THE CVO ARCHITECTURE SYSTEM STUDY IN KOREA

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Abstract: Recently, many counties issued the CVO system, which are appropriate for their inherent transportation environment. It set out the architecture design with not only transport system but also with standard ISO guide. The key factor is how much it satisfies with the international standard level. The standards development identifies potential standards areas, reviews existing standards efforts, describes a general process to assist standards development, and suggests beneficial actions to support and encourage CVO deployment. This study review CVO architecture method and looks at the design policy to meet the ISO standard and also is intended for use as a guide to using the architecture standard in Korea. It is directed toward standards development organisations, product developers, service providers, and public agencies at all levels.

Key Words: CVO, ITS, Architecture, Standard, Logistics

1. INTRODUCTION

1.1 Background

As our roads become more congested, the costs of commercial carriers and government charge to meet the demands of the consumer have risen. The logistics cost are some 74.2 Trillion Won ($ 62 billion) annually and represent approximately 16.5 percent of nation's gross domestic product in Korea. At the same time, commercial transportation industry face increasing pressure to ensure that they remain competitive and technologically efficient. The need to find the solution that improve carrier safety and productivity, reduce congestion cost for carrier, and minimize carrier delays has become significant. Costs to the transport industry are continuing to rise while profit margins shrink. To solve the problem, the government suggested some of strategies. Recently, the MOCT announced its master plan to invest a total of USD 3.5 billion in establishing an ITS system by the year 2010. The Ministry also announced its plan to invite Korean private firms to invest in this project. This is because, ultimately, the industries will benefit from the installation of ITS systems, which will contribute to lowering their transportation and distribution costs. The MOCT plans to implement and test the first phase of the ITS plan in the Seoul metro area by the year 2000. An electronic service of providing information on routes will start and be extended to other major Korean cities by 2005 in the second phase. Finally, they introduce "The national logistics plan 2001-2020" in early 2001. This plan includes establishing the national logistics system for transportation industries. Specially, the 21-centry logistics vision shows "Cyber Logistics" which focus on networking in this plan. The cyber logistics mainly base on CVO(Commercial Vehicle Operations) system. However CVO does not establishing as a national system, because of different interest groups. For establishing the CVO system, it would be meeting standardization with international standard level.

Many institute in Korea have introduced national logistics system architecture in transport industry. But these systems didn't develope as a national system. Similar CVO systems are operating in private sector. In a study sponsored by MOCT(Ministry of Construction and Transportation), small group of professionals begun to discuss ITS(Intelligent Transportation Systems) architecture in 1994. Studies continued in 1997 at KRIHS(Korea Research Institute for Human) for establishing the national ITS architecture. Following the 1997 study, KRHIS set up the national ITS architecture including CVO in 1999 with attendees from the academia, private sector, and government. Our study was about CVO architecture in the 1999 study. But, Korea has problems that are similar to CVO system without avoiding investing over again, before introducing ITS/CVO.

1.2 Purposes and Scope

The National Architecture is an important step in a larger process that is intended to promote national compatibility and interoperability across CVO deployments. To support this crucial transition between architecture and standards, this standards study reviews:

- Review standards efforts and their relationship with the architecture framework in existing logistics system.
- Describe the general process by which the National Architecture can inform and assist standards development.
- Establish CVO system and design the standard areas associated with the National ITS Architecture.
- Suggests actions to encourage timely and beneficial standardisation to support CVO deployment in Korea.

In the following chapter, we discuss the concept of Korea CVO system and earlier practical work in the subject. Chapter 2 describes the review of CVO architectures and standard technology in leading counties. The CVO architecture in Korea is described in chapter 3, followed by our result in chapter 4. We close by discussing a vision for CVO and suggest some of the barriers to implementation of the important new technology.

2. THE REVIEW OF CVO ARCHITECTURE

The CVO refers to the collection of information systems and communication networks that support the logistics system. These include information systems owned and operated by government, motor carriers, and other group related transportation. The CVO architecture is trying to create a information system, but rather to create a way for existing and newly designed system to exchange information through the use of standards and available communication infrastructure. The CVO architecture is the part of ITS architecture. It includes standards for communications technologies such as EDI(Electronic Data Interchange) and DSRC(Dedicated Short Range Communication). These standard are being developed to promote interoperability and efficiency through the standard development organization.

There are many standards development organisations - Independent organisations that develop standards in the world. Each organisation is typically responsible to some specific community. Because ITS spans such a large number of agencies, producers, and technologies, there are a number of standards development organisations that of interest. The following section briefly reviews CVO architecture considering standardization in leading countries.

2.1 CVO architecture in leading counties

In USA, the DOT plays a major role. DOT started a 33-month program to develop the System Architecture. USA has developed CVO system as a CVISN in some of group as ANSI (American National Standards Institute), SAE (Society of Automotive Engineers), and AASHTO (American Association of State Highway and Transportation Officials), etc. The TEA-21(Transportation Equity Act for the 21st Century), which controls the budget for domestic surface transportation, assigns subsidies for the deployment project of ITS on a condition of preparing system based on the National System Architecture.
Japan decided that the five government bodies would compile the System Architecture for ITS in co-operation with VERTIS. The System Architecture for ITS will be revised occasionally in case the plan such as "comprehensive plan for ITS in Japan" is revised and conditions of ITS promotion changes, such as rapid progress in element technologies related to ITS. Japan is actively participated in ISO standard working group in ETC, AHS, TICS.
In Europe, the European Commission (EC) is in charge. The EC started T-TAP (Transport - Telematic Application Programme). One of activities is CONVERGE, a method to examine System Architecture. They reformed the method examine in STAIN, and added a method of System Architecture.
In the case of Korea, MOCT has developed ITS Architecture in charge. It is at a starting level now. Also, The ITS was composed of 4 sections - ATMS, ATIS, APTS, and CVO in 1997. The System Architecture for Korean ITS adapted the USA method, which makes it easy to expand part the System Architecture.

2.2 CVO Standard Technology Area

The standard for CVO can be derived from the national architecture definition in several different ways. This section reviews the CVO standard area from the following 3 viewpoints.

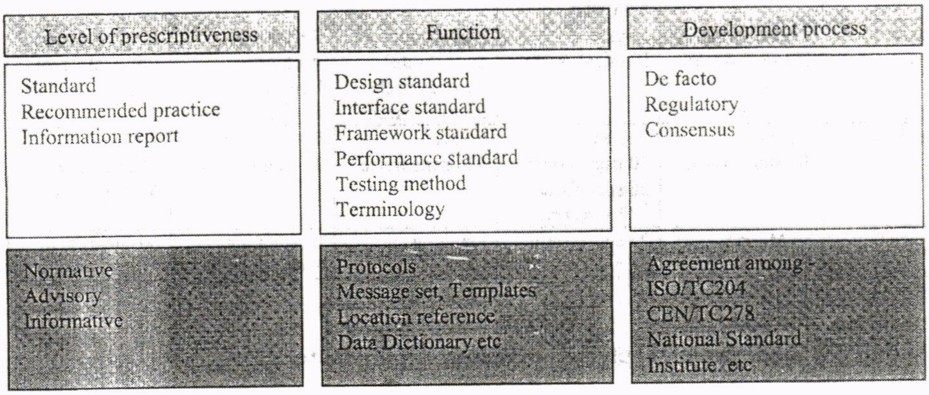

Figure 1. Viewpoint of standard area

The CVO is a reference framework that spans all of these standards activities and provides a means of detecting gaps, overlaps, and inconsistencies between the standards. Standards

Requirements, based on the Logical and Physical Architecture, provide a requirement starting point for the standards activities and a tool for measuring their output. There are some standard areas by function.

- Dedicate Short Range Communications (DSRC)
- Digital Map Data Exchange and Location Referencing
- Information Service Provider Wireless Interfaces
- Inter-Center Data Exchange for Commercial Vehicle Operations
- Traffic Management Subsystems to Other Centers
- Emergency Management to Other Centers
- Information Service Provider to Other Centers
- Archived Data Management Interfaces
- Human Interfaces

Also, some of standard areas are shown on ISO technical activities. The working group 4. 5, 7, 15 in ISO/TC204 are in charge of standard area related CVO technologies similar with CEN/TC278.

3. CVO ARCHITECTURE IN KOREA

When constructing the System Architecture for CVO, it is necessary to clarify the overall system structure to build the system, while keeping their county and the principal in mind. When adapting the CVO Architecture, it is also necessary to following comparison:

Table 1. Comparison ITS Architecture

	U.S.A	JAPAN	Europe	ISO	KOREA
Involve year	1994	1998	1998	1997	1997
Character of ITS Architecture (Archi')	Top-down Strong recommend type Business unit focus	Integration current business type Service focus Object oriented approach	Pan-Europe master plan. Integration current business type	Standard Archi' Button-up Object oriented approach	Open/Recommend type Service /business unit focus
Structure	Logical Archi' Physical Archi'	Logical Archi' Physical Archi'	Function/Information Archi' Logical Archi' Physical Archi'	Reference Archi' Logical Archi' Physical Archi'	Logical Archi' Physical Archi'
User Service	6 Area 30 user service	9 Area 20 user service 56 specific ser' 172 sub service	6 Area 32 user service	8 Area 32 user service	7 Area 16 user service 62 specific ser'
Service unit	56 Market package	24 sub-system type	Planning	Developing Methodology	60 sub-system

3.1 Set up the Guideline on Applying the System Architecture

It is necessary to analys a standard level of National Architecture among the various interested parties in order to achieve the future image of ITS. For establishing the Guideline of system architecture, we choose the following specific element of CVO architecture and setting up the Guideline.

- Character of CVO User Services

- Structures of CVO User Services
- Constructing the Logical Architecture
- Constructing the physical Architecture
- Standardisation Area

3.2 Adapting the CVO standardization architectures in Korea

CVO Architecture as a part of ITS architecture follows basic frame of the National ITS configuration. Korea had designed first national ITS architecture except the CVO part. This Study takes the project that performed second national ITS architecture with KRIHS to build Korean type CVO considering the ISO Standard Architecture. In order to adapt standardization architecture, it was necessary to follow steps.

3.2.1 Analysis of ITS/CVO architecture

The ITS elements support Commercial vehicle operations. These include information system, network, sensor system such as AVI/AEI, technologies such as DSRC equipment, and the components of the intelligent commercial vehicle. The national ITS/CVO architecture defines these CVO user services.
In order to determine CVO user services, we examined over the ITS leading countries. These countries selected user service item to fit the service item for their transportation environment and finished architecture task. The following table is the comparison of each country user service comparison;

Table 2. user service item comparison

User Service	
U.S.A Commercial Vehicle Electronic Clearance Automated Roadside Safety Inspection Commercial Vehicle On-board Safety Monitoring Commercial Vehicle Administrative Processes Hazardous Material Incident Response Freight Mobility	**EUROPE** Co-ordinated City Logistics Fleet and Resource Management Freight Management Hazardous Good Management Operational Planning Management
ISO Commercial Vehicle Pre-clearance Commercial Vehicle Administrative Processes Automated Roadside Safety Inspection Commercial Vehicle On-board Safety Monitoring Commercial Vehicle Fleet Management	**JAPAN** Commercial Vehicle Operation and Other Freight Information Operation Information in the other mode Automated Platooning

The result of above comparison and analysing sub-system classified these following user services.

- **Freight and Transportation Mode**
  Fleet management, Transportation operation management, Freight management, Safety & road management
- **Administration and Clearance**
  Freight administration
- **Safety**
  Hazard good vehicle Management, Hazard good management, and Rescue system management

3.2.2 Review of ISO standard

ISO/TC204/WG1 are in charge of developing the Reference Architecture and based on this development logical and physical architecture. This method set up the Core Reference Architecture using the Object-oriented Analysis. To select the standard technology, we investigated present condition of Korea about ISO activities concentrating the working group in ISO.

Table 3. ISO standard and Response

WG	Standard Items	ISO Stage						Response strategy	Activities
		1	2	3	4	5	6		
1-1	Terminology						o	Adapting	Finished Adpt'
1-2	Reference Architecture					o		Adapting	Adpt' consider
1-3	Data Modelling		o					Participate	Not participate
1-4	Cross Mapping Object-oriented RA	o						Participate	Not participate
4-1	AVI/AEI Architecture						o	Adapting	Not participate
4-4	Intermodal AVI/AEI Reference Architecture		o					Participate	Not participate
4-5	Numbering and Data Structure		o					Participate	Not participate
4-6	System parameters		o					Participate	Not participate
4-7	Interface Specification		o					Participate	Not participate
5-1	Fee and Toll Collection						o	Adapting	Not participate
7-1	Commercial/Fleet management	o						Participate	Not participate
15.1	Dedicated Short Range Communication			o				Participate	Participate

Note: Adapting: Adapting the Standard in Korea

3.2.3 National transportation environment study

Coupled with the rapid growth of Korean industries over the last two decades, the nation is currently facing terrible traffic problems. Some of the key difficulties include: congestion on all major roads and highways, lack of railway capacity, delayed shipment in major ports. Due to this traffic congestion, the Korean industry currently pays almost 16 percent of total sales revenue in transportation costs. The major reasons cited by industry experts include: poor infra-structural development of transportation industries due to low social overhead investment, low efficiency in traffic control systems, and an abundance of private and commercial vehicles.

The following items are the present condition of Korean transportation environment.
- The prime object of export transportation system, High international trading environment
- Serious problem of Urban traffic congestion and traffic regulation
- Increasing transportation cost in logistic cost
- High percentage of commercial vehicle companies rate
- Weak linkage between transport information system etc.

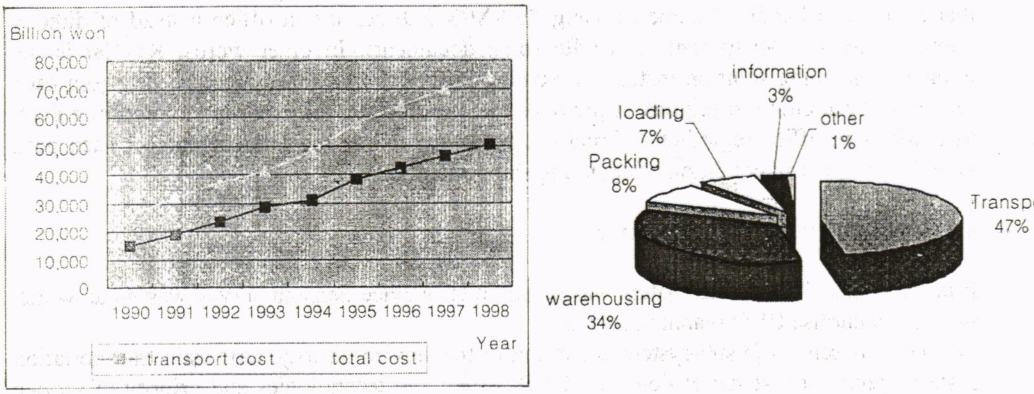

Figure 2. Logistics cost

3.2.4 Existing transportation systems and technology

Domestic Transportation system in Korea was developed in relation with logistics and new system supporting international trade was developed and currently in use. The following system, which is related CVO;
- National system: KL-net, KT-net, KROSIS, Port-MIS etc.
- Company system: HYDEX, Glovan, Dacom VAN, CONSIS, KIFOS, KT logis, etc

- KT-Losis : Korean telecom.

This system developed with putting emphasis on air cargo transport is the most similar system that has ever come out when CVO is designed. It has the functions capable of the computerization and the automation of information flow that relates general logistics activities over land, sea, air as well as the management and the tracking it in real time. The MOCT nominated KT for the full responsibility enterprise. And KT constructed the integrated logistics information network. KT developed and constructed CVO focused on road part of CVO and based on the basic plan of the integrated logistics information network in the latter of 1997. And then KT put a practical use service on it in November 1998. KT-Losis began CVO service including trade logistic information, Internet logistic EDI, cyber logistic information in 1997. its service is composed of 1) tracking vehicles/cargo in real time 2) managing vehicles movement 3) mediating delivery 4) providing traffic flow information 5) providing geographical information 6) offering cyber logistics information 7) advising the national cargo transport information.

- KL-Net : Port-MIS

KL-Net applied AVI/AEI, the core of CVO technologies is the system that uses the automation gate system regarding departure and arrival of ships from port. It receives and handles automatically the cargo information. To make national ports system into a bundle handling KT-Net constructed Port-MIS EDI at Young-Nam regions in 1996. KT-Net gradually constructed it all over the countries' ports such as Kyoung-In, Ho-Nam, Young-Dong in 1997. And then Port-MIS national unifying network provided integrating service as making each region's unit into one region unit last June. Therefore it is able to provide one-stop service all over the countries' ports. Port-MIS national unifying network is very useful in that a man can handle documents using Port-MIS EDI service in office instead of directly going to the sea department to handle some documents. In other words, KL-Net is the integrated handling solution instead of existing Post-MIS EDI that is requested to join each region unit according to regions. It provides the one-stop service as a man is reporting Post-MIS forms in office regardless of regions, inquiring and seeing DB contents of each port, knowing the present condition of operating ships in harbour.

3.2.5 Selecting the CVO user service

Priority of establishing sub-system was set up, after service demand survey was made which was to standardise CVO planning system.
We have chosen CVO sub-system according to the service priority. Domestic transportation system specialities, status of domestic CVO system and technologies and priority of service demand surveys were used to select logical architecture sub-system.

Table 4. Selecting the Service item

	Transport environment	Enabling System Service	Service demand	Leading county CVO Archi'	Level of Standard	Priority
Commercial Vehicle Operation Management	1	2	3	2	3	2
Commercial Vehicle Management	2	1	2	1	4	1
Commercial Vehicle Electronic Clearance	4	5	1	3	1	3
Commercial Vehicle Administration	5	4	4	4	5	4
Freight administration	3	3	5	6	6	5
Hazardous Material Management	6	6	6	5	2	6

4. THE RESULT OF KOREA CVO

The CVO architecture area is divided into the following 4 standard technologies and reflected in this architecture.

- Enabling Standard: Terminology, Architecture, Data Dictionary
- Message Set: Message set specification

- Communication Type: Wire-line, Wide Area Wireless, Wide Area Broadcast, Vehicle-to-Roadside, DSRC, Vehicle-to-Vehicle
- Other Technology: EDI, AVI/AEI technology, Container tag etc.

CVOMS(Commercial Vehicle Operation Management system)
CVOMS provide the capability for commercial driver, dispatcher, and intermodal operator to receive real-time route information and track vehicle and cargo locations using GPS. The communications capability of CVOMS subsystem support FMC, RTIC(Regional Traffic information Center)

CVMS(Commercial Vehicle Management system)
CVNS is used by the commercial vehicle operator to manage and optimise vehicle usage. It is for supporting the decision making to management.

FMS(Freight administration System)
FMS is used by the commercial vehicle operator to track cargo from source to destination using data links to intermodal freight shipper and depots. Also it provides the information to the warehouse system for entry or exit freight.

CECS(Commercial Vehicle Electronic Clearance system)
CECS provides export/import information to trading organization. It sends trade data and credential information through the trading system.

CVAS(Commercial Vehicle Administration system)
CVAS is used by the vehicle operator to automatic the filing of credentials and vehicle use taxes. Commercial vehicle operator to manage document for registration uses CVAS on line.

HMMS(Hazardous Material Management)
HMMS provides technical resources, which supply information in the proper handling and routing of hazardous cargo and on emergency damage control procedures. Its purpose is to maintain maximum operational safety standards through rapid dissemination of information both internally and to the Emergency center.

Table 5. Subsystem definition

Subsystem	Chief object		Managing Area	Service
	Leader	Coordinator		
CVOMS	MOCT Private	Carrier & Related group	Nation	Real-time tracking and locating
CVMS	MOCT Private	Carrier & Related group	Nation	Transport statistics Vehicle management
FMS	MOCT Private	Carrier & Related group	Nation	Freight statistics Freight Real-time tracking
CECS	Customs Service	MOCT MOCIE MOMAF	Region unit	On-line trade proceeding
CVAS	MOCT	NTS MOGAHA	Nation	On-line register, Tax, Clearance
HMMS	MOCT	Police 119 MOGAHA MOENV	Nation	Emergency procedure Routing, seceding

Note : MOCIE - Ministry of Commerce, Industry, and Energy
MOMAF - Ministry of Maritime Affairs and Fisheries
NTS - National Tax Service
MOGAHA -Ministry of Government Administration and Home Affairs

4.1 Design CVO architecture

CVO architecture was designed by ISO standard, which analysed above the study considering the expansion of linking with other systems. Also we chose the USA architecture method. Korea had already finished ITS architecture in 1998, but CVO was not included in its work because of many operating logistics information system. Our researchers designed CVO architecture on the former national ITS architecture study under the MOCT support in 1999. Simultaneously, we performed CVO technologies standard develop project. The result of that study was product following logical & physical architecture, data dictionary & massage set and communication & hardware standard.

CVO architecture procedure

1. Selecting the subsystem Logical Architecture
2. Physical Architecture
3. Functional Specification
4. Data flow definition
5. Data dictionary

The CVO data architecture consists of a structured definition of information used in national logistics system or ITS. It defines data entities and attributes. An entity means any person, place, thing, concept, or event about which the enterprise stores data. An attribute is a named characteristic of an entity.

The process architecture is a structured definition of all the processes necessary to carry out all the functions of CVO. It is defined as a hierarchy of processes and sub processes.
An application is a computer system or software package that performs some related set of functions. The applications architecture is not a design for applications, nor is it a detailed requirement specification for each application. It is a definition of the major functions to be performed and the top-level requirements to be met by each application, the interfaces to other applications, and the distribution of data among applications.
Note that with CVO, it is not possible to define application architecture in the same way as it might be done for a large company or a single state. We cannot state definitively what applications each stakeholder will have. We can only create a generic "model" that each stakeholder will adapt to meet its needs.

- Logical Architecture

The logical architecture provides a description of what the user does and the information it uses. The logical architecture contains two primary elements: the process architecture and the data architecture. The following figure (3) is shown logical architecture using the Structured analysis and top-level layer function.

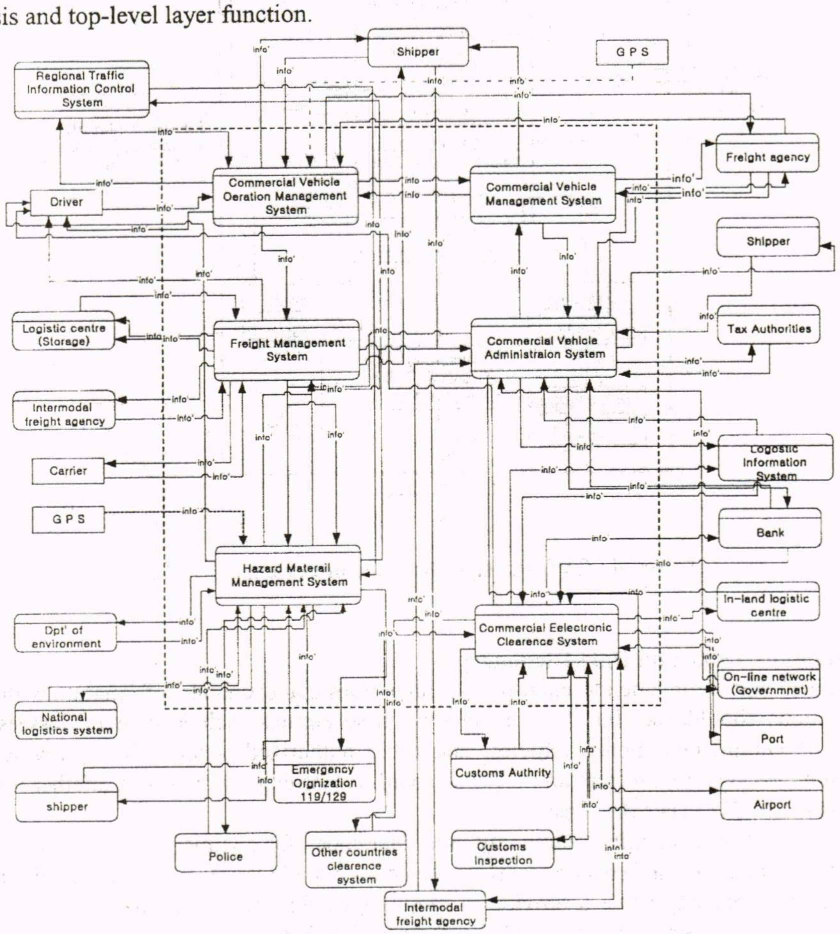

Figure 3. CVO Logical Architecture

- **Physical Architecture**

The following figure (4) is showing physical architecture dividing communication layer, transportation layer and institutional layer.
Centres: CVOMS, CVMS, FMS, CECS, CVAS, HMMS
Roadside: VMS, detecting beacon,
Vehicle: Tag
Traveller or Remote Access: RTS, TIS
Equipment Package: note CVO physical architecture

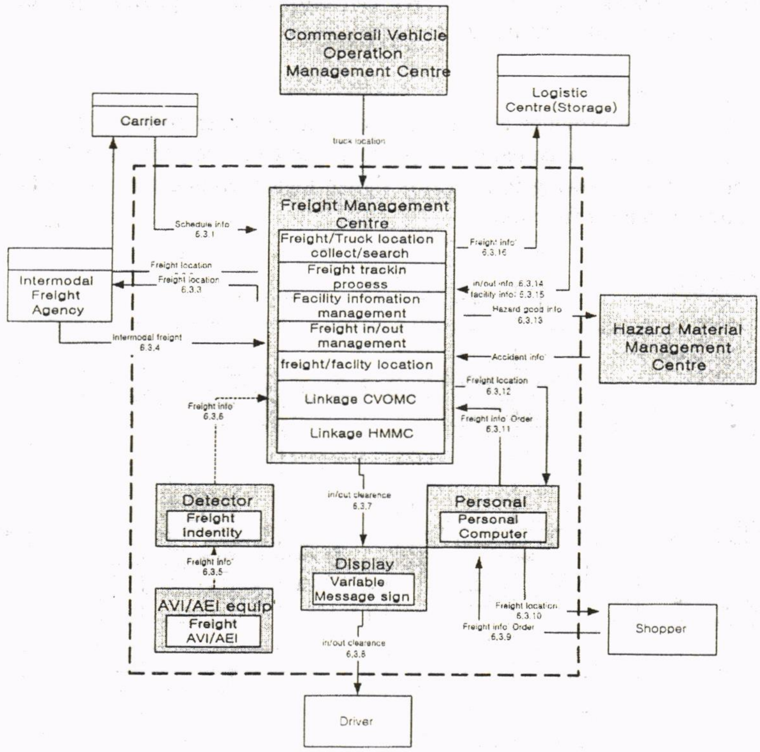

Figure 4. CVO Physical Architecture example - FMS

- **Data Flow Table and Data Dictionary**

Government and enforcement organizations, and entities that exchange information with these organizations should use this data dictionary. These entities include owners, lessees, and drivers of commercial motor vehicles, and other authorized parties. Our study was an establishment CVO architecture and CVO standard. According to this study, another institute as KOTI made CVO Data dictionary.
A following tables containing commonly used data codes for commercial vehicle operation. The data dictionary identifiers correspond to the codes cited in the AVI/AEI Standard for Data Element and structure. Table 6 provides a sample data flow table and data dictionary with explanations for the information provided in the actual code tables.

Table 6. Data Flow Table and Data Dictionary example

ID : 6.5.1		Data flow table	
Name		Hazimat Vehicle Information	
Subsystem(Origin)		HMMS	
Data flow		Origin	Destination
	Subsystem	HMMS(System)	RTIS(System)
	Unit	HMMC(Center)	RTIC(Center)
	EP	Link RTIC	Link HMMC
Description		Link the RTIC for sending Hazimet information	
Specification		Hazimat information	
Usage		When transport Hazimat, send data to RTIC	
Source		HMMC	
Collection method		Creating transport information by carrier	
Frequency		When require	
Delivery method		Wire Communication	

Data Dictionary

Data Concept Identifier	40150
Descriptive Name	CVAD_HriHazard_Code
Descriptive Korean Name	-
Descriptive Name Context	CVO
Definition	Control function Hazard information
Formula	-
Source	ITS Logical Architecture – Volume III
Class Name	CVAD
Classification Scheme Name	ITS Data dictionary
Classification Scheme Version	V1.0
Data Concept Type	Data Element
Keywords	Hri
Keywords Korean	-
Related Data concept	Not Applicable
Relationship Type	Not Applicable
Remarks	-
Symbolic Name	-
Symbolic Name Context	-
ASN Name	cvas-HriHazard
Representation Layout	Not Applicable
Constraints	-
Value Domain	ASNI X3.4
Data Type	Not Applicable
Representation Class Term	Code
Valid Value Rule	Not Applicable
Data Concept Version	V0.01
Security Class	General
Registration Status	Unregistered
Date Registered	-
Last Change Date	20000228
Register Organization	MOCT
Register Phone No.	8225004057
Steward Organization Name	KRIHS
Steward Phone No.	823433800337
Submitter Organization Name	KOTI
Submitter Phone No.	823449103084
Relevant Group	-

To ensure business requirements of the user community are met, MOCT would be directed as main group through KRIHS, KOTI, and Hanyang University Transportation Laboratory with government agencies to provide user support, coordination, and oversight of on-going development and maintenance of the data directory. Therefore, if users want to submit data requirements not covered in this data dictionary document, these groups let its version 1.0 update timely.

4.2 Korean CVO perspectives

Korea isn't probably got the high score when modern transportation systems are compared with the others in the view of efficiency, safety and all over the general things. Its main reason is the serious congestion. However, there are a number of areas where improvements could be made in order to further enhance Commercial Vehicle Operations Systems benefits in air cargo industry. These are captured in the following challenges and opportunities.

- **Develop ITS application in CVO:** Governmental investment in evaluation, development and deployment of Intelligent Transportation System applications and technologies, and support for system integration, warrants high priority to identify and reduce impediments and remove disincentives to deployment of these technologies. This will greatly assist in bringing about striking transportation benefits in mobility, safety, efficiency, and productivity.

- **Improve Logistics:** Applications of modern sensing, information processing, display an communications technologies to traffic and logistics management and other transportation functions on the ground, in the air, and on the sea will have a dramatic impact on transportation and logistics.

- **Integration and Interoperability:** In Korea, MOCT, Local government, and private industries are in the process of determining the functional requirements of CVO services, developing and assessing alternative designs, and recommending the appropriate design framework for the CVO services. ITS/CVO Architecture and Standards group formed to address standards. These standards will allow a truck to travel throughout Shipper, forwarder, and Carrier with full interoperability. The group also addresses intermodal aspects as well as electronic payment compatibility. Korea is likely to adopt the same forms and standards that are used in ISO standard. Because it is essential that vehicle-to-roadside communications transponder systems be interoperable and compatible across many systems, the ITS/CVO is preparing standards for them.

There are many system related CVO. The key factor of establishing CVO is linkage other system. We also find that modifying the existing system to new CVO architecture is better then new-built.

5. CONCLUSION

It was very hard to make general conclusion because measuring efficiency analysis of CVO standardisation is based on business oriented self-appraisal result, which came from limited survey. Although horizontal comparison was not made due to all different measurement was used.

Economic efficiency in adapting CVO architecture standard was very difficult showing the general conclusion because of limited survey result. However, we found good efficiency in which companies built CVO system by standard architectures in spite of different measurement with horizontal comparison. Therefore, future of CVO system architecture in Korea should consider new standard about ITS architecture and frequently participate ITS standard congress for obtaining the advanced technologies.

Our results indicate that CVO systems in Korea don't set up by itself for national ITS sector. we found the guideline on applying the system architecture in each standardisation leading country. Also we arranged constructing the architecture under the generic environment. Therefore we attained trend of CVO architecture standardisation and CVO policy of promotion of standardisation activities in each country.

ACKNOWLEDGMENT

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REFERENCE

1. Korea Research Institute for Human Settlement (KRIHS), *The study on national ITS architecture,* 1998
2. Korea Research Institute for Human Settlement (KRIHS), *The study on national ITS architecture stage 2, 1999*
3. Korea Research Institute for Human Settlement (KRIHS), *The study on national ITS Technical standardization stage 2*, 2000
4. http://www.aashto.org/ -AASHTO (American Association of State Highway and Transportation
5. http://www.itsa.org/ - ITS (Intelligent Transportation Society) America
6. http://www.ertico.com/index.htm
7. http://www.nahsc.org