



APEC Implementation for Cargo Status Information Network for enhancing Supply Chain Visibility

APEC Sub-Committee on Standards and Conformance
APEC Committee on Trade and Investment

July 2012

APEC Project CTI 28/2011T
21 May 2012

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APEC#212-CT-03.1

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1 Background and Objectives

1.1 Current Status of Cargo Status Information Sharing in APEC region

APEC member economies are working toward achieving the Bogor Goals for free and open trade and investment in the Asia-Pacific. At the Yokohama APEC Leaders' meeting held two years ago, agreement was reached on a vision for proceeding beyond the Bogor Goals. Called the "Yokohama Vision," it calls for further liberalization of trade and investment.

Enhancing supply chains to reduce the time, cost, and uncertainty involved in movement of goods and services in the Asia-Pacific is tremendously important to advancing liberalization of trade and investment and furthering economic growth in the region. This importance is reflected in developments such as the Supply Chain Connectivity Initiative at the 2009 APEC Leaders' meeting in Singapore, and the issue remains high on the agenda at the APEC Leaders' meeting in Russia in 2012 following the 2011 APEC Leaders' meeting in the United States.

Given their importance, active steps need to be taken to develop and enhance reliable supply chains by, among other things, capacity building to develop single windows and lowering barriers to small and medium enterprises (SMEs). In addition, international logistics needs to be facilitated, which is why provision has been made in the Supply Chain Connectivity Framework Action Plan ("Supply Chain Visibility Initiative" under Chokepoint 6) for mechanisms of sharing cargo status information as one important means to this end.

Optimizing and further enhancing the logistical elements of the global supply chains that enterprises need to engage in production and distribution on a global footing, including supply and production logistics, international transportation, and sales distribution, is growing in importance.

For example, production bases and distribution routes need to be quickly and dynamically reorganized to cope with supply chain disruption caused by contingencies (e.g., unexpected disasters such as the March 11 earthquake in Japan and recent massive flooding in Thailand) and changes in external requirements (e.g., changes in resource prices, exchange rates, and market size).

It is accordingly crucially important for firms to be able to promptly and flexibly adjust inventories in response to changes in the marketplace by keeping track of cargo movements in real time using information on commercial transactions, enabling abnormalities to be detected early on and improving visibility of trade inventories. The effect of thus facilitating the international logistics used as a common platform by all firms to enhance production and sales management in business operation should be to stimulate investment and corporate activity in the entire APEC region.

This can be achieved by developing common frameworks for the diverse participants in logistics concerning information to be shared and sharing such information and by pursuing a common approach to rules on its application.

As the number of trade participants and logistics providers involved in supply chains has steadily risen with economic globalization, however, worldwide movements of goods, information, and funds

have grown increasingly complex, making it unfeasible for them to be controlled by any single company.

In the case of the movement of goods in particular, the absence of common mechanisms for sharing necessary information between interested parties means that information cannot be communicated smoothly between trade participants and logistics providers, and this is noticeably impeding optimization of global supply chain management (SCM) and efficiency improvements in areas of international logistics such as export/import procedures.

All kinds of inefficiencies arise as a result. For example, the unavailability in real time of information on performance of the supply chain plans drawn up and put into effect by individual entities leads to buildup of excess safety stock and prolongation of lead times.

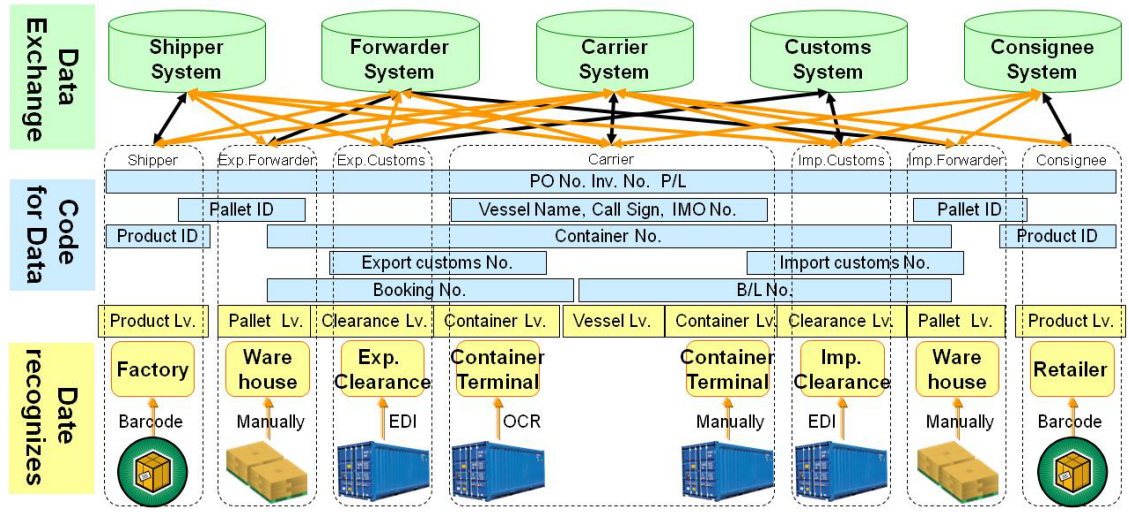
There are certainly cases of the logistics providers that are central players in global supply chains each using their own IT solutions to acquire and provide data on actual movements on an individual basis. Shipping companies, for example, monitor a whole range of information, including information on when and to whom empty containers have been lent in exporting economies, when loaded containers have been received at ports, when they have been loaded onto vessels, when vessels have departed from exporting ports, when they have arrived at importing ports, and when containers have been unloaded and delivered to importers. Shippers also monitor when cargo has been shipped from factories, when it has arrived at export warehouses, when and which containers it has been loaded into, and when it has left warehouses.

As the situation now stands, however, this data cannot be shared among participants. Even in its simplest form, international marine container transportation, which accounts for the majority of marine transportation, involves numerous entities and a tremendous range of processes, including numerous import and export permits, certificates of origin, import and export clearance, quarantining, opening of accounts with international credit banks, booking of shipping space, issuance of bills of lading (B/L), arrangement of land transportation, exchanging of container information with port terminals, and issuance of cargo acceptance certificates and pick-up orders for land carriers.

Regarding firstly cargo identification, information is obtained by each entity by a variety of methods such as visual inspection, barcodes, electronic data interchange(EDI), and optical character recognition (OCR), depending on the form of the cargo concerned (e.g., container or pallet).

Regarding also coding of information on cargo identified in order to download it into companies' systems, the codes used for monitoring actual cargo movements vary according to entity and packaging.

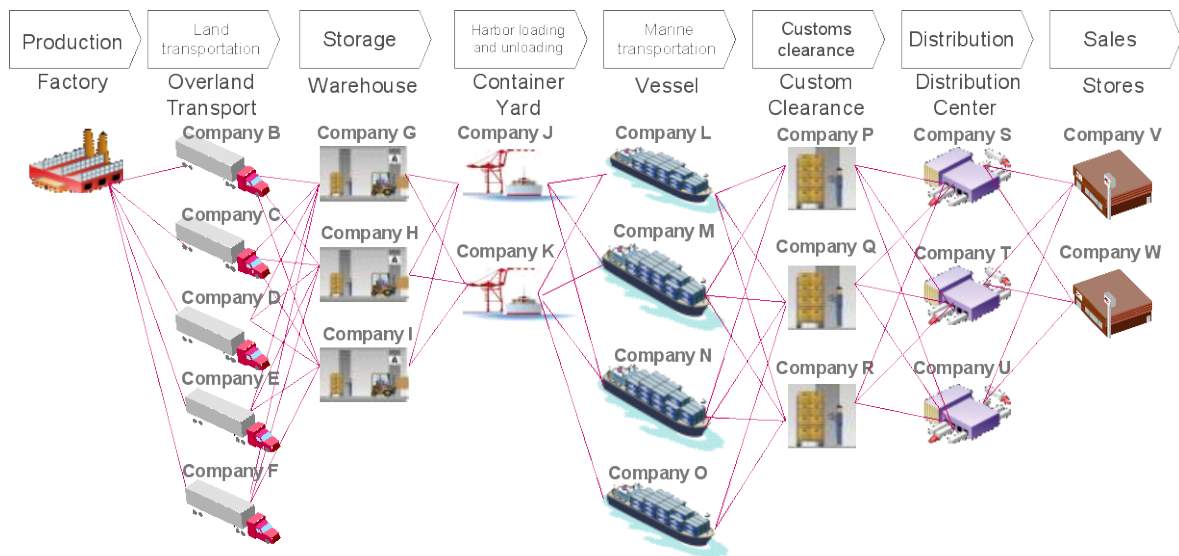
Figure: Steps in international marine container transportation and cargo identification, coding, and data exchange situation



As the entities that possess this information and those that want to use it are not necessarily connected by EDI or information networks, developing a new system connecting up their respective systems is essential if information is to be shared in marine container transportation supply chains. Due to the huge expenditures required to acquire actual data in real time, however, little progress has been made on the sharing of cargo status information.

Additionally, as major global shippers select their logistics providers and other service contractors each year through competitive tenders for multiple transportation lanes, they are reluctant to make the heavy investments needed to achieve connectivity between differing management systems. As the figure below shows, major global shippers naturally make use of multiple contractors in a variety of situations with a view to reducing costs and ensuring competitiveness in each area, and they expect competition between contractors to yield lower costs. Consequently, one major reason why sharing of information on actual cargo movements has not progressed is that even if a shipper develops a system with a contractor to access such information in real time, there is a risk that that contractor may change the next year.

Figure: Steps in international marine container transportation and relations between participants



Recognizing the above issues, Japan as lead economy and its co-sponsor economies have been studying the question of supply chain visibility in the Sub-Committee on Standards and Conformance of the Committee on Trade and Investment. Having liaised regularly with the Sub-Committee on Customs Procedures, the Electronic Commerce Steering Group, and the Transportation Working Group of the Senior Officials' Meeting Steering Committee on Economic and Technical Cooperation, we are now in a position to report our recommendations on standards for sharing of cargo status information in global supply chains in the APEC region.

We would like to acknowledge here the considerable assistance provided in the course of study of these recommendations by the members of the Northeast Asia Logistics Information Service Network (NEAL-NET) involving China, Korea, and Japan (see below for details).

1.2 Impact of Cargo Status Information Network on Supply Chain among APEC region

In order for international cargo status information to be shared between participants along supply chains as close to real time as possible, an information-sharing platform needs to be developed. The anticipated benefits resulting from the use of such a platform are summarized in the figure below.

These benefits are of four types: direct effects, increases in the effectiveness of SCM, effects of standardization, and creation of added value. The principal direct effects that are envisaged are a reduction of queries, process synchronization, process automation, and a reduction in the risks of delays, etc. The increases in the effectiveness of SCM that are envisaged are process synchronization, risk control, development of trust, and expansion of choice. An envisaged effect of standardization is joint use of systems. Finally, the creation of value added envisaged comprises business process innovation, creation of new business, fostering of safety and assurance, and sustainable harmonization. Although these effects will vary according to users' current levels, the possibility of their attainment should rise as a result of sharing of cargo status information.

Figure: Effects of global supply chain visibility

Type of effect	Examples
Direct effects	Reduction of queries Process synchronization and automation Reduction of risk of delays, etc.
Increased effectiveness of SCM	Greater frequency Shorter lead times Greater choice of logistics providers Greater choice of ports/shipping routes Consequent reduction of safety inventory levels
Effects of standardization	Batch development of logistical information systems to common specifications Reduction of maintenance of master data for shipping routes
Creation of added value	Process innovation and creation of new business Sustainable development (environmental measures)

According to the results of a questionnaire conducted for the APEC-funded Supply Chain Visibility Feasibility Study (Phase 1) (CTI-SCSC 07 2011T) in 2011, the anticipated effects include enhanced levels of disclosure and service for customers, the ability to cope with abnormal situations, reduced query handling, more rapid access to cargo status information, improved accuracy of cargo status information, confirmation of urgent cargoes, and arrangement of post-operations such as allocation of vehicles.

These effects should produce financial benefits in the form of lower personnel expenditures, lower logistical costs, maintenance and growth of sales, reduced inventories, and reduced system investment. Supply chain visibility should therefore contribute to corporate management as well as simply improving the efficiency of international logistics along supply chains. In order to benefit from these effects, it is important that the necessary cargo status information be shared between global supply chain participants from an early stage.

2 Ideal Cargo Status Information Network for enhancing Supply Chain Visibility

2.1 Ideal Cargo Status Information Network

In this section, we look at the ideal platform for sharing cargo status information. We consider, in other words, what form the system network for sharing information should take.

We begin by confirming the requirements of a system network for sharing cargo status information in international logistics based primarily on the findings of the APEC-funded Supply Chain Visibility Feasibility Study (Phase 1) (CTI-SCSC 07 2011T). Firstly, the varying areas of responsibility that exist along supply chains mean that multiple entities have to be involved in acquiring the cargo status information that will as a minimum have to be shared. Secondly, multiple participants will want to have access to cargo status information. Thirdly, numerous counterparts will be involved when a given entity discloses cargo status information. And fourthly, effective use of information will depend to a large extent on its availability in as close to real time as possible.

Satisfying these requirements will require first and foremost mechanisms for sharing information that conform with international standards if multi-party to multi-party exchanges of cargo status information are to be possible.

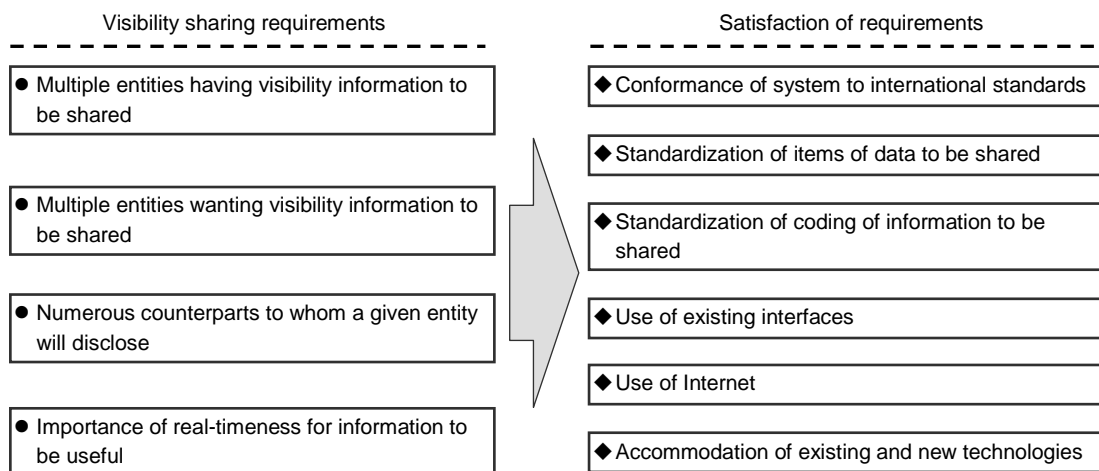
Next, standards for specific items of information to be shared and systems of coding these items need to be established.

Also required will be easy access to information via pre-established, interoperable interfaces. This will make it possible to acquire cargo status information simply by developing a new interface for connecting with companies' own existing systems.

Internet technology will additionally need to be used to ensure real-timeness.

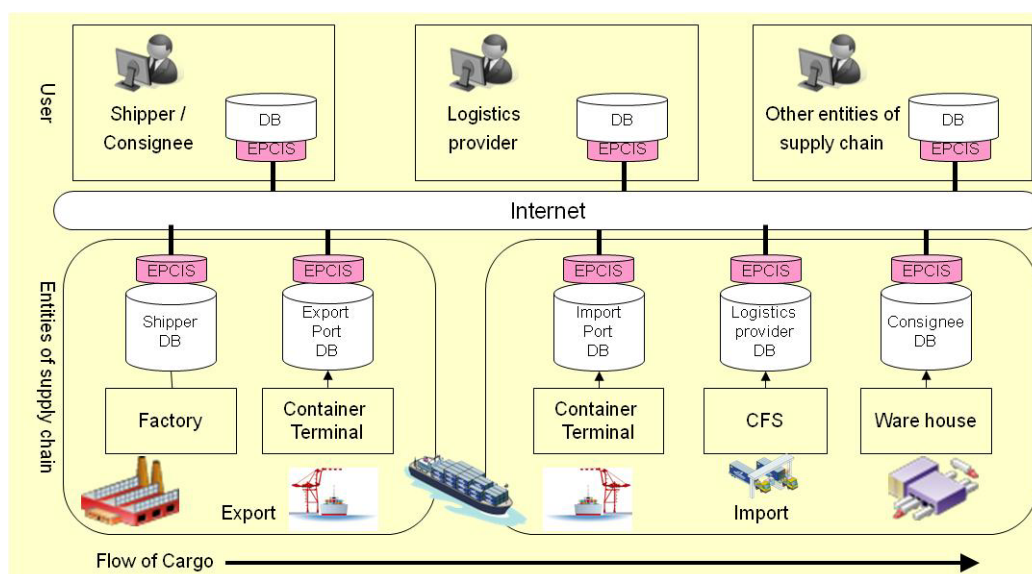
Lastly, in order to easy access to cargo status information, the system that is adopted must be able to accommodate new technologies, such as radio frequency identification (RFID)-based automatic recognition, as well as existing technologies such as barcodes.

Figure: Requirements and how they will be met



The system network described below is envisaged to be capable of meeting these requirements. In concrete terms, it adds an interface designed to the electronic product code information services (EPCIS) standard (described below) to entities' own systems to enable mutual exchanges of necessary information between entities in accordance with standard codes. If this system quickly finds widespread use in the APEC region and development in the region progresses, then ideally it will be necessary to establish the conditions to enable all kinds of participants in global supply chains around the world to easily share information provided by other entities.

Figure: Ideal system network for sharing cargo status information



While the ideal is for each entity in cargo, transportation, and other logistical supply chains to disclose data by standard methods of sharing, the huge number of entities involved in supply chains makes this difficult through the initiative of the private sector. Because of this, port authorities in Northeast Asia are already leading moves to develop a system network for sharing cargo status information. Using these moves as a useful point of reference for considering mechanisms for sharing cargo status information in global supply chains, the realistic approach is to first pursue measures that improve the visibility of cargo status information among ports involved in handling international marine containers.

2.2 Scope of this Recommendation

The scope of matters to consider regarding sharing of cargo status information in global supply chains is broad. To begin with, there are various modes of transportation to consider, such as ships, aircraft, railways, and trucks. There are also various forms of transportation used, including containers for transportation such as marine containers, various types of packaging such as pallets and corrugated board, and bulk transport such as coal and iron ore.

These recommendations seek to cover sharing of cargo status information for all means and forms of transportation foreseeable in the medium term. The initial focus, however, is on the main form of

transportation of marine cargo in recent years, marine container transportation, which involves long lead times and numerous parties. There are three reasons for this. Firstly, information on this form of transportation can be easily shared because the necessary data items and codes have been unified as almost all shipping companies and terminals use global standard information codes. Secondly, unique specifications, identifying container numbers, and B/L numbers, which are key for commercial transactions, are already used for marine containers by shippers, forwarders, customs authorities, and other supply chain participants. And thirdly, shipping companies and container terminal operators need to manage container inventories for asset management reasons, making them highly likely to possess information in electronic format.

In light of the above, these recommendations will focus on the marine container transportation element of global supply chains as a first step toward achieving joined-up networks that improve the visibility of cargo status information.

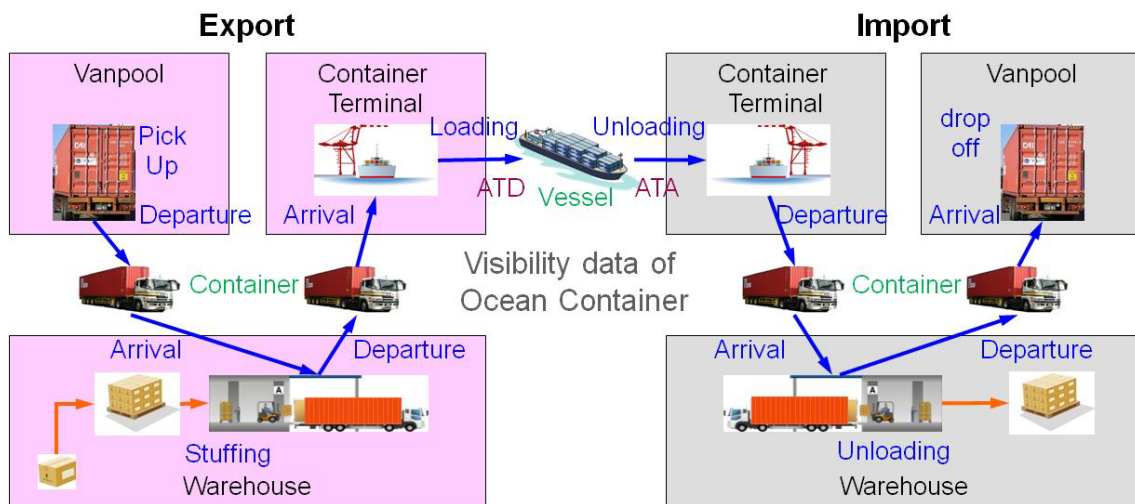
3 Necessary Technology and Information Sharing

3.1 Information sharing

In these recommendations, we put forward technologies needed to capture information on marine container cargo movements along global supply chains and mechanisms to facilitate the necessary sharing of such information. More specifically, we provide details of suggested data items and codes, the system architecture for an information-sharing platform, and related technological components.

The rough sequence of steps in international marine container transportation from export to import is as shown below. These steps can be broadly divided into visibility of vessel movements, visibility of containers between the ports of export and import (container terminals), and visibility at the door-to-door container level outside ports. While it will naturally be necessary to consider also the cargo content of containers as well, we begin as noted above by considering how best to go about sharing of cargo status information focusing on containers.

Figure: Visibility data of Ocean Container



3.1.1 Items to be shared

The specific data items that will as a minimum have to be shared to improve visibility are those that concern the “what,” “where,” “why,” and “when” of international marine container transportation. The “what” are the containers and the vessels and trucks in the layer above them. Regarding next the “where” (location) and the “why” (actions and events), in the case of exports items of data in these categories cover the leasing of containers at container depots (which are mostly the property of shipping companies), stuffing at factories, the arrival and loading of containers at container terminals, and departure and arrival in port of vessels. In the case of imports, these items cover the arrival of vessels at container terminals, the unloading of containers and their departure, the unloading of containers at warehouses, and the return of containers to container depots. In the case of both imports and exports, customs clearance status is also an important concern.

These items were identified based on the results of a questionnaire survey for shippers, forwarders shipping companies, container terminals, and customs authorities in the APEC region conducted as part of the Supply Chain Visibility Feasibility Study (Phase 1) (CTI-SCSC 07 2011T) to assist preparation of these recommendations. Information on the “when” (timing of performance) of such actions and events is also necessary in order to track cargo movements. (A total of 23 questionnaires were returned by shippers and forwarders, 20 by shipping companies and container terminals, and one by customs authorities.)

Figure: Contents of the information items to be shared Container status of Export: All

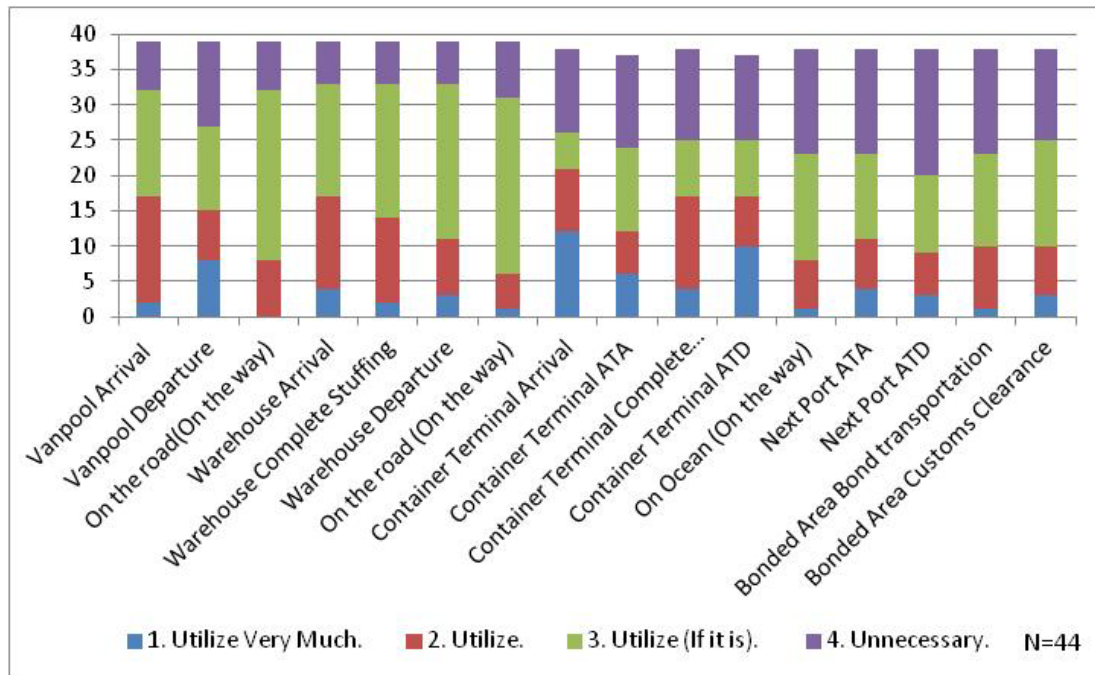
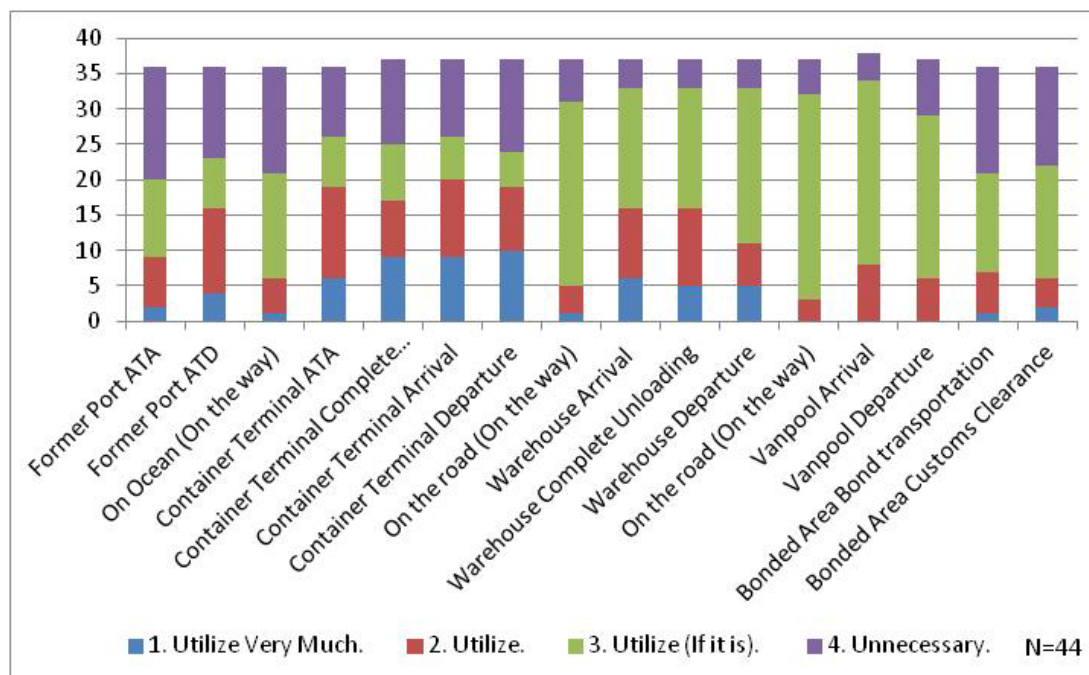


Figure: Contents of the information items to be shared Container status of Import: All



Based on the above results, the cargo status information required in order to track vessel and container movements may be summarized as shown in the table below. (Level of importance of status data based on the questionnaire results is shown in the rightmost column.)

An important point to recognize here is that “who” information (on entities, product items, etc.) should not be shared among global supply chain participants. The reasons for this are as follows. Firstly, as information on entity and product item, etc. is already known to participants, there is no need for it to be again shared via a common platform. And secondly, security concerns dictate that this information should not be shared in order to avoid the risk of highly confidential information on entities and product items being stored on the Internet, where it might be accessible to third parties.

As it will be technologically possible to add any other information required by participants for sharing, it is recommended that the information to be shared at the marine container level should consist of the “4Ws,” i.e., when, where, why, and what.

Table: Vessel and Container Status Data (export)

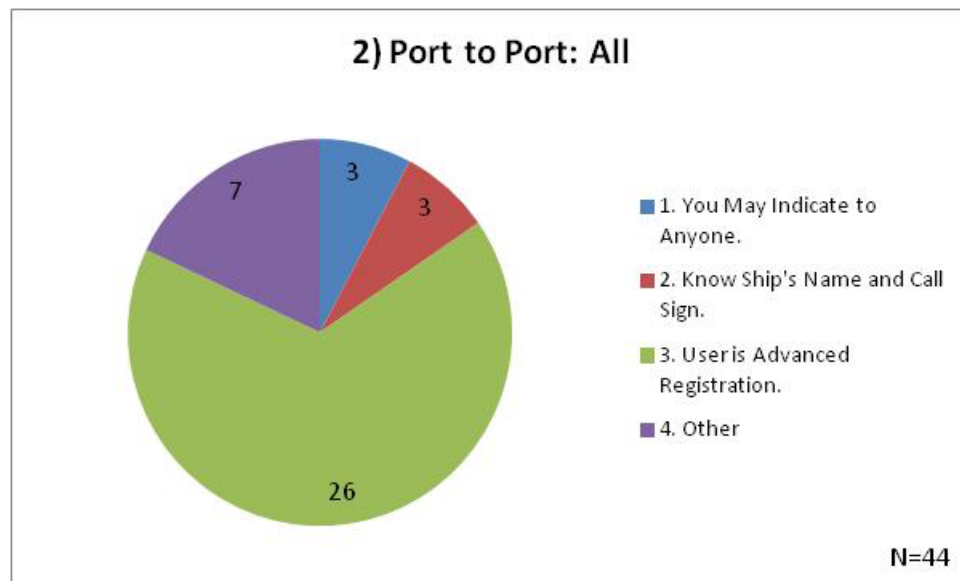
When	Where	Why	What	Importance
YMD HHMMSS	Container Depot	Arrival	Truck	Middle
YMD HHMMSS	Container Depot	Departure	Container	High
YMD HHMMSS	On the road	On the way	Container	Low
YMD HHMMSS	Warehouse	Arrival	Container	High
YMD HHMMSS	Warehouse	Complete Stuffing	Container	High
YMD HHMMSS	Warehouse	Departure	Container	High
YMD HHMMSS	On the road	On the way	Container	Low
YMD HHMMSS	Container Terminal	Arrival	Container	High
YMD HHMMSS	Container Terminal	Actual time of Arrival (ATA)	Vessel	High
YMD HHMMSS	Container Terminal	Complete Loading	Container	High
YMD HHMMSS	Container Terminal	Actual time of Departure (ATD)	Vessel	High
YMD HHMMSS	On Ocean	On the way	Vessel	Low
YMD HHMMSS	Next Port	ATA	Vessel	Middle
YMD HHMMSS	Next Port	ATD	Vessel	Middle
YMD HHMMSS	Bonded Area	Bond transportation	Container	Low
YMD HHMMSS	Bonded Area	Customs Clearance	Container	High

Table: Vessel and Container Status Data (import)

When	Where	Why	What	Importance
YMD HHMMSS	Former Port	ATA	Vessel	Middle
YMD HHMMSS	Former Port	ATD	Vessel	Middle
YMD HHMMSS	On Ocean	On the way	Vessel	Low
YMD HHMMSS	Container Terminal	ATA	Vessel	High
YMD HHMMSS	Container Terminal	Complete Unloading	Container	High
YMD HHMMSS	Container Terminal	Arrival	Truck	High
YMD HHMMSS	Container Terminal	Departure	Container	High
YMD HHMMSS	On the road	On the way	Container	Low
YMD HHMMSS	Warehouse	Arrival	Container	High
YMD HHMMSS	Warehouse	Complete Unloading	Container	High
YMD HHMMSS	Warehouse	Departure	Container	High
YMD HHMMSS	On the road	On the way	Container	Low
YMD HHMMSS	Container Depot	Arrival	Container	High
YMD HHMMSS	Container Depot	Departure	Truck	Middle
YMD HHMMSS	Bonded Area	Bond transportation	Container	Low
YMD HHMMSS	Bonded Area	Customs Clearance	Container	High

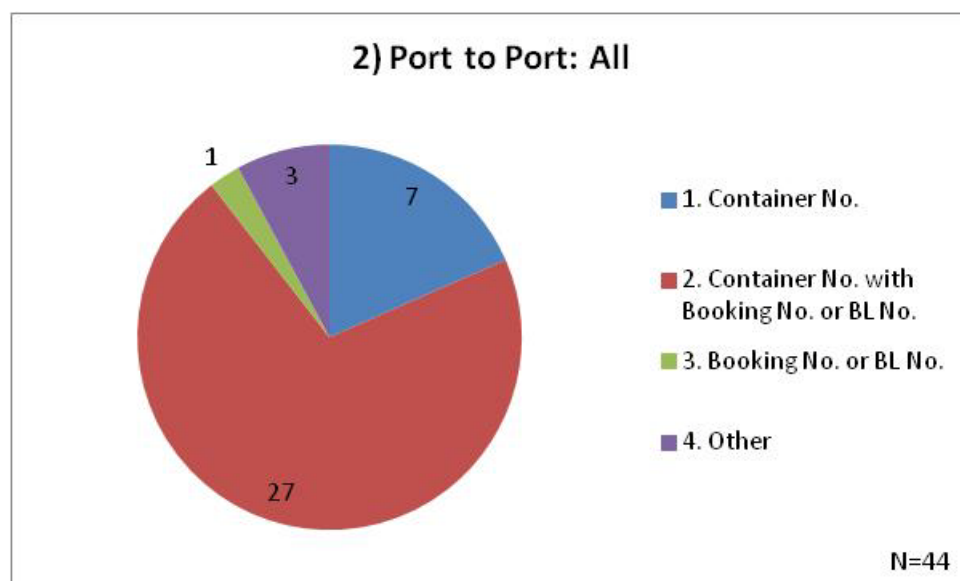
The questionnaire results show that 54.1% of the entities surveyed believe that information disclosure should be by means of a system of pre-registration, where users who want to use the common platform for cargo status information apply in advance to the providers of the information concerned to pre-register user information (e.g., company name and contact details) and obtain an identification(ID) to access the network, thereby ensuring that anyone who accesses the network can be identified.

Figure: Conditions when providing information Access authority to Port to Port Container Status data: All



62.2% of the respondents said that the key codes for searching for cargo status information are the container number along with a booking number or B/L number. It is therefore recommended that information be disclosed to entities that have performed searches using the container number only or the B/L number or booking number only further to combining the container number with booking number or ID and password as security option.

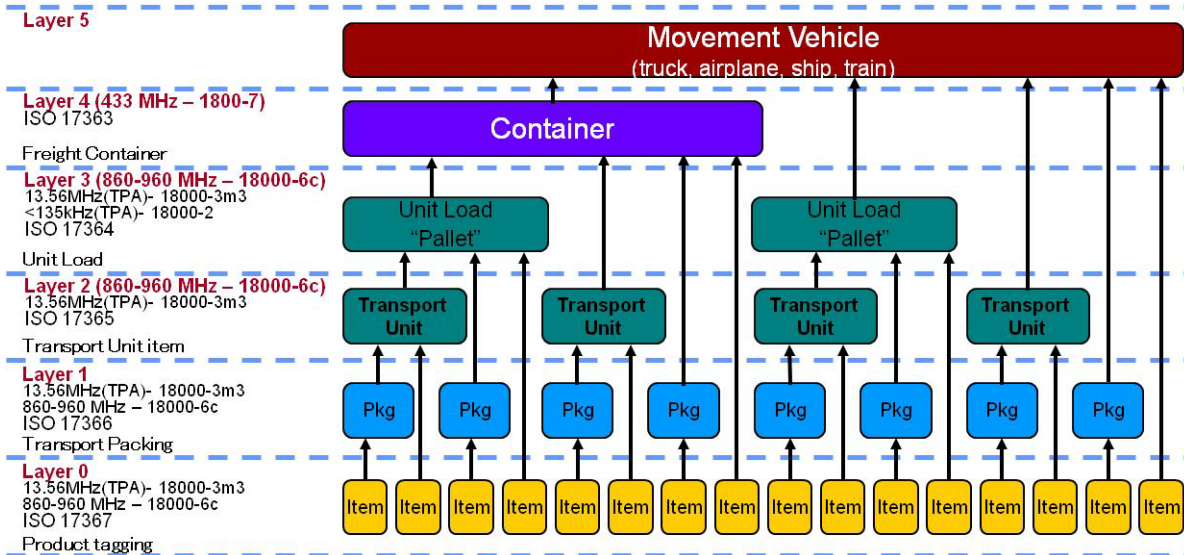
Figure: Conditions when providing information Search key for Port to Port Container Status data: All



If this cargo status information at the vessel and container levels can be shared, it will also become possible to share information at the level of individual items of merchandise (articles) by linking

containers with less-than-container loads (e.g., at the pallet level) as per the International Organization for Standardization (ISO) cargo layers shown below.

Figure: Supply chain layers



Source) ISO/IEC17363

3.1.2 Code Scheme

Below we present a system of coding information items aimed at making visible cargo status information for movements of the aforementioned marine containers along global supply chains. Such a scheme of coding information items in a globally usable manner should ideally (1) guarantee uniqueness globally, (2) be in use already by the many participants in global supply chains in their own systems and EDI, etc., and (3) be expandable to accommodate more means and forms of transport than just marine containers. As UN/EDIFACT¹-based EDI is used as a basis for international marine container transportation by the shipping companies, terminals, and other entities involved, the definitions used should be based on those defined by United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) in particular (as their managing entity) and other standards bodies (including ISO).

Here, we consider relevant items of information on status under each of the 4Ws (why, where, what, and when).

(1) Why (Cargo Status)

For events indicating vessel, marine container, and cargo status ("why"), it is recommended that use be made of the United Nations Economic Commission for Europe² (UN/ECE) status codes

¹ UN/EDIFACT is an EDI standard developed by the United Nations Economic Commission for Europe and other bodies, and was created to streamline trade procedures.

² The United Nations Economic Commission for Europe's activities include designing methods of information interchange and mutual cooperation to strengthen economic relations between member economies. These are

recommended in UN Recommendation No. 24.

Cargo status codes are represented by a three-digit alphanumeric character code. The code name is the name of the status code, and the code description is a plain text description of the named status code not exceeding 350 characters in length and in English (see appendix).

Although the examples of best practice and other initiatives described in Chapter 4 indicate that this should be sufficient for indicating the status of marine containers, arrangements for filing additions and modifications have also been provided in case that inadequacies are detected or that inadequacies are detected when an application extends to the less-than container level.

While assuming use of the status codes prescribed by UN Recommendation No. 24 for marine containers, consideration should also be given to allowing use of the business steps provided for in GS1³ to represent less-than-container level cargo status alongside UN/ECE status codes where already in use.

(2) Where (Location)

For the “where” representing the locations such as container terminals, container depots, and warehouses where operations such as container stuffing and unloading are performed, we recommend use of the United Nations Code for Trade and Transport Locations (UN/LOCODE)⁴ system of regional codes prescribed by UN/ECE. The UN/LOCODE system is also used for standards such as UN/EDIFACT.

These codes consist of five alphabetic characters, with the first two representing the economy code and the following three characters representing the city code. These codes are designed mainly to represent import/export-related location data, and so cover international ports, airports, and domestic border points. Being a registration system, applications can be made to register new locations such as ports.

The UN thus has unique global location codes for port quays serving mainly marine containers.

As locations outside terminals are not necessarily coded, however, consideration will need to be given to dealing with such locations. One possibility, for example, is to use global location number (GLN)⁵ as recommended by GS1/EPCglobal. It is especially necessary to consider how to encode and share code data on locations such as the large number of warehouses outside ports that handle marine containers, and present candidates among the existing codes include making combined use of GS1/EPCglobal’s GLN with information on latitude and longitude, domestic postcodes, and addresses.

located mainly in Europe, but now also include economies in North America, West Asia, and Central Asia (<http://www.unece.org/>).

³ GS1 is an international organization established to design and formulate international standards to improve trans-regional supply chain efficiency and transparency. More than 100 economies are members (<http://www.gs1.org/>).

⁴ <http://www.unece.org/etrades/download/downloadmain.htm#locode> (Hong Kong, China’s comment: the website is not valid)

⁵ GLN is a GS1 identification key for uniquely identifying enterprises and establishments, etc. in business-to-business transactions. It consists of a GS1 enterprise code, location code, and check digit.

(3) What

“What” information consists of information on vessels and containers. We recommend the combined use of International Maritime Organization (IMO) codes⁶ and call signs for vessels, and the container numbers prescribed by the Bureau International des Containers et du Transport Intermodal (BIC)⁷ for containers.

IMO codes, call signs, and container numbers are not merely unique IDs used by shipping companies and container terminals, but also codes employed by shippers, forwarders, and customs authorities. Using them “as is” is therefore advisable from the point of view of assisting system uptake.

As repeated use of containers as returnable assets makes it difficult to identify the marine container transportation of a given cargo solely from its container number, it is also recommended that container numbers be used in conjunction with the booking numbers (at the time of export) or B/L numbers (at the time of import) issued by shipping companies to shippers.

Although the B/L number is a key code attached to the transportation agreement between a shipping company and shipper, the rule that it must be issued within 24 hours of a vessel leaving the port of export means that an entity waiting for a B/L number to be issued cannot track export-side status. It is therefore recommended that use also be made of the booking number. Such an approach appears effective as these codes are used by shippers, forwarders, and customs authorities too.

To allow for the future expansion of this system to include less-than-container level cargoes, we recommend using the electric product code (EPC) advocated by GS1/EPCglobal as well. EPC is a system of identification codes for uniquely identifying physical items using technologies such as RFID. More specifically, it consists of a coding scheme based on the GS1 identification codes⁸ prescribed by GS1 that can be effectively used with RFID tags, etc.

(4) When

To express “when” information on when the preceding series of “why,” “what,” and “where” events occurred, we recommend Coordinated Universal Time (UTC). UTC is a method of indicating an official time for use when recording time all over the world.

Using UTC, “when” is expressed as the year/month/day, hour/minute/second, and time difference, with a T inserted between the date and the time. For example, 9 a.m. on April 1, 2004, is expressed as follows: 2004-04-01T12:00:00+09:00.

3.2 Visibility Platform Architecture

There is no need to develop a new architecture for sharing cargo status information, as full advantage can be taken of the existing EPCIS standard recommended by GS1/EPCglobal, which presently appears to be the only standard based on open specifications.

⁶ The IMO code is a vessel identification number consisting of a seven-digit number allocated to all vessels followed by the three letters “IMO.” This is a unique seven digit number that is assigned to propelled, sea-going merchant ships of 100 gross tons and above.

⁷ BIC: <http://www.bic-code.org/>

⁸ GS1 identification codes: http://www.gs1.org/barcodes/technical/id_keys.

EPCIS is an EPCglobal standard designed to enable EPC related data sharing within and across enterprises. This data sharing is aimed at enabling participants in the EPCglobal Network to obtain a common view of the disposition of EPC objects within a business context. The initial version of the EPCIS standard was ratified on April 12, 2007 and provided basic capability that meets the requirements of a set of use cases that the EPCglobal community identified as a minimal useful set. As such, the EPCIS standard can be used by any application in any industry. However, the standard supports extensibility so end users and industry groups can address specific application and industry use cases through industry and custom extensions or companion specifications.

The objective of EPCIS as stated above is obviously very broad, implying that the “S” in EPCIS stands for EPC Information Sharing. The intent of this broad objective is to encompass the widest possible set of use cases and to not overly constrain the technical approaches for addressing them.

EPCIS focuses on an EPC Information Service approach which defines a standard interface to enable EPC-related data to be captured and queried using a defined set of service operations and associated EPC-related data standards, all combined with appropriate security mechanisms that satisfy the needs of user companies. This will involve the use of one or more persistent databases of EPC-related data, though elements of the Services approach could be used for direct application-to-application sharing without persistent databases. Thus EPCIS enables users to exchange EPC-related data with trading partners through the EPCglobal Network.

Figure: System Architecture of EPCIS

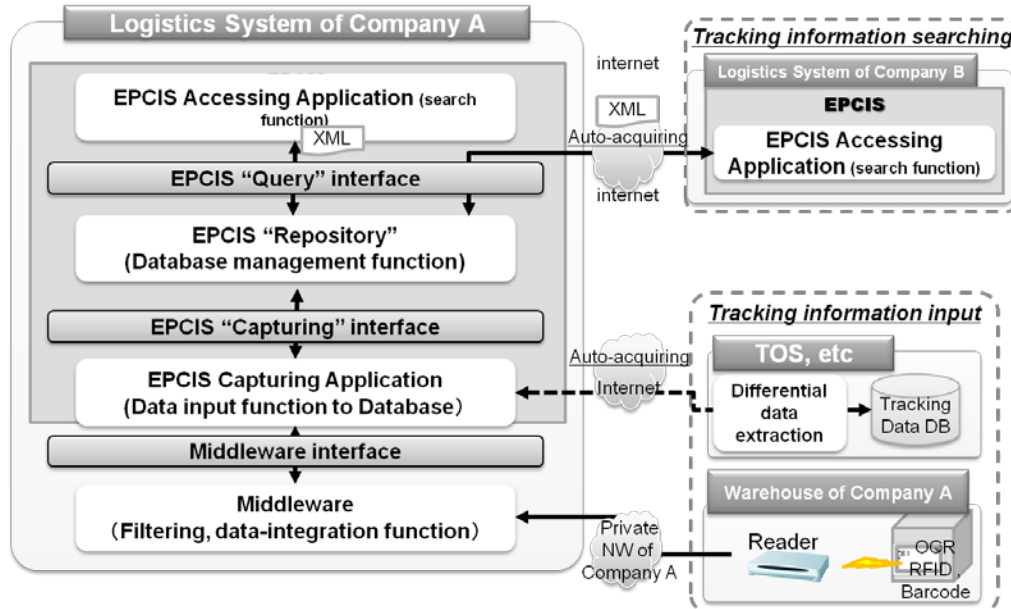
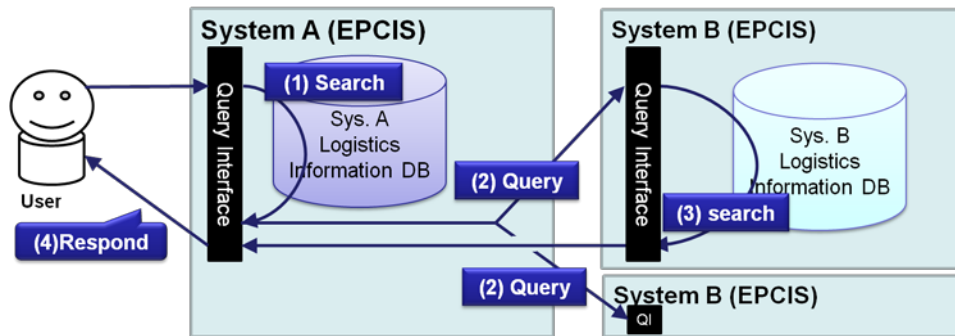


Figure: Image of Query by EPCIS



In implementing EPCIS, most of the corporate may consider to have its own EPCIS for cargo visibility. For mass deployment or adoption of EPCIS network in the society, some organization may consider building an ASP (application service provider) mode for EPCIS network.

EPCIS network under ASP model refer to an organization which set up the EPCIS infrastructure and provide EPC data exchange service for industry participants who subscribed to the service. This kind of service is always welcomed by SMEs as they can enjoy low investment cost and being flexible to their business operations. In the following section, we summarize the benefits and challenges between operating ASP model based EPCIS network or individually host it as one of the corporate systems from industry user perspectives.

Table: Benefits of EPCIS

	ASP model based EPCIS Network	Self owned EPCIS model
Benefits	<ul style="list-style-type: none"> ■ Low investment. ■ No technical know-how on EPCIS setup and maintenance ■ Less entrance barriers for new company ■ Ensure wide adoption to SMEs 	<ul style="list-style-type: none"> ■ Business logic can be highly customized to meet end user requirements ■ Flexible to change business logic functionality ■ Provide unique operations visibility to customers which lead to market differentiations. ■ Keep peace with the EPCIS technology and knowledge.
Challenges	<ul style="list-style-type: none"> ■ Business logic is general and cannot be highly customized for specific operational needs ■ Not flexible to change the business logic when to suit dynamic operational needs ■ No market differentiations 	<ul style="list-style-type: none"> ■ Relatively significant investment on EPCIS implementations ■ Require significant technical know-how on EPCIS setup and maintenance

3.3 Technological Specifications

3.3.1 Technologies for Capturing Data

To provide a means of capturing data, a study was made of EPCIS assuming data capture using advanced RFID. An advantage of EPCIS is that it will also be suitable for when RFID technology becomes more widespread. EPCIS is additionally technically capable of capturing data held by existing systems as well as simply RFID data. Taking port-to-port marine container movements, for example, actual data on operations such as gating in and out of terminals and vessel loading and unloading held by the terminal operations systems (TOS) found at almost all container terminals can be used “as is.” In Japan, dramatic reductions in phone queries made to terminals have been achieved by centralizing and disclosing TOS data on portal sites, indicating that this can provide an extremely effective means of cheaply sharing cargo status information simply by developing interfaces with existing systems. Data is entered into TOS by means such as manual input and OCR, and EPCIS capture of data on cargo recognized by any kind of method, including RFID in the future, will also be possible. (Spreading adoption of RFID is likely to necessitate continued action in areas such as standardization of domestic legislation on radio waves.)

Where supply chain participants thus already possess information on cargo movements, data is captured in a standards-compliant manner and stored in EPCIS, resulting in its being shared to the extent of a company’s area of responsibility. This appears to offer an effective means of expanding the range of cargo status information covered.

In these recommendations, therefore, we recommend that platform development be based on EPCIS in order to cargo status information more visible.

3.3.2 Database Interfaces

Although it is recommended that EPCIS be used for the database interface, supply chain participants’ existing databases may be used if queries from other supply chain users have to be handled. For example, Japan and Korea are developing measures to obtain information necessary for tracking cargo movements from container TOS databases and disclose it, and all that needs to be done in such cases is to develop an interface.

When visibility information data is captured and then a visibility event will be constructed through middleware system. All visibility events will be stored in EPCIS so that events can be queried through the accessing application to provide cargo visibility. Furthermore, interoperability across multiple EPCIS is also the ultimate goal of the EPC information exchange to create visibility among supply chain partners. Therefore having a common standard in constructing and store visibility event is crucial for information exchange.

There are 4 EPCIS event types which are essential for the designing of each visibility event for each of the read in order to effectively store in EPCIS. They are the Object Event, Aggregation Event, Transaction Event and Quantity Event.

(1) Object Event

An Object Event captures visibility information about an event pertaining to one or more physical objects identified by EPCs. In the Object Event, besides containing the mentioned 7 basics visibility data elements (EPC, Time, Read Points, Business Locations, Business Steps, Disposition and Business Transaction Type), it also has the Action attribute to indicate the action of this event: ADD, OBSERVE and DELETE.

(2) Aggregation Event

The Aggregation Event describes events that apply to objects that have been physically aggregated to one another. The aggregation means that there is a parent EPC which higher in the aggregation hierarchy and there are lists of child EPCs as the subordinate in hierarchy. This implies a physical grouping of EPC(s) under one parent EPC. It is commonly be used when several tagged cartons are loaded on one tagged pallet. An aggregated event will be constructed to represent the physical group of cartons as one cargo unit having pallet EPC as the parent while the list of carton EPC(s) as the child.

(3) Transaction Event

The Transaction Event describes events that the association or disassociation of physical tagged cargo object to a business transaction information (such as Purchase Order (PO) no., Invoice no.) This event is also used to declare in an unequivocal way that certain EPC(s) have been associated or disassociated with a business transaction as part of the event. It implies a logical association between all Business document IDs and the listed EPC(s). Multiple Business document IDs of the same nature could also be attached. For example, if a single pallet is shipped in response to two different POs then the allocation of individual cases to individual PO No(s) is not specified.

(4) Quantity Event

The Quantity Event is relatively less common to be used. It is used when capturing an event that takes place with respect to a specified quantity of cargo objects. This Event Type may be used, for example, to report inventory levels of a product. Regarding the Event data structures, please refer to the Appendix for details.

After understanding different types of the EPCIS event and its usage, we can go into the detail on the how it can be constructed based on the read point requirements. Based on the global pilots, we consolidated some practice in designing visibility events.

(5) Event stored for Event Query

With the event data mentioned in Table it is able to configure an Accessing application using query interface to query EPCIS visibility event. Query key can be the EPC, location code, extension field or any other data field mentioned in the table.

There may have multiple events returned based on the query design. Event data can then be analyzed and organized to present useful logistics flow information to bring visibility to the logistics partner. Detail explanation on query interface and accessing application will be described in appendix section

3.3.3 Application

As mentioned above, developing accessing applications and a query interface is essential if information sharing is to be achieved for users using the container numbers and B/L numbers or booking numbers that are key codes. For this purpose, we recommend the method proposed by EPCIS.

Having the EPCIS and its global standard, organization like manufacturer, distributor or logistics provider having business involves handling physical goods can exchange information internally or externally about the location and status of material with a much finer granularity of detail and cost-effectively basis.

(1) EPCIS Capture Interface

It is an interface in providing a path for communicating EPCIS events generated by EPCIS Capturing Applications to EPCIS Repositories.

(2) EPCIS Capturing Application

It is responsible for recognizing the occurrence of EPC-related business events, and delivers these as EPCIS data. It may also coordinate multiple sources of data in the course of recognizing an individual EPCIS event. Sources of data may include filtered, collected EPC data obtained through the Filtering & Collection Interface, other device-generated data such as bar code data, human input, and data gathered from other software systems.

(3) EPCIS Query Interface

It is responsible for providing means such that an EPCIS Accessing Application can request EPCIS data from an EPCIS Repository. It also provides a means for mutual authentication of the two parties and reflects the result of authorization decisions taken by the providing party, which may include denying a request made by the requesting party, or limiting the scope of data that is delivered in response.

In the case of port-to-port information sharing, standard methods should be established for authenticating data and managing users as the items of information to be shared will, as noted above, be standardized.

(4) EPCIS Accessing Application

It is responsible for carrying out overall enterprise business processes, such as warehouse management, shipping and receiving, historical throughput analysis, and so forth with the aid of EPC-related data

3.3.4 Security

Port-to-port information will be publicly accessible, as noted above, making it necessary to be able to monitor who has accessed what by means of a pre-registration system.

Having no “who” information, IDs and passwords are first issued to pre-registered users for authentication when data queries are made.

Regarding, secondly, the keys for actual queries, we recommend the use of IMO codes or call signs as key codes for vessels, as per UN practice. For containers, we recommend that searches be made adding the container number to the B/L number or booking number.

This is sufficiently secure because the container number, B/L number and booking number in particular are distributed only to participants.

Information sharing will also be made more convenient, as the ability to perform searches using just the container number or B/L number or booking number with IDs and passwords issued based on user pre-registration will reduce the search load on users. Being more convenient to use, operational sustainability will be ensured by employing means of recovering costs through the provision of for-fee services delivered by service providers.

4 Best Practices

4.1 Japan-China Container RFID Tracking System

4.1.1 Outline

- (1) Trial implementer: Nippon Express Group/Shanghai International Port Group (SIPG) Pilot Secretariat
- (2) Trial route: Shanghai Luojing Port (China) → Hakata Port (Japan) (shipping company: Shanghai Super Express (SSE); China export/Japan import)
- (3) Trial period: December 24, 2011 – February 25, 2012
- (4) Shippers: Precision instrument manufacturers, consumer goods trading companies
- (5) Features: RFID deployment to provide real-time container status information read at reading points. Customs declarations are made at the same time that unloading at Hakata (the port of import in Japan) is detected by the RFID system, enabling customs clearance immediately upon arrival and faster customs release.
- (6) System configuration
 - 1) RFID system (2.45 GHz, active tags, readers)
 - 2) Database of event records for each container (Chinese port administrator: experimental)
 - 3) EPCIS data repository (Japanese Ministry of Land, Infrastructure, Transport and Tourism)
 - 4) User query system (private firms)
 - 5) Forwarder customs declaration system (private sector)

Table: Container Event between Shanghai - Hakata

When	Where	Why	What	IDs
YMD HHMMSS	Factory/Warehouse	Stuffing	Container	Container No. UN/Status Code UN/Locode (Longitude/ Latitude)
YMD HHMMSS	Container Yard	Gate in	Container	
YMD HHMMSS	Container Yard	Loading	Container	
YMD HHMMSS	Container Yard	Discharge	Container	
YMD HHMMSS	Container Yard	Gate out	Container	
YMD HHMMSS	Factory/Warehouse	Unloading	Container	

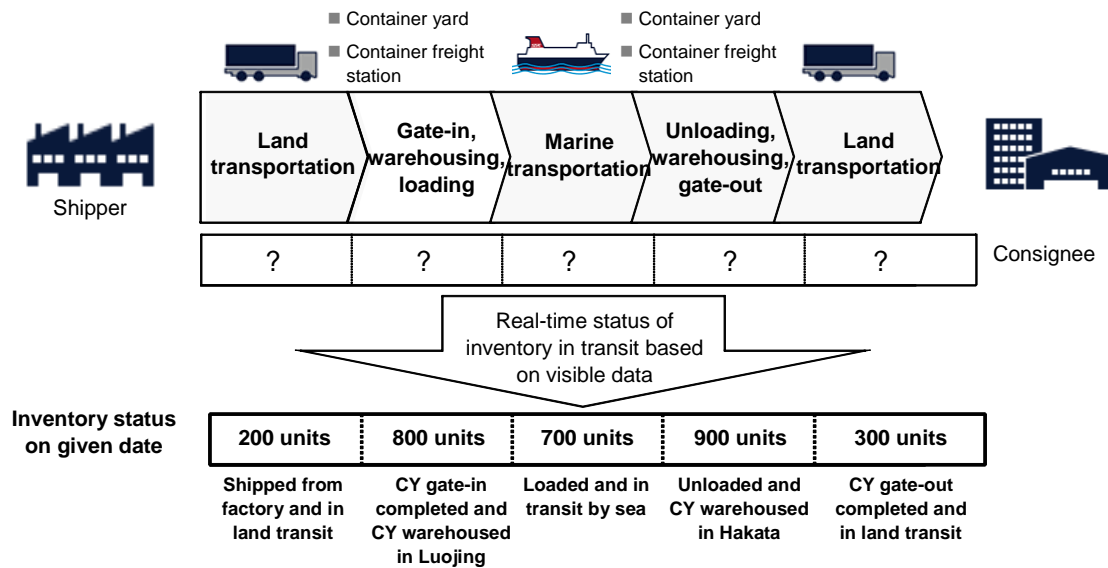
4.1.2 Practicality of Supply Chain Visibility Platform

Key Performance Indicators (KPIs) for Verification of the Effects of Practicality of Supply Chain Visibility Platform

- 1) Reduction of safety inventory levels

Improved visibility of cargo status information allows stock on hand to be reduced. More specifically, real-time tracking of container locations at the port of departure, at sea, and at the port of

receipt makes it possible to treat products in transit as inventory, thereby allowing them to be allocated to orders.



2) Improved efficiency of query handling

Improved visibility makes a range of query-handling processes more efficient. Shippers that want to take their cargoes as soon as possible, shippers seeking to confirm loading and departure from port at the end of the month, truck companies receiving container transportation instructions, and so on make queries by phone. In this project, however, information could be shared simply by accessing a shared platform (website, etc.).

3) Reduced lead times due to expediting of customs declaration and release procedures

Customs declarations following arrival are conventionally made after batch gate-in confirmation once all containers have been unloaded. Movements of individual containers are made visible by RFID tagging. When each container is unloaded once the SSE vessel has docked in Hakata, reading of RFIDs by readers triggers customs clearance immediately upon gate-in. As vessel unloading normally takes two hours on this trade lane, the time taken for the first container to emerge can be shortened by this two-hour period.

4.1.3 Verification of the Effects of Improvements in SCM

1) Inventory levels

Improved visibility should enable inventories of Chinese import/export cargoes to be reduced by four days' worth (two days for imports and two days for exports) as a result of enabling physical checks (e.g., confirmation of arrival of cargoes and security checks) to be performed electronically. For example, the average time taken for door-to-door container transportation using the Shanghai-Hakata route covered by the present trial is around one week (seven days). There thus exists potential for safety inventory levels to be cut.

2) Query operations

Real-time sharing of cargo status information via the Internet entirely eliminates query-handling tasks for query recipients. Time expended on making queries is also halved, because inquirers have to spend less time phoning and emailing as information can be obtained in real time by entering key codes (container numbers, etc.). The combined reduction of work involved for inquirers and query recipients is 70-80%.

3) Quicker customs clearance

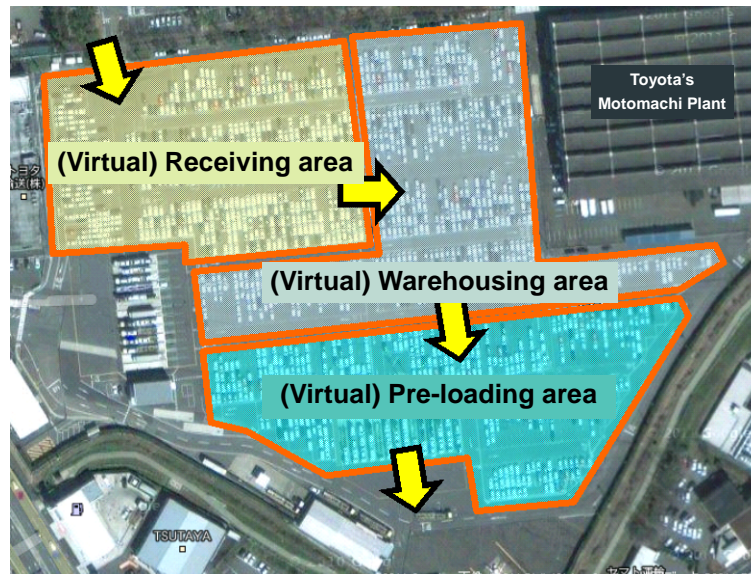
This pilot project shortened import customs release by 30-120 minutes. This allowed connections to be made to domestic transportation (coastal/rail) services in Japan that had previously been inaccessible and made it possible to shorten the time taken to deliver to customers wanting cargoes as soon as possible.

4.2 Japan-China Automobile RFID Tracking System

4.2.1 Outline

- (1) Trial implementer: NYK Line
- (2) Trial location: Kinuura Branch Office, Toyota Transportation, Hekinan City, Aichi
VDC, NYK Automotive Logistics China, Tianjin, China
- (3) Trial period: (Kinuura) Mid-November 2011
(Tianjin) Mid-December 2011 – mid-February 2012
- (4) Shippers: Automakers
- (5) Features: A system for real-time tracking the locations of electronically tagged finished vehicles in a large automobile terminal is deployed. The terminal is divided into several zones and each vehicle's status in the system updates when it enters a zone.

Figure 2: Event management by zoning

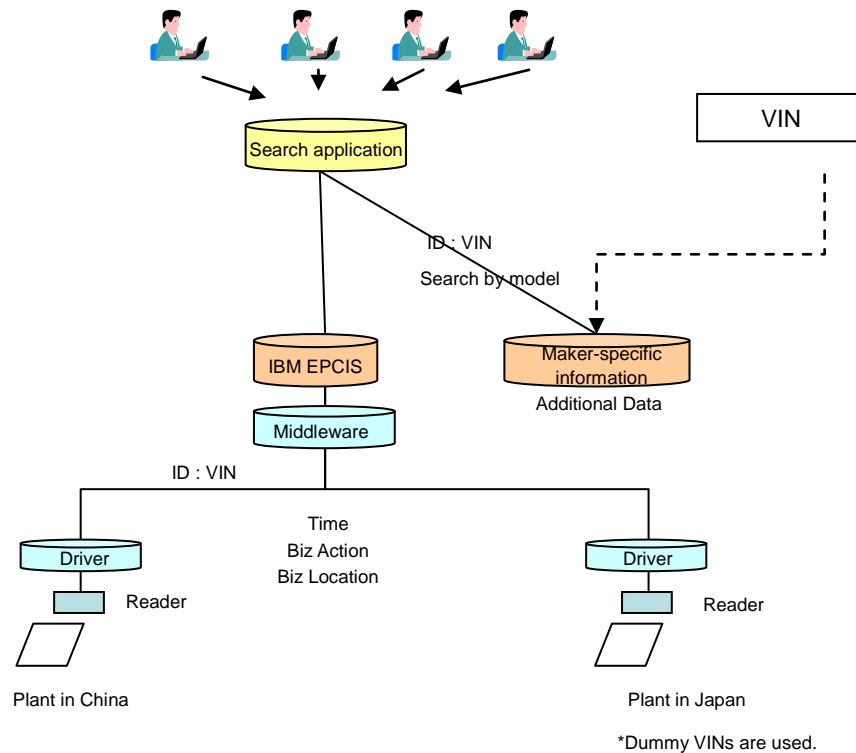


Information on each vehicle (model, name, destination, etc.) is tied to vehicle ID to enable searches for specific vehicles.

(6) System configuration

- 1) RFID system (433 MHz, active tags, readers)
- 2) EPCIS database (IBM Japan: experimental)
- 3) Finished vehicle database (IBM Japan: experimental)
- 4) Online search application (IBM Japan: experimental)

Figure: Experimental system in outline



4.2.2 Practicality of Supply Chain Visibility Platform

KPIs for Verification of the Effects of Practicality of Supply Chain Visibility Platform

1) Reduction of safety inventory at stock points such as warehouses by shippers

As each finished vehicle differs, it is important for dealers to know where the vehicles that customers want are and be able to immediately arrange their delivery. As searches for vehicles in pipeline inventory, changes of destination, and so on cannot presently be properly implemented, safety inventories have to be kept.

As manufacturers have to overproduce for similar reasons, considerable benefits can be obtained by being able to rationalize output. The trial implementer estimates the likely cost savings achievable if adopted by automakers in Japan to be in the region of ¥20-30 billion per year (based on estimation of the annual reduction in inventories kept by each automaker obtainable by reducing transportation lead times on domestically produced vehicle supply chains by 0.5 days).

2) Reduction of work involved in confirmation of cargo locations, etc. by shippers and logistics providers

Being able to instantaneously track inventories at the transportation stage dramatically reduces manual searches. The trialed system should also reduce the amount of work involved in picking out vehicles, etc. at work sites such as automobile terminals, generated estimated savings of ¥2-3 billion

per year (calculated based on the savings in man-hours expended on onsite searches for, delivery, dispatch from warehouses, etc. of domestically produced vehicles).

4.2.3 Verification of the Effects of Improvements in SCM

1) Reduction of safety inventories at stock points such as warehouses by shippers

Interviews with automakers indicated that reductions in safety inventories should be possible, but no specific figures on the scale of such reductions could be obtained.

2) Reduction of operational errors by logistics providers and increased quality of service

Late/wrong deliveries of and damage to vehicles significantly reduce the level of service that can be delivered by logistics providers in the luxury imported car market. RFID logistics management systems for finished vehicles make such a contribution to resolving such issues that their use is now sought by manufacturers.

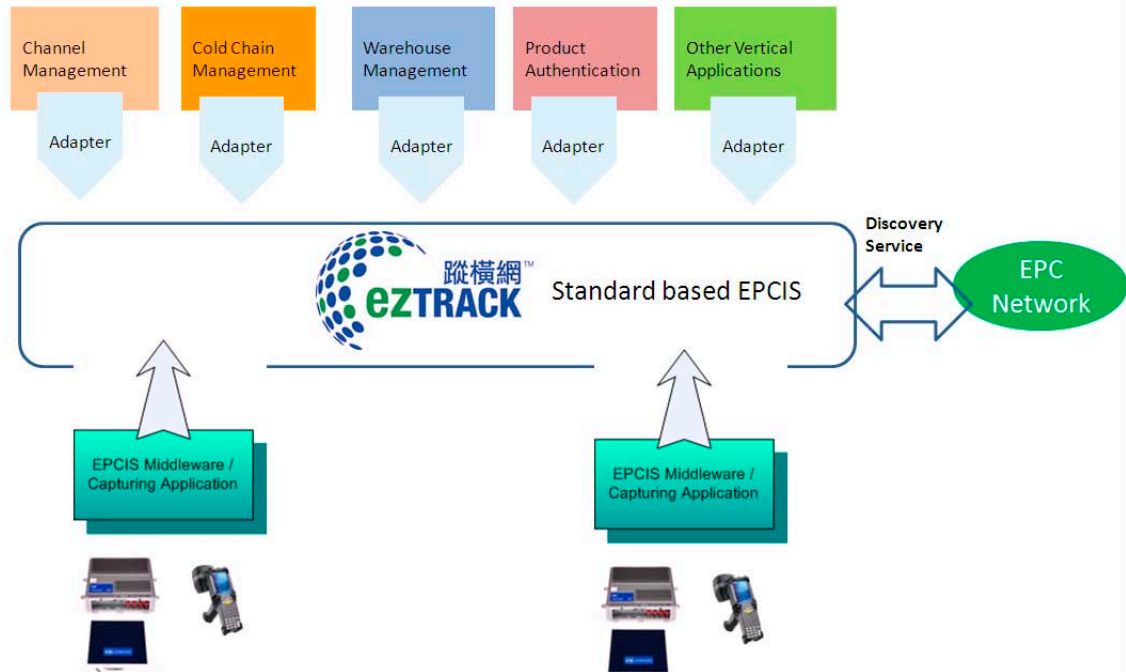
4.3 Global Wine Supply Chain Visibility project

4.3.1 Outline

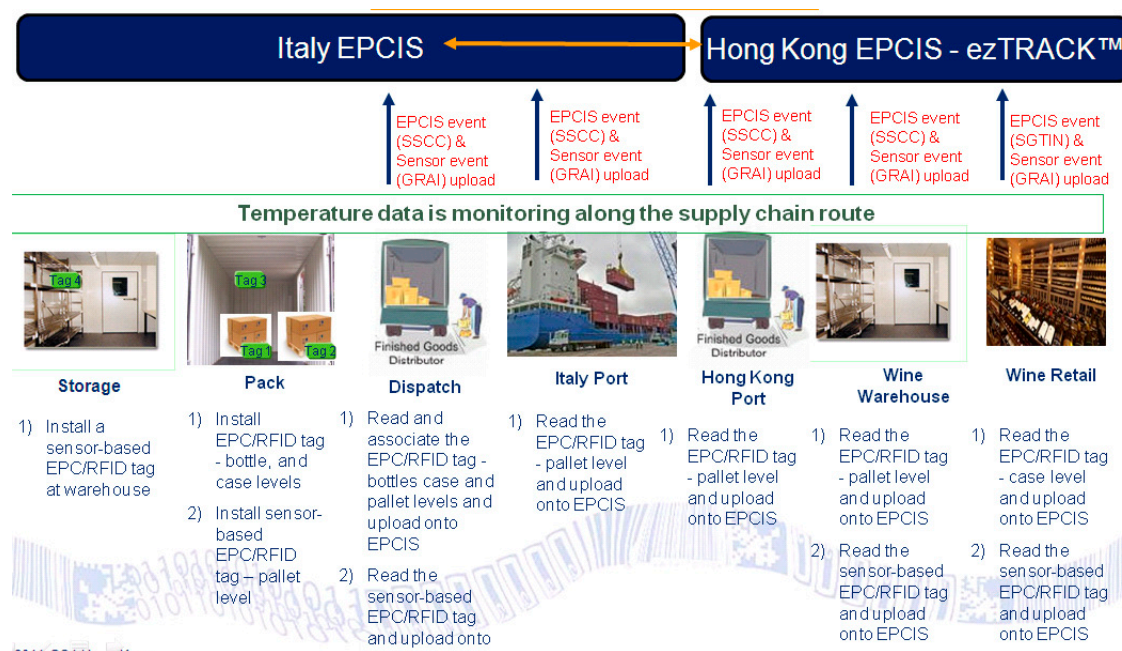
- (1) Operating Body : GS1 Hong Kong
- (2) Tracking Path: Italy (vineyard, warehouse) → Hong Kong, China(HKC) (port, wine cellar, retail outlet)
- (3) Project Period: June 2011 – August 2011
- (4) Cargo Owner : Italian Wine maker
- (5) Features: Each bottle of wine is tagged with a RFID label encoded with a unique global trade item number. In addition, temperature-sensor RFID tags are attached to the wine boxes and pallets to ensure the wine is being transported at an appropriate temperature. The different levels of goods information, from individual items, to boxes, and pallets as well as the temperature – sensor based RFID tags are all associated to provide full visibility of information along the wine supply chain, that is from source (vineyard) to the final destination (retail outlet). The wine in-transit and temperature information are captured at different read points defined by the project team. Both information are then uploaded to the standard based EPCIS server in Italy or HKC. Carriers have authentication and authorization in place can access the server to obtain real time wine in-transit and temperature information along the chain. This makes it possible to maintain and ensure the quality of temperature-sensitive wine and to provide value-added product information for the local wine importers as well as the wine cellars.
- (6) System Overview
 - 1) Transport data captured in the respective location is stored in standard based EPCIS system in the respective region, that is to say information captured from Italy will be uploaded to Italy EPCIS and information collected from HKC will be loaded to HKC EPCIS
 - 2) HKC carrier uses ezTRACK, a commercial and standard based EPCIS.
 - 3) Interchange and information access enquiries between the Italy EPCIS and HKC EPCIS are executed via the GS1 Hong Kong Discovery Service

4) Stakeholders can access the wine supply chain information via User Query System via ezTRACK.

(7) System Configuration (HKC EPCIS)



4.3.2 Practicality of Supply Chain Visibility Platform



- 1) RFID tags are attached to wine bottles, cases, and pallets
- 2) Temperature-sensor RFID tags are applied to the cases and pallets.
- 3) At the Italian vineyard, carriers read the RFID tags with handheld RFID terminals, associate the RFID tags information on bottles with the cases, pallets and the temperature-sensor RFID tags, and upload the information to the Italian EPCIS server via the Discovery Service before releasing the pallets for delivery
- 4) Italy carriers read the pallet RFID tags at the warehouse and the port with the handheld readers and upload the information to Italian EPCIS via the GS1 Hong Kong Discovery Service.
- 5) Upon the arrival of the pallets of wine at the HKC port, the HKC carriers reads the RFID tags with the handheld readers and upload to HKC EPCIS via the Discovery Service
- 6) When the wine arrives at the HKC warehouse, the warehouse reads the RFID tags and the temperature sensor tags attached to the pallets and uploads the information to the HKC EPCIS.
- 7) HKC retailers can refer to the wine transport information and the temperature data in-transit by accessing the EPCIS servers via ezTRACK on HKC side and Italian suppliers can also obtain real time supply chain information via the Italian EPCIS.

Real Time Product Traceability Information between Italy- HKC

DataLink Main

Select View: GS1HK Demo - Search by PO Number

PO number (GS1IT)* equals PO#21463443

Search

5 items found, displaying all items.

BizLocation	Event Time	BizStep	PO number (GS1IT)	EPC	
HongKong wine cellar retail shop	15/08/2011 15:00:00 +0800	Receiving	PO#21463443	urn:epc:id:sgtin:805961626.1170.1	Detail
HongKong wine cellar warehouse	15/08/2011 09:00:00 +0800	Shipping	PO#21463443	urn:epc:id:sgtin:805961626.1170.1	Detail
HongKong wine cellar warehouse	11/08/2011 13:00:00 +0800	Receiving	PO#21463443	urn:epc:id:sscc:805061626.00000003	Detail
Italy Wine warehouse	08/07/2011 20:00:00 +0800	Shipping	PO#21463443	urn:epc:id:sscc:805061626.00000003	Detail
Italy Wine Warehouse	23/06/2011 17:43:56 +0800	Picking	PO#21463443	Click to Hide urn:epc:id:sgtin:805961626.1170.1 urn:epc:id:sgtin:805961626.1170.10 urn:epc:id:sgtin:805961626.1170.2 urn:epc:id:sgtin:805961626.1170.3 urn:epc:id:sgtin:805961626.1170.4 urn:epc:id:sgtin:805961626.1170.5 urn:epc:id:sgtin:805961626.1170.6 urn:epc:id:sgtin:805961626.1170.7 urn:epc:id:sgtin:805961626.1170.8 urn:epc:id:sgtin:805961626.1170.9	Detail

Export options: CSV | Excel | XML | PDF

Annotations: Red arrows point to 'Case level' for PO#21463443 and 'Pallet level' for the sscc EPC.

4.3.3 Verification of the Effects of Improvements in SCM

(1) KPIs for Verification of the Effects of Practicality of the Supply Chain Visibility system

1) Improved on-shelf availability (improved sales) for retailers

Traditionally, it is difficult for retailers to know exactly how many bottles of any given wine are on their shelves. Moreover, because of the lack of inventory visibility and accurate information, usually retailers order or replenish the wine they needed when out of stock occurs and it took days or even months before the wine arrived from the wine makers and hence lost the sales opportunities for both the wine cellars or the retailers. The RFID implementation enabled retailers know how many bottles of any given wine are on their shelves and place order for good-selling popular wines well before the stock goes out. As such, with on-shelf availability being improved, more sales opportunities will be available for retailers.

2) Enabling inventory visibility

Traditionally, staff manually counted the numbers of bottles in wine storage and warehouse which is time and labor consuming. Human errors and miscounts may occur no matter it is done with paper based forms or barcode scanning which caused inaccurate inventory information that may lead to out of stock situation on the sales floor or overstocking in the warehouse.

By automatic reading of RFID tags enables retailers to have the inventory visibility, maintain accurate inventory counts and avoid overstocking. In fact, with better inventory visibility and 100% information accuracy in a timely manner, retailers hence do not have to overstock and occupy a lot of warehouse spacing. More importantly, with the accurate and round the clock inventory information available, retailers and wine cellars can better plan their replenishment cycles for any given wines

and plan their logistics and warehouse management. In this way, not only the retailers will benefit but also the warehouse operators can also benefit from better warehousing with better turnover rate of storage space available.

At the vineyard, operators can efficiently validate the packing list with the automatic counting made possible by RFID tagging on individual bottles which can minimize the human errors, risks of chargebacks and claims for wrong deliveries.

3) Enabling wine temperature monitoring in-transit

Temperature changes during transportation may have a great impact on the flavor and bouquet of wine. Retailers may receive customer complaints about variations in quality even for the same wine they consumed before. The introduction of temperature-sensor tags enabled stakeholders of the wine value chains to round the clock monitor wine temperature during transportation, identify critical temperature fluctuations by knowing what, when, where and why information available via the EPCIS system. With such information available, ownership and liabilities of the goods in transit can easily be identified and the quality of the wine to be sold to end consumers can be assured.

(2) Summary Result of Verification

Key Benefits enabled via the RFID tagging

	Before RFID Tagging	After RFID Tagging
Inventory visibility/On shelf availability	?	100% visibility of the inventory flow achieved
Human error prevention	?	100% via RFID technology
Increased data accuracy	80%	100% data accuracy
Better logistic management	Partial	Enhanced
Real time product flow monitoring	Not	All information is available on real time basis

4.4 The Security and Trade Facilitation system

4.4.1 Outline

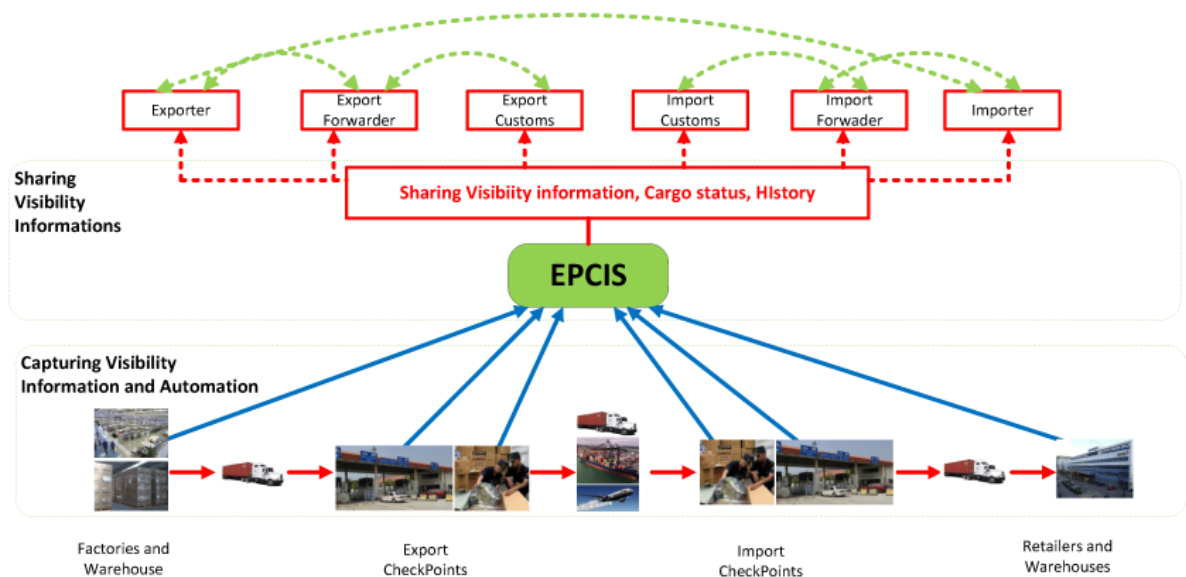
- (1) Operating Body : GS1 Malaysia
- (2) Tracking Path : Malay peninsula key points such as
Bukit Kayu Hitam, second Air cargo complex, Teluk Panglima Garang, Tanjung Kupang
- (3) Project Period : Actual Phase
- (4) Cargo Owner : Cargo owner
- (5) Features: Due to Malaysia's active efforts to attract new factory investments, many

foreign-capital companies have set up facilities in the economy. As transactions between those factories in Malaysia and their foreign business partners rapidly increase, the total trade volume of imports and exports has also recently increased. As a result, more efficient and faster import and export procedures including simplified customs procedures have been required. At the same time, shipping containers must be sealed to improve security and prevent pilferage of container contents. To solve both of these problems, eSeals using RFID tags were implemented to reduce customs clearance paperwork and ensure the security of containers and their cargo.

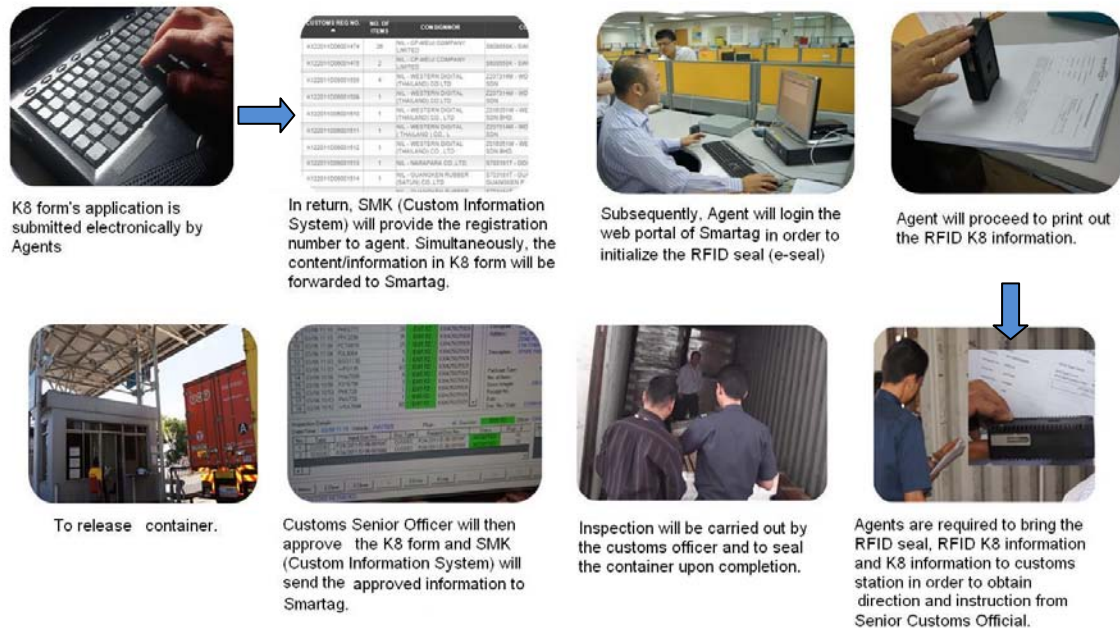
(6) System Overview

- 1) Many transportation companies participated, including DHL, TNT, WD, FedEx, A. Hartrodt, Toshiba (Nippon Express), and Priority Cargo.
- 2) Royal Malaysian Customs (RMC) Department also participated
- 3) Electronic customs clearance application on the Web
- 4) Many check points available in Malaysia to verify the sealing of containers
- 5) The Security and Trade Facilitation System using RFID project was launched in Penang, Malaysia in September 2011. The system is designed and built closely following the ISO18186:2010 and GS1 EPCglobal's EPCIS standards.
- 6) The RFID seal and EPCIS components form a larger cross-border customs system. When the containers moved across the border and arrived at the customs of the destination economy, the data is captured and stored in the customs' EPCIS. With EPCIS serving as a bridge, the customs information systems are able to query each other's event data. The EPCIS events data include events of RFID seals commissioning, container transits and movements along the logistic routes.

(7) System Configuration



4.4.2 Practicality of Supply Chain Visibility Process



- 1) K8 application form for customs clearance is submitted by import and export application agents.
- 2) RMC information system issues a registration number upon receiving the K8 application and writes the same information from the K8 form to an RFID tag.
- 3) Agents login to the Web system and register the initial data to the eSeal RFID tag.
- 4) Agents print out the K8 form information.
- 5) According to RMC's instructions, agents bring the eSeal RFID tag and K8 form printout to RMC.
- 6) Agents seal the container with the eSeal RFID tag in the presence of RMC officials.
- 7) RMC registers the completion of the container sealing.
- 8) The driver of the container carrier passes through check points, and unseals and unlocks the container at the last check point.

4.4.3 EPCIS Events

Container status is scanned by the RFID reader and the information is uploaded to the server at each check point. The container status information is as follows:

EPCIS Event
Accepting, Arriving, Commissioning, Departing, Encoding, Entering_exiting, Holding, Inspecting Receiving, Storing, Active Container_closed Encoded, Inactive In_progress In_transit , Other

4.4.4 Practicality of the Supply Chain Visibility system

(1) KPIs for Verification of the Effects of Practicality of Supply Chain Visibility system

1) Electronic procedures improved transportation speed

Traditionally, customs clearance applications were paper-based manual work and application forms were also checked manually. Whenever applications increased, they were unprocessed and queued. At the same time, detecting tampering of containers was also inspectors' manual work and

the appearance of each container was visually checked one-by-one at each check point. These complicated manual procedures became the main cause of delays in container transportation. The implemented system enabled electronic Web-based procedures and automatic inspection of container sealing status using eSeals. Consequently, transportation delays for queuing were eliminated and transportation speed was improved.

2) Reduced paperwork for customs clearance applications

Electronic customs clearance applications encourage paperless procedures which not only bring about improvements in transportation speed but are also eco-conscious and earth-friendly measures. Conventional methods required physical management of paper application forms and storing the forms was also a challenge. Proper management to prevent the theft of the application forms was also an issue. For these reasons, manual management and inspection of paper-based applications not only took much time, but also became a problem that required much labor. Electronic customs clearance applications led to the reduction of paperwork by users as well as the reduction of work by RMC officials.

3) Reduced pilferage of container contents and improved security

The security of containers must be ensured to prevent pilferage of their contents and damage to the containers themselves. However, security measures require much time and labor. Since more check points to inspect the sealing status of containers would require more staffing, inspection check points could not be easily increased using conventional methods. New methods using RFID tags enable automatic inspection of the sealing status of containers and dramatically reduce the time and labor required for inspection. As a result, check points can be increased, pilferage of container contents reduced and security improved.

(3) Result of Verification

Key Benefits enabled via the RFID tagging

- 1) No delay in transportation and no pilferage of container contents.
- 2) Reduced queuing time at RMC and check points near borders.
- 3) Reduced paperwork and filing procedures.
- 4) Faster procedures for sealing and unlocking of containers due to automatic use of RFID tags.
- 5) Real-time visibility of information on container transport status and container sealing and unlocking status.
- 6) Using EPCglobal and EPCIS standards enabled higher security and detection of pilferage than using wire locks.

4.5 e-Seal Program in Chinese Taipei

4.5.1 Outline

- (1) Operating Body : Chinese Taipei Customs
- (2) Tracking Path : Container and cargo movement inside the international ports of Taiwan , such as Taipei port, Taichung harbor, Taoyuan international airport, Keelung harbor and Kaohsiung harbor.
- (3) Program Period: Sequential Projects from 2009 to 2012
- (4) Cargo Owner: Actual Cargo Owner (No specific cargo owner for the project)
- (5) Features:

Chinese Taipei Customs has applied RFID e-Seal technologies on container and cargo movement security control and received their preliminary effect. In 2009, Chinese Taipei Customs piloted a project of passive RFID e-Seals as replacement of physical escort for transshipment containers in Kaohsiung harbor. The pilot project created benefits to both private and public sectors, i.e. saving of Customs escort manpower, business entities reduce cost and enhance logistic efficiency. Based on the successful experience, Chinese Taipei Customs started to develop an integral Cargo Movement Security Program in 2009. The program adopts passive, semi-active and active RFID e-Seals and state-of-the-art information technologies to monitor the movement of import, export, transit and transshipment containers in the major ports of the island. Chinese Taipei Customs has completed the RFID e-Seal system at Taichung harbor, Taoyuan International airport, Taipei harbor and Keelung harbor, and will update and extend the system at Kaohsiung harbors before 2012.

(6) System Overview

1) Program objectives:

- A. To develop risk management mechanisms conformed to guidelines proposed by WCO SAFE Framework.
- B. To improve visibility, security and efficiency of container and cargo transportation.
- C. To create win-win situation for all stakeholders in the supply chain.
- D. The information sharing mechanism among Customs for high-risk and low-risk cross-border containers should be the most economic, effective way to manage risk.

2) Project owner: Chinese Taipei Customs

3) Project scope:

To build RFID e-Seal system at Taichung harbor, Taipei harbor, Keelung harbor, Kaohsiung harbor and Taoyuan International airport for import, export, transit and transshipment containers.

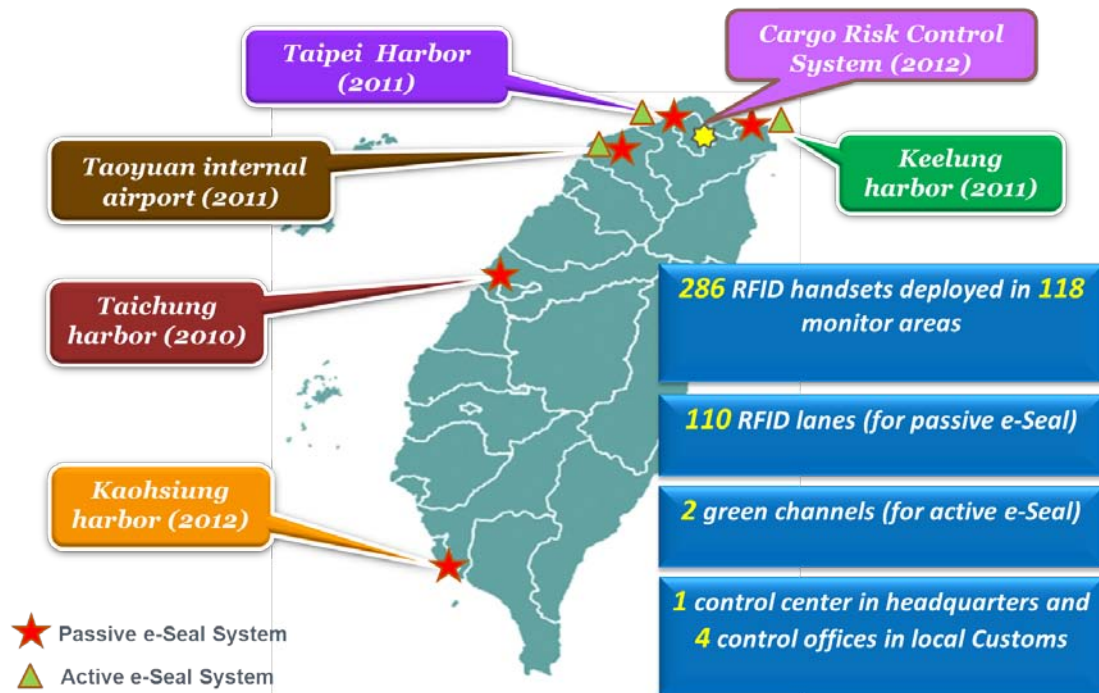
4) Implementation details:

- One control center in Customs headquarters and four control offices in field Customs Offices
- Two green channels (Active e-Seal)
- 110 non-stop fast lanes (Passive e-Seal)
- 286 RFID handsets deployed in 118 monitor areas
- One EPCIS

5) Data collection:

- Devices monitoring
- Real time warning and alarm
- Historical information of container movement
- Synchronized display of comparison results of RFID lanes
- Container status from customs clearance systems
- Instant log of container notes

6) Implementation schedule



4.5.2 Practicality of the Supply Chain Visibility Process

(4) The Standards Operation Procedures in Kaohsiung Harbor



- 1) The CY operators transmit corresponding container notes and affix the transshipment container with passive RFID e-Seals.
- 2) The administrative personnel examine the containers and verify the e-Seals by handsets at outbound.
- 3) Relevant data are automatically captured and compared when outbound drays pass checkpoints.
- 4) The verification results are displayed by LED board at the checkpoint. The authorized officers stop the suspicious containers when warning.
- 5) Relevant data are automatically captured and compared when inbound drays pass checkpoints.

- 6) The administrative personnel examine the containers and verify the e-Seals by handsets at inbound.

(5) Status of Individual Processes

- 1) A RFID e-Seal is affixed and locked container.
- 2) When the container passes through checkpoints, relevant data are automatically captured and verified in real time by RFID/ICT devices installed in the RFID land.
- 3) The handheld devices are used to scan the e-Seal status manually.
- 4) The container and cargo movement and status information are reported to the control center for risk analysis and assessment.
- 5) The container movement can be tracked and queried at cross-border information sharing platform which is built according to EPCIS.
- 6) The Customs officers in control office monitor the information captured by fixed/handset readers including containers' departure time, arrival time, status of the trip, e-Seal lock & unlock time (for active e-Seal), alert or warning.

(6) Customs Risk Management Mechanism

- 1) To establish efficient clearance environment and effective investigation capability, Chinese Taipei Customs adopts risk management mechanism. The information sharing mechanism among Customs for high-risk and low-risk cross-border containers should be the most economic, effective way to manage risk.
- 2) In consideration of logistic flow efficiency, the export containers with risk should be affixed with RFID e-Seal and to notice next Customs through the cross-border containers information sharing platform. The destination Customs can analyze the pre-interchange information for the purpose of further inspection.
- 3) Develop a safe green path for the cross-border movement of AEO containers affixed with RFID e-Seal to enhance the Customs clearance efficiency.

4.5.3 EPCIS Events

Regarding high risk and low risk containers, they will be attached e-Seals and their physical movement can be recorded and shared via EPCIS.

4.5.4 Practicality of the Supply Chain Visibility System

(2) KPIs for Verification of the Effects of Practicality of the Supply Chain Visibility System.

- 1) From Jan. 2011 to Dec. 2011, there are 57,990 containers sealed by passive e-Seals.
- 2) From Customs' perspective

No.	KPI Item	Description	KPI value	Result
1.	Mechanical intensity	The mechanical intensity must conform to WCO SAFE requirement	ISO/PAS 17712 high security	ISO/PAS 17712 high security
2.	Reading rate	The percentage of e-Seals that was read successfully.	95%	97.42%
3.	Data accuracy	The accuracy of the reading data	100%	100%
4.	Effectiveness (reading distance)	The maximum of effective reading distance between RFID reader and e-Seal.	7 meters	≥ 7 meters (static) and 14 meters (dynamic)

No.	KPI Item	Description	KPI value	Result
5.	Effectiveness (container truck speed)	The speed limit that a container truck passes through a RFID checkpoint.	60 km/h	≥ 60 km/h
6.	Time-saving	Time saving for Customs operation procedures	-	63,000 hours
7.	Physical escort cutting	The reduced number of physical escort	-	30,000 times

3) From business entities' perspective

	KPI Item	Description	KPI value	Result
1.	Cost-saving	Cost saving by replacing physical escorts with RFID e-Seals	-	NTD 35,000,000 (USD 1,170,000)
2.	Time-saving	Time saving in Customs clearance	-	100,000 hours

(3) Result of Verification

Key Benefits Enabled via the RFID e-Seal Systems

In general, RFID e-Seal systems have established an efficient clearance environment and brought benefits to all stakeholders. Effective ICTs and automatic data processing systems can enhance the Customs enforcement capability and increase border security. The key benefits are as follows.

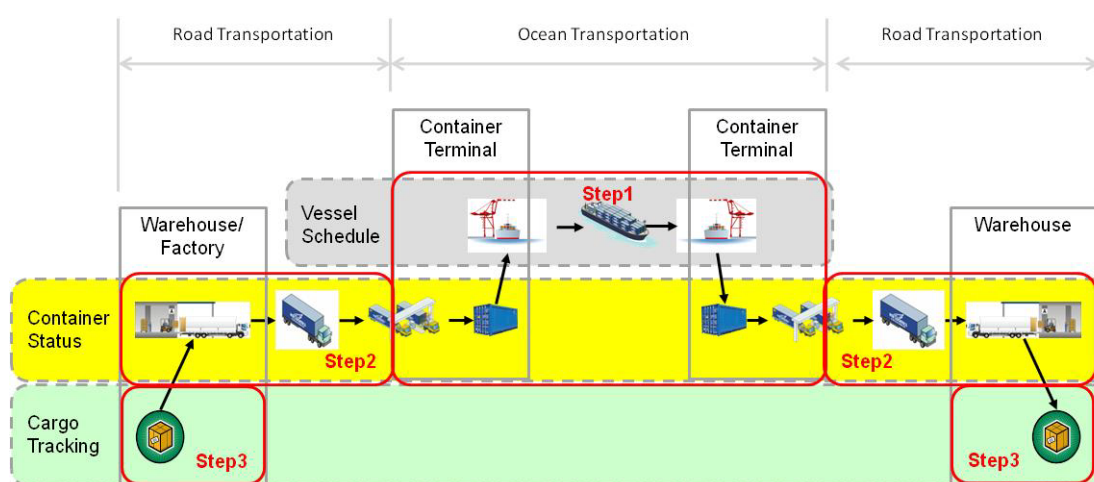
- Although manual identification is commonly employed at ports, investigations have shown that, there are 35% of information gathered manually is inaccurate or postponed. The RFID systems can save the manual effort and decrease unnecessary man-made errors. With the help of RFID systems, Customs can efficiently manage risks against smuggling with less manpower.
- RFID e-Seal can be used to track the movement of container from consignor to consignee.
- In comparison with mechanical seals, e-Seal is not easily tampered with and therefore difficult to forgery.
- The active e-Seal technology used by Chinese Taipei Customs can provide speedy Customs clearance environment called green channel. The movement of sea containers and air cargoes in green channels can be tracked in real time.

5 How to promote the implementation

5.1 Implementation Step

As noted earlier, consideration of how to deploy a platform for sharing cargo status information should begin with marine container transportation. In specific terms, it is envisaged that sharing will be introduced in three steps: a first step consisting of sharing of vessel level and port-to-port container level information, a second step consisting of sharing of door-to-door container level information, and a third step consisting of sharing of information on the contents of containers, i.e., cargo-level information. These steps may also be commenced simultaneously.

Figure: Implementation Step of SCV



5.1.1 Port-to-Port Implementation

Information on the status of vessel movements and port-to-port container movements constitutes the first type of information that should be shared by a platform for sharing cargo status information. Information on vessel movements and port-to-port container movements has been shared by EDI between shipping companies and between shipping companies and terminal operators since the 1980s, and as unique data and codes are in global use, sharing of information of this type between participants should be relatively easy to achieve.

Implementation of a network for sharing cargo status information can draw usefully on initiatives such as the NEAL-NET being developed by port authorities in Japan, China, and Korea.

Key points are as follows:

- Sharing of existing information (most obviously that held in TOS) by means of an EPCIS-based visibility platform
- For key search codes, use of booking numbers or B/L numbers for participant authentication in conjunction with IMO numbers or call signs for vessels and container numbers for marine containers
- No sharing of “who” information known between participants, as use of a cheap and simple system using the Internet is recommended

5.1.2 Cooperation with Customs Systems

Customs clearance in the economies of import and export occupies an important position in improving the visibility of marine container transportation. As it is impossible to proceed to the next step of domestic transportation without customs release or permission for bonded transportation, for example, tracking customs clearance status is also important from a compliance point of view, making linkage with customs authorities' information systems vital.

Cooperation with customs authorities is therefore an essential next step once port-to-port visibility has been achieved, and connectivity needs to be pursued paying consideration to the following points:

- Having consistency between customs clearance unit and container unit, disclosure of customs clearance status to users based on synchronization of booking numbers or B/L numbers
- Consideration of handling of less-than-container loads and linkage to cargo level at the next step

5.1.3 Eventual Provision of Door-to-Door Services from the Original Shipper to the Consignee

The next step once port-to-port and customs linkages have been achieved is to focus on door-to-door information sharing at the container level. Development of a visibility platform needs to take into account several factors, including the facts that loading and unloading of cargo to and from containers is performed in a variety of locations around the world, that means of transportation used are envisaged to include coastal and rail services as well as just trucks, and that customs clearance of mixed cargoes takes place before loading into containers or after unloading from containers.

It is therefore advisable that a visibility platform be adopted that is based on the locations of loading and unloading of cargoes to and from containers and takes the form of a port-to-port visibility platform. More specifically, these are the locations where stuffing and loading/unloading of containers occur, such as warehouses and factories.

5.1.4 Response to the needs of specific industries

These recommendations have concerned themselves only with the minimum level of information sharing required for visibility of port-to-port and door-to-door marine container transportation. In practice, however, information sharing is likely to have to cater for variety of wider needs. In the case of industries that use refrigerated containers ("reefers") requiring temperature control, for example, the visibility platform will have to be able to share additional relevant items of information.

At present, these might foreseeably include information on temperature, humidity, vibration, and latitude/longitude, and it is envisaged that this information will be shared by means of "extension fields" within the EPCIS architecture here recommended as the basis for platform development.

5.2 Implementation method of Cargo Status Information Network

For the above implementation to serve as a cargo visibility platform, development of the following based on existing systems is essential.

5.2.1 Economy-wide Database Development

In order for the economies of APEC to develop a visibility platform, work should begin with development of a visibility platform at the vessel and container port level. The next step should then be to facilitate connectivity with customs systems developed at the economy level.

The scope of such action will likely vary according to individual economies' circumstances, and we recommend that information on port-level vessel and container statuses and their corresponding customs clearance level status be subsumed within the scope of action bearing in mind regional levels as described below.

5.2.2 Regional Database Development

Where system development takes place at the regional level within APEC economies and numerous ports exist within an economy, as in the case of geographically large economies such as China and the United States, there are likely to be cases where development may be more rationally pursued by dividing the economy concerned into several regions.

Regarding the scope of information to be shared at this level, it is recommended that systems be developed to allow sharing of information on port-level vessel and container statuses and corresponding customs clearance status as at the economy level described above.

5.2.3 Private Investment (Database Development by Port Operators)

Assuming creation of a visibility platform for sharing port-level vessel and container statuses and their corresponding customs clearance status, systems should be developed at the private sector level to enable linkages with container-level door-to-door and less-than-container cargo-level statuses.

6 Future Plan

6.1 Harmonization with International-standard-making organizations

For visibility to be expanded beyond the APEC region to the rest of the world, coordination with key standards bodies and other organizations is crucial. Coordination with GS1, which recommends EPCIS, and other standards bodies including UN/CEFACT, ISO, and WCO, will be particularly necessary if the visibility platform is to achieve widespread adoption.

The first area requiring coordination with key standards bodies is code scheme standardization. To enable greater system versatility, harmonization with the codes laid down by standards bodies is important. As almost all standards bodies have code modification processes, their use should be effective.

Secondly, global uptake will require making key standards bodies aware of details of the system and coordinating action with them on encouraging wider adoption.

Thirdly, requests for cooperation should be made to improve visibility of cargo status information at the cargo level by the private sector. In concrete terms, it is envisaged that such requests will concern standardization in areas such as product item codes not required until the second step and codes for items such as IDs for management of pallets and other returnable assets, locations such as warehouses, and so forth.

Collaboration in these areas will enable use of the standard codes and messages, etc. already used by global supply chain participants, facilitating steady uptake of mechanisms to make cargo status information more visible.

The specific initiatives envisaged are as follows:

- Collaboration with GS1 on establishment and popularization of a visibility platform developed at the economy and regional levels (particularly arrangement of data and codes stored in EPCIS, represented by EPC)
- Collaboration with UN/CEFACT (regarding XML-based information exchange)
- Harmonization with WCO to assist connectivity with customs systems

6.2 Collaboration with Other region

In addition to collaboration with standards bodies, collaboration with regions outside APEC, such as the EU, will also be essential. Particularly crucial will be collaboration with the EU, which is pursuing a variety of initiatives to improve visibility, and collaboration will be necessary if APEC's visibility platform is to go global.

6.3 Others

The focus of these recommendations has been on the design of mechanisms for sharing visibility data on marine containers within the areas of responsibility of each participant in global supply chains as a first step toward the creation of a visibility platform in the APEC region. In order to create a visibility platform that helps make global supply chains more efficient, information sharing will have to be expanded to accommodate less-than-container loads and incorporate other international means of transport such as air and rail.

Figure: Course of future expansion

