Development of Online Reference Model for the Logistics Information Standard

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Abstract: - The purpose of this study is to develop an online reference model for the management of the logistics information standard. In order to help users easily gain access to logistics information standard and manage them efficiently, this study has integrated three layers of a user, documents, and process, thus making a new reference model for the management of the logistics information standard. To this end, we have analyzed step by step the logistics information users, import-export process, and import-export documents. Also, in order to comprehensively store three defined objects, we have designed an ontology-based data repository. Through this online reference model, this study has tried to suggest a new methodology of storing, retrieving, and processing the logistics information standard.

Key-Words: Logistics information, Standard, reference model, Retrieval

1 Introduction
One of the significant problems in the national logistics industry is very high national logistics costs. In order to reduce the high national logistics costs, many efforts have been made in the hardware aspect such as infrastructure establishment, transportation, stevedoring, and packaging technology, and also in
the software aspect, continuous efforts to share and exchange logistics information have been made. Logistics information plays a critical role in combining organically the major logistics activities such as packaging, transportation, storage, and stevedoring, so that various functions of logistics can be performed efficiently and effectively.

This means that logistics information should efficiently be provided to the logistics entities in order to reduce national logistics costs. However, because of lack of standardization on logistics information, desirable progress has not been made in sharing and exchanging logistics information [9].

To organically combine major logistics functions by providing proper logistics information efficiently, thus reducing national logistics costs, much more efforts are required to be made for the standardization of logistics information. To this end, this study has tried to develop an online reference model for the management of the logistics information standard, so that all the participants in the logistics fields may be able to retrieve under an online environment all the standards needed in the logistics activities.

2 Usage and Management Situation of Logistics Information Standard

For the development of an online reference model, first of all, this study has analyzed the current logistics standard-related systems, checking the problems of current situation of logistics information standard and its management. At present, the management system for the logistics information standard is not being operated individually in Korea. Instead, the e-documents used in the logistics information transactions are being managed by KIEC (Korea Institute for Electronic Commerce) which is under the Ministry of Knowledge Economy.

In order to check the management situation of the logistics information standard, this study has analyzed the KEC (Korea E-Document Standard Committee) and REMKO (Registry & Repository of ebXML in Korea) which both belong to KIEC. KEC is in charge of formulating, amending, and annulling the standards on e-business contents and application technologies pertaining to them. The standard registration situation of trade and marine, land, and air transportation related to the logistics are shown in the below <table 1>.

<table>
<thead>
<tr>
<th></th>
<th>EDI</th>
<th>XML/EDI</th>
<th>XML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade</td>
<td>37</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>Marine transportation</td>
<td>38</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Land transportation</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Customs clearance</td>
<td>39</td>
<td>0</td>
<td>65</td>
</tr>
</tbody>
</table>

The standards pertaining to the trade, marine transportation, land transportation, and customs clearance run to 247 kinds in all, which are mostly composed of EDI or XML standards for import and export reporting.

As of now all the standards management is conducted via REMCO. The REMCO has a great store of all kinds of e-business contents at home and abroad. In addition, the REMCO, in connection with each industrial repository, is trying to share information so that it may play a pivotal role for the domestic e-business. Its system is based on ebXML framework. Although e-documents have now been standardized for logistics information transactions, however, many problems are being raised with regard to the usage of logistics information standard.

These problems can be summarized as follows. First, the information system of each individual domain is being used independently. We can find this problem in the <table 2>, which shows the current situation of domestic logistics information. Although logistics-related EDI and XML standards had already been established and brought into use, the information system connection between government organizations and/or private organizations is still in a poor condition [6].

Secondly, in case of the codes and data that are being used in the import export-related documents, their own codes are still being used. In other words, although people are using the standardized documents via EDI and XML, the codes and data for the documents have not been standardized enough, and are not fully being used. This means that information sharing and exchanges between related organizations are not smooth. For this reason, it is very difficult to connect and integrate existing information systems, and also causes disconnection of information in some cases.

The <table 2> shows the code usage for logistics and code operating system. As illustrated in the tables, each logistics entity has a different code operating system of its own [3]. Because of this, information connection is
difficult, and also it causes a problem for the usage of database. As a key value plays a critical role in the operating aspect such as input and output, its standardization is absolutely necessary.

Table 2 Example of logistics information-related code operating system

<table>
<thead>
<tr>
<th>Section</th>
<th>Container information</th>
<th>Ship information</th>
<th>Vehicle information</th>
</tr>
</thead>
</table>
| Key value of information | • Container number | • Different key values of information according to organizations  
1. Maritime office: call sign, port docking year, number of times  
2. Customs house: MRN  
3. Terminal: mother ship’s code, navigation numbers of terminal  
4. Shipping company: ship’s name, navigation numbers of shipping companies | • Vehicle number, container number  
- Only in case that a car number is connected to the container information (number), it carries a meaning. |
| Code system | • Container number system  
- Shipping company sign(4)+serial number(6)+CKD(1)  
- Container code system  
- Container length(1)+height, width(1)+class(1)+container usage(1) | • In case of above 1: call sign, year(4), the number of Busan port dockings(3)  
• In case of above 2: year(2)+shipping company sign(4)+serial number(4)+CK(1)  
• In case of above 3: mother ship’s code(4)+navigation numbers of terminal(2) | • Vehicle ID system  
- Agreement system: transporter code(4-digit) + vehicle’s serial number(4)  
- Some terminals is using vehicle’s serial number (four-digit) alone. |
| Management/operating system | • Industrial circles including shipping companies  
- One’s own code or ISO code  
- In case of reporting to customs house: conversion  
- Customs house: ISO code usage/management | • Each organization or entity has and manages their own code  
• In case of the field logistics, all the logistics activities are based on the shipping company. | • Each terminal has different system of its own.  
- Each terminal issues its own vehicle ID cards and manages them. |

We have judged that one of these problems comes from the lack of efficient and effective standard management and operating system. The reason is that according to the in-depth survey of field logistics workers the majority of them badly feel the necessity of standards, but they think that it is very difficult to approach standards. In other words, most of them don’t know where and how to use those standards.

Meanwhile, in case of already published standard code books, they are taking the form of a text book. Therefore, whenever people want to use the standard codes, they have to consult the printed manual. Because of this, the printed manuals are causing inconvenience, and also are of little avail. In order to solve these problems, this study has aimed to develop a user-friendly online reference model for the logistics information standard, focusing on easy accessibility.

3 Reference Model Design for Logistics Information Standard

The purpose of a reference model for the logistics information standard is to increase understanding of information standard, improving reliability of logistics information, enhancing information sharing and connection, and consequently contributing to the logistics competitiveness [4, 5]. The reference model is composed of three components: document type, user type, and process type. The reference model can graphically be expressed in a 3-dimensional cubic form. Each entity participating in the logistics activities is able to extract necessary information from among the total logistics information standard contained in the cube. In order to develop this reference model, first of all, we had to analyze the three components in detail.

3.1 Document Design
Document type is a logistics information standard object for logistics users to refer to in their work process. In order to select the logistics information standard object, first of all, this study has decided to choose the EDI and XML documents in the REMCO. However, as mentioned in the previous chapter, the EDI and XML documents have already been standardized, but the codes and data used in these documents have not yet standardized. Because of this problem, information sharing and connection between logistics entities are meeting with difficulty. Therefore, people are using an off-line method in order to obtain and share information from outside organizations. Their method to store information depends on an off-line method.

Therefore, the codes and data to be used in the document have been chosen as the document - i.e. standard object – of this reference model of the logistics information standard. To this end, this study has made a survey of what kinds of information object are most frequently used in the logistics field. The results are as follows. The four kinds of information - customs clearance, schedule, cargo, and cargo tracking – account for nearly 80%. Therefore, these four are to be the first information objects to be standardized. The codes and data that have been chosen as standard objects in this study are shown in the <table 3>.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Where</strong></td>
<td><strong>Recognition number</strong></td>
<td>Transportation number/Invoice number</td>
<td>HAWB/MAWB/MRN/Bonded transportation number</td>
</tr>
<tr>
<td></td>
<td>Port</td>
<td>Pier code/shipment terminal code/shipping port/code/port in charge of CIQ</td>
<td>容号</td>
</tr>
<tr>
<td></td>
<td>Airport</td>
<td>Airport code/departure airport/transit airport/destination airport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warehouse</td>
<td>Warehouse code/yard code/bonded yard code/import place code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Railroad station</td>
<td>Departure station/docking station/docking ship (cargo train) code</td>
<td></td>
</tr>
<tr>
<td><strong>Related public organizations</strong></td>
<td>CIQ</td>
<td>Place for CIQ/code number of the customs house where a declaration has been presented/customs house code/quarantine code/immigrant bureau code/organ code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>others</td>
<td>Country code/area code</td>
<td></td>
</tr>
<tr>
<td><strong>When</strong></td>
<td></td>
<td>Date and time of export/estimated cargo arrival date and time/handling date/delivery period</td>
<td></td>
</tr>
<tr>
<td><strong>Who</strong></td>
<td>Owner</td>
<td>Business registration No./company code/sender code/receiver code/customer code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Broker</td>
<td>Forwarder code/licensed customs agent/stevedore code/corporation code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transporter</td>
<td>Airlines code/shipper code/transporter code/bonded transportation ID</td>
<td></td>
</tr>
<tr>
<td><strong>How</strong></td>
<td>Sea transportation</td>
<td>Navigation numbers of shipper/mother ship code/navigation numbers of terminal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air transportation</td>
<td>Airline flight name</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Railroad transportation</td>
<td>Locomotive No./train No./cargo train No./container vehicles No.</td>
<td></td>
</tr>
<tr>
<td>Land transportation (vehicle info.)</td>
<td>Vehicle ID/vehicle No./chassis No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>What</strong></td>
<td>Cargo type</td>
<td></td>
<td>Cargo code</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General</td>
<td>Special (freezing/dangerous goods/animal and plant)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Special cargo code</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cargo attributes</td>
<td>Cargo item/specs/length/height/cargo temperature/cargo capacity/cargo tonnage</td>
<td></td>
</tr>
<tr>
<td><strong>Why</strong></td>
<td>Purpose</td>
<td>Export section</td>
<td>Customs clearance section</td>
</tr>
</tbody>
</table>

The level 1 in the above <table 3> has been classified according to the maxim of the 5 Ws and I H, and the
proper items and entities have been elicited in the level 2. Level 3 and level 4 include the examples of the codes and data of each item, which finally have been chosen as logistics information standard objects.

### 3.2 User Design

Table 4 Organizational system of logistic information-related administration organizations and their missions

<table>
<thead>
<tr>
<th>Sector</th>
<th>Section</th>
<th>Name of organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public sector</td>
<td>Logistics/Customs clearance</td>
<td>Ministry of Land, Transportation and Maritime Affairs, Korea Customs Service, Korea Railroad Corporation</td>
</tr>
<tr>
<td>Public sector</td>
<td>Quarantine Inspection</td>
<td>National Fisheries Products Quality Inspection Service, National Veterinary Research and Quarantine Service, National Plant Quarantine Service, Korea Food and Drug Administration, National Quarantine Station, Immigration Office, Korea Maritime Dangerous Goods Inspection Center</td>
</tr>
<tr>
<td>Private sector</td>
<td>Logistics-related centers</td>
<td>Port container terminal, airport terminal, ICD, general cargo terminal, composite cargo terminal, ODCY/ bonded warehouse, logistics center/ CFS</td>
</tr>
<tr>
<td>Private sector</td>
<td>Logistics service providers</td>
<td>Shipper, shipping company, airlines, railroad corporation, transporter, pilot, inspector, forwarder, warehouse (including bonded warehouse), stevedore, terminal/CFS, CVO company, VAN company</td>
</tr>
</tbody>
</table>

Footnote: This table is based on the Ministry of Construction and Transportation’s report (2004) “Import and export-centered national logistics information system innovation project.”

The entities of logistics information can be divided into two: public sector and private sector. The organizational system of those administration organizations in the public sector and private sector is summarized in the following table 4[1].

The private sector is mainly generating logistics information, and the public sector plays a role of storing and processing the information generated by the private sector.

### 3.3 Business Process Design

Finally, this study has integrated and analyzed the logistics business process. The business process has been grouped into three: maritime import-inland transportation, maritime export-inland, and transshipment between maritime transportation and air transportation. In order to effectively and easily integrate and analyze the business process, according to the order of reporting jobs, the flow of information has been described in sequence.

Accordingly, the vertical line represents the temporal order of reporting jobs, and the horizontal line represents the entities of information.

![Business process analysis of maritime import-inland transportation (partial)](image)

The business process analysis of maritime import-inland transportation has been described in sequence.

According to the temporal order in the vertical line, we have described what kinds of reporting jobs the entities of information in the horizontal line have to perform and to which organization they have to report.
We also have described how they are delivered at the time of reporting.

Through this business process, we can find out in their import, export, and transshipment activity what kinds of information are being produced by the reporting entities and how they are delivered. This business process has been composed by MS Visio 2007 version. Due to the limited space, this study is showing only partial process of maritime import-inland transportation as illustrated in the <fig.1>.

In addition, after analyzing the business process of import and export, this study has summarized the documents and delivery methods according to each job. According to the temporal order of business process, job procedure, document format name, producing entity, receiving entity, usage, delivery method, and related system have been rearranged in detail. The business process design in this study has been made based on the in-depth interviews with experienced workers and experts in the logistics field and also based on literature review[1, 2, 6, 7, 8, 10, 11, 12, 13].

4 Design of the Reference Model for Logistics Information Standard

4.1 Ontology-based Data Repository

The data repository created in this study is based on ontology. In order to express logistics information standard more effectively, ontology gives meaning between different information, establishing their relationships, so that standardized knowledge can be expressed, shared, and reused. To this end, first of all, this study has designed an ER (Entity-Relationship) diagram of the data repository as shown in the <fig.2>.

The key entities in the <fig.2> are users, documents, and process. Here the users can be divided into two: the reporting entity of users in the private sector and the receiving entity of public-users in the public sector. The document contains the codes in detail, and finally the information system to be used for reporting has been expressed as an entity. The ontology in this study has been based on this ER diagram. In this study the ontology has been represented in such a way to sequentially connect the document, code and data, user, and process.

For example, if you refer to a call sign (code) standard, the document shows an docking/ departure declaration form and cargo import/export declaration form where the call sign is used. Next, the user shows declaring organizations (shipper, etc.) and responding organizations (MLTM, customs house, etc.) that are related to the document. Finally, the process shows docking, cargo declaration, and departure. Like this, by enabling one logistics information standard to elicit other related information, users can easily gain accessibility.

The ontology configuration chart is shown in the <fig.3>, in which the entities in the ER diagram of the <fig.2> have been used. In general, the ER diagram
mainly shows the cardinality of entity’s relationships, but ontology is able to define the relationships between entities. That is to say, if a user participates in a declaration process, the declaration document will be produced, and the user will refer to the declaration item (doc-object) necessary for the document, eventually using the code (doc-code) for the declaration item. That is, the object types in the upper layer plays a role of defining the objects type in the lower layer. Also, by defining the association type between users, the relationships of diverse transaction types have been expressed.

Based on the Protégé 3.4 developed at the Stanford University of the USA, Fig.4 illustrates an example picture that has produced a class, a slot, and an instance, which have been presented in the Fig.3. First, each class is to be produced, and its relationship with other class can be expressed through a slot, defining the instance of each class, and presenting a concrete value of relationships [14, 15]. For example, the instances of a document class are a docking/Departure declaration form and a cargo declaration form, and the instances of a process class are docking and departure. At this point in time, the relationship of “declaration” between the instance of docking and departure declaration form and the instance of docking is to be defined through a slot. At this time, the “declaration” again becomes the instance of “collaboration.”

![Fig.4](image.png)

4.2 Prototype Design

Fig.5 shows a prototype of the comprehensive retrieval of logistics information standard, which is based on the reference model. The salient feature of this prototype is that a user, through this comprehensive retrieval, can search not only logistics information standard, but also diverse related information. For example, if you input a “container export,” it produces a document, a standard code, a declaring organization, a responding organization, and its related workflow, together with the container export. This comprehensive retrieval has been made possible through the ontology-based data repository.

The beginning of all the comprehensive retrieval starts with “document” or “document code,” which is designed to be connected to “user” and “process.” In addition, the prototype enables a user to make a copy through the text window, so that he can conveniently use the retrieval results. If there are related documents or data, the user can download them.

![Fig.5](image.png)

5 Conclusion

In an effort to improve and spread logistics information standard, this study has developed an online reference model. By using the reference model, users can more
easily retrieve logistics information standard, consequently enabling them to apply the retrieval results to their job. To this end, based on the questionnaire survey and interviews with experts in the logistics field, this study has analyzed three key components – user, document, and process - and also has designed an ontology-based data repository in order to elicit the relationships between each entity. The online reference model suggested in this study is considered to be a new methodology for the management of logistics information standard, so that it can be used as a basic tool for further study.

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