STUDY REPORT ON FACILITATION OF PORT COMMUNITY SYSTEM AND NEW TECHNOLOGIES IN SELECTED ESCAP MEMBER COUNTRIES

December 2019
Acknowledgment

The present publication was prepared by the Transport Connectivity and Logistics Section, Transport Division, ESCAP, based on i) data collection and analysis through literature review and field surveys, ii) draft guidelines for Port Community Systems (PCS) development for target member States, and iii) review of the draft guidelines through Capacity building workshop on Strengthening Transport Connectivity among Cambodia, Lao People’s Democratic Republic, Myanmar, Viet Nam and Thailand (CLMV-T), held in Vientiane on 08-09 October 2019. The Workshop was attended by a total of 43 participants from Ministries of Transport and Maritime Administrations from invited countries, as well as representatives of intergovernmental organizations, port authorities, university, research institutes, and private sector. The document was prepared by Mr. Sooyoeb Kim, Economic Affairs Officer, Transport Division with Ms. Kyeongrim Ahn as core author; under the supervision of Ms. Azhar Jaimurzina Ducrest, Chief of Transport Connectivity and Logistics Section.

This study report was prepared by ESCAP with financial assistance and technical input from the Korea Maritime Institute. Grateful acknowledgement is also made to the Government of the Republic of Korea for the generous funding of this study.

The designations employed and the presentation of the material in this report do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries.

This report has been issued without formal editing.
SUMMARY

Port Community System (PCS) is one of the open electronic platforms which connects the multiple systems operated by a variety of organizations and is enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea ports’ communities. From this perspective, PCS has great potential to optimize, manage and automate port and logistics processes through a single submission of data, as well as connecting transport and logistics chains.

Currently, the Port Community System in the Asia-Pacific region vary from port to port depending on the port management system, ICT technologies applied at ports and the degree of development of logistics chain among stakeholders. While not the only neutral and open electronic information system for use in ports, it is one of the most user-friendly and cost-effective thereby making it the most popular. The PCS is considered the most basic and scalable system for small ports in the developing countries.

To support countries’ efforts to establish a Port Community System, ESCAP Transport Division has conducted a study on facilitation of Port Community System and new Technologies in selected ports of CLMV-T as part of its ongoing work on supporting member States in Asia and the Pacific to adopt and implement the Regional Action Plan for Sustainable Transport Development in Asia and the Pacific, Phase I (2017-2021)).

The Study aims to provide a common methodology on facilitation of PCS and new technology in ports of ESCAP Member States in order to provide higher visibility to cargo and transport operations, improve efficiency of port operations, further simplify documentary requirements and procedures and prevent the unnecessary delay of ships calling on the ports in the region.

Study team conducted a field investigation in Cambodia, Viet Name, and Thailand in August 2019 to analyze the status of port operations and to collect the requirements and views of Port Authorities. During this field investigation, study team gathered necessary data through in-depth discussions with the stakeholders.

This Study provides the relevant outputs of the field survey and the recommendations proposed by study team, including different aspects, such as documentary requirements, technical standard, technical specifications, implementation schedule, and expected effects of facilitation of PCS and new technologies in ports.

The focal points, while conducting this field investigation in Cambodia, Viet Name, and Thailand were national Port Authorities: PAS of Cambodia, QNP of Viet Name, Port Authority of Thailand. ESCAP's study team sincerely expresses thanks for the hospitality and the excellent preparation and critical support of the field survey and capacity building workshops provided by these organizations.
<table>
<thead>
<tr>
<th>ABBREVIATIONS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>Artificial Intelligent</td>
</tr>
<tr>
<td>AJAX</td>
<td>Asynchronous JavaScript + XML</td>
</tr>
<tr>
<td>B2B</td>
<td>Business-to-Business</td>
</tr>
<tr>
<td>BP</td>
<td>Business Process</td>
</tr>
<tr>
<td>BPA</td>
<td>Business Process Analysis</td>
</tr>
<tr>
<td>BPR</td>
<td>Business Process Re-engineering</td>
</tr>
<tr>
<td>CCL</td>
<td>Core Component Library</td>
</tr>
<tr>
<td>CIP</td>
<td>Container Inspection Program</td>
</tr>
<tr>
<td>CLMV-T</td>
<td>Cambodia, Laos, Myanmar, Viet Nam, and Thailand</td>
</tr>
<tr>
<td>C/O</td>
<td>Certificate of Origin</td>
</tr>
<tr>
<td>CODECO</td>
<td>Container gate-in/gate-out report message</td>
</tr>
<tr>
<td>DH</td>
<td>Data Harmonization</td>
</tr>
<tr>
<td>DM</td>
<td>Data Model</td>
</tr>
<tr>
<td>EA</td>
<td>Enterprise Architecture</td>
</tr>
<tr>
<td>ebMS</td>
<td>ebXML Messaging Service Specification</td>
</tr>
<tr>
<td>ECMA</td>
<td>European Computer Manufacturer’s Association</td>
</tr>
<tr>
<td>EDI</td>
<td>Electronic Data Interchange</td>
</tr>
<tr>
<td>EEU</td>
<td>Eurasian Economic Union</td>
</tr>
<tr>
<td>ESCAP</td>
<td>Economic and Social Commission for Asia and the Pacific</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAL</td>
<td>The Facilitation Committee</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hyper-Text Transfer Protocol</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IETF</td>
<td>Internet Engineering Task Force</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>ISA</td>
<td>International Society of Automation</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>ISP</td>
<td>Information Strategic Planning</td>
</tr>
<tr>
<td>JSON</td>
<td>JavaScript Object Notation</td>
</tr>
<tr>
<td>MACCS</td>
<td>The Myanmar Automated Cargo Clearance System</td>
</tr>
<tr>
<td>MPA</td>
<td>Myanmar Port Authority</td>
</tr>
<tr>
<td>MVC</td>
<td>Model-View-Controller</td>
</tr>
<tr>
<td>NDR</td>
<td>Naming and Design Rule</td>
</tr>
<tr>
<td>NIEM</td>
<td>National Information Exchange Model</td>
</tr>
<tr>
<td>OASIS</td>
<td>Organization for the Advancement of Structured Information Standards</td>
</tr>
<tr>
<td>PAS</td>
<td>Sihanoukville Autonomous Port of Cambodia</td>
</tr>
<tr>
<td>PCS</td>
<td>Port Community System</td>
</tr>
<tr>
<td>QNP</td>
<td>Quy Nhon Port of Viet Name</td>
</tr>
<tr>
<td>REST</td>
<td>Representational state transfer</td>
</tr>
<tr>
<td>RFC</td>
<td>Request for Comments</td>
</tr>
<tr>
<td>RoRo</td>
<td>Roll-on Roll-off</td>
</tr>
<tr>
<td>SCM</td>
<td>Supply Chain Management</td>
</tr>
<tr>
<td>SEM</td>
<td>Strategic Enterprise Management</td>
</tr>
<tr>
<td>SNS</td>
<td>Social Networking Service</td>
</tr>
<tr>
<td>SMTP</td>
<td>Simple Mail Transfer Protocol</td>
</tr>
<tr>
<td>SOAP</td>
<td>Simple Object Access Protocol</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission Control Protocol/Internet Protocol</td>
</tr>
<tr>
<td>TOS</td>
<td>Terminal Operation system</td>
</tr>
<tr>
<td>TSD</td>
<td>Trusted Source of Data for Business to Consumer applications</td>
</tr>
<tr>
<td>UBL</td>
<td>Universal Business Language</td>
</tr>
<tr>
<td>UDDI</td>
<td>Universal Description Discovery Integration</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
</tr>
<tr>
<td>UN/CEFACT</td>
<td>United Nations Centre for Trade Facilitation and Electronic Business</td>
</tr>
<tr>
<td>UNNExT</td>
<td>United Nations Network of Experts for Paperless Trade and Transport in Asia and the Pacific</td>
</tr>
<tr>
<td>VASSCM</td>
<td>Viet Nam Automated System for Seaport Customs Management</td>
</tr>
<tr>
<td>W3C</td>
<td>World Wide Web Consortium</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>WCO</td>
<td>World Customs Organization</td>
</tr>
<tr>
<td>WSDL</td>
<td>WEB-Service Description Language</td>
</tr>
<tr>
<td>XML</td>
<td>eXtensible Markup Language</td>
</tr>
</tbody>
</table>
1 Introduction

1.1 Background

In today's global logistics system, there is a lot of data and information needed to ensure that all phases of logistical activity are accurate and fast. The development of information and communication technology has dramatically improved the sharing and exchange of information and data needed in trade and transport, and new technologies that still affect business processes and the business environment are emerging from time to time. In particular, efficient processing of logistics information at ports that are the starting and ending point of import and export logistics activities is critical to enhancing the port's productivity and securing the reliability of the global supply chain. The efficient exchange of logistics information among logistics players has a significant impact on the overall logistics performance, such as increased productivity, reduced logistics costs, increased efficiency in integrated multimodal transport, and reduced berthing time of ships.

Port Community System (PCS) is one of the open electronic platforms which connects the multiple systems operated by a variety of organizations and is enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea ports’ communities. From this perspective, PCS has great potential to optimize, manage and automate port and logistics processes through a single submission of data, as well as connecting transport and logistics chains. Currently, the Port Community Systems in the Asia-Pacific region vary from port to port depending on the port management system, ICT technologies applied at ports and the degree of development of logistics chain among stakeholders. While not the only neutral and open electronic information system for use in ports, it is one of the most user-friendly and cost-effective thereby making it the most popular. Other platforms are also considered in this study, however, the PCS system was considered the most basic and scalable system for small ports in the developing countries, so it was identified an appropriate information system for these small ports of the project target countries.

In view of the above, there is an urgent need to establish a Port Community System considering the development status and technical conditions of the port to enhance the productivity of port logistics and to share and exchange accurate and reliable logistics information among relevant stakeholders.

To do this, the project aimed to achieve two main objectives; 1) to assist countries in designing, planning and developing efficient Port Community System to improve logistics information sharing and logistics performance; and 2) to examine the application of various new information and communication technologies, which are currently being discussed in the development of Port Community System. The guidelines developed through this project can be applied to the development of new PCS and expansion of existing PCS, and also can be applied to selected countries as well as other countries.

1.2 Business Context and requirements

Sustainable transport connectivity has been set as an important policy objective in the Regional Action Program Phase I (2017-2021) (RAP Phase I (2017-2021), and studies/workshops/advisory services have been established as one of the outputs of Regional transport operational connectivity. The Port Community System for efficient port clearance and improving logistics information exchang
e is applied in many ports, but for some ports including medium and small-sized ports, there is a lot of room for improvement in terms of information and communication technology application. ESCAP must intervene to strengthen the capacity of Member States to contribute to the achievement of SDGs and objectives of RAP Phase I (2017-2021) through designing, planning and developing Port Community Systems for efficient logistics data exchange and port clearance.

By providing guidelines for establishing efficient Port Community Systems as well as conducting an Expert Group Meeting for disseminating the guideline and policy recommendations, this study contributes to enhancing knowledge and awareness of the stakeholders involved in Port Community Systems and ultimately to improving logistics data exchange between stakeholders and logistic performance in selected member countries.

1.3 Objectives

In today’s global logistics system, there is a lot of data and information needed to ensure that all phases of logistical activity are accurate and fast. The development of information and communication technology has dramatically improved the sharing and exchange of information and data needed in trade and transport, and new technologies that still affect business processes and the business environment are emerging from time to time. In particular, efficient processing of logistics information at ports that are the starting and ending point of import and export logistics activities is critical to enhancing the port’s productivity and securing the reliability of the global supply chain. The efficient exchange of logistics information among logistics players has a significant impact on the overall logistics performance, such as increased productivity, reduced logistics costs, increased efficiency in integrated multimodal transport, and reduced berthing time of ships.

In this context, the project will contribute to fostering progress toward achievement of SDG 9 ‘Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation’, in particular target 9.4 (By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities) and 9.a (Facilitate sustainable and resilient infrastructure development in developing countries through enhanced technological support to least developed countries, landlocked developing countries and small island developing States).

The study team, under the direct supervision of the Chief, Transport Connectivity and Logistics Section, and the project manager, organized and conducted activities on Facilitation of Port Community System and new Technologies in selected ports. The Study team also involved to developing a report of the result of meeting, collecting national plan related to Port Community System, preparation of guidelines to improve information exchange among stakeholders.

The project is aligned with the means of implementation and partnership identified in the Roadmap, with particular contributions being envisaged in the area of enhancing technology by facilitating the sharing of best practices and capacity-building across member countries (para 16 (a)).

The project supports the thematic issue of “connectivity for the 2030 Agenda”, as outlined in the Regional Roadmap for SDG implementation in Asia and the Pacific through improvements in the regional connectivity in terms of transport, information and communications technology and trade. para.31).
The project is directly linked to the objectives described in para 32(a) of the Roadmap:

32(a): Develop and integrate maritime connectivity and implement regional transport facilitation frameworks and other technical standards for operationalizing transport connectivity

1.4 Scope and limitation

Despite the era when state-of-the-art information technology is applied, many member countries still handle port operations based on paper documents, with information and communication technologies, including Electronic Data Exchange (EDI), often remaining an auxiliary tool. While some ports computerize information sharing and data exchanging among stakeholders in the whole logistics chain, there are still many ports that use information technology in limited or partial ways. Documenting, re-entering, and duplicating submissions between various stakeholders are not only at risk of additional time and expense in the trade and transport process but also at risk of human error, counterfeit, and modulation.

As mentioned above, PCS has great potential to optimize, manage and automate port and logistics processes through a single submission of data, as well as connecting transport and logistics chains. In view of the above, there is an urgent need to establish a Port Community System considering the development status and technical conditions of the port to enhance the productivity of port logistics and to share and exchange accurate and reliable logistics information among relevant stakeholders. In this context, ESCAP Transport Division, with financial support from the Korea Maritime Institute, Republic of Korea, conducted a study aiming to assist countries in designing, planning and developing efficient Port Community Systems to improve logistics information sharing and logistics performance.

Therefore, this study has identified the current status and challenges of PCS in the target country, and it is understood that technical guidelines through the research will help strengthen the country’s port informatization capacity. This study also examined the application of various new information and communication technologies, which are currently being discussed in the development of Port Community Systems.

Figure 1 shows the goal of this study on facilitation of PCS and new technologies in ports. Business and IT environments are dramatically changing every day and connecting network of transport domain is changing to complex structure. That means scope of transport becomes globalization and heterogeneous participating entities are involved. Additionally, the participating entities want to know the current status of their cargo and receive live information. Live information means it is a real-time data that is accurate and timely.
To achieve the goal of Figure 1, the following elements are required:

- First is to ensure visibility with tracking and tracing of consignment and transport means;
- Second is to ensure interoperability using international standard and common interface;
- Last is to ensure sustainability with eco-friendly strategic.

All these aspects contribute to port and transport facilitation. To do this, it is able to enhance maritime transport infrastructure if using the advanced technology and international standard.

1.5 Target countries

Target countries of this study are maritime countries in South-East Asia: Cambodia, Myanmar, Thailand and Viet Nam. The report intends to provide the reference guide to policy-makers, port authority, terminal operators and transport service providers in implementing Port Community system (PCS) and introducing new technology in ports. It also provides a useful guidance for project managers in managing an implementation of information systems and a team of experts can used
this report in establishing plan through methodology. Furthermore, this report can help system architects, system designers, and programmers in designing and developing a data exchanging system on facilitation of PCS and new technology in ports of target countries.

1.6 Challenges and issues

This section describes challenges and issues extracted from field investigation conducted on August 2019 as following aspects.

a. Aspects of work processes

- Cambodia: Sihanoukville
  - Port Operation: User sends data to Port Authority by email or SNS, then PAS enter data to system by manually
  - PAS has their own system for port operation such as port clearance, payment, RoRo (Roll-on Roll-off), etc., but not EDI system (IMO FAL Form 1, 2, and 7)
  - Terminal operation: user submits paper document

- Viet Nam: Quy Nhon port
  - QNP (Quy Nhon Port) has their own system. But user submits paper document to QNP.
  - Then QNP enters data by manually to their system
  - QNP sends EDI (CODECO) to user for reporting gate in/out

- Myanmar: Yangon port
  - Operates Port-EDI system on 2018 (1st phase: General Declaration, berth allocation, pilotage, tug boat, tax) in MPA (Myanmar Port Authority) and TOS (Terminal Operating System) in terminals
  - Still remains manual processing and F2F (face-to-Face) meeting

- Thailand: Bangkok port
  - Through the National Single Window, which is led by Thai customs, Bangkok Port handles the arrival and departure of ships and the import and export of container cargoes by Electronic Data Interchange.
  - It was fully implemented in August 2015 and provided services followings:
    . Providing services on Pre-arrival Notification and Ship Arrival Report
    . Port Departure (issue of Port Clearance)
    . Dangerous cargo operation permission
    . Waste/garbage discharge permission
b. Aspect of information sharing
   - Cambodia: No connection and no information sharing with other organizations
   - Viet Nam
     - No connection between QNP and VASSCM (Viet Nam Customs System)
     - QNP just connect to VASSCM and check the related Customs information at VASSCM
   - Myanmar
     - User submit paper or excel by email to MPA
     - MPA converts into MACCS format and submits this data to Myanmar Customs system (called to MACCS) using entering data to Customs client modules
     - Not receive response from MACCS
   - Thailand
     - Sharing information to enable users to conduct electronic transactions with government agencies such as customs and related business sectors through the National Single Window (NSW) system
     - Users can follow up and track any import/export procedures via the internet on 24/7 basis
     - Providing services on Pre-arrival Notification and Ship Arrival Report
       • Port Departure (issue of Port Clearance)
       • Dangerous cargo operation permission
       • Waste/garbage discharge permission
       • Marine Pilot

c. Aspects of constructing information system
   - Cambodia is now implementing Port EDI system and will be launching EDI system on 2021 or 2022 (Port clearance, not PCS)
   - Viet Nam wants to implement information system of port operation
   - Myanmar plan to implement Port-EDI (2nd phase: cargo declaration)
     - After implementing an information system, CLMV-T PA want to exchange information with user or other organizations
     - User strongly want to exchange information with government system using e-document
     - Not considering about information security
     - Some countries already setup a Master Plan or development strategy for systematization or standardization.
Thailand plans to complete the development in 2020 after the As-is analysis and To-be design of the PCS system construction started in the first half of 2019.

2 The technical issues and new trends

2.1 Definition of PCS

- PCS is a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea and air ports’ communities.
- Optimizes, manages and automates port and logistics processes through a single submission of data and connecting transport and logistics chains
- Port Community Systems can, and will, play a major role as Countries move towards the Single Window environment and national logistics standardization;
- will be working together to provide expert opinion on proposed new regulation and contribute to the harmonization and coordination of reporting formalities, processes and procedures

2.2 Standards

2.2.1 For Documents: EDI, XML, UBL, WCO DM, etc.

A message standard defines attributes as well as possible values that a business must use in order to support interoperable e-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, inter-operable and reusable for different business sectors and governments.

Standard bodies, such as World Customs Organization (WCO), International Organization for Standardization (ISO), Consortium for advancing open standards for the information society (OASIS), World Wide Web consortium (W3C) and UNECE through its UN Centre for Trade Facilitation and Electronic Business (UN/CEFACT), are involved in development and publication of relevant standards. Main standard bodies publishing message standards include WCO, UNCEFACT, ISO and OASIS.

If target countries adopt existing standards or submit their information requirements to standardization process of standard bodies, variance in messages would be significantly reduced, and cost of implementing and maintaining them would be decreased.

Therefore, target countries may select one among existing standards depending on each country’s environment. The selected standard may be used to PCS or on exchanging information with other organization’s system.
2.2.2 Interface: WEB Service, Rest (Restfull), ebMS, etc.

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

W3C defines a Web service as a software system designed to support interoperable machine-to-machine interaction over a network\(^1\) and interconnect heterogeneous systems on network. In the earlier period, a WEB service has been based on such technologies as XML (eXtensible Markup Language), SOAP (Simple Object Access Protocol), WSDL (Web Services Description Language), and UDDI (Universal Description Discovery Integration). However, because these technologies are relatively complex and heavy, there have emerged lighter WEB service technologies such as REST (Representational state transfer) (or RESTFul) and JSON (JavaScript Object Notion).

ESCAP member states may exchange information with user or other organizations in conducting transport facilitation using an interface based on international standard(s), which can also support user convenience and interoperability. However, because an interface (communication protocol) is selected based on an agreement among participating entities, they should determine an appropriate interface by considering their circumstances and requirements.

2.2.3 Another Data Format: JSON

JSON (JavaScript Object Notation) is another way to express data for exchange on the Internet. JSON is an open-standard file format, self-describing, and easy for humans to read and write. Some advantages of JSON include: 1) no major restrictions on the type of data JSON can represent; 2) easy for an application to control JSON objects; and, 3) lightweight in file size because it can be exchanged in an object form. JSON originally started as a JavaScript-based format, but it currently supports different languages. It is also an international standard: IETF RFC 7159 (The JavaScript Object Notation (JSON) Data Interchange Format) and ECMA-404 (The JSON Data Interchange Syntax).

JSON is a text format completely language independent. When exchanging data between a browser and a server, the data can only be text. This feature allows users to work with the data as JavaScript objects, without any complicated parsing and translations. JSON uses conventions that are familiar to programmer of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal language for data interchange.

JSON is a standard text-based format for representing structured data based on JavaScript object syntax. Programmers can include standard JavaScript objects inside JSON, such as strings, numbers, arrays, Booleans, and other object literals.

\(^1\) Source: http://www.w3.org/TR/ws-arch/#whatis
2.3 Technical issues

2.3.1 BPR (Business Process Re-engineering)

BPR is a management innovation technique that redesigns organizations, jobs, workflows, governance bodies, and information systems by focusing on the business processes. In other words, BPR optimizes core processes into customer-oriented to secure competitive advantage and enhances work efficiency by combining work process redesign and information technology. Thereby, BPR means activity to improve work efficiency by fundamentally improving work process and changing work process itself.

<table>
<thead>
<tr>
<th>Needs</th>
<th>Basic Principle</th>
<th>The Expected effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Limitation of the existing systems</td>
<td>integration of Business</td>
<td>Customer value maximization</td>
</tr>
<tr>
<td>User requirements diversification</td>
<td>Quick response to environmental changes</td>
<td>The Growth of optimal Production / Revenue</td>
</tr>
<tr>
<td>Internationalization</td>
<td>Management cost reduction with Distributed resource management</td>
<td>Differentiated Customer Service Strategy</td>
</tr>
<tr>
<td>Informatization</td>
<td>Reduction of work time through simultaneous processing</td>
<td>Value-oriented management</td>
</tr>
</tbody>
</table>

Table 1. characteristics of BPR

Seven principles for reengineering a work process and achieving a significant level of improvement in quality, time management, speed and profitability are following;

1. Organize around outcomes, not tasks.
2. Identify all the processes in an organization and prioritize them in order of redesign urgency.
3. Integrate information processing work into the real work that produces the information.
4. Treat geographically dispersed resources as though they were centralized.
5. Link parallel activities in the workflow instead of just integrating their results.
6. Put the decision point where the work is performed and build control into the process.
7. Capture information once and at the source.

The business community’s enthusiasm for business process reengineering inevitably generated many interpretations for how radical change should be implemented. For example, while Hammer used the word reengineering and provided business leaders with broad guiding principles, Thomas
Davenport used the word *redesign* and provided business leaders with more concrete advice, emphasizing the value of prototypes, simulations and tests.

Davenport’s book with James Short, entitled “The New Industrial Engineering: Information Technology and Business Process Redesign,” suggested that business leaders use a five-step approach to radically change workflow:

1. Develop the business vision and process objectives.
2. Identify the processes to be redesigned.
3. Understand and measure the existing processes.
4. Identify IT levers.
5. Design and build a prototype of the new process.

Figure 2 shows the role of IT on conducting BPR against the existing business process. For example, various supporting tool such as modeling, simulation, or requirement elicitation, etc. are needed on conducting BPR such as process or requirement analysis activity. IT in BPR must play an active role in grasping the trend of IT (new technology) and how to introduce IT on BPR to improve business processes. In other words, it means to be changing the existing business processes by utilizing various ITs to enhance the business capability.

**Figure 2. Roles of IT in BPR**

ISP (Information Strategic Planning) is to find strategies and solutions and establish action plans (as following plan) on how to effectively connect and apply information technology in order to achieve the organization’s future.

- Mid and long term informatization plan to establish vision and strategy of information system for effective support of management goals
Development plan for suggesting information system necessary for business development and building integrated information system based on management strategy and plan

Figure 3 show the relationship between BPR and ISP. The business process may be improved through BPR. Through ISP, the current status of IT is assessed to support the business processes, TO-BE model is designed, and action plans is derived. Then, the required information system may be implemented according to action plans.

**Figure 3. The relationship between BPR and ISP**

2.3.2 The advanced technology

The Gartner has been released top 10 strategic technology trends for 2020, that these are composed of technologies having an innovative potential². Figure 4 show the top 10 strategic technology for 2020 released on December 2019.

a. Hyperautomation

Hyperautomation deals with the application of advanced technologies, including artificial intelligence (AI) and machine learning (ML), to increasingly automate processes and augment humans. Hyperautomation extends across a range of tools that can be automated, but also refers to the sophistication of the automation (i.e., discover, analyze, design, automate, measure, monitor, reassess.)

b. Democratization

Democratization of technology means providing people with easy access to technical or business expertise without extensive (and costly) training. It focuses on four key areas - application development, data and analytics, design and knowledge - and is often referred to as “citizen access,” which has led to the rise of citizen data scientists, citizen programmers and more.

² Source: Gartner, https://www.gartner.com/smarterwithgartner/
c. Transparency and traceability

The evolution of technology is creating a trust crisis. As consumers become more aware of how their data is being collected and used, organizations are also recognizing the increasing liability of storing and gathering the data.

Additionally, AI and ML are increasingly used to make decisions in place of humans, evolving the

---

3 Source: Gartner, https://www.gartner.com/smarterwithgartner/
trust crisis and driving the need for ideas like explainable AI and AI governance.

d. The empowered edge

Edge computing is a topology where information processing and content collection and delivery are placed closer to the sources of the information, with the idea that keeping traffic local and distributed will reduce latency. This includes all the technology on the Internet of Things (IoT). Empowered edge looks at how these devices are increasing and forming the foundations for smart spaces, and moves key applications and services closer to the people and devices that use them.

e. Practical blockchain

Blockchain is a type of distributed ledger, an expanding chronologically ordered list of cryptographically signed, irrevocable transactional records shared by all participants in a network. Blockchain also allows parties to trace assets back to their origin, which is beneficial for traditional assets, but also paves the way for other uses such as tracing food-borne illnesses back to the original supplier. It also allows two or more parties who don’t know each other to safely interact in a digital environment and exchange value without the need for a centralized authority.

**What can blockchain do for PCS**

Blockchain is the core technology of the 4th Industrial Revolution and can be called an innovative infrastructure. Block chain, which is attracting attention as a future innovation, can be used in areas such as transport, trade, logistics, distribution, and government public and administrative services, as it can provide mutual trust through a structure that cannot be forged.

The Ministry of Oceans and Fisheries of the Republic of Korea has implemented a pilot project using blockchain technology in maritime transport domain between Busan, the Republic of Korea and Qingdao, China, and provided refrigerated container information attached with IoT equipment about from shipment booking to cargo delivery process in real time using blockchain technology.

Therefore, when the blockchain is introduced in maritime transport, following things including transaction transparency can be guaranteed from possible risks such as unauthorized access, counterfeit, modification, illegal copy, or etc.

- **Ensure Data Integrity**
  - The distributed ledger concept would guarantee the integrity of the data stored in the blockchain as the blockchain is incremented
  - Ensure every piece of information having been generated by its originator

- **Grasp Information on any shipment**
  - Can see the necessary and accurate data that have been tied with the goods to be declared and also keep track of the location and status of such goods in real time
- Ensure Simplification and reliable information sharing
- Increase security
- Multi-use big data
- Guarantee confidentiality
3 Stepwise approach of planning a system implementation for an efficient Port Community System

3.1 Methodology

An information system is developed by going through different steps, such as analysis, design, implementation, etc., using a system development methodology for its effective implementation. A system development methodology specifies tasks and outputs of each step. The Guidelines for setting up a single window system in maritime transport (FAL. 5/Circ. 36) recommends a technical methodology for IMO Member States to implement a single window system.

This report suggests adding BPR/ISP stage to develop technical roadmap or masterplan for study on facilitation of PCS and new technologies in ports. Therefore, this report adopts a commonly used methodology with six phases (pre-plan, plan, analysis, design, implementation, test and delivery), whose phases are shown in Figure 5. Examples of detailed tasks for each phase can be referred to ISO 28005-1:2013. A system designed and implemented based on a generalized and systematic methodology can have a structured and layered architecture and a module-based structure. Such a system is more scalable in incorporating additional requirements, modifying existing modules or connecting to a new information system for data exchange.

Figure 5. Methodology on facilitation of Port Community System and new Technologies in port
3.2 Details of Methodology

3.2.1 Step 1: Pre-Plan of system implementation

Table 2. Tasks and deliverable of methodology – Pre-plan phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Plan</td>
<td>• Develop roadmap or masterplan</td>
<td>• Establish Roadmap or Masterplan</td>
<td>• Roadmap or masterplan</td>
</tr>
<tr>
<td></td>
<td>• Analyze business processes within an organization</td>
<td>• Conduct Business Process Re-engineering and Information Strategic Planning</td>
<td>• BPR output</td>
</tr>
<tr>
<td></td>
<td>• Practice rethinking and redesigning work</td>
<td></td>
<td>• ISP output</td>
</tr>
</tbody>
</table>

3.2.2 Step 2: System Implementation Plan

Table 3. Tasks and deliverable of methodology – Plan phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>• Analyze current business and Understand system environment</td>
<td>• Identify current work processes and relevant systems</td>
<td>• Analysis of existing work processes and systems</td>
</tr>
<tr>
<td></td>
<td>• Establish system development plan</td>
<td>• Team formation, division of labor and development schedule</td>
<td>• Development plan</td>
</tr>
</tbody>
</table>

3.2.3 Step 3: Analysis of system implementation

Table 4. Tasks and deliverable of methodology – Analysis phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis</td>
<td>• Analyze Business Process (work flow)</td>
<td>• Analyze current businesses (work flow)</td>
<td>• Business analysis report</td>
</tr>
<tr>
<td></td>
<td>• Business modeling</td>
<td></td>
<td>• Definition of business</td>
</tr>
<tr>
<td></td>
<td>• Analyze service system</td>
<td>• Service system analysis</td>
<td>• System analysis report</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3.2.4 Step 4: Design of system implementation

**Table 5. Tasks and deliverable of methodology – Design phase**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Define services</td>
<td>• Define business processes as services</td>
<td>• Service list</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Design services to be implemented</td>
<td>• Description document of Service</td>
</tr>
<tr>
<td></td>
<td>Define architecture</td>
<td>• architecture specification &amp; Design</td>
<td>• architecture specification &amp; Design</td>
</tr>
<tr>
<td></td>
<td>framework for PCS</td>
<td>• database design</td>
<td>• database design</td>
</tr>
<tr>
<td></td>
<td>Design components of PCS</td>
<td>• component specification</td>
<td>• component specification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• component design</td>
<td>• component design</td>
</tr>
<tr>
<td></td>
<td>Design interface</td>
<td>• Internal and external Interface specification &amp; Design</td>
<td>• Interface specification &amp; Design</td>
</tr>
<tr>
<td></td>
<td>Design User Interface</td>
<td>• UI design</td>
<td>• UI design</td>
</tr>
</tbody>
</table>
3.2.5 Step 5: System Implementation

**Table 6. Tasks and deliverable of methodology – Implementation phase**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation</td>
<td>Establish development environment</td>
<td>Define development environment</td>
<td>Definition of development environment</td>
</tr>
<tr>
<td></td>
<td>Implement component</td>
<td>Implement components</td>
<td>components codes</td>
</tr>
<tr>
<td></td>
<td>Implement interface</td>
<td>Implement interface</td>
<td>interface codes</td>
</tr>
<tr>
<td></td>
<td>Implement User Interface</td>
<td>Implement UI</td>
<td>UI codes</td>
</tr>
<tr>
<td></td>
<td>Implement services</td>
<td>Implement services</td>
<td>services implementation codes</td>
</tr>
</tbody>
</table>

3.2.6 Step 6: Test and Deployment

**Table 7. Tasks and deliverable of methodology – Test & Operation phase**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test &amp; Delivery</td>
<td>Test</td>
<td>Prepare test cases</td>
<td>Test cases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduct unit test</td>
<td>Result of unit test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design combined and stress test</td>
<td>Combined and stress test specification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduct combined and stress test</td>
<td>Result of combined and stress test</td>
</tr>
<tr>
<td>Training</td>
<td>Prepare user manual</td>
<td>User manual</td>
<td>User manual</td>
</tr>
<tr>
<td></td>
<td>Prepare operator manual</td>
<td>operator manual</td>
<td>operator manual</td>
</tr>
<tr>
<td></td>
<td>Train users and operators</td>
<td>Report on training</td>
<td>Report on training</td>
</tr>
<tr>
<td>Deployment</td>
<td>Takeover test</td>
<td>Result of takeover test</td>
<td>Report on system release</td>
</tr>
<tr>
<td></td>
<td>System release</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
System computerization plan (Action Plan)

3.2.7 Recommendation on procedure

By reference to document FAL 36/5/2, submitted by the Republic of Korea, when implementing information system or interconnecting with other information system, cautions should be paid to the following issues:

- Unified Standard Electronic Document
  
  Processes relevant to single window include general declaration, cargo declaration, and crew/passenger list. All electronic and paper documents used in the government agencies participating in single window should be analyzed and listed by agencies. Only essential data elements will be collected in consideration of usage frequency, importance and connectivity. All the government agencies participating in single window should be able to agree on the collected data elements at this stage.

- Simplified Work Processes
  
  Government agencies participating in single window should define their work processes related to single window. Each agency should describe its work processes in the form of a graphical diagram. By analyzing the work processes, redundant or unnecessary processes may be identified and removed. In addition, by redefining works, work processes of each agency are modified. In this stage, it is highly likely that work processes of each agency are changed with possible amendments to relevant regulations.

- Migration to Existing Information System
  
  Some government agencies may have information systems for processing whole or part of single window services electronically. If electronic documents and work processes are possibly changed, the existing information systems may need to be modified with potential burden of financial costs. Therefore, migration to an existing information system should be considered when electronic documents and work processes are redefined.

- Minimization of User Interface Change
  
  It is possible that users may be confused when work processes are transitioned to an information system such as Port-EDI or single window. In case electronic documents or communication protocols are changed, a relevant adapter should be developed and distributed, or relevant information needed for the development of an adapter should be prepared and distributed to the users. Another alternative would be the development of a web-based system for easy use by users.
3.2.8 Architecture of target system

The architecture illustrated in this report should be applicable to each information system. This architecture, based on the general concept of Enterprise Architecture (EA), aims to support flexibility and easy integration of advanced technologies for efficient paperless trade transactions. EA was introduced to efficiently manage complex IT resources and to design systems suitable for the concept of strategic enterprise management (SEM). With EA, it is possible to minimize trial and error at decision-making stage through an information strategic planning and to consider standardization and interoperability through information resource sharing. Additionally, it can prevent repetitive development of an information system. This report suggests using the following methodologies in designing an architecture of an information system.

- **Model-driven development methodology:** It views developing a software system as an abstraction of complicated business and allows developing a module-based structure of Model-View-Control (MVC) independently. It uses the Unified Modelling Language (UML) as a modelling language.

- **Service-oriented development methodology:** A "service orientation" is based on the "separate of concerns" in software engineering theory. In other words, it is based on the concept of dividing and classifying a big problem into individual areas of interest. Services are platform independent and accessed by applications in a standardized way. Services may be reusable and have a loosely coupled relationship with an architecture.

The architecture illustrated in Figure 6 should be independent of a hardware system, scalable in its structure, and reusable to the extent possible. Additionally, it is better to be designing an architecture that has following characteristics:

- Architecture, based on the general concept of Enterprise Architecture (EA), aims to support flexibility and easy integration of advanced technologies for efficient Port Community System as well as port-EDI, National Single Window, etc.

- EA was introduced to efficiently manage complex IT resources and to design systems suitable for the concept of strategic enterprise management (SEM)

- With EA, it is possible to minimize trial and error at decision-making stage through an information strategic planning and to consider standardization and interoperability through information resource sharing

- Additionally, it can prevent repetitive development of an information system

The architecture also defines all the necessary business processes and low-level functions as simple service components. These components should be stored in a service repository. They can be used as:

---

4. MVC is used to develop an application in a division of View, Model and Control. View is for presentation to users, Model is for processing business logic and Control is for managing Model and View. An MVC pattern is to avoid difficulties in development and maintenance of complicated source codes resulting from the effort to write all the functions within an application. The advantage of an MVC pattern is to realize object-oriented and component-based methodologies.
is or composed (assembled) into more complex services as needed. Users can access service system using standard communication protocols such as Transmission Control Protocol (TCP)/Internet Protocol (IP), Hyper Text Transfer Protocol (HTTP), or WEB Service. A set of services needed to process data and the sequence in which they are executed are determined by additional external logic typically written in any object-oriented language.

**Figure 6. the proposed architecture in this report**

The expected effects are following if the proposed architecture is using on PCS implementation;

- **Enhance the productivity of development**
  - Minimizes the redundancy on implementation by providing Commonly needed features (or functions)
  - Improve the efficiency of development by defining underlying infrastructure

- **Enhance the interoperability**
  - Utilizes open and common technologies or standard
  - Utilizes open source to ensure platform-independency

- **Ensure the standardization of application**
  - Manages effectively source code by providing the standardized development guide

- **Ensure the flexibility for the new technology**
  - Designs service system by the loosely-coupled structure
  - Minimize the modification of interface between modules using common interface
3.2.9 Documentary Requirements

The IMO Compendium explains why it is necessary to exchange e-documents between or within IMO Member States for maritime transport procedures and documentary requirements.

- One of the arguments commonly stated against the paperwork and procedures in maritime transport is that they may give rise to avoidable costs, e.g., those concerning duplication and reproduction of data, a problem which is greatly accentuated when documents contain errors or are not in line with other information.

- Given that massive information is required in international maritime transport, which can result in a mass of paperwork, any method that simplifies the production of numbers and copies of documents is attractive. Many of the difficulties associated with the information flows can be eliminated by the use of the standardized documentation system which the FAL Convention provides through the FAL Forms, i.e. the document layout and information content in compliance with the Convention.

- Although the range of documents aligned to the FAL forms is now fairly extensive, many Governments still do not avail themselves of this facility. The benefits from using the aligned FAL documents should be clear in that the respective formalities, documentary requirements and procedures are simplified and minimized.

- In considering reforms in documentation and procedures, commercial interests will be much influenced by likely effective reductions in the overall cost of financing, handling and moving goods from exporter to importer, seller to buyer. It should be realized in this respect that the direct costs of documents and procedures are only one part of the story. Indirect costs, such as fines, demurrage and loss of business because of inadequate documentation can be far more significant and are often difficult if not impossible to quantify. Documentation and procedural costs in a particular transaction may be minimal yet any one of the many minor errors, which are endemic throughout present systems, may result, for example, in demurrage costs of thousands of dollars.

- In this context, those asking for information, e.g., customs, port authorities, immigration, etc., should ask for minimum amount of information. And, when they ask others to complete their documents (e.g., goods declarations), they should provide a standard format. Those providing information have a responsibility to provide accurate data at the right time in the agreed format. When these conditions are fulfilled, each party – both the provider and receiver of information – can operate efficient documentation systems and carry out their own processes in minimum time.

The IMO Compendium also explains the necessary Electronic Data Interchange Techniques and the IMO FAL Convention on exchanging e-documents. Recently introduced amendments to the Annex to the FAL Convention contains provisions using mandatory implementation of electronic exchange of information, as well as using single window systems are recommended.
Those provisions may be found in section “C. Systems for the electronic exchange of information” of the revised Annex to the FAL Convention (resolution FAL.12(40))

3.2.10 Standard and interface

A message standard defines attributes as well as possible values that a business has to use in order to support interoperable electronic message exchange. Standardization of messages should be the end result of a process involving business process analysis, document simplification and data harmonization. Message standards ensure that messages are robust, inter-operable and reusable for many business sectors and governments. There are many business messages or document standards in use but main ones are published by UN/CEFACT, ISO and OASIS. These standards are split into semantic, syntax and specifications. Semantic standards refer to the meaning of the data, its representation, and its context and how it relates to other documents within a supply chain. The following are semantic standards used in Business to Business (B2B) and Business to Government (B2G).

If decision makers in various parts of a supply chain decided to develop their own unique messages and did not share this with others in a similar position, then it would be very difficult for others involved in them to automate exchange of messages. This is because there would be a different message for every exchange. Instead, if these decision makers decided to adapt an existing standard or to submit the information to a standards process, then varieties of messages used in this exchange would be significantly reduced as well as the cost of implementing and maintaining them.

Each Business Message Standard brings together the appropriate classes, attributes, and values needed to fulfill the message objective. Specific definitions are provided to ensure clarity around class, attributes, and values. Syntax constraints are identified. The standard also includes high level and detailed level class diagrams depicting the scope of message, and relationship of its elements to each other.

- A message standard defines attributes as well as possible values that a business must use in order to support interoperable e-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, inter-operable and reusable for different business sectors and governments
- Port or Terminal related message standards
  - UN/CEFACT EDI or XML
  - IMO FAL Compendium Form 1~7
  - WCO DM
- Reference ESCAP Guideline on business process modeling and e-document development: BPA and DH Guideline
- An international standard based interface should be used for data exchange to maximize interoperability among information systems.
- International standard bodies have defined communication interface standards for data exchange among different entities, such as Electronic Business Messaging services (ebMS) and WEB Services (REST, RESTFull, JSON, etc.).
- CLMV-T country may exchange information with their user or neighboring countries using an interface based on international standard(s), which can also support user convenience and interoperability.

According to document FAL 36/5/6 submitted by the Republic of Korea, ISO, UN/CEFACT and OASIS have already defined ebMS (Electronic Business Messaging) or WEB Service as communication interface standard for data exchange between business entities. This report proposes WEB Service based communication protocol, which is recommended as e-Business communication standard in interconnecting with other information system.

3.2.11 Recommendation on organization plan

**Figure 7.** Organization plan on facilitation of PCS and new technologies in port

- **Organizational level** (left-hand side of Figure 7)
  - Port Authority or the Ministry of Transport of ESCAP member states should be establishing master plan or roadmap on facilitation of PCS and new technology.
  - Then, they will be starting to implement PCS and to link PCS to other logistics information system such as Port EDI or single window.
  - Additionally, they should have a strong relationship with domestic user and other Governmental Organizations to capture requirements and share logistics.
information.

- **Implementation level** (right-hand side of Figure 7)
  - If ESCAP member states decide to start PCS implementation after completing of master plan or roadmap, then below will be needed;
  - Project Manager (PM) should be in charge of overall PCS implementation; the PM should preferably be graduated from any relevant field of engineering and must have at least ten years’ experience as a project manager in any relevant field. PM must have at least eight years’ experience in the field of logistics information construction work.
  - On management part, project leader should act as the coordinator for the performance of Implementation works and also must have at least five years’ experience in the field of logistics information construction work.
  - On implementation part, programmer will act as the field-level engineer for all of the hardware systems such as servers, storage, network and other facilities to be installed under this project. Programmer will act as the field-level engineer for all of the software development to be installed under this Project, such as RFID, System association, WEB, Translation, etc. He/she must have at least five years’ experience as an engineer in any relevant field of the Project including at least three years’ experience in the field of logistics information construction work.
  - On supporting parts, he/she will act as the field-level engineer for Quality Control, and architecture and Framework Design and must have at least five years’ experience as engineer in any relevant field of the Project including at least three years’ experience in the field of Quality Control, and architecture and Framework Design.
3.2.12 Implementation Schedule

Figure 8. Implementation plan

- **System Implementation**
  - Implement Port EDI and PCS
  - Link with other government organization’s information system
  - Link with user information system
  - How to connect with other countries such as ASEAN

- **Service Scope Expanding**
  - Expand Port EDI and PCS
  - Prepare IoT and Mobile Service
  - Nation Single Window
  - Link with other countries
  - Start information sharing service with other country

- **Regional Logistics**
  - ASEAN Single Window Design and Develop
  - Expand the linkage with ASEAN Country
  - Attempt to link with EU, etc.
  - Prepare to introduce the advanced technology

- **International SCM**
  - Global Maritime SCM

- **National Logistics**

- **Expanding Strategic**
  - Capturing Requirements
  - Roadmap or Masterplan
  - BPR/ISP, design & implementation, operational/maintenance, training plan
  - System & Service Design

- **Deploying Stage**

- **Developing Stage**

- **Initiating Stage**

- **Stage 1**

- **Stage 2**

- **Stage 3**

- **Stage 4**

- Time
### Figure 9. Roadmap

<table>
<thead>
<tr>
<th>Goal</th>
<th>System</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
<th>Phase 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visibility</strong></td>
<td>Planning</td>
<td>1st Technical Roadmap</td>
<td></td>
<td>2nd Technical Roadmap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1st Masterplan of Implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Port EDI</td>
<td>Requirements</td>
<td>Implement</td>
<td>Mobile Application</td>
<td>Port Safety with IoT</td>
<td>Interconnect with other information system of other country</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analysis</td>
<td>Test</td>
<td>Interconnect with other information system of public part</td>
<td>Interconnect with other information system of private part</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design</td>
<td>Deploy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single Window</td>
<td></td>
<td>National Single Window</td>
<td>Regional Single Window</td>
<td>IMO Single Window</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Port Community System</td>
<td>Analysis and Design</td>
<td>Implement, Test</td>
<td>Link to National Single Window</td>
<td>Link to Regional Single Window</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interoperability</strong></td>
<td>Link with other organizations</td>
<td>Link to Customs</td>
<td>Link to Road and Railway transport</td>
<td>Link to other organizations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Link with other countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Next Logistics Model</td>
<td>Data Center</td>
<td></td>
<td>Future Model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IoT</td>
<td>Block Chain</td>
<td>Cloud Computing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Big Data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Robotic, AI</td>
</tr>
</tbody>
</table>

- **Goal**:
  - **Visibility**
  - **Interoperability**
  - **Next Logistics Model**
3.2.13 Readiness of implementation

Generally, logistics information system should support flexibility, loosely-coupled structure that is independent of the hardware system, scalability in its structure, extensibility, and possibly reusability. It must also define all the necessary business processes and low-level functions as simple service components. These components can be used as is, or composed (assembled) into more complex services as needed. Users and other organizations can access this information system using standard communication protocols such as TCP/IP, HTTP, WEB Service, and SMTP. If this logistics information system is developed as a Web-based system, which is our recommendation, it will contain a Web server. To process the data transmitted to this logistics information system, we recommend a common internal interface within the logistics information system. The set of services needed to process that data, and the sequence in which they are executed, are determined by additional external logic typically written in Java or any other object-oriented language.
4 Conclusions

As mentioned above, PCSs, despite their high usefulness, differ widely, depending on development stage and application by country and port. The scope of service provision, users, and technologies that apply to information-sharing stake holders are different because the level of informatization by country and the capabilities and demands of ports differ. Despite the introduction of PCS, some of the ports are still maintaining paper-based business practices, and sharing with other government agencies is limited.

However, most port experts are active in the introduction of PCS and expect it to increase work efficiency. This is because there is a limit to developing a sustainable port without informatization, and it cannot meet the demand for information sharing and utilization in the global supply chain. Most ports have a basic environment for informatization and sufficient intentions for adoption, but they often lack the budget and expertise needed to actually scale or upgrade systems.

This report presented the guidelines needed to introduce PCS or expand the existing system, using step-by-step development strategy, but the difficulties faced by ports are political support and budget securing rather than technical challenges.

Technological innovation and change, as noted in the report of the Gartner Group, is happening very quickly, and the port’s competitiveness is bound to face limitations if these changes are not adequately addressed. As technology change will accelerate further in the future, ESCAP member countries need to keep an eye on new trends in technology change and apply the necessary technology in a timely manner to improve business processes and improve productivity and functionality. Many advanced ports recognize PCS as the backbone of informatization, and based on this, they are expanding their service areas and applying new technologies to respond to user demands while also implementing strategies to provide various value added services.

The expected effects of the introduction of PSC, ESCAP and the role of member countries are as follows.

4.1 The Expected Results

PCS will bring the following qualitative advantages for strengthening competitiveness of maritime logistics, national competitiveness and increasing the efficiency of supply chain management:

a. Qualitative effects

• strengthening of the competitiveness of Logistics including transport:
  - Enhancement of national competitiveness by providing high-tech information technology to transport;
  - Maximization of security and stability of dangerous cargo loaded into container.

• the Efficiency of Supply Chain Management (SCM):
  - easy cargo tracking for cargo owner, preventing custom’s delay;
  - minimization of lead time of container, preventing long-term stay;
  - preparation of a basis for response action against CIP (Container Inspection Program)

• strengthening national competitiveness of logistics:
- Providing consistent basic infrastructure related to information sharing;
- Enhancement of quality of service with processing time reduction;
- Construction of unified logistics information service architecture using advanced technology.

• International/domestic standardization on green port:
  - Setting up national standard specification referencing to international standards;
  - Support standard processes by national private companies;
  - Standard work for green port business model.

• Enhance work efficiency:
  - Possibility to set up national maritime logistics management policy;
  - Enhancement of quality of logistics service that is provided to users in ESCAP member states;
  - Ensuring visibility of logistics flow;
  - Enhancement of work productivity in logistics for private sector;
  - Reduction of processing time and cost and eliminate paper documents through standardization and information system;
  - User can easily retrieve their wanted information by accessing to ESCAP member states’ logistics information system every time and everywhere.

b. The Social Effect
• Contribution to national information strategy through expanding the advanced technology to logistics including transport business;
• Grasping ahead in competition through improving quality of service to meet the needs of customers;
• Shortening of the lead time and increase accuracy of work with export/import work automation in maritime area;
• Contribution to enhancing the competitiveness of ports with reduction of logistics costs;
• Reduce congestion of port or terminal by Port-EDI and information sharing;
• Improve competitiveness of ports by sharing logistics information among logistics industry, such as shipping agency, freight forwarder, carrier, etc., academia, and the related organizations of ESCAP member states.

c. Increase in Productivity
• Possibility to construct national integrated logistics network to realize national level logistics service as a way to promote logistics information sharing service;
• Providing user convenience by increasing reusability of logistics information;
• Improvement of work efficiency of Myanmar ports by eliminating manual processing and duplicated data elements.
4.2 The steps to be taken by ESCAP member states

- Define a national-level Roadmap, including
  - Carrying out a comprehensive analysis of industrial ecosystem such as direction of vessel development, change of global economic structure, change of transshipment port, change of trade structure of port city, etc.
  - Organizing task forces team with relevant government agencies
  - Developing detailed strategy and action plans
  - Analyzing which technology is useful to enhance the efficient port connectivity
- Provide Strong leadership to manage task-force team and achieve concrete results
- Maintain close relationship between government and the PCS-related organizations

4.3 The Role of ESCAP

- Prepare a Guide for Smart Port building including PCS, Single Window, Cross-border data exchange for transport facilitation
  - Reference the existing ESCAP Guide such as BPA Guide, UNNExT DH Guide, and GUIDE ON IMPLEMENTATION OF ELECTRONIC MESSAGE FOR CROSS-BORDER PAPERLESS TRADE
  - Reference international guide released by international standard body such as UN/CEFACT or WCO; UN/CEFACT recommendation No. 33, WCO Single Window Compendium, IMO FAL Single Window Guideline, etc.
- Provide and share guide and the related knowledge with ESCAP member states
- Provide Capacity Building Workshop to ESCAP member states
  - Introduce stepwise approach to what to do and how to do for the efficient port connectivity
  - Training as followings;
    - How to perform BPR
    - How to perform business process analysis
    - How to perform data harmonization
    - How to develop e-message
- Provide technical assistance and feasibility analysis for PCS and smart port development

From the perspective of digital innovation and globalization, rapid and accurate information sharing must be developed among related stakeholders to ensure a seamless logistics flow not only within the country but also between countries. In addition, in some countries, PCS is still in the introductory or early stages of development, so paper documents are used in parallel, and information and data-driven business practices are not yet in place. It is difficult for individual ports to adopt PCS right away using the guidelines provided here, but at least they set the standards for development, and use them as basic material to discuss with stakeholders about the technology to be introduced and the range of services to be provided. Meanwhile, it is expected to be used to develop a detail master plan for Port Community System.