Smart and Sustainable Ports: Tools for Implementing Port Community Systems

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SMART AND SUSTAINABLE PORTS

TOOLS FOR IMPLEMENTING PORT COMMUNITY SYSTEMS

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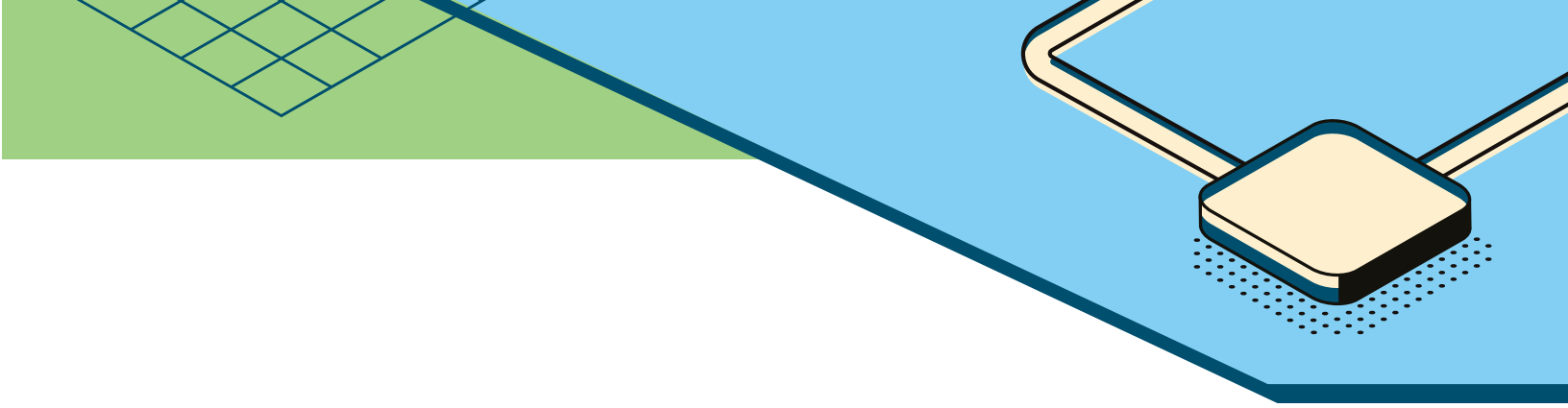
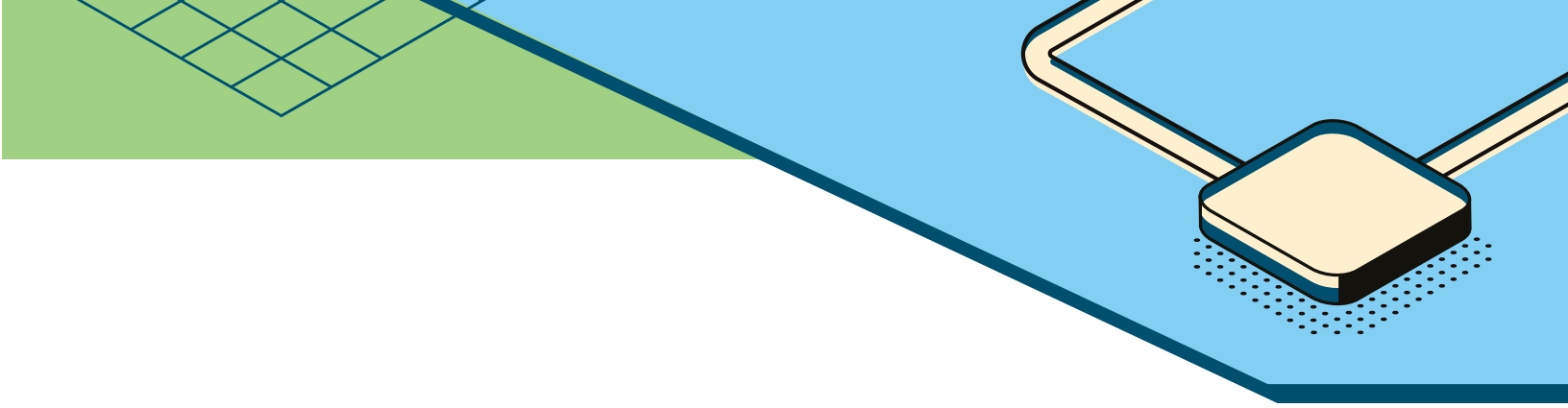


Contents



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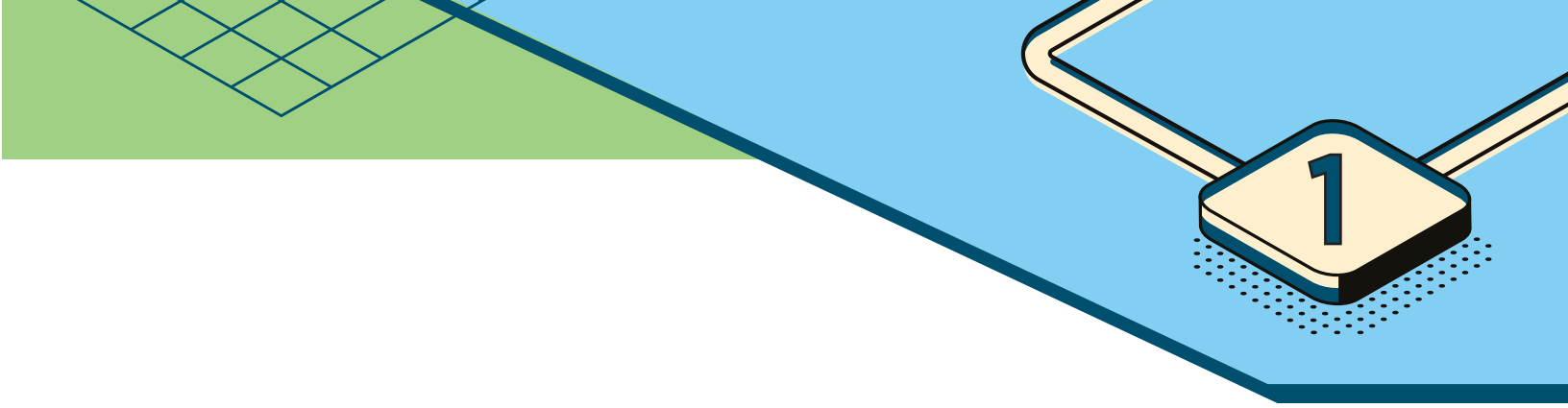


Executive Summary

Ports are critical components of global supply chains, connecting producers and consumers around the world. As such, they play a vital role in facilitating international trade, creating jobs, and driving economic growth. However, the efficiency and competitiveness of a port are influenced by several factors, including the level of integration and collaboration among port stakeholders. In addition, due to geographical capacity constraints, ports are seeking innovative ways to stand out, including by implementing smart and sustainable infrastructure and systems. One such innovation, implemented more in Europe and Asia than in Latin America and the Caribbean until recently, is the port community system (PCS).

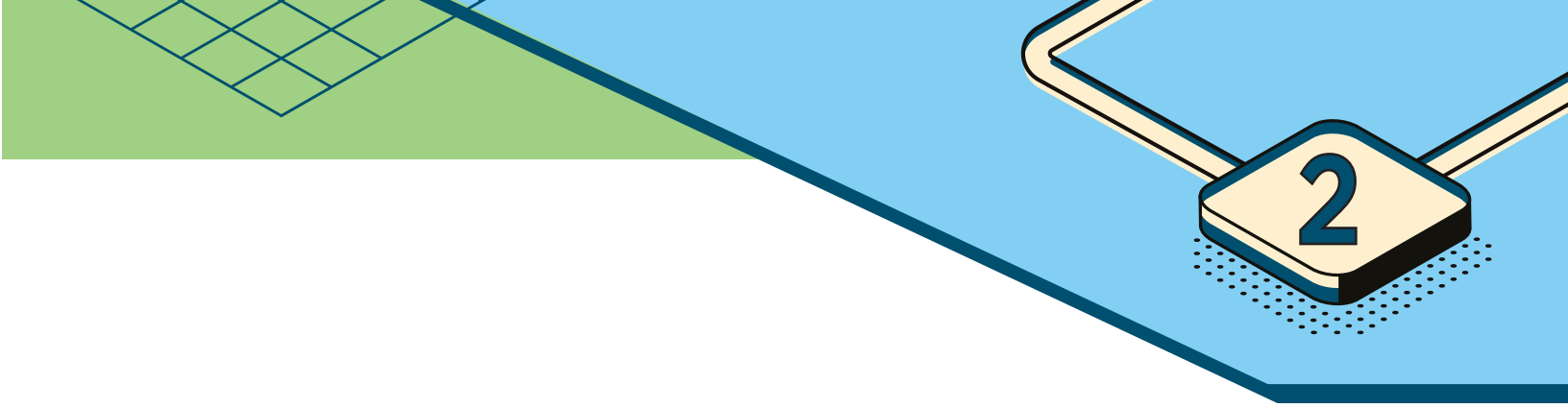
A PCS is an electronic platform that facilitates the exchange of information between various entities involved in port operations, including port authorities, terminal operators, shipping lines, customs, and other agencies involved in goods clearance. By centralizing data and streamlining workflows through a fair operation (neutral, independent, or mixed), the PCS stimulates collaboration, improves logistics efficiencies, and helps reduce the time, cost and complexity of port operations.

One of the primary benefits of a PCS is improved visibility and transparency. By providing a single source for all relevant data, a PCS can help reduce the risk of errors, delays, and disputes. This can be especially valuable for stakeholders like shippers, who need to track the movement of their goods across multiple modes of transport and through various regulatory checkpoints. In addition to improving visibility, a PCS can also help ensure compliance with relevant regulations and standards. The automation of many routine tasks and processes reduces errors and improves quality of data for performing cargo risk analyses, as do business rule validation checks. For example, a PCS can be used to generate and transmit bills of lading, customs declarations, and other documents automatically. Another key advantage of a PCS is improved efficiency and productivity. This can be especially valuable in busy ports, where congestion and delays can be a major challenge. Finally, a PCS can also help improve security and safety in port operations. By centralizing data and providing real-time visibility into port activity, a PCS can help identify potential risks and threats. This can be especially important as ports are high-risk environments where cargo theft and other security issues can pose a significant threat. However, successfully connecting the different organizations and multiple systems that make up a port community is a complex process.

This publication contributes to the literature on PCS in two complementary ways: first, it contains an overview of the legislative, institutional, operational, and technological practices involved in implementing a

PCS, including a detailed look at governance and business models; and second, it provides useful tools for government agencies and the private sector interested in implementing a PCS. These include an Excel-based questionnaire that helps port communities gauge how ready they are to implement a PCS and identify any red flags and gaps they should address urgently; guidelines for creating an advocacy plan, critical for galvanizing and maintaining support of the port community through the creation of committees and the identification of champions; and a methodology for assessing the qualitative and quantitative benefits that a PCS would bring a given port.

The implementation of a PCS is a long process which requires commitment and constant engagement by both the public and private sector. This publication aims to reduce the complexity of designing and implementing a PCS by providing useful tools to assess a port community's readiness before initiating a PCS project and then support the successful execution and transition from project to operations.



Introduction

The need to improve port processes and increase efficiency has become paramount in the current economic climate. As ports have evolved, numerous solutions and systems have emerged to respond to new challenges within port ecosystems. One of the most significant of these is the port community system (PCS), an electronic platform that connects the different systems operated by stakeholders in a port, allowing information to be exchanged efficiently among them (figure 1). According to the International Port Community System Association (IPCSA), a PCS "optimizes, manages and automates port and logistics processes through a single submission of data and connecting transport and logistics chains."[1]

Implementing a PCS can help ports and countries save time, money, and effort. A PCS also adds value by offering a portfolio of services that streamline trade-related processes, transportation, and regulatory requirements. Some examples of the benefits a PCS can bring include:

- Reduced paperwork, office work, administrative tasks, and waiting times in the drafting, sending, or reception of documents or information to public authorities or other parties;
- Less task duplication, as data does not need to be reentered into different systems;
- The automation of standard and ad-hoc reports, which reduces the time needed to gather, sort, and consolidate data manually and improves decision-making;
- Greater information transparency and advance information on the goods that arrive at the port;
- Better traceability for both the public and private sector thanks to real-time data and fast access to information; and
- More competitive ports due to more efficient coordination of port services and cargo inspections and controls by different public authorities.

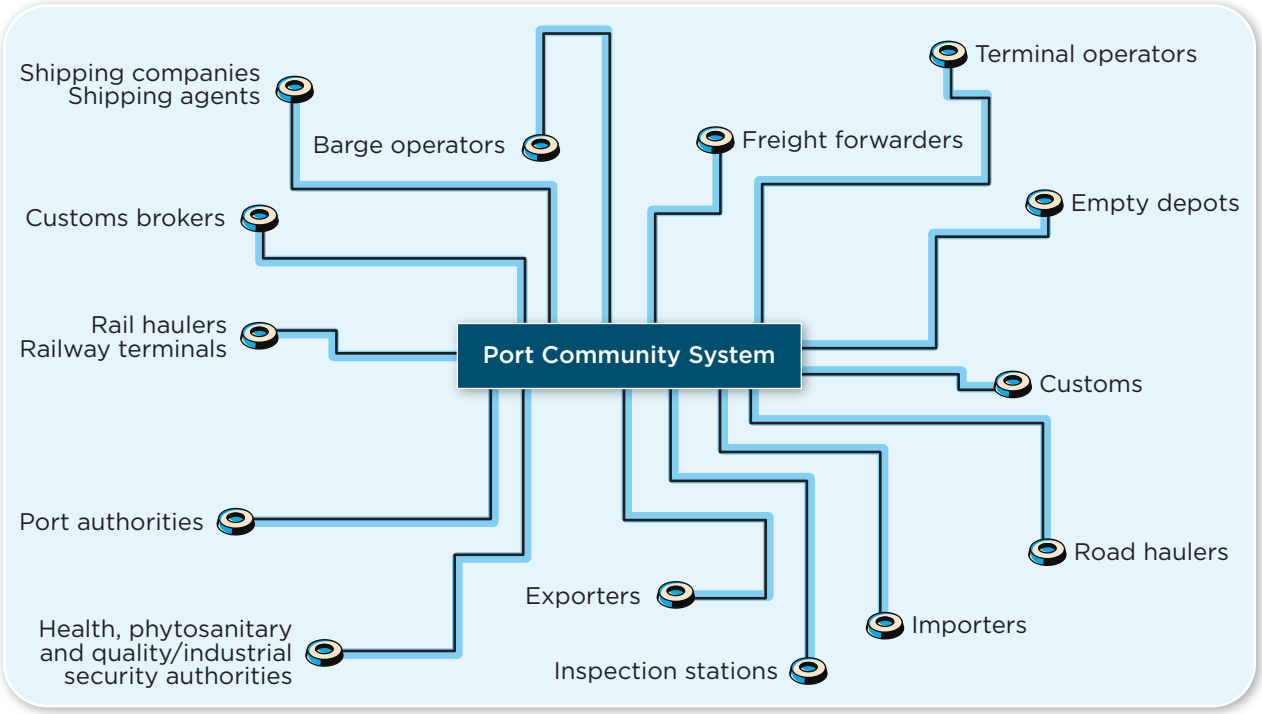
However, successfully connecting the multiple systems operated by the different organizations that make up a port community is a complex process.

Consistent with its mandate to support regional integration and increase productivity in Latin America and the Caribbean, the IDB approved a regional public good in 2020 to develop and deliver tools to support the implementation of PCS and trade single windows.[2] In addition to providing some new data and relevant contextual information, this publication contributes three user-friendly tools:

- An Excel-based questionnaire that assesses a port community's readiness to implement a PCS;

[1] https://ipcsa.international/pcs/pcs-general/.
[2] In addition to knowledge generation and transfer, the IDB, through its Trade and Investment Division, is supporting the implementation of PCS platforms, both financially and through technical assistance, in over 12 countries in Latin America and the Caribbean.

Figure 1 Users of Port Community Systems



Source: IDOM.

- Guidelines for developing an advocacy plan, essential for creating, nurturing, and sustaining stakeholder engagement; and
- A methodology for assessing the qualitative and quantitative benefits that a PCS would bring to a given port.

The rest of this document is organized as follows. Section 3 introduces key concepts and the typical stakeholders in a PCS before taking a detailed look at governance models, technological infrastructure, and operational and legal considerations. Section 4 focuses on the first practical tool for implementing a PCS, the PCS Readiness Assessment Questionnaire, and is intended to be read before completing the latter. Section 5 includes guidelines for creating an advocacy plan and outlines a methodology for estimating the qualitative and quantitative benefits a PCS will bring. Together, the three tools will help evaluators analyze shortfalls in their current systems, identify areas for improvement, and start planning a course of action to move forward.

Ultimately, the tools provided through this regional public good can ensure that a PCS project is initiated when the community is ready to do so, avoiding the risk of additional financial costs, delays, and possible noncompliance or lack of use by stakeholders. Adequate preparedness and a strong community, forged from consultations and through leadership, will ensure a successful implementation of a PCS, benefiting all stakeholders.

Context and Background Information

Prior to initiating a PCS project, the value associated with its implementation must be evaluated for each stakeholder in the port community. These benefits can be analyzed both quantitatively and qualitatively—methodologies for doing so are presented in section 5.2. In terms of quantitative benefits, table 1 provides some examples of the cost savings from the implementation of a PCS, demonstrating a value-for-money proposition for all stakeholders.

Table 2 lists the main benefits that a PCS brings to each stakeholder.

The following section is intended to be read before completing the questionnaire as it provides helpful explanations and context on four different aspects of port operations that are addressed in it, namely institutional, technological, legal, and operational issues.[3]

3.1. Institutional infrastructure

The institutional aspects of ports comprise the main stakeholders and institutional frameworks that are needed to establish a port community committee (PCC) and, eventually, a PCS.

3.1.1. Port communities

A port community is a group of public or private stakeholders operating in the port environment that intervene either directly or indirectly in port logistics processes.

[3] Additional background information on PCS is available in Mendes Constante, J. 2019. International Case Studies and Good Practices for Implementing Port Community Systems, IDB Technical Note no. IDB-TN-1641, Washington, DC: IDB; available at http://dx.doi.org/10.18235/0001665.

Table 1 Savings Brought by PCSs Worldwide

Country / Port	PCS	Savings
The Netherlands	Portbase	US$59 million per year
Jamaica	Jamaica PCS	US$13 million per year
Valencia	ValenciaportPCS	US$27 million per year
Singapore	Portnet	US$80 million over three years

Source: PCS websites and IDOM projects.

Table 2 Main Benefits of a PCS, by Stakeholder

Stakeholder	Benefits
Port authorities	• Ease of coordinating port activities and services. • Better supervision of the activities of port operators. • Time-dependent, accurate database for decision-making and developing strategic plans. • Compliance with standards and regulations.
Maritime authorities	• More efficient coordination of the vessel and cargo inspections. • Automatic reception of port call documents and certificates once submitted by the shipping agent. • Access to vessel and cargo traceability.
Customs authority	• Better traceability and control of cargo thanks to real-time data and fast access to information. • More efficient planning of inspections. • Better quality of data for performing cargo risk analyses. • Reduction in illegal transactions. • Reception of vessel loading or unloading lists of cargo carried on board at the same time as terminal operators.
Terminal operators	• Improved competitiveness thanks to increased operational efficiency. • More precise estimation of required labor (stevedores) and handling equipment at the terminal. • More accurate planning thanks to real-time data and information received in advance.
Shipping companies	• Greater vessel traceability at the port area. • Ensure quality of real-time data and information related to vessel services and events in the port area. • Possibility of using integrated port logistics services instead of isolated services.
Shipping agents	• Reduction of communication channels between shipping agents and public authorities as PCS is the unique point of entry. • More efficient vessel operations thanks to data-sharing between shipping agents, terminal operators, service providers, port authority, the coast guard, etc. • More efficient coordination of inspection on board vessels by different public authorities and of port services. • Compliance with standards and regulations.
Freight forwarders	• Use of a single platform to manage bookings with shipping companies. • Reduction of transaction expenses and human errors when introducing data manually.
Customs brokers	• Less time spent on introducing data manually, since most data will be available in the system. • Simplification of customs processes without the use of paper-based documents. • More efficient coordination of cargo inspections by customs and/or other public authorities. • Real-time cargo traceability, enabling customs brokers to monitor its status.
Haulage coordinators	• Faster and more efficient coordination of road haulage thanks to electronic transportation orders and vehicle booking systems. • More efficient coordination with haulers and empty container depots to pick up or deliver empty containers.

(continued on next page)

Table 2 Main Benefits of a PCS, by Stakeholder *(continued)*

Stakeholder	Benefits
Haulers	• Optimization of work and shorter waiting times thanks to the use of vehicle booking systems. • Increased transparency around the duration of cargo handling at port, allowing haulers and truckers to better plan their trips and improve overall turnaround times. • Interoperability between all port supply chain systems and more efficient communication. • Better traceability of truck operations.
Importers/exporters	• Reduction of manual data entry and procedures. • Reduced import/export cargo dwell time. • Greater traceability of goods. • Greater visibility and transparency around the status of goods, as all port logistics processes are in a single portal.

Source: Carlan, V., Sys, C., & Vanelslander, T. 2016. How Port Community Systems Can Contribute to Port Competitiveness: Developing a Cost–benefit Framework, Research in Transportation Business & Management 19: 51–64. Available at https://www.sciencedirect.com/science/article/abs/pii/S2210539516300141.

They include shipping companies, shipping agents, terminal operators, customs authorities, customs brokers, road haulers, etc. These subsections deal with institutional port communities with an established management model.

Port communities tend to develop over time, such that some countries or ports have already developed more advanced port communities, while others are still at the early stages. Identifying the level of maturity of the community will help ensure that advocacy strategies and risk mitigation plans are put in place when the PCS is being developed. These levels of maturity can be categorized as follows:

- **Low**: relationships between stakeholders and the business processes are established but the criteria and the basis on which the port community will be built have yet to be agreed on by the stakeholders.
- **Medium**: the strategic objectives and roadmap of the port community have been defined and the stakeholders' core processes have been digitized.
- **High**: the port community is ready to launch key cooperative projects such as a PCS and/or other projects that involve various stakeholders.

3.1.1.1. Stakeholders in port communities

The specific ministries and institutions involved in a port community, their functions, and objectives will differ from country to country. They include **public institutions,** such as the ports and maritime authorities and customs agencies, as well as **private stakeholders,** such as transportation companies, shipping agents and customs brokers. For a list of potential stakeholders in a PCS, see appendix 1.

The public institutions involved in port communities need to have a mandate to carry out certain functions that are relevant to their remits (see appendix 2 for a complete list of these functions).

3.1.1.2. The port community committee

PCCs are steering committees that generate consensus among stakeholders, improve communication and coordination, and address the issues of a demanding industry. The PCC needs to be recognized and validated by the other members of the port community, have sufficient resources, be available to spearhead initiatives, and have the executive powers necessary to carry out its functions.

3.1.2. Implementing a PCS

Once the PCC has been established and has been widely accepted by the stakeholders, work can begin on implementing a PCS. Before launching this, certain steps should be taken to avoid risks such as a low rate of buy-in from the port community or a lack of resources to change the management system. These essential steps are explained in the following subsections.

3.1.2.1. Step 1: Create PCS committees

To successfully implement a PCS and ensure that its members are willing to adopt new processes and a PCS culture, certain committees need to be established that include representatives of these same agencies/organizations. The port community must understand that implementing a PCS and reengineering processes will benefit all stakeholders, not just a specific member or sector, as it will streamline work within port logistics chains. Doing so makes sense because in a globalized world, competition takes place between logistics chains in different geographical areas rather than between companies within the same logistics chain or port.

The first step toward increasing the port community's acceptance of a PCS project is to create a three-tier institutional framework to promote a holistic approach to developing efficiency and resilience in the community.[4] These committees are each chaired by a president and should meet regularly to keep up the momentum of the process of establishing a PCS. A committee is required for each of the tiers, which are described briefly below (see appendix 4 for more details):

- **Level 1: Interministerial committee**
  This committee will focus on strategic coordination, driving innovation and policy reform and legal/regulatory review. It usually comprises high-ranking decision-makers such as ministers or vice-ministers/permanent secretaries. Ideally, the interministerial committee should meet quarterly, and a representative from the office of the prime minister or president could act as its president, given the "all of government" approach that PCS implementation requires. Efforts should be made to include PCS as a critical agenda item in countries where existing interministerial committees are operational, rather than attempt to create a new committee.

[4] This a good practice that is recognized by the International Association of Ports and Harbors (IAPH). World Bank. 2020. "Accelerating Digitization: Critical Actions to Strengthen the Resilience of the Maritime Supply Chain." Washington, DC: World Bank. *https://thedocs.worldbank.org/en/doc/773741610730436879-0190022021/original/AcceleratingDigitalizationAcrosstheMaritimeSupplyChain.pdf*.

- **Level 2: Steering committee**
  The steering committee should be made up of the directors general of public agencies and members of the upper management of private bodies. The main function of this committee is to spearhead the digital maritime trade and logistics roadmap while also seeking to guarantee the sustainability of digital platforms and systems. The steering committee could meet monthly and the port authority, maritime affairs, customs, and/or foreign trade representatives would all be appropriate choices for presiding over it.
- **Business process committee**
  The business process committee should include representatives of both the public and private stakeholders involved in the project. Each entity should nominate two individuals who are preferably business process experts in their respective organizations.

The committee will participate in analyzing, optimizing, automating, re-engineering, and rethinking the business process roadmap. This committee is expected to play a key role in the long-term evolution and sustainability of digital business processes. The business process committee could meet quarterly, and a representative from the leading agency/champion would be the best person to preside over it.

3.1.2.2. Step 2: Set up technical working groups

Once the committees described in section 3.1.2.1 have been defined, working groups involving different stakeholders in the port logistics chain should be created. Their tasks are to resolve existing challenges, work toward improving specific processes, and re-engineer specific procedures in the port logistics chain. When necessary, the business process committee can designate these working groups and identify the port community stakeholders that should take part in them.

The working groups and the PCS committees need to be aligned and aware of each other's work. In the early stages, it is recommended that no more than 2 or 3 working groups be created to ensure that they operate well. A port community representative should be assigned to coordinate these working groups full-time.

3.1.2.3. Step 3: Designate the PCS ambassador

Ambassadors will be responsible for promoting the PCS both within the port environment and outside it, making sure that all the stakeholders in the port community understand the concept of the PCS, the changes that will come with implementing it, and the benefits that the PCS will bring to the entire community as well as to the general population by reducing the times and costs of international trade.[5] Ambassadors do not need to be selected from a specific entity or authority—this decision will vary depending on the specific circumstances of the port community.[6]

[5] Identifying ambassadors to promote the PCS concept and develop this is one of the actions recognized as a good practice by the International Port Community System Association (IPCSA). IPSCA. "How to Develop a Port Community System. Simple, Efficient Solutions for Swift and Smooth Supply Chains." *https://ipcsa.international/wp-content/uploads/2020/07/ipcsa-guide-english-2015.pdf.*

[6] In the PCS of Barcelona, the ambassador was the Port Authority of Barcelona; in Callao, it was the Ministry of Foreign Trade and Tourism and the National Port Authority; in San Antonio (Chile), it was the Ministry of Transportation and Telecommunications and the Port Authority of San Antonio; in Jamaica, it was the Port Authority of Jamaica and the Shipping Association of Jamaica; in Rotterdam, it was the Port Authority of Rotterdam and the Port Authority of Amsterdam; and in Abu Dhabi, it was the Abu Dhabi Ports Company (similar to a port authority).

Selecting an influential ambassador can serve to increase the involvement of major stakeholders in the project, ensuring buy-in at the highest political levels and from powerful terminal operators and carriers.

3.2. PCS governance

The successful implementation and operation of the PCS will largely depend on the design of the governance model. After careful consideration of the financial resources needed to implement the PCS, the question of who will operate the PCS once it is up and running will need to be answered. This should be done early on in the project, and the human and financial resources required for operation should be considered. When analyzing the economic-financial viability of a PCS project, a time horizon of about 10 years is usually used.

Governance models and revenue streams must be defined based on the stakeholders involved. The following sections will examine the governance and business model of the PCS and explain the key issues that determine the economic sustainability of a PCS and the most common revenue models used in international PCSs. A brief benchmarking exercise of some PCSs around the world is also included.

The section also looks at the willingness of users to pay for PCS services, since delivering value will be critical to ensuring the economic sustainability of the platform through a pay-to-use model.

3.2.1. PCS governance models

In terms of the ownership and business model, it is crucial to distinguish between the PCS platform owner and the organization or authority that runs the PCS (the PCS operator). There are two main governance models for a PCS: the ownership model and the operation model.

The ownership model relates to ownership of the PCS platform, software, and hardware. Depending on what type of entity owns the platform, this model can be public (the PCS is owned and controlled by a public body), private (the PCS is owned and controlled by a private organization), or a public–private partnership (PPP—the control and ownership of the PCS platform are shared between one or more public and private parties, who share the financial and technical risks).

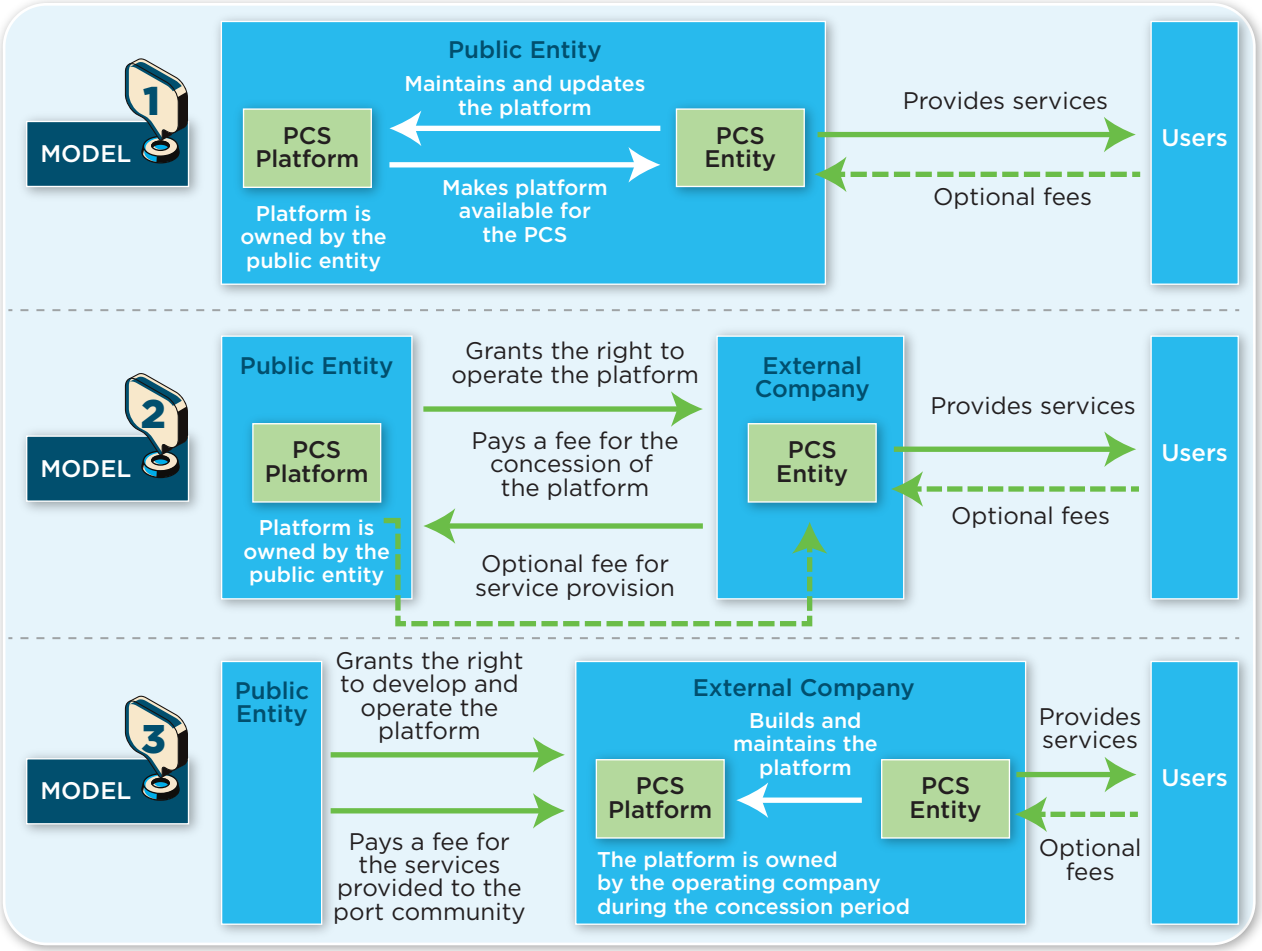
The operation model concerns the organizational unit that manages and operates the PCS once it has been implemented and its different modules have been developed. The PCS operator is responsible for customer support, corrective and adaptive maintenance, the commercialization of services, and so on. Like ownership models, operation models can be public, private, or a PPP.

Figure 2 shows three basic types of PCS governance models that are used internationally. The differences between these models depend on the ownership and operation models and the relationship between these. The models are discussed in the following subsections.

3.2.1.1. Model 1: public

In this model, a public entity owns, controls and also operates the PCS platform. This is a simple solution: the public entity operates the PCS through an operating entity that remains within its organization. Within this entirely public governance and oper-

Figure 2 PCS governance models



Source: IDOM.

ation model, the public entity can partially or totally outsource operation and maintenance activities.

In this sense, the PCS is offered as a public service. However, despite the simplicity of the model, a PCS operated in this way may be less dynamic, as decision-making processes tend to be slower in public entities. Furthermore, it does not allow other stakeholders to take part in strategic decisions around platform investments. There might be an external advisory board in place made up of other parties, but the public entity is ultimately responsible for all decisions. Even though the PCS is a public service, the public entity may opt to charge PCS users fees to cover operating expenses and capital expenditure.

International examples of model 1 include Ports of Jamaica, Port of Bilbao (Spain), Port of Algeciras (Spain), Port of Los Angeles (USA), and Ports of Israel, all of which are owned and run by public authorities.

Table 3 SWOT Analysis of PCS Governance Model 1

Strengths	Weaknesses
• Greater control over the platform • Service operated by the state, which implies more long-term stability • Potential synergies with other ICT government resources • Basic investments are guaranteed • Legal simplicity and fast adoption of the model • Full control of the implementation, development, and operation costs	• Bureaucratic limitations of public administration procedures (e.g., in hiring personnel, financing, subcontracting, etc.) • The lifecycle of an ICT product is much shorter than a port infrastructure project, so there is less justification for a PCS project to be managed by a public entity, as usually happens in physical infrastructure projects
Opportunities	**Threats**
• Develop internal know-how • More ability to support national plans and strategies • Services for port community competitivity are prioritized over business criteria	• Risk of lack of dynamism due to a slow response to port community needs beyond basic services • Execution risk due to the lack of expert knowledge • Model is not financially self-sustaining unless fees are introduced • Legal threats due to the imposition of a monopoly

Source: IDOM.

Table 3 presents a SWOT analysis for this model from the perspective of the port authority or any other public entity that promotes the PCS.

3.2.1.3. Model 2: public–private

Within model 2, a public entity still owns the PCS platform, but it is managed and operated by an outside company, which can be private or a PPP created as a special-purpose vehicle to develop, maintain, and operate the PCS for the contracted period. In this governance and operation model, the public entity provides the infrastructure but grants a concession to the outside company that will operate it. Examples of this governance model include PORTIC (Port of Barcelona) and PORTBASE (Port of Rotterdam and Port of Amsterdam).

In this scenario, public bodies play an active role in the PCS to ensure its services are provided fairly and neutrally to all stakeholders, while a private company operates the PCS on a commercial basis. The challenge here is justifying that the services are of a public nature and thus that the PCS should be regulated to protect port users from potential monopolistic practices around pricing schemes, information accessibility, neutrality, improper use of data, and equity.

Table 4 contains a SWOT analysis for this model from the perspective of the port authority or any other public entity that promotes the PCS.

3.2.1.13 Model 3: private

In the final model, the PCS platform is owned and operated by a private entity. An outside

Table 4 SWOT Analysis of PCS Governance Model 2

Strengths	Weaknesses
• Control over the platform, while keeping the advantages of a separate entity operating it • Potential synergies with other government ICT resources • Control over implementation, development, and operation costs • Platform investments and adaptive maintenance are guaranteed	• Complexity in the regulation and enforcement of the relationship between the platform owner and the PCS operator • Complexity in the governance of the PCS operator if it has private shareholders
Opportunities	**Threats**
• Benefits of separating the owner and operator of the infrastructure • Open up the PCS operation management to the port community to attract new ideas and insights • Ability to implement logistics strategy and focus on value	• Difficulties in aligning objectives between the platform owner and the PCS operator • Failure in achieving the minimum economic sustainability objectives established for the external company

Source: IDOM.

company is thus in charge of the design, development, operation, and maintenance of the PCS. Examples of a completely private model include the Port of Hamburg (DAKOSY), the Port of Felixstowe (Destin8), and the Port of Dubai (Dubai Trade).

Table 5 presents a SWOT analysis for this model from the point of view of the port authority or any other public entity that promotes the PCS.

3.2.2. Economic sustainability

Ensuring long-term economic sustainability is important when planning PCS projects. There are various funding schemes for financing PCSs, which must be provided for in the legislation and regulations of the country or location where the project is implemented.

Ideally, revenues should be sufficient to cover both the platform operating costs and the hardware and software investments made when it is implemented. However, this may be difficult to achieve, so a financing model in which the medium- or long-term operation costs are partially or totally covered by the revenues is widespread in many ports.

In the long-term, the recommendation is for the PCS to be self-sustainable: in other words, it should not incur expenses that are greater than the revenue obtained from user fees. Any profits should be reinvested in maintenance, improvement, and developing the system to incorporate new services and/or improve existing services, while also covering ICT maintenance. In terms of financing, the PCS can be managed in the following ways:

- Cost center: certain resources are allocated to the PCS as part of the annual public budget for platform maintenance.
- Benefit center: the PCS operator charges fees for its use to cover operational and maintenance costs, partially or totally,

Table 5 SWOT Analysis of PCS Governance Model 3

Strengths	Weaknesses
• Greater agility and flexibility • Rapid incorporation of experience and know-how • Risks associated with development and execution are reduced by being carried out by entities with experience • The business should be completely self-sustained based on the income contributed by the port community • More flexible model for commercializing services	• Less control from the government • Difficulty (impossibility) for the public entity to implement national plans and strategies • No regulation of the PCS fees • Public entity does not develop in-house know-how
Opportunities	**Threats**
• Transfer of all the operator's know-how to the public entity at the end of the concession • Simple implementation for public administration • Commercial freedom of the operator, which motivates the search for new services to satisfy the needs of the port community	• Long-term investment constraints due to limited ability to obtain returns on investments • Possibility of discriminatory treatment among private companies, which runs counter to the ideal of a PCS as an open, neutral platform

Source: IDOM.

through the services provided to private entities of the port community.

Figure 3 shows a decision path scheme for a financing model. This should be considered at the beginning of a PCS implementation project to decide how far PCS clients will contribute to its sustainability.

3.2.3. Revenue models

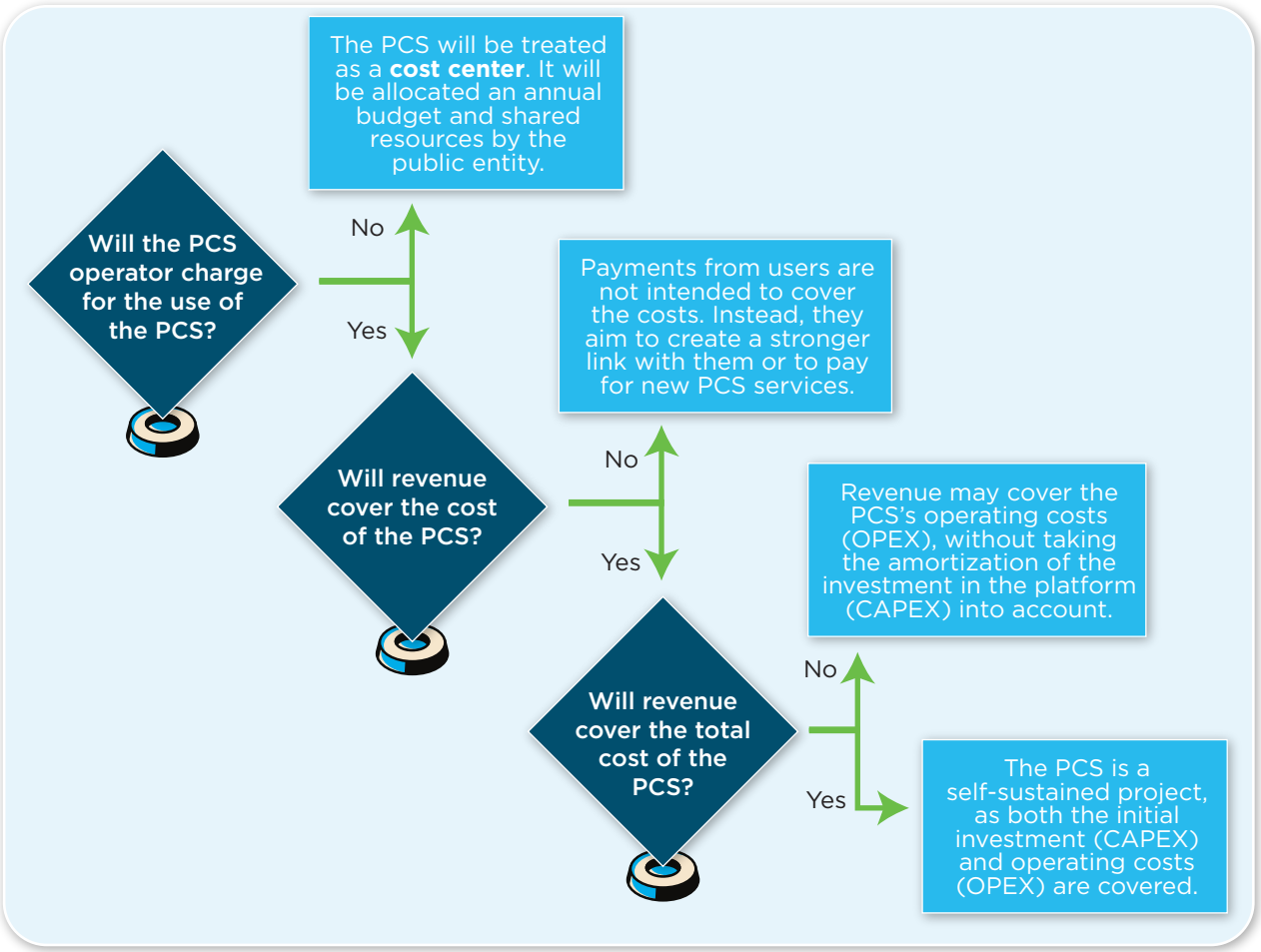
There are various PCS fee systems, such as subscription fees with an annual, monthly, or weekly payment or payments for each transaction. Two or more systems can coexist within a PCS, with fixed monthly fees and transaction fees being charged at the same time. This may be useful, for example, for those companies that use the PCS sporadically. There may also be fees for additional services, such as notification fees, integrations, and so on. Table 6 summarizes different fee schemes.

The commercialization of the services offered by a PCS within the port community is very important for the revenue stream, and users must be willing to pay the fees defined by the PCS operator.

3.2.4. Willingness to pay for PCS services

Initially, no port community in the world is willing to pay for PCS services. The process of getting port communities to accept that fees must be paid is often a long one. This process starts with getting buy-in for the qualitative and quantitative benefits mentioned in section 5.2.2. But it would be naïve to think that all stakeholders would agree to pay fees after merely having the the-

Figure 3 Decision Path Scheme for PCS Financing Models



Source: IPCSA.[a]

[a] *https*://unctad.org/system/files/non-official-document/MyEM6th_day03ppt_Morton_en.pdf.

oretical qualitative and quantitative benefits of a PCS explained to them, despite the reduction in operating costs a PCS may bring them.

Members of a port community often invest time and resources in maintaining their own systems and the processes they use to control and optimize their daily operations. As a consequence, they can be slow to trust outside systems. With this in mind, when defining the fee structure of the PCS, the value-added services to be offered to the port community must be considered, along with the characteristics of each user. Users will be more willing to pay for services if their operations improve and efficiency increases. The effort involved in adopting a new system must be minimal and benefits must be direct, clearly recognizable, and happen quickly. Early adoption of new value-added services will be quicker if the user's system can be easily integrated with the PCS and

Table 6 Common PCS Fees

Fee	Description
Registration fee	Paid once when signing up with the PCS.
Subscription fee	Can be paid yearly, monthly, or weekly, and varies according to the kind of stakeholder. Terminal operators usually pay higher fees than logistics companies like shipping agents, freight forwarders, and so on. It is also common to differentiate among companies in the same company type depending on their size, number of users, and/or the volume of cargo they move.
Transaction fee	Different for each user, depending on the number of electronic messages (EDI, XML, etc.) they send through the PCS platform (vessel loading lists, container release orders, etc.).
Unit fee	Applied based on the number of movements, twenty-foot equivalent units (TEUs), tons, barrels, vessels, customs declarations, hours, etc. carried out by the company that uses the PCS over a year.

Source: IADB,[a] IAPH.[b]
[a] *https*://publications.iadb.org/publications/english/document/International_Case_Studies_and_Good_Practices_for_Implementing_Port_Community_Systems.pdf.
[b] *https*://www.iaphworldports.org/n-iaph/wp-content/uploads/2020/11/ReportOnPCSBenchmarkSurvey_TFPCS_Jun2011.pdf.

few changes in working practices and processes are needed.

Another factor to consider is whether or not there is an alternative to the PCS in the port community. If there is no other system available within the community offering comparable services, it may be easier to convince stakeholders of the benefits of paying for the services offered by the PCS. The following are some actions that could be considered to increase port community member's willingness to pay fees to use the PCS:

- Compare the costs of each process/service and the savings generated by the PCS, quantifying the added value of each service that would be provided by the PCS (see sections 5.2.2.1 and 5.2.2.2). This would help to set an acceptable price for each service, perhaps initially covering only operating expenses.
- Services could be classified as either mandatory or optional, to establish a fair fee structure:
  - The fee for mandatory services could be set to cover the operational costs of these services. These mandatory services could be linked to B2G processes and are services for which there is no other alternative for port users to complete the required transactions or procedures for the shipping of goods.
  - For optional services, the PCS operator must convince the stakeholders by clearly demonstrating the benefits of using the services offered. These could be B2B services, where other alternatives or systems exist for processing and the user will have the option to choose. The added value of the PCS per se is that it can take advantage of information from other services to facilitate the data entry work for mes-

sages/transactions. In addition to operating expenses, optional services fees may also cover the capital expenditure incurred during the design of the value-added PCS services, be it partially or fully.

- A fair revenue model that takes into account the different characteristics of port community stakeholders. Those who move large amounts of cargo will pay different rates than operators moving less cargo. The revenue models presented in section 5.3.3 could be a starting point for designing this model.

A classic cost/benefit approach to PCSs, where potential users accept to pay a fee in return for the benefits provided by the platform, is not always the best option. At the beginning of a PCS project, it is recommended that the focus be placed on achieving a high level of uptake of PCS services, instead of looking for a quick return on the initial investment. Once PCS use becomes widespread among major stakeholders and the port community starts to see the real benefits of the platform, it is easier to introduce a fee structure. This period could be long- or short-term, depending on the needs of each port. It might last until all initial PCS services have been implemented and platform operations have been established.

There are many PCSs around the world that are fully financed by public resources and thus do not charge fees. Some examples of non-fee-paying PCSs include Los Angeles (Port Optimizer), Israel (MAINSYS), or Bilbao (ePuertoBilbao).

By using the correct timeframe and good management, a PCS can be economically sustainable while satisfying the needs of the private port community stakeholders. This is the case for PORTIC (Port of Barcelona) and PORTBASE (Port of Rotterdam and Port of Amsterdam), whose port communities report a high level of satisfaction while the PCS generates sufficient revenue to cover its operating expenses.

3.2.5. Benchmarking

The following is a brief benchmarking exercise of four PCSs from around the world:

- ePuertoBilbao—Port of Bilbao, Spain
- PORTIC—Port of Barcelona, Spain
- PORTBASE—Port of Rotterdam, Netherlands
- Dubai Trade—Port of Dubai, United Arab Emirates

Though every port community has its own unique context and circumstances which will define its governance model, reviewing other good practices and undertaking a benchmarking exercise can help to better define the model in respective countries.

This benchmarking exercise identifies the governance model (described in section 3.2.1) for these PCSs and examines their fee structures. Table 7 summarizes the governance model and fees charged at each of these ports.

While these four PCSs are considered mature, it should be noted that most PCSs began as government-financed entities but then came to be seen as value for money as interest in them grew. In fact, the PCSs of Barcelona, Rotterdam, and Dubai began as public initiatives with public financing. This benchmarking process is explained in detail in appendix 12.

Table 7 Governance Model and Fee Structure of Selected International PCSs

PCS	Governance Model	Fees
ePuertoBilbao	Model 1	No fees are charged
PORTIC	Model 2	Registration fee Subscription fee
PORTBASE	Model 2	Subscription fee Transaction/unit fee
Dubai Trade	Model 3	Subscription fee Transaction/unit fee

Source: IDOM.

3.3. Technological infrastructure

This section covers best practices in the ICT sector that apply to ports and identifies global trends that have an impact on port community systems and platforms around the world.

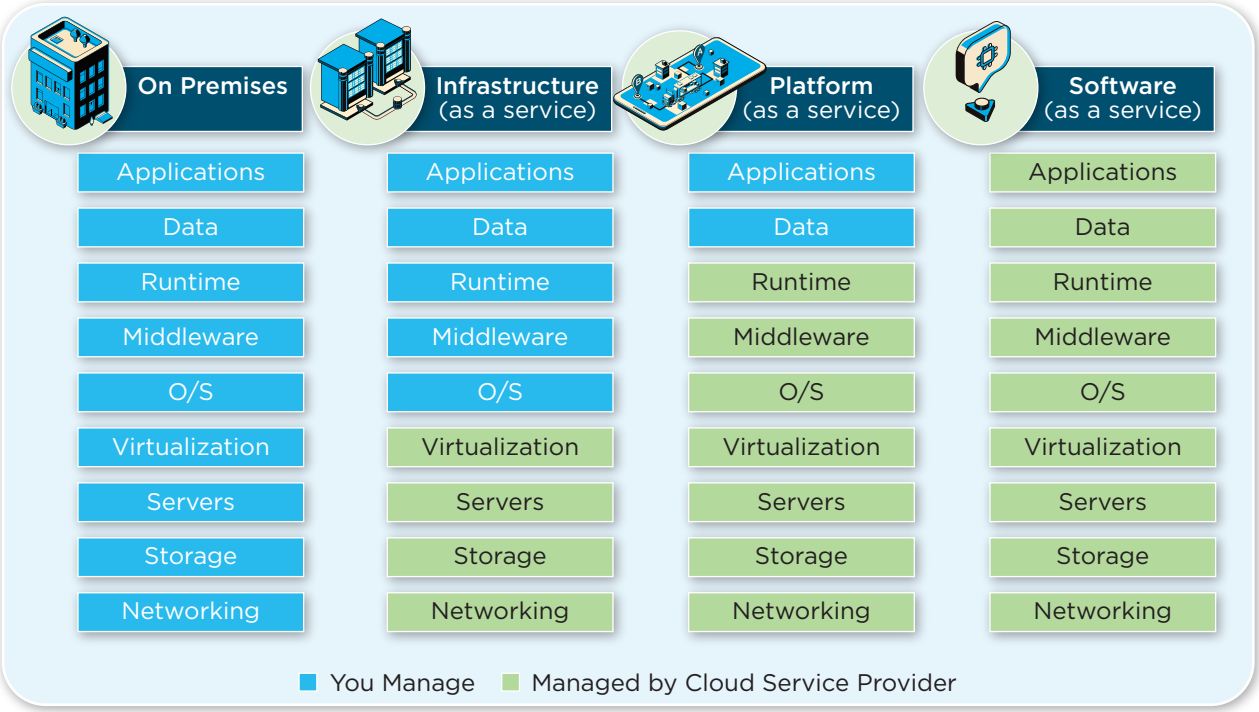
3.3.1. ICT services used in ports

Port leaders entering the smart port age face increasingly complex decisions regarding investments in new technologies, such as big data, the Internet of Things (IoT), artificial intelligence (AI), and digital currency exchanges to improve operational performance, enhance automated processes, and increase competitiveness. Subsections 3.3.1.1 through 3.3.1.5 cover trending technologies that are becoming key building blocks for smart port environments.

3.3.1.1. Cloud computing services

- While most of the shipping industry still operates on-site software solutions, cloud-based solutions are gaining momentum in the port sector. The benefits of cloud computing services include greater flexibility, security, scalability, increased availability, and cost savings. Depending on the database engine used, data can be backed up continually in two or even three different geographic zones. As a result, data will remain fully available to users in the event of a local shutdown or crash, without the need to implement additional devices, and at no time will the service be interrupted, or information lost.
- Another advantage of cloud services is that systems can be scaled only as needed, which implies the optimization of resources as users only pay for what they use, without the need to provide more infrastructure. Furthermore, the security measures that are implemented by cloud services tend to be superior to those that can be implemented in-house.
- Today's cloud computing providers enable organizations to access a range of resources "as a service," from infrastructure to software, as shown in figure 4. Leveraging a software as a service (SaaS) delivery model allows ports to eliminate

Figure 4 Cloud Service Models



Source: Thomas M. Siebel. 2019. Digital Transformation: Survive and Thrive in an Era of Mass Extinction.

hidden costs and unscheduled downtime at terminals.[7]

3.3.1.2. Open-source technologies

"Open-source" is a term used for software that is distributed under a license that allows the end user to see, modify, and improve the program's source code and redistribute it. This enables programmers to add options, correct potential problems, and do so much faster than would be the case with closed code programming.

Like many other sectors, the port industry is developing tools on application servers that are supported by open-source technologies, allowing for greater flexibility and lower costs on software licenses.

3.3.1.3. Communications protocols

Given how many stakeholders interact in port communities, interoperability mechanisms and standards need to be put in place for both B2G and B2B communications. These mechanisms are based on international standards recommended by international organizations

[7] Recent reports note that port industry adoption of SaaS is expected to increase to 67% within the next five years and these findings are echoed by a Navis survey, "Understanding Your Terminal Strategy with Cloud-based Technologies." This survey is based on responses from 79 Navis customers and provides insight into the current level of interest and projected timelines for moving their TOS and other terminal applications to the cloud. It found that market interest in cloud solutions has increased nearly 40 percentage points (54% in 2019 vs. 93% in 2020) and that 79% of respondents had a timeline in place for moving to the cloud or were considering doing so.

such as UN/CEFACT, the International Maritime Operation (IMO), or the WCO. Appendix 5 contains a detailed description of three such protocols: the Simple Object Access Protocol (SOAP), the Representational State Transfer (REST) protocol, and the United Nations' Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT).

3.3.1.4. Cybersecurity

As ports become more digitalized, the security of the ICT systems and processes that they use is increasingly vital. However, many of the digital developments in the port sector were designed and deployed without considering cybersecurity.[8] One factor driving the evolution and complexity of cyber-physical threats in ports is the convergence and interconnectedness of ICT-based systems, domain awareness systems, operational technology systems. The many distinct yet interdependent members that make up the port community ecosystem could work together to reduce these risks—appendix 6 describes vulnerabilities and good practices for addressing them in greater detail.

3.3.1.5. Industry 4.0

Since 2010, ports have entered the digital transformation stage and begun to align with the practices associated with Industry 4.0: Internet of Things (IoT) and sensing solutions, blockchain, cybersecurity, horizontal and vertical system integration, cloud computing, 3D printing and additive manufacturing, big data and business analytics, augmented reality, and simulation and modeling. As a result, the term "Port 4.0" is also spreading rapidly. Figure 5 illustrates this transformation.

These factors can be grouped into three main categories: advanced methods and tools, horizontally and vertically integrated solutions and systems, and new challenges. Table 8 presents examples of how they are being applied in the port sector.

IoT and sensing solutions, as well as horizontally and vertically integrated solutions, have taken the lead among emerging technologies, particularly within terminal operating systems. In contrast, other technologies such as blockchain, 3D printing, augmented reality, big data, or AI have not evolved sufficiently.[9] Implementing cybersecurity measures and building trust for information-sharing in a hypercompetitive cyber world may be the main barrier preventing these new technologies from truly taking off.

3.3.2. Port ICT ecosystem

The world's main port ICT ecosystems draw on multiple internal and external data sources that allow all events linked to the port operations and its hinterland to be described in detail. Most of the port information and data resources that can be used in PCSs are presented in figure 6.

Port ecosystem platforms are important for ensuring that stakeholders can communicate with a PCS. Table 9 summarizes some of the main data exchange platforms that exist in ports with high levels of digitization.

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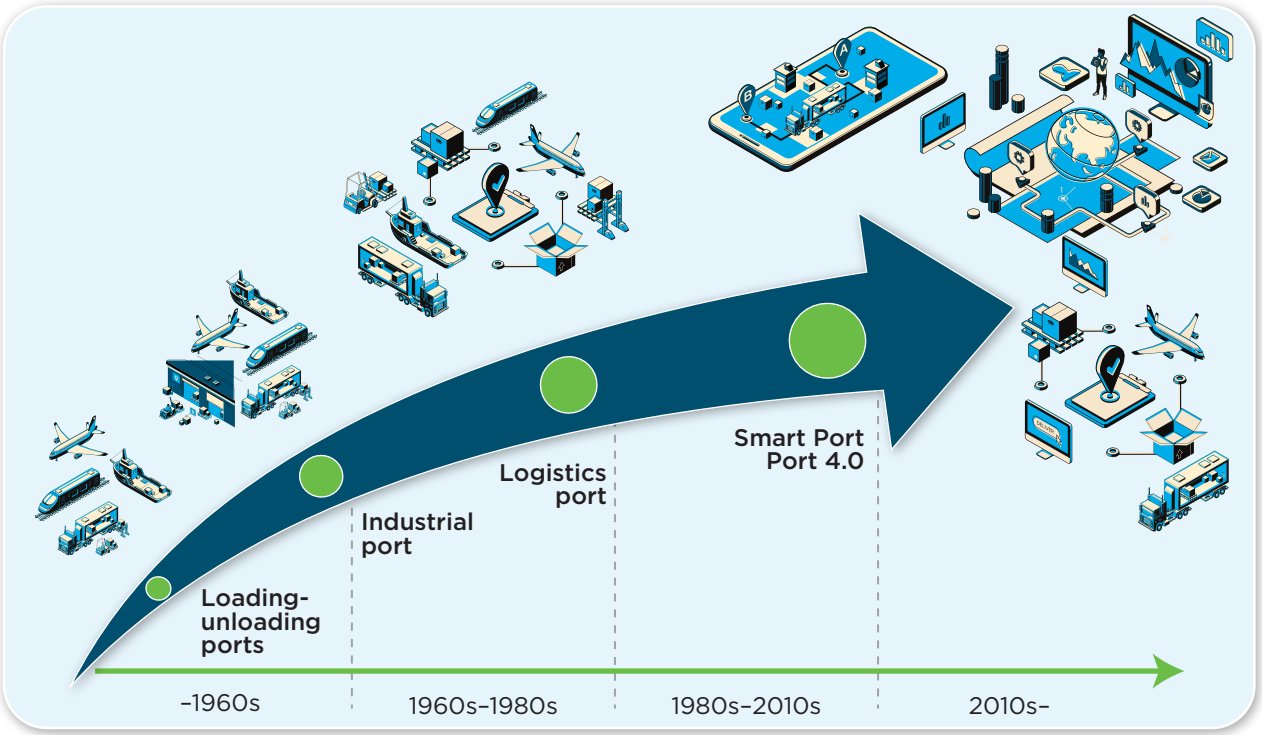
[8] World Bank. 2020. "Accelerating Digitization: Critical Actions to Strengthen the Resilience of the Maritime Supply Chain." Washington, DC: World Bank.*https://thedocs.worldbank.org/en/doc/773741610730436879-0190022021/original/AcceleratingDigitalizationAcrossttheMaritimeSupplyChain.pdf*.

[9] The Inter-American Development Bank, through the Trade and Investment Division, has published a Smart Ports Manual to help port authorities and terminal operators monitor and evaluate the process of transforming ports into smart ports. It is available at *https://publications.iadb.org/en/smart-ports-manual-strategy-and-roadmap*.

Figure 5 Impact of Industry 4.0 on the Port Sector



Source: de la Peña Zarzuelo, I., Seoane, M.J.F., and Bermúdez, B.L. 2020. "Industry 4.0 in the Port and Maritime Industry: A Literature Review." *Journal of Industrial Information Integration*, 20: 100–173.

To gauge the technological maturity of a port community, one recognized good practice involves building an inventory of the system and/or platforms existing inside it. This makes it easier to identify gaps in processes such as becoming a paperless port. Table 10 lists the different areas that should be analyzed as part of this assessment.

3.3.3. Technological standards of the port industry

Several international organizations have made advances in recent years on creating technological standards for the communications and documentary processes used by port community stakeholders. This standardization is crucial to guaranteeing interoperability or interconnectivity between the different platforms that exist in the port ecosystem, or between national systems in partner countries. PCSs need to meet the standards set by international bodies so that they can exchange data securely between countries using these standardized formats. Relevant standards' establishing bodies include: the United Nations Centre for Trade Facilitation and Electronic Commerce (UN/CEFACT), the Digital Container Shipping Association (DCSA), the World Customs Organization (WCO), the International Maritime Organization (IMO), and the Port Call Optimization working group. For a detailed list of these standards, see appendix 7.

Table 8 Application of Industry 4.0 Trends in Ports

Group	Industry 4.0 Trends	Application in ports
Advanced methods and tools	IoT, sensing solutions, big data, and cloud computing	Predictive maintenance in terminal cranes
	Blockchain	TradeLens
	Drones, robotics, and automation	Automated guided vehicles
	3D printing and additive manufacturing	Printing of spare parts for vessels and/or cranes
	Augmented and virtual reality	Gate entrance control
	AI and machine learning	Estimated time of arrival predictor
Horizontally and vertically integrated solutions and systems	Horizontal and vertical system integration and applications through new standards	Advanced terminal operating systems
	Simulation and modeling	New infrastructure projects
	Energy solutions	On-shore power supply
	Smart asset management	Digital twin and building information modeling for port infrastructures
New challenges	Cybersecurity	ICT port ecosystem breaches
	Connectivity, standards, and federated database systems of multiple stakeholders	5G networks

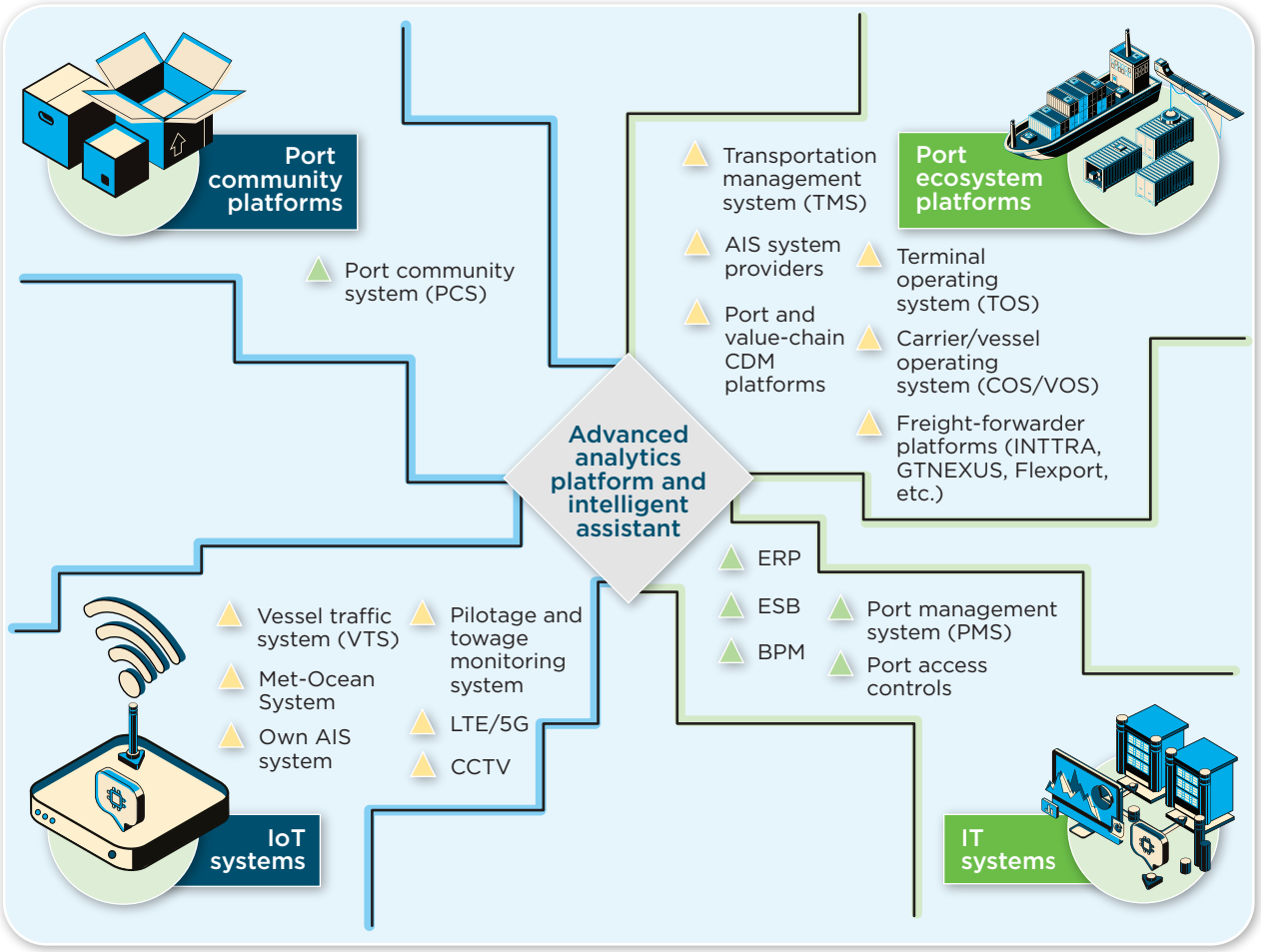
Source: de la Peña Zarzuelo, I., Seoane, M.J.F., and Bermúdez, B.L. 2020. "Industry 4.0 in the Port and Maritime Industry: A Literature Review." Journal of Industrial Information Integration, 20: 100–173.

Table 9 Main Data Exchange Platforms by Stakeholder

Stakeholder	System or plattform
National government	National single window, cross-border regulations single window, maritime single window, trade single window
Customs	Customs management system
Port authority	Port management system, vessel traffic management system, automatic identification system
Terminal operators	Terminal operation systems, gate operation systems
Freight forwarders	Booking platforms (INTTRA, GT Nexus, etc.)
Shipping companies	Carrier operation systems
Shipping agents	Global platforms linked to shipping companies
Road haulers	Transport management systems

Source: IDOM.

Figure 6 PCSs and other Systems Used in Ports



Source: IDOM.

Table 10 Guidelines for Analyzing the Technological Maturity of a Port Community

Focal point	Core questions	Comments
Stakeholder type	Who are the public and private stakeholders in the port community?	Describe the most common uses of different ICT systems by freight forwarders, customs brokers, road and rail haulers, and logistics companies in general.
System type	What types of system do agents use? i.e., customs management system, terminal operating systems, customs clearance applications, etc.	Exclude systems that are beyond the scope of logistics processes (i.e., company ERP systems).

(continued on next page)

Table 10 Guidelines for Analyzing the Technological Maturity of a Port Community *(continued)*

Focal point	Core questions	Comments
Software type	Is the software in-house, commercial-off-the-shelf, etc.?	Identify the vendor.
Functionality	What are the system's main functions?	Include any unique functionalities of the system.
Technological infrastructure type	Is the system hybrid/cloud-based/physical (on-site)?	Provide a general scheme of the technological architecture, if relevant.
Adoption	How far has the system been adopted by users?	As far as possible, specify this by module or functionality.
Management of the system	Who manages the system? (i.e., ICT department, team within another department, etc.)	Note when management is internal or outsourced.
Security protocols	What security mechanisms are in place as regards access, communications, certifications, physical devices, etc.?	Report if any security standards like ISO 27001 or NIST are followed.
Integrations	What system-to-system integrations with other platforms are in place?	Identify the type of interface (SFTP, FTP, webservice, email, APIs, others).
Technologies 4.0	Are technologies like blockchain, IoT, AI, etc. in use?	Identify any new functionalities or results from the adoption of new technologies.
Future plans	Do stakeholders plan to renew or improve information systems in the future?	Distinguish between the short, medium, and long term (less than one year, 1–3 years, and >3–4 years).

Source: IDOM.

3.3.1.1. PCS integration with other digital platforms

A PCS is an integration tool/entity or an interorganizational middleware system (IOMS).[10] A PCS facilitates data interchange, transforming and adapting communication protocols and securely sharing information between companies.

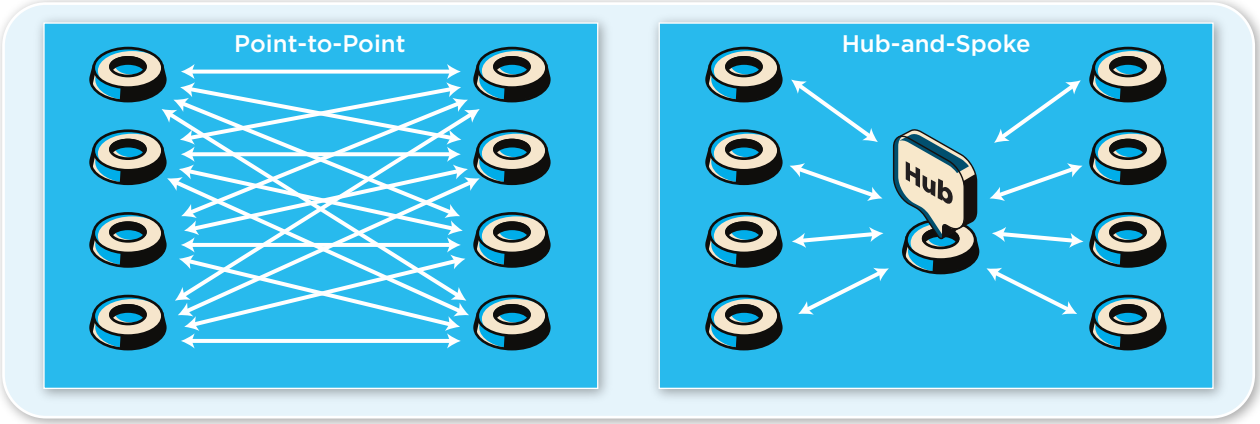
The following section looks at how a PCS could function as an IOMS, the most common alternatives to building an IOMS, and the main integration services that need to be analyzed when implementing a PCS.

3.3.1.2. Interorganizational middleware models

Different models can be used to connect organizations to a PCS and unify data. Perhaps the most commonly used technology for integration is point-to-point or hub-and-spoke. Point-to-point integration uses middleware or software that provides services to software applications to enable data-sharing

[10] https://pdfs.semanticscholar.org/85e0/d8bf3fccccaf7c5c9ad2a9a93472f9ccdaef.pdf"Inter-Organizational Information and Middleware System Projects: Success, Failure, Complexity, and Challenges

Figure 7 IOMS Models



Source: The Geography of Transport Systems.[a]
[a] *Rodrigue, Jean-Paul. 2020. The Geography of Transport Systems.*

between two systems. Middleware facilitates both data transformation and the mechanics of transporting data.

Hub-and-spoke integration, on the other hand, does not require a direct connection between each sharing system and any other sharing system. Instead, each system that wants to share data across the enterprise has one connection point with a single, central hub that mediates requests, thereby decoupling senders and receivers of data. Each organization's system has one connection to the hub.

Figure 7 presents simple diagrams of the architecture of hub-and-spoke and point-to-point communication. While hub-and-spoke models may seem much simpler, if the hub fails then the entire system can be compromised. In terms of resilience, duplicating PCS infrastructure and designing a system that has high availability is essential.

Trusted third party is another key concept in the design of a PCS. Port companies delegate activities such as communication, transformation, validation, auditing, logging, and tracing to the PCS. The PCS can also ensure that entities cannot deny the validity of electronic transactions. Nonrepudiation is a legal concept used to provide proof of the origin of data and the integrity of such data.

PCSs are not responsible for the content of the information exchanged or its veracity. The PCS must guarantee that data is not manipulated during interchanges or disclosed to unauthorized stakeholders. As such, implementing security measures and following international security standards, such as ISO 27001, is critical to PCSs.

3.3.1.3. PCS implementation alternatives

The core of the PCS is middleware software that connects the PCS with other companies' systems through standard communication protocols and messages. In addition, a PCS may implement other key features to guarantee the security of transactions.

The most widely used middleware includes message-oriented middleware and

API-oriented middleware. A modern PCS normally integrates the two models in their implementation projects, depending on the demands of the business and service types required. New technologies like blockchain could be also used to design a modern PCS.

3.3.1.4. PCS integration services

A PCS links the businesses of the port community members. In terms of integration, a PCS gives all stakeholders access to data that is of interest to them, improving the efficiency and efficacy of interactions between them. However, the level of efficiency and efficacy depends on how different systems (many are legacy platforms) are integrated to share information. Different enterprise systems need to be integrated with those that need to be accessed by external stakeholders. UN/CEFACT Recommendation No. 37 states that the different stakeholders in the trade chain need to comply with their declarative obligations through a single point of submission and suggests that data be shared between economic operators.

Figure 8 shows how a PCS can handle different kinds of electronic information exchange between public and private entities using different formats, protocols, and internal and external systems.

3.4. Operational factors

This section examines the documentary processes that are linked to physical or operational port and logistics processes: for example, those that enable the clearance of ships submitted through maritime or foreign trade single windows and integrated or interfaced with the PCS.

These documents are categorized into three groups and based on the main port processes (figure 9). These are (i) vessel processes, which relate to port entry, stay, and departure, including basic port services such as technical/nautical services, and other port services; and (ii) inbound and (iii) outbound processes, including import and export cargo flows with transshipment.

3.4.1. Operational tools

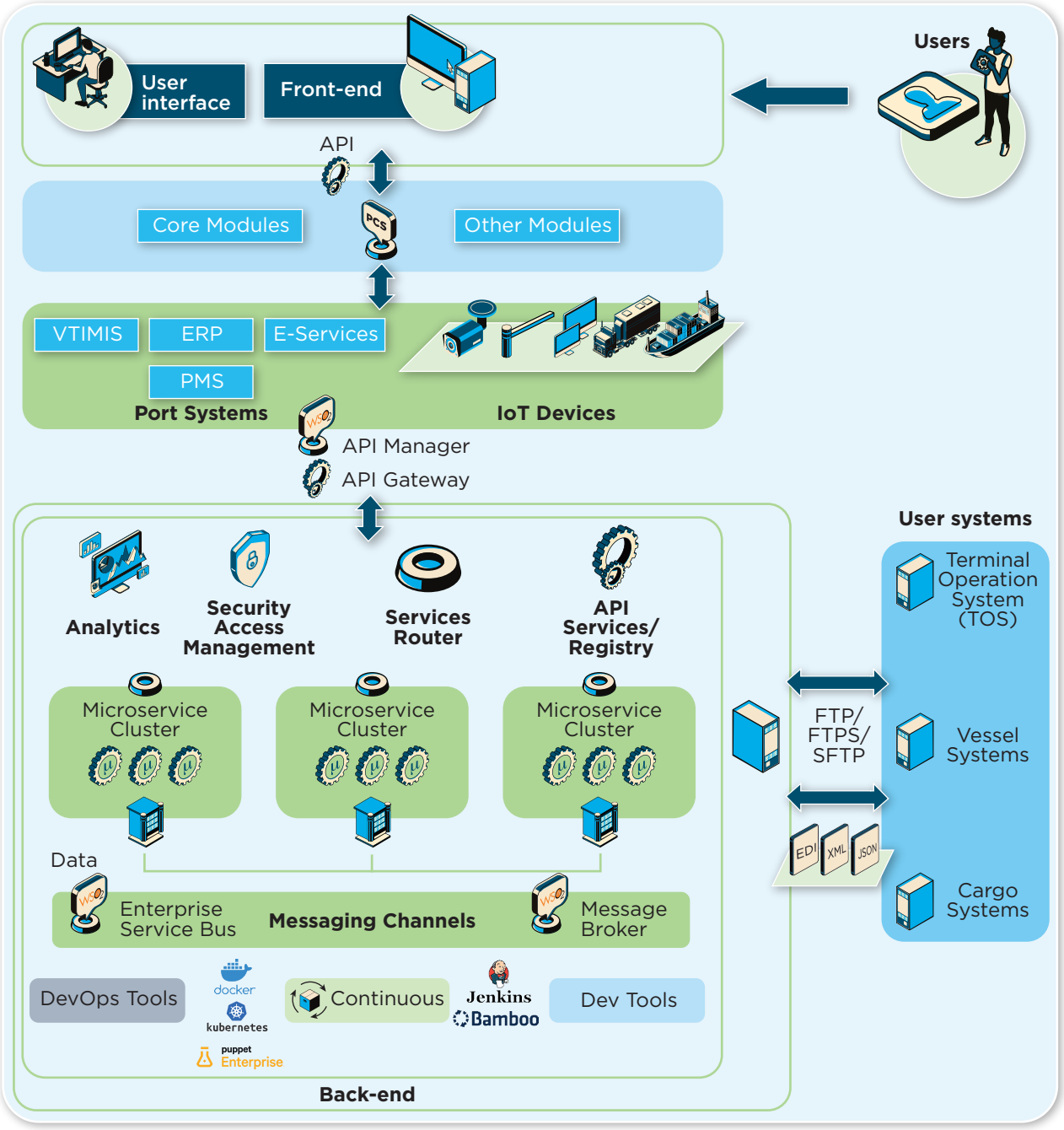
This section provides information on major operational aspects that should be considered when assessing whether a country or port community is ready to implement a PCS. The focus on process mapping is for analyzing operational processes to determine the existing level of digitalization, benchmarking against best practices, and to guide decision-making around the identification and prioritization of processes to be included in the phasing of a PCS implementation.

3.4.1.1. Core process mapping

Process mapping can be used to identify core process flows. Process mapping is the graphic representation of how work is done, using illustrative descriptions. It helps to visualize the details of processes closely and guides decision-making. Major areas of strengths and weaknesses in the existing process can be identified, along with how individual steps (activities) contribute to this process. It helps to reduce cycle times and defects in the process and enhances productivity once they have been re-engineered.

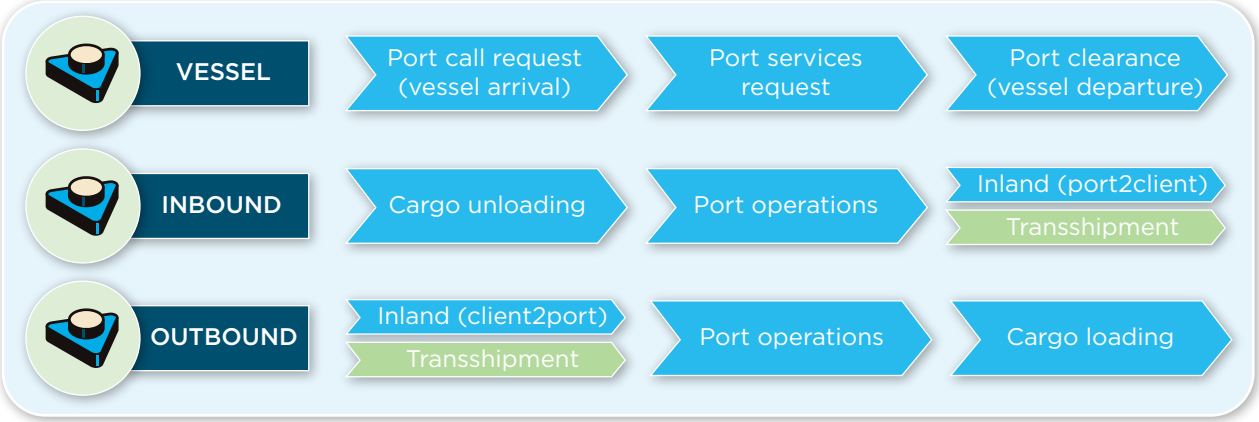
The major components of a process map include the inputs, outputs, and activities that the process entails. A good port logistics process map should illustrate the

Figure 8 General PCS Architecture



Source: IDOM.

Figure 9 **High-Level Port Process Categories**



Source: IDOM.

physical flow of goods and the workflow for documents together with stakeholder interactions. It should make use of common language (symbols) that are easily understood by everyone. An ideal process map should contain appropriate details on multiple paths, decisions, and rework loops.

To represent these processes, an end-to-end approach is recommended, as this allows the integration of the port community stakeholders to be presented transversally, including the different document-related and physical transactions involved in the process from the beginning to the end. By applying this method, in-depth knowledge of the operations and relationships existing within the port community and their impact on the operations can be obtained. Using the Business Process Model and Notation (BPMN) 3.0 standard is also recommended.

The core processes to be mapped can be divided into two groups: macro processes (level 0) and low-level processes (level 1), which include the detailed activities that each port community stakeholder carries out, including interactions with other stakeholders. Appendix 13 contains a complete list of the processes to be mapped.

3.4.2. Operational standards

3.4.2.1. Vessel operations

This subsection describes best practices for operations and the standardization of port call processes based on the work of the port call optimization working group.[11] These standards apply to all types of cargo vessels (container vessels, liquid and dry bulk carriers, passenger ships, etc.).

These are maritime business guidelines and are not enforced by any law. Data accuracy and data ownership are important requisites, as operations cannot be planned correctly if the data used is not correct.

[11] https://portcalloptimization.org/.

Just-in-time vessel arrival (Port Call Optimization)

Port Call Optimization, a collaborative initiative for the standardization of port call processes, is led by a working group made up of global ports and shipping companies whose common objective is improving the quality and availability of master and event data. This initiative aims to increase safety, achieve a cleaner environment, and lower costs for shipping companies, shippers, terminal operators, and ports.

One critical activity is improving the quality and availability of master data (e.g., berth depths and admission policies of each port), which ensures vessel–berth compatibility and provides clear information on when it is safe to arrive or leave (the Avanti project[12]). In addition, a focus on improving the quality and availability of event data (e.g., planned time of arrival berth, estimated time of completion of cargo operations) enables just-in-time planning of pilot on board, preplanning of all port services, and planning the departure to the next port (the Pronto project[13]).

These two projects bring existing standards together but do not develop commercial solutions. This is left to the ports themselves to tailor to their specific circumstances. The projects use existing and robust nautical and supply chain standards and formats that meet worldwide shipping requirements. They are also backed by internationally recognized organizations with a strong track record to ensure the long-term sustainable development and maintenance of the associated standards. For more details on the Port Call Optimization initiative, see appendix 7.

3.4.2.2. Container operations

The DCSA's Business Blueprint 3.0 Standard[14] is perhaps the most relevant international standard for container shipping. This standard was developed based on input from DCSA member shipping companies, industry stakeholders, and technology experts from other industries.

The universal, open-source nature of this standard is the reason for including it in this section, as it is important when defining the core processes for handling containers. The high-level processes covered by the standard include the shipment journey, the equipment journey, and the vessel journey.

3.4.2.3. Other cargo operations

The primary source of data for operational standards on noncontainerized cargo is the IMO, as well as the Baltic and International Maritime Council (BIMCO), an NGO member of the IMO. BIMCO also promotes and supports the achievement of global standards and regulations for the maritime sector, including those related to reducing the industry's CO_2 emissions by 50% by 2050. At the political level, BIMCO advises member states on the consequences of proposed regulations and suggests solutions to making regulation effective and practicable.[15]

The IMO itself issues codes to be followed by carriers and/or shippers when transporting certain types of cargo, primarily related to operational safety. See appendix 7 for a complete list of these mandatory and optional IMO conventions and instruments.

[12] https://portcalloptimization.org/images/Flyer%20port%20call%20optimization.pdf.
[13] Ibid.
[14] https://dcsa.org/documentation/.
[15] https://www.bimco.org/about-us-and-our-members .

Table 11 Vessel Processes Scheme

	Port call request (vessel arrival)	Port services request	Port clearance (vessel departure)
Activities	• Submit Port of Call Declaration • Provide IMO FAL forms and other port call-related documentation • Manage vessel inspections • Quarantine (if necessary) • Arrival timestamps (at berth and at pilot boarding place)	• Manage services requests • Authorization by maritime authority • Authorization by terminal operator • Timestamps for services • Inform that services have been executed	• Submit updated FAL forms and other departure-related documentation • Port clearance request • Departure timestamps (loading/unloading, at berth)
Related documents	• Port of Call Declaration • IMO FAL forms • Maritime Health Declaration (arrival) • Inspection documents • SOLAS documentation • Danger goods cargo information	• MARPOL documentation (for waste management) • Port services request • Authorization for port services execution • Port services report	• Port clearance • Maritime Health Declaration (departure)

Source: IDOM.

3.4.3. Inventory of potential digital documentation

This section provides guidance on port operation documents that have been digitized in world-class ports, both for containerized cargo and other types (liquid or dry bulk, ro-ro, general cargo, etc.). The standard DCSA documentation was analyzed for the containerized cargo, drawing on the experience of other port logistics projects, while regulations such as SOLAS and MARPOL (IMO) were reviewed for other cargo.

3.4.3.1. Vessel-related documentation

Table 11 shows core vessel processes along with the main activities and documentation that these require.

Relevant IMO documents include the FAL forms[16] (see appendix 7). Standard 2.1 includes a list of documents that public authorities can demand of a vessel and recommends the maximum information and number of copies which should be required. Most of the maritime national single-window services in countries that have adopted the FAL Convention apply these standards to define the fields included in the forms.

The PROTECT Group[17] is one benchmark for best practices in the standardization of maritime documentation and the definition of formats for the electronic exchange of

[16] https://www.imo.org/en/OurWork/Facilitation/Pages/FormsCartificates-default.aspx.
[17] https://ipcsa.international/protect/about-protect/.

data between shipping agents and public authorities. It was originally formed in the 1990s, and its activities support the electronic reporting required by public authorities for vessels entering or leaving a port or port area. In January 2020, PROTECT was integrated into IPCSA to support and develop expertise and design new electronic exchanges for port authorities around the world. See appendix 7 for more information on the PROTECT Group's initiatives.

All documents relating to port call processes and basic port services (technical-nautical services, waste discharge, ship chandlering, etc.) are digitized and automated when a PCS is implemented. Vessel-related documentation is summarized in table 12.

Table 12 Vessel-Related Documents: Port Call Processes and Basic Port Services

Document	Description
Port of Call Declaration	Document sent by the shipping agent to the respective port authority to announce the arrival of the vessel. Usually accompanied by the FAL forms (if they are part of the legislation) or other documents covering similar functions.
IMO FAL Forms	Documents required by the IMO (if adopted by the national legislative framework) within FAL forms: 1. IMO General Declaration (FAL form 1) 2. Cargo Declaration (FAL form 2) 3. Ship's Stores Declaration (FAL form 3) 4. Crew's Effects Declaration (FAL form 4) 5. Crew List (FAL form 5) 6. Passenger List (FAL form 6) 7. Dangerous Goods (FAL form 7)
Maritime Health Declaration	When a vessel arrives at a port to which health regulations apply, it is mandatory for the master to report on the health conditions on board their vessel and any circumstances on board that are likely to cause the spread of infectious disease.
Security-related information SOLAS regulation XI-2/9.2.2	Security information refers to the possession of certain security certificates on board and a questionnaire on security information.[a]
Advance Notification Form for Waste Delivery to Port Reception Facilities	Document provided by IMO to report waste discharge in the destination port, including data on type of waste according to MARPOL, maximum dedicated storage capacity in cubic meters, amount of waste retained on board, port at which remaining waste will be delivered (if known), and the estimated amount of waste to be generated between notification and next port of call (only for the case of waste management service).
Port Services Request	Document sent by shipping agent or captain of the vessel requesting port services from the port authority or service providers, such as technical-nautical services, MARPOL services, ship chandlering, etc.
Port Services Report	Document sent by the service provider to the port authority after the execution of the port service. It includes timestamps of the start and completion of the services and other details required by the port authority.

(continued on next page)

Table 12 Vessel-Related Documents: Port Call Processes and Basic Port Services *(continued)*

Authorization for the execution of port services	Authorizations needed in most ports to execute port services, such as the authorization by the port authority, maritime authority, or the terminal to allow access to its installations to perform the service. Authorization from the maritime authority is sometimes also required.
Dangerous goods cargo information	Any documentation relating to dangerous goods, such as the Material Safety Data Sheet (MSDS), which is recommended by the IMO and required by terminals or public authorities to authorize such cargo.
Port Clearance	A document that provides permission for a vessel to depart a port when it complies with the documents and formalities required by the public authorities in the port of call. It allows the vessel to leave the country's customs territory and is mostly issued by the port authority.

Source: IDOM.
[a] *The complete requirements are available at*: http://tfig.unece.org/pdf_files/A9R65C2.pdf.

Table 13 Outbound Processes

	Inland	Port operations	Cargo loading
Activities	• Export documentation preparation • Booking • Empty container pick-up • Customs clearance • Road/rail haulage • Cargo pick-up	• Truck appointment system • Terminal gate-in • VGM submission • Customs and other inspections • Dangerous goods handling • Cargo stacking • Cut-off • Cargo loaded on the vessel	• Bill of lading • Export manifest declarations • Final customs clearance
Related documents	• Booking (container) • Empty container release order • Shipping instructions • Road/rail transportation order • Export customs declaration, customs clearance • Empty container gate-out • EIR (container) • Legal transportation documents • Rail unloading list and report	• Cargo acceptance order • VGM (container) • EIR (container) • Loading list (container) • Stowage plan (container) • Loading plan (other cargo) • Gate-in (terminal) • Dangerous goods authorization • Invoices and payments for terminal services • Truck appointment	• Loading report • Export cargo manifest • Bill of lading • Final customs clearance declaration

Source: IDOM.

Table 14 Inbound Processes and Transshipment

	Unloading	Port operations	Inland	Transshipment
Activities	• Submit import cargo manifest declaration • Arrival notice • Submit unloading list • Customs declaration • ETC/ATC (terminal) • ETD/ATD (shipping agent)	• Cargo unloaded at terminal • Customs and other inspections • Payment for terminal services • Truck appointment in terminal • Terminal handling • Cargo release • Gate-out (terminal)	• Empty container destination instructions • Truck appointment (empty container depots) • Road/rail haulage • Empty gate-in (container)	• Transshipment declaration • Payment to customs • Unloading • Loading
Related documents	• Customs import declaration • Dangerous goods authorization • Import cargo manifest • Arrival notice • Unloading list • Stowage plan • Unloading reports	• Bill of lading • Cargo release order • Inspection documents (if applicable) • EIR (container) • Invoices and payments for terminal services • Truck appointment (terminals)	• Road/rail transportation order • Rail loading list • Rail loading report • Terminal authorization • Customs authorization • Inland transportation document • Empty acceptance order (container) • Empty container destination instructions • EIR (container)	• In-transit bond (transshipment) customs declaration • Transshipment payment • Unloading list • Stowage plan • Unloading reports • Inspection documents (if applicable) • Loading reports

Source: IDOM.

3.4.3.2. Containerized cargo documentation

The foundation for the international messaging and documentation standards for containerized cargo operations is the Ship Message Design Group (SMDG),[18] which develops, maintains, and promotes the use of UN/EDIFACT EDI messages within the maritime industry. Some of the documents analyzed in this subsection may be sent in electronic format using these standards.

International trade and shipping documents will be divided into three cargo flow groups: **inbound, outbound, and transshipment**. They are distributed among the high-level processes as shown in tables 13 and 14. Transshipment has been included within the inbound process in green.

Documents relating to shipments (goods) or equipment (container) during export, import, and transshipment are described in detail in appendix 8.

[18] SMDG: User Group for Electronic Data Interchange (EDI) in the Maritime Container Business. For more information, see https://smdg.org.

3.5. Legal factors

PCS implementation initiatives require a review of international and regional legal frameworks, including rules and standards on topics such as digitization, cybersecurity, data protection, and business regulation, among others. National legal frameworks should also be analyzed as part of PCS implementation.

3.5.1. International or regional legal frameworks

3.5.1.1. Legal frameworks for electronic documents

World Trade Organization (WTO)—Trade Facilitation Agreement (TFA)[19]

The TFA commits member states to observe certain good practices, including the presentation of electronic documents before the arrival of vessels.

Moreover, article 10.4 of the TFA establishes that member countries must endeavor to maintain or establish a single window (and the necessary ICT to support this) for the presentation of documentation and/or information required by the authorities for the import, export, or transit of goods. Likewise, section III states that each country must establish or maintain a national trade facilitation committee or define a mechanism to facilitate internal coordination.

World Customs Organization (WCO)—Building a Single Window Environment[20]

Documents relating to single windows ("Building a Single Window Environment," "Single Window Data Harmonization Guidelines," etc.) promote their use by customs authorities and provide guidelines for implementation. In "Building a Single Window Environment," the WCO emphasizes that political will is crucial to ensuring the success of such projects and that this must be translated into sustained policy-making routines to support ongoing efforts. The document concludes that customs authorities "have to treat Single Window projects with the utmost priority" and that communication between stakeholders is critical during the policy modeling phase.

International Maritime Organization (IMO)—FAL Convention on Facilitation of International Maritime Traffic and FAL forms

The FAL Convention contains standards and recommended practices and rules for simplifying formalities, documentary requirements, and procedures regarding ships' arrival, stay, and departure. The IMO has developed standardized FAL documentation for authorities and governments (FAL forms).

The FAL Convention mandates the electronic exchange of FAL forms between ships and ports and encourages the use of single windows for this purpose. EU member states were instructed to accept electronic FAL forms to ease maritime traffic in Directive 2010/65/EU.[21] The complete list of FAL forms is included in table 12.[22]

[19] https://www.wto.org/english/tratop_e/tradfa_e/tradfa_e.htm.
[20] http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/single-window/compendium/swcompendiumvol1all-parts.pdf.
[21] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1568879869082&uri=CELEX:32010L0065.
[22] https://www.imo.org/en/OurWork/Facilitation/Pages/FormsCartificates-default.aspx.

United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) at the United Nations Economic Commission for Europe (UNECE)

UNECE has developed a series of recommendations and standards for international trade[23] that reflect best practices in trade procedures and data and documentary requirements and are used worldwide to simplify and harmonize international trade procedures and information flows. Specific recommendations on the digitization and electronic exchange of information are:

- **UN/CEFACT Recommendation No. 18 (Facilitation Measures Related to International Trade Procedures[24])** establishes a set of recommendations related to best practices and standards for the facilitation and harmonization of commercial transactions, including trade documents at the beginning of the process, payment measures, official controls, and transportation of goods.
- **UN/CEFACT Recommendation No. 33 (Establishing a Single Window to Enhance the Efficient Exchange of Information Between Trade and Government[25])** promotes the implementation of single windows to allow the exchange of information relating to international trade transactions, based on a legal framework that provides confidentiality and security in the exchange of information.
- **UN/CEFACT Recommendation No. 34 (Data Simplification and Standardization for International Trade[26])** suggests simplifying and standardizing data to eliminate the duplication of information that may be required by public bodies and supports the consolidation of information in a single dataset, allowing interoperability between authorities and even between single windows.
- **UN/CEFACT Recommendation No. 35 (Establishing a Legal Framework for an International Trade Single Window[27])** complements Recommendation No. 33 by covering issues relating to legal frameworks for single windows including data protection, governance, the identification and authentication of data, electronic documents, and intellectual property. The recommendation also suggests considering international legal instruments and standards.

European Single Window—Regulation (EU) 2019/1239[28]

The EU has its own regulations regarding the digitization of maritime processes. The European Single Window initiative establishes that each member state's maritime single windows be connected to the European Maritime Single Window Environment (EMSWe), which is technologically neutral and interoperable. National maritime single windows should be a general information entry point for maritime transportation operators, from which the data gathered is then transmitted to all relevant competent authorities and port services providers.

[23] https://unece.org/trade/uncefact/tf_recommendations.
[24] https://unece.org/fileadmin/DAM/cefact/recommendations/rec18/Rec18_pub_2002_ecetr271.pdf.
[25] https://unece.org/DAM/cefact/recommendations/rec33/rec33_trd352e.pdf.
[26] https://unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-400E_Rec34.pdf.
[27] https://unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-401E_Rec35.pdf.
[28] https://eur-lex.europa.eu/eli/reg/2019/1239/oj.

Different information channels provided by member states and service providers could be maintained as optional access points for transmitting information and should be able to act as data service providers—PCSs are examples of these.

The purpose of these regulations is to establish different harmonized standards for the exchange of information required during port calls, ensuring that data sets can be communicated in the same way to each national maritime single window. This regulation is also intended to facilitate the transmission of information between declarants, competent authorities, and port service providers at the port of call and other member states. The application of this regulation will be mandatory as of August 2025.

Pacific Alliance

The Pacific Alliance is an economic integration and cooperation initiative led by Chile, Colombia, Mexico, and Peru. The commitment to digitize foreign trade is set out in the Pacific Alliance Framework Agreement,[29] and Chapter 5 of the Additional Protocol to the Framework Agreement[30] specifically sets out the commitments relating to trade facilitation and customs cooperation. Article 5.9 sets out the conditions for implementing and enhancing national single windows for foreign trade and for the harmonization of forms and data which allows for the interoperability of single windows between countries.

Additionally, in decisions no. 1[31] and no. 8,[32] the Pacific Alliance defines the framework for the recognition of electronically signed documents and the electronic documents viewer as part of the single windows for foreign trade of the Pacific Alliance Interoperability Framework.

3.5.1.2. Legal frameworks for cybersecurity and data protection

Measures for a high common level of security of network and information systems across the European Union—EU Directive 2016/1148[33]

EU Directive 2016/1158 sets out legal measures to boost the overall level of cybersecurity in the EU. To achieve this, the directive must be transposed onto member states' national laws and the operators of essential services must be identified. The directive seeks to ensure the following:

- Member states' readiness to adopt the directive by requiring them to be appropriately equipped to do so, namely by establishing a computer security incident response team and a competent national network and information systems (NIS) authority.
- Cooperation among all member states by setting up a group to support and facilitate strategic cooperation and the exchange of information.[34]

[29] https://alianzapacifico.net/download/acuerdo-marco-de-la-alianza-del-pacifico/.
[30] https://alianzapacifico.net/download/protocolo-adicional-al-acuerdo-marco-de-la-alianza-del-pacifico/.
[31] https://alianzapacifico.net/download/decision-n1-reconocimiento-de-los-documentos-firmados-electronicamente-en-el-marco-de-la-interoperabilidad-de-las-ventanillas-unicas-de-comercio-exterior-en-la-alianza-del-pacifico/.
[32] https://alianzapacifico.net/download/decision-no-8-visualizador-de-documentos-electronicos-para-la-exportacion-e-importacion-en-las-ventanillas-unicas-de-comercio-exterior-en-la-alianza-del-pacifico/.
[33] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L1148&rid=1.
[34] States' computer security incident response teams will need to form a network to promote swift, effective operational cooperation on specific cybersecurity incidents and to share information about risks.

- Culture of security across the sectors which are vital for the economy and society and rely on ICTs. These include energy, transportation, water, banking, financial market infrastructures, healthcare, and digital infrastructure.[35]

General Data Protection Regulation (GDPR)—EU Regulation 2016/679[36]

The main objective of this regulation is to give individuals control over their personal data and simplify the regulatory environment for international businesses by unifying regulations within the EU. This means that companies should only collect essential data for their business and must make sure that they protect it (for example, with encryption, tokenization, or pseudonymization). The GDPR also gives the individual control over what data is collected on different websites or apps and regulates the exchange of personal data between companies.[37]

Regulation 2019/881 on ENISA (the European Union Agency for Cybersecurity) and on Information and Communications Technology Cybersecurity Certification[38]

This law consists of two main axes: first, it lays the foundations for the structure and operation of the European Agency for Cybersecurity (ENISA)[39]; second, it defines the standards that allow ICT cybersecurity to be certified within the EU.

According to article 56, cybersecurity certification shall be voluntary unless otherwise specified by EU or member state law. In some areas, it might be necessary to impose specific cybersecurity requirements in the future and make the certification of these mandatory for certain ICT products, services, or processes, to improve cybersecurity levels in the EU. The European Commission should regularly monitor the impact of any European cybersecurity certification schemes that are adopted and reevaluate whether specific schemes should be made mandatory.

3.5.2. National or local legal frameworks

Good practices at the national or local level were also analyzed as part of this research project. An overview of the relevant regulations from countries where PCS projects have been implemented, including Peru, Spain, Chile, and Jamaica were considered. This legislation played an important role in these countries designing and implementing PCS and can be viewed as a good practice for other countries planning to follow suit. Appendix 9 lists these findings in detail.

[35] Businesses in these sectors that are identified by member states as essential services providers will have to take appropriate security measures and notify serious incidents to the relevant national authority. Providers of key digital services (such as search engines, cloud computing services, and online marketplaces) must comply with the security and notification requirements set out in the directive.

[36] https://eur-lex.europa.eu/eli/reg/2016/679/oj.

[37] For example, every time that a user accesses a website or app, they must be notified what data is collected and how it is going to be used and they have to be asked for their permission to do so. The GDPR is applicable to the EU itself, the European Economic Area, and any outside area where personal data is transferred from the EU.

[38] https://eur-lex.europa.eu/eli/reg/2019/881/oj.

[39] ENISA was established in 2004 and was strengthened by the EU Cybersecurity Act (Regulation No. 526/2013), which first introduced an EU-wide cybersecurity certification framework for ICT products, services, and processes. This regulation was repealed by Regulation 2019/881, which seeks to enhance the trustworthiness of ICT products, services, and processes through cybersecurity certification schemes such that companies doing business in the EU will benefit from having their products certified. ENISA has played a key role in the creation of the cybersecurity certification framework.

The PCS Readiness Assessment Questionnaire

4.1. Introduction to the PCS Readiness Assessment Questionnaire

The international good practices described in this document are benchmarks against which port communities can measure their performance as they assess the feasibility of implementing a PCS project.

The PCS Readiness Assessment Questionnaire ("the Questionnaire") is a tool to support port communities to identify any existing gaps which may prevent or delay the successful implementation of a PCS. The Questionnaire is an easy-to-use Microsoft Excel that helps users assess the institutional, technological, legal, and operational aspects of their port. Figure 10 presents a section of the Questionnaire.

Questions 1–34 are yes/no questions, while question 35 requests information regarding the primary cargo type handled at the port: selecting an option reveals one or two further question(s), depending on the selection. Each question row, except the final question, includes a dropdown answer cell, as well as a cell for comments and notes. Providing comments is not mandatory but doing so may be helpful when analyzing gaps and next steps. The end of each question row indicates which section of this document contains explanations or further information that may be useful when answering each question. The final question requires the respondent to identify the documents that are digitized in the port community.

It should take approximately one hour to fill in the questionnaire, although researching the information needed to answer the questions and consulting with other stakeholders may take considerably longer. Once the respondent has completed all the questions, the document will automatically generate a score that provides an indication of the port community's level of readiness to implement a PCS. For more on this score, see section 4.3.

4.2. Who Should Complete the PCS Readiness Assessment Questionnaire?

The target users of the Questionnaire are country or port authority representatives who are considering implementing a PCS. However, it can also be completed by relevant private-sector actors who may be interested in either initiating and operating a PCS or participating in one. Generally speaking, a representative from the port authority, customs or ministry of trade, or any other similar body with legitimacy for representing the port community would be the ideal candidate for coordinating the preparation of the Questionnaire. This agency/body should become an ambassador for the PCS.

Figure 10 The PCS Readiness Assessment Questionnaire

	Readiness level	Score		
	Questionnaire not finished	0		
Question No.		Answer (select from dropdown)	Comments	For more information, see the following section of Smart and Sustainable Ports: Tools for Implementing Port
	Institutional aspects	0		
	This section evaluates the involvement of the most important stakeholders in implementing a PCS, the need to set up a formal Port Community Committee with public and private representation, and the expected role(s) of public entities in the PCS project.			
1	Has a Port Community Committee been formally established?			3.1.1.2
2	Does the Port Community Committee include representatives from public institutions and private stakeholders as well as terminal operators and shipping lines?			3.1.1.1
3	Are there any statutes or rules that determine how the Port Community Committee is organized?			3.1.1.2
4	Does the Port Community Committee have a dedicated full-time president?			3.1.1.2
5	Are the frequency and dynamics of the Port Community Committee meetings clearly established?			3.1.1.2

Although it is recommended that the Questionnaire be answered by one respondent, a single individual may not be able to answer all the questions. The respondent should be able to call on different stakeholders to request support or further information. The questionnaire can be saved and shared with other people for this purpose.

In other words, any person participating in the completion of the Questionnaire should:

- have a holistic vision of port processes and be able to answer most or all questions and identify the stakeholders involved in the different processes and activities;
- have enough influence and access to other stakeholders who may need to be consulted to obtain additional information, such as a Trade Facilitation National Committee; and
- be willing to promote the PCS project.

4.3. The PCS Readiness Assessment Score

Once the Questionnaire has been completed, the spreadsheet will generate a score that indicates how ready the country or port is to implement a PCS. Scores are grouped into three readiness bands: not ready (0–12, or a higher score with at least one red flag answer), partially ready (13–24), and ready (more than 24).

Scores are calculated as follows:

- **Yes/no questions**
  All "yes" answers to the institutional, technological, and legal questions are given one point in the scoring system. This also applies to the questions on operational indicators on international standards, with the exception of those questions that relate to digital documentation (question 36 or 37, depending on cargo type). For

these, the percentage of documents that are digitized is calculated and points are assigned to these as follows:
  - Less than 10% of documents are digitized ("red flag"): no (0 points);
  - More than 30% of documents are digitized: yes (1 point); or
  - More than 60% of documents are digitized: yes (2 points).
- **Red flags**
  There are certain questions throughout the Readiness Assessment for which a negative answer means that the port/country is not ready to move forward with a PCS implementation project regardless of how high its overall score is. A red flag *does not* suggest a PCS should not be implemented; rather, it indicates that based on experiences in other countries, addressing these priority areas first is critical to ensuring success of the project.

Once users have obtained a score on the Questionnaire, they can find an explanation of the result in section 4.4 and suggested courses of action in section 5.

4.4. Interpreting the Readiness Assessment Score

Once all sections of the Questionnaire have been completed, a score on a scale of 0 to 36 or 37 (depending on the type of cargo selected in question 35) will automatically be displayed. Scores are grouped into three readiness bands: **not ready** (0–12, or a higher score with at least one red flag answer), **partially ready** (13–24), and **ready** (more than 24). For more on the scoring system, see section 4.3. These bands are intended to help ports or countries define the course of action they should follow to eventually implement a PCS.

- **Not ready**: there are two possible scenarios within this category, depending on respondents' answers to the red flag questions:
  - *At least one negative answer to any of the red flag questions*: the port or country should focus on addressing the issue(s) covered in these questions to be ready to implement a PCS project.
  - *A low score (0–12) but no negative answers to any of the red flag questions*: the port or country should address issues which received a negative score, focusing on those that the port community might find easiest to address. However, it may consider launching the early phases of a PCS project.
- **Partially ready**: the port or country can comfortably launch a PCS project. However, they must continue to work to bridge some of the gaps identified in the Questionnaire, prioritizing the aspects that the port community might find easiest to address.
- **Ready**: the port or country is fully prepared to implement a PCS. The suggested course of action is to implement international best practices to address any outstanding gaps that were identified in the Questionnaire.

Based on this score, ports can design a course of action to remedy existing shortfalls and move toward implementing a PCS.

Creating and Sustaining Stakeholder Engagement in the PCS: Preparing an Advocacy Plan and Demonstrating Results

The following subsections contain guidance on two practical tools that ports or countries can use to help address existing shortfalls in their port communities and move toward implementing a PCS. Galvanizing the involvement and commitment of key stakeholders is vital to the successful implementation of a PCS. The first of these tools is an advocacy plan: when tailored to the specific characteristics and needs of the members of each port community, this can address the misconceptions and doubts surrounding the PCS project. The second tool is a proposed methodology for assessing the impact and benefits that implementing a PCS would bring the port community, which is important to give the platform credibility and demonstrate results.

5.1. Advocacy plan

The process of implementing a PCS will likely imply making many changes to the existing port system and community. An advocacy plan facilitates these modifications and changes by getting all stakeholders on board. As with any change, it is normal that there will be some resistance. To address this, it is essential to:

- Understand the current situation and how the proposed change will impact individual stakeholders and/or institutions;
- Identify and describe target audiences, messages, and messengers;
- Recognize gaps, assign resources, set goals, and develop an action plan; and
- Monitor and evaluate results.

One of the main outputs of the advocacy plan will be a roadmap that includes specific messages to be transmitted and the actions to be undertaken to achieve buy-in among the port community. It is recommended that the advocacy plan be launched and implemented before the PCS is introduced, which should only take place after the initiative has been approved by the appropriate government bodies.

The following subsections describe the different stages in the process of developing an advocacy plan.

5.1.1. Addressing resistance to change

A new PCS will change the way that information is managed and shared among port community stakeholders, resulting in more agile and efficient logistic processes. How-

ever, the introduction of a new system will ultimately bring with it changes to the way things are done. As mentioned earlier, there may be resistance to the change that the plan seeks to bring about.

The first step in developing an advocacy plan is identifying the problem and the affected parties, as well as defining its causes and impact.

On the one hand, champion(s) need to possess and demonstrate some general features or qualities to build up the trust of the port community. These include credibility for the role, effective communication skills, conflict resolution skills, ability to influence, among others. These qualities will facilitate building strong relationships among stakeholders and permit discussions for cooperation on the PCS project even in parallel to existing disagreements with port community members, inclusion of all stakeholders in the project, openness to share all project information, and so on.

On the other hand, the plan needs to propose an approach to dealing with the transition or transformation of operations and processes, whether in terms of practices or technology. It should include a change management section to reduce or, if possible, eliminate doubts and reluctance among stakeholders. By anticipating areas of resistance and designing a strategy to reduce or eliminate these, the port community will encounter less resistance to the required changes among port community stakeholders; greater acceptance of the new system (PCS); possible reduction in the number of corrective changes while the new processes and procedures are being introduced; more rapid system stabilization as defects are corrected and its use becomes widespread; and a quicker understanding of the benefits derived.

Developing a PCS project will require process re-engineering for most port community stakeholders. This, in turn, will entail bringing stakeholders on board with sharing certain information with other parties. They will ultimately benefit from the new system by obtaining better quality data or streamlining their processes but may initially be reluctant to implement the necessary changes, for reasons listed below:

- PCS implementation requires process re-engineering, changes in documentary procedures, and the introduction of new digital processes. This may result in a reduction in staff numbers or staff moving to other positions, which may in turn bring unease and uncertainty.
- Each stakeholder will have to cover the costs of adapting their systems and integrating these with the PCS, although these should be minimal.
- Certain PCS services may seem redundant when compared to stakeholders' systems. However, while a stakeholder can use their own systems for certain tasks, it may benefit the port community as a whole for them to integrate these tasks into the PCS, thereby avoiding having to upload the same data to various platforms or having to manage different accounts.
- Stakeholders may be reluctant to share their information, fearing that the information will be misused. The management of data security, roles, and confidentiality agreements may also be a sensitive matter for certain stakeholders.
- Fees may be charged for the use of certain PCS services. If stakeholders do not under-

stand the benefits that a PCS will bring them, they may be less willing to pay such fees.
- Depending on the chosen business model, certain B2B services may be mandatory. Stakeholders may therefore see the PCS as being anticompetitive as they may already offer the services it will provide. There may also be possible legal questions for the stakeholders themselves regarding data-sharing.
- Stakeholders may distrust the PCS governance model and be unwilling to use it. For instance, if the PCS is run entirely by a private entity, stakeholders may be more reluctant to share data. On the other hand, if it is managed by a public entity and the private sector has little trust in public institutions, buy-in may also be difficult to achieve.
- Stakeholders may perceive the PCS as a threat to their competitive advantage, given that they are now sharing resources with possible competitors in the same port community, e.g., between terminals. As a consequence, they may not be willing to share the ICT functionalities or services that they offer their clients exclusively.

Each port or country should analyze the specific problems it is facing to identify the main pitfalls relating to PCS buy-in. These can vary significantly depending on the legal framework chosen for the PCS, the business model, the revenue model, the functional design, and other characteristics or features of the PCS.

5.1.2. Description of objectives

Once the main problems relating to acceptance of the PCS among stakeholders have been clearly identified, the next step is to define the purpose of the advocacy plan, that is, what is expected to be achieved by the end of the advocacy campaign. The advocacy plan should follow the SMART goal-setting approach:[40]

Specifically, with regards to the timeframe, it is useful to set short-term, intermediate and long-term objectives. For example:

- **Short-term objectives**: these will help measure the progress of the project and provide small action steps.
  - Get buy-in for the project from all ministries and governmental bodies related to ports and foreign trade.
  - Involve all port community stakeholders in the project from the outset through the PCS committees.
  - Convince customs and/or terminal operators to become PCS ambassadors.
- **Intermediate objectives:** these represent specific steps toward the main goals of the project.
  - Create a cohesive, stable, and well-organized port community.
  - Convince the port community and the importers/exporters as to how the PCS will benefit them and the country's foreign trade.
- **Long-term objectives:** these are to be achieved by the end of the advocacy campaign.

[40] In other words, the advocacy plan should be (i) **specific**: it should set clearly defined objectives; (ii) **measurable**: it must be possible to verify if the objectives have been achieved, in order to monitor progress on the plan; (iii) **achievable**: the objectives have to be realistic, which means that they must be achievable with the resources defined; (iv) **relevant**: the objectives must help achieve the overall objective and not deviate from it; (v) **timed:** the objectives have to be accomplished within a defined timeframe.

- All professional associations that represent the different port community stakeholders agree to actively participate in the implementation of the PCS.
- The PCS becomes the single window for all port logistics activities.

The advocacy plans of each country or port will have requirements or objectives which are specific to them, based on the analysis carried out in the first stage of the methodology.

5.1.3. Target audiences

PCS projects involve the participation of all stakeholders (public and private entities or organizations) in port logistics processes. After defining the goals of the advocacy plan, the next step is to identify the stakeholders that may have sufficient power to influence the project. A stakeholder analysis should be undertaken to answer the following questions:

- Who is most likely to benefit from the proposed changes?
- Who is most likely to be adversely influenced by the proposed changes?
- Who has the power and resources to make these changes happen?
- Who is most reluctant to accept the project?
- Who may be affected by the project?

The stakeholder leading the advocacy plan should consider classifying other stakeholders according to the influence they have on the PCS project and the attitude they have toward change. Table 15 describes stakeholders' level of influence and their potential attitude to PCS projects.

Finally, once the stakeholders have been classified, the following information should be compiled for each: stakeholder's name and type of stakeholder (public/private/PPP); changes affecting the stakeholder and their resistance to change, if any; and the stakeholder's influence (high/medium/low) and attitude (opponent/undecided/promoter).

5.1.4. Communications strategy

Once the stakeholder (target audience) has been identified and classified, the messages to be sent to them need to be designed and a communications strategy implemented. The aim of this strategy is to report on the actions to be carried out within the PCS project, ensuring that all port community stakeholders have correct, up-to-date information. This should further reduce possible resistance to change and increase involvement in the project.

A well-designed **communications strategy** should:

- **Inform stakeholders** who are directly and indirectly affected by the PCS project;
- **Provide clear information**, avoiding errors and incoherent messages;
- **Develop realistic expectations** by analyzing the impact and future benefits of the changes to be implemented;
- **Enlist the support** of professional groups and association leaders to promote and increase acceptance of the PCS; and
- **Gather feedback** to improve the original communications strategy.

A clear and simple methodology that could be used when designing and executing a communications strategy is as follows: analyze stakeholders, define content, design messaging, send communications and gather feedback. Messages need to be

Table 15 Levels of Stakeholder Influence on the PCS Project and Attitudes toward Change

Degree of stakeholder influence	**Low:** these stakeholders have an informal capacity to bring about change in the PCS project. All port community members and future PCS users (professionals and technicians who work within port community companies) are deemed to have low influence on the PCS project.
	Medium: these stakeholders may have some formal capacity to bring about change. Different professional port community groups and associations fall into this category since they make business decisions.
	High: these stakeholders have the formal capacity to cause change in the project. They include port authorities, foreign trade ministries, or customs, due to their power within the port community.
Types of attitude toward change	**Opponents** have a negative attitude toward change and behave accordingly.
	Undecided stakeholders generally have neither a positive nor negative attitude toward change but are simply not yet convinced of it.
	Promoters have a positive attitude toward change and support it because they will profit from it.

Source: IDOM.

sent to stakeholders before the PCS is implemented and should be monitored and followed up during the implementation stage.

As part of the communication strategy, individual communication plans (for each stakeholder) and a collective communication plan (for the entire port community) should be developed. This will help refine the general and specific content of the messages described above and identify the correct messengers.

Some examples of individual and collective messages are provided in table 16. These messages and their approaches are only intended as suggestions, not as strict guidelines. All messaging should be adapted to suit each country and/or specific port community.

5.1.5. Resources and assets

While the advocacy plan is being developed, resources and assets should be assigned to ensure it can be implemented correctly.

An inventory should be made of all available and necessary resources. Existing resources that can be expanded or built on should be included. A detailed list of required resources that are currently unavailable should be compiled by specifically examining the partnerships, alliances, and knowledge capacities that need to be developed, along with other necessary inputs, such as research to support assertions, media support, etc.

Past experiences should be examined to see if any initiatives or projects similar to advocacy plans or communication have been developed. Alliances and partnerships may exist in the port environment, and the experience of the stakeholders involved could be drawn upon, as could any other information and resources that are already available and might be used again. Financial, human, and infrastructure resources should also be evaluated. These are described in more detail in appendix 11.

Table 16 Examples of Individual and Collective Messages around Implementing a PCS

Analyze stakeholders			Define content	Design message		Send message
Communication type	**Stakeholder**	**Type**	**Objectives**	**Message**	**Preparation**	**Channel**
Individual	Customs	Undecided	Convince customs to become PCS ambassadors	The active participation of customs is key to implementing the PCS, since critical information for services comes from customs.	Identify the regulations that should be changed to recognize the PCS as a new valid actor for customs.	Interministerial committee
Individual	Terminal operators	Opponent	Convince terminal operators to become PCS ambassadors	Establish high-level communication to convince them to join the PCS as a key stakeholder, communicating how a PCS would benefit their activities and complement existing systems.	Prepare the benefits provided by the PCS for the terminal operators.	In-person meeting
Individual	Other government agencies	Undecided	Achieve buy-in to the project by all ministries and government bodies related to ports and foreign trade	Explain that the PCS is a useful tool for foreign trade facilitation that will help them to coordinate inspections with customs, customs brokers, and inspections points to eliminate current inefficiencies in coordination and communication between the different public and private parties involved in an inspection.	Collect information obtained during the design of the PCS services, extracting benefits related to inspection coordination	In-person meeting

(continued on next page)

Table 16 Examples of Individual and Collective Messages around Implementing a PCS *(continued)*

Analyze stakeholders			Define content	Design message		Send message
Communication type	**Stakeholder**	**Type**	**Objectives**	**Message**	**Preparation**	**Channel**
Collective	Entire port community		Get all professional associations that represent the different port community stakeholders to take an active part in implementing the PCS.	Explain the business and governance models that have been chosen for the PCS—a long-term project that serves the entire port community for a common good—without favoring particular stakeholders in the logistics chain.	Prepare a presentation on why the business model has been selected and its main advantages, also explaining the revenue model if there are fees to pay.	Plenary meetings of committees
Collective	Entire port community		Convince the port community and importers/exporters of how a PCS will benefit them and the country's foreign trade.	Present quantitative benefits for the port community from implementing a PCS, such as potential saving benefits for both the port community as well as importers and exporters.	Collect the information obtained during the design of the PCS services, extracting, and quantifying the main benefits.	Plenary meetings of committees, newsletters, and local press
Collective	Entire port community		Achieve buy-in to the project by all ministries and government bodies related to ports and foreign trade.	Highlight the risk of inaction and communicate the emerging need to differentiate the port from its competitors. Stress that digitization is essential and should be prioritized to keep the country competitive within the region.	Provide examples of comparable countries.	Plenary meetings of committees, newsletters, and local press
Collective	Entire port community		Involve all port community stakeholders in the project from its inception through the PCS committees.	Explain that the PCS will minimize the cost of the integration between stakeholders, providing value for the entire port community.	Provide examples of comparable costs.	Plenary meetings of committees

Source: IDOM.

5.1.6. Timeline

Once the strategy for collective and individual communication plans has been defined, a timeline needs to be established for each of the messages, including start and end dates. It is strongly recommended to launch the advocacy plan as early as possible before implementing the PCS project. This will ensure that all stakeholders are informed and clear about the PCS project and its benefits prior to development. Once system development commences, messages sent previously will need to be repeated, updated, and modified based on the feedback received from the port community stakeholders.

The content, timing, and sequencing of the messages must be clearly defined to reduce resistance to change among stakeholders. Messages relating to the short-term objectives could be transmitted first, followed by those relating to the medium- and then long-term objectives.

5.1.7. Evaluation

In the final stage, the advocacy plan itself should be evaluated so that progress can be monitored. Indicators should be designed to monitor and evaluate the execution. These should be quantitative to make it easy to evaluate the progress or impact of the advocacy plan. The following types of indicators could be used:

- Progress indicators identify each phase in the advocacy plan. These should reflect the main deadlines and activities defined above and represent small steps toward achieving larger goals. An example of a progress indicator might be the percentage of messages that have been sent during the send communications stage. More detailed examples of these indicators and how they could be measured are listed in appendix 10.
- Impact indicators provide evidence on whether the advocacy plan was successful or not, that is, whether it positively influenced or changed opinions on the issue. Impact indicators might include the percentage fulfillment of the SMART objectives defined during stage 2 of the advocacy plan. Examples of impact indicators based on the hypothetical objectives previously defined in section 5.1.2 are included in appendix 10.

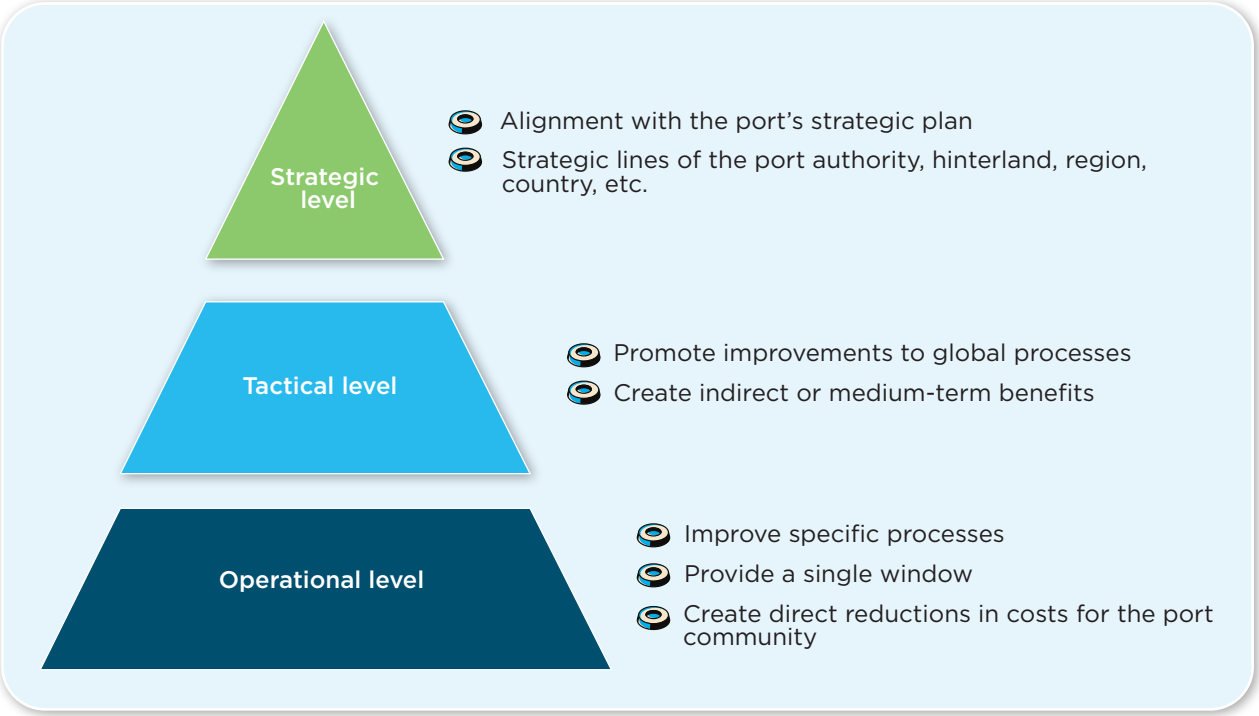
5.2. Demonstrating Results: Impact and Benefit Assessment Methodologies

Different methodologies can be used to identify and measure the qualitative and quantitative benefits of a PCS for the port community, and demonstrate results—this is essential for achieving and maintaining buy-in for the PCS project.

Qualitative benefits derive from aligning the PCS project with the objectives of the strategic plan for the port or the entire national port system. The port community will also obtain benefits from the platform, such as process integration, information visibility and transparency, round-the-clock user support, and improved information security.

The quantitative benefits of implementing a PCS include time and cost savings for the port community. These benefits derive from the increased efficiency and effectiveness of stakeholder operations and are asso-

Figure 11 Proposed Approaches to Analyzing Qualitative Benefits



Source: IDOM.

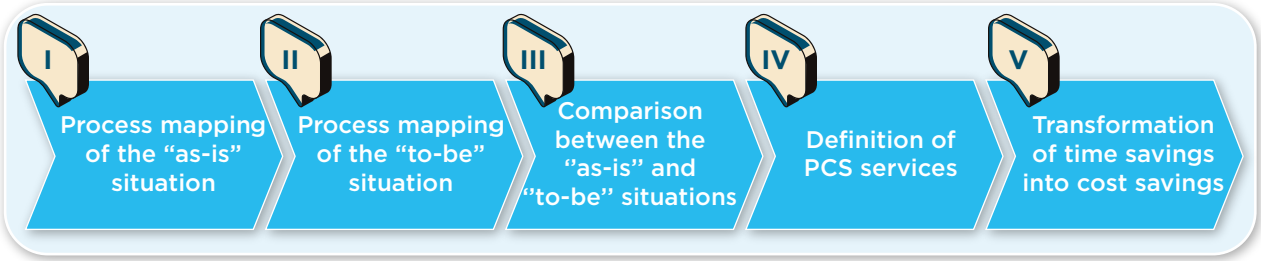
ciated with the different services provided by the PCS. Introducing a PCS benefits each stakeholder and the port community as a whole, making it more competitive among other port communities.

5.2.1. Methodology for identifying the qualitative benefits of a PCS

Given the expansion of maritime transport in recent decades, flexible information exchange has become a key factor in the competitiveness of the entire logistics chain, especially at ports. Supply chains use a wide range of powerful, reliable, and advanced technological tools. The role of ports as intermodal distribution nodes is essential to improving the cost and reliability of the entire logistics chain. Shippers and shipping companies base their port selection not only on cargo handling capacity but also on the value-added services they offer. A PCS is a technological platform that provides some of these services.

The majority of systems used within a port community can be integrated into the PCS, improving the efficiency and effectiveness of port community companies' operations. The PCS should improve the competitiveness of foreign trade and transit through the port, increasing the quality of the services offered by the port community members. Likewise, the PCS will aid in forecasting and

Figure 12 Proposed Methodology for Calculating the Quantitative Benefits of a PCS



Source: IDOM.

planning, which should in turn attract foreign investment. Other electronic platforms such as maritime single windows or government institutional systems could also be included in the PCS, providing a fully integrated value-added service to the port community.

The development of a PCS is an important step toward becoming a "smart port." When a port has a PCS, the port community that is connected through the platform is considered to have reached a certain level of maturity, as standardized procedures, operations, and quality systems are required to achieve this. Figure 11 presents a three-level approach to presenting the qualitative benefits that a PCS brings:

Appendix 14 presents an analysis undertaken after identifying the main benefits shared by the entire port community on a strategic, tactical, and operational level.

5.2.2. Methodology for calculating the quantitative benefits of a PCS

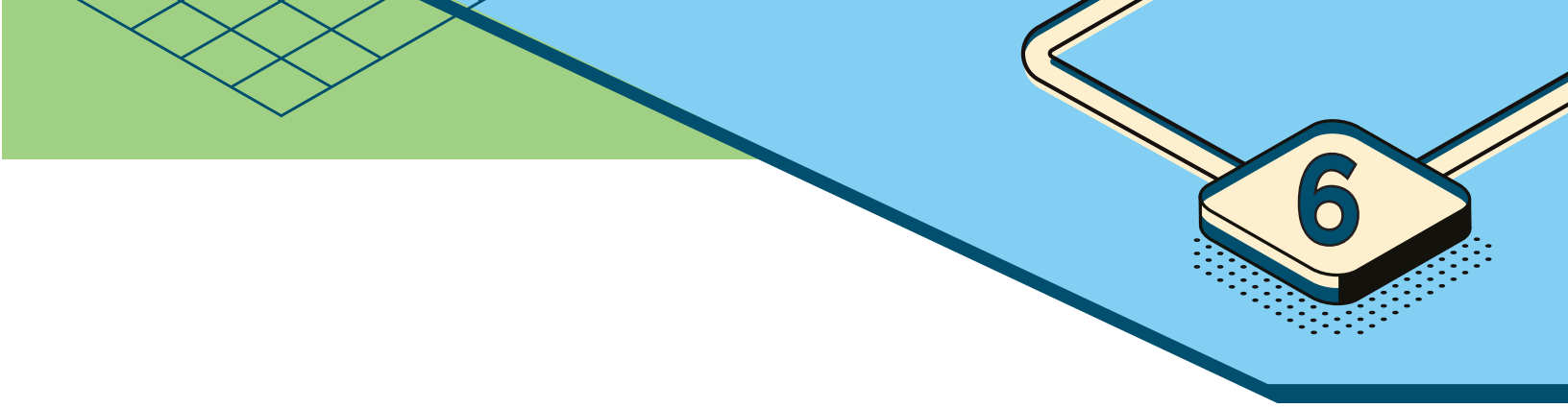
Implementing a PCS brings multiple quantitative benefits and these affect each stakeholder differently. Overall, a PCS will improve productivity significantly for the entire port community. Other benefits include cost savings or other positive monetary effects. Others derive results from greater efficiency and productivity, making the stakeholders more competitive, which can result in attracting more cargo, thereby financially benefiting the entire port community. These potential benefits can be quantified by analyzing current processes (the *as-is situation*) and comparing these with how processes would function after they have been re-engineered (the *to-be situation*).

The phases required for the application of this methodology are shown in figure 12 and described below.

- **Process mapping of the as-is situation (current situation):** A map of the port processes and exchange of documents between the different stakeholders is drawn so that it can later be used for process re-engineering and to propose the functional requirements for the value-added services to be developed through the PCS.
- **Process mapping of the to-be situation (future situation):** The *to-be situation* of the port after process redesign is

described, based on the *as-is* bottleneck analysis of current processes. A process re-engineering task is carried out to optimize the flow of goods through the port. It is recommended that the proposed improvements be evaluated and validated with the port community so that each agent can share their ideas and expectations for the future PCS.

- **Comparison between the as-is and to-be situations:** First, the main sources of time-saving that can be identified should be quantified. These savings should come directly from the process re-engineering carried out during the previous stage. The information to be considered in this analysis must be provided by the members of the port community. This information can be obtained through in-person meetings with stakeholders or calls made to company representatives participating in the meetings. To measure the time saved during each process, a unit is assigned to it (the main unit is the personnel belonging to the port community companies who execute the processes and the time it takes them to accomplish each task).
- **Definition of PCS services:** After analyzing the as-is process mapping and evaluating the improvements proposed in the to-be analysis, a set of value-added PCS services are proposed, each of which is linked to one of these improvements. The processes (messages/actions/tasks) that can be improved by the implementation of the PCS are identified. The port community members involved in or affected by each process associated with a value-added PCS service are then identified.
- **Transforming time into cost savings:** To calculate the financial savings associated with the corresponding time savings, a series of **steps** must be taken. The most common steps in such calculations are listed below:
  - **Estimate a general labor cost** per year and per person for the administrative staff of the different port community members (customs brokers, shipping agents, terminal operators, shipping companies, etc.).
  - **Associate the appropriate unit with each process** (hours/vessel, hours/container, etc.) for the current situation (as-is) and future situation (to-be).
  - **Obtain information on the annual traffic** in goods and vessels, which can be obtained from port authorities and other government institutions.
  - Once all the variables and calculations are available, the result in terms of time obtained in the comparison between as-is and to-be are multiplied by the number of vessels, containers, or other units, and by the hourly labor cost. A monetary saving estimate is thus obtained for each PCS process and service, and the sum of these will result in the total savings brought about by implementing the PCS.



Conclusions

The implementation of a PCS is a long process which requires commitment and constant engagement by both the public and private sector.

This publication aims to reduce the complexity of designing and implementing a PCS by providing a clear overview of how a PCS functions and three practical tools to help countries or ports wishing to implement one. Setting up and operating a PCS will require human and financial resources, and well-defined governance and revenue models will need to be introduced to guarantee the economic sustainability of the system. PCS governance should be determined in the early stages to ensure that the implementation is smooth and that the correct guidance and funding are available. The same can be said for the identification of the operational and technological infrastructure. The revenue model—specifically, deciding whether to introduce a fee structure for the services offered—may not need to be introduced until the implementation stage or even later.

A good starting point before embarking on implementing a PCS is to assess the level of readiness of a port or country using the PCS Readiness Assessment Questionnaire, which accompanies this publication. This will identify the institutional, technological, legal, or operational shortfalls that need to be addressed before a port or country moves forward with its PCS project. In addition, preparing an advocacy plan and assessing the impacts and benefits of the PCS to all stakeholders will ensure continued commitment during the implementation and operation of the system.

PCS platforms are increasingly becoming essential tools for managing the complex logistics operations of modern ports. By providing a central hub for all information related to the movement of goods, these platforms can improve collaboration, reduce delays and costs, and enhance security and safety across the entire supply chain. As the shipping industry continues to grow and evolve, the importance of PCS platforms is only set to increase, and they will continue to play a crucial role in facilitating the efficient and effective movement of goods around the world.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