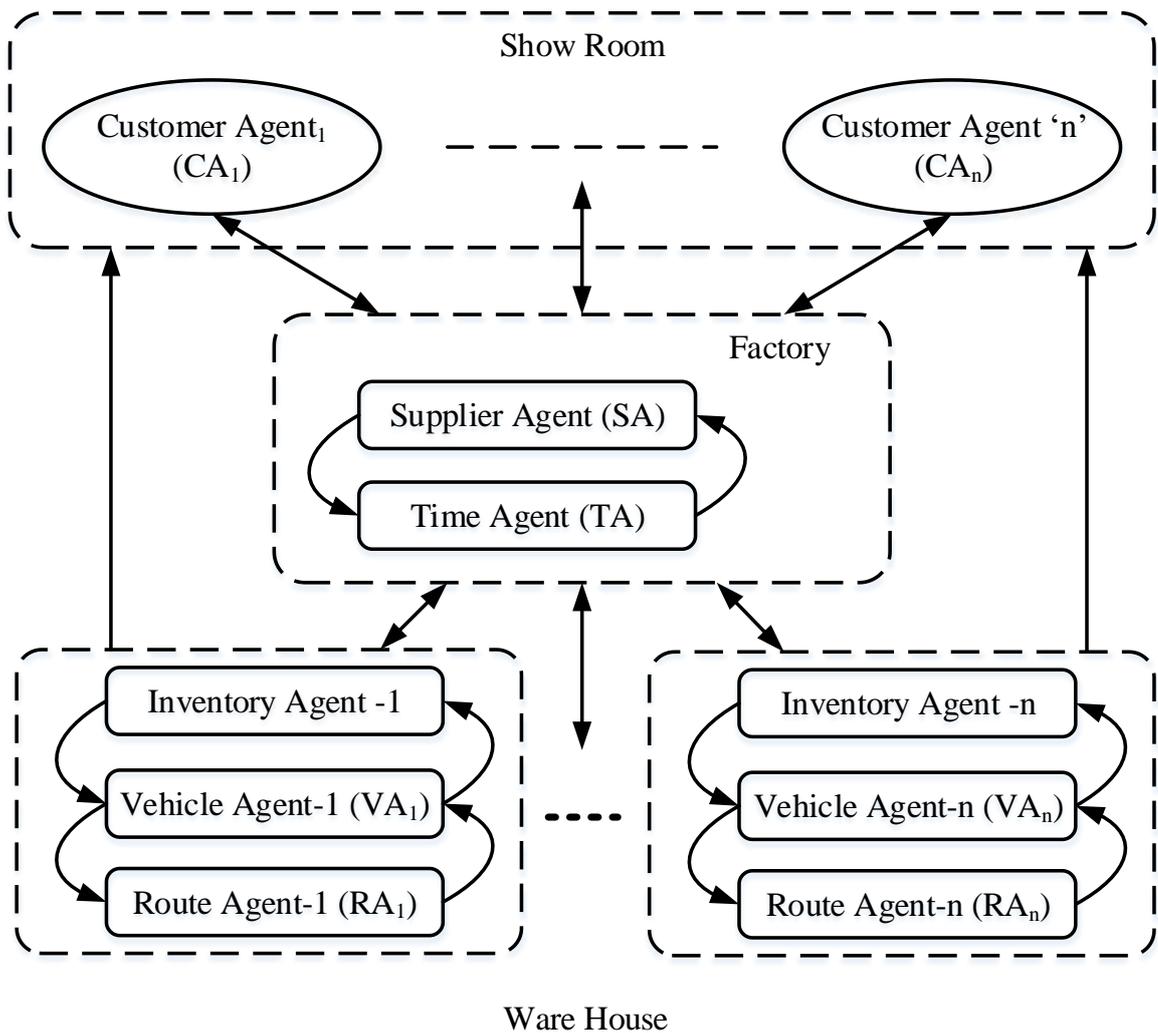


Figure 3.2. Model for Agent-based IRP

The production line holder has two specialists such as Time Agent (TA) and Supplier Agent (SA). The provider specialist gathered the requested shape CA and checked the things in the distribution center stack. If the event has less stock, then it

begins the generation of the required elements with required amount in the processing plant. The time specialist has finished data of all the timetable of stuff.

The distribution center holder has three sub operators who are, Vehicle Agent (VA), Inventory Agent (IA), and Route Agent (RA) for taking care of out the coal demand. The IA upgrades the close by the stock level of "m" things. The VA allows the required number of vehicles relies on upon the limit. At that point, it forwards to the RA to produce the ideal course of every vehicle to achieve the client specialist in time with less transportation cost.

3.3 Proposed Multi-Agent System for E-O-L Product Disassembly

A multi-operator framework made out of a few clever specialists and individual operators may perform diverse parts. The operators in a multi-specialist framework can work self-sufficiently, settle on choices freely, and cooperate with each other to accomplish common goals.

As of now, most multi-operator based methodologies for power framework rebuilding have focal controllers which are accountable for different exercises of the frameworks. In any case, these frameworks, with a center controller, are exceptionally hard to take framework wide successive activities in large scale control brace frameworks, including correspondence, investigation, forecast, and central leadership, inside a brief time frame. To beat this restriction, a few analysts have proposed decentralized multi-specialist frameworks for power network frameworks reclamation, which permit hubs in the frameworks to discuss just with their neighbors to secure data.

In the execution part, thesis chapter presented six multi-specialists as in Fig 3.2 used to dismantle sequencing and making arrangements for remanufacturing framework. They are Collection, Disassembly, Inspection, Inventory and Remanufacturing Agents. The part and exercises of every specialist are as follows;

3.3.1 Collection Agent (CA)

The major responsibility of the CA is to manage (increment/pull) the accumulation of the chosen models of white merchandise in EOL condition from different end clients. They have gathered into different zones given the topographical zone. Dole out a different accumulation specialist for every zone. Every Customer Agent needs to collect the E-O-L products and direct them to DA.

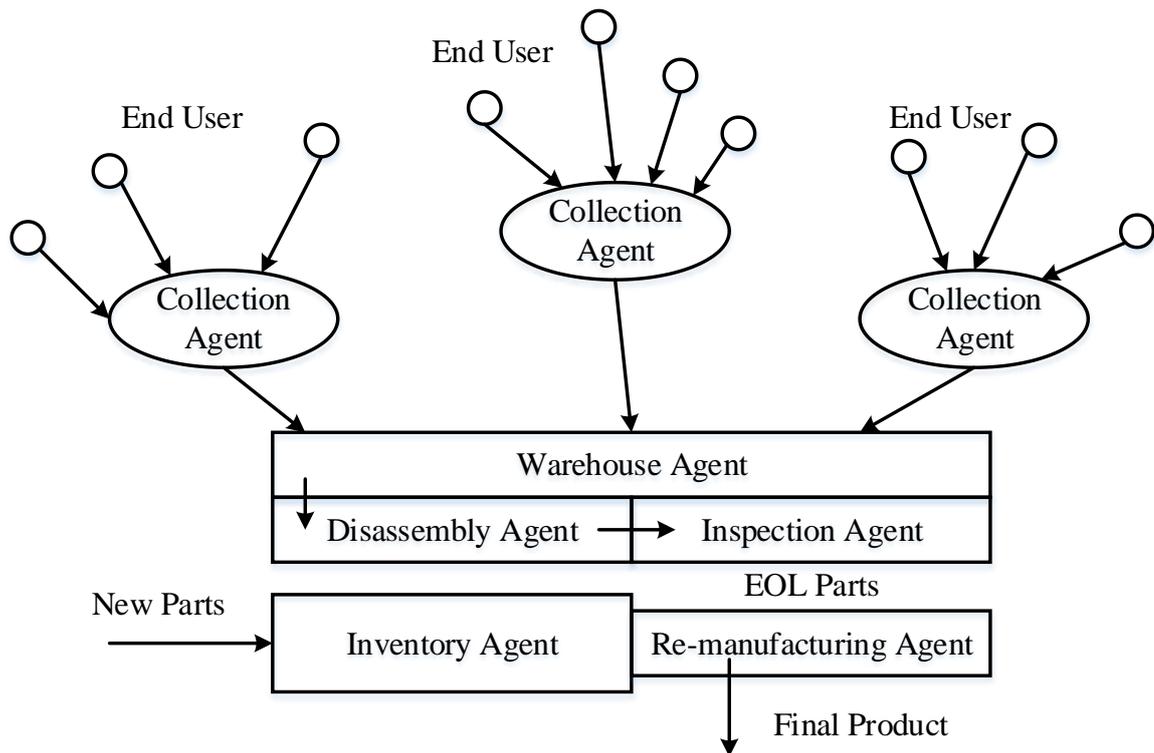


Figure 3.3. Implementation of Jade

3.3.2 Disassembly Agent (DA)

Disassembly becomes the most concentrating processes in E-O-L reverse logistics. Its need to actualize the request of parts to be dismantled from principle. In the first place, a product information maintains from all CAs. At that point set up a detail get ready for dismantling the arrangement of various models.

3.3.3 Inspection Agent (Ins A)

Verify the wellness of the sub get together/parts by both visual and physical tests. At that point, first detail functional wellness test to guarantee 100% capacity

wellness of the retrieved parts. Strive the non-practical parts and their assistants to reuse.

3.3.4 Inventory Agent (*Inv A*)

Then they keep up isolated stock for the acknowledged EOL and new parts. They need to keep up and manage the security stock/monetary request amount of new as well as EOL parts in light of the application.

3.3.5 Remanufacturing Agent (*Re A*)

They modify the last get together in different successions of replicas and adjust the gathering the line of either new parts or employed EOL parts in light of the request. Hence ReA needs to figure the get-together sequencing and adjusting assignment and gather the data and send the correspondence to every single other operator.

3.4 Simulation Results

The proposed multi-agent system for the SCM have comprised of six agents which are; Customer, Supplier, Time, Inventory, Vehicle and Route agents. The proposed model is implemented using a JAVA based system called JADE, and its operator appearance shown in Fig 3.4.

The stream of client's demand from route and customer agent has recreated and it appeared in Fig 3.5. Here the JADE RMA application demonstrates the SNIFFER agent with the full most pertinent ACL Messages. It implies on the off chance that consider an exchange between two operators, the appropriate responses will once in a while, not rely on upon the two specialists themselves, but rather likewise on a third operator, for instance.

To test validate the proposed strategy, a simple supply chain configuration has been considered with customer, first-tier supplier and second-tier supplier. To carry out this experiment, random data between 20 and 80 have been considered.

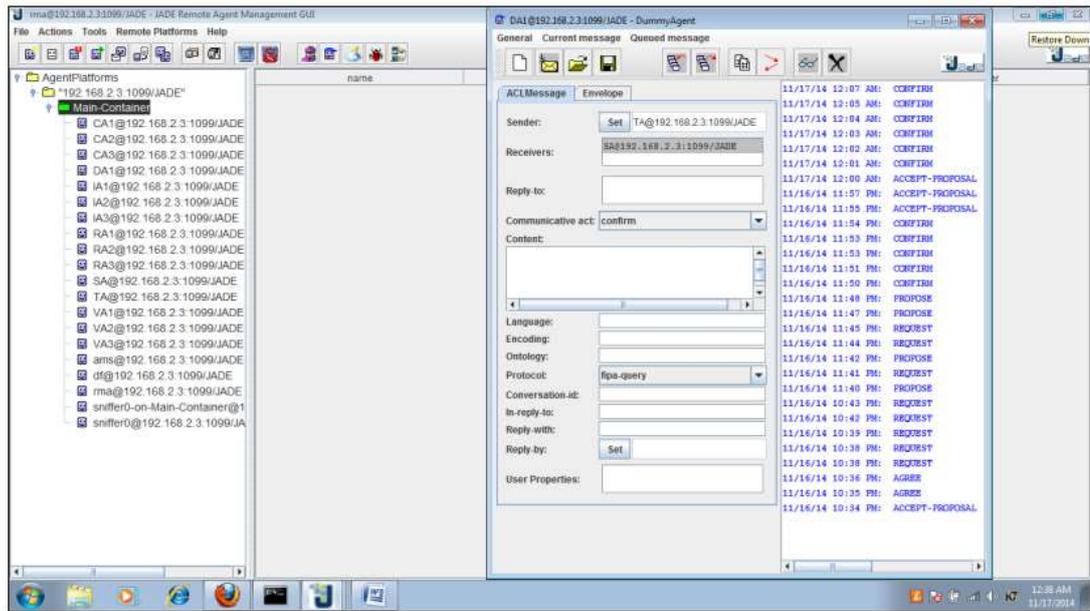


Figure 3.4. Proposed model with Six Agents in JADE

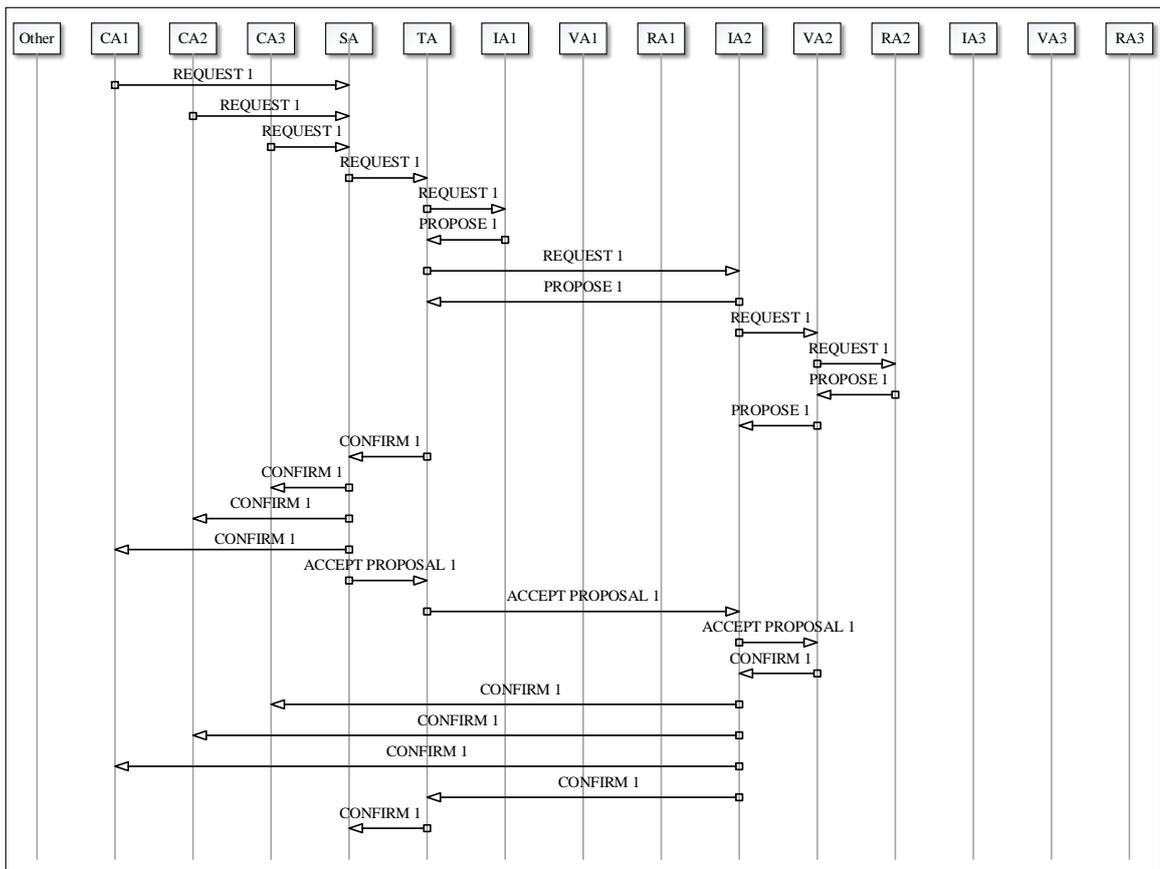


Figure 3.5. Cooperation and Communication link between Agents

This chapter described a multi-agent approach for understanding an area stock steering model for SCM with perishable items. The proposed model includes three holders and six agents. Every Agent has accomplished the fluctuating client's request of multi-items. The reenacted JADE results outlined the ideal cost of item circulation from inventory to showroom as well as inventory cost. The analysis demonstrated a critical reserve fund when contrasted and conventional multi-step streamlining models. Conceivable augmentations of this model may be to utilize half breed with heuristic models.

The study proposed in this chapter helps to understand the overall behavior and flow of the reverse logistics for E-O-L product disassembly. This chapter didn't provided any idea to solve the multi period disassembly problem and to reduce the loss of manufacturers. Hence in the next chapter (chapter 4) an adaptive genetic algorithm is proposed for the optimal product selection in disassembly of order. The proposed AGA acts as an optimizer to reduce the cost spend for the E-O-L product disassembly.