

# Application Research on Modern Logistics Management System Based on Multi-Agent

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**Abstract:** For the mistake application areas of agent technology in practice, from an aspect of cost-benefit analysis, this paper proposes three standpoints about the rational and applicable orientations for the agent technology. According to some successful applications that the agent technology applied to existing logistics systems, this paper analyzes that modern logistics management system should import the agent technology. Taking Yiwu modern logistics management system for example, this paper also further proposes the general frame and layer system structure and logic system structure of modern logistics management system based on Multi-Agent System.

**Keywords:** Modern Logistics Management System; Multi-Agent; Application Research

## I. Introduction

From the point of view of economics, cost and profit analysis is a key factor to implement a concrete system, for a normal project, if the cost to be implemented by the agent technology is higher than that to be implemented by object-oriented development technology, and the two can reach the same aim, then multi-agent technology is not necessary to be selected, so when we use the multi-agent technology, we should not insist on the blindness but the reasonableness. Multi-Agent Systems (MASs) although have gotten some successes in the following fields[1]: language disposal, industry manufacturing, organization information system, air traffic control, parallel project design, distributed sense and explanation, transportation scheduling, monitoring and robot and so on, but for what kind of concrete projects, under the premise of combining low cost analysis with high profit analysis and solving them very difficult by the present software technology, if we use the agent technology, we should understand its rational and applicable orientations, so this paper proposes three standpoints, which are shown as follows:

1)standpoint one: for example, many agile systems (e.g. agile vehicle scheduling systems) demand higher service level and lower cost, which are complicated software systems, which are also really fit to be developed with the agent technology.

2)standpoint two: many parallel engineering systems, which need to use agent's expression ability and their rules can

easily be denoted as various agents, which are really fit to be developed with the agent technology.

3)standpoint three: many intelligent software systems whose reasoning format can deeply lead to the status of thought (such as Belief-Desire-Intention, BDI)[2], which are really fit to be developed with the agent technology.

Based on these discussions, this paper emphasizes how to apply the agent technology to modern logistics system design based on the analysis for the construction of modern logistics management system.

## II. Literatures Reviewing and Analyzing about Modern Logistics Management System Based on Multi-Agent

This paper thinks that modern logistics management system is constructed based on Internet/Intranet and 3G communications network, which is also an integrated system, which includes logistics management information platform, client ERP systems, logistics management information systems (LMISs) of logistics enterprises, management information systems (MISs) of government charge departments, vehicle systems and the present software systems and so on.

Does modern logistics management system need use the agent technology? In order to answer the problem, this paper has studied some foreign research literatures. The foreign literatures about logistics system applications based on the multi-agent technology mostly focus on logistics system modeling based on multi-agent[3~5], logistics planning research based on multi-agent[6~10], logistics network planning research based on multi-agent[11~12], logistics agile scheduling technology based on multi-agent[11], logistics system cooperation research based on multi-agent[12~15], logistics system simulation based on multi-agent[11] and so on. From these literatures, it can be seen that many logistics systems have used the agent technology and gotten some successful applications. From the Japanese viewpoint "logistics is the third profit source" and real logistics fee can not be commanded by the current finance accounting system and accounting check methods, so this paper thinks that logistics activities are complex, which make logistics systems be of complexity (according with standpoint one). Logistics cooperation partner selection, logistics network planning and logistics agile scheduling technology also need the support of agent' knowledge

expression and reasoning ability (according with standpoint two and standpoint three), so this paper thinks modern logistics management system needs use the agent technology. The use of the agent technology at least can provide solutions or effective research ways for the following problems that the modern logistics management system happens: (1) the agent technology can support modern logistics management system negotiation very well. (2) the agent technology can solve many problems in the modern logistics management system such as decentralization and complexity problems and so on very well.

In the modern logistics management system, because logistics management information platform, client ERP systems, LMISs of logistics enterprises, MISs of government charge departments, vehicle systems and the present software systems and many other systems have existed and many of them have relevantly mature softwares, but the interfaces among these softwares exist some problems which are difficult to unify and integrate and so on. If the current systems are upgraded into an integrated system based on multi-agent system, then the cost will rise inevitable much times, so it is very difficult to burden for the present clients, logistics enterprises, government charge departments. But, by the use of the agent technology to realize the present interface problems among these systems and business functions (interface rules or business functions can easily be denoted as various agents, which accord with standpoint two), which also will reduce cost, improve the integration degree of the whole system and strengthen information sharing among systems very well. The following content takes a project "the development and research of modern logistics management system" based on the background of Yiwu logistics market for example, by the use of the agent technology, the paper introduces how to construct the modern logistics management system based on the multi-agent technology.

### III. Application Research on the Modern Logistics Management System Based on the Multi-Agent Technology

#### 3.1 The description of practical background

Yiwu city has more than 5000 ton goods everyday to transport more than 250 big and middle cities by 136 transportation lines. Everyday more than 200 standard box goods, through Shanghai, Ningbo, Wenzhou port and inland 9 ports export to southeast Asia, Africa, Europe, America and so on. Everyday about 1000 vehicles stay here, who return or pass to wait goods service.

The traditional logistics operation ways in Yiwu city are about various social logistics resources integration problems and whole logistics level operation problems and so on, which stay the level of traditional logistics operation. In order to improve logistics service level, decrease vehicle

empty loading rate, reduce logistics cost, satisfy the demands of client much better, promote the development of modern logistics industry in Yiwu city, this paper thinks Yiwu city should rely on logistics information platform and construct the following modern logistics management system.

#### 3.2 The general frame of Yiwu modern logistics management system

According to the characteristics of Yiwu city and its logistics operation way and its development demand in the future, combining with the construction idea for the modern logistics management system, the paper constructs a general frame of Yiwu modern logistics management system, which is shown in Fig. 1.

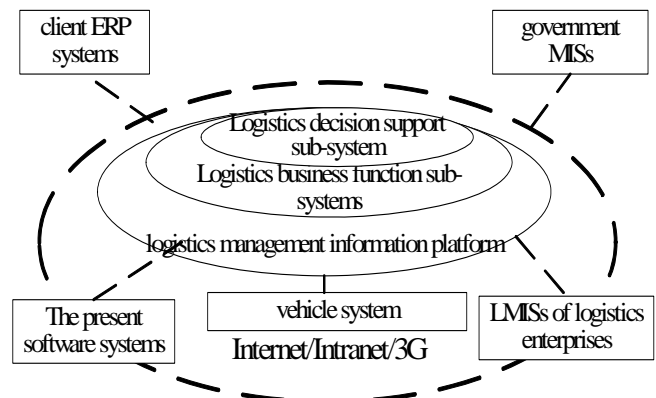


Fig.1 The general frame of Yiwu modern logistics management system

In Fig.1, the logistics management information platform is the core of the whole modern logistics management system, which integrates logistics resource, logistics demand and traffic foundation information and so on, and burdens the organization and negotiation functions of the whole logistics system. The platform mainly includes two levels: logistics management decision support information platform, logistics management business information platform. The construction core of the first level platform is to build "logistics decision support sub-system", the construct core of the second level platform is to build "national logistics business sub-system" and "international logistics business sub-system". The client ERP systems include the ERP systems of production enterprises and circulation enterprises. Government MISs means the MISs of charge departments related to logistics management. The vehicle system is made up of information receiving, sending and collecting devices installed on the vehicles, whose main purposes are to communicate with the present software systems and the LMISs of logistics enterprises. The present software systems mean the logistics facilities systems distributed in various logistics work locations.

3.3 The layer system structure of Yiwu modern logistics management system based on multi-agent

From the general frame, this paper designs out a layer system structure, combining with multi-agent technology, so this paper develops the layer system structure figure of Yiwu modern logistics management system based on multi-agent, which is shown in Fig. 2.

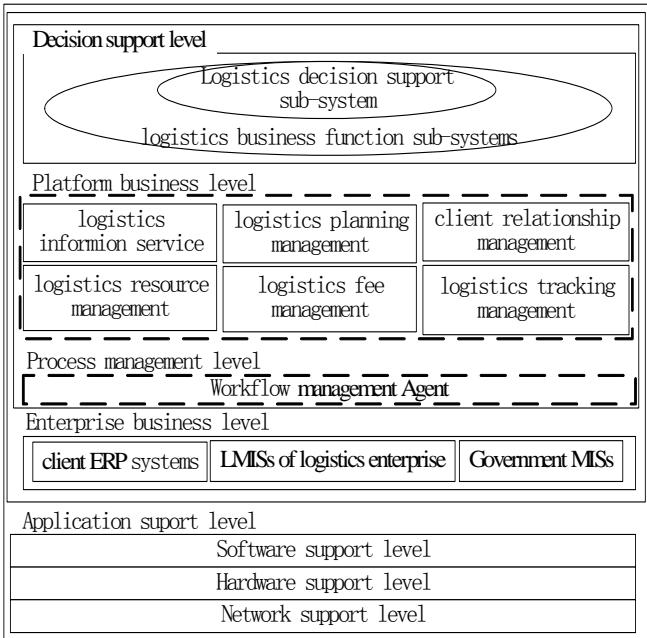


Fig. 2 The layer system structure of Yiwu modern logistics management system based on multi-agent

In Fig.2, the layer system structure is made up of application support level, enterprise business level, process management level, platform business level and decision support level. By integrating the present system resources and analyzing the interfaces and business functions of various systems, this paper finds the business level interfaces of old systems are difficult to link up, but the interface rules and business functions can easily denote as various agents (according with standpoint two), so this paper uses the agent technology to improve the integration degree of the whole system and strengthen information sharing among systems. The concrete contents are as follows:

**Application support level:** It includes software, hardware, Internet/Intranet/3G network support platform, which is the foundational platform of constructing modern logistics information system. The application support level based on the Internet/Intranet/3G network provides a safe, stabile, high bandwidth and various data transferring network application support platform for the realization of Yiwu modern logistics management system. In this level, the communication protocols and communication realization ways of the vehicle system (including its interlinking devices) and the present software systems (including their interlinking devices) and among various linking systems needed to be emphasized especially.

**Enterprise business level:** It includes various members' enterprise information systems distributed in Yiwu modern logistics management systems, which burdens the concrete work of modern logistics management system and realizes information sharing with logistics information platform by various interface agents.

**Process management level:** For the aim among member enterprises, according to promissory rules, it designs the tasks of various member enterprises and logical relations between tasks, by auto planning and managing concrete logistics business workflow, which is also an automatic support for the transferring process of tasks, information, files and so on in the whole logistics system.

**Platform business level:** It is a business function part of modern logistics information platform, it provides standard construction ways and uniform transferring mechanism for the superior level, and makes the constructing of the superior level be simpler. The level makes use of groupware technology and distributed object technology, such as COM+, XML, JAVA EJB to combine groupwares with distributed objects to realize many relatively independent business functions and provide some application solutions for enterprises. In addition, the business function level uses functional component agent, makes it standardization and supports the reconstruction and expansion functions of modern logistics decision support sub-system and many application systems very well, thus finishes the construction of groupwares with distributed objects to business application layer and makes the application system realizes the integration on the level of knowledge.

**Decision support level:** Under the support of great decision information and negotiation information provided by the platform business layer, by transferring the decision models from the system model base, method base and rule base to realize the optimization management of Yiwu logistics business.

3.4 The logic system structure of Yiwu modern logistics management system based multi-agent

Combining with the layer system structure, the paper further analyzes the logic system structure of Yiwu modern logistics management system based multi-agent, which is shown in Fig. 3.

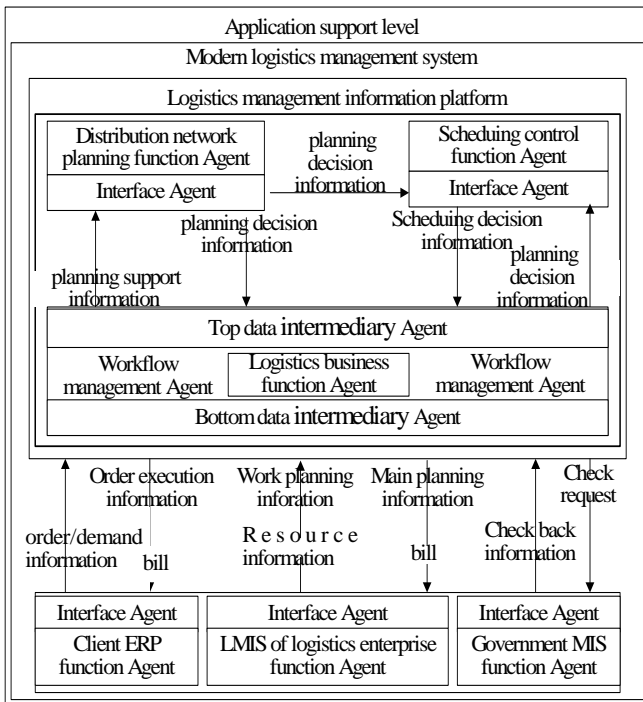


Fig.3 The logic system structure of Yiwu modern logistics management system based multi-agent

In Fig.3, the explanations about the logic system structure are as follows:

**Interface Agent:** It means an intelligent interface between computers, which is responsible for information sharing between users and system, and transfers the instructions sent by users to logistics business function system and returns the disposing result of system to users. In the system, it includes the following 5 interface agents.

**Client interface agent:** It means an interface agent between logistics service demand side system such as business enterprises and logistics common information platform, which transfers some related logistics service demand information with the platform and returns related information need to be executed.

**Resource interface agent:** It means an interface agent between logistics enterprises and logistics information platform, which transfers some related resource status information and logistics work information for the platform, returns resource optimization scheduling information and bill information and other information.

**Government interface agent:** It means an interface agent between government charge department and logistics information platform, which sends some related service request information for the government charge department and returns governmental related examination and approval result.

**Rule interface agent:** It means an internal interface agent between distribution network planning decision support sub-system and logistics business function system, which extracts related geographical information system(GIS) information, freight demand history information, logistics

node information from business function system and returns related distribution network information.

**Scheduling interface agent:** It means an internal interface agent between logistics negotiation control sub-system and logistics business function system, which extracts related vehicle resources, distribution network and other regulation support information from business function system and returns regulation plan and control instructions to business function sub-system.

**Intermediary agent:** It means the extraction and updating for the information content from information resource, which regards as the medium of other agents visit various database resources in the logistics system. The concrete content is as follows:

**Top layer data intermediary agent:** By the use of data warehouse, mathematics model and so on, to accomplish the extracting, mining, OLAP of logistics business data and the updating of platform negotiation support information, it is the data exchange medium between various task agents on the logistics negotiation support function system and various task agents on the logistics business function system.

**Bottom layer data intermediary agent:** It accomplishes the extracting, standardization and elementary mining of enterprise business data and its updating of platform logistics business data, which is also the data exchange medium between various task agents on logistics business function system and various interface agents of external enterprise systems or among task agents. Because the business information of modern logistics management information platform comes from different enterprises, but the information standard used by each enterprise exists great differences, for the problems, so this paper plans to use data format transformation model, XML technology, ontology technology and groupware technology and so on to solve the problems, in which, data format transformation model provides different data format, different information and knowledge expression format and transformation application model which understands consistently in semantic. The XML technology realizes the consistence of information description format and makes information exchange and information sharing be possible. Moreover, the field standard ontology does not make knowledge understanding between application systems show twoness, and solves the problem of information semantic.

**Task agent:** Various function sub-systems in the modern logistics management system are of task agents. Namely, it gets the task from other agents, and confirms the aim to be reached and arranges the plan to realize the aim, by negotiating related task agents or resource agents to accomplish the task together. For example, the realization process of logistics service function in the logistics enterprise LMIS, in which the logistics service support sub-system gets a task from transportation management sub-system in the LMIS of logistics enterprises, by negotiating top and bottom layer data resource agent, planning assistant decision support sub-system task agent and control and

negotiation sub-system task agent and other task agents to accomplish.

**Process Agent:** For every process, the system will produce a relevant process agent, which is responsible for the running of workflow example. The process agent stores the model definition and related information of the process and is responsible for the running of the whole workflow example. In the system, workflow management agent is a process agent, which accomplishes its organization of a workflow example with other agents (such as relevant logistics business function system) according to the definitions of different workflows.

## IV. Conclusion

From the aspect of cost-benefit analysis, this paper proposes three standpoints about the rational and applicable orientations for the agent technology, which are very important for how to construct a multi-agent system.

According to some successful applications that the agent technology applied to existing logistics systems, by literatures reviewing and analyzing about modern logistics management system based on multi-agent, this paper analyzes that modern logistics management system should import the agent technology, which provides a theoretical reference for how to establish the Yiwu modern logistics management system.

The concrete constructions about the general frame, layer system structure and logic system structure are the core contents of Yiwu modern logistics management system based on multi-agent, the construction solution had been tried to use in the project “the development and research of Yiwu modern logistics management system”. To be sure, the application of research object is only a case in domestic, the research achievement to produce widely practical economical effect still need the implement of many projects to verify.

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