

TRAINING MANUAL

STANDARD OF LOGISTICS INFORMATION SYSTEM



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ABBREVIATIONS

API	Application Programming Interface
ECE	Economic Commission for Europe
ESCAP	Economic and Social Commission for Asia and Pacific
FAL	Facilitation
4IR	fourth industrial revolution
ITC	information and communication technology
ISO	International Organization for Standardization
IT	information technology
ITU	International Telecommunication Union
NEAL-Net	Northeast Asia Logistics Information Service Network
OASIS	Organization for the Advancement of Structured Information Standards
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
UNNEXT	The United Nations Network of Experts for Paperless Trade and Transport in Asia and the Pacific
WCO	World Customs Organization

1. INTRODUCTION

1.1 Background

As the volume of international trade continues to increase on the back of such factors as economic development and trade liberalization, the importance and necessity of logistics also increases. This has become especially apparent during the COVID-19 pandemic, which has caused major social structural changes globally, such as the acceleration of digitalization of communication, non-contacting of service and product provision, and unmanned and process innovation of the manufacturing industry. Although these structural changes were already taking place prior to the pandemic, they were accelerated as the effects of this event took hold.

From the perspective of logistics, the collapse of the global supply chain during the COVID-19 pandemic brought cargo handling to a standstill, as the major elements of this logistics network, which includes ports, warehouses, terminals, or distribution centres, shut down.

Furthermore, because of the labour-intensive nature of logistics, the vulnerability of logistics was particularly highlighted in a situation in which the movement of personnel (lockdowns) was restricted. Accordingly, logistics need to cost less and be more efficient. In addition, going forward, eco-friendly and sustainable logistics and logistics security should be emphasized.

Traditional logistics transactions and the exchange of logistics data are carried out using paper documents, which is costly, time consuming and done manually. Greater accessibility to advances in information and communication technology (ICT) provides an opportunity to transform the logistics information system through paperless logistics transactions. This transformation is highly beneficial for both the public and private sectors.

Digital transformation can result in more rapid processing, better risk management and a reduction in processing costs and time. Ultimately, it will result in tangible gains in productivity and competitiveness in logistics transactions and, in cases in which information-sharing among stakeholders are made across borders, the potential benefits can be even higher.

Users of a logistics network are hoping to reap the benefits of this transformation. Accordingly, digital transformation in the logistics industry with digital technology needs to be accelerated to address user requirements and to cope with unexpected events, such as the COVID-19 pandemic. This entails deploying the latest technologies, such as robots, artificial intelligence, and big data, in developing digital transformation strategies. Under this scenario, the need for labour declines and productivity increases.

In other words, digital transformation or logistics informatization that combines information technology (IT) into a logistics business is an essential requirement for improving logistics.

1.2 Purpose of the training manual

This training manual was developed as part of a project covering short-term responses to transport and trade connectivity during a pandemic. Lessons learned from the COVID-19

outbreak were used to guide governments and businesses in developing a logistics information system with the objective to carry out digital transformation or logistics informatization.

Included in the training manual are definitions of logistics, logistics information and a logistics information system, a description of a of logistics information systems, a stepwise approach on how to develop a logistics information system and a list of required standards to implement such a system.

The training manual is intended to support Economic and Social Commission for Asia and the Pacific (ESCAP) member States in their efforts to develop logistics information systems using standards to improve work productivity and efficiency in a sustainable way.

1.3 Scope and limitation

The logistics environment is going through rapid changes in line with advancing technology. Many stakeholders are keen to change the way they exchange logistics information at borders to support transport connectivity, but they still continue to rely on exchanging paper documents using a paper format, which is time consuming and inefficient. This alone presents the case to implement a logistics information system and exchange electronic data with other countries through digital transformation and connectivity.

The Economic and Social Commission of Asia and the Pacific is positioned to support the digital transformation to build a logistic information system by providing relevant information and consultations. One example of this support is the present guide.

Before going further, it should be noted that the standards and considerations presented in this training manual are general concepts and strategies according to ESCAP requirements, which can be altered over time to adapt to changing conditions.

1.4 Challenges and issues

Most countries have introduced some form of automation and informatization to improve their logistics procedures and operations and build their overall capability, however, in general, these efforts have been limited. To carry this effort further, they are likely to face the following challenges:

- Large Information gap among member States because of the high percentage of manual processing, in particular, for processing paper documents;
- Insufficient linkage of information systems among member States;
- Absence of information exchange among member States;
- Limited compatibility and standardization;
- Difficulties in finding or accessing required information.

The logistics industry, including transport, is becoming more sophisticated and competitive, requiring logistics information systems to be resilient and sustainable, have interoperability, and can share information with other information systems.

This training manual includes a review of the “logistics, logistics information and logistics information system” concept, and a comprehensive guide for implementing such a system. It is ultimately aimed at providing technical consideration and the referenced standards for ESCAP member States to apply or refer to when developing their own logistics information system.

2. STEPWISE APPROACH FOR DEVELOPMENT OF A LOGISTICS INFORMATION SYSTEM

2.1 The need to develop a logistics information system

As the trade and transport environment diversifies and evolves globally, the importance of transportation and logistics increases. Notably, many changes in the supply chain have occurred in line with advances in technology during the fourth industrial revolution (4IR). Digital transformation is inevitable in global supply chains to respond to these changes. Furthermore, the COVID-19 pandemic has rapidly shifted consumers' purchasing pattern behaviour to shopping online, forcing changes in transport and logistics to respond to the new condition.

The complexity of the logistics system is increasing. Some of the factors behind this are the need to accommodate the increasing cargo volume, reduce transportation and handling time, and adapt to multi-transport or intermodal transport.

Keeping transport and logistics competitive is an important factor. This is determined by not only a single organization, but also by an industry and a country. The development of IT is a major innovation for logistics management and has become a major factor in the competitiveness of a logistics system.

To date, the focus has been mainly on the expansion of hardware-centred social overhead capital for logistics management or improvements to a logistics system. Going forward, greater emphasis will be placed on the transformation of a logistics information system to make it more efficient and be able to systematically manage logistics information.

Accordingly, it makes sense to develop a logistics information system to improve efficiency in the transport and logistics sector, with the objective to facilitate interoperability and scalability using standards. In other words, applying international standards is a prerequisite for development of a logistics information system.

2.2 Definition

2.2.1 Logistics¹

The global technology media company TechTarget defines logistics as the process of planning and executing the transportation, storage, loading/unloading, transshipment of cargo from its origin to final destination. It explains that the objective of logistics is to address requirements of users, such as exporters, importers, freight forwarders and carriers, and or the relevant

¹ David Essex, "Logistics", TechTarget. Available at <https://searcherp.techtarget.com/definition/logistics>.

organizations, such as port authorities, railway authorities and customs agencies, in a timely and cent red effective manner.

Figure 1
Example of a supply chain, including logistics



Some of the major functions of logistics are transportation, warehousing, loading/unloading, stuffing. Among the stakeholders in the related supply chain are consignors/consignees, freight carriers, freight forwarders, customs brokers and terminal operation (figure 1).

Transportation, one of the main components of logistics, implies moving cargo from its place of origin, such as manufacturers, warehouses, or terminals, to its destination, the ultimate receiver of the cargo. Cargo can be transported by sea, air, railway, or road, or through multimodal transport.

2.2.2 Logistics information

Logistics information is information generated through the whole supply chain, including, for example, transportation, storage, loading/unloading, packaging and distribution. More specifically, it is the following:

- Information generated on logistics activities, such as transport, packaging, unloading and storage;
- Materials that give value to a specific user for a specific purpose, present or future, in a specific situation.

In other words, valuable logistics information is accumulated while performing the main functions of logistics, such as transport, storage, unloading, and packaging, which are major phased activities of logistics management. The accumulated data, if well organized and analyzed, can be a valuable resource for logistics management.

Accordingly, logistics information can be used to recognize and evaluate the current status of logistics activities and determine the future direction based on this, and will contribute to the achievement of logistics goals by promoting cooperation among participating parties.

Logistics information is generated from various subjects, such as a business entity's system, and Internet of things devices, in any place or any time, which, as a result, gives it a wide scope. Another important characteristic of logistics information is consistency, as there may be a time difference between cargo flow and information flow because cargo moves at a different pace than information flow.

The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT), an intergovernmental body that serves as a focal point for trade facilitation, explains that the logistics information process involves the management of shipping, which is closely related to the management of information flows relevant to logistics. It also clarifies that the management of logistics information processes and systems vary, depending on the sectors and type of goods involved.²

Accordingly, the management of a logistics information system encompasses all its subsystems, such as cargo collection, delivery, transport, storage and loading and unloading.

2.2.3 Logistics Information System

2.2.3.1 Definition

A logistics information system is an information system that enables efficient logistics management by organically combining all logistics functions, such as transport, storage, unloading and packaging, that constitute logistics activities. It, therefore, supports all functional areas of logistics, such as transportation, delivery, warehouse management and order management, and works closely with the activities of corporate management.

The role of a logistics information system is as follows:³

- Provide logistics information on goods and follows their delivery path, progress and status;
- Provide logistics information-sharing with external logistics information systems;
- Adopt international standards to comply with regulations, and use standardized ways

² See <http://tfig.unece.org/contents/logistics-information-process.htm>.

³ Ibid.

of exchanging logistic information with other systems and with authorities.

In addition, the logistics information system carries out the following functions:

- Monitors the actual products and articles to know whether they will arrive on time and in proper condition at the delivery destination, and if it will be possible to take prompt action when incidents occur;
- Monitors the progress and status of the transport means and the transport equipment;
- Detects incidents or delays involving logistics activities, and alerts or reports them to managers or clients.

2.2.3.2 Considerations for introducing the logistics information system

Logistics activities are carried by various organizations, including, among them, enterprises, carriers, distribution centres, wholesalers, retailers and customers. Accordingly, the logistics information system should be planned with the intention to improve the quality of service and reduce logistics costs, while taking into consideration the effects on the environment and the characteristics of the entities involved. In addition, to facilitate the flow of logistics information and minimize the overall logistics cycle, the optimization of the logistics network and interoperability between information elements should be considered.

For a logistics information system to actively respond to internal and external environmental changes, a standard code, which is the most basic element of an information system, standard interfaces and data standards must be defined to enable data compatibility between related subsystems. Moreover, as global trade and logistics expand, interworking with external systems is essential. Consequently, in terms of interoperability, logistics information systems must be developed by applying standards.

The design of a logistics information system should be based on the organization's goals and short- and long-term strategies by considering the complex factors that would affect such a system. In addition, the logistics information system must be flexible so that it can respond to user service demands during the system construction process.

Finally, to fit in with specific characteristics, a logistics information system needs to have capacity to accommodate the following:

- Huge volume of information
- Large gaps in the transmission of between peak times and normal times
- Wide distribution of the source of information
- Concurrency of cargo flow and the logistics flow
- High relevance with other industry sectors, such as customs and trade

In addition, it is necessary to consider the following when designing a logistics information system:

- Ensure real-time processing in terms of the time of information occurrence
- Linkage and interconnectedness between systems so that information can be reused

- The physical flow of cargo
- Emphasis on the work management plan
- Being able to provide predictive services based on accumulated logistics information

2.2.3.3 Types of logistics information systems

There are many types of logistics information systems; among them are transport means management, transportation management, cargo management, facility (equipment) management, and warehouse management. Table 1 shows an example of classifying the logistics information system by means of transport that moves cargo.

Table 1
Examples of the types of logistics information systems

Sea	Land	Railway	Connectivity
<ul style="list-style-type: none"> • Vessel management • Cargo Management • Facility Management • Crew management 	<ul style="list-style-type: none"> • Transport management • Terminal operation • Container yard/container freight station management • Warehouse management • Driver management 	<ul style="list-style-type: none"> • Freight Car management • Freight wagon management • Cargo management • Facility management • Crew management 	<ul style="list-style-type: none"> • Port community system • Single Window • Cargo tracking • Information sharing

When classifying the kind of logistics information systems referred to in table 1, logistics information systems in terms of transportation means and transport management may exist, including, for example, vessel management by the sea, transport management on land, freight car and wagon management in a railway side and airline management.

A terminal operation system, a logistics information system for terminal operation at a road, is used to control and monitor the movement and storage of various types of cargo in and around the container terminal, port or inland depot.⁴ In road transportation, the transportation management system for transport management assists in meeting the demands of transport-related logistics and supports the planning and executing of the transportation of the shipment and optimizing the route of the shipment.

Another logistics information system on the road is a yard management system, which is developed to manage the movement of trucks and trailers at a manufacturing facility, warehouse or distribution centre, and to plan a container loading/unloading position to

⁴ Thomas Ward, "Terminal operating system" selection, Port Technology (2013). Available at https://www.porttechnology.org/technical-papers/terminal_operating_system_selection/

optimize the loading/unloading time.

Finally, the role of a warehouse management system is to help control and manage warehouse operations from the time goods or materials enter a warehouse until they are sent out in the most efficient and cost-effective way. Some of the prominent features of warehouse management systems are inventory tracking, picking and packing goods, shipping, and yard and dock management.

Case study of how to determine the required e logistics information system for moving cargo by transport means

Case 1. Cargo moving from exporter to importer by multimodal transportation (figure 2)

1. Define workflow and the participants: refer to the black arrow in figure 2;
 - Define the interface, electronic messaging, process modelling and other facets;
 - Define the role of each participant.

2. Consider which type of logistics information system is needed at the defined workflow from the participant's roles (refer to the blue box (system) and green star (functions) in figure2)
 - Exporter: warehouse management system, order management and others,
 - Carrier: transportation management system;
 - Terminal: terminal operation system (including yard planning);
 - Port authority: port management system, inspection;
 - Customs: customs declaration system, manifest system, inspection and others;
 - Shipping company: vessel planning system.

3. Consider whether to develop the logistics information system inhouse or use a solution.
 - * Carriers should either implement a transportation operation system or use a solution.
 - * Terminal operators should either implement a terminal operation system or use a solution.

Quiz question 1.

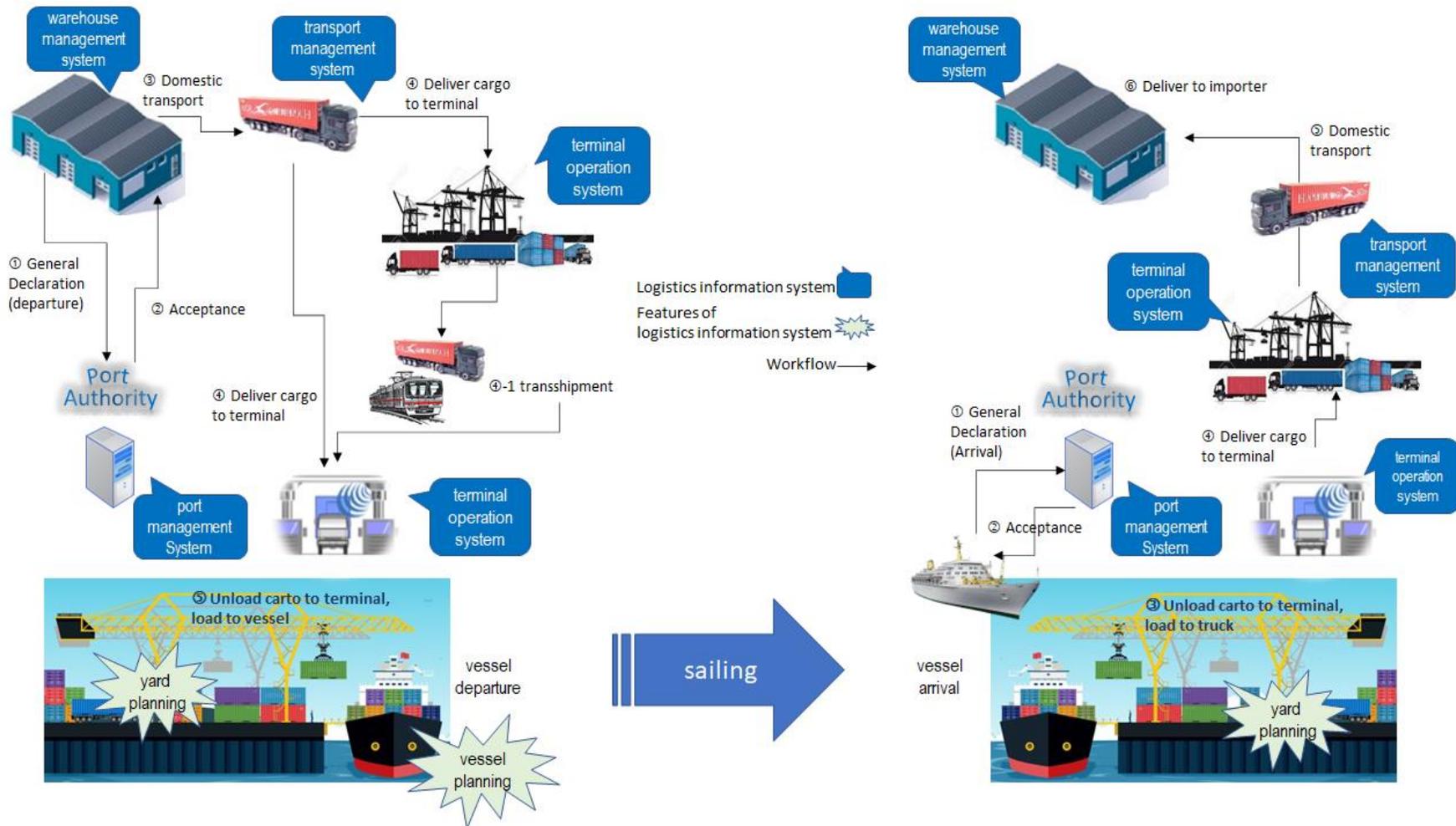
Assume you are a terminal operator.

Which logistics information system is needed for a terminal operator? (Answer:)

- ① transportation management system ② warehouse management system
③ terminal operation system ④ yard management system

Figure 2

Using multimodal transport, such as trucks, railways and vessels in international transport to move cargo



Case 2. Cargo moving from origin to destination by multimodal transportation (figure 3)

1. Define workflow and the participants: refer to black arrow in figure 2:

- Define the interface, electronic messaging, process modelling and other facets;
- Define the role of each participant.

2. Consider which type of logistics information system is needed at the defined workflow from the perspective of the participant (refer to the blue box (system) and green star (functions) in figure III):

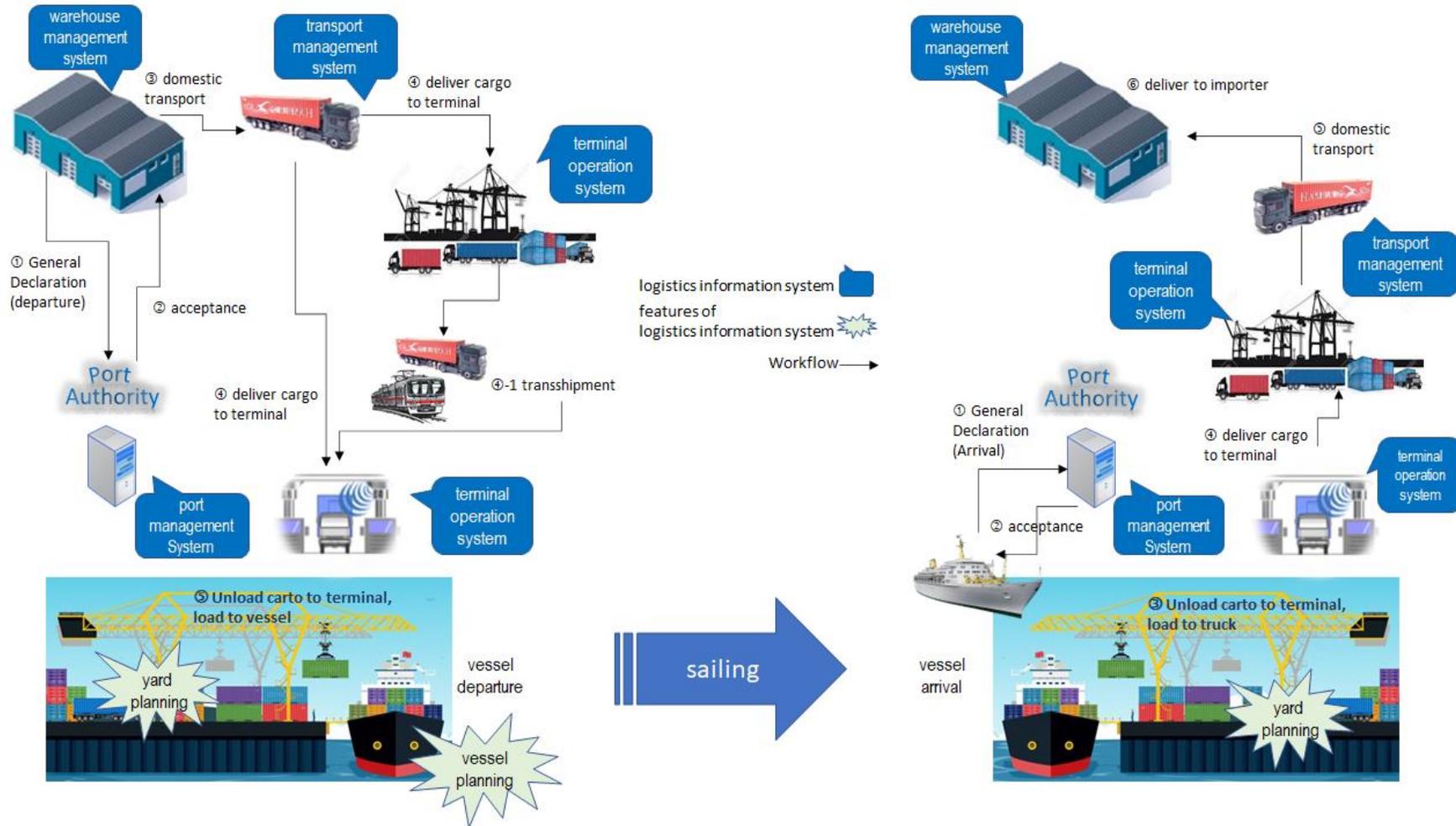
- Cargo owner: warehouse management system, order management and other functions;
- Carrier: transport management system;
- Terminal: terminal operating system, yard management for yard planning and container loading/unloading, and others functions;
- Railway authority: railway logistics information system for wagon and freight car scheduling, container loading/unloading and other functions.

3. Considering whether to develop the logistics information system inhouse or use a solution

- * Carrier should implement a transport management system or use a relevant transport management system solution.
- * Railway authorities should develop a railway logistics information system that includes features for freight wagons and car scheduling and management, and container loading/unloading and other functions or use relevant solutions to these functions.

Figure 3

Moving cargo using multimodal transport, such as trucks and railways in domestic transport



As previously mentioned, the logistics environment is rapidly changing, raising the need to exchange logistics information with counterparts in neighbouring countries to enhance transport connectivity. However, most countries still exchange related documents via a heterogeneous paper format. Under this process, it takes a long time to receive information and process it, raising the need to develop new the information systems and exchange electronic data with other countries using a system involving digital transformation and connectivity.

Some examples of connectivity in the logistics domain are port community systems, single window, NEAL-Net, certificate of origin exchange and road transport control.

The International Port Community Systems Association describes port community systems as being neutral and open electronic platforms, which enable secure exchange of information among public and private stakeholders in order to improve the competitive position of the seaport and airport communities. Through this system, the port and logistic process can be optimized, managed and automated by a single submission of data and connecting transport and logistics chains.

According to the Port Community Systems Association, other characteristics of a port community system operator are as follows:

- A public, private or public-private organization that operates and maintains a port community system, comprised of the core of the organization's business;
- Has a board, or some form of a steering committee, made up of representatives from internal and external groups within the port and logistics community;
- Has signed "service-level agreements" with users of the system to manage the electronic exchange of information between different parties on their behalf.

Single window⁵ is a facility that allows parties involved in trade and transport to lodge standardized messages with a single-entry point to fulfil import, export and transit-related regulatory requirements. For messages that are electronic, individual data elements only need to be submitted one time.

A single window that incorporates logistics should be developed based on general single window concepts and characteristics and expanded to integrate the requirements for transport and logistics. When designing and implementing a single window, the following are required:

- Integration of business and technical aspects;
- Explanation of the necessary technical components;
- Consideration of the system implementation processes and methods.

In addition, a single window system should be developed using an open standard based on

⁵ See UN/CEFACT Recommendation 33 – single window recommendation (https://unece.org/DAM/cefact/recommendations/rec33/rec33_trd352e.pdf).

the framework and emerging technology and standards and comprised of component-based modules

The Northeast Asia Logistics Information Service Network (NEAL-Net), a logistics information-sharing platform involving three countries, China, Japan and the Republic of Korea, was established to promote the sharing of logistics information among East Asian countries. It is guided by a mechanism set up by the China-Japan-Korea Ministerial Conference on Transport and Logistics. The Republic of Korea has developed the Network's NEAL-Net standard message and interface using international standards, such as UNLOCODE, and Electronic Product Code Information Services, which enables port-related information to be exchanged through each country's own information systems.

To keep pace with technical and environmental trends, organizations should try to adapt new systems or new technology to enhance their capabilities.

Quiz question 2.

Users should submit the same e-document to various organizations.

As such, what type of information system is most suitable? (Answer:)

- ① port community systems ② single window
- ③ NEAL-Net ④ e-Freight

2.3 Benefits of a logistics information system

A logistics information system provides the following benefits related to the strengthening of the competitiveness of logistics and increasing the efficiency of the supply chain:

- Optimizes the efficiency and flexibility of logistics activities connecting to each logistics information system;
- Makes information on using a logistic service accessible;
- Transparency, including identification of which entities are handling specific logistics activities;
- Cargo tracking: can check the status of cargo at any time;
- Fault-detect and recovery capability: when a problem occurs, can find out where and when it is occurring and how to resolve it;
- Enhances economic and national competitiveness.

Quiz question 3.

Please map the appropriate information systems for the locations listed in the left column below with the systems listed on the right.

Place		System
Warehouse	<input type="radio"/>	<input type="radio"/> Single window
Container terminal	<input type="radio"/>	<input type="radio"/> Port community system
Yard	<input type="radio"/>	<input type="radio"/> Warehouse management system
Single entry	<input type="radio"/>	<input type="radio"/> Terminal operation system
Community system	<input type="radio"/>	<input type="radio"/> Yard management system

2.4 Methodology for development of a logistics information system

2.4.1 Goal

Business operations and information technology are evolving rapidly, resulting in changes in the complex structure of the connecting network in the logistics industry. As a result, the scope of logistics is becoming globalized and heterogeneous business entities are becoming involved in the global supply chain.

Additionally, participating entities in logistics want to know the current status of their cargo through live information, real-time data that are accurate and timely.

Figure 4 shows the objectives of a logistics information system using new logistics technologies. To achieve them, the system must do the following:

- Ensure visibility with tracking and tracing of consignment and transport means;
- Ensure interoperability using international standards and a common interface;
- Ensure sustainability by applying an eco-friendly strategy.

If these aspects become reality, logistics facilitation and infrastructure will be enhanced through the adaptation of advanced technology and adoption of international standards.

Figure 4

Objectives of the logistics information system

- ❑ Ensure visibility, interoperability, and sustainability of national logistics
- ❑ Ensure paperless transport and transit procedures
- ❑ Innovation with the advanced technology and the enhanced processes

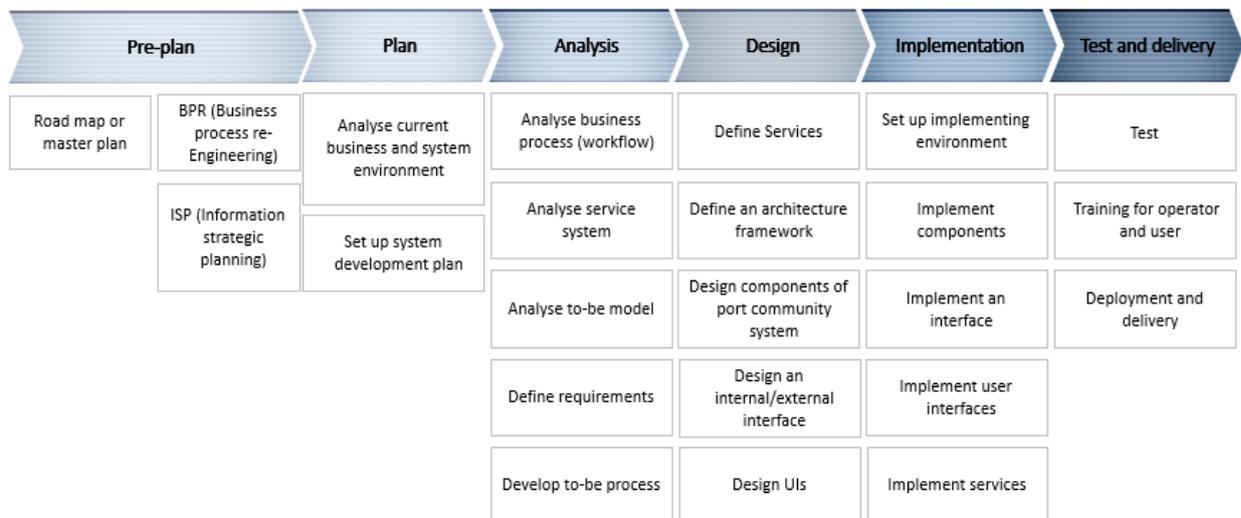


2.4.2 Overview and steps

The process to develop an information system involves many steps, including, among them, analysis, design and implementation. In addition, a system development methodology whose role is to specify tasks and outputs at each step must be applied for the implementation to be effective.

Figure 5

Methodology for the implementation of a logistics information system



In this manual, it is recommended that a technical methodology be used to implement the logistics information system and that a pre-plan stage be added to the general development methodology. The pre-plan stage may consist of a technical road map or a master plan.

The suggested methodology is comprised of five general stages, namely analysis, design, implementation, testing and delivery, in addition to the planning stage (figure 5). The methodology should be formulated so that it can reduce work gathering errors occurring in the operating stage after development and add requirements through to the monitoring stage.

2.4.3 Preliminary requirements for development of a logistics information system

The following requirements need to be considered when starting to implement a logistics information system (figure 6).

Figure 6

Preliminary requirements for the development of a logistics information system



Preliminary requirements for setting up a logistics information system:

- From an environmental and policy perspective: ensure that the system is in sync with national policies and strategies, operational and technical requirements are identified, and an analysis has been conducted on the environmental changes.
- From a strategic perspective: revision of legacy laws, regulations and policies, if necessary, development of a national-level master plan or road map along with securing the required budgets and resources for the master plan or road map and organizing high-level training of professional manpower.
- From the perspective of process innovation: application of advanced technologies, such as the 4IR technology, in order to secure end-to-end visibility through dataization and to provide prediction and demand service to users.

2.4.4 Details of the steps

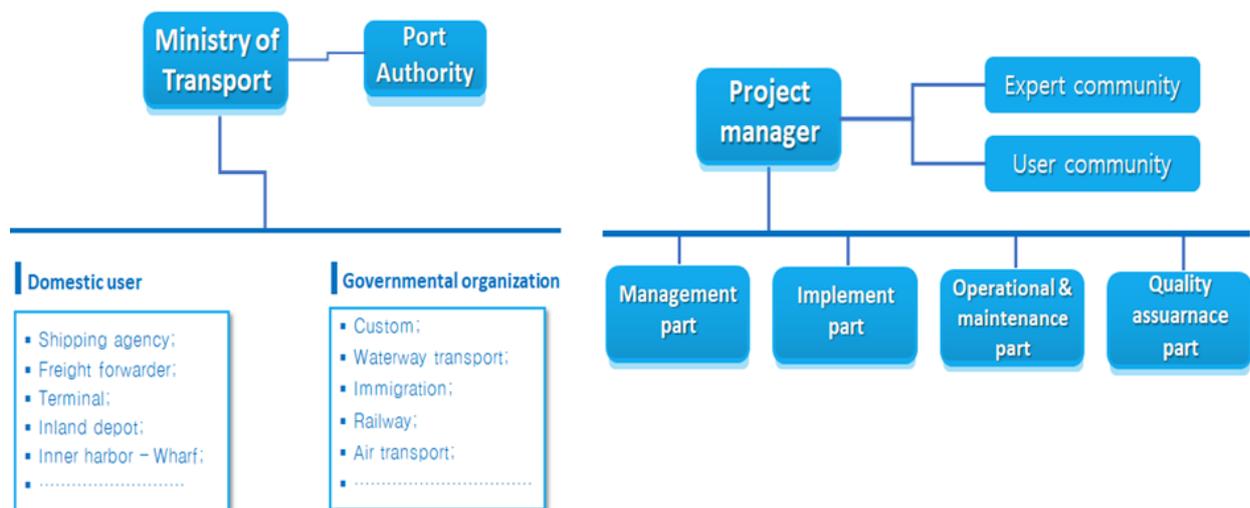
2.4.4.1 Pre-plan

The pre-plan stage includes developing a road map or master plan and setting up a project team before starting implementation. The role of the project team is to successfully implement a project. Suggested participants in the team are a project manager, a leading manager, a coordinator, a quality manager and a programmer for implementation (refer to the right part of figure 7).

In addition, a working relationship should be established with a government entity, such as the ministry of transport, and a dialogue should be nurtured with other organizations and user groups that have logistics information systems or user groups (see the left part of figure 7). Additionally, a strong relationship with domestic users and other governmental entities is required to identify requirements and share logistics information.

Figure 7

Example of a project team for implementing a logistics information system



2.4.4.2 Plan

The planning stage involves checking current logistics business (including the logistics operations) environment, systems and establishing a plan and project schedule for implementing the logistics information system

2.4.4.3 Analysis

In the analysis stage, the challenges, issues and requirements from the user and corresponding parties are identified. Figure 8 shows the detailed flow from the analysis stage to the design stage. After identifying them, it is necessary to consider how to resolve the challenges and fulfil the requirements. Most are either structural, pertaining to some part of the physical operation, or behavioural, which are caused by users' preferences for doing things

in certain ways.

Figure 8

Detailed flow from the analysis stage to the design stage

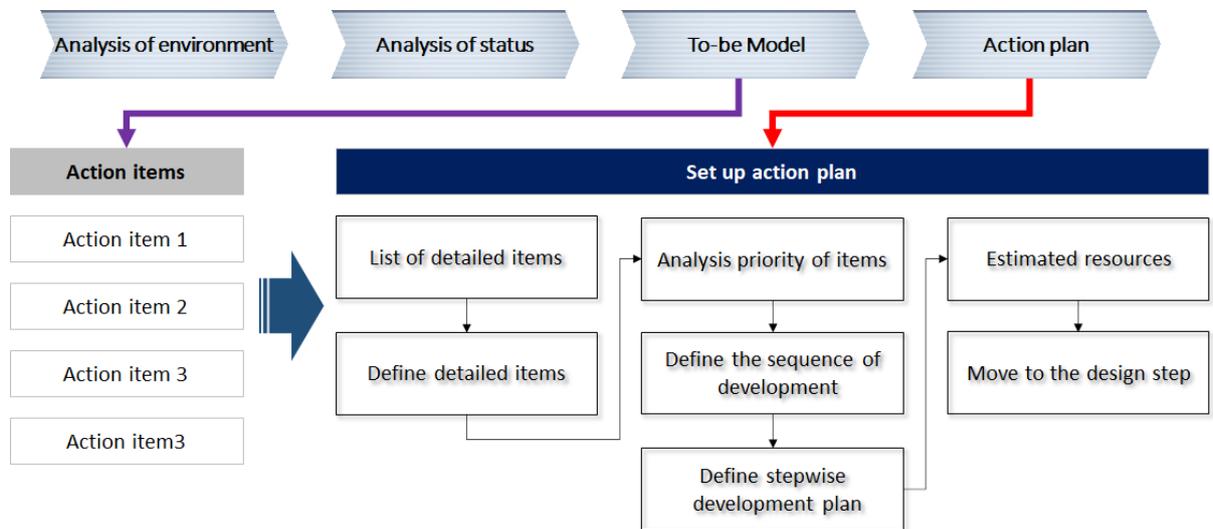


2.4.4.4 Design

The design stage involves developing a to-be model for building a logistics information system accompanied by a detailed discussion of the functions. It also includes checking whether the challenges and requirements identified in the previous stage can be solved through advanced technologies.

Figure 9

How to establish an implementation plan



To fulfil the requirements and address the challenges shown in figure 9, it is necessary to identify a suitable approach and establish an implementation plan. In other words, a list of action items and a step-by-step implementation road map based on the priority results needs to be developed. Figure 9 shows detailed steps for establishing an implementation plan.

The first step involves laying out the goals for each action item and then arranging them based on their relationships between the preceding and following action items. Next, a detailed

implementation plan needs to be development. A lot of iterations are made in the modelling stage, which are then considered when making detailed plans

In addition, a suitable solution or a method for development needs to be identified. Various methods (technologies) should be evaluated and tested to determine the most suitable approach for a specific situation.

2.4.4.5 Implementation

The implementation stage entails developing services, components, modules, interfaces and other items, based on the to-be model designed in the fourth stage. At this point, it is necessary to decide whether to purchase off-the-shelf technology for the implementation of the system or to develop it as part of the project.

When implementing, each component or application should be developed by a model driven method, using an open application programming interface and by a loosely coupled structure. An application refers to a programme or software that supports functions needed for the logistics information system.

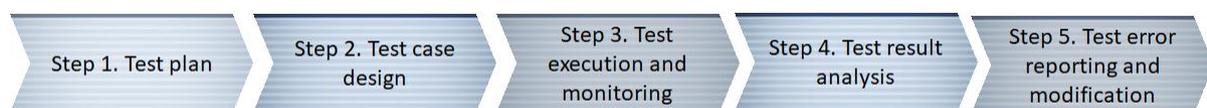
2.4.4.6 Test and Deploy

The final step, test and deploy, is to operate and maintain the logistics information system after testing it. It is important to reduce trial and error during operations after full and extensive testing. Risk management should also be finalized in the operation stage.

During the testing, checking is needed to determine whether the system meets pre-defined requirements and if there are any differences between the expected and actual test results. Testing should be conducted in accordance with the pre-defined procedure for each phase. Figure 10 shows the detailed steps of the test stage.

Figure 10

The detailed steps of the test stage



2.4.5 Example on how to analyse and define action items

The following case is used as a test scenario.

Users apply an e-document (electronic data interchange: EDI) or WEB when a vessel arrives and submit a general declaration to the port authority and then receive a response from port authority's logistics information system. Users also have face-to-face meetings with the port authority for the allocation of a berth and receive a paper document as a confirmation.

At this point, three challenges may occur, which are related to paper document usage, manual processing and using a human handled facility, as shown in figure 11.

Figure 11

Example case for analysis

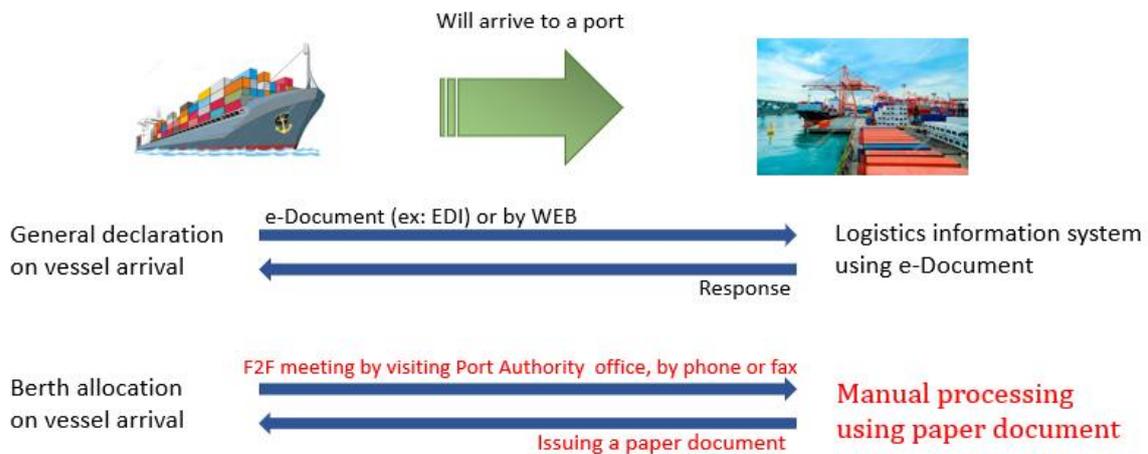
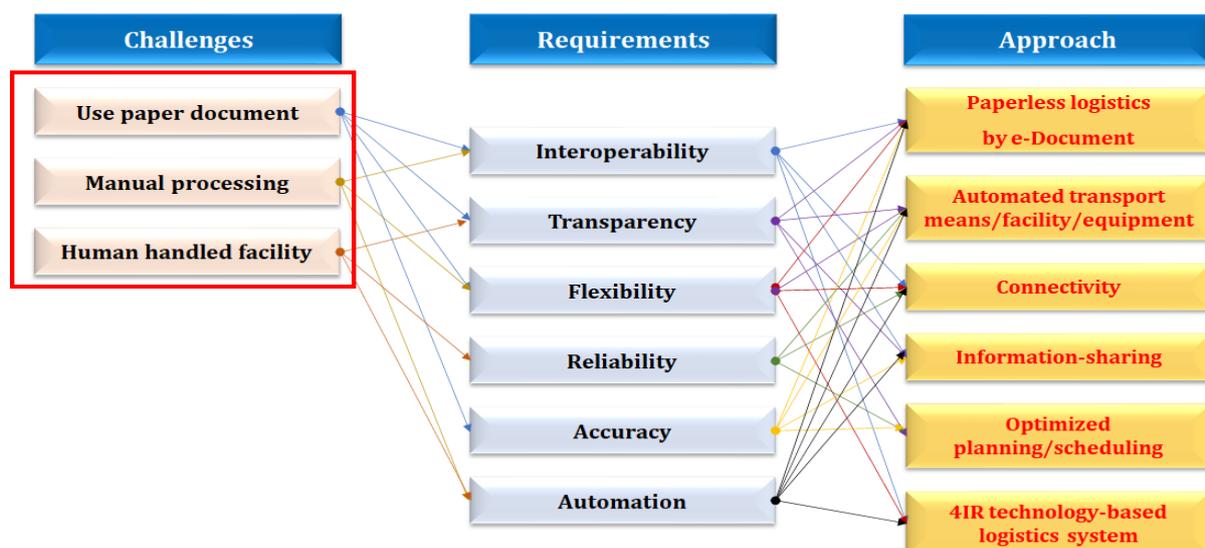


Figure 12

Defining a suitable approach based on requirements and challenges



These challenges may be matched with various requirements, such as interoperability, transparency, accuracy and flexibility (refer to the middle column of figure 12). To meet these requirements, a suitable approach must be identified, for example, using an e-document and connectivity are needed for interoperability (refer to the right column of figure 12).

After determining suitable approaches, an implementation plan that has action items and action plans needs to be developed. For the action items, a stepwise approach based on the priority results must be established. This approach includes defining clearly the goals for each action item and arranging them based on each one's relationship with the preceding and following action items.

To define the priority of action items, priority criteria from various perspectives based on inputs from stakeholder must be established and evaluated:

- In terms of importance, for example, when considering strategic importance, the degree to which the task needs to be fulfilled in relation the vision of the action item should be considered
- In terms of feasibility, for example, regarding technical ease, the degree of difficulty in completing the implementation based on technical level and competence needs to be considered.

3. STANDARDS RECOMMENDED FOR THE DEVELOPMENT OF A LOGISTICS INFORMATION SYSTEM

3.1 Overview

This section includes a discussion on the definition, necessity and the types of standards. In this context, standard refers to reasonable rules, such as products, concepts, methods and procedures, required by consensus and approved by an accredited organization to improve work capability and efficiency in all areas of the industry. Standardization refers to the structured activities that ensure that most entities fit this criterion (standard).

When implementing a logistics information system, the introduction of a unified and common standard is required to do the following:

- Ensure interoperability to exchange logistics information between the participated entities or information systems or interconnect between systems;
- Support scalability and flexibility;
- Support transport and logistics facilitation.

Table 2 shows the various types of standards.

Table 2

Classification of standards

Type	Description
Private standard	• Standard used by specific enterprises
Industry domain standard	• Standards used by specific organizations • ex: ASME, ANSI, OASIS, IEEE.
National standard	• Standards used by specific countries • ex: The Republic of Korea (KS), the United Kingdom (BS), Japan (JIS), China (GB), Russian Federation (GOST), Germany (DIN)
Regional standard	• Standards used by specific regions • ex: PASC, APEC/SCSC. EU CEN, EU ETSI.
International standard	• Standards used by international standard bodies • ex: ISO, IEC, ITU, WCO, UN/CEFACT, ESCAP

- * *ASME*: American Society of Mechanical Engineers
- * *ANSI*: American National Standards Institute
- * *OASIS*: *Organization for the Advancement of Structured Information Standards*
- * *IEEE*: Institute of Electrical and Electronics Engineers
- * *KS*: *Korean Industrial Standards*

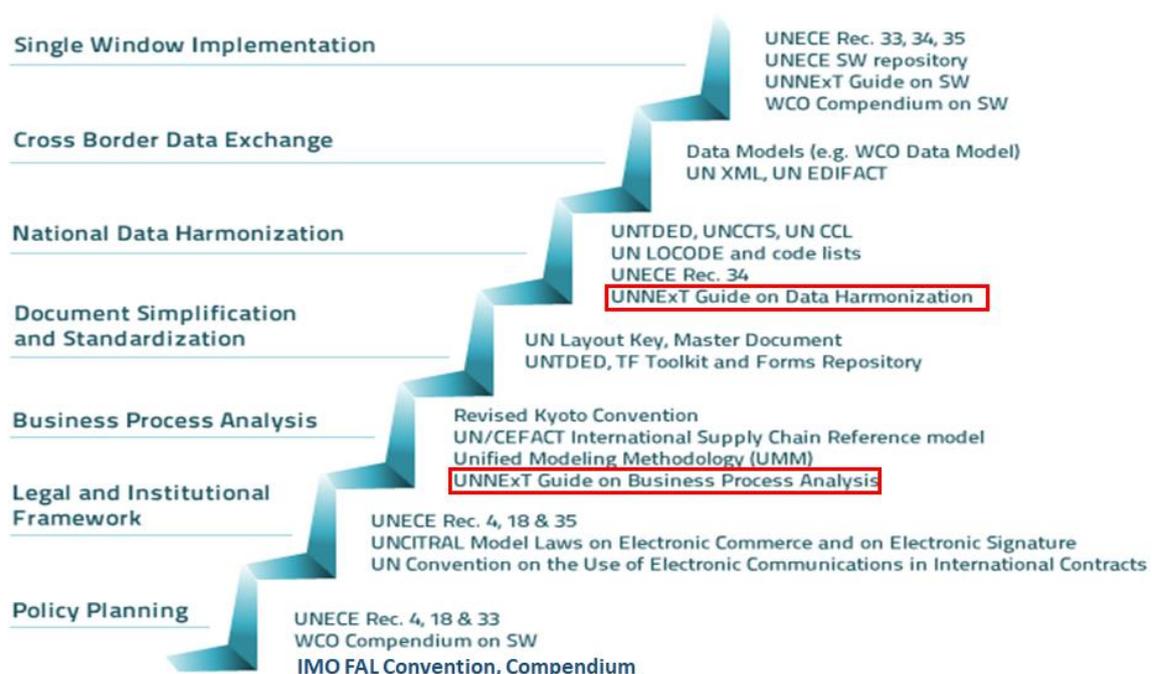
- * *BS: British Standard*
- * *JIS: Japanese Industrial Standards*
- * *GB: Guobiao Standard*
- * *GOST: Gosstandart of the Russian Federation*
- * *DI: Deutsche Industric Normen*
- * *PASC: Pacific Area Standards Congress*
- * *APEC: Asia-Pacific Economy Cooperation*
- * *SCSC: Sub-Committee on Standards and Conformance*
- * *EU: European Union*
- * *CEN: European Committee for Standardization*
- * *ETSI: European Telecommunications Standards Institute*
- * *IEC: International Electrotechnical Commission*
- * *ITU: International Telecommunication Union*

3.2 Recommendations and standards

There are many standards or recommendations for implementing a logistics information system using e-Document. In that regard, UN/CEFACT has divided standards and recommendations for e-business facilitation including trade and transport, into seven categories, as shown in figure 13.

Figure 13

Standards and recommendations for e-business facilitation released by UN/CEFACT



One of seven categories, business process analysis, is used to analyse current business and technical environments, as a basis to identify challenges, issues and problems. The results are useful for designing a to-be model of a logistics information system to tackle current issues and to fulfil the requirements.

Data standardization is essentially defining the needed data elements and assembling them for electronic messaging. Standard data elements and electronic messages are set based on recommendations, guides, technical specifications and a standard code or library.

Single window, which is a good example of connectivity and of a type of logistics information system, is intended to expedite and simplify information flows regarding trade with governments and to benefit all parties involved in cross-border trade.

For a single window, various international standard bodies have issued recommendations and technical specifications. Accordingly, prior to implementing a logistics information system, it is better to reference these standards or recommendations when identifying functionality and activities, or developing the system.

Documents from the entities setting standard are easily accessible on their respective website. They can also be obtained by contacting ESCAP.

3.2.1 United Nations Centre for Trade Facilitation and Electronic Business⁶

The United Nations Centre for Trade Facilitation and Electronic Business is a subsidiary, intergovernmental body of the Economic Commission for Europe (ECE), which serves as a focal point within the United Nations Economic and Social Council for trade facilitation recommendations and electronic business standards. The Centre has a global membership comprised of experts from intergovernmental organizations, individual countries' authorities and the business community.

The Centre has developed and maintained a series of recommendations and standards for international trade and is expanding the coverage to supply chains, including transport.

For business process analysis, ECE has issued technical specifications, such as the UN/CEFACT Modeling Methodology, business requirements specifications and requirements specification mappings.

For data simplification and standardization, ECE has proposed recommendations, standards and technical specifications, such as core component technical specifications (XML Naming and Design Rule) and e-Document standards, including XML schemas, UN/EDIFACT, and core component library.

For connectivity and cross-border data exchange, ECE has issued Recommendation 18 under which measures related to the movement of goods, grouped according to the phases of an

⁶ See <https://unece.org/trade/uncefact>

international trade transaction, are suggested. It has also issued Recommendation 33, which is about single window and its function as a facility that allows parties involved in trade and transport to lodge standardized information and documents at a single-entry point to fulfil import, export, and transit-related regulatory requirements.

Table 3 contains a list of trade facilitation recommendations and table 4 provides code list recommendations; both were issued by UN/CEFACT.

Table 3
Trade facilitation recommendations

Rec. #	Name of the recommendation
Rec. 1	UN Layout Key for Trade Documents
Rec. 4	National Trade Facilitation Bodies
Rec. 6	Aligned Invoice Layout Key for International Trade
Rec. 8	Unique Identification Code Methodology – UNIC
Rec. 11	Documentary Aspects of the Transport of Dangerous Goods
Rec. 12	Measures to Facilitate Maritime Transport Documents Procedures
Rec. 13	Facilitation of Identified Legal Problems in Import Clearance Procedures
Rec. 14	Authentication of Trade Documents
Rec. 15	Simpler Shipping Marks
Rec. 18	Facilitation Measures Related to International Trade Procedures
Rec. 22	Layout Key for Standard Consignment Instructions
Rec. 25	Use of the UN Electronic Data Interchange for Administration, Commerce and Transport Standard (UN/EDIFACT)
Rec. 26	The Commercial Use of Interchange Agreements for Electronic Data Interchange
Rec. 27	Pre-shipment Inspection
Rec. 31	Electronic Commerce Agreement
Rec. 32	E-Commerce Self-Regulatory Instruments (Codes of Conduct)
Rec. 33	Single Window Recommendation
Rec. 34	Data Simplification and Standardization for International Trade
Rec. 35	Establishing a legal framework for international trade Single Window
Rec. 36	Single Window Interoperability
Rec. 37	Single Submission Portals (SSPs)
Rec. 40	Consultation Approaches
Rec. 41	Public-Private Partnerships in Trade Facilitation
Rec. 42	Establishment of a Trade and Transport Facilitation Monitoring Mechanism (TTFMM)
Rec. 43	Sustainable Procurement

Table 4

Code list recommendations

Rec. #	Name of the recommendation
Rec. 3	Code for the Representation of Names of Countries
Rec. 5	Abbreviations of INCOTERMS
Rec. 7	Numerical Representation of Dates, Time and Periods of Time
Rec. 9	Alphabetic Code for the Representation of Currencies
Rec. 10	Codes for the Identification of Ships
Rec. 16	LOCODE Code for Trade and Transport Locations
Rec. 17	Payment Abbreviations for Terms of Payment
Rec. 19	Code for modes of transport
Rec. 20	Codes for Units of Measure Used in International Trade
Rec. 21	Codes for Passengers, Types of Cargo, Packages and Packaging Materials (with Complementary Codes for Package Names)
Rec. 23	Freight Cost Code (FCC)
Rec. 24	Trade and Transport Status Codes
Rec. 28	Codes for Types of Means of Transport

Quiz 4.

Which recommendation among the following was developed for a single window released by UN/CEFACT? (Answer:)

- ① Rec. 19 ② Rec.36 ③ Rec.18 ④ Rec. 33

3.2.2 International Maritime Organization⁷

The International Maritime Organization (IMO) is a specialized agency of the United Nations, which issues measures to improve the safety and security of international shipping and prevent marine pollution from ships. The organization's work supports efforts to realize the Sustainable Development Goals and sets standards for the safety and security of international shipping.

The International Maritime Organization facilitated the adoption of the FAL Convention. The purpose of the Convention is to prevent unnecessary delays in maritime traffic, to promote cooperation between Governments, and to secure the highest practicable degree of uniformity in formalities and other procedures. The FAL Convention has been in force since

⁷ See www.imo.org/

1967, but is amended continually and updated by Governments of the FAL Committee of IMO. The IMO Compendium is a tool for software developers used to design the systems required to support the transmission, receipt and response via electronic data exchange of information needed for the arrival, stay and departure of ships, persons and cargo to a port.

By harmonizing the data elements required during a port call and by standardizing electronic messages, the IMO Compendium facilitates the exchange of information ship to shore and the interoperability of single windows, reducing the administrative burden for ships linked to formalities in ports.

3.2.3 World Customs Organization⁸

The World Customs Organization (WCO) is an intergovernmental organization set up to support the following functions:

- Simplification and standardization of customs technology and regulations at the international level;
- Provide technical support for international exchange of information on customs procedures;
- Support intergovernmental cooperation.

For data standardization and harmonization, WCO offers the WCO Data Model, which is a set of carefully combined data requirements that are mutually supportive to meet the procedural and legal needs of cross-border regulatory agencies, such as customs, controlling export, import and transit transactions.

The WCO Data Model not only includes data sets for different customs procedures, but it also provides information needed by other cross-border regulatory agencies for cross-border release and clearance at the border. The model contains the following information:

- The content of information exchange: business process models;
- The content of information exchange: data sets and code lists;
- The structures of information exchange: information models;
- The technical solutions for information exchange: UN/EDIFACT and XML message design.

In addition, for connectivity or cross-border data exchange, WCO released the WCO Compendium on Single Window.

3.2.4 International Organization for Standardization⁹

The International Organization for Standardization (ISO) is an independent, non-governmental international organization. It has a membership of 165 national standards bodies and provides 23, 787 international standards covering almost all aspects of technology.

⁸ See www.wcoomd.org/.

⁹ See www.iso.org/.

ISO develops the approved global standards to solve the problems of industrial and trade, which vary from country to country.

ISO/IEC 19845:2015, developed for data standardization, specifies the OASIS Universal Business, which defines a generic XML interchange format for business documents that can be restricted or extended to meet the requirements of particular industries. Specifically, it provides the following:

- A suite of structured business objects and their associated semantics expressed as reusable data components and common business documents;
- A library of XML schemas for reusable data components such as "address", "item", and "payment", the common data elements of everyday business documents;
- A set of XML schemas for common business documents, such as "order", "dispatch advice", and "invoice", which are constructed from the UBL library components and can be used in generic procurement and transportation contexts.¹⁰

In addition, another standard, ISO/IEC 19987:2017 defines Version 1.2 of the electric product code of information services. The goal of the electric product code of information services is to enable disparate applications to create and share visibility event data, both within and across enterprises.

3.2.5 Economic and Social Commission for Asia and Pacific¹¹

The Economic and Social Commission for Asia and the Pacific serves as the regional hub of the United Nations tasked with promoting cooperation among countries to achieve inclusive and sustainable development.

The Commission has published the UNNExT Guide on Business Process Analysis for Business Process and the UNNExT Guide on Data Harmonization.

The UNNExT Guide on Business Process Analysis is comprised of UN/CEFACT technical specifications, business requirement specifications, and requirements for specification mapping and modelling using unified modeling language. It is also intended to serve government officials as an instrument for the identification of bottlenecks in trade processes and procedures, the prioritization of areas for improvement and the design of strategies to eliminate these bottlenecks. The business process analysis guide presents a step-by-step approach to business process analysis and the development of recommendations for improvements. The set of practical steps and activities suggested in the guide start with the setting of the scope of the business process analysis project; planning its implementation; collecting relevant data; and presenting them in an easily understandable manner.

The business process analysis guide is directed to practitioners, policymakers from

¹⁰ See <https://www.iso.org/standard/66370.html>.

¹¹ See <https://www.unescap.org/>.

government agencies and the private sector involved in the harmonization and simplification of international trade procedures; the harmonization of related data requirements with the international standard; and the implementation of single window.

The objective of the UNNExT Data Harmonization and Modelling Guide is to assist governments and businesses in harmonizing and standardizing international trade data required in fulfilling import, export and transit-related regulatory requirements. In the guide, a step-by-step approach is presented on how to conduct a data harmonization exercise along with a discussion on the basic concept for assembling electronic messages. The guide's target groups are practitioners, project managers, data modellers and data analysts that are involved in a harmonization project. It complements the UNNExT Business Process Analysis Guide and can be used as a tool in capacity-building efforts.

The final guide listed is the Guide to Implementation of Electronic Messages for Cross-Border Paperless Trade. Developed as a tool to assist Governments and businesses in developing an e-message system to be used for cross-border electronic data exchange, the Guide also supports relevant regional and international agreements and initiatives on cross-border electronic data exchanges by harmonizing trade data and designing electronic messaging for data exchange.

The Guide to Implementation of Electric Messages for Cross-Border Paperless Trade provides a stepwise approach on how to develop and implement an electronic message system for paperless trade data exchange. Building on the UNNExT Business Process Analysis Guide to Simplify Trade Procedures (BPA Guide) and the UNNExT Data Harmonization and Modelling Guide for Single Window Environment (DH Guide), it provides guidance on how to systematically move from process analysis and modelling to data harmonization and modelling, and then to designing an electronic message system.

Quiz question 5

Which of the following is not a standard for business process analysis? (Answer:)

- ① Business requirement specifications
- ② requirements specification mappings
- ③ core component technical specifications BPA
- ④ UNNExT Business Process Analysis Guide

Quiz question 6

What is the standard for data harmonization published ESCAP? (Answer:)

- ① UN/CEFACT Modeling Methodology
- ② Kyoto Convention
- ③ Business requirements specifications
- ④ UNNExT guide on data harmonization

3.3 Implementing a logistics information system (technical points)

3.3.1 General requirements

A logistics information system should be designed and developed based on the objective to improve interoperability and flexibility. A generalized and systematic methodology should be applied for designing the logistics information system. The logistics information system should be configured to the structured and hierarchical IT architecture and designed in a flexible structure to be able to add additional requirements or to easily modify or expand existing modules.

To define the process of the logistics information system, it is necessary to remove redundant or unnecessary processes through AS-IS analysis, and to minimize business transactions by redesigning work processes through process re-engineering. In addition, the design of the logistics information system must include interfaces that are easy to work with and can be integrated into existing systems and interfaces for new systems.

3.3.2 Design methodology

Among the widely used design and development methodologies are DevOps deployment methodology, waterfall development methodology and Agile methodology. Each has its own strengths and weaknesses and works effectively in various situations. Consequently, the selection of a suitable design and development methodology can be a combination of parts of each method that best suits the user's your needs.

The author of this manual recommends the system design and development methodology shown in figure 14.

Figure 14
Implementation methodology (example)



This methodology is comprised of the five general stages of development (analysis, design, implementation, testing and delivery) and the planning stage for design and development in advance and the feedback stage. The main goal of the feedback stage is to attain insight for improving the system by monitoring additional requirements and errors occurring in the operation process after development.

3.3.3 Architecture

The architecture of a logistics information system should be based on enterprise architecture, which offers flexibility and facilitates the integration of advanced technologies for efficient paperless transport and logistics transactions. This architecture was introduced to efficiently manage complex IT resources and for designing suitable systems based on the concept of strategic enterprise management.

By using enterprise architecture, it is possible to minimize trial and error at the decision-making stage through information strategic planning and to consider standardization and interoperability through information resource sharing. Additionally, it helps prevent repetitive developments of an information system.

3.3.4 Messaging

A message standard defines attributes and possible values that a business must use in order to support interoperable electronic message exchange. A standardized message should be the end result of a process involving business process analysis, document simplification and data harmonization. Using a standard-based message ensures that a message is robust, interoperable and reusable for different business sectors and governments.

Main standard bodies publish message standards, including, among them, WCO, UNCEFACT, ISO, OASIS and ESCAP.

- WCO: WCO Data model (DM)
- UN/CEFACT: Core component library (XML Schema, code list, EDI directories, message implementation guide (MIG), etc.
- ISO: ISO 19845:2015 library
- ESCAP: *Data Harmonization and Modelling Guide for Single Window Environment*

3.3.5 Interface

An international standard based interface should be used for data exchange in a cross-border paperless transport environment to maximize interoperability among logistics information systems. International standard bodies have defined communication interface standards for data exchange among different logistics entities, such as Electronic Business Messaging services (ebMS) and WEB Services.

Countries can exchange information with neighbouring countries to conduct cross-border paperless transport and logistics using an interface based on international standard(s), which

can also support user convenience and interoperability. An application refers to programme or software supporting functions needed for exchanging an electronic message among different logistics information systems. When implementing a system, each component or application should be developed using a model-driven method, openAPI, and a system independent data format.

3.3.6 Cybersecurity

Information technology security is needed to protect a firm's digital information and IT assets from malicious and accidental threats from inside and outside of the organization. This includes threat detection, prevention and response using security policies, software tools, and IT services. If security is weak, systems or data can be damaged by threat actors or unintended internal threats.

When implementing and operating a logistics information system, physical security, communication security, user management and the security of the data itself must be accounted for to prevent forgery and alteration of data.

Information security, also known as "infosec", should include a broad range of strategies for managing processes, tools and policies aimed at preventing, detecting, and responding to threats to digital and non-digital information assets.

The logistics information system must be constructed using advanced technology, and the physical environment should evolve into a smart space where people and surrounding objects interact through various sensors and sensory channels. Smart spaces have various advantages, but through them new threats to cybersecurity may arise. As logistics information systems may be operating in smart spaces, cybersecurity is needed to respond to digital security threats.

Quiz question 7

Which of the following is not a standard for electronic messages related to cross-border data exchanging? (Answer:)

- ① IMO FAL Convention
- ② WCO Data Model
- ③ EDIFACT
- ④ ISO 19845:2015 (UBL)

4. CONCLUSION

The rapidly changing landscape of the global trade and logistics environment is increasing the importance of logistics. Accordingly, it is necessary to establish an IT-based logistics information system to secure connectivity between logistics resources, such as consignments, manpower, equipment, facilitate logistics work and strengthen connectivity with external resources.

In addition, it is advisable to secure visibility, interoperability and predictability through a logistics information system that is comprised of standards and uses new technologies, which would improve the overall efficiency of the logistics.

Member States of ESCAP, therefore, need to consider implementing a logistics information system to improve the efficiency of their own logistics operations. Each member State should begin this process by developing a road map or master plan and secure in advance the required budget and resources. Most important, however, is that each member State clarify the level of sophistication of its current system before starting, and then define action plans for developing a logistics information system. Strong leadership and a close relationship between government and other stakeholders are also required.

Previously, some member States had faced analysis or technical difficulties in building a case to develop a logistics information system. With supporting information extended by ESCAP, however member States would be in a better position to fully understand why they need to develop a logistics information system and gain the political will to proceed.

If most organizations in ESCAP member States were to set up logistics information systems that are interconnected, the development of a smart and intelligent logistics networks in the region connected to the global supply chain would be possible. ESCAP member States should work closely with the secretariat to try to improve their capability in accessing the global supply chain through the following actions:

- Participate in international standardization work for international logistics information and systems;
- Define ESCAP standards, including data and an interface, platform for the logistics information system;
- Design a logistics information system standard framework;
- Consider how to share and use the logistics information of logistics information system among member States,
- Consider linking globally logistics information in order to promote a logistics information system for multimodal transportation.

QUIZ AND ANSWERS

Question 1.

Assume that you are a terminal operator.

Which logistics information system is needed for your job function? (Answer: ③)

- ① Transportation management system
- ② Warehouse management system
- ③ Terminal operation system
- ④ Yard management system

Question 2.

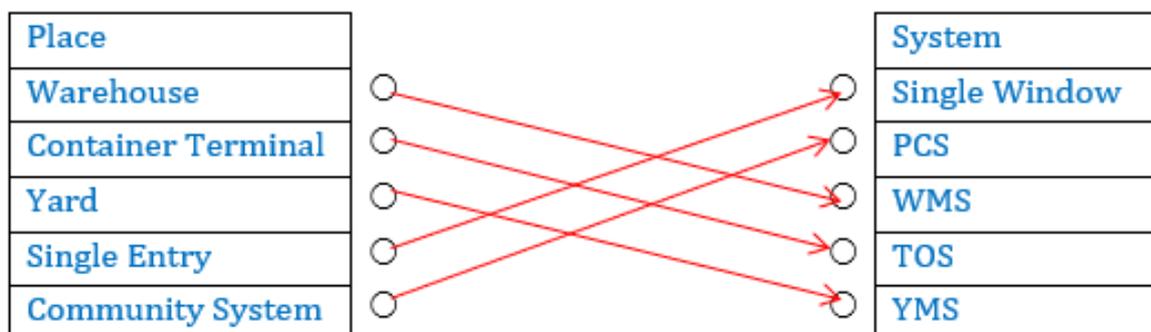
A user needs to submit an e-document to various organization.

Which is the most suitable information system to use? (Answer: ②)

- ① Port community system
- ② Single window
- ③ NEAL-Net
- ④ e-Freight

Question 3.

Mapping the appropriate information systems for the locations listed in the left column with the systems listed on the right.



Question 4.

Which recommendation was developed for a single window under the guidance of UN/CEFACT? (Answer: ②)

- ① Rec. 19 ② Rec.33 ③ Rec.18 ④ Rec. 36

Question 5.

Which of the following is not a standard for business process analysis? (Answer: ③)

- ① Business requirement specification ② Requirement specification mappings
③ Core component technical specifications ④ UNNExT Business Process Analysis Guide

Question 6.

Which standard was developed to accommodate data harmonization under the guidance of ESCAP? (Answer: ④)

- ① UN/CEFACT Modeling Methodology ② Kyoto Convention
③ Business requirements specifications ④ UNNExT Guide on Data Harmonization

Question 7.

Which of the followings is not a standard for electronic messaging for cross-border data exchanging? (Answer: ①)

- ① IMO FAL Convention ② WCO Data Model
③ EDIFACT ④ ISO 19845:2015 (UBL)