Multi-agent Based Booking of Consignment for Supply Chain Management

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Abstract

The main objective of this paper is to design a sub module named "Booking of Consignment" for SCM architecture which increases flexibility in freight transport by interlinking organizational and operating Processes. Combined with the use of small autonomous transport units, this helps to meet changed market requirements for freight transport .Booking of Consignment using multi-agent technology which deals with warehouse goods inventory details, registration for consignment booking fee collection of the goods in a SCM environment. An Agent-based Modeling is an approach based on the idea that a system is composed of decentralized individual 'agents' and that each agent interacts with other agents according to its localized knowledge. Our aim is to design a flexible architecture that can deal with next generation supply chain problems based on a multi-agent architecture.

Keywords: *SCM, Consignment, MAS.*

1. Introduction

An agent is a computer system, situated in some environment, that is capable of flexible autonomous action in order to meet its design objectives. The environment in which agents operate and interact is usually dynamic and unpredictable. The agent takes sensory input from the environment, and produces as output actions that affect it. The interaction is usually an ongoing, non-terminating one. Multi-agent systems (MASs) are computational systems in which a collection of loosely coupled autonomous agents interact in order to solve a given problem. As this is about how booking of consignment is done using multiagent Technology. Problem is usually beyond the agents' individual capabilities, agents exploit their ability to communicate, Cooperate, coordinate and negotiate with one another.

An agent can figure out for itself what it needs to do in order to satisfy its design objectives, rather than having to be told explicitly what to do at any given moment. In the most general case, the agents in a multiagent system will be representing or acting on behalf of users or owners with very different goals and motivations. In order to successfully interact, these agents will thus require the ability to cooperate, coordinate, and negotiate with each other, in much the same way that we cooperate, coordinate, and negotiate with other people in our everyday lives.

We do not (usually) build agents for no reason. We build them in order to carry out tasks for us. In order to get the agent to do the task, we must somehow communicate the desired task to the agent. This implies that the task to be carried out must be specified by us in some way. An obvious question is how to specify these tasks: how to tell the agent what to do. One way to specify the task would be simply to write a program for the agent to execute. The obvious advantage of this approach is that we are left in no uncertainty about what the agent will do; it will do exactly what we told it to, and no more. But the very obvious disadvantage is that we have to think about exactly how the task will be carried out ourselves -

if unforeseen circumstances arise, the agent executing the task will be unable to respond accordingly. So, more usually, we want to tell our agent what to do without telling it how to do it. One way of doing this is to define tasks indirectly, via some kind of performance measure.

Booking Agent comprises all activities for planning, controlling, monitoring, storing, and transporting goods. Here in order to execute a particular operation in this sub module, agents not only interact with each other, but they also share information and negotiate and coordinate with each other which leads to improvement in delivery performance and inventory reduction and Eliminate Manual Process of calling Customer service for Booking Consignment and Reduce unnecessary manual intervention in cancellations on electronically booked consignment (which could do calculation of various charges levied at the goods in a supply chain Logistics)

2. MULTI-AGENT BASED BOOKING OF CONSIGNMENT FRAMEWORK

This sub module acts as an input for Booking agent. Here various booking consignment processes are collected and waived using this sub module. Here is the list of functions that are carried using different agents cooperating and interacting with each other in order to achieve its final goal.

List of Functions performed by agents:

- Outward Goods On Ground
- Planned Traffic
- Premium Booking Fee Collection
- Forwarding Note
- Demand Fulfill
- Maintenance of Restrictions
- Removal of Goods before Booking

Functional Hierarchy Diagram
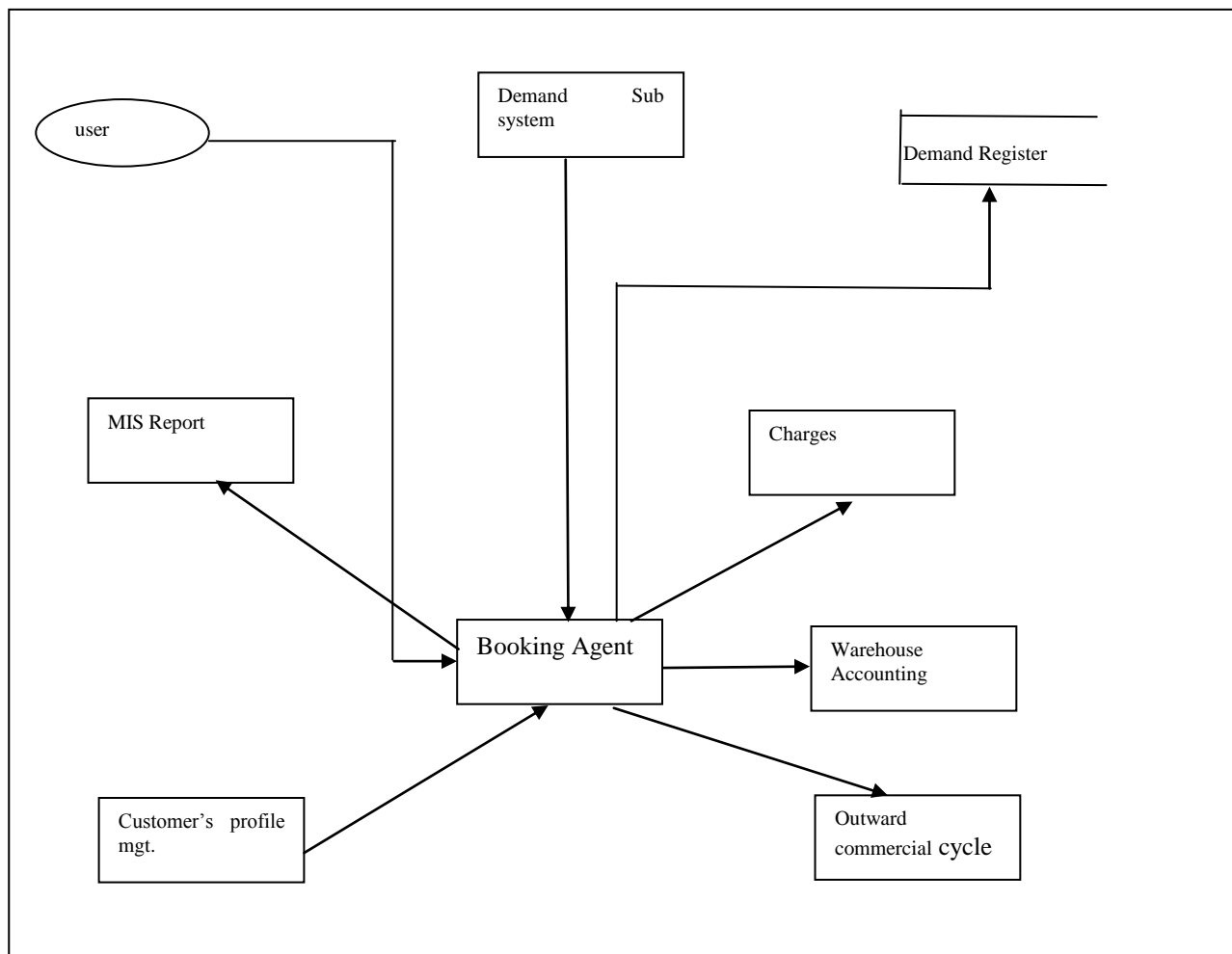
Assumptions:

- This sub module shall not restrict Registration of Demand for commodities not on ground provided customer DB is available.
- This sub module shall not check the Forwarding Note for correctness and rules for acceptance in force.
- This sub module shall not prohibit any registration on the basis of any restrictions.
- All the date fields shall correspond to the event date.
- The codified fields like Warehouse, customer, wagon type and commodity shall be validated from the master tables.
- Logs shall be maintained for all modifications and cancellations.

Agent function for Outward Goods:

Arrival of Goods is a process in which the consignment is recorded into the Warehouse's goods inventory. This agent is to be invoked by the Goods Shed user and captures the details of the consignment.

In case the warehouse is without a device, the designated Reporting warehouse shall forward these details before entering the wagon/truck wise loading details.

The date and time of arrival of Goods to warehouse is captured, Lots of goods shall be maintained day wise. The Wharfage for these goods(In case of third party space), if applicable, shall be calculated depending upon:

- Day end of that Warehouse
- Registration of Forwarding Note for these goods
- Withdrawal of these Goods
- Loading of these goods

Usually Wharfage shall be calculated in case of railway where customer uses railway premises. Also if customer uses 3PLSP warehouse, then Wharfage will be charged.

Validations and Checks:

- The arrival date and time should be less than or equal to the current date time and greater than previous arrival date time.

Agent functions for Planned Traffic:

Regular Customers can give an advance plan for loading of unit. The loading plan is given periodically, which helps service provider in planning the Stock movement. The traffic planned for such requests is called Planned Traffic.

Total number of expected specials shall be entered first, before the details of individual specials. The system shall maintain a counter for the no. of specials entered. Total no. of specials entered for the planned traffic shall be equal to the no. of specials specified earlier for the completion of Planned Traffic.

On completion of the capture of planned traffic, the information shall be available at the respective loading Warehouses for capturing the demand by the Goods Clerk at the specified locations

The plan of movement is in terms of Loading Warehouse, Special Number, Loading Date, Group Rake/truck Commodity, Consignee, Commodity codes and Commodity wise Wagon/truck Type & No. of Wagons/truck. This loading plan is circulated among the respective agents for their loading plan.

Agent divides the task into following categories:

- Specials with destination known
- Specials with destination not known
- Specials with a set of originating Warehouses/destinations

Validations and Checks:

- The Loading date should be a future date.
- For a special number, total number of units to be loaded at various loading Warehouses should match the total number of units specified for different destinations.
- Transshipment Warehouse should be valid transshipment Warehouse

Agent functions for Premium Booking:

This agent shall be used for collecting the Premium Booking Fee for the demands tabled as Premium Booking. This collection of fees shall be under local charge section against the first F/Note of the demand, which will be non-refundable. The demand shall be treated as incomplete till the collection against it takes place.

Validations and Checks:

- In case of payment through Lumpsum Account, these shall be a valid lumpsum account and with valid balance against the customer.
- The Demand shall be tabled as Premium Booking.

Agent behavior in case of Forwarding Note:

Forwarding Note is a request form filled by the customer for his request of wagons/truck. Depending on the type and no. of wagons/truck requested for, a token amount known as Advanced Registration Fee (ARF) if applicable is collected from the customer by the agent. The goods clerk shall check the Forwarding Note manually for correctness and rules for acceptance including restrictions in force in case agent sends some warning messages.

Based on Commodity and Consignor, Customer's request is put under some priority class by the agent automatically. Priority number is generated and assigned to respective Forwarding Notes by the agents.

Cancellation of F-note: In case of rake demand, if by virtue of cancellation of any F-note, balance units do not meet standard rake size requirements, then cancellation of f-note is permitted only if Service Provider has failed to supply the demanded number of units by the customer and no wagon has been commercially placed and allotted against the f-notes to be cancelled. This cancellation shall be allowed from 'demand fulfill task' internally.

This function cannot be called by the agent independently but shall be called only through Demand Registration function by selecting the incomplete demand. The details captured at demand level are displayed automatically and additional details of the Forwarding Note are captured by the agent.
If destination is specified, there should be a record for the chargeable distance in the Warehouse index maintained in the system for the combination of From Warehouse, Destination Warehouse. Commodity description is displayed. Multiple stock types can be entered for a Forwarding Note. The stock types specified and the commodity codes specified shall be validated against those the rake type and rake commodity captured in the current incomplete Demand.

Demands may be tabled against the outward goods on ground hand. For each commodity, the arrival of goods shall be reported using OUTWARD GOODS ON

GROUND task before capturing the forwarding note details. At the time of registration of forwarding note the weight specified shall be validated against the goods inventory

Modification of Forwarding Note by the agent is possible at customers' request or on administrative account and for correction of data entry error. Forwarding Note can be modified due to Data Entry Errors only before Demand is completed. Modification after completion of demand cannot be done without Authority.
If old demand palette is not MIXD LWL and new rake commodity is different than the other's F-note commodity of LWL then F-note new rake cmdt column will be changed to new commodity and Demand pallete also changed to Mixd.
Fields of Forwarding Note can be modified as follows:

a) Before completion of demand
b) After completion of demand and before allotment
c) After allotment and before release of first vehicle

Following rules are observed during the Modification of Forwarding Note Details:

Modification of Forwarding Note Details can be done through this agent only. No modification is allowed in ARF amount & payment mode through which the amount is collected. In case the no. of wagons is increased, Additional ARF is collected by the agent.

If outstanding against a forwarding note is cleared through the demand fulfillment task then modification of forwarding note will be done implicitly and agent shall retain both the original numbers of units indented and final units allotted.

A log is to be maintained for modification(s) of Forwarding Note after the details have been saved. All modifications in Forwarding Note details shall be reflected in AMS subsystem.

Cancellation of Forwarding Note:

This option is to be invoked to cancel a Forwarding Note. The demand is selected from the list of demands and the Forwarding Note number to be cancelled for that demand is specified to fetch the relevant Forwarding Note details:

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Validations and Checks:

- Goods shed can have only one current incomplete demand at a time i.e. unless all the constituent Forwarding Notes of a demand are not captured; the new demand cannot be initiated. When demand completion flag is set to YES, the demand is treated as completed. And now a fresh demand can be initiated
- After the completion of demand, number of wagons for each wagon type captured in demand should be equal to number of wagons for specified wagon type reported in Forwarding Note details. If this condition is not satisfied, the demand cannot be COMPLETED.
- For all Forwarding Notes under the same demand, priority class is same as it was captured for a demand.
- Forwarding Note is treated as restricted if any type of restriction is imposed on Forwarding Note.
- No modification is allowed in ARF amount & payment mode through which the amount is collected.
- At the time of Demand Registration, Group Rake Commodities that can be loaded in the permissible Group Rake Type be crosschecked with the referential data available.
- For Rake Demand Registration Rake Commodity Cannot be "MIXD" or "OTHR", whereas this is allowed in case of Piecemeal Demands.
- "MIXD" Rake Commodity is allowed in case of less than wagonload (LWL) demand registration.
- In case of Rake Demand Registration, the system shall validate for both the source and the destination Warehouses as Full rake Warehouses/Sidings in the referential data. The system shall validate for the Rake Commodities for both Source and Destination Warehouses for loading and unloading respectively.
- In case of demand for two-point rake, the system shall validate the approved combinations of two points available in the referential data, wherein each point shall be at least a half rake point.
- Rake demand can be tabled only if units demanded is more than or equal to the standard number specified for given rake type. If standard number is not specified for given rake type then only piecemeal demand can be tableed
- If Modification of Rake demand is done to reduce the number of units and consequent modifications results in reduction of demand units from the standard units for the given rake type then modification of demand shall not be allowed.

If Modification / Cancellation of Forwarding Notes of a Rake demand is done to reduce the number of units and consequent modifications results in reduction of demand units from the standard units for the given rake type then

modification / cancellation of Forwarding Note shall not be allowed.

Agent functions to Demand Fulfill :

When all the constituent forwarding notes of a demand, are fulfilled, the demand is fulfilled. The forwarding note is considered cleared when an outstanding request for wagons is met with. The fulfillment of a demand / forwarding note can be due to customer's request or administrative reasons.

This option shall be invoked by goods shed functionary to clear the corresponding Forwarding Notes in case of piecemeal demands. In case of rake, this function is called along with COMPLETE RELEASE task.

Validation and Checks:

- None

Maintenance of Restrictions Agent:

Service Provider may want to restrict movement of goods under some circumstances for a certain period. These restrictions may be related to a particular Warehouse, or consignor, or commodity, etc. Goods Clerk must update all the possible traffic restrictions, so that whenever a demand is tabled, it can be cross-checked against these restrictions.

Routine daily activities of Goods shed staff include the updation of Restrictions. All the pending Forwarding Notes are made restricted or free depending upon the current status of restrictions. Fresh forwarding notes are also restricted accordingly.

In some cases, a particular restriction may affect several Forwarding Notes at different Warehouses/section/division. It shall be possible to restrict or free all the Forwarding Notes for a specific route, commodity, consignor or a consignee, destination, type of stock, rake/piecemeal and Traffic type either singly or in multiples.

Validations and Checks:

- On a Forwarding Note, if any one of the restriction type is applied, Forwarding Note is considered to be restricted.

Removal of Withdrawn Goods Agent:

The Customer may want to remove his goods, which were stacked in advance, without booking them.

This function is to be invoked by the Goods Shed Clerk to accept wharfage charges and capture the details of the consignment removed by the customer.

Validations and Checks:

- Removal of goods shall be allowed only for those lots for which forwarding note has either not been tabled or F-Note is cancelled.
- The removal date should be greater than or equal to the arrival date time and previous removal date time.
  Number of articles / actual weight removed shall be
validated against the Number of articles / actual weight in hand

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