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A UML-Based Approach for Modeling of Air Cargo Forwarder System of Third-Party Logistics

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ABSTRACT: *Air freight forwarders as shippers and customers of the servers play an important role in the whole process of the supply chain. However, air freight forwarders are an operations-intensive industry involving many participants and complex operations. Therefore, a strong information system is needed to optimize the performance of cargo control between overseas business partners, customers and branch offices, and to improve competitiveness. The purpose of this study is to use a Unified Modeling Language (UML) to model the logistics provider's air freight forwarding system. First, the study will discuss the concepts of supply chain management, the characteristics of global logistics management, and the third-party definition of logistics providers - air freight forwarders. Then the study use UML as a modeling tool to construct an air cargo forward system. From this study can see that system modeled by UML is better suited to the real needs of the business than ever before and take the information flow along the supply chain with maximum cost-effectiveness, delivery, and flexibility.*

Keywords: *Unified modeling language, Supply chain management, Logistics service provider, Air cargo forwarder*

I. INTRODUCTION

In today's global marketplace, companies are no longer competing as independent entities, but as part of the supply chain [1]. With the shrinking efficiency of the international business, the company's global logistics capabilities become increasingly focused on its manufacturing strategy [2]. The most competitive companies are building decentralized global networks of small, more flexible facilities located in key regional markets [3]. Supply chain management is no longer concerned about the flow of materials, but more concerned with the flow of information. This trend in strategy suggests the need for a logistics system to help companies effectively move goods between regional markets in their global supply network [2]. It requires a single provider that can plan the overall optimization of the entire logistics operation base and develop a multi-modal transport solution. Logistics Service Provider (LSP), which is the third-party logistics, is considered to be an effective provider to meet these requirements. This study proposes a Unified Modeling Language (UML) to develop an air freight forwarder system by:

1. Discuss the future of global logistics and air freight forwarders.
2. Understand the demand attributes of air freight forwarding services.
3. Build the air cargo forward system through UML.

II. LITERATURE REVIEW

2.1. Global Logistics and Air Cargo Forwarder

There are four factors which underline the dramatic rise of globalization those are global market forces, technological forces, global cost force, and political and macroeconomic force [4]. In these situations, businesses cannot ignore the tremendous growth potential of foreign markets, and they must search for comparatively low cost, including raw materials, labor, etc. from countries worldwide. In global logistics, components may be sourced in one country, assembled in another country, and distributed to customers all over the world.Efficient supply chain involves many companies, including raw material suppliers, manufacturers, agents and third-party logistics (3PL). In a competitive environment, the company's primary goal is to improve its efficiency, improve its core competitiveness and outsource its non-core business. An important step in the supply chain is the selection and cooperation of third-party logistics. In the chain, theglobal forwarding agent is the center of international logistics. The business of airway forwarder is airfreight, which is to collect products from various customers and airline ships where consignees are or to import products shipped by airline and transport to consignees.Forwarding agents and airlines are interdependent. They usually contract with airlines and play a key role in the airfreight workflow.The third-party logistics is an external provider that by agreement performs customer specific logistics services based on long-term goals with mutual benefit and trust. It assumes free flow of logistics information. The activities performed include at least management and execution of transportation and warehousing [5].

2.2. Air Cargo Forwarder Information System

Software development life cycle can be divided into five stages: system planning, system analysis, system design, system development and system implementation [6]. “System planning" attempts to determine the strategic importance of information systems within an organization. “System analysis” begins with a project definition and ends with a logical design. “System design” begins with the translation of logical specifications and ends with technical design specifications. “System development” includes coding and testing. “System implementation” will install the application software.The flexibility of the logistics system may represent a potential source of improved efficiency. However, contrary to the flexibility of manufacturing systems that have been extensively studied, it appears that the study of logistics system flexibility is significant because of its absence[7].The information system of an LSP enables the transport service provider to distribute the shipment status information to another party, such as a consignee, a third-party logistics company, a shipper, or another transportation service provider. A transport service provider is a party that adds value to moving goods from one place to another. For example, consolidators, warehousing entities, freight forwarders, document personnel, carriers, or customs clearing personnel. Shipping status may be assigned at any time after the transport service provider has tendered a shipment (accepted and placed in transit). As stipulated in the trading partner agreement. As a follow-up to the execution of RosettaNet's PIPs (Partner Interface Processing), for example, shipment lost, delivery address not found, storage not open. Shipping status information monitors the progress of the shipment(RosettaNet is a subsidiary of Uniform Code Council, Inc.).

2.3. UnifiedModeling Language

Unified Modeling Language (UML) is the name of the modeling language, rather than method or process. UML is composed of very specific notations and associated grammatical rules for building software models. UML itself does not prescribe or suggest how to use this notation in the software development process or as part of the object-oriented design methodology.UML supports a rich set of graphical notation elements. It describes notations for classes, components, nodes, activities, workflows, use cases, objects, states, and how the relationships between these elements are modeled. UML also supports the notation of custom extensions through stereotypes. UML includes four views, which are UseCase View, Logical View, Process View, Implementation View, and Development View; and there are nine diagrams, they are Use Case Diagram, Class Diagram, Object Diagram, Activity Diagram, Sequence Diagram, State Diagram, Collaboration Diagram, Component Diagram, Deployment Diagram.UML is derived from a shared set of commonly accepted concepts that have been successfully demonstrated in the modeling of large and complex systems, especially software systems. It provides significant benefits to software engineers and organizations by helping to build rigorous, traceable, and maintainable models that support the full software development lifecycle.

III. METHOD

3.1. The Scope of Air Cargo Forwarder System

The entire e-LSP solution is the process of moving goods and funds across borders, typically in three steps: trade compliance and loaded-cost solutions, transportation management solutions and trade settlement solutions [8]. Because the process of e-LSP is very complex, involving national laws and regulations, tariffs, taxes, banks, etc., this research cannot study all the views of e-LSP, so the only focus on the management of air cargo forwarder system.

3.2. The Air Freight Forwarder Process Flow

In general, air freight forwarders are responsible for handling cargo flows from customers (shippers) to customers (consignees) in international trade flows; including customs brokers, since most freight forwarders use customs operations, distribution centers or freight transport waiting for air freight covering the services of schedule arrangement, palletizing loading planning and customs check-in(Fig.1).The export flow and the import flow are described below. The export flow includes:(1) the marketing issues of buyers and sellers;(2) confirming the order, booking the transit and obtaining MAWB-No; (3) the place of storage and access;(4) the production of export documents (invoices, packing lists, entries, and B/L);(5) access to cargo information and palletizing load plan;(6) the broker or himself authorizeexport customs;(7) check the customs examination or not;(8) customs clearance release;(9) lifting or departure the cargo. The import flow includes:(1) the marketing issue for both buyer, and then confirming the order; (2) receiving the departure information of the destination forwarding agent;(3) through the airline company to obtain delivery orders;(4) make the declaration of import documents;(5) the broker or himself authorize import customs;(6) to pay taxes according to the import tax bill; (7) check the customs examination or not;(8) customs clearance release;(9) proof of delivery.The steps of this study in developing an air cargo forwarding system are as follows:(1) create the Use Case Diagram;(2) createthe Actor’s Relational Diagram;(3) createtheActivity Diagram;(4) create the Class Diagram;(5) create the Sequence Diagram;(6) repeated development.

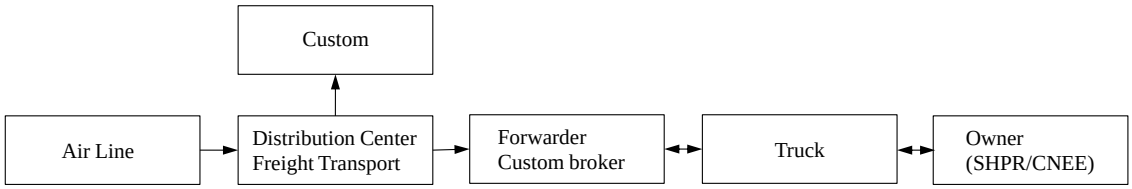

Figure1. The international air cargo procedure

3.3. Design the System by UML's Diagram

3.3.1. Create UML model

Rational Rose is a UML design tool for use in this study. First, create the Rational Rose UML model. It will automatically make five parts likeUse Case View, Logical View, Component View, Deployment View, and Model Properties.

3.3.2. Use Case Diagram

In UML, Use Cases are the primary method of capturing system functionality from the user's perspective and can often be substituted for the "functional requirements" document. According to the international trade process, as shown in Fig.1, the Use Cases of international trade and air freight forwarder systems are described below(Fig.2):

- Pre-request: The user should be identified before entering the system.
- Main process: Based on authorization, the user is allowed to use the approved parts and select the related business on marketing, bill of lading, filing, customs declaration, shipment status, goods receipt and delivery, and forwarding.
- Description:Afterentering the correct ID, the customer can select the "online inquiry" under marketing, as well as the forwarding agent "online quotation". After the offering, it can book a flight after order confirmation.
- Sub-process: Depending on the user's choice, the system will enter another sub-system.
- Abnormal process: Enter a user pin that is either empty or belongs to the wrong user.

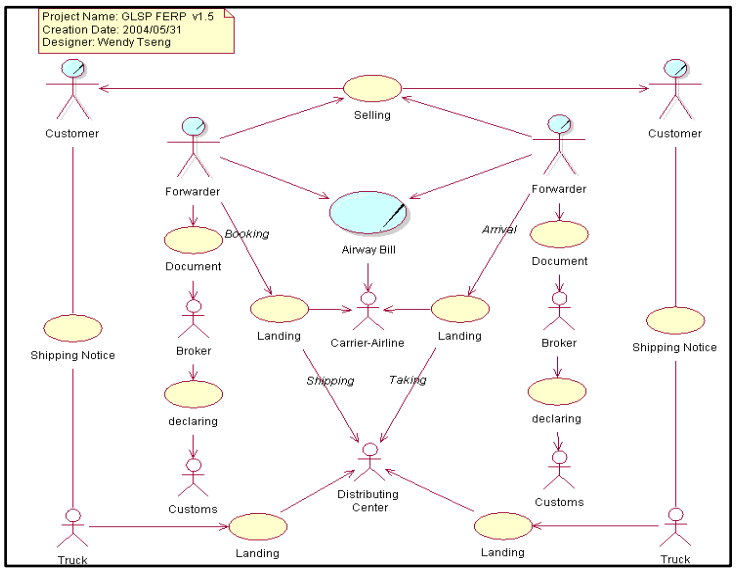

Figure2. User Case Diagram

3.3.3. Actor's Relational Diagram

An actor is the user of the system. This includes human users and other computer systems. Actors use aUse Case to perform a number of works that are valuable to the business. A set of use cases that an actor can access defines their overall roles in the system and their range of actions, as shown in Fig. 3. The actors are classified as end users (B2C) who are consignees, business users who do business with banks (B2B), and government (B2G). Actor's Relationship Diagram clearly describes the interrelationships among users:

- Customer: There are shippers and consignees depending on the business to be taken. Customer material can be used worldwide. Designers must categorize user types of Shipment Track & Trace, as well as global freight statistics.

- Forwarding agent: Users in the global station. Designers must consider authorization, personal information (including e-mail addresses, cell phone numbers, warning messages to be sent).
- Customsbroker: It can be a forwarding agent (forwarding agent also provides service of customs declaration).
- Custom: Shipping documents randomly inspects with trade van system for cargo release.
- Banks: Insurance policy delivery and cash flow management of ATM.
- Logistics: e-logistics information exchange.

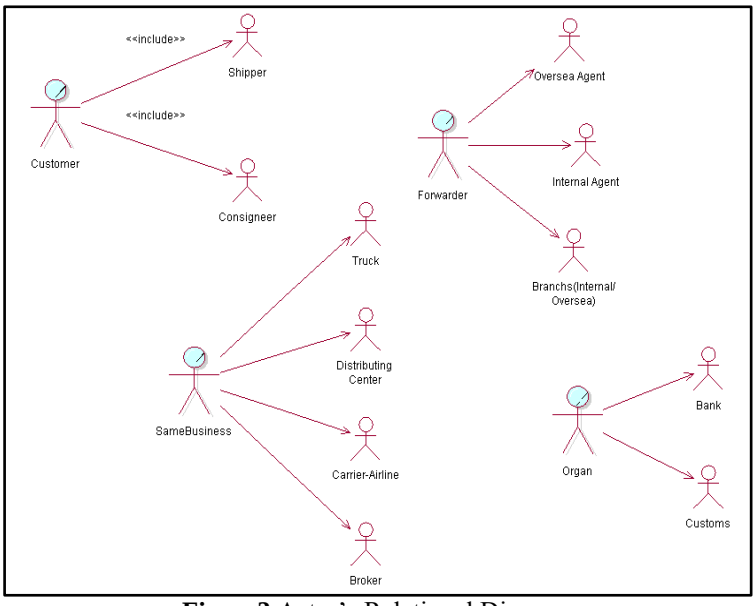

Figure3. Actor's Relational Diagram

3.3.4. Activity Diagram

Activity Diagrams are used to show how differences between workflows or processes in a system can be constructed, how they start, a number of decision paths that can be taken from the beginning to the end, and parallel processing can occur during execution (shown in Fig. 4). Activities are typically implemented by one or more Use Cases, the Activity describes the process that is undertaken, and the Use Case how an Actor will use the system to realize all or part of an Activity. Illustrations for user's actions are:

- Shipper: Quotation query.
- Sales: Generatequotation sheet.
- Customer Service: Quotation review, global customer data keying, shipping notification.
- Co-loaders: Consolidation, reservation, cargo loading plan and airfreight.
- OP: Document production, house airway bill production, master airway bill production, freight calculation, and account production.
- Accounting: Billing production and mailing.
- Airline Company: freight report.

The activity flow diagram is as follows:

- Customer request or online inquiry.
- Marketing departments accept inquiries, quotes, approved by the supervisor, and then provided to the customer.
- After confirmation of quotation, direct transfer the order.The quotation details will be reviewedby customer service department.
- After order approval, customer service sets up Global Customer Data.
- Customer Service will issue a shipping notice or shipping instruction after the product is packed.
- OP (or co-loader) books to the airline and prepare the cargo loading plan.
- OP prepares shipping documents, master and house airway bill, as well as freight collected or prepaid.
- Accountantproduces bills.
- Accountant delivers bills.
- Accountant closed the account.

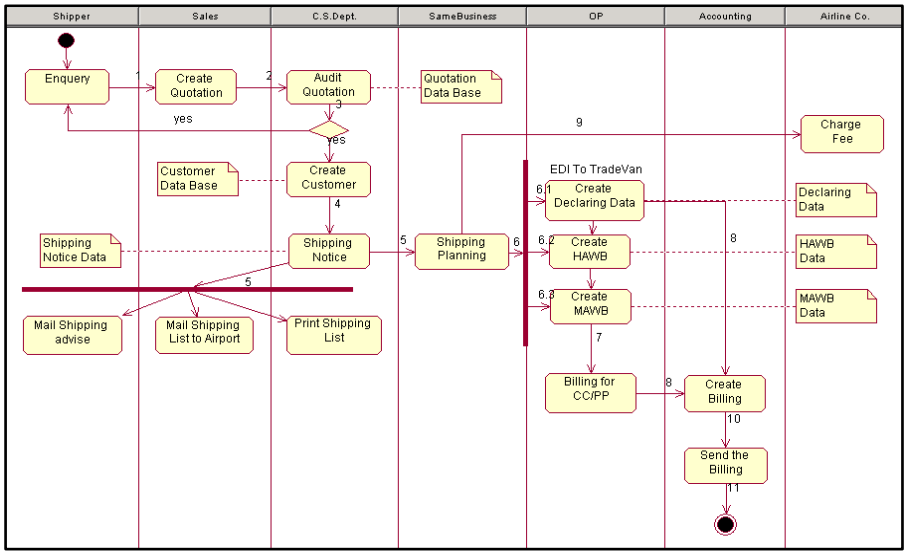

Figure4. Activity Diagram

3.3.5. Class Diagram

The following example, "Authenticating Login Users," illustrates how to design a static model using notations. Fig. 5 shows the relationship between the user and their permissions and account details. It also includes customer preferences. This notation indicates that the customer can have one or more accounts, and the account is made up of one or more Account Items. The attributes (or data) associated with each class are detailed (at the top) and supported behavior (in the bottom).

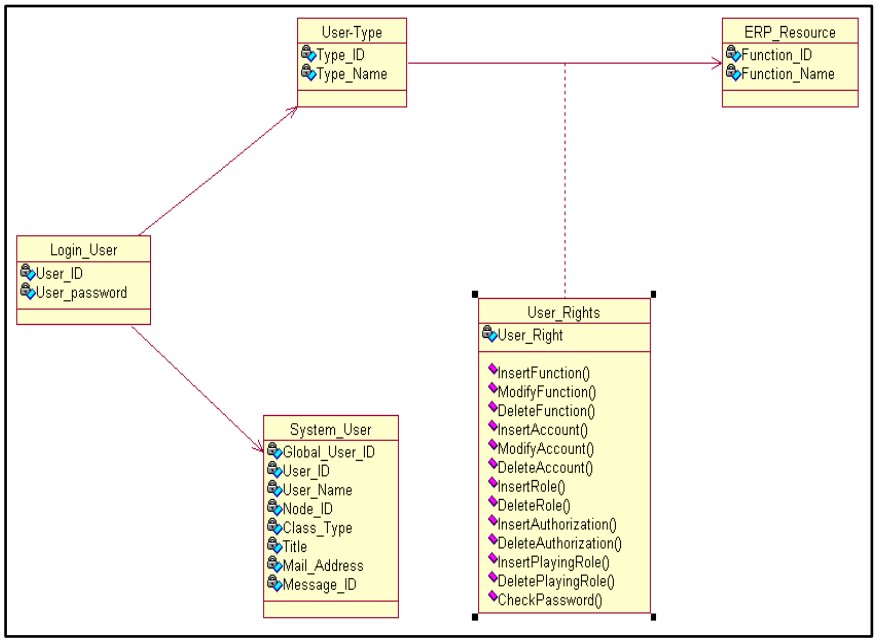

Figure5. Class Diagram

3.3.6. Sequence Diagram

UML provides a graphical way to depict object interactions over time in Sequence Diagrams. These typically display users or actors, and the objects and components they interact with when they use the Use Case. A sequence diagram usually represents a single Use Case "scenario" or event flow. Sequence Diagrams are an excellent way to document usage scenarios and to capture the required objects early in the analysis and to verify objects usage later in the design. Sequence Diagrams show the flow of messages from one object to another and thus correspond to methods and events supported by classes/objects. Fig. 6 shows an example of a Sequence Diagram where the user or actor on the left initiates an event flow and a message flow corresponding to the Use Case scenario.

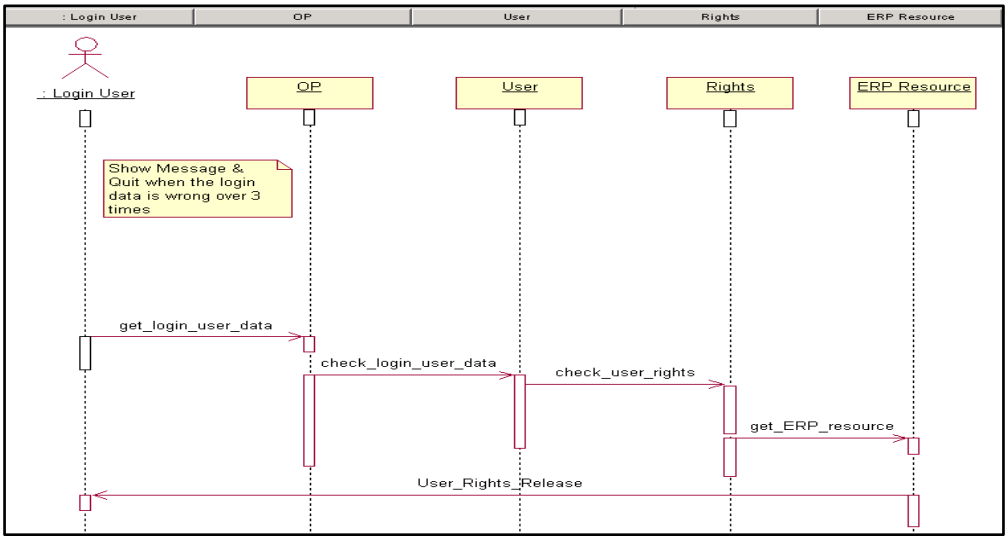

Figure6. Sequence Diagram

3.3.7. Repeat project development and new needs supplement

According to the previous chart, the system will not be able to meet the needs of users in a variety of multitasking. Therefore, the needs for an international air forwarding system for international transport companies are:

- User Security Control: For Internet applications, a well-planned user security control must be designed for both internal users and global external users.
- Version Control: The system will be verified at the branches and outstations. Therefore, the information center to control various system versions is a challenge.
- Workflow: A branch or substation has its own workflow. The effective management of organizational workflow is the goal that managers and system operators should strive for.
- Report Designer: Flexible report designer will allow users to design reports according to their needs.
- Multilanguage: It is important to consider branches and outside stations for multilingual systems that are appropriate for a globalized system when designing your system.
- Multi-platform: The system must consider a variety of cross-industry integration platforms.
- Message format: Provides a system to allow the exchange of all message formats that are also suitable for all levels of the local system.
- Support Database: When a database is exchanged, it can integrate many formats of databases for system integration.
- Multi Sections: The standardized operating system must take into account the differences between the subsystems of each branch and outstations.
- Mail Tool: The auto mail tool sends a message to receivers by e-mail or fax.

And a system operating mode can be quickly set-up through UML as following:

- Global user settings: User security controls (data is not shareable, and subordinator's data can be read by the supervisor).
- User rights control: A tree structure for user page management, where each group is authorized to run, such as modifiable but not deletable, obtainable but not printable, and so on.
- Multi-node and section: Function set for multiple nodes and sections.
- Automatic accounts: Users can set up automatic accounts according to company rules.
- Parameter: Branch can set its own management or operation model based on workflow.
- Reporting: Integration with the system, can be designed.
- Route setting: Fax or mail to the consignee.

3.3.8. System mode analysis and structure setting

This study gets a system structure and mode from the UML diagram as showing Fig.7. The international airfreight forwarding system provides multiple index searches, allowing users to change pages during the same search phase and to support fuzzy search. In the personal information page, it will be classified as security, customer data, quotation data and so on. Each part of the system will pre-set the sample of standard

operating time, the exception management will warn when the category violet standard workflow and in an exceptional condition.Functions of the system structure and mode are:

- Parameter setup: The Outside section can set up its own management or operational modes on its workflow, such as monetary, language, messaging, message delivery for a warranting system for shipping management.
- Business &marketing: Co-loader web setup, company data availability and online quote management, quote review and outdated quotation filing. Forwarding-related charges can be entered via the unit price and the system automatically calculates the charges. The expense report will provide an estimated profit for business management.
- Airwaybill of landing: This is the key to the entire airfreight system. It includes OP air freight import and export airway bill of landing, the management of interchangeable global airway bill of landing. When section A ships the product to section B, the B/L of A can be transmitted to section B system.
- Documentation: Send the customer's shipping instructions (such as invoices or packing lists) to the custom clearance data system via a file. In this way, it will save the OP typing time and immediately print out the custom clear data and EDI transmission. It can transfer different formats to the custom clearance data system.
- Globaldata: Set unique codes and basic information for the global shipper/consignee. Each department can have its own fax number, contact person, salesperson, customs brokers, e-mail and so on. It may also include their relationship to the shipper/consignee/agent, from which the user can read who is the consignee and then the agent.
- DSS: Exploredinformation from global shipping guidance, customer information, and user performance, which can be used by decision-makers in branch settings or strategies review.
- Financial systems: Global financial system managers in the branch can manage based on co-load in/out, consolidation in/out, income and cost.
- Cargo tracking: It shows the status of transit goods arriving at the terminal consignee or gateway (the point at which the goods are transferred from one area to another is exchanged between the lines). A requesting partner to perform Cargo Track and Tracewhen this transaction did not complete successfully. By providing shipping conditions from the start, users will capture the global supply chain, forecast demand and supply in the market, and competition strength.
- e-Logisticsmessage flow: e-logistics messages will provide global communication standards (RNIF, SMS, RTF) and provide EDI/XML/ebXML message exchange.
- Automaticdeclaration: The customs clearance document will automatically generate XML (also used for EDI) format files for customs clearance. Track files are automatically generated after clearance.
- Custom service: The system will link all customers according to their type. It can also connect banksto do the transfer and financing business. In the future, the system will provide cross-industry or customized systems-based services according to the business category:
  (1) P/O control or VMI: Inventory management includes order handle, information format, order transmits, confirm and deal with.
  (2) Trucks and GPRS: The management before productsdeliver.
  (3) WMS: In distribution and warehouse management,the following information and IT technology are closely related, including the picking, stock, customs clearance, inventory management, billing handling, packing lists and so on. Through IT flow management, product in/out and inventory can be handled.

The internationalairfreight forwarding system will strengthen the integration of information technology and supply chain of the fourth party logistics. The system design features are as follows:

- Standardization: In order to maintain a unified system, it is necessary to set up a standard system that is suitable for the global sections. A distributed database can be applied to a standardized database. However, updating the database is important.
- Flexibility: System parameter settings will help the system with the flexibility in the face of various languages, modes of operation and exchange rates. In addition, a standardized system will be verified for needs of a section.
- Modular: The system will be modularized according to the user's differences. Develop their types, objects, and components to make them detachable and assembled. The need for modulation will result in the system.
- Format: Under the multi (crossindustry) alliance, users tend to use information exchange as a system integration. Combined with e-logistics and the Internetthose had formed a formatting effect.

- Customization: The goal of logistics is to provide high-quality services by meeting the needs of customers. A system developed by object-oriented will be easily integrated with another system. In addition, a customized service can also be provided[9].
- Differentiation: In international trade flows, customs clearance must be verified in accordance with government regulations. Under the standardized system, shipping documents will vary according to the laws of each section. However, various clearance systems must be operated under a standardized airway forwarding system.

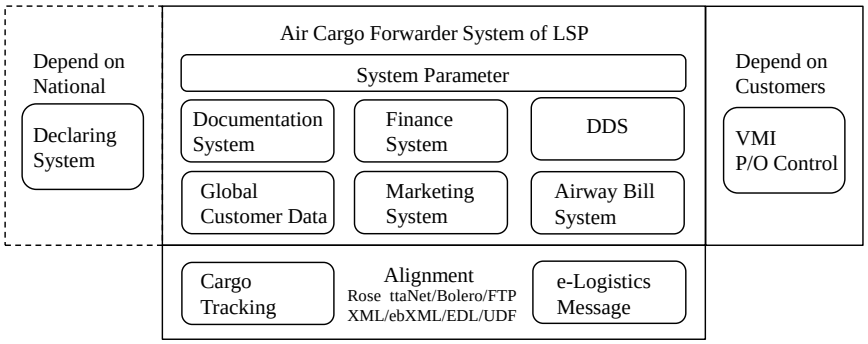

Figure7. System modeling

IV. CONCLUSION

Traditional waterfall model system development workflow is an interview, system analysis and design, programming, testing, setup, and maintenance. When a new flow is entered, the previous flow must end. In other words, changes in customer demand will be stopped. Therefore, in the system development document, the program is completed for the writing work, and ignore the user's needs. UML iterative mode system development hires an object as a unit to enter and develop in a respective flow repeatedly. Each time, change is allowed. The advantages of the iterative model are: (1) needs allowing change; (2) reduce conflicts with customers; (3) improve the quality of software repeatedly development; (4) project members can learn more; (5) more interaction with customers.As mentioned in the previous section, documents in a traditional development model are more difficult to display the relationship between a user and a system. This is why the development of the system from the perspective of the use case is very important.More and more enterprises outsource their information systems to experts. 3PL and 4PL to provide information to customers, prepare and build information systems to consumers. In order to meet all types of user needs, information systems must be designed to be standardized, flexible, modular, formatted, customized and differentiated. In this way, the analyst can use the same modular language to adapt to various categories, such as air cargo forwarder systems. It will make the system easier to integrate with users at the customer site (B2B, B2C), intro-industry or cross-industry or bank (B2B), and government's custom (B2G). This study uses UML as a system development tool to explore the application of international logistics information system. It also focuses on the analysis of requirements management, combined with object-oriented technology to set up by the distributed module components to build the air forwarding system. If UML, JAVA component programming language, data mining technology, and embedded search engine tools together and used to manage the category, the enterprise will be in a new stage.

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