한국산학기술학회논문지
Vol. 9, No. 4, pp. 980-985, 2008

Implementation and Design of the Framework for Consolidated Transportation Model

Myeong-Ho Lee[1*]

공동 수배송 모델을 위한 프레임워크 설계 및 구축

이명호[1*]

Abstract The environment of IT is, currently, on its developing process to the period of web 2.0 and mashup which not only enable computer and internet to be utilized like the water or the air, but also be a new motivating force for its advance. One of the biggest changes of the industry that lies ahead is consolidated transportation. However, no party outstands as the leading party for nationwide improvement of logistics, nor does the right analysis and design for it. Therefore, successful nationwide logistics model is yet to exist. This study provides individual parties, which consider consolidated transportation model as their implementation and design of the framework, with instructions for logistics information system so that they could be competitive in the market. It also helps companies collect user requirements for logistics information system consolidated transportation, and utilize it for its development. Finally, the study provides a implementation and design of pilot system for consolidated transportation model.

Key Words : Consolidated Transportation Model, Framework, Logistics Information System

요 약 IT의 환경은 컴퓨터와 인터넷을 물과 공기처럼 이용할 수 있고, 새로운 성장 동력이 될 수 있는 웹 2.0과 매쉬업의 시대로 진화되고 있다. 그 중에서도 국내 기업들의 효율적인 공동 수배송 업무의 합리화는 국내 기업 물류관리의 가장 중요한 과제 중의 하나로 부각되고 있다. 그러나 효율적인 공동 수배송 시스템의 통합운영 모델의 분석 및 설계에 관한 연구는 미비하였다. 본 연구는 경쟁력있는 공동 수배송 물류정보시스템을 위한 프레임워크 설계 및 구축을 하는데 있다. 또한 공동 수배송 물류정보시스템을 위한 사용자 요구사항을 분석하여 개발 지침을 제공한다. 마지막으로 공동 수배송 모델을 위한 파일럿 시스템을 설계하고 구축하도록 한다.

1. Introduction

Fast employment of broadband communication and wireless network services has made the internet replace the medium of B2B e-commerce. B2C shopping malls and e-payment are also ubiquitous, telematics and portal services using mobile technologies are booming. Enhanced web-security technologies made it possible for many small and mid-sized companies, which lack in-house security infrastructure, to easily implement e-commerce services.

As in many other industries, communication and data manipulation technology have led to systematical change to the logistics industry. One of the biggest changes of the industry that lies ahead is Consolidated Transportation. Logistical cost in Korea is significantly higher than other developed countries because of the multi-stage logistics system and separated transportation practices. To improve this systematically false logistical environment, developing an integrated logistics information system with consolidated transportation, standardization, and data integration is essential. However, no party outstands as the leading party for nationwide improvement of logistics, nor does the right methodology

[1]Department of eCommerce in Semyung University
*Corresponding author : M. H. Lee(mhlee@semyung.ac.kr)

Received July 29, 2008 Revised August 10, 2008 Accepted August 11, 2008

for it. Therefore, successful nationwide logistics model is yet to exist[2][3][5].

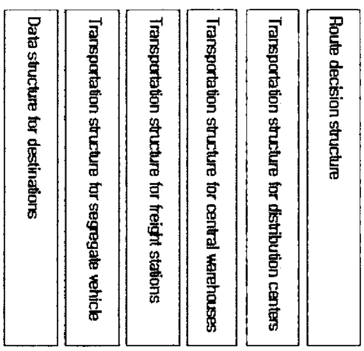
This study provides individual parties, which consider consolidated transportation as their business models, with instructions for logistics information system so that they could be competitive in the market. It also helps companies collect user requirements for logistics information system consolidated transportation, and utilize it for its development. Finally, the study provides a case study of consolidated transportation.

2. Implementation of Framework

2.1 Architecture of Consolidated Transportation

Technologies currently used for data service of consolidated transportation include distributed object middleware technology in N-tier web application server environment and web service environment[4].

Distributed objects, also known as Components, are individually complete module that can interact with others such as O/S, networks, programming languages, application tools, and hardware. [Fig. 1] describes the horizontal structure of consolidated transportation framework in distributed N-tier environment.



[Fig. 1] Architecture of Consolidated Transportation

2.1.1 Data structure for destinations

Data structure for destinations consists of delivery request data for each destination. If, customer A requested 3 freights of 2 tons, 3 tons, and 5 tons to be delivered to B in 3 different times, there will be 3 request data for customer A, and these data could be reorganized into a single delivery request.

2.1.2 Transportation structure for segregate vehicle

Transportation structure for segregate vehicle is used when separate vehicle is needed for a transportation request. This structure is applied only when separate vehicle is required, and the specification of the vehicle must be given those cases. If no vehicle meets the specification, a backup vehicle is assigned.

2.1.3 Transportation structure for freight stations

Transportation structure for freight stations constructs a transportation plan from freight stations to destinations. First, transportation plan is established for direct delivery, and then plans for other freights are made. Direct delivery is optimized by grouping big freights with few destinations and by using arterial roads. That is, direct delivery is transporting freights from freight stations directly to distribution center or to destinations, which is also called arterial move.

2.1.4 Transportation structure for central warehouses

Transportation structure for central warehouses constructs a plan for transportation that departs from central warehouses. First, plan is made for direct deliveries and for other freights. Freights that are not delivered directly are all delivered to distribution centers.

2.1.5 Transportation structure for distribution centers

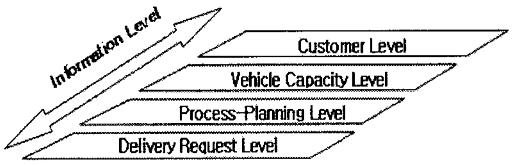
Transportation structure for distribution centers constructs a plan for transportation that departs from distribution centers. It optimizes vehicle utilization by maximizing shipment and minimizing vehicle use.

2.1.6 Route decision structure

Route decision structure decides the sequence of each vehicle in the delivery. It finds the shortest route available and calculates the transportation cost. This process uses Nearest Neighborhood Algorithm, which finds the nearest destination from the current location.

2.2. Information Level

The informational respect of consolidated transportation is approached through 4-level structure as depicted in the [Fig. 2].



[Fig. 2] Information level

First, delivery request level deals with the service requests from customers. Delivery requests are made by registered customers, and the receiving party may or may not be a registered customer. Delivery request is executed with one or more vehicles depending on what the freight is like and where the requester is located. A customer can request a segregate vehicle to carry out his/her request. In this case, the customer must specify the type and size of the vehicle. Priority is given to the customers who request segregate vehicle when assigning vehicles for delivery. If the specified vehicle is not available back-up vehicle is used.

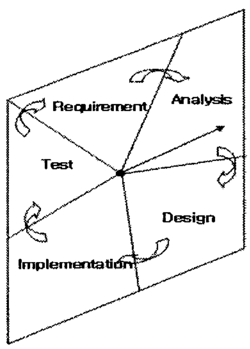
Second, process-planning level assigns appropriate vehicles for specific delivery requests. The process-planning level is executed only when request for planning is in place, which must be accompanied by information of delivery plan and of vehicles. This level optimizes the delivery by assigning proper vehicles regarding location, freight specification, and vehicle capacity. It also provides simulation of delivery and comparison of shipment rate, turnover rate, and cost in different cases.

Third, vehicle capacity level deals with the information of the transportation vehicles. Capacity in both volume and weight of the vehicle can be managed either together or separately. You can define minimum and maximum level of shipment and control the shipment amount, which can lead to a better quality of planning process.

Fourth, customer level deals with the customer information used in consolidated transportation services. This level can work only if accounting information and logistics information of the customers are provided. Logistics information must be provided when a customer registers, and the information includes GIS coordination, road status for vehicle entrance, unloading environment, and service request time-band.

2.3. Modeling of evolutionary life cycle

Software life cycle, or software development cycle, is a continuous developmental cycle that occurs when making a information system. Waterfall model, a typical life-cycle model, checks each stage of the development steadily and moves to the next stage. The number of stages in the development - such as planning, analysis, drafting, coding, testing, maintenance - makes this model costly and time consuming, and it is also hard to modify the original scheme when the analysis is over. Prototyping model alleviates this problem by developing software that is actually going to be built. First, a prototype is made to verify the feasibility of the software. Then, Waterfall model is used after the evaluation of the prototype is taken place. Such evolutionary developing environment, which utilizes pre-established prototypes, is recently gaining ground as n-tier distributed object technology became in widespread use. The most popular model is Spiral model[1], which tries to evolve the prototype by executing risk analysis whenever a prototype is changed. As described in [Fig. 3], this study will integrate Waterfall model and Spiral model, and provide evolutionary life cycle model in consolidated transportation.



[Fig. 3] Evolutionary life cycle

3. Data Modeling

3.1 Data modeling of planned delivery request.

Data for planned delivery request contains user ID, date and time. The data is processed to enable continuous request and planning. [Table 1] shows the data modeling of planned delivery request.

[Table 1] Data modeling of planned delivery request

User ID	Request date	Request time
Request No.	Customer code	Request type
Vehicle capacity	Vehicle type	Volume
Weight	Amount	Departure code
Freight station code	FS location X	FS location Y
FS shipment code	FS shipment location X	FS shipment location Y
FS request date	Freight request time	FS vehicle entrance condition
FS unloading condition	FS area code	DC shipment code
Distribution center code	DC location X	DC location Y
DC customer code	DC shipment location X	DC shipment location Y
DC request date	Delivery request time	DC vehicle entrance condition
DC unloading condition	DC area code	

3.2 Data modeling of vehicle information.

This data includes detail information of the vehicle to be used for the delivery. [Table 2] shows the data modeling of vehicle information.

[Table 2] Data Modeling of vehicle information

User ID	Request date	Request time
Vehicle No.	Area code	Vehicle type
Capacity	Direct delivery	Min weight
Max weight	Min volume	Max volume

3.3 Data modeling for destination freight information (H)

Data for destination freight information (H) contains information of delivery classified by customers and destinations. [Table 3] shows data modeling for destination freight information(H).

[Table 3] Destination freight information (H)

User ID	Request date	Request time
Request No.	Customer code	Request type
Vehicle capacity	Vehicle type	Volume
Weight	Amount	Departure code
Freight station code	FS location X	FS location Y
FS shipment code	FS shipment location X	FS shipment location Y
FS request date	Freight request time	FS vehicle entrance condition
FS unloading condition	FS area code	DC shipment code
Distribution enter code	DC location X	DC location Y
DC customer code	DC shipment location X	DC shipment location Y
DC request date	Delivery request time	DC vehicle entrance condition
DC unloading condition	DC area code	

3.4 Data modeling for destination freight information (D)

Data for destination freight information (D) contains detail information at the destination of the delivery. The data is updated when delivery plan is made. [Table 4] shows the data modeling for destination freight information (D).

[Table 4] Destination freight information (D)

User ID	Request date	Request time
Destination No.	Request No.	Vehicle No.
Delivery Sequence		

3.5 Data modeling for delivery plan

Data of delivery plan contains detail information of the established delivery plan. [Table 5] shows the data modeling for delivery plan.

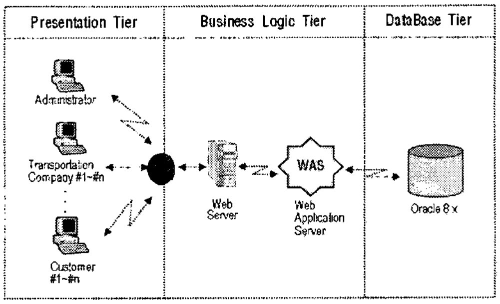
[Table 5] Data modeling for delivery plan

User ID	Request date	Request time
Vehicle No.	Capacity	Volume
No. of destinations	Cost	Departure code
Destination code		

4. Implementation of Pilot System

4.1 Developing environment

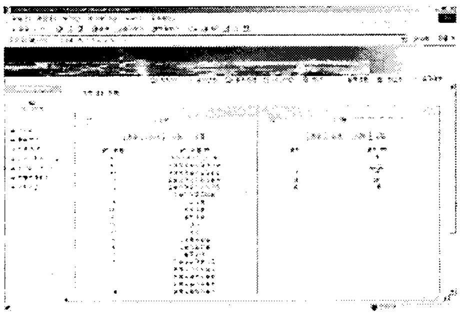
The N-tier distributed development environment of consolidated transportation model is shown in [Fig. 5][6].



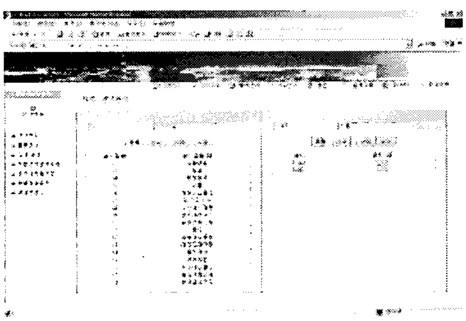
[Fig. 5] Development platform using J2EE

J2EE web application platform is used for development environment, and a web-interfaced Oracle is used as DB.

4.2 Building consolidated transportation system



[Fig. 6] Basic code management



[Fig. 7] Area definition

In this study, consolidated transportation is divided into two main parts; management part, and transportation company and customer part. The management part is again divided to standard management part and manager part. Standard management includes; basic code management, which defines codes; distribution center management; area allocation, which defines the area the distribution center is located; area definition; zip code; shipment assignment; vehicle capacity inquiry; and local office management. [Fig. 6] and [Fig. 7] shows Basic code management and Area definition, respectively.

5. Conclusion

The current business environment requires the integrated information system to reuse existing components and be compatible with legacy system. It also requires services to be integrated, without additional programming, under distributed object platform and web environment. However, framework that utilizes logistical data properly has not been established yet for consolidated transportation. Building framework of the data structure of consolidated transportation is hindered by many particular problems of the industry.

Therefore, this study has provided instructions and framework for building consolidated transportation model in n-tiers distributed object environment, and provided a case study based on data modeling. Hereafter, mathematical model that takes more realistic problem in account should be developed, and studies must be continued on how to make consolidated transportation model using EJB (Enterprise JavaBeans) of J2EE platform or asynchronous JMS(Java Message Service).

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Myeong-Ho Lee [Life Member]

- Feb. 1984 : Department of Industrial Engineering, Ajou Univ. (B.E.)
- Feb. 1986 : Department of Industrial Engineering, Ajou Univ. (M.S.)
- Feb. 2001 : Department of Industrial Engineering, Ajou Univ. (Ph. D.)
- March 2002 ~ Present : Department of eCommerce, Semyung Univ. (Associate Professor)

<Area of Interest>
Logistics Information Systems, Web Application Server Programming, Real-Time Monitoring Systems.