PORT COMMUNITY SYSTEMS

LESSONS FROM GLOBAL EXPERIENCE

Satya Prasad Sahu, Periklis Saragiotis,
Pascal Ollivier; Editors

CONFERENCE EDITION

Disclaimer

Although the authors have made every effort to engage with a wide spectrum of stakeholders and involve highly qualified, relevant peer reviewers, this Paper remains a living document to be updated as and when additional information is made available. It provides an overview of global experiences and offers a set of guiding principles to help inform stakeholders in maritime trade and pave the way to reform the national trade facilitation and logistical framework.
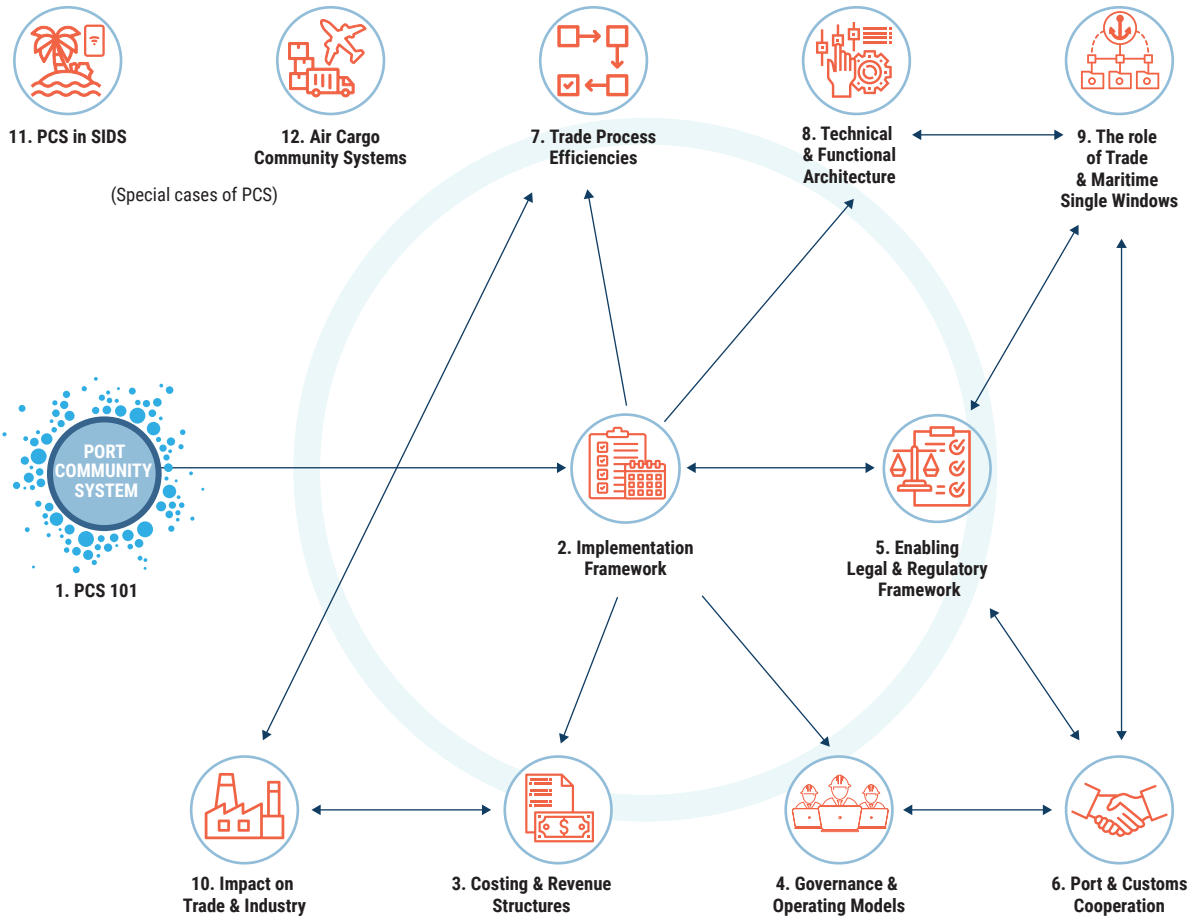
Acronyms

ACCS	Air Cargo Community Systems		**ESB**	Enterprise Service Bus
ACI	Advance Cargo Information		**EU**	European Union
ACS	Association of Caribbean States		**EUA**	End User Agreement
ADKAR	Awareness, Desire, Knowledge, Ability and Reinforcement		**FMC**	Federal Maritime Commission (United States)
AEO	Authorized Economic Operator		**GDPR**	General Data Protection Regulation
AERA	Airports Economic Regulatory Authority (India)		**GNSS**	Global Navigation Satellite Systems
AI	Artificial Intelligence		**GSA**	Global Shippers Alliance
AIS	Automatic Identification System		**IAPH**	International Association of Ports and Harbours
API	Application Programming Interface		**IATA**	International Air Transport Association
B2B	Business to Business		**IBMS**	Integrated Border Management System
BCO	Beneficial Cargo Owner		**ICAO**	International Civil Aviation Organization
BCP	Border Crossing Point		**ICC**	International Chamber of Commerce
BPMN	Business Process Modelling Notation		**ICT**	Information and Communications Technology
BPR	Business Process Reengineering		**IDB**	Inter-American Development Bank
CAPEX	Capital Expenditure		**IFI**	International Financial Institutions
CARICOM	The Caribbean Community		**IMO**	International Maritime Organization
CBP	Customs & Border Protection (United States)		**IOC**	Indian Ocean Commission
COO	Chief Operating Officer		**IOT**	Internet of Things
COTS	Commercial off the Shelf		**IPCSA**	International Port Community Systems Association
CSF	Critical Success Factor		**ISV**	Independent Software Vendor
CT-PAT	Customs Trade Partnership Against Terrorism		**ITPCO**	International Taskforce on Port Call Optimization
DBFOM	Design, Build Finance Operate and Maintain		**ITS**	Intelligent Transport System
DCSA	Digital Container Shipping Association		**JIT**	Just-In-Time
DLT	Distributor Ledger Technology		**JSON**	JavaScript Object Notation
DSI	Digital Standards Initiative (of ICC)		**KPI**	Key Performance Indicator
ECDIS	Electronic Chart Display and Information Systems		**LEI**	Legal Entity Identifier
EDI	Electronic Data Interchange		**MDB**	Multilateral Development Bank
EIF	European Interoperability Framework		**MOM**	Message Oriented Middleware
EMSA	European Maritime Safety Agency		**MPA**	Maritime and Port Authority (Singapore)
EMSWe	European Maritime Single Window environment		**MSME**	Micro Small, and Medium Enterprise
ENISA	The European Union Agency for Cybersecurity		**MSW**	Maritime Single Window

NOTN	Network of Trusted Networks		**SSP**	Single Submission Portal
NPCC	National Port Community Council		**TEU**	Twenty-Foot Equivalent Unit
NTFB	National Trade Facilitation Body		**TFA**	Trade Facilitation Agreement
NTFC	National Trade Facilitation Committee		**TOGAF**	The Open Group Architecture Framework
OAS	Organization of American States		**TOS**	Terminal Operator System
OGA	Other Government Agencies		**TRS**	Time Release Studies
OPEX	Operating Expenditure		**TSW**	Trade Single Window
PA	Port Authority		**ULD**	Unit Load Device
PCS	Port Community System		**UML**	Unified Modeling Language
PCSO	Port Community Systems Operator		**UN EDIFACT**	United Nations rules for Electronic Data Interchange for Administration, Commerce and Transport
PMI	Project Management Institute			
PMIS	Port Management Information System		**UN/CEFACT**	United Nations Centre for Trade Facilitation and Electronic Business
PPI	Port Process Improvement			
PPP	Public-Private Partnership		**UNECE**	United Nations Economic Commission for Europe
SaaS	Software as a Service			
SIDS	Small Island Developing States		**VTMIS**	Vessel Traffic Management Information System
SLA	Service Level Agreement		**WBG**	World Bank Group
SLO	Service Level Obligation		**WCO**	World Customs Organization
SOE	State Owned Enterprise		**WCO SAFE**	WCO Framework of Standards to Secure and Facilitate Trade
SOLAS	International Convention for the Safety of Life at Sea			
SPC	the Pacific Community		**WEF**	World Economic Forum
SPS	Sanitary and phytosanitary		**WMS**	Warehouse Management System
SPV	Special Purpose Vehicle		**WPSP**	World Port Sustainability Program

Structure of the Book

11. PCS in SIDS

12. Air Cargo Community Systems

(Special cases of PCS)

7. Trade Process Efficiencies

8. Technical & Functional Architecture

9. The role of Trade & Maritime Single Windows

PORT COMMUNITY SYSTEM

1. PCS 101

2. Implementation Framework

5. Enabling Legal & Regulatory Framework

10. Impact on Trade & Industry

3. Costing & Revenue Structures

4. Governance & Operating Models

6. Port & Customs Cooperation

About the Lead Authors

Satya Prasad Sahu is a Senior Trade Facilitation Specialist with the World Bank's Global Practice on Trade and Regional Integration. He specializes in the use of ICT in trade facilitation and works extensively on projects and analytical activities concerning digitalization of international trade, transport, and regulatory procedures.

Periklis Saragiotis is a Senior Private Sector Specialist with World Bank's Global Practice on Trade and Regional Integration. He has a firm understanding of global trade and transport logistics trends, challenges, and opportunities and possesses extensive experience on trade facilitation compliance policies, especially in relation to the Trade Facilitation Agreement of the World Trade Organization.

Olivier Hartmann is a Senior Private Sector Specialist with World Bank's Global Practice on Trade and Regional Integration. He specializes in transport and logistics services reforms along international corridors, working on analytical activities and World Bank investment operations in transport and trade facilitation.

Daniel Saslavsky is a Senior Economist with the World Bank's Global Practice on Trade and Regional Integration. He specializes in trade logistics and connectivity and works on projects and analytical activities aimed at improving the efficiency and delivery of infrastructure services supporting cross border trade.

Pascal Ollivier is President of Maritime Street, and advisor to international financial institutions on the digital port infrastructure and maritime trade supply chain. He is the chairman of the International Association of Ports and Harbors (IAPH) Data Collaboration Committee, where he is leading digitalization initiatives with the International Maritime Organization, the World Customs Organization, the World Bank, and the World Economic Forum.

Natalie Gupta works as an Independent Consultant through her own company Port Processes Limited, focusing on ports and shipping and trade facilitation and the energy transition with a particular focus on hydrogen derived fuels. She has previously held corporate roles in Abu Dhabi Ports and Yara Clean Ammonia. Natalie has a PhD in Development Economics and MSc in Finance and Financial Law.

Acknowledgments

Contents

CHAPTER 2

A Framework for Implementation 33

How to organize for implementing a PCS

CHAPTER 3

Financing the development and operations of a PCS 51

Models for sustainable financing

CHAPTER 4

Governance & Operating Models   63

CHAPTER 9

The role of Trade and Maritime Single Windows

Boxes

Figures

Tables

EXECUTIVE SUMMARY

I. PREFACE

The Emergence of Port Community Systems (PCS). PCS represent a pivotal development in the world of maritime trade facilitation and logistics. These sophisticated digital platforms enable seamless exchange of information, coordination, and collaboration among the port community stakeholders. By streamlining communication and automating data exchange, PCS drive efficiency, transparency, and security in the complex ecosystem of global trade. As the volume of international trade continues to grow, the implementation of PCS has become increasingly vital. This book digs into the complexities of these platforms and examines their roles in shaping the future of international trade and supply chain management.

Demystifying the concept, functionalities, and impact. Confusion surrounding the PCS concept and the limited understanding of its fundamental building blocks represents a significant challenge for both policy formulation and industry practice. Conversations with stakeholders from diverse backgrounds revealed a lack of clarity on the functionalities, benefits, and potential challenges associated with PCS. These experiences highlighted the pressing need for a comprehensive resource that demystifies PCS and provides practical guidance on their establishment, operation, and integration into existing port ecosystems. The aim of this study is to bridge the knowledge gap, share valuable insights, and contribute to the sustainable development of maritime trade facilitation and logistics through effective PCS implementation.

Contributing to the port digitalization knowledge base. The recent wave in the port digitalization agenda has accentuated the relevance of this study, making it a timely and critical contribution to the ongoing global dialogue. This study stands out as an essential resource that aligns with and complements the efforts of international organizations such as UNCTAD, IMO, WCO, and WTO in promoting digital ports and trade facilitation. By building on the recent World Bank-IAPH report, "Accelerating Digitalization Across the Maritime Supply Chain," this publication not only demonstrates a clear understanding of the existing knowledge base, but also seeks to further expand it by providing valuable insights and recommendations.

The scope of this study. This study is split in two main sections: Thematic Chapters and Case Studies. We embark on a comprehensive exploration of the concept, evolution, and impact of PCS in modern global trade. We delve into the strategies and best practices for implementing PCS and examine the financial, governance, and legal aspects of their deployment. Central themes of our analysis include strengthening customs-port collaboration and optimizing trade processes through PCS-enabled efficiencies. We also discuss the relationship with the trade and maritime single windows and provide tailored implementation guidance for small island developing states. Lastly, the book extends the principles of sea PCS to Air Cargo Community Systems (ACCS) and explains how key learnings from one sector can benefit the other.

Leveraging the industry's global expertise. We are deeply grateful to the numerous industry experts, academic researchers, and policymakers for their invaluable contribution and support throughout the research and writing process. We are honored to have collaborated with the International Association of Ports and Harbors (IAPH) and with their affiliated PCS operators as co-authors, benefiting from their vast experience and knowledge. Special thanks are due to the International Port Community Systems Association (IPCSA) for their unwavering commitment to promoting innovative solutions for efficient, secure, and sustainable maritime trade, as well as providing constructive inputs into this book.

How to use this publication. We strongly encourage port, maritime and air industry C-Suites and practitioners, , international organization experts, government officials, or international consultants to explore the contents of this book. By engaging critically with this content, we hope that readers will emerge with a deeper understanding of the implications of PCS on their own work and industry and be inspired to explore new opportunities and approaches.

Candidate future analytics. The scope of this first attempt to cover the PCS fundamentals is de-facto limited. In future editions, we hope to explore the evolving role of emerging technologies in enhancing PCS functionalities and capabilities, and techniques for analyzing big data generated by PCS to support informed decision-making for port logistics and trade facilitation. Finally, we plan to delve deeper into the challenges and opportunities associated to potential contributions to reducing carbon footprints in support of green port initiatives.

II. THE CONCEPT AND GLOBAL EVOLUTION OF PCS

What is a PCS? PCS are digital platforms designed to facilitate and optimize the exchange of information and data between a wide range of port stakeholders, including shippers, cargo owners, carriers, terminal operators, freight forwarders, clearing agents, port and maritime authorities, Customs administrations, and other regulatory agencies, enabling them to exchange data and enable data collaboration. The main purpose of PCS is to enhance the efficiency, security, and reliability of maritime trade and logistics operations, by reducing administrative burdens, minimizing waiting times, and improving visibility and transparency along the entire supply chain. PCS offer a variety of functionalities, including cargo tracking and tracing, vessel scheduling and berth planning, Customs clearance and inspection, and invoicing and payment, among others. In **Chapter 1** we discuss the concept of PCS and scan though its main characteristics.

Their evolution over time. From their humble beginnings as basic communication systems, PCS have undergone significant transformation over the years. The first-generation PCS emerged in the 1980s and were primarily designed to improve communication and information exchange among port stakeholders. In the 1990s, the focus shifted towards enhancing efficiency and streamlining port operations, leading to the emergence of second-generation PCS. Today, third generation PCS have evolved into sophisticated digital and cloud-based platforms that enable real-time information sharing, integrated logistics, and supply chain visibility, among other capabilities. This technological evolution was driven by the pressing need for the industry to use data to further reduce costs and time of international trade channeled via ports.

The Next-Gen PCS. We envision a future characterized by continuous evolution and remarkable innovative advancements for PCS. Driven by rapid technological progress, growing industry demands, and stricter regulatory obligations, they will continue to transform the landscape of port and maritime logistics. This evolution will be marked by the further integration of cutting-edge technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT). Moreover, data analytics and predictive modeling are paving the way for enhanced data-driven decision-making, proactive risk management, and optimized resource allocation.

Analyzing The Current Landscape of PCS Adoption Worldwide

PCS global adoption rates. In this study, we analyze the adoption rates of PCS across different regions and countries. The study examined PCS implementation in over 897 ports based on UNCTAD's top ports listed in the Liner Shipping Connectivity Index (2022:Q4) covering 201 countries and territories. The following table summarizes the status of PCS implementation.

Most of the functional PCS operate in the ports of high-income countries and are rarely found in low-income countries. Countries in North America are an exception, where extensive digitalization of port logistics systems is seen in the different segments of port operation, with recent attempts to introduce PCS in several ports. Over 90 percent of the ports in low- and middle-income countries have not yet implemented these platforms. It is interesting to note that 32 low- and middle-income countries have initiated projects or are in various stages of implementing PCS covering 93 ports.

Table 1. Status of PCS implementation

WB Income Group	Pcs Status													
	Count of Countries							Count of Ports						
	NO PCS	Project initiated	Build phase	Design phase	Some modules operational	PCS is operational	Status unclear	NO PCS	Project initiated	Build phase	Design phase	Some modules operational	PCS is operational	Status unclear
High income	37	13	2	2	3	25	3	227	28	2	2	6	179	8
Upper middle income	26	17		4	2	3	1	107	61		5	3	5	42
Lower middle income	26	8	1		3	8	2	81	23	2		15	25	46
Low income	11	1	1			2		23	1	1			3	

Figure 1. Status of PCS Implementation
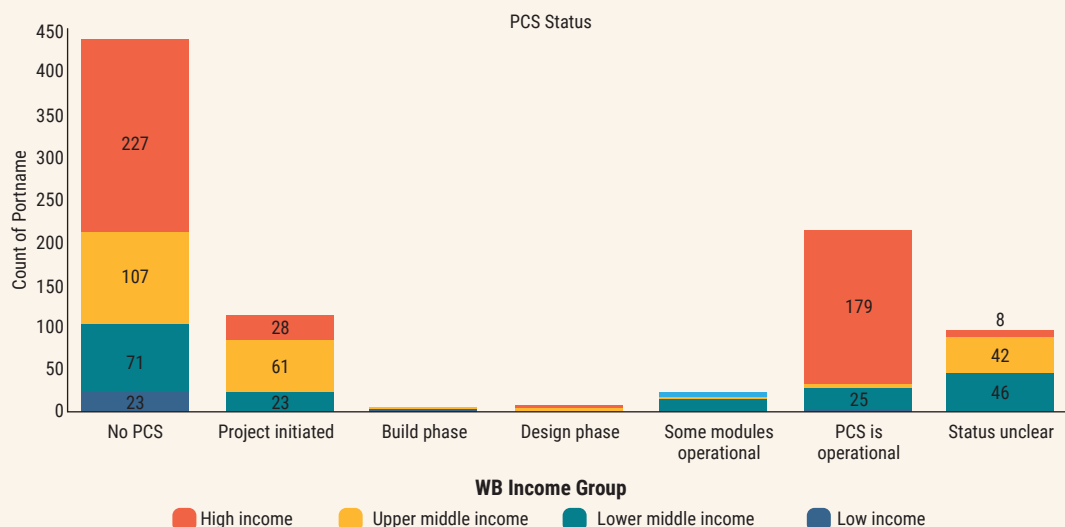
Gap between developed and developing countries. We found that Europe, Asia, and the Americas have high adoption rates, with some countries having mandatory PCS implementation in their ports. The United Kingdom, France, Germany, Netherlands, Belgium, Spain, Singapore, Japan, and South Korea are among the leading countries in PCS adoption. We also identified emerging markets, such as India and Chile, that have been implementing PCS to improve their trade facilitation and logistics processes. There are serious initiatives underway in emerging markets such as Indonesia, Malaysia, Thailand, Mexico, and Brazil. However, developing countries face challenges in adopting PCS due to limited resources and technical expertise. Our report includes **Case Studies** summarizing experiences from both high and low-adoption rate regions. These provide insights for policymakers, port authorities, and logistics providers on how to enhance PCS adoption and leverage its benefits.

Embracing digital connectivity in SIDS. As Small Island Developing States (SIDS) are sea-locked, digital connectivity to port and maritime hubs becomes essential. Implementing PCS is crucial for enhancing their trade capacities and overall efficiency. The economies of SIDS are characterized by heavy reliance on international trade. By adopting PCS, these countries can significantly improve the efficiency of their local supply chains. Several SIDS have adopted PCS, and 12 out of 58 are PCS-ready. These early adopters offer valuable lessons for broader implementation across all SIDS, paving the way for more efficient and sustainable port operations. The mandatory requirement, under the International Maritime Organization's (IMO) Facilitation of International Maritime Traffic (FAL) Convention, for the adoption of a Maritime Single Window (MSW) presents an excellent opportunity to promote PCS implementation in SIDS, with MSW as the first module of a PCS. In **Chapter 11**, we outline how PCS can be implemented in the special economic and sectoral context of SIDS.

Linkages with Trade and Maritime Single Windows. PCS vary around the world in terms of their scope, functionality, and interoperability. In some countries, PCS are integrated with MSW systems, which enable the ship-to-shore data exchange. In other countries, PCS are integrated with Trade Single Window (TSW) systems, which allow the exchange of information between traders and border agencies. The overlap between PCS, MSW, and TSW systems is significant, as they all aim to facilitate the exchange of information and data between various stakeholders involved in maritime trade and logistics. The challenge lies in achieving interoperability and standardization between these systems to enable seamless data exchange and improve efficiency and sustainability in global supply chains. In **Chapter 9,** we present the MSW and TSW and identify opportunities for functional and architectural complementarities with the PCS.

Three distinct operating models have been identified. The different operating models of PCS have significant implications for how they are managed, funded, and governed. Some are owned and operated by port authorities or government agencies, which can lead to greater accountability and control. In contrast, PCS managed by private companies or joint ventures may be more agile and able to respond quickly to changes in the market or industry. Alternatively, the public-private partnership (PPP) model follows a hybrid approach, where the government collaborates with private entities to share the responsibilities and risks associated with the development, management, and financing of the PCS. The governance structure of PCS also plays a critical role in how decisions are made and how stakeholders are represented. A single

entity managing the PCS may be able to make decisions more efficiently, but it may also limit stakeholders' participation. In contrast, a multi-stakeholder committee can ensure that the interests of different actors in the port community are considered, but it may also lead to slower decision-making processes. The funding mechanisms of PCS also vary, with some being fully funded by the government, while others rely on fees and charges from users. Self-sustaining PCS are more likely to be responsive to market demands, but they may also exclude smaller players who cannot afford the fees.

Adapting lessons from ACCS to PCS. At a conceptual level, both ports and airports are physical gateways that cargo goes through to reach the final consumer. As in the case of seaports, Airport Cargo Community Systems (ACCS) are digital platforms set up to share and ease the flow of information and expedite merchandise movements. Given its similarities and differences, it is useful to explore how the digital environment around airports can significantly contribute to the successful implementation of PCS. **In Chapter 12**, we analyze the key characteristics of ACCS and draw conclusions about successes and failures. Key insights include the importance of customization and localization, which ensures faster adoption, highlighting the need for a PCS to addresses specific needs and priorities of the port community to foster greater adoption and effectiveness. Active engagement and collaboration with all stakeholders, facilitated through transparent communication, fair distribution of benefits and costs, and neutrality in leadership, are crucial to building trust and fostering cooperation among the involved parties. Considering flexible governance models, as seen in ACCS, can help find the best fit for each port community, ensuring successful implementation and long-term viability. In practice many countries have established linkages between PCS and ACCS. The future of PCS is linked to the development of multimodal platforms that integrate different modes of transport.

III. THE POSITIVE IMPACT OF PCS

The most common benefits of automation are cost reduction in handling documentation, increased efficiency, and increased compliance. Analytical literature was surveyed to classify the benefits of PCS and the methods for their measurement:

I. Cost reductions in handling the documentation stem from the suppression of duplicate data entry, resulting in time savings not only by suppressing multiple entries, but also because it requires less correction and validation of the data.

II. Increased efficiency stems from early availability of information that enables advance planning of operations and reduces idle time between them.

III. Increased compliance can be facilitated by advance information that allows for better risk management, and traceability of the data which makes it easier to reconcile information.

It is important to identify and quantify benefits of implementing a PCS but is crucial to identify what prior actions may be needed to maximize the chances of bringing positive benefits to the PCS stakeholders. The expected transaction cost reduction and efficiency gains from a PCS, thanks to the digitalization of the information exchange, depends on several assumptions. The main ones are the degree of digitalization of the logistics and trading industries which may require dedicated support for the small to medium-size operators, the actual suppression of the paper trail, and effective business process reengineering and simplification.

The PCS primarily serves the local port community, but a recent evolution, resulting from the disruption of the global supply chains during the COVID-19 pandemic, saw shippers and Beneficial Cargo Owners (cargo owners) taking interest in the data that can be obtained through PCS. Global shippers with greater visibility over their cargo found this very helpful and have been increasingly demanding this feature.

The impact of PCS on the private sector. The adoption of PCS can significantly benefit the private sector by reducing costs, saving time, and enhancing predictability in supply chain management. By facilitating seamless information exchange and collaboration among port stakeholders, PCS promotes more efficient and sustainable port operations, ultimately leading to a more competitive and resilient global supply chain. In addition, PCS implementation has been found to stimulate private sector development and innovation in the maritime industry. Its implementation encourages the development of new technologies and digital solutions by private companies and creates demand for innovative

solutions that enhance the port efficiency and competitiveness. In **Chapter 10**, we analyze in more details the impact of PCS on the trade industry from different angles.

Improved port efficiency and effectiveness. PCS are revolutionizing port logistics by improving efficiency and effectiveness. The automation and streamlining of processes can facilitate cargo tracking, Customs clearance, and enable real-time data collaboration between different stakeholders. This not only reduces delays and costs but also increases the predictability of supply chains going through the port. By eliminating the need for paper-based documentation and manual processes, PCS can improve accuracy, reduce errors, and improve communication between different stakeholders. The port ecosystem becomes more efficient and effective, ultimately supporting the growth of international trade and commerce. PCS is a critical tool for the modern port, providing the necessary infrastructure to manage the increasing volumes of trade passing through ports.

Visibility of cargo flows. Enhanced visibility and transparency provided by PCS can help to facilitate more effective supply chain management, while reducing the risk of fraud in trade. By providing real-time data on the location, status, and condition of goods, PCS can help to build greater trust and confidence between different stakeholders in the supply chain. This increased transparency can lead to increased collaboration, better coordination, and streamlined logistics processes. Additionally, PCS can enable shippers and cargo owners to track cargo and adjust their supply chains in real-time, resulting in greater flexibility and responsiveness. With enhanced supply chain visibility, supply chain participants can better anticipate potential problems and take pre-emptive measures to mitigate their impact.

Reductions on trade cost and time. One of the significant benefits of PCS in trade facilitation is the reduction of transaction costs and time. PCS automate and digitalize trade procedures, eliminating the need for paper-based documentation, manual data entry, and physical inspections. By streamlining processes such as Customs clearance, document processing, and cargo tracking, PCS enable faster and more cost-effective trade transactions, leading to reduced administrative burdens and increased efficiency.

PCS and port procedural improvement. The implementation of PCS has a direct impact on the improvement of port procedures. Based on the global experiences PCS can simplify, standardize, and digitalize port logistics processes, resulting in positive effects on procedural efficiency. In addition, the re-engineering of port business processes is an integral part of both PCS and maritime or trade single windows. This can be conducted either during the design phase or after the adoption of PCS. To accurately map existing processes and discuss and sequence re-engineering activities, public-private consultation mechanisms like Port Community Council (PCCs) and National Trade Facilitation Bodies (NTFB) are necessary. In the future, the application of process mining technology in the port sector will further simplify the process mapping phase by using big data gathered in PCS platforms. An in-depth analysis of the relationship between PCS and business process improvement is offered in **Chapter 7**.

PCS as a trade facilitation tool. PCS are often viewed as a port and maritime solution, but they are, in essence, a trade facilitation tool. In **Chapter 1**, we illustrate the interdependence of regulatory processes and the significantly larger and more cumbersome logistical and commercial processes involved in importing and exporting. While the regulatory processes may be covered by Customs automated systems and trade single windows, the PCS steps in to automate and integrate the complementary logistical and commercial processes involving multiple actors in the private sector. These collaborative interchanges delivered by the PCS contribute significantly to reducing trade transaction costs and time, improve supply chain visibility and transparency, and enhance compliance with Customs regulations and procedures. The PCS can contribute to the compliance and effective implementation of the Trade Facilitation Agreement (TFA) of the World Trade Organization (WTO). By serving as a hub for the exchange of regulatory data, the specific articles where PCS can play a part are Article 10.4 on "Single Window," Article 12.2 on "Cooperation and Consultation," Article 7.5 on "Pre-arrival Processing" and Article 7.6 on "Risk Management". By providing a digital platform for electronic data interchange, risk assessment, and automated Customs clearance, PCS border authorities streamline compliance procedures, reduce errors, and reward compliant trade.

Initiating Customs-Port collaboration. In this context collaboration between Customs and Port Authorities is essential. The success of a PCS depends on the active backing and stewardship of Customs authorities, as they have a crucial and determining role. The four pillars of cooperation between Ports and Customs are legal and regulatory, institutional and governance, business processes and data, and ICT systems and interoperability. Therefore, institutionalization of cooperation between the two parties is foundational for building trust between them and synchronize their regulatory procedures and clearance formalities. We analyze in depth the need for collaboration between ports and Customs in **Chapter 6**.

IV. BUILDING BLOCKS FOR SUCCESSFUL IMPLEMENTATION

A. PCS Implementation Framework

Planning a successful PCS implementation. Developing a PCS involves several stages and preparatory actions. One of the most important one is the **PCS visioning**. This requires the port community to collectively agree on the scope and objectives of the system and how it should function. In the PCS preparation stage, it is also essential to create a detailed **PCS blueprint**. This covers several factors, such as governance and operating models, financial models, legal and regulatory frameworks, business process and data models, technical and functional architecture, and a detailed implementation roadmap. When creating the blueprint, it is crucial to consider existing digital infrastructure and **how the PCS will fit into the already functioning digital ecosystem**. The development of the blueprint demands intense collaboration led by specialized teams made up of port community members. In **Chapter 2**, we discuss what a framework for implementation entails.

The importance of technical capacity and expertise. Developing a roadmap and blueprint for a trade facilitation and logistics digital solution requires specialized expertise and technical knowledge. To guide them through this process, governments should consider **hiring technical advisors**. The World Bank is an organization with vast experience in the proper development of trade facilitation and logistics digital solutions, and it can provide valuable insights into best practices and the latest technologies. As an honest broker and advisor, it can assist interested governments in the upstream stages of project development and transfer implementation knowledge across countries and regions. A comprehensive technical support system is highly recommended to cover the various dimensions of project development, including creating buy-in from all stakeholders, facilitating communication, building consensus, and managing changes to existing processes, systems, and workflows. Advisors with experience in change management can help develop strategies to mitigate resistance, train staff, and ensure a smooth transition to the new system.

B. The Enabling Environment

Sustainable Funding and Operational PCS Models

PCS Financial Framework. Securing appropriate funding is vital for the success of such an endeavor. It is crucial to carefully plan capital and operating expenses to guarantee that the advantages of establishing a PCS surpass its costs. The financial framework for a PCS needs to account for the intricate web of stakeholders and the services provided—the more extensive and complicated the services, the higher the expenses. While determining the overall establishment costs is essential, it is also important to distribute them fairly among stakeholders. The creation and maintenance of a PCS can be costly, necessitating considerable investments in software, hardware, other infrastructure, and human resources. The financing model must pinpoint and apportion these expenses sustainably, ensuring the system's long-term financial viability. In **Chapter 3**, we discuss in details the various funding options available throughout the PCS project cycle.

Essential Funding for Preparatory Phase. The funding for the **preparatory** phase is essential. Funds are required for the need's- evaluation, feasibility analysis, visioning workshop, digitalization gap assessment, and the creation of a roadmap and implementation blueprint. It also encompasses the creation of the enabling environment including the setting up a legal structure, organizational models, and institutional support and an open-minded examination of PCS concepts and desired outcomes. Obtaining **public funds** for this stage of the project can be challenging, due to the governments' competing priorities and limited resources.

Funding options for PCS development. The level and sources of funding during the **development phase** largely depends on the PCS operator model adopted. The operator is required to create a business plan to ensure the financial viability of the PCS. Case studies have shown that the development costs for a PCS can vary significantly. In smaller ports, the cost may be under $10 million, while it can increase to over $50 million for medium ports. For larger ports, the cost may exceed $100 million, and for an implementation covering a group of regional or national ports, the expenses can be considerably higher. The varying costs are determined by factors such as port size, technology used, and the modules and features provided. Funding sources can be public, typically allocated from the port authority budget, private capital, or a combination of both.

Sustaining revenue streams. Revenue generation during the **operational stage** can be achieved through various methods, with funding sources grouped into three main categories. The first category is government financing. PCS frequently **receive public funds** because efficient ports are considered a public good and deserving of taxpayer support. This approach ensures that the PCS receives stable financial backing, allowing it to operate smoothly and provide essential services to the port community. The second category involves generating income through a **transaction-based user fee** per transaction conducted within the PCS. Customs declarations are often used as the standard unit for payment. Lastly, the third category is a **user fee subscription model** where connected users paying a subscription fee usually on an annual basis. These funding options can be implemented independently or in combination with one another, depending on the specific needs and preferences of the PCS and its stakeholders.

The **role of a PCS Operator**. Deciding the most appropriate PCS operator model is one of the most important decisions to be taken during the preparatory stage. The role of a PCS Operator encompasses overseeing the development, integration, and management of the digital infrastructure, systems, and applications within one single platform. This involves working closely with port stakeholders to ensure effective exchange of data, legal and regulatory compliance, and the adoption of new technologies. It is responsible for managing the day-to-day operations of the system, including technical support, user training, system maintenance and evolution. Currently, there is strong interest from cargo owners and shippers to become stakeholders of PCS operator for cargo visibility, predictability to enhance supply operations and resilience. In **Chapter 4**, we touch upon the pros and cons of various operating models.

PCS operator models. There are three schemes identified from international experience. PCS can be operated by either public entities, private entities or under a Public-Private Partnership (PPP) scheme. When operated by a government, it leads to increased public oversight and unfolds opportunities for leveraging existing public financial and human resources. The privately operated PCS is more flexible and responsive to market demands. The PPP operator model balances between public policy objectives and commercial interests, promotes joint involvement in the decision-making process and leverages on technical expertise and financial resources across the board.

Identifying and managing operating risks. The PCS operator's risk management strategy can adversely affect the performance of the system. These are summarized in four categories and include technology, regulatory, operational, and financial risks. The operators must be aware of the challenges, apply effective risk management strategies and a customer-centric approach to mitigate these risks and improve their performance. Tools they have in their disposal include the adoption of robust risk management strategies which encompass regular system audits, cybersecurity measures, compliance monitoring, and financial planning.

Operators may encounter **resistance to change** during the preparatory and development stages. Stakeholders may be hesitant to adopt new technologies, feel threatened by the potential loss of control, while in many cases, the culture within the port community values tradition and established ways of working. PCS operators should develop clear digital strategies, foster stakeholder engagement, prioritize key areas for improvement, select the right technology solutions, and measure overall progress. By using these tools and strategies, the operator can minimize resistance to change and ensure that the PCS's success in the medium to long run.

The Power of Governance, Institutions and Leadership

A clear and well-defined governance and institutional framework facilitates effective collaboration and coordination of siloed port stakeholders. In the absence of such a structure, fragmentation, duplication, and conflicting priorities may arise, leading to delays, inefficiencies, and higher costs. Such a framework helps to minimize the risks associated with implementing these systems by defining clear roles and responsibilities, decision-making processes, and mechanisms for dispute resolution and conflict management. The typical elements of a governance framework as identified by global case studies and international best practices, include four tiers: the Inter-ministerial Committee, Steering Committee, Business Process Committee, and Working Groups.

The **benefits of a robust governance** structure for the port community are clear. Firstly, it encourages stakeholder which, in turn, leads to better decision-making and a stronger sense of ownership. Secondly, it aids in establishing data governance, which ensures its proper management, security, and integrity within the system. Thirdly, it leads to improved data orchestration which helps coordinate the collection, processing, and distribution of data from different sources. Fourthly, it supports change management by providing a clear framework for adapting to new requirements,

technologies, or regulations. Lastly, a well-designed governance structure contributes to long-term financial sustainability by ensuring that resources are allocated efficiently, and the system remains viable in the face of changing market conditions or regulatory requirements. This fosters confidence among stakeholders, which is crucial for the system's continued success. In **Chapter 4**, we outline the core elements of a successful PCS governance structure.

During the preparatory phase, the steering committee and business process committee play crucial roles in delineating the project's scope, formulating strategic objectives, and ensuring that the PCS effectively addresses the needs of all stakeholders. These committees work hand-in-hand with specialized working groups, which contribute their expertise during the design phase by offering technical guidance and recommendations on specific aspects of the system, such as data standards and interoperability. By working collaboratively, these various components of the governance structure facilitate a comprehensive and well-rounded approach to the development of a robust and effective PCS that meets the expectations and requirements of all involved parties.

During the implementation phase, the steering committee plays a crucial role in overseeing the execution process by monitoring the project's progress, guaranteeing that it adheres to the established plan, and addressing any issues or risks in a timely fashion. This oversight is critical to the successful deployment of the PCS and the realization of its benefits. Simultaneously, the business process committee is responsible for making sure that the PCS aligns with the varying business needs of all stakeholders. This alignment is important to ensure that the system is not only technically sound but also practical and useful for the port community. Meanwhile, the working groups contribute significantly by providing technical support and guidance to both the steering committee and the business process committee. Their expertise helps to refine the PCS, adapt it to changing needs and circumstances, and facilitate the smooth integration of the system within the port community. By working together, these committees and groups form a cohesive governance structure that drives the successful implementation of the PCS and maximizes its impact on the port community as a whole.

The importance of the human element. PCS projects can not materialize without strong leadership and strategic guidance at the highest levels. The role of the port authority CEO and the head of Customs is crucial. In addition, C-level top management of the PCS, is responsible for setting the organization's vision and direction, and ensures alignment with the overarching business strategy. The CEOs and CIOs of the PCS operator should have a comprehensive understanding of the port community, and effectively engage and collaborate with both public and private stakeholders. The CEO's role is to guarantee that the PCS aligns with the company's overall objectives and values, while the CIO oversees technical aspects such as system architecture and cybersecurity. It is vital to emphasize that the success of a PCS relies on the capabilities of individuals involved, transcending merely the technology or systems employed. Effective top management prioritize on cultivating relationships and promoting a collaborative culture among all participating parties.

Legislative Framework

Legal framework for PCS efficiency. An efficient legal framework **is critical** to the PCS's successful implementation and functioning. It defines the roles, responsibilities, and obligations of parties involved, particularly the PCS operator and internal and external user. It serves as a guide and ensures that all parties involved are held accountable and responsible for their actions, thereby promoting transparency and fairness. In summary, a well-defined legislative framework is crucial to the smooth functioning of a PCS, ensuring the seamless exchange of information, fostering trust among stakeholders, and promoting accountability. In **Chapter 5**, we analyze the legal and regulatory framework for PCS from various angles.

Reforms for PCS functionality. Legal and regulatory reforms are necessary to facilitate two key aspects related to the PCS. Firstly, these reforms are required for the **establishment of the PCS** itself, ensuring that the necessary legal framework is in place to support its functioning. Secondly, these reforms are needed **to enable the PCS operator to effectively provide its services**. Both aspects require adjustments to existing laws and regulations to accommodate the unique requirements and complexities of the PCS environment. In many instances, regulations or decrees have institutionalized governance frameworks to facilitate public-private collaboration. These often include the **establishment of various entities** such as the Inter-ministerial Committee, Steering Committee, Business Process Committee, and Working Groups.

Legal principles of data collaboration. Data exchanges among public and private stakeholders is a complex process that requires adequate legislative support. Several countries such as Belize and Namibia are looking to the opportunity to establish a comprehensive legal framework towards a "PCS Data Collaboration Act," which not only lays out the legal principles of **data governance** but also defines the rules of stakeholder engagement, data orchestration, change management, and long-term sustainability. This act ensures **data protection, privacy compliance**, and **cybersecurity risks** are managed effectively. This is critical for a platform that handles vast amounts of sensitive personal and commercial data which needs to be safeguarded from unauthorized access, misuse, or disclosure. Moreover, the legal and regulatory environment should be flexible and adaptable to keep pace with emerging cyber threats and technology advancements. Legislative actions, in this context, include foundational electronic transaction and data protection laws that recognize electronic records, transmission, authentication, and signatures.

National and international legislative considerations. When creating a national legal framework, it is crucial to consider the **legislation of all port, maritime and cross-border agencie**s to ensure compliance. Any process re-engineering that takes place should adhere to Customs law and the laws of other relevant regulatory agencies. This means that procedural changes must be legally conformant and aligned with existing regulations to avoid legal complications, unnecessary delays, or even legal disputes. In addition, the national legislation should comply with **international legal instruments by the** World Trade Organization's Trade Facilitation Agreement (TFA), International Maritime Organization's (IMO) Facilitation Convention (FAL), the World Customs Organization's (WCO) Framework of Standards to Secure and Facilitate Global Trade (SAFE) and the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT). Failure to comply may lead to legal or reputational risks, which could have serious consequences for the PCS and its stakeholders.

PPP and Concessions Legal Framework. The establishment of a public-private partnership (PPP) and concessions legal framework is a crucial aspect of the legislative infrastructure required, particularly if this PCS operator model is selected. The legal framework must define the roles, responsibilities, and obligations of all parties involved in the PPP, including the government, the private sector, and the PCS operator. It should also provide a framework for risk allocation, revenue-sharing, and dispute resolution. The success of the PCS largely depends on the effectiveness of the PPP and concessions legal framework in ensuring transparency, accountability, and sustainability.

Technical and functional Architecture

The importance of PCS architecture. Despite the presence of numerous port, maritime, and border management systems1, **there remains a critical need for a Port Community System (PCS) to serve** as the central hub for communication and data exchange. The technical architecture of a PCS significantly impacts existing ICT systems and their vital functions. Consequently, defining the scope of a PCS project and ensuring its seamless integration within the port's existing digital infrastructure is one of the most challenging aspects. To guarantee successful data exchange between PCS and the various trade and transport information systems, interoperability and interconnectivity must be prioritized. In **Chapter 8**, we look into the challenges and opportunities of existing PCS technical and functional architecture.

Architecture for the port community system. The technical architecture and functional requirements of a PCS **must address the diverse needs of all stakeholders**. Developers should conduct a thorough analysis of stakeholder requirements, working closely with each group to identify and prioritize their specific needs. This collaborative approach allows for a PCS design that effectively meets diverse demands while promoting interoperability, scalability, and adaptability. As a result, the PCS can evolve with the changing needs of the port community and technological landscape, enhancing communication, collaboration, and data exchange, ultimately improving port operations.

The challenging task of developing a PCS scope. Defining the PCS scope is challenging due to diverse stakeholder needs. Integration requires understanding stakeholder requirements and addressing complexities. Establishing common interoperability principles, guidelines, and standards is essential, along with developing community artifacts that foster trust. Adherence to **semantic data standards** and **embracing interoperability principles** like openness, transparency, and user-centricity ensure seamless integration. This improves communication, information exchange, and supports complex operations across port, maritime, and border management systems. A well-defined PCS scope and focus on interoperability enhance overall efficiency and collaboration within the port community.

The layered concept architecture. The PCS technology architecture utilizes a **layered concept**, organizing components into distinct layers for specific functionalities and services. This structured approach simplifies organization and management, enabling efficient integration of stakeholders' diverse needs. Layers include **access**, **gateway**, **security**, **application**, data, and **infrastructure**. The access layer manages secure access, the gateway layer enables seamless interoperability, and the security layer safeguards the system. The application layer drives functionality, while the data layer manages information. The infrastructure layer provides necessary hardware and network resources, allowing developers to create a comprehensive solution for the port community.

Smart Ports and Technology Architecture. The PCS architecture of must keep pace with the evolving maritime industry. Emerging technologies such as **IoT, Big Data Analytics, and AI** offer powerful tools for optimizing decision-making and streamlining port operations. Incorporating these innovations into PCS technology can enhance efficiency, monitor data in real-time, and identify trends. PCS play a crucial role in facilitating communication and data exchange between diverse port systems and stakeholders, ensuring smooth operations. Smart Ports emphasize the importance of integrating PCS with advanced technologies to create a seamless, interconnected port environment. PCS technology architecture can be designed to support the development of Smart Ports, enhancing the benefits and value provided by PCS in the maritime industry.

V. Concluding Remarks

The global momentum of PCS. In recent years, PCS have gained significant momentum worldwide, and this trend is expected to continue in the upcoming decade. The benefits of implementing PCS are becoming increasingly evident, including enhanced efficiency, reduced costs, and improved collaboration and communication between different port community stakeholders. As a result, more and more countries are recognizing the value of PCS and are investing in their development. However, developing countries may face significant challenges in implementing PCS due to limited financial and human resources, and as such, support from international organizations may be crucial to ensure the widespread adoption of PCS and the benefits they bring to all countries, regardless of their level of development.

A trade-oriented perspective of PCS. Although our analysis primarily concentrates on the port and maritime industry, it is essential to recognize that this is, in essence, a study of trade facilitation. The unique value-added of this research, compared to other studies, lies in its examination of PCS from a trade-oriented perspective. By viewing PCS as a trade and transport facilitation tool, we can better understand its potential to enhance the efficiency and effectiveness of port operations. This comprehensive approach considers both the transport and trade aspects of port activities, bridging the gap between these two critical components. Consequently, our investigation advocates for a holistic strategy that aims to improve port operations by unifying trade and transport elements within the broader framework of PCS.

Essential PCS knowledge for governments. Governments must understand the concept of PCS, put in place building blocks for its successful development to maximize the developmental impact form its adoption. By integrating PCS into the existing digital port infrastructure, port stakeholders can achieve more efficient and secure communication, enhance cargo visibility, and reduce the time and costs associated with manual paper-based processes. Additionally, PCS can help governments streamline Customs and border procedures, and contribute to national trade facilitation programs. This is particularly important for small island developing states that are mostly trading via ports as their main, if not the only, option. Therefore, governments must prioritize the implementation of PCS as it will lead to more efficient and secure port operations, improved trade facilitation, and increased economic growth.

The value-added of the World Bank. This is the first World Bank study, in an intense collaboration with IAPH and its members, on PCS that has comprehensively addressed the concept. This groundbreaking study examines PCS from various perspectives, shedding light on its potential benefits and challenges. What's more, this study complements other analytical pieces that the World Bank is developing in the trade facilitation and transport connectivity domains. By doing so, it creates a more complete picture of the role that PCS can play in promoting economic growth and facilitating trade.

PCS 101 - WHAT ARE PORT COMMUNITY SYSTEMS?

Executive Summary

Key Takeaways

- Dependable information management systems are critical to the success and seamless operation of the world's seaports and airports. They connect seaports and airports with Customs, transport, and logistics service providers.

- A Port Community System (PCS) facilitates the exchange of data to ensure the quick and efficient operation of a port, its vessel calls and cargo.

- The COVID-19 pandemic has accelerated a shift towards digital transformation in global trade, transport, and logistics.

- Technological progress is accelerating, leading to an increased ability to handle complexity. This advancement results in notable cost reduction. Regulation is fostering greater efficiency and transparency.

- The PCS is paving the way for countries to reap the benefits of wider digitalization, smart ports, just in time arrival and port call optimization.

- The benefits of digital collaboration in a PCS include cost savings, better coordination of activities, reduced delays and bottlenecks, increased responsiveness to changes in demand and market conditions, and enhanced customer satisfaction.

- Most of the advanced industrial nations have PCSs. However, nearly 80 percent of newly industrialized countries and 90 percent of the ports in small and medium income countries do not.

- This decade presents an opportune moment to digitalize global maritime trade and transport logistics for good as more developing countries seek to transform their ports.

- The spread of simpler and cheaper technology, standardization, regulation, and industry demand is putting PCSs at the heart of smarter and more sustainable shipping.

- The maritime sector contributes to 8 percent of the world's carbon emissions and must take adaptive measures to limit fossil fuel consumption drastically. Fuel savings using more accurate and real-time data can ensure ships don't "rush to wait" at ports and do not have to wait at anchorage. PCSs can be a part of the solution.

- There are some rules of thumb for PCSs to succeed. They must remain neutral, transparent, and open entities. They exchange business-critical information and must not favor a particular stakeholder or technology.

- The Port Community System has the power to create smarter, safer, and more sustainable shipping in the 21st century. It is time for everyone, everywhere, to consider the benefits of getting on board.

Maritime trade is the mainstay of global trade. Ports connect markets around the globe. Seaports, airports, and other logistics hubs must be fast, safe, and reliable in transporting international cargo. They are the lynchpins of a country's competitiveness and pivotal to the efficiency of the global marketplace.

Reducing trade costs is critical to grease the wheels of global trade. The broader concept of trade facilitation extends beyond the provisions outlined in the WTO Trade Facilitation Agreement (TFA) and encompasses any policies related to transportation and logistics that reduce international trade costs. TFA measures help governments to reform trade, making importing and exporting easier. When it comes to global supply chains, however, more comprehensive policy may be needed to lower trade costs in transport and logistics at seaports, airports, land borders, dry ports, and container freight stations.

Customs automated systems and trade single windows cover a crucial segment of international trade. However, these systems do not cover business-to-business (B2B) exchanges required to fulfil port and airport procedures involving transport and logistics service providers and their intermediaries. A Port Community System (PCS) complements a government's system. It does so by providing an electronic communications platform that connects different ICT systems, including those of companies and organizations using or serving ports. The PCS facilitates the exchange of operational data to ensure the quick and efficient operation of a port, its vessels and cargo. The PCS is critical to cargo transport on sea, in the air and on land. They operate at seaports, airports, and land border posts. They may connect a single port or a cluster of regional ports. In some cases, they may connect all major ports in one country.

Close cousins of the PCS are the Air Cargo Community Systems (ACCS). PCSs and ACCSs can be used by logistics and cargo operators connected to ports and airports. As an integral part of the global supply chain, they must be plugged into the wider digital supply chain and logistics platforms.

PCSs play two critical roles in global trade. Firstly, they provide an easy-to-use and standardized digital communication platform to exchange operational data and documentation. They do this punctually, securely, reliably, and inexpensively. Secondly, they boost a port's competitiveness by increasing port community collaboration.

There have been four waves of PCS adoption since the early 1980s. Initially European ports in Germany, France, the UK, and the Netherlands led the way. Since then, they have spread around the world. We are now cresting the fourth wave with solutions on the cloud. Busy ports and airports serving many carriers and countries with lots of trade are spearheading the use of PCS and Air Cargo Community Systems (ACCS). Not all countries with significant trade intensity (ratio of total trade to GDP), however, have rolled out such technology. This includes Small Island Developing States (SIDS). Nonetheless, these digital systems are being harnessed across middle-income

and low-income countries. Naturally, progress in adaptation tends to reflect a country's digital and Information and Communications Technology (ICT) readiness.

PCSs tend to have three common elements. Firstly, they are overwhelmingly not-for-profit entities. Secondly, port authorities either own or hold a controlling stake. Thirdly, the system implementing entity engaged by the PCS operator is either a digital solutions provider or has a strong partnership with companies experienced in digital logistics.

The benefits of PCS adoption are clear. They facilitate efficient trade in countries with dominant gateway ports but also help landlocked countries with transport corridors to gateway ports.

The COVID-19 pandemic has accelerated a shift towards digital transformation in global trade, transport, and logistics. **This decade presents a unique opportunity for developing countries to fully digitalize their international trade.** Technology is advancing rapidly. Complexity is growing. Cost savings are significant. Regulation is fostering greater efficiency and transparency.

The PCS is paving the way for countries to reap the benefits of wider digitalization, such as smart ports, just-in- time arrival and port call optimization. Just-in-time arrivals reduce carbon emissions and operational costs. It has the power to create smarter, safer, and more sustainable shipping in the 21st century, reducing CO_2 emissions by reducing waiting times and increasing just-in-time sailing.

PCS costs are falling thanks to the spread of digital technologies in emerging markets and less developed countries. PCSs are increasingly being offered as modular and scalable applications. There are 'pay as you go' options. There is widespread use of cloud computing. PCSs are providing the plumbing for the broader digitalization of the maritime sector. They are letting trade flow faster and more efficiently than at any point in history. They are helping to transform the fortunes of countries and the future of trade on land, on the sea and in the air. **This decade presents an opportune moment to digitalize global maritime trade and transport logistics for good.**

It is time for everyone, everywhere, to consider the benefits of getting on board.

1. Introduction

International trade helps to power a country's economic development. Countries with higher international trade are more likely to have faster and more sustained economic growth. It increases access to resources, technology, and capital. It boosts productivity and lifts living standards. It also diversifies economies, provides new market opportunities for businesses, and creates jobs at home.

Ports play a critical role in global supply chains and production networks. By serving as nodes in international trade networks, ports are platforms for the movement of raw material and merchandise. Seaports and airports are gateways for businesses to buy goods and materials from around the world. They also allow them to sell products to customers in far-flung markets.

Advances in transportation and communication technologies, liberalization of trade policies, and the globalization of production networks, among others, have driven the globalization of supply chains. This has increased competition among ports striving to provide more efficient handling facilities and better connectivity to landlocked regions.

Efficient and resilient ports are highly prized by international trade. They are critical to reliable and timely trade. They are central to sustaining a country's economic activities and dynamism, including transportation and logistics. Ports play a vital role in reducing friction in international trade, striving to minimize costly delays and disruption. Modernizing ports helps to attract foreign investment and boosts economic opportunities.

Trade facilitation reforms alone cannot unlock a country's trade potential. Efficient ports are key. Technology, in turn, is critical to efficiency. The WTO-Trade Facilitation Agreement (TFA) backs the use of automated platforms, as appropriate, throughout the cargo clearance process. The ultimate objective is to increase the efficiency, transparency, and accountability of trade.

While investment by governments and businesses in transport infrastructure, such as roads and ports, is crucial to international trade, investment in digital infrastructure is no less important. That "soft" investment includes the promotion of trade facilitation measures for effective and efficient regulatory clearances. It includes support for digital platforms that power the collaborative exchange of regulatory and operational information.

Ports thrive on effective collaboration and partnerships. The port terminal operators must communicate with the ocean and hinterland carriers, the freight forwarders and Customs brokers, the regulatory agencies and insurance providers, and numerous other port users.

Efficient information exchange reduces costs and boosts efficiency. PCSs are neutral and open electronic platforms that optimize, manage, and automate seaport logistics through single data submission. They ensure an intelligent and secure information exchange between public and private stakeholders. A PCS connects the automated systems operated by various port community organizations. PCSs support trade and logistics at ports. The stakeholders of a port come together to set up a PCS.

2. Port competitiveness and trade facilitation

2.1. Trade facilitation & trade costs

Trade facilitation measures, such as those contained in the WTO TFA, set out to improve and simplify international trade. They seek to remove obstacles to trade, such as administrative and regulatory barriers. Reform of border management makes importing and exporting easier and reduces trade costs. Trade facilitation also includes more comprehensive policies to reduce trade costs, including making transport more efficient. It can include the streamlining of border management processes under the TFA. It encompasses a drive to reduce operational costs and the removal of procedural uncertainties. In a nutshell, trade facilitation includes any policy which simplifies trade and reduces trade costs. It seeks to "reduce the wedges between export & import prices" to unlock economic growth for all.[1]

Trade costs influence the strength and direction of trade.[2] High trade costs tend to exclude countries from participation in global commerce. The OECD developed a model listing three groups of trade costs:[3]

---

1   Working Paper No. 129, UNESCAP (2013) "Who Profits from Trade Facilitation Initiatives?" by Bernard Hoekman and Ben Shepherd (2013)
2   In a working paper titled 'Trade costs', Anderson and Wincoop (2004) defined it to include "all costs incurred in getting a good to a final user other than the cost of producing the good itself: transportation costs (both freight costs and time costs), policy barriers (tariffs and non-tariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs and local distribution costs (wholesale and retail).
3   "Trade Costs: What have we learned? A synthesis report" OECD Trade Policy Paper No. 150 - By Evdokia Moïse and Florian Le Bris (2013)

Figure 1. The diagram is OECD's illustration of policy areas affecting trade costs. Areas highlighted and enclosed in dotted lines (by the authors) represent opportunities for governments and the logistics sector to reduce trade costs
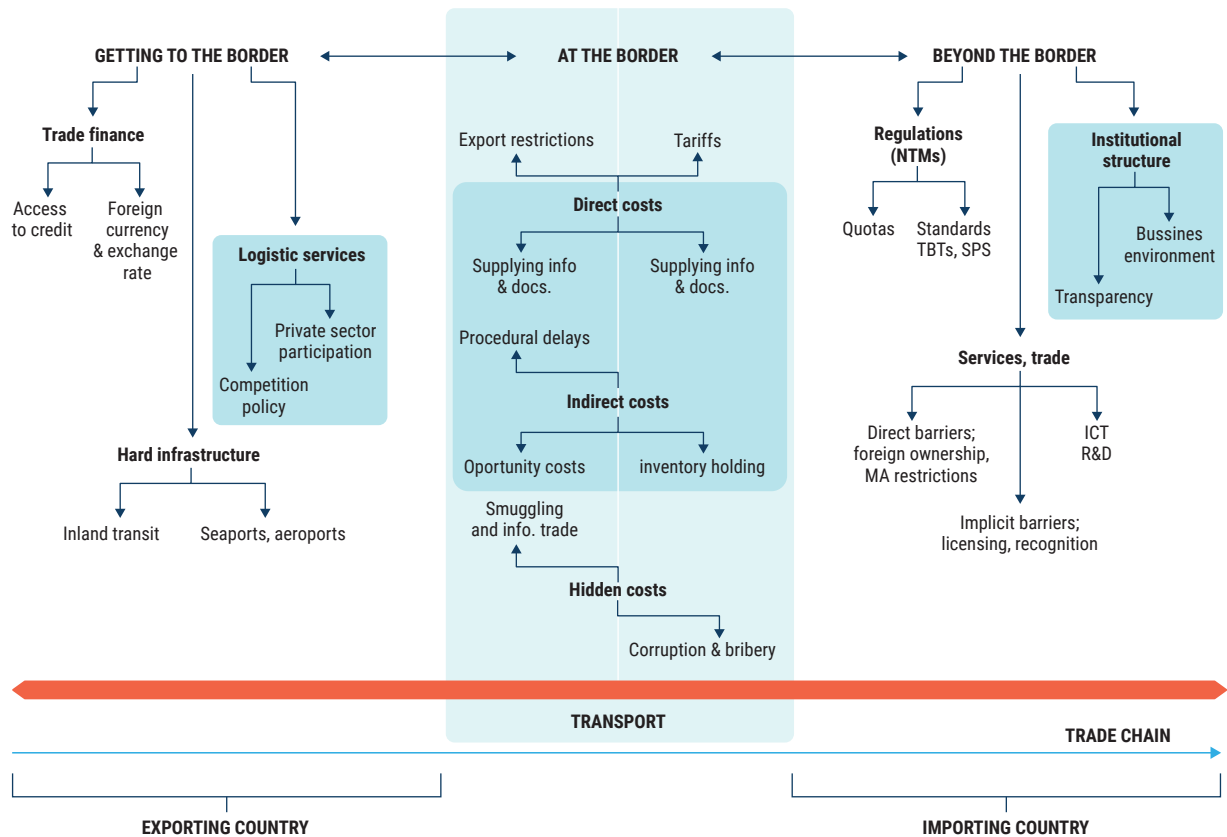
I. Border policies (non-tariff regulatory measures, market access restrictions, costs, and general impediments to doing business).

II. Border crossings (documentation and Customs compliance requirements).

III. Getting to the border (transport infrastructure and logistics services).

Figure 1 maps the factors associated with trade costs along the entire supply chain beginning with the country of export, through the transport chain and ending with the country of import. Implementing the TFA will help to reduce one set of trade costs (especially those dealing with Customs and border procedures).

Trade policy development and other trade promotion activities can help reduce costs due to friction in market access and non-tariff restrictions.

However, other measures are needed to tackle transport and logistics challenges. The OECD study found that transport infrastructure and logistics services are the determining cost factors in all stages of the trade supply chain. These factors impact trade

costs through time delays and can be "more taxing on trade than tariffs". Poor transport infrastructure contributes significantly to the ad valorem costs in the maritime supply chain. Without efficient and competitive logistics services, however, the gains from quality transport infrastructure will be lost.

2.2. Port efficiency and its contribution to trade facilitation

Streamlining port procedures and trade facilitation go hand in hand, reducing costs and delays. Improvements in port processes, such as cargo handling systems and logistics management services, reduce waiting times at ports for importers and exporters while minimizing overall costs. Both trade facilitation and port logistics improvements require complementary regulatory policies, appropriate operation practices, and ICT systems.

Table 1, located in Appendix 2, offers a comprehensive insight into the interplay between regulatory and administrative procedures, alongside logistics operations. These procedures are intricately intertwined, showcasing how they function in tandem and their inherent connection with multiple ICT systems. A pivotal aspect of these processes is the consistent use of overlapping

datasets. Central to their efficiency is the seamless transfer of data amongst stakeholders, predominantly facilitated through the exchange of electronic messages. Although there might be congruence in the received data, there exists a distinct difference in its utilization. Regulatory and administrative authorities, in contrast to logistics operators, interpret and employ this data in unique ways. Table 2 in Appendix 2 depicts how members within the port community harness specific data submitted by trade and transport participants for varied objectives. By aligning data requisites, it lays the foundation for port community members to cultivate and actualize the tenets of data collaboration.

Operations at a port involve a complex array of information interchange. Ports serve a range of vessel types, such as bulk and break-bulk cargo vessels, container vessels, recreational vessels, barges, cruise ships and ferries. Ports have many responsibilities, including dealing with a vessel's call, the management of cargo and passengers, the movement of trucks, rail, and barges to connect with the hinterland, ensuring security of people and property, and safety and efficiency of operations. Most aspects of movement and cargo handling in ports is covered by government regulations and permits. Authorities need a tremendous amount of data and documentation to move and monitor vessels, cargo, trucks, and people through a port.

When looking at a port's paperwork and procedures, it is helpful to examine the different regulations for vessels, cargo, and people.

A recent World Bank study on a Pacific island found that as many as 59 documents would be required for a vessel's arrival and 15 documents were associated with a vessel's departure. The problem of duplicative, redundant submission of data and documents is even more daunting for cargo clearance.

An average international trade transaction involves between 20-30 different parties, up to 40 documents and around 200 data elements, many of which are repeated multiple times in documents.[4]

Traders moving goods across borders face this complexity when they are required to produce a range of data to be reproduced from these documents to fulfil regulatory requirements. Some of these documents, such as licenses, permits, and certificates, are issued by government agencies. In the past, when there was little automation, government agencies required traders to produce hard copies of regulatory declarations, applications, licenses, certificates, permits, and other authorizations. But even with the digitalization of processes, the data remains with the respective government agencies and in separate silos, and the trader has to make repeated data submissions in those countries.

2.3. Physical and digital infrastructure are complementary

Both physical and digital infrastructure are necessary for efficient international trade logistics because they work together to support the movement of goods and information. The movement of goods depends critically on the management of commercial and regulatory information.

Digital infrastructure enables the efficient exchange of information about the flow of those goods, such as tracking and monitoring their location and status. Digital infrastructure can also support the automation of many logistics processes, such as Customs clearance and inventory management, which can reduce costs and improve the overall efficiency of the logistics chain. Additionally, digital infrastructure can help optimize the use of physical infrastructure by providing real-time data on traffic and supply chain conditions, allowing for more efficient routing and scheduling of transportation resources. Data enriches the risk management systems, allowing authorities to reduce physical inspection and improve the targeting of illegal activity.

In maritime trade, information is the glue that binds port processes together and serves as the basis for achieving optimization of the port call, terminal, and hinterland flows. There are several perspectives in organizing the exchange of data in the international supply chain. Intra-organizational data collaboration deals with processes occurring in the private domain and will not be the concern of public policy. Exchange of data between organizations that are linked vertically within the supply chain is driven by business efficiency and competitiveness considerations. In fact, if supply chains must compete with one another, they must collaborate on data more efficiently than their competition.

4   APEC Business Advisory Council - Report to the Economic Leaders 1996 – file:///C:/Users/wb536937/Downloads/96_abac_rpt.pdf

3. Port Community Systems – Strategic Role

Transport Booking · Secure Empty Containers · Stuffing · Gate Appointment · Customs Inspection & Clearance · Loading & Unberthing · Outbond Vessel Clearances · Vessel Departure

OUTBOND — Hinterland connectivity · Port Terminal · Navigational — **EXPORT**

IMPORT — Hinterland connectivity · Port Terminal · Navigational — **INBOUND**

Transport Booking · Stripping & Delivery · Transport Booking · Gate Appointment · Berthing & Unloading · Customs Inspection & Clearance · Vessel Arrival · Inbound Vessel Clearance

3.1. Digital collaboration in port logistics

To manage the services described in the previous section, port community members must exchange vital information with their business and operational partners at each stage of a vessel call or cargo clearance operation. Vessel and cargo clearance operations comprise a range of business processes and can be divided into three categories: (i) Hinterland Connectivity (ii) Port Terminal operations (iii) Navigation. There are opportunities for digital collaboration in all three.

Digital collaboration can improve a port's efficiency, reduce costs, and increase transparency in the supply chain. Digital collaboration centers around the exchange of electronic data and documents about port logistics and maritime regulatory declarations, reports, and certificates. It helps to streamline the flow of information and reduces paper documentation for vessel and cargo operations. Digital logistics collaboration can involve tracking and visibility tools, such as GPS, to monitor the movement of cargo in real-time, allowing stakeholders to track the location and status of their shipments. Stakeholders in the port can use data generated in the supply chain processes to plan and

Figure 2. Port Call Optimization

Port call optimization

Port call synchronization | Port call cordination

THE PORT AS A HUB

Ships · Previous and next ports · Hinterland operators — **EXTERNAL COLLABORATION** — Actor A · Actor B · Actor C · Actor D · **INTERNAL COLLABORATION**
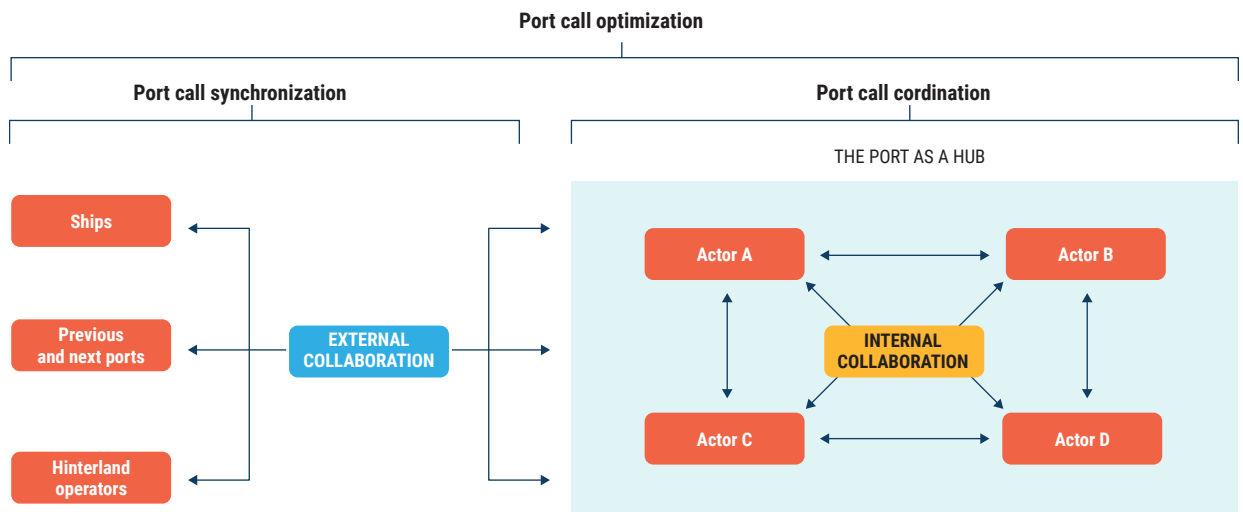
Source: Port Collaborative Decision Making (PortCDM): An enabler for Port Call Optimization empowered by international harmonization (January 2018), EU). The International Task Force Port Call on Optimization (ITPCO) defines the standards for PCO and Just-in-time arrival of vessels.

coordinate the movement of cargo and other resources and track and monitor the performance of various logistics actors, such as carriers and freight forwarders, helping to identify bottlenecks and improve efficiency.

The port community benefits from the optimization of operations that reduce cargo clearance time and berth time at ports. To achieve this, global initiatives are focusing on improving the exchange of nautical, administrative, and operational data between ship operators and authorities based on the shore. This aids the efficient completion of a vessel port call through digital collaboration. The Figure 2 is an illustration of port call operations and the opportunities for digital collaboration to increase its efficiency.

Some, but not all, members of the port community are involved in each part of port operations. Rights to access data and when that data can be accessed are among the most important issues to be negotiated in a PCS.

3.2. Port Community Systems (PCS) – definition

A Port Community System (PCS) is a digital platform that connects multiple members of the port community and their ICT systems. The PCS provides a single submission platform for exchanging information and documentation among all parties involved in the cargo movement through the port. By integrating the various systems, the PCS reduces duplication of effort, saves time, and improves communication among all stakeholders. A PCS is run by a Port Community System Operator (PCSO).

The International Port Community Systems Association (IPCSA) defines the Port Community System (PCS) as "a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea and airports' communities; and optimizes, manages and automates port and logistics processes through a single submission of data and connecting transport and logistics chains."

The above definition of the PCS is carefully worded and captures its essence. Other scholars have defined it differently.[5] PCSs can be defined as holistic, geographically bounded information hubs in global supply chains that primarily serve the interest of a heterogeneous collective of port related companies.

The PCS concept arises from the stakeholders' need to establish and maintain the port's competitive position. The success of a port depends on fast, structured, well ordered, and reliable communication between all other transport and logistics

What is a PCS? It is a digital platform that: (i) Facilitates the exchange of electronic information between organizations that are members of the port community. (ii) Facilitates inter-organizational business processes at a port and (iii) provides value added analytical services to the members of the port community.

Who uses it? Public and private sector stakeholders in a port or airport –the community of sea and airport users. PCS covers all types of exchanges - Business to Business (B2B), Business to Government (B2G) and Government to Business (G2B) and in some cases Government to Government (G2G).

How is the PCS a trade facilitation tool? PCS synchronizes the regulatory/administrative procedures with operational procedures electronically via the exchange of messages, thereby, simplifying procedures, cutting down steps required, procedural red-tape, hand-offs, paperwork and delays.

What is in it for PCS users? A PCS improves the competitive position of the seaport/airport and its users by automating and streamlining the port's regulatory and logistics processes, eliminating duplication through single submission of data, connecting transport and logistics chains. PCSs are built modularly, and their users can access and use specific services in their respective sectors. A PCS helps integrate a broad range of port processes covering the maritime, terminal and hinterland segments giving its users a seamless view of operations.

What makes a PCS reliable and trustworthy? The PCS Operator is neutral and open. It acts like a trusted third party. It enables intelligent and secure electronic exchange between the members of the community.

providers and cargo owners. A PCS is an electronic platform that connects to multiple organizations and businesses in the port community. The efficiency and simplicity of the PCS arise from the adoption of the 'single window' concept, where each entity is concerned with the adoption of a single and simplified interface instead of connecting with multiple systems of various stakeholders. The following diagram illustrates this well:

The PCS replaces the need for members of the community to connect individually with all other stakeholders. It provides the technical infrastructure and tools to handle digital connectivity between the stakeholders, thereby serving as a valuable trade facilitation tool that electronically links both administrative

---

5   Srour, F. & Oosterhout, Marcel & Baalen, Peter J. & Zuidwijk, Rob. (2008). Port Community System Implementation: Lessons Learned from International Scan.

Figure 3. Collaboration between members of the port Community Before and after a PCS
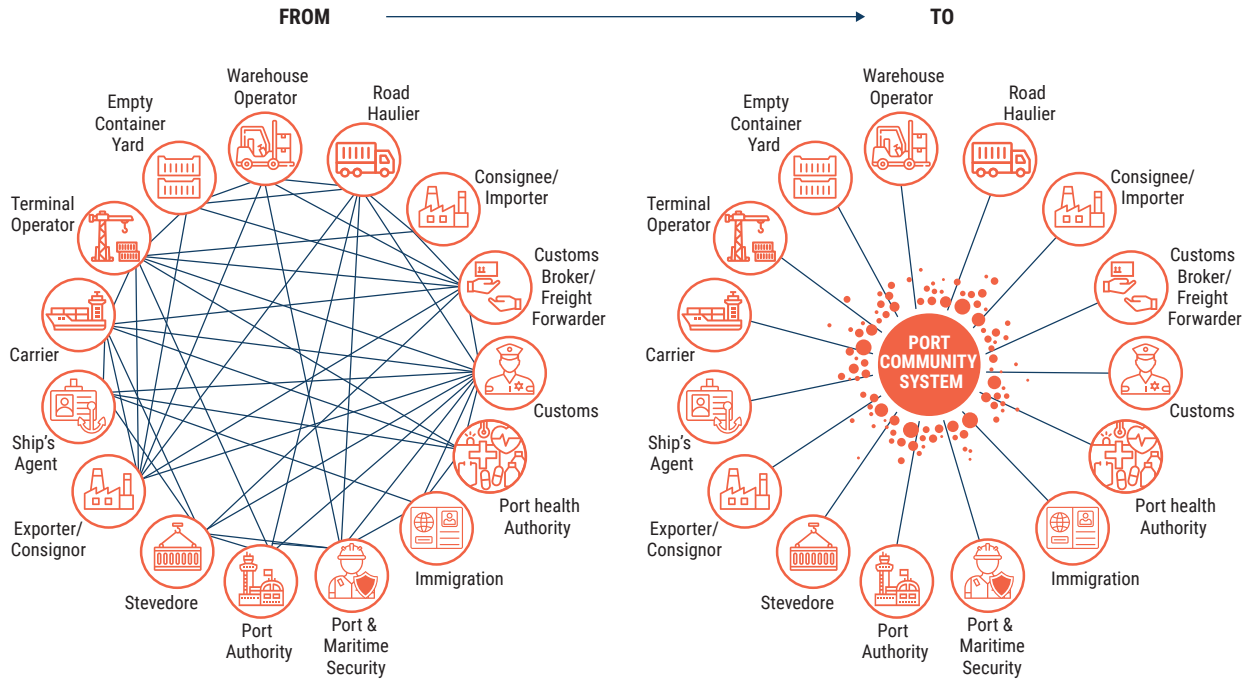
(B2G2B, G2G) and operational procedures (B2B) electronically via the exchange of messages.

The PCS construct stretches the traditional concept of trade facilitation beyond border management to include the digital dimension of port processes and procedures. It acts as the three-way information bridge between the ship to shore operations, regulatory controls, and hinterland logistics, providing the opportunity to the participants to streamline, synchronize and optimize port operations and cargo flows. Thus, PCSs are a part of the port's regulatory as well as transport infrastructure. They contribute to a procompetitive environment in logistics services.

Port operations involve multiple actors who must co-ordinate with one another. These actors could be: (a) Public authorities, such as the port authority, Customs, immigration. (b) Port-based service providers, such as terminal operators, pilotage, stevedoring, and bunkering services. (c) Hinterland logistics services, such as rail, road, or barge services. A port must manage the physical flows and information flows between the users of the port on the ocean side, as well as the hinterland. Information flows are of special importance in the planning and execution of the movement of cargo. This is vital in the movement of containerized cargo. It also needs to manage the strongly connected business processes for the movement of goods, means of transport and crew. PCSs serve users of ports as hubs for information exchange and operations. Principally, PCSs manage a system of records and act as an electronic intermediary for exchange of information and documentation

between the port users. PCS is also a process enabler, linking the processes of the respective actors into an overall port process. In its advanced form, it aims to provide a level of integration deep enough to meet the information needs of all participants in the supply chain.

A PCS is the focal point for port call optimization and involves port call synchronization (ensuring that the vessel arrives just in time) between the ship and the shore and port call co-ordination within the facilities and agencies on shore.

3.2.1. PCS functions and how PCS participants benefit

The PCS helps the port succeed and preserve customer value. By aggregating critical data from the information systems of the community participants onto a single platform, a PCS streamlines interdependent logistics procedures. The PCS provides real-time visibility of shipments, allows for better coordination between different stakeholders, and reduces costs associated with paperwork and manual processes.

At the beginning of their development, PCSs were more centered around the concept of a "data exchange hub" or "electronic mailbox." Gradually, stakeholders realized its potential to offer a variety of services that greatly enhance a port's efficiency, reliability, and resilience. The following table summarizes PCS benefits and provides pointers to the quantification of those benefits.

Table 1. Categories of PCS Benefits. Carlan, V., C. Sys, T. Vanelslander, Port Community System cost and benefits: from competition to collaboration within the supply chain, 2015, Hellenic Institute of Transport

Digital Economies Benefits		Quantification Methods
Economic Benefits	Reduce the cost of information access	Value of time and labour saved
	Reduce the cost of communication	Previous cost of communication
	Extra revenue to government authority or administrator	Value of revenue
	Correct taxation (port authority services)	Difference between before and after tax revenue
	Prevention of illegal transactions	Percent of illegal transactions reduction
Increased Quality of Information	Decrease in error rates	Time and labour consumed to correct errors
	Elimination of data inconsistency / Decrease in data redundancy	Time and labour consumed to sort and verify data
Increased Performance	Fast access to information	Measurement of Increased Labour Productivity
	Efficient use of resources	Better use of equipment capacities
Community attendance benefits		**Quantification Methods**
Increased competitiveness at Stakeholder level	Increased access to information	Savings in costs of information
	Added value services	Revenue in Added Value services through PCS
Increased efficiency	Compliance with community standards and regulations	Less investment needed through business growth

3.2.2. *PCSs differ from other types of systems found in a port*

There are several principal port systems: Terminal Operating System (TOS), Port Management Information System (PMIS)/ Harbor Management Systems and Automated Customs Systems/Cross-border Regulatory Single Windows.[6] Besides, in some countries, there are Maritime Single Window systems (MSW) that require ship operators to submit all regulatory data related to vessel, cargo, passenger, and crew at a single point of entry. The carriers (shipping lines, pre- and onward carriage operators, such as trucks, railway, and waterways) have their own systems and platforms. All these systems have legitimate and distinct functions and services requiring businesses to subscribe to them. The PCS is distinct from these systems as it enables communication and interconnection between them, offering services that are only possible thanks to this interconnection.

In some ports, the TOS or the PMIS or the MSW may appear to provide services that are akin to a PCS. That could be due to community efforts to establish one-to-one connections between existing systems. A PCS, with its hub-and-spoke topology is a superior solution because of the greater possibilities for interconnectivity and effectiveness. Even in ports where there are existing one-to-one connections, it may still be beneficial to implement a PCS. (Chapter 8 and chapter 9 discuss this in detail.)

3.2.3. *Air Cargo Community Systems (ACCS)*

The PCS concept extends to other modes of transport – namely the Air Cargo Community System (ACCS) and Land Port Community System. An Air Cargo Community System differs marginally from PCS in the sense that it is organized around International Civil Aviation Organization (ICAO) recommendations and International Air Transport Association (IATA) standards. IATA is an industry organization with near universal membership among commercial carriers. With air carriers under IATA's umbrella, the broader air freight industry is generally a follower of IATA's guidance and standards, which then get adopted on to ICT platforms used by the community. However, there are differences between PCSs and ACCSs. Air cargo does not have the equivalent of the shipping container. Unit load devices (ULDs) are transport unitization equipment to facilitate cargo handling in aviation, but they are unlike multi modal shipping containers that can transported by road, rail, and ships. Leaving aside those differences, airports, much like ports, require a high degree of data collaboration. The air cargo community benefits from the electronic interface between air cargo terminals, airlines, freight forwarders, trucking operators, customs, aviation security, and ground handlers in much the same way as the port community does in the case of PCSs. Interestingly, ACCSs and PCSs successfully interoperate in countries such as the United Arab Emirates (UAE), Singapore, and Mauritius.

---

6   Trade Single Windows and Cross-Border Regulatory Single Windows are often referred to as National Single Windows (NSW).

Box 1. Port Community Systems: Benefits Realized

1. PCS at King Abdullah Port, Saudi Arabia

In the heart of the Red Sea, the King Abdullah Port thrived as one of the world's most advanced and swiftly growing ports. But behind its towering cranes and vast berths was a technological marvel less visible, yet equally impactful: the Port Community System. Envisioned as a digital nexus, the PCS seamlessly integrated various operations within the port, connecting shipping agents, customs officers, terminal operators, and transport companies. The real-time data exchange fostered an environment of transparency, collaboration, and efficiency.

Paperwork has been replaced by automated workflows and digitalized processes, allowing for faster cargo clearance and minimal dwell time. With PCS at its backbone, the port could promise not just swift transshipments but also accurate, secure, and predictable services.

The benefits of digitalization are visible. King Abdullah Port has managed to secure high positions in the World Bank Container Port Performance Index (CPPI) rankings.

Source: https://www.kingabdullahport.com.sa/port-technology/port-community-system/

2. PCS at Port Cotonou, Benin

Yet another example of benefit is that the PCS in Port Cotonou in Benin delivered through Just-In-Time processes for trucks. The PCS at Port Cotonou was implemented in 2011, and within a year, it reduced the average stay time of large trucks in the Port of Cotonou from 269 to 3 hours. Digitalization is also high on the agenda, with partners such as Webb Fontaine creating Single Window solutions for the clearance of goods, interconnecting all stakeholders involved in foreign trade and allowing them to perform trade procedures on one platform. This was not an effort of the PCS alone. Partners such as Benin Control and Benin Customs Service have also joined the effort in creating online and digital solutions for cargo declaration, valuation, and the tracking of goods. The Port Authority of Cotonou is expected to make further advancements to its PCS whereby all actors involved in the handling of vessels and goods will be electronically linked. The African Development Bank Group has approved further investments into the port infrastructure and digital solutions that link entry and exit points to the port's database. An integrated center will be established at the port for trade and freight processing. The goal is to cut transit time in the port area to two hours and relieve congestion along nearby roads.

Source: African Development Bank: https://www.afdb.org/en/news-and-events/press-releases/benin-african-development-bank-group-extends-eu80-million-loan-port-cotonou-upgrading-63154

3.2.4. Land borders and the Integrated Border Management System (IBMS)

There is considerable heterogeneity in land border crossing points (BCPs). BCPS differ widely in terms of remoteness of location, size in terms of number of lanes, cargo /passenger volumes handled, infrastructure and technology, security considerations, regulatory environment, border processing and waiting times. It is often said that the best border crossing point is the one travelers and truckers don't even notice when they cross it. But such instances are rare and can be found only in the EU where there is a high degree of economic integration between member states.

Most BCPs in the developing world are highly complex. In some land border posts, regulations require the transloading of cargo at land borders (unloading of cargo from one truck and loading of the cargo on another truck across the border). In many countries, customs inspection and clearance does not take place at off-border facilities (cargo terminals) but is undertaken right at the border, requiring authorities to build inspection, storage, and warehousing facilities at the BCPs.

Transshipment is also necessary when railway connections abruptly end at land borders, for example, if the railhead terminates, or there is a change in rail gauge. At certain borders, regulatory authorities carry out intensive controls, leading to the heavy accumulation and warehousing of cargo at borders. In all these situations, there is considerable information asymmetry, a heavy footprint of trucks, cargo, and freight operations, giving rise to the need for a community platform for freight and logistics operators, in much the same way as a PCS or ACCS.

Figure 4. The Schematic of an Integrated Border Management System
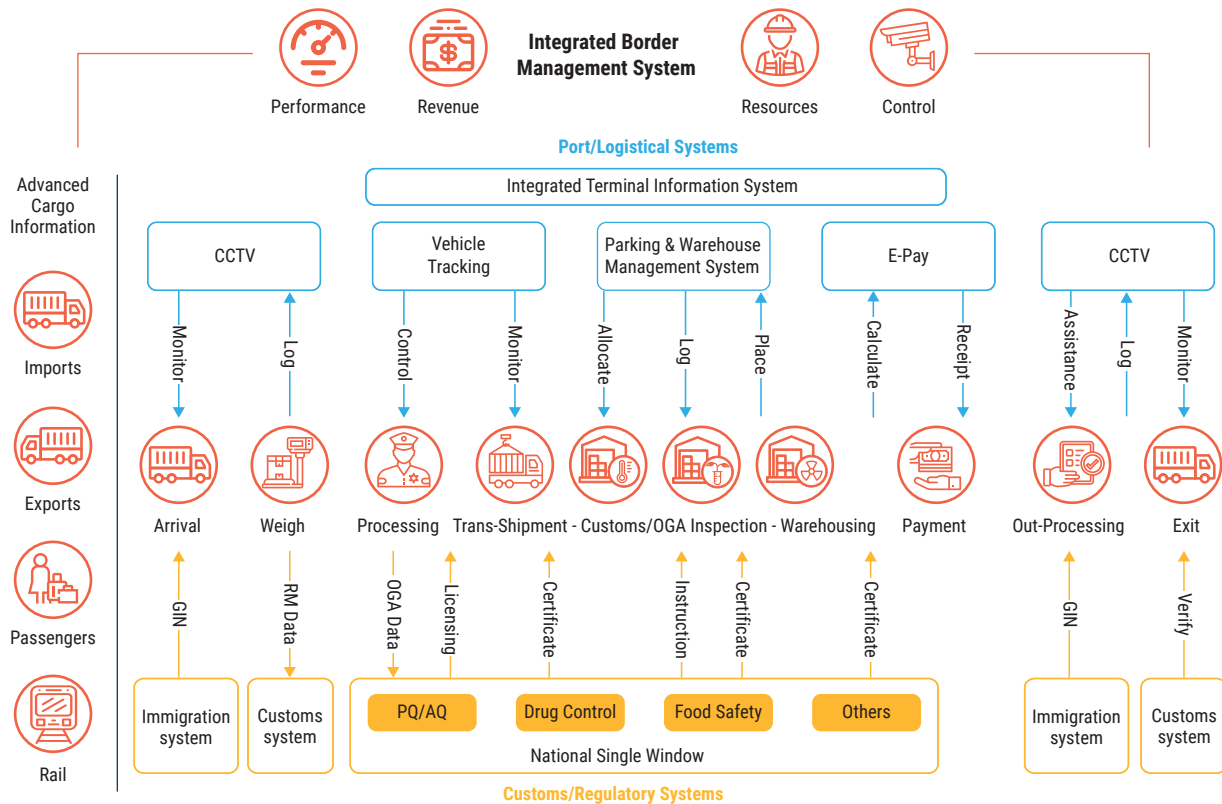
Ensuring the physical security of cargo and implementing cross-border controls of people, goods and means of transport makes border management complex. Security agencies and border control authorities benefit from 'integrated border management systems'(IBMS). The existence of layered systems of information management and control in the EU allows its authorities and industry to manage cargo efficiently and with a light footprint. Advance cargo information (ACI), technical means of Customs control and cross-border data collaboration between border agencies, logistics operators, transporters, and traders, has helped established modern border management systems. IOT devices attached to trucks, electronic weigh bridges, automated boom barriers, CCTV cameras, Automated Number Plate Recognition Systems, electronic queuing facilities, truck appointment systems and so on, that are common features of the ACCS and PCS, apply equally to the IBMS.

3.3. The import and export process with and without a PCS

Automated Customs systems and trade single window systems can speed up cargo clearance at ports. However, they need to be complemented by improved infrastructure and capacity, and effective coordination and collaboration among stakeholders in the transport and logistics sectors. The process to clear import and export cargo involves a complex interplay of regulatory, logistical, and transport-related procedures, each of which must be carefully managed to ensure the efficient and timely movement of goods. This calls for a thorough study of processes that require close coordination of shipping lines, freight forwarders, transporters, the Customs authority, and terminal operators. The following description of the import and export process shows the role of the PCS in automating and integrating the business and governmental processes at a port. The description would confirm that less than a third of the cargo clearance process involves the Customs automated system and single window, which is shown in *italics*, while the rest can be facilitated by the PCS.

3.3.1. *The import process*

- *Shipping lines or the ship's agents electronically submit a cargo manifest to the PCS. Several countries require the submission of ACI, which is a norm under the WCO SAFE Framework of Standards.*

- *The cargo manifest is a document containing the details of each consignment on board a vessel and includes a brief description of cargo, ownership, handling and information about the consignor and the consignee.*

- The PCS transmits the manifest to the Customs and port authorities and distributes it to the terminal operators and other government agencies. Port authorities use the manifest to calculate and collect statutory vessel and cargo-related charges.

- The importer pays the shipping lines the applicable charges and fulfils the documentary requirements, enabling the shipping line to issue a 'commercial release' along with the validated Bill of Lading.

- The validated Bill of Lading is stored on the PCS for subsequent use.

- *In parallel, the importer seeks and receives the required permits and licenses from the relevant government agencies on the Trade Single Window (TSW). The Customs broker then submits an import Customs declaration in the automated Customs system/Trade Single Wi*ndow, which sends a notification back to the importer and the broker about the relevant duties, taxes, and fees.

- *Once paid or secures through a guarantee, the importer receives a Customs Release notification, after conducting inspections where necessary.*

- The PCS also receives the release notification, transmits it to the terminal operator, and updates this information for viewing by several other participants.

- The freight forwarder pays the shipping line the documentary and liner charges on the PCS, (submits the bank release, where the Bill of Lading is endorsed to the commercial bank) and generate the 'commercial (or liner) release'.

- The importer pays storage and handling costs for the shipment to generate a 'terminal release'. This may be paid to the terminal operator's system or on the PCS.

- Having generated the 'commercial release' through the validated bill of lading (or Delivery Order), the Customs Release and Terminal Release documents, the PCS then generates a final release at the gate and notifies the importer, the broker, and the trucker that the shipment is ready for pick-up.

- The automated handling of the final release facilitates the gate appointment process. It involves the sequential interchange of information among the freight forwarder, trucking company, and the terminal operator. The PCS allows forwarders to select the trucking company on the PCS, the trucking company enters the truck and crew details on the PCS, and the PCS notifies the terminal operator about pick-up.

- On the PCS, the terminal operator notifies the delivery window, and the gate appointment. The PCS opens up the possibility to automate gate entry. In automated gates, the PCS or the TOS help electronically authenticate: (i) Cargo release details. (ii) Identity of the truck and crew. (ii) Validate truck appointment. (iv) Transmit yard pick-up instructions. (v) Deliver equipment interchange reports.

3.3.2. *The exports process*

- The exporter, Customs broker or freight forwarder may submit a booking request to the shipping agent on the PCS and receive the booking confirmation along with the container number.

- The PCS notifies the Terminal or Empty Container yard with instructions for the release of an empty container along with pick-up instructions.

- The freight forwarder must then identify the trucker responsible for picking up the empty container. To access the terminal/empty container yard, the trucker must book an appointment in the terminal/empty container depot on the Truck Appointment System, which is either hosted on or connected to the PCS.

- Once the appointment is validated, the PCS notifies the shipping agent, the trucker, and the freight forwarder. The trucker can then proceed with the appointment to pick up their empty container from the empty container yard/ terminal.

- After the trucker collects the empty container, the terminal operator sends the number of the container collected by the trucker to the PCS and the information is redirected to the shipping agent, updating the booking confirmation.

- Upon receipt of the empty container from the trucker, the exporter or freight forwarder registers the arrival with the PCS. The container is then stuffed.

- After stuffing and sealing, the exporter or freight forwarder updates the booking confirmation record on the PCS.

- *The exporter or freight forwarder assigns the task of filing a Customs declaration to a customs broker, who can lodge (or update) the export customs declaration. Customs risk assesses the declaration and approves the Customs release.*

- The release information needs to be notified on the PCS to all parties concerned – the exporter, the Customs broker, the freight forwarder, the first-mile carrier (trucker), the shipping line and the terminal.

- Updating the PCS with the Customs release information ensures that everyone involved in moving the container to the port and loading it on a vessel is in the picture.

- The freight forwarder notifies the trucker and the PCS about the readiness to pick up the container from the exporter's or freight forwarder's facility and haul the container to the terminal. But before the container can be brought to the terminal gates, the freight forwarder (who had booked the container in the first step) must recheck with the PCS on the shipping line's confirmation and the terminal operator's confirmation of the expected sailing date for the voyage as well as the time window for the receipt of containers at the terminal gate.

- Containers that are ready for loading on a vessel need to move to the port. The shipping line can confirm the list of containers that are included in the loading list and shares it with the terminal on the PCS.

- When the trucker picks up the container from the exporter or freight forwarder facility, its departure is registered in the PCS and the trucker can proceed to the terminal gate.

- The trucker uses the terminal or PCS's truck appointment system to book the arrival of the truck and the container to the terminal gate within the allotted time window.

- When the truck with the export container approaches the terminal gates, the terminal gate operator authenticates the 'Customs release' on the PCS. Thus, the trucker can go through the "gating" authorization to access the terminal only when there is a Customs release, booking confirmation, terminal authorization, and trucker identification.

- In some countries, security-related documentation of the truck and crew is vetted by security agencies at gate and when entry is permitted, the terminal operator sends a gate-in report to the PCS.

- *The container may be checked again by Customs at the terminal, and once completed it is then loaded onto the exporting vessel and an update is sent to the PCS.* After the vessel's departure an export manifest is generated in the PCS and sent to the shipping agent while Customs are notified. In some countries (viz, the Netherlands), the PCS also receives automatic notification that the ship has left the Customs territory, confirming the 'exported' status of all goods on board.

No single agency manages all this. Customs release takes place in the automated Customs system, the empty container booking takes place with the operator of the yard or terminal managing empty containers, the booking of the container for carriage on a vessel takes place on the shipping lines system. The port terminal manages the Truck Appointment System, the freight forwarder interacts with the local fleet operators to book a trailer truck for the first mile carriage. All these systems must communicate with and through the PCS to ensure data synchronization

and visibility. In an environment where there is no PCS, all the co-ordination between different participants occurs based on bilateral data sharing, phone calls, email exchanges and quite a lot of guesswork. In cases where there is poor coordination, the situation at the ports can be chaotic and unreliable, raising the specter of corruption, collusion, and nepotism. The PCS provides a single window environment harmonizing and optimizing port and logistics services through automation. It improves security, reduces costs and unlocks greater competitiveness for users.

3.4. Salient functions and features of PCS

A PCS covers a range of services to support import and export operations at a port. It is useful to divide a PCS's services into three broad categories: (i) Arrival and departure of ships. (ii) Operations at the terminal. (iii) Inbound and outbound connectivity with the hinterland. The Figure 5 illustrates the main functions.

A PCS's services are seldom self-contained. They are critically dependent on data and functionality offered by other systems with which the PCS connects. That is why the PCS operator must define and offer services after careful consultation with the PCS's stakeholders.[7]

Table 2. PCS Modules and Use by Stakeholders

Stakeholder	% Modules PCS Used
Ships' Agents	57%
Shipping Lines	52%
Freight Forwarders	45%
Terminal Operators	41%
Port Authority.	30%
Customs Brokers	21%
Customs Authority	9%
Truck Operators	5%

A modern PCS emphasizes real-time visibility, providing instant updates on vessel movements, cargo status, customs clearances, and transport activities. It also focuses on exception management, offering immediate notifications for discrepancies, predictive analysis for potential issues, and collaborative tools for resolution. Benefits include enhanced operational efficiency, reduced delays, increased transparency, and cost savings. However, challenges arise from the need for system integration and ensuring data quality. Overall, the PCS plays a crucial role in optimizing port operations and fostering collaboration.

---

7   At the inception of a PCS project, the stakeholders must agree and appoint a PCS Operator.

Figure 5. The PCS of the Port of Barcelona

Inbound Transport
Cargo collection note
Container delivery note
Prior notice of cargo collection
Prior notice of empty-container delivery
Notification of cargo collection
Notification of empty-container delivery

Booking
Schedules
Hazardous Cargo
Booking
Stopover request
Shipping instructions

Inbound Customs
Confirmation of clearance

Outbond Transport
Transport order
Container collection note
Cargo delivery note
Prior notice of empty-container collection
Prior notice of cargo delivery
Notification of empty-container collection
Notification of cargo delivery

Payment
Electronic payment
Electronic invoice

Outbond Customs
Customs Declaration

Unloading Ship
Schedules
Stopover request
Waste notification
Shipment confirmation request
Request of dockers
Summary declaration
Hazardous cargo
Shipment confirmation and
proforma invoice

Loading Ship
Request for dockers
Cargo Manifest

Source: PORTIC.

Initial consultations among a PCSs stakeholders can be contentious. Initial stakeholder responses to the proposed PCS services may range from a cautious welcome to an outright disinterest or opposition. The Terminal Operators typically hold crucial logistics data that the proposed PCS would need and vice versa, and their coming on board is crucial for a PCSs success. The port community leaders must be prepared to discuss and explain the role and scope of PCS services in the context of the port and effectively respond to questions from stakeholders.

Detailed knowledge of the actual services offered by existing systems at the port would be necessary.

With greater knowledge about the boundaries of the respective systems and those of the PCS, there will be greater acceptance of the PCSs role.

A study carried out in European ports revealed that most of the modules developed for a PCS are used by the ships' agents, followed by shipping lines and freight forwarders. The interface with regulatory authorities may support crucial functions but they are not the biggest consumers of PCS Modules. Nonetheless, a regulatory authority's mandate requiring the shipping lines and freight forwarders to use the PCS as a gateway to submit the regulatory reports, the PCSs implementation would be greatly facilitated.

3.5. PCS supports horizontal and vertical collaboration

A PCS involves both vertical data collaboration (data exchange within a supply chain) and horizontal data collaboration (data exchange between players taking part in different supply chains). A PCS answers these critical needs by automating inter-organizational business processes and systems of the port. In fact, the efficient sharing of information *amongst* shipping lines, freight forwarders, truck fleet operators and others enables efficient time-sharing of the port's infrastructure, such as berths, yard equipment, terminal gates etc.

Supply chain collaboration can be vertical or horizontal. Vertical collaboration involves managing relationships up and down the supply chain and improving the overall performance, strengthened by the collaboration of suppliers, manufacturers, distribution centres, customers, and Logistics Service Providers. As the saying goes: "Supply chains compete, not companies." The benefits of vertical collaboration are well known and the tight integration within global value chains (GVCs) is well documented.[8]

Horizontal collaboration refers to cooperation and coordination among companies at the same level of the supply chain, and

8   Marchi, Valentina De, Eleonora Di Maria, and Stefano Micelli. "Environmental strategies, upgrading and competitive advantage in global value chains." Business strategy and the environment 22.1 (2013): 62-72.

sometimes, even competitors must collaborate.[9] Scholars have posited that PCSs promote horizontal collaboration,[10] a trend that will be accelerated with the development of the concept of the Physical Internet. The opportunities for horizontal collaboration in a PCS include reduction in empty hauling, improved usage of storage facilities, joining forces to bid as a consortium for larger shipping contracts, participating in online marketplaces, sharing of resources (e.g., trailers and trucks) and field agents.

A study carried out in the context of the Antwerp PCS documented the benefits of horizontal and vertical collaboration in the implementation of the PCS module for the "Export Control System (ECS) - Arrival notice of export cargo at terminals".[11] [12] Under the EU legislation, a trader must file an export declaration electronically through the ECS under the EU's operational model and messaging system to control consignments exported out of the EU. Terminal operators at the port of Antwerp began reusing the ECS data as the advance notice of arrival. What began as an initiative between one terminal operator was taken-up by the PCS and extended horizontally to several terminals that operate parallel supply chains. Currently, terminal operators, freight forwarders and customs use it across most of APCS terminals.

3.6. PCS furthers 'Single Window' and paperless processes

A PCS can function as a Single Window if it holds a mandate from the government to perform the relevant regulatory tasks as the sole platform in an economy for these operations. It can also function as a Single Submission Portal (SSP), providing trade facilitation functions to the stakeholders, notably the possibility to submit all information on the movement of goods to a single portal.[13] In both cases, the portal can function either as an integrated system where the data is processed directly within the portal, or as a decentralized, interfaced system where the data is sent through the portal to the relevant partner organizations for processing, or as a hybrid model of the two. Within a port environment, there are often multiple stakeholders exchanging information, each with their own internal systems. Some of these will be based on internationally agreed standards. Others may be based on internal organizational standards. Ideally, the PCS needs to be able to interact with each of these and provide end-to-end visibility of the movement of goods (for the benefit of either the government agencies, the port authority, the owner of the goods or a combination of these or others).

The establishment of a PCS in a port can help with the transition from paper-based systems to an electronic environment. The move towards a paperless system entails the identification of the required documents/forms/licenses and the data that the goods require. This can help to streamline the processes for the stakeholders, removing redundant information and harmonizing similar data elements. This can also assist in aligning with international standards, making the portal interoperable with other solutions around the world using the same standards.

The PCS should be a trusted third party. The platforms of other stakeholders, which are interfacing with the PCS, should not perceive it as a competing solution, but rather as a vector for facilitation and outwards connectivity to other systems. To maintain this status as trusted third party, the PCS should avoid overlapping services and should not discriminate in favor of their own services. The PCS should be neutral and open, allowing all relevant organizations to link to stakeholders through their platform.

The technology for the data exchange with the PCS also needs to be neutral. All information needs to be clearly defined both at the data level (semantics) and the messaging structure level (syntax). Of these two the formers is probably more important. All parties need to understand the data in the same way, so any variation or interpretation may create misinformation. For example, the date of arrival can be very different depending on the stakeholder who is declaring it. If it is a vessel declaring the arrival of the vessel, this would probably be the arrival in the port. If it is a warehouse operator expecting merchandise to arrive, this would probably be the arrival in the warehouse. If it is the inspection agency, it may be the arrival in the inspection shed. It is imperative that all stakeholders understand the data in the same way to avoid any confusion. Aligning these to international standards can ensure interoperability with other partners referencing the same international standards.

3.7. PCS promotes inclusive trade

A Micro-, Small & Medium Enterprise (MSME) can benefit from the existence of the PCS as a Single Submission Portal. Due to a combination of features of a PCS in the trade environment, the following benefits accrue:

- **Single submission:** When allowed by national legislation, MSMEs just need to submit all the required information (e.g. customs, tax, inspection, logistics-related) once and do not need to submit information to different places. This

9   Collaborate with your competitors and win, Y Doz, G Hamel, CK Prahalad - Harvard business review, 1989 https://hbr.org/1989/01/collaborate-with-your-competitors-and-win
10   Caldeirinha V, Nabais JL, Pinto C. Port Community Systems: Accelerating the Transition of Seaports toward the Physical Internet—The Portuguese Case. Journal of Marine Science and Engineering. 2022; 10(2):152. https://doi.org/10.3390/jmse10020152
11   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 and Management, 19, 51–64. https://doi.org/10.1016/j.rtbm.2016.03.009
12   In some of the implementations, the PCS may also provide nautical data of the ship reaching the Pilot Boarding Place. Customs may use it as a confirmation of physical exports of goods declared under the ECS .
13   UNECE, Technical Note on Terminology for Single Window and other ePlatforms, ECE/TRADE/C/CEFACT/2017/10, 2017.

Figure 6. A Study in Brazil showed that the border delays can be saved significantly through a port community system. The diagram shows the limitations in the time savings a trade Single Window program can achieve
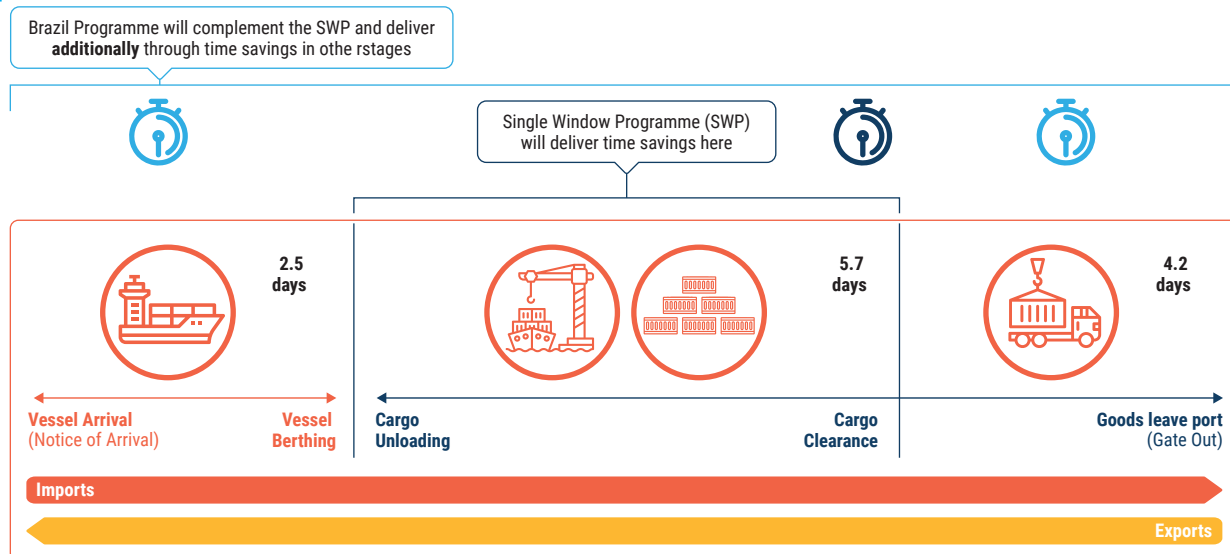
Source: CIP - IPCSA/CIP Webinar. April 21,2021 – PROCOMEX, Brazil.

can improve their efficiency in international trade and reduce their costs.

- **Easier clearance:** MSMEs can rely on a PCS to help them to take care of the clearance process because it can facilitate the provision of complete and accurate declaration data to cross-border agencies, pay terminal fees, facilitate truck appointment, share shipping line and customs release information with the terminal operator.

- **Better financial support:** MSMEs can get better financial support from banks with the help of a PCS because a PCS may be able to facilitate increased trade finance collection security and provide better business risk control. Banks can provide MSMEs with better credit ratings and access to trade finance instruments when information on trade transactions is readily available through a PCS.

- **More efficient logistics:** MSMEs can get more efficient and cheaper logistics and transport services because the portal can offer a wide range of services connecting transport and logistics chains.

- **Reduced business transaction costs:** With a PCS, MSMEs can interact with the standard import and export service eco-system with lower costs and higher efficiency. This may reduce the recruitment needs of MSMEs within their own international trade staff, saving human resources and management costs. Providing the MSME with a web page allows it to interact with the community without the need to develop and maintain expensive, dedicated ICT systems. It lowers the entry barrier and encourages competition.

3.8. PCS as a trade facilitation priority and NTFC's crucial role

National Trade Facilitation Committees (NTFCs) set up under the WTO TFA can provide impetus to key trade facilitation priorities. PCSs cover a broad array of trade procedures and involve the widest range of stakeholders in international trade. That is why the NTFC's role in promoting the PCS as an indispensable trade facilitation priority is crucial. To start with, it should help to establish a joint stakeholder forum or working group to develop a common understanding of the end-to-end process and milestones involving all actors participating in cargo clearance. NTFCs can initiate Time Release Studies (TRS) at ports, airports, and land borders to identify the weak links and to gather valuable insights into border delays and inefficiencies.

TRSs can be helpful in making the case for a PCS. An increasingly common finding of TRSs is that Customs account for the least amount of time taken, and a significant proportion of delays in clearance are attributable to private sector actors that provide transport and logistics services. Reasons for delays and inefficiencies in clearances must be identified and reported accurately, regardless of whether they originate in the public or private sectors. The traditional TRSs have been focused on Customs delays. The scope of TRSs should be extended to involve other government agencies and logistics operators ('TRS-plus') to generate granular data on the bottlenecks and inefficiencies attributable to all players, including logistics operators

Whether it is the analysis of TRS results or business process analysis, significant results can be achieved through stakeholder

Figure 7. WBG-IAPH Maritime Trade Logistics Digitalization Road Map
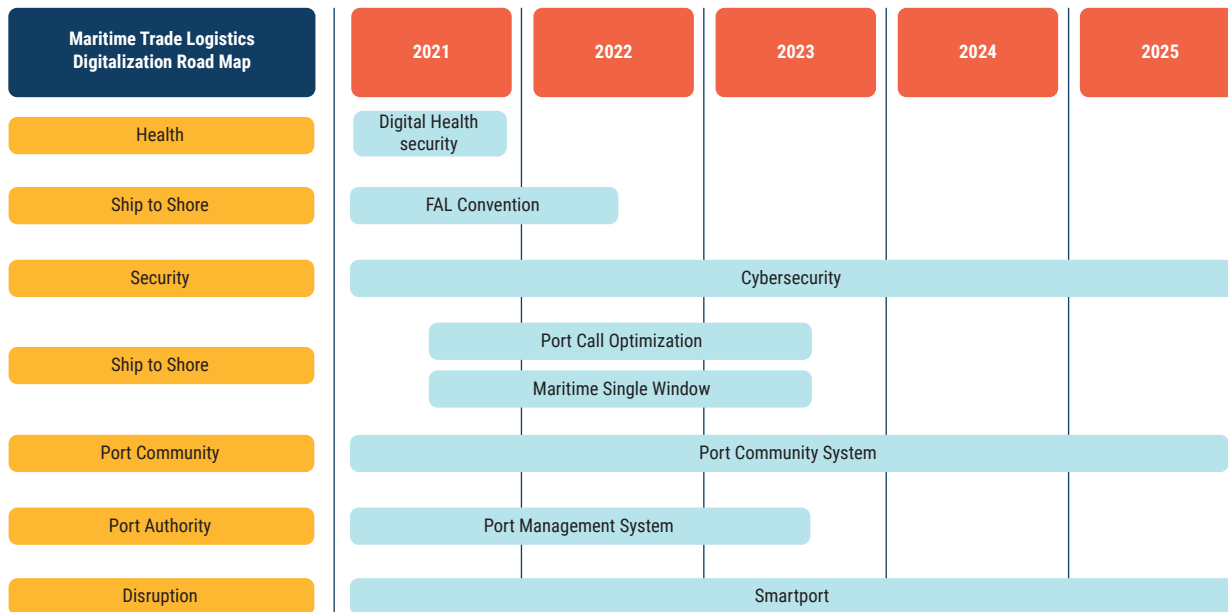
collaboration and consultation. A national, multi-agency study undertaken in Brazil established that significant time savings and efficiencies would be achieved when both PCS and Trade Single Window are implemented. The trade single window systems help achieve reductions in the time between cargo unloading and cargo clearance, whereas reducing the vessel call and gate out processes require a more extensive data collaboration that can be achieved through a PCS. Given the broad mandate and position of authority, NTFCs can launch studies of this type to help strengthen the case for developing a PCS.

In June 2020, the International Association of Ports and Harbors (IAPH) and the International Maritime Organization (IMO) called on governments to work to accelerate the digitalization of maritime trade and logistics. The two organizations stressed the need for intergovernmental collaboration locally, nationally and regionally. They highlighted nine priorities to accelerate digitalization. In January 2021, IAPH and the World Bank released a report on "Accelerating on Digitalization, Critical Actions to Strengthen the Resilience of the Maritime Supply Chain." The report provided a digitalization road map for ports and notes: "National Trade Facilitation Committees could be an excellent instrument to help member states, Maritime and Port Authorities to drive the change process in relation to the digitalization of the maritime and logistics space." The report aslo noted: "Setting up NTFCs to focus on the digitalization effort would require a change in the mandate and their scope of action but doing so will offer significant potential synergies to go beyond the Trade Facilitation Agreement. " Based on the roadmap, PCSs should be an ongoing priority.

3.9. Which ports should implement PCS?

Around 1,300 ports are at the heart of the global supply chains. Over 100 ports or port clusters in 58 countries have created PCSs. Studies have found ports in small island and low-income countries add significantly to their country's output and are 1.5 and 2.0 times more reliant on their ports compared to the global average. In Chapter 10, we find that 12 SIDS out of 58 have PCSs in operation. Size and remoteness are not standing in the way of the spread of PCSs.

3.9.1. How many PCSs in a country?

Countries undertaking PCS projects have preferred national solutions covering all their major ports. Data from recent PCS implementations suggests that port and maritime authorities are conceiving PCS projects as national projects. One of the larger ports may initiate work on a PCS, but with plans to extend it to all major ports. The main reason for this trend may be that PCSs require the government's administrative and financial support. In smaller countries, national PCS solutions are the norm. Even in countries of Western Europe that pioneered PCSs, while a single PCS may not cover the entire country, implementations now cover a cluster of ports. PCS installations reflect a concentration of solutions. PCS solutions provided by SOGET and MGI cover more than 50 small and large ports in France. MPC and Community Network Services dominate the field in the UK, and PORTEL, PORTIC and the Bilbao Port Authority's (APB) e-puertobilbao lead implementation in the Spanish ports. A PCS can be public, private or a public/private model. Public authorities play a lead role in most PCS implementations and are central to solutions for nationwide coverage.

Box 2. National port sector reforms helped establish Israel PCS (IPCS)

Israel is one of the few countries in which there is a nationwide PCS offering free of charge PCS services to maritime supply chain stakeholders. At the heart of this approach is the 2005 Israeli Port Sector reform, which divided the Israeli Port Authority into four government-owned companies and one administration. The three companies are Port of Haifa, Port of Ashdod, and Port of Eilat. Their roles are to operate the Israeli commercial ports. The fourth company is Israel Ports Company (IPC), the landlord of the ports, responsible for the development of the Israeli ports infrastructure and managing the port's assets. The Administration of Shipping and Ports (ASP), the national regulator, is part of the Ministry of Transport.

The companies faced a "tower of babel" problem, with each potentially "speaking" their own language and having different procedures and data requirements from the maritime community. Such a situation would have been problematic for the industry and an obstacle to free competition. To prevent it, IPC management decided to take the digital developments to the next level and set up the Israeli Port Community System (IPCS). To achieve the highest levels of cooperation from the stakeholders it was decided that:

- The body, which will approve the IPCS roadmap and annual plans, will be a steering committee jointly headed by the head of Customs and the head of Foreign Relations at ASP.

- The members of this committee are the high-level managers of the various organizations that represents the main maritime supply chain stakeholders and appointed by the Minister of Transport: Port Operating Companies, the Chamber of Shipping, the Export Institute, the Chamber of Commerce, and the Transporters Association.

- At the beginning, this committee met twice a year but in the recent years only once. In addition, the steering committee heads receive periodic updates.

- A working forum discussed the procedures, harmonized them, set the standards to digitalize them and coordinated the implementation steps and timing with the stakeholders.

- The members of this forum are representatives from the various organizations that represents the main maritime supply chain stakeholders, mainly from the operations and IT divisions. Since 2005 this forum meets once a month.

- IPC was assigned to design, develop, operate, and support the PCS. The IPC's Chief Information Officer (CIO) was assigned as the project manager and presents to the steering committee and acts as the head of the working forum.

3.9.2. Electronic Data Interchange (EDI) for FAL reporting

One barometer of digitalization of port processes is the implementation of EDI to fulfil the IMO FAL reporting requirements, which are mandatory with effect from January 2024. An IAPH/WPSP survey[14] in 2021 covering 111 countries revealed that only 34 percent of the ports responding to the survey have an EDI system in place that meets the IMO FAL new mandatory requirement and 35 percent of the ports are at design or implementation stage of setting up such systems, with the remaining 30 percent reporting that they have taken no action. The survey reveals that 1 in 5 countries have approached International Development Banks or other organizations to assist with implementing electronic systems at their port(s). Peer to peer learning seems to be more important than developmental assistance. Roughly one in two countries confirmed that they have looked at other countries who have piloted / implemented EDI systems.

3.9.3. Implementing PCSs can be challenging in some countries

Even though PCSs can significantly streamline and optimize the flow of information and goods in and out of ports and hold the potential to revolutionize port operations, their implementation is not universal. Several countries, including advanced economies, have found their PCS journeys challenging for the following reasons.

---

14   Fal, I. M. O. (2021). IAPH global ports survey on the implementation of electronic data exchange to conform with the IMO Convention on Facilitation of International Maritime Traffic (FAL)

Box 3. Norway's Maritime Digital Infrastructure

Maritime Single Windows and Port Management Systems can handle the ship to port communication to a significant extent. The Terminal Operators Systems manage the interface with the hinterland, apart from running the terminal's cargo handling operation. The Norwegian case suggests that where efficient facilities already exist, there may not be the incentive for the stakeholders to introduce a PCS.

There are more than 150 ports and 700 port reception facilities (PRFs) along the Norwegian coast. Most of the ports are publicly owned and operated. The PRF's are a combination of public/private. The ports are autonomous and somewhat specialized in their operations. Internationally most of them are to be considered as being relatively small when it comes to container cargo. None of the ports have implemented (or are planning) a PCS. The largest ports (around 100) are mainly using port management system and/or container terminal operating systems (TOSs). Regulatory B2G and some B2B (ship2port) communication are handled through the Norwegian Maritime Single Window.

- *Fragmented Stakeholder Interests:* Ports involve many stakeholders with different interests and priorities, making it tough to align and commit them to a PCS project.

- *Legacy Systems & Infrastructure:* Many ports have legacy systems and infrastructure that must be designed to integrate with modern digital technologies in a PCS context. Upgrading these systems can be expensive and time-consuming, requiring significant effort and investment by the stakeholders.

- *Regulatory Compliance:* Trade and Port regulatory authorities administer a complex web of regulations and standards that the trade and transport industry must adhere to. These authorities also have intricate compliance management systems that may be at risk of unravelling due to a PCS implementation.

- *Commercial secrecy, Privacy & Data Protection:* A PCS requires sharing sensitive data among multiple stakeholders. Some stakeholders may be risk averse. Ensuring data security and privacy can be a challenge, particularly given the increasing sophistication of cyber threats.

- *Collective inertia:* Implementing a PCS requires significant changes to existing processes and workflows—stakeholders accustomed to traditional working methods may be reluctant to adopt new processes and technologies.

- *Efficient facilities already exist:* Customs, Port Authorities, and Terminal Operators are dominant players, each with a significant footprint of systems and interfaces with each providing a range of digital services to facilitate trade. For example, a Terminal Operating System (TOS) may have implemented a truck appointment system and extended some other facilities. Digital interfaces between these dominant players may also be in place, weakening the argument for a PCS. Likewise, Maritime Single Windows, driven by the IMO FAL mandate ensure an efficient single point of entry for maritime regulatory data. See Box 3.)

- *High financial and non-financial costs:* While the benefits of a PCS can be significant, it requires considerable financial investment, collaboration, and stakeholder commitment.

4. Neutrality and openness of PCSs

4.1. Dimensions of neutrality

In order to be respected and used, PCSs must remain neutral and open entities. Stakeholders place trust in the PCS operators that facilitate the exchange of their business-critical information. PCSs must transparently ensure that, as neutral entities, they are not affiliated with any particular stakeholder group and do not have a vested interest in the outcomes of the information exchange.

First, neutrality helps to ensure that all stakeholders have equal access to information and can participate in the decision-making process. This can help prevent any one stakeholder group from having an unfair advantage over others. Second, neutrality helps to promote trust and cooperation among stakeholders. It ensures that all parties feel confident that the PCS is not biased towards any stakeholder. Finally, neutrality helps to ensure the integrity and reliability of the information being exchanged.

PCS's neutrality has several key dimensions. A PCS must be neutral in governance. It must have policies and guidelines that ensure an even handed and impartial administration. A PCS must be financially neutral to ensure that financial interests of all stakeholders are safeguarded. For a similar usage of the facility, no stakeholder should be financially worse off when compared to their peers. PCSs operations should be open to all stakeholders. A PCS should not show any preferences based on the size or type of the company and the system should be open to participation by all entities. A PCS should be technologically neutral, it should not favour any particular technology platform or data standard that is proprietary and favours only a section of stakeholders. It must use globally recognized and neutral standards. The PCS should not favour or discriminate against any particular product, service, or application that runs on it.

Example 1: "Portbase is neutral, of and for the port community and has no profit motive". (Based on the Portbase website." (From the Portbase website).

Example 2: PCS SAVONA is a neutral and open information platform, available on cloud computing and also accessible from mobile devices, which is aimed at intelligent and safe information exchange. (Website of PCS SAVONA - Ports of Genoa)

4.2. Port authorities and transparent governance

It is imperative for PCSs to remain neutral and open, and stakeholders must appoint such an entity as the operating agency. The operating agency could be either a for-profit or a not-for-profit entity. A preliminary scrutiny of PCSs suggests that most operating entities of PCSs have three common elements: (i) They are overwhelmingly not-for-profit entities. (ii) Port authorities have either ownership of the PCSs or a controlling stake. (iii) The system implementing entity engaged by the PCSO is either a digital solutions provider or has a strong partnership with companies experienced in digital logistics.

By virtue of their formation (shareholdings, composition of governing bodies), PCSs organized by port authorities can engender trust. Port authorities and administrative entities have the responsibility to operate ICT systems for the management of ports and harbors. Stakeholders need to have confidence in the port authority's capacity to serve as data exchange hubs and neutral data managers.

Platform neutrality is especially important for port authorities which often lead and occupy positions of importance in the governance of PCSs. Some of the port authorities operate terminals and other port-related services that compete with private sector entities that also run such services in the port. The PCS must not favor the port authority-managed services over the private sector ones. To maintain neutrality, it is also necessary to implement safeguards and checks to prevent any one group from gaining an unfair advantage or manipulating the system for their benefit. In a PCS's governing documents, it might be useful to mention neutrality as a founding principle.

A port authority's motivations in setting-up or running a PCS will seldom be questioned given its role shaping the port's development strategy and as the convenor of the port community. With responsibility for the port's safety, competitiveness and resilience, port authorities have significant influence over the decision process. The following examples illustrate the role of port authorities in providing transparent governance to PCSs.

Portbase: The Dutch PCS, Portbase, is a non-profit organisation providing ICT-based logistics services. Portbase is owned by the Port of Amsterdam and Rotterdam Authorities, which is a public body. The Dutch government has a role in setting the overall direction and policy for the organization.

APICS/APCS: C-point is the facility that runs the PCS of the Antwerp Bruges port. It is an initiative of Antwerp Port Authority

and Alfaport Antwerp. NxtPort is the logistics platform provider that powers the C-point technical platform. C-point offers confidentiality to ensure that data ownership remains with the sender of the data and cybersecurity standards.

TPCS: Italy's "Tuscan Port Community System" covers the Port Authority of the Northern Tyrrhenian Sea (Ports of Livorno, Piombino, Capraia, Portoferraio, Rio Marina and Cavo). It is managed by Autorità di Sistema Portuale del Mar Tirreno Settentrionale.

Jamaican PCS: The Port Authority of Jamaica joined forces with the Customs Agency and is supported by the Shipping Association of Jamaica to develop and run the Jamaica PCS.

Polski PCS: The Polish PCS is owned by multiple Polish ports, namely the Port of Gdansk Authority S.A., Szczecin and Swinoujscie Seaports Authority S.A. and PGZ System Sp. z o.o. in Radom. The Port of Gdynia Authority S.A. is expected to join Polski PCS. Each Port Authority will be the holder of an equal percentage of the shares in the Polski PCS.

PCS 1.x, India: The Indian Ports Association runs India's Port Community System currently called 'PCS1x' and will soon be part of the National Logistics Platform - Maritime. The Indian Ports Association (IPA) is a registered society established under the supervision of the Ministry of Ports Shipping, and Inland Waterways. The Chairpersons of major port trusts of India run the IPA.

5. Global trends in PCS implementation

5.1. The four waves of PCS implementation

The World Bank-IAPH study relied on an inventory of PCS implementations that was originally developed by IAPH for its benchmarking study (2010) and updated it based on internet research. This inventory approximates a compilation found in an academic publication entitled "Port Community Systems: A structured literature review," published in the journal 'Transportation Research'[15]. This section divides PCS implementations into four waves with each wave sharing a common deployment time, geo-economic and socio-technical settings. Each wave exploits a specific set of legal instruments, regulatory imperatives, and technological developments.[16]

The *first wave* was from 1982 (first PCS) until 2000. This wave exploited the widespread use of the technical and legal instruments that underpin the implementation of Electronic Data Interchange (EDI), especially on the back of the global data standards developed under the umbrella of the International Standards Organization (ISO), and the United Nations. This wave drove businesses to adopt paperless procedures, and the digitalization of customs declarations. Europe's common market helped to unleash this wave. Its dynamic economies were heavily dependent on international trade with large, competitive, and high-performing gateway ports that invested heavily in port mechanization, multimodality, and digitalization. The earliest PCSs in Hamburg Dakosy (1982), Le Havre SOGET (1983), Felixstowe MCP (1984) were products of this environment. The Singapore PCS is the Asian example, born out

of similar circumstances but with the drive to become Asia's topmost transshipment hub.

The *second wave* occurred in the decade between 2001 to 2011, building upon the gains from the previous two decades. The second wave rode the growth of regulatory data standards championed by the United Nations Center for Trade Facilitation and Electronic Business (UN/CEFACT) and ISO. The International Maritime Organization (IMO) produced the IMO Compendium on Facilitation and Electronic Business (2001 edition), consolidating data standards for the electronic reporting by ship operators to shore based regulatory authorities and terminals. International organizations worked together with industry bodies, such as the SMDG[17] and PROTECT Group, which has been working with the industry since the 1990s to build data standards. The World Customs Organization (WCO) produced the WCO Data Model capturing the foundational customs and cross-border regulatory data requirements. These efforts converged to produce electronic data standards known by the acronym UN/EDIFACT, which was universally adopted by the industry. Technological developments such as the n-tier, loosely coupled architectures, distributed web-applications, and service-oriented architectures (SOA) also spurred developments. The Internet Engineering Task Force (IETF) produced multiple internet-based protocols to support EDI, which had hitherto used privately leased data networks. On the regulatory front, the European Union's directive (EMSA, 2002) on maritime safety required all ports to implement Vessel Traffic Management Systems spurring several European ports to adopt PCSs. In this wave, the Spanish ports of Valencia and Bilbao, Port of Sines in Portugal, the Italian ports of Ravena,

15   Moros-Daza, A., Amaya-Mier, R., & Paternina-Arboleda, C. (2020). Port Community Systems: A structured literature review. Transportation Research Part A: Policy and Practice, 133(December 2019), 27–46. https://doi.org/10.1016/j.tra.2019.12.021
16   UN Recommendation 26 provides a harmonized model agreement for electronic data interchange (EDI) in commercial transactions.
17   Ship Message Design Group (SMDG) is registered non-profit industry association.

Genoa and La Spezia, the Israel PCS, the Chinese ports of Shanghai and Dalian, the Port of Cotonou in Benin and several other ports implemented PCS solutions.

The legal and technological dimensions of the *third wave* (2012 to 2017) are also significant. The EU regulations required member states to adopt eCustoms solutions (the EU Single Window environment for customs), and EU e-Maritime Single Windows. These were significant influences not only for the European ports but also for the rest of the world. In parallel, the development of the Web 2.0 technologies contributed to the evolution of ICT architecture towards more open, flexible, and user-centered systems. Specific influences include: (i) The increased use of Application Programming Interfaces (APIs), making it easier for different applications and services to communicate with each other and exchange data, and enabling development of more complex and interconnected ICT architectures. (ii) Greater reliance on cloud computing platforms, which allow PCS applications to scale and handle large amounts of traffic and data and the shift towards distributed and highly available ICT architectures. (iii) The increased use of microservices, which are small, independent units of functionality that can be developed and deployed independently. (iv) Lastly, a greater focus on design and user-centered approaches in ICT architecture. The third wave saw the introduction of PCSs into Asia, Africa, and the Americas. In Asia, Ports of Jakarta, Abu Dhabi Ports (United Arab Emirates) and the major public sector Ports of India introduced PCSs. The African ports that introduced PCSs include the ports in Djibouti (Djibouti), (Tangier Med, Casablanca) Morocco, Port Louis (Mauritius), the ports of Kinshasa, Boma, Goma, Kisangani, Matadi (Congo), and Port of Lomé (Togo). In Europe, the Port of Trieste (Italy) and Port of Odessa (Ukraine) introduced PCSs. Likewise, in the Americas, there are PCSs in Valparaiso and Jamaica. Projects exist in Montréal and Port Prince Rupert (Canada) and Port of Santos (Brazil).

The structured literature review classifies the current wave as the fourth wave which began in 2018 and is ongoing. Increasingly, PCSs are going to be based on multimodal service offerings. PCS solutions will be offered on the cloud and are being linked to external digital logistics platforms (some of which may be based on blockchain technology). The fourth wave will witness the influence of the adoption of Industry 4.0 technologies in the maritime industry to improve the efficiency and effectiveness of logistics and supply chain management, as well as to automate and optimize cargo handling. The current trend of port automation and data exchange includes applying artificial intelligence (AI) techniques that consume 'big data' from supply chain platforms and the Internet of Things (IoT)[18]. These technologies could include autonomous vehicles, sensors and tracking systems, augmented reality, and digital twins. On the regulatory side, the measures that would influence PCS adoption include obligations under the IMO FAL convention on Maritime Single

Window (MSW), the introduction of privacy legislation, such as General Data Protection Regulation (GDPR), and adoption of Legal Entity Identifiers (LEIs) in the maritime industry. Several new ports have started adopting these technologies, including the traditionally active PCSs in Europe but also US West Coast ports and ports in Asia.

5.2. Lessons learnt from 4 decades of PCS roll outs

For more than 40 years, the PCS concept has been at the heart of digital port innovation. It has contributed to the fluidity and security of international maritime trade and optimized supply chain flows. In the preceding section, we analyzed the growth of PCSs by identifying the four waves of developments. In this section, we capture some of the key lessons learnt.

Strong growth in demand for maritime transportation in the 1980s sparked the need for extensive electronic data exchanges between terminal operators and shipping companies.

Port terminal operators realized that Electronic Data Interchange (EDI) was critical to manage the growing volumes of container traffic. It simply took a lot of work to handle paper documents to load and discharge cargo.

EDI exchanges between the port stakeholders used a value-added private data network but without necessarily providing a central database and an IT application. It was also the start of standardization initiatives on electronic data exchanges, particularly with UN/CEFACT, which produced the EDIFACT standards for B2B information exchanges. Modern methods of communication emerged, with ports increasingly adopting APIs and data payloads that were defined more nimbly using standards such as XML and JSON. Notwithstanding these improvements, the data standards underpinning UN/EDIFACT remain the cornerstones of trade. For port and terminal automation, these standards are still recognized and used extensively by the shipping industry. *The rapid, and extensive adoption of EDI by the maritime industry was the basis to the digitalization of the industry. Despite the growth of alternative technologies, the adoption of EDI remains foundational to port modernization, including PCS implementation.*

The maritime industry consortia and international bodies further improved the data standards in the 1990s to ensure the dematerialization of cargo procedures between different stakeholders, such as Customs, port authorities, shipping companies and freight forwarders. In many cases, a central database was set up as a trusted third party between stakeholders, sometimes with the establishment of a dedicated company to operate it for the entire port community. In these cases, the port stakeholders founded a neutral entity to assure the port community's neutrality

---

18   Insert a Reference on UN/CEFACT Smart Containers BRS

on data and system governance. These new systems were called Cargo Community Systems (CCS) and represented investments often made by private companies in Europe to strengthen the competitiveness of the port. In a few years, the industry and governments recognized CCSs as key for accelerating goods' passage through ports and useful for Customs to target containers for security or illicit traffic controls. CCSs have shaped up to be labelled as Authorized Economic Operators (AEOs), bringing them into the trusted circle of entities operating at the port in a country. *When the ambit of electronic data exchange grows beyond exchanges between shipping lines and terminal operators, the industry feels the need for a neutral party, necessitating the establishment of a PCS.*

In the 2000s, European and international regulations required port and maritime authorities to improve marine safety and security, particularly related to goods or passenger transportation. These regulations have led ports to develop digital solutions to process administrative declarations related to ships, goods, or passengers. Many of these systems became PCSs because they focused on the whole port management process and no longer only on goods. They have seen their role strengthened, bringing together all port stakeholders to meet the new challenges of monitoring a ship's calls at, and between ports, and dealing with hazardous goods, waste, health and even security formalities. The mandate to implement the ISPS code, the role of information management in handling dangerous goods, and advance cargo information (following 9/11) introduced new obligations on shipping lines and ship operators. S*hipping lines now have a binding obligation and the capacity to transmit electronic data on safety and security in advance. On the strength of these government mandates and capacities, the port's administrative and regulatory authorities can build consensus around the need to develop a PCS.*

Governments have also taken steps to facilitate international maritime trade, with the Maritime Single Window (MSW) environment proposed by the IMO (mandatory from 2024) and by the European Union (compulsory since 2015). Governments must ensure the introduction of the MSW across a country to harmonize vessel formalities worldwide through IMO's recommendations and standards for dealing with electronic data between private declarants and all authorities involved in the maritime sector. The MSW provides a single electronic interface to fulfil regulatory requirements. In parallel, the WTO TFA requires countries to implement a 'Trade Single Window' providing the trade with a single point interface for all import, export and transit related regulatory requirements. For cargo vessels, the IMO and WTO mandates intersect and must be harmonized to avoid any duplication. This is simply done by ensuring that the pipeline of cargo data originating from the maritime industry that is supplied to the MSW is reused alongside the Customs goods declarations submitted to the TSW for the regulatory control of goods and for risk management purposes. That is why today, the IMO and WCO have collaborated to produce the IMO Compendium on Facilitation and Electronic Business containing a data set. Besides, there

also exists a comprehensive partnership agreement between the WCO, IMO, the United Nations and ISO to work together on that compendium and comprehensively address the best way to reuse data between TSWs and MSWs. The PCS relies on these standards and goes a step further than TSW and MSW combined, because it deals with both cargo and vessel information. *The obligations on governments under the WTO TFA and IMO FAL convention to implement the TSW and MSW respectively would serve as an excellent opportunity to initiate the development of a PCS project.*

The PCS covers all regulatory authorities concerned with vessel clearance - customs, harbor master, police, border control, Port State Control, the coast guard, the navy, health services, immigration, and maritime affairs. PCSs are designed to collect comprehensive administrative data from the shipping lines. The PCS can also serve as an efficient and operational gateway to feed MSW or TSW with electronic data, avoiding reinventing the wheel with additional IT applications. PCSs play a genuine role in connecting the 'Single Windows' to the supply chain stakeholders because they already deliver facilities for ship entry and exit into ports. They can easily transmit administrative data to national authorities without imposing any administrative burden on users. *The PCS project could serve as an excellent initiative to implement coordinated border management and to introduce improvements to vessel/port security and reducing the vessel turnaround time.*

5.3. Current global priorities: How PCSs can help?

Globalization of production increases trade and investment. Recent protectionism by some countries has signaled a partial retreat from globalization. Shifts in trade patterns can also affect a port's business. International trade has been affected by trade policy discontinuities (tensions between the US and China, and Brexit) and disruptive events. The realignment of trade partnerships - through on-shoring, near-shoring, and friend-shoring - has also introduced volatility into global trade. To navigate such uncertainties, ports must remain agile, adaptive, and resilient to the changeable mix of cargo and demand patterns. For ports to remain competitive, they must coordinate with the leading players in international supply chains to strengthen their interconnectivity with the physical and digital networks. This implies a high degree of alignment between port and logistics processes. PCSs have a significant role to play in this.

5.3.1. *From just-in-time to just-in-case production*

In the early 2020s, the COVID-19 pandemic, the running aground of the container ship 'Ever Given' (causing the blocking of the Suez Canal), and the war in Ukraine posed new challenges for the industry. These disruptions hit large parts of the global economy critically dependent on the maritime supply chain. The maritime

logistics industry must respond to these challenges by introducing operational elements to ensure agility in redeploying its resources to restore the flow of goods quickly. Consequently, the industry demands agile and resilient supply chains that rapidly adapt to disruptions and restore predictability[19] in deliveries and schedules.

Improved predictability is ensured by a wider array of sources of advance data, especially of supply chain events (locations and times of individual events in the respective supply chains). PCSs, along with other logistics platforms, are storehouses of extensive supply chain events data, and are being called upon by the industry to offer insights and solutions to the challenges posed by disruptions. PCSs must play a crucial role in the event of disruptions: (i) Assist with the efforts of affected ports in reorienting their resources. (ii) Provide timely and actionable information to its stakeholders in real-time, especially the freight forwarders and shipping lines, to improve the predictability of their supply chain operations. (iii) The PCS shall provide information to shippers and BCOs to increase visibility and predictability. A 2011 study conducted[20] on the role of PCSs in supply chain risk management suggested that the information offered by a PCS to freight forwarders was not sufficient. PCSs were not yet geared for collecting, packaging, and distributing data on supply chain risks within the port community. That has changed with the growth of digital logistics platforms, and freight forwarders can now seek information from an array of data sources. This problem would be lessened further if PCSs connect with one another and with other supply chain platforms to offer value added information and insights to their most valuable clients - the shippers, consignees, and freight forwarders. In this regard, IPCSA's initiative to set-up a network of trusted networks (NOTN) is of particular note.

Lastly, ports themselves are vulnerable to disruptions (for example in the Port of Beirut in 2020). They must develop a risk profile of scenarios of disruption that cause a loss of business continuity and offer mitigating strategies to the members of their community. Collectively, the association of PCSs can act as a bulwark against major supply chain disruptions.

5.3.2. PCSs and decarbonization

The maritime sector contributes to 8 percent of the world's carbon emissions and must take adaptive measures to limit fossil fuel consumption drastically. To meet these strategic challenges, PCSs are evolving to integrate additional processes related to nautical and port operations to share more accurate and reliable data for improving the predictability of vessels' berthing and cargo operations. The climate crisis has brought 'low emission supply chains' onto the agenda of every shipping company's boardroom.

New technologies, such as AI , 5G, IoT, Big Data, Generative AI, and advanced web services such as JSON API, have equipped PCSs with additional capabilities to meet the energy optimization challenge on shore and on the high seas. PCSs assist shipping lines and logisticians with granular data on administrative, commercial, and nautical aspects of a port's operations. The latter applies AI and Big Data analysis to develop indicators to forecast the actual dates/times of vessel arrival and the delivery of cargo, reflecting stakeholders' planning capabilities.

There is evidence that shipping lines save fuel by ensuring that ships don't 'rush to wait' at ports. With a more accurate prediction in real-time, ships can adjust their cruising speeds to the most fuel-efficient levels and not have to wait at the anchorage. 'Just in Time Model' port calls are made possible because of the PCS's capacity to 'multi-synchronize' between stakeholders during a vessel's calls[21]. When a ship avoids rushing to wait for its turn to berth, it saves on fuel for the voyage and all expenses at anchorage while waiting in the outer harbour. The port should maintain a reliable welcoming window where all resources are available and planned for the vessels that call on a port and with loading and unloading appointments for hinterland operations. In the very near future, ports backed by PCSs will be able to exchange voyage and passage planning in electronic format[22]. PCSs can provide fleet operators and other supply chain players with accurate data and guarantees about the readiness of the port ecosystem. These efforts will result in fewer empty runs, more return loads and shorter waiting times. It not only saves time for fleet operators, but it also helps the industry move more cargo with lower levels of emission.

In a more collaborative chain of interaction between PCSs and logistics systems, vessels will adapt their sailing speed. Ships will arrive just in time to pick up their goods, providing more efficient and seamless port operations and helping to decarbonize maritime transportation.

19   Mthembu, S. E., & Chasomeris, M. G. (2021). A systems approach to developing a port community system for South Africa. Journal of Shipping and Trade, 7(1). https://doi.org/10.1186/s41072-022-00128-3

20   Thesis, M., & Treppte, S. (2011). The Role and Scope of Port Community Systems in Providing Data that Enhances Supply Chain Risk Management A Case Study for Freight Forwarders in the Port of Rotterdam. Total Quality Management.

21   The International Taskforce on Port Call optimization (ITPCO) has developed a new paradigm that tracks 17 times stamps associated with a port call. The expected (ETA), Predicted (PTA), Requested (RTA) and Actual (ATA) are tracked for a Just in time Port Call.

22   The Singapore Rotterdam Green & Digital Corridor is a pilot to test the concept of digital exchange of passage plans to form the world's longest green corridor to enable low and zero carbon shipping.

6. Why there are so few PCSs, and what next?

Most of the advanced industrial nations have PCSs. However, nearly 80 percent of the newly industrialized countries and 90 percent of the ports in small and medium income countries do not. This decade presents a unique opportunity for developing countries to fully digitalize their ports. The spread of simpler and cheaper technology, standardization, regulation, and industry demand is putting PCSs at the heart of smarter and more sustainable shipping.

A combination of factors will drive the acceleration in the implementation of PCSs. The following are some of the factors:

Technological advancements: The implementation of Smart Ports, the spread of IOT in the maritime supply chain, the roll out of customs automated systems and national single windows, the growth in digital trade and logistics platforms, use of mobile computing devices and the widespread and ubiquitous availability of high-speed internet are all catalysts for wider adoption of PCSs.

Regulatory mandates: The International Maritime Organization looks set to introduce mandatory electronic reporting of all ship to shore declarations in a Single Window by January 2024. Maritime Single Windows (MSWs) can pave the way for a Port Community System. Countries that have an MSW, or are planning to develop one, can take advantage of this.

Growing industry demand: Industry bodies are seeking to accelerate the implementation of digital solutions. DCSA has called upon the industry to accelerate end-to-end digitalization of container shipping documentation. Carriers that are DCSA members have committed to a 100 percent adoption of electronic Bills of Lading by 2030. The International Chamber of Commerce (ICC) through its Digital Standards Initiative (DSI), is also working on an ambitious timeline.

COVID-19 pandemic: The pandemic has opened the industry's eyes to the advantages of digital and remote working. During the pandemic, many digital business practices turned from aspiration into reality. This decade is an opportune moment to comprehensively digitalize maritime trade and transport logistics.

Reduction in implementation costs: PCS costs have fallen thanks to greater use of digital technologies in emerging markets and less developed countries. PCSs are increasingly being offered as modular and scalable applications that can be deployed on 'pay as you go' infrastructure and cloud computing technologies. PCSs have their own benefits but also provide the plumbing for the broader digitalization of the maritime sector.

Global advocacy: Multilateral development banks (MDBs), inter-governmental organizations (IGOs), international organizations (IOs), and industry bodies have a crucial role to play in promoting and supporting the rapid adoption of PCSs. That support is critical to transformation of the maritime sector.

The Port Community System has the power to create smarter, safer, and more sustainable shipping in the 21st century. It is time for everyone, everywhere, to consider the benefits of getting on board.

Appendix 1. The Port community & port services

The idea of a port community reflects the realities of today's major ports. Ports are industrial nodes that connect businesses with their global partners. They are also logistical nodes that join international shipping lines and their partners in the hinterland. The ports serve as value-adding transit points for nearby enterprises. The range of logistical and transport infrastructure facilities a port provides determines its reach and importance. Ports come in different sizes and deal with a variety of cargo operations (containerized, dry, and liquid bulk, break-bulk, Ro-Ro) and shipping services. Some large ports can be the size of a city.

Regardless of the size and type of a port, its users constitute a community of businesses, regulatory authorities and government agencies that share a unique economic relationship with it. Because of the port, these enterprises, their employees, and the surrounding economy thrive. The port is an integral part of the global value chain. The entities that contribute to the creation and preservation of economic value constitute a community with unique bonds and relationships. A useful way to describe the port community is by grouping its members into categories of services they provide.

Transport services: A port acts as a node that joins transport services from the maritime and hinterland sides. On the maritime side, it serves ocean-going vessels - shipping lines, the ship's operators, and their agents. On the hinterland side, it provides cargo facilities that connect transport service providers that use highways, railways, and coastal and inland waterways. Thus, operators running fleets of trucks, trains, and barges are members of the port community.

Cargo & Terminal services: A port is often understood to comprise the terminals it houses. A port can have multiple terminals that serve as locations for the loading and unloading of people and cargo. Terminals are among the most prominent entities connecting different transport modes and serving as cargo management hubs. Ports equipped with cruise terminals and ferry terminals also handle domestic/international passengers. Connected to a Port Terminal are satellite cargo management facilities such as storage yards, tank farms and warehouses for bulk, breakbulk and containerized cargo. Inland Container Depots are an extension of ports' terminals in the hinterland. Container Freight Stations are used as facilities for stuffing and stripping containers, and empty container storage yards. Operators of these facilities are also members of the port community.

Port Management Services (Vessel-related) : A port provides various services to ensure vessels' safe and efficient movement in and out of the harbor. It begins with the port registering vessels that seek to call. After that, the shipping lines announce the schedule of voyages. Ships arriving from the foreland drop anchor at the outer harbor and wait for their turn to access the port. The port provides pilot services for safe navigation through the channels in the harbor, tugboat and mooring services that push or tow the vessels quickly and efficiently into and out of the berth, bunkering services to refuel, waste disposal services and vessel repair and maintenance services.

Regulatory Services: Port authorities are public bodies responsible for managing the whole port. The Customs authority is responsible for collecting duties and taxes on goods cleared through the port for import and (sometimes) exports. It also ensures that goods fulfil the country's border regulatory requirements. Customs collaborate with other cross-border regulatory agencies accountable for enforcing legally mandated prohibitions, restrictions, or other conditions on trading certain commodities. Customs have extensive powers to control movements into and out of the port. Customs are empowered to conduct patrolling, enforcement, and other preventive measures. Similarly, immigration authorities control the movement of passengers and crew. Health authorities are responsible for the inspection of ships and the issuance of Ship Sanitation Certificates. Health authorities are also responsible for issuing the Free pratique – which is "the permission for a ship to enter a port, embark or disembark, discharge or load cargo or stores." Sanitary and Phytosanitary authorities control for the risks of disease and invasive species. There are authorities responsible for inspecting and certifying a vessel's safety and seaworthiness. Authorities controlling the operational and occupational safety of ports also have a significant regulatory role. Security agencies are responsible for monitoring the security certification and secure operation of vessels, besides ensuring the security of people and property within the port area.

Logistics Services: Logistics service providers ensure that their clients - businesses that use the port to import and export- can efficiently plan, implement, and manage their supply chains. Numerically, they constitute the bulk of the members of the port community. Freight forwarders serve their clients in a variety of ways. They help select transport services, including the first-mile carriage and last-mile carriage, negotiate freight rates, and consolidate and deconsolidate shipments. They prepare trade-related documents necessary for importing or exporting goods. If required, they maintain inventories on their client's behalf and file insurance claims when necessary. Freight forwarders are often on the front, interacting with shipping lines, terminal operators, and Customs brokers. Customs brokers are entities licensed to prepare trade-related documents and interface with all cross-border regulatory agencies to ensure compliance with trade-related regulations. Freight forwarders often also fulfil the role of Customs broker for their clients. Surveyors and insurance firms provide assurance and verification services to the trader and transport service providers.

Traders /Beneficial Cargo Owners (BCOs): Participants in international trade transactions (buyers, sellers, and their agents) and

Table A1. Members of the Port Community grouped by the services they provide

Transport services:	Port Management Services:	Regulatory Services:
Maritime transport • Shipping lines, Shipping agents **Hinterland transport** • Truckers, Chassis providers, • Rail operators, Inland Waterway/ Barge services	• Navigational Services Longshoremen • Stevedores • Bunkering Services • Ship Repair	• Customs • Immigration Health • Maritime Safety • Environment/ Dangerous goods Port/Coastal Security
Cargo Management Services	**Financial Services**	**Logistics Intermediaries:**
• Terminal operators, • Inland Container Depots Container Freight Stations warehouses operators	Banks Survey &Inspection Insurance firms	• Customs brokers, • Freight forwarders • Logistics specialists, Insurance Firms
	Traders	
	• Consignors, Consignees & Cargo owners	

the transport contract (the carrier, consignor, and consignee) are seldom present physically at the port but are nonetheless vital members of the port community. The community's most influential members are the businesses that own the goods traded through the port. Ultimately, a port is founded to serve their interests and property.

Financial Service Providers: Commercial banks perform two vital functions. (i) They finance the trade transactions, acting as providers of trade credit, as participants in a trade agreement, and in the formalities related to the settlement of a trade transaction. Many jurisdictions require commercial banks to keep the country's central banks informed of trade-related remittances.

(ii) They help collect payment for services described above and assist with the performance and payment guarantees. As banks digitalize the trade finance operations and begin to participate in the concept of a negotiable/transferable record in the form of an electronic Bills of Lading, the insurance firms will increasingly interact digitally with other members of the port community. Insurance companies often require detailed assessments of cargo's value and the potential risks during transportation.

Claims Management: In the event of damage, loss, or theft, insurance companies handle claims made by the insured party. This involves assessing the extent of the damage or loss, determining the compensation amount, and processing the payout.

Appendix 2. Operational logistics and regulatory procedures are intertwined

The following description of a trucker reaching a port to take delivery of goods illustrates the relationship between the underlying logistical and regulatory procedures and systems:

Table A2. Cargo clearance at maritime ports involve simultaneous and synchronized processes occurring in transport, logistics and Customs Systems

	The visible process	Port and Terminal Systems	Customs Systems / Trade Single Window
1	Arrival at the terminal gates at the designated time. Check-in with the terminal.	• Freight forwarder presents documents e.g., Bill of Lading (BL), bank's release, etc., pays delivery order charges and obtains delivery order from the shipping line. • Pays port terminal and relevant handling charges. • Freight forwarder selects trucker, generates the transport order, books truck appointment, provides necessary documentation.	• Customs broker submits Customs/ single window declaration. • Shipping lines file advance cargo information to secure release on arrival. • Trader or Customs broker: (i) Submits the required documentation including licenses, certificates and permits. (ii) Pays duties taxes and fees. (iii) Online confirmation of release status.
2	Presentation of needed documents.	• Register arrival at gate; obtain pick-up instructions online. • Present vehicle and driver ID systems in compliance with ISPS code; driver's license, (including the required endorsements), vehicle registration, and proof of insurance.	• Present to Customs authorities any documents demanded, including Customs declaration, proof of release, and supporting documents.
3	Goods unloaded from the ship and inspected by Customs officials, if necessary.	• Check online the location and container/ packages and Customs status of goods; move to location at the yard/truck-docking bay for delivery	• Customs and OGA officials inspect cargo, examine goods; screens documentation; examines scan images. • Check the location of inspection/ screening. • Customs officials rely on risk management systems and technical means of Customs control.
4	Loading the Customs cleared goods onto the truck.	• Inspect goods or containers to ensure they are in good condition and match the documentation.	• Customs updates release, notifies declarant, advises terminal operator or warehouse.
5	Sign any necessary paperwork to acknowledge receipt of the goods. Secure the goods in the truck and prepare for transport.	• In the case of containerized cargo, receive the 'Equipment Interchange Receipt'. Confirm the terms of interchange as the "receiving party" online or in hardcopy.	• Customs system updates physical release / exit notes.

The above table explains how regulatory and administrative procedures and logistics operations occur synchronously, how they are linked to one another, and how they involve various ICT systems. These procedures utilize similar datasets and rely heavily on the transfer of information between the stakeholders via the exchange of electronic messages. The data received may be similar but there is a difference between how the regulatory /administrative authorities and logistics operators use the data. The following table provides a rough illustration of this concept.

Table A3. **How different stakeholders use the information provided by shipping lines and freight forwarders etc. in different ways**

Information/ Message	Customs	Port/ Maritime Authorities	Terminal Operator	SPS/ Health Authorities
Vessel Info.; Berth Info.; Vessel Security info	Risk Assessment, Control of vessel-related declaration, Rummaging, Vessel Boarding formalities.	Port State/Flag State Controls/ Port Services (pilot/tugboat services), Ship Chandlers; Port dues; Vessel Security.	Scheduling; Planning; Unloading and Loading Operations.	Risk Management, Controls related to health and safety of the vessel, crew and cargo; Free Pratique and Quarantine.
Cargo Report/ Dangerous Cargo	Cargo Control and release; risk assessment; Cargo accounting.	Operational Safety, Charging of port services; management of operational services. Stevedoring etc.	Cargo operations, Operational safety, special procedures linked to Dangerous goods; Charging of terminal services; Cargo accounting; Management of unclaimed/uncleared cargo.	Risk Assessment; Control; Fumigation services.
Customs Declaration & Response, Cargo Release	Customs control on goods and release. Collection of duties, taxes, and fees.	Bonded Stores to ships; Bunker fuel supply.	Terminal gate management; loading and unloading operations.	Risk Assessment & Controls.

The above table illustrates how members of the port community use selected data submitted by trade and transport participants for very different purposes. The alignment of data requirements prepares the ground for the port community members to develop and implement the principles of data collaboration.[23]

---

23 See UNECE Recommendation 34 on Data Simplification and Standardization for International Trade, 2013: http://www.unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-400E_Rec34.pdf
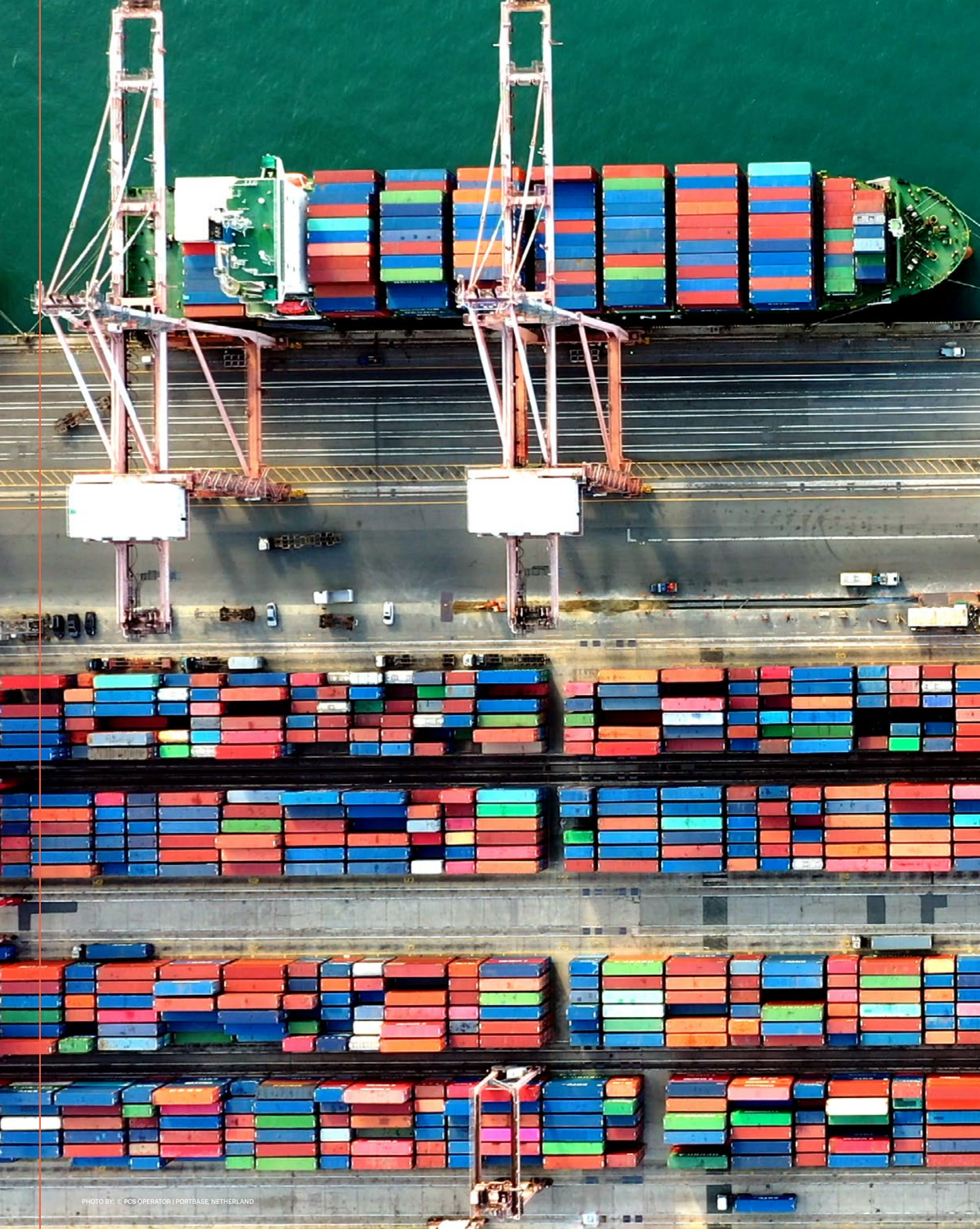
CHAPTER 2

A FRAMEWORK FOR IMPLEMENTATION

HOW TO ORGANIZE FOR IMPLEMENTING A PCS

Executive Summary

Key Takeaways

- Creating a Port Community System (PCS) is complex, collaborative, and costly.

- An implementation framework helps to set out the crucial steps stakeholders must take on the road to success for the smooth adoption and operation of the PCS.

- The framework creates a shared approach, shared vision, shared road map and shared understanding of roles, responsibilities, and activities.

- The implementation of a PCS is a change management project under which the PCS operator 'holds it together' for and on behalf of the entire port community.

- The PCS platform must adopt globally recognized electronic data standards to ensure rapid adoption.

Creating a Port Community System (PCS) is complex, costly, and collaborative. It involves many port and maritime stakeholders. Success hinges on tackling technical, legal, regulatory, and social challenges. People, process, technology, and collaborative governance are critical to ensure stakeholders' combine data in a transparent, effective, and efficient way to boost the competitiveness of maritime and port operations.

Transformation of ports through improved digitalization does not come cheap, but the potential cost savings from synergies and efficiencies are enormous. The business case for implementing a PCS needs careful analysis.

Change management is at the heart of PCS implementation. Success hinges on tackling technical, legal, regulatory, and social challenges. Strong leadership is vital for a PCS operator to keep everyone on board as systems are refined to reduce duplication, waiting times and other inefficiencies in cargo handling at ports.

Success also hinges on the port community embracing globally recognized electronic data standards to ensure rapid adoption.[1]

Stakeholders need to agree on a shared approach, shared vision, shared road map and shared understanding of roles, responsibilities, and activities. They need to cooperate, collaborate, and come together to turn vision into reality.

That vision needs strong foundations rooted in a framework. The framework creates that shared approach, shared vision, shared road map.

Those successful foundations allow a PCS to move towards full operations, led by the PCS Operator.

---

1   Organizations such as the International Maritime Organization, United Nations Center for Trade Facilitation & Electronic Commerce [UN CEFACT], the World Customs Organization, and International Standards Organization develop and maintain global electronic data standards.

1. Introduction

A successful PCS needs solid foundations. An implementing framework provides those foundations. The framework creates a shared approach. It creates a shared vision, shared road map and shared understanding of roles, responsibilities, and activities.

PCSs are at the heart of the modern maritime sector. They offer a centralized digital platform and streamline the exchange of information. A successful PCS needs solid foundations that a sound implementing framework can provide. People, process, technology, and collaborative governance are all critical to the successful operation of a PCS. They are also crucial to developing a successful framework. In turn that means governance and collaboration are critical to make the PCS work effectively and efficiently. The implementation framework proposed below draws not only on the World Bank Group and IAPH members' experience but also considers the interplay between technology, industrial ecology, and the political economy of the port.

People involved in creating a PCS need to understand its potential. They need to gain the knowledge and skills needed to use the system successfully. They must also canvas and campaign in the maritime and trade community to turn their aspirations into reality by getting all stakeholders on board. Choosing and appointing a PCS Operator is the most important step in creating a PCS. It is as important as the development of the PCS itself.

Process is also critical. Processes must be defined and optimized to ensure that the system is integrated into the operations of the port community seamlessly. **Technology** is the main ingredient that helps realize the PCS solution. Stakeholders must opt for the right hardware and software. The right technical processes are needed to develop and support the system. Last but not least, getting **governance** and collaboration right is vital, with the role of the appointed PCS Operator being crucial. This ensures that all stakeholders are involved in decision-making. They must work together to achieve success.

There are three distinct stages in the implementation framework. The first is the Preparatory Phase in which stakeholders reach a community-wide agreement on the type of PCS they plan to create. These agreements are sealed by documents that the community agrees to abide by. The second is the Development and Implementation Phase. When the PCS is developed, pilot tested and implemented, we reach the Operational Phase. There are two critical transitional points.

1.1. Preparatory phase

The PCS program must recognize the complexity of consultations involving multiple government agencies, regulatory authorities, industry associations, and interest groups. A typical large-scale ICT project in the public-private set-up goes beyond traditional project management tasks. The PCS program leadership goes through the delicate process of negotiating and agreeing with members of the port community, comprising independent regulatory authorities and businesses, on the crucial aspects of the PCS platform. PCS projects take a long time and are gradual. The first step in implementing a PCS is to conduct a thorough needs assessment to determine the specific requirements of the port community. This involves identifying the current challenges the stakeholders face, assessing the existing systems, and analyzing the potential benefits of implementing a PCS. The findings from the assessment will serve as the foundation for the PCS implementation plan. In the preparatory phase, the stakeholders might tentatively identify a candidate for the role of a PCS Operator.

Developing a PCS requires active engagement and collaboration from all stakeholders involved in the port ecosystem. This includes forming a steering committee of representatives from port authorities, shipping companies, terminal operators, the customs authority, and logistics service providers. The steering committee will guide development and implementation, ensuring that the PCS meets the needs of all stakeholders and complies with relevant regulations and standards.

Figure 1. The Preparatory Phase, the Design and Implementation Phase, and Operational Phase

Source: World Bank Group.
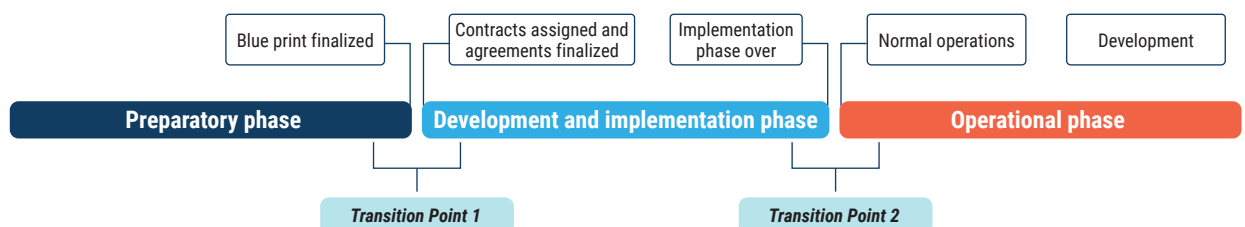
Figure 2. The Blueprint Phase assesses the current situation and develops the agreed vision and concept. The agreed concept is transformed into a 'Blueprint for Implementation'

	People	Process	Technology	Collaboration/Governance
Current	Engaging Stakeholders; Defining Roles & Responsibilities; Exposure & Capacity Building	Process mapping; Process assessment; Process Standardization	Technology Landscape; Data Management Practices	Governance Structure; Legal & Regulatory Framework; Communications & Collaboration
Vision	Recognize, enlist, and empower PCS stakeholders; Foster a knowledge and expertise	Streamline and optimize maritime logistics processes; Establish standardized procedures and protocols	Leverage cutting-edge technology; Business value through realtime information & data analytics	Transparent and inclusive governance structure; Robust and compliant legal and regulatory framework

A 'Vision Statement' capturing the essence of the people, process, technology and collaboration aspects

	People	Process	Technology	Collaboration/Governance
Concept	Stakeholders join hands to implement PCS; Capacity/ capability for an endto-end digital only PCS	Streamlined process and exchange of standardized data; Enhances overall efficiency of cargo and maritime processes	A Centralized digital platform for secure data exchange; Leverages technology such as cloud computing, IoT, and the other technologies	Operated and maintained by a neutral governing body; Encourages collaboration among stakeholders
Blueprint	A 'Blueprint for Implementation, covering a Governance and Operating model, a Legal and Regulatory Framework, a Revenue and Financial Model, a Functional and Technology Architecture and an Implementation Plan			

Source: Authors' depiction based on World Bank Group documents.

The preparatory steps in the Blueprint Phase includes the establishment of a shared vision, agreement on the governance and collaboration framework, the legal and regulatory basis, setting-up and organizing the PCS Operator, establishing the community business process and data models, preparing the technical and functional architecture, and developing an implementation plan. These preparatory steps constitute the 'Blueprint for Implementation'.[2] Each of the elements constitutes a task cluster and can be organized and outlined in the following map.

1.2. Development and implementation phase

The "Blueprint for Implementation" identifies an action plan for each of the components. The PCS design and development process can start when all recommendations in the Blueprint have been accepted and actioned. The PCS program leadership is organized under the structure of a steering committee. It has the confidence and approval of the stakeholders on the PCS vision, governance structure, legal and regulatory framework, the way forward on financing the PCS, the revenue model and fee structure, functional scope, the process, data, and technical standards it must follow, and the overall implementation plan. Once the stakeholders agree on the operating model and take steps to appoint and organize the PCS Operator, it assumes responsibility for taking the steps needed to procure the goods and services, which should

begin immediately to ensure that the envisaged timeline for implementation is honoured. The PCS Steering Committee is strongly advised against skipping or postponing the crucial decisions that are outlined in the Blueprint. Proper legal and regulatory frameworks, appropriate staff and resources and agreement on business process and data standards are critical to safeguard investments.

There are several steps in the development and implementation phase. These steps ensure a seamless transition to the new system. They also ensure effective collaboration. The assessment carried out during the Preparatory (Blueprint) Phase on the existing port processes identifies inefficiencies. The assessment also determines requirements for the PCS. These requirements determine procurement, including the system's design and architecture. The artefacts produced in the Blueprint will be taken to a level close to implementation when the system's functionalities, user interfaces, data structures, and integration points with existing systems and processes are further elaborated. Some of the important steps at this stage are as follows:

- Ensure the PCS adheres to relevant regulations and industry standards, such as data privacy, security, and maritime-specific protocols.

- Ensure that Customs and other government agency laws allow the PCS to participate in the regulatory control processes and handle regulatory data.

---

2   The World Bank Group uses its methodology called 'Blueprint for Implementation' for developing Trade Single Windows. Several countries have used this methodology.

Table 1. The visioning process begins with an as-is assessment, the elaboration of the PCS concept, followed by an agreed statement of the vision. The 'People, Process, Technology and Governance/Collaboration aspects are vital during the preparatory phase

Stage	People	Process	Technology	Governance & Collaboration
Current	• **Engaging stakeholders:** What is the current level of participation from all relevant parties such as port authorities, terminal operators, shipping lines, freight forwarders, customs, and other government agencies? • **Defining roles and responsibilities:** Do community members understand their roles and responsibilities for each stakeholder to ensure efficient collaboration and communication. • **Exposure visits and capacity building:** Do stakeholders have an understand of a PCS system? What is the knowledge and experiential gap?	• **Process and data mapping:** Have the existing business process been identified and mapped?\ Is there an understanding of the how processes and workflows in a PCS environment look like? How will a PCS fit into the current ecosystem? • **Process and data standardization:** Do existing process reflect internationally recognized standards and best practices to ensure interoperability, data accuracy, and ease of communication between stakeholders?	• **Current technology landscape:** What are the platforms currently in place? Are the architecture and technologies suitable for aligning with a to build the PCS? • **Data management practices:** Do members of the port community have their respective data management strategy, including data exchange protocols, data security, and data privacy measures? Is there a basic agreement on these at least at the bilateral level, if not at a port community level? Are there existing documents in practice	• **Governance structure:** Is there a community level governance structure comprising representatives from all stakeholders? • **Legal and regulatory framework**: Is there a legal and regulatory framework to support the implementation and operation of the PCS; Also consider e-transaction laws. • **Communication and collaboration:** Does a culture of communication and collaboration among stakeholders exist? Are there regular meetings, workshops, and joint initiatives to address common challenges and share best practices. • **Performance measurement culture:** Is the whole community as a whole looking at Key Performance Indicators (KPIs) looking at a process of continuous improvement.
Vision (Example)	• **Recognize, enlist, and empower PCS stakeholders** through effective communication and collaboration - hold regular interactions enable the community to make informed decisions about community initiatives. • **Foster a knowledge and expertise** on PCS; Focus on capabilities to leverage the PCS benefits; Encourage actions to drive innovation in the maritime logistics sector.	• **Through PCS, streamline and optimize maritime logistics processes**, reducing complexities and redundancies to enhance efficiency and cost-effectiveness for all stakeholders. Automation of business processes through data exchange. • **Establish standardized procedures and protocols** that align with international best practices, ensuring seamless interoperability and data accuracy across the port community.	• **Leverage cutting-edge technology** to create a secure, scalable, and user-friendly PCS that seamlessly integrates with existing TSW, TOS and PMIS systems and supports innovations in the maritime logistics domain. • **Right from get go, produce value to port community members** by harnessing the power of data analytics and automation to drive continuous improvement, enabling stakeholders to make data-driven decisions and achieve operational excellence.	• **Establish a steering committee that provides a transparent and inclusive governance structure** that promotes collaboration, accountability, and effective decision-making among diverse stakeholders. A business process committee to harmonize business processes. • **Develop a robust legal and regulatory framework** that supports data collaboration, cybersecurity, and privacy, while fostering trust and cooperation within the port community.
Concept (Example)	• **Include all stakeholders in the maritime trade supply chain**, covering maritime, port terminal and hinterland operations collaborate to implement; • **End-to-end, 'digital-only' collaboration and communication** between stakeholders to facilitate the smooth flow of means of transport, cargo, travelers and information.	• **Streamlined process and exchange of standardized data** between different parties involved in a port's vessel, terminal and hinterland cargo operations. • **Enhances overall efficiency in cargo handling and the port call process**, reducing dwell times, reduces port delays and minimizing delays in the supply chain.	• **A centralized, cloud-based digital platform** that enables secure and real-time exchange of information and data. • **A facility that leverages technology, Industry 4.0** technologies such as IoT, to improve data accuracy, security, and transparency. Data is harnessed to optimize and reduced emission intensity.	• **Operated and maintained by a neutral governing body** that ensures equal access and representation for all stakeholders. • **Encourages collaboration among stakeholders** to address common challenges, share best practices, and optimize port operations.

Source: Authors.

Figure 3. Components of a PCS Blueprint

A clear, bold, ambitions and farsighted PCS Vision statement

Legal and Regulatory Framework

Governance and Operating Model

Revenue and Fee Structure

Business Process Reengineering & Data Harmonization

Service Level & Service Level Agreements

Business & User Requirements

Technical and Functional Architecture

Capacity Building & Implementation Plan

Adopt a Change Management Strategy & Framework
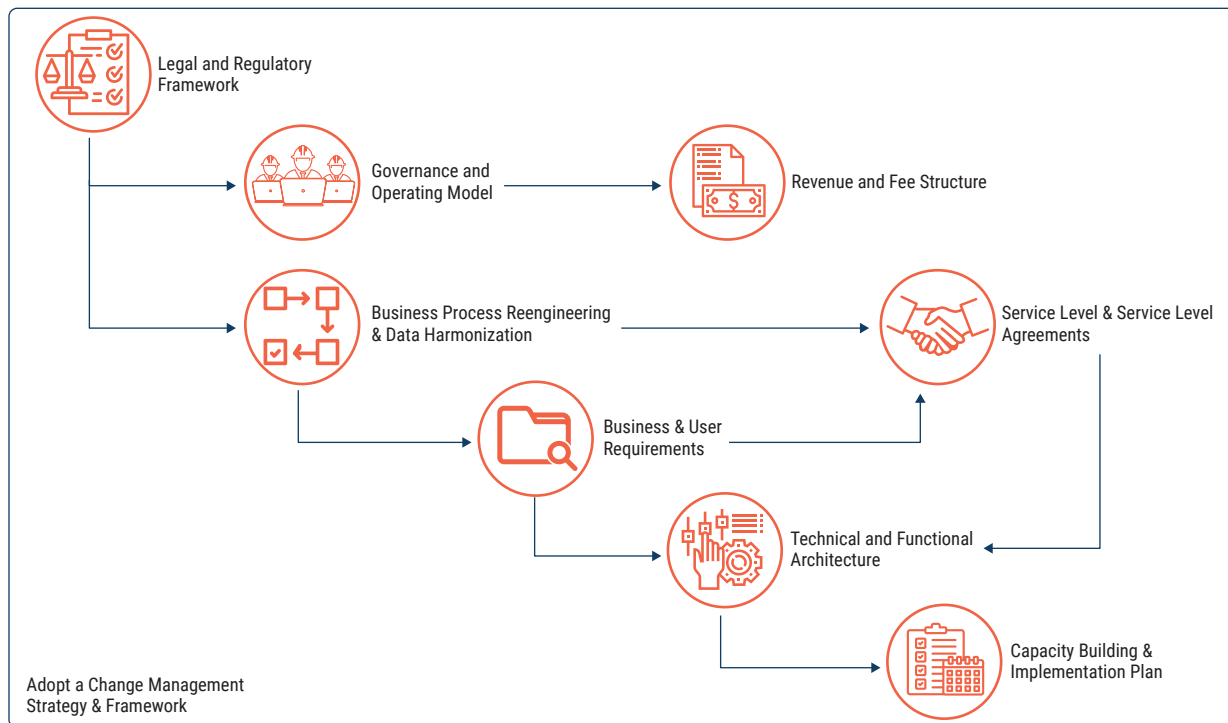
A collaboratiion mindset - open-minded and inclusive, Focused on trust-building and problem solving

Source: World Bank Group.

- Involve stakeholders throughout the development process, soliciting their feedback and meeting their needs. This collaboration is crucial for user acceptance and the overall success of the PCS.

- Develop the PCS services, incorporating the desired functionalities, interfaces, and data exchange mechanisms. This phase includes programming, testing, and refining the system based on stakeholder feedback.

- Integrate the PCS with existing systems, ensuring seamless data exchange and interoperability among all parties. This step may involve connecting the PCS to existing port management systems, the customs system, VTMIS, Terminal Operator System, Trade Single Window, and other relevant IT infrastructure.

- Train end-users and administrators to ensure they are well-versed in using the PCS. This includes technical training on system operations and process-related training on new workflows.

- Perform thorough testing of the PCS, including functionality, performance, security, and compatibility tests, to ensure it meets the requirements and can handle real-world scenarios.

- Roll out the PCS to all stakeholders, including the port community and external partners. This phase may involve a phased approach, starting with pilot testing and gradually expanding to full-scale deployment. The operational acceptance of the system will be a crucial step prior to full-scale deployment.

- Continuously monitor the system's performance, provide ongoing support to users, and address any issues that may arise. Additionally, gather feedback and analyze system usage to identify areas for improvement and future enhancements.

1.3. Operational phase

During the operational phase, the question of sustainability, business continuity, and business value are uppermost in the minds of the stakeholders. An appropriate service management framework should be implemented to ensure that the service levels and quality are maintained. The PCSO must keep the system up to date with the latest technology upgrades and security measures. To ensure system resilience, the Operator must oversee regular maintenance to minimize downtime and maintain system integrity. The following are some of the key steps to ensure long term sustainability of the PCS:

Table 2. The 'People, Process, Technology, Governance/Collaboration' aspects remain important during the development, implementation and ongoing operations phases of a PCS project. This table corresponds to the description in Sections 1.2 and 1.3

Stage	People	Process	Technology	Governance & Collaboration
Requirements (Example)	**Identify and engage all relevant stakeholders within the port community** to ensure alignment and buy-in for the requirements to develop a PCS. Develop and deliver programs to equip stakeholders to articulate and manage requirements	**Engage stakeholders to gather and prioritize their technical and functional requirement**s for the PCS, ensuring that the system addresses their most critical needs.	**Establish requirements to support strong data management practices,** including secure storage, backup, and recovery processes, to ensure the confidentiality, integrity, and availability of information within the PCS.	**Encourage collaboration between stakeholders** during the requirement gathering process, enabling knowledge sharing, consensus-building, and a shared sense of ownership over the PCS.
Design (Example)	**Establish a dedicated team of technical and functional experts** to provide ongoing support for the PCS design, ensuring its reliability and performance.	**Establish standardized processes and data models, electronic message formats** across the port community to promote efficient information exchange and streamline operations within the PCS.	**Design the system to be adaptable and flexible. Design a modular system architecture for the PCS** to allow for easy integration of new features, updates, and third-party solutions as needed.	**Ensure that the PCS adheres to all relevant international, national, and local regulation**s, as well as industry standards, to maintain compliance and promote trust among stakeholders.
Develop (Example)	**Involve end-users in the development process** to ensure that the PCS meets their needs and expectations, enhancing overall user satisfaction and adoption rates.	**Adopt international standards** and best practices for information exchange, data formats, and process workflows.	**Develop robust data management capabilities within the PCS**, enabling stakeholders to access, analyze, and leverage information for improved decision-making and operational efficiency.	**Encourage regular communication, knowledge sharing, and joint problem-solving** among stakeholders to promote trust and strong working relationships.
Test/Deploy (Example)	**Have a clear understanding of their roles and responsibilities of PCS users** during the testing and deployment phase, and engage stakeholders intensively to build their capacities.	**Adopt a structured methodology**, e.g., agile for development, testing and deployment of PCSs	**Adherence to proper controls on versioning and specification of standards,** to ensure seamless integration and interoperability between various systems and technologies used by different PCS stakeholders	**Ensuring that during testing, the PCS adheres to relevant regulations,** such as data protection and cybersecurity standards, during development and testing.
Operate (Example)	**Ensure continuous skill development and training** for system users to maximize their effectiveness and adapt to any updates or changes in the system.	**Establish a process for regularly monitoring and evaluating the performance** of the system, identifying areas for improvement, and adapting to evolving requirements.	**Avoid the frequent changes to the technical requirements for integration** with stakeholders' systems. Ensure sufficient lead times for the stakeholders to adapt to changes.	**Encourage regular communication, knowledge sharing, and joint problem-solving** among stakeholders to promote trust and strong working relationships.
Sustain (Example)	**Regularly engage stakeholders to understand their changing needs**, and ensure they are able to address any emerging challenges.	**Monitor opportunities for measuring and improving business processes,** especially taking advantage of the availability of process data in real-time..	**Track and analyze systems performance. Identifying inefficiencies** or potential bottlenecks and address them.	**Maintain open lines of communication with all stakeholders; Conduct regular reviews on regulatory compliances,** share information, and promote collaboration.

- Maintain open lines of communication with all stakeholders to address concerns, share information, and promote collaboration.

- As the PCS integrates with various systems for efficient data exchange and streamlined operations, the PCS Operator should encourage innovation and offer new services.

- Develop comprehensive risk management strategies to identify, assess, and mitigate cybersecurity risks.

- Ensure cybersecurity, and protect the integrity, confidentiality, and availability of data shared within the PCS.

- Monitor key performance indicators (KPIs) and conduct periodic evaluations to help identify areas for improvement,

measure the system's effectiveness, and ensure that it continues to meet the needs of its users.

- Establish contingency plans to address potential disruptions or emergencies, ensuring business continuity and system resilience.

- Track and analyze systems performance. Identify inefficiencies or potential bottlenecks and address them.

- Adopt a sustainable funding model to support ongoing operational costs, maintenance, and future expansion of the system. Adjust fees so that they are commensurate with the offered value of services.

- Keep emission reduction as a business goal for the PCS. Promote sustainable port operations. Implement environmentally friendly practices and technologies in the operation of the system.

2. Who initiates? Who takes the lead?

It is essential to involve key stakeholders from the start when launching a PCS. These stakeholders may include port authorities, shipping companies, Customs and other border control agencies, terminal operators, logistics providers, the relevant government departments, and local businesses. The lead entity for the PCS project will depend on the port community's context and needs. With multiple domains and interests involved, a strong initiator must spearhead the PCS. It could be a port authority or another organization that has vested interests in the project's success and the overall competitiveness of the port.

Studies on PCSs indicate that forms of PCSO ownership vary. While the port authorities played a major role in the early implementations, such as Rotterdam, Antwerp, Barcelona, and Klaipeda, there are also examples of PCS ownership being distributed among different private entities (for example, DAKOSY in Hamburg, and MPLC in Felixstowe.) In the 1980s and 1990s, private sector PCSs dominated. Recently however, most PCSs are being developed in the public sector with port authorities taking the lead. For a PCS to be successful, it should be regarded as useful and trusted by the PCS users. They will be required to use it regularly. To build trust in the PCS, the stakeholders will be called upon to participate in its development and implementation. Right from the beginning, the PCS lead agency should command the stakeholders' trust.

Type of collaboration	Examples in a PCS Implementation
Public-Private Partnerships (PPPs)	• Leverage respective resources, expertise, and capabilities. • Developing, financing, and operating the PCS
Joint planning and decision-making	• Involve private sector stakeholders in the planning and decision-making processes
Standard-setting and regulatory compliance	• Work together to establish and adopt common standards, data formats, and communication protocols for the PCS • Ensure compliance with relevant regulations, such as data protection and cybersecurity standards.
Capacity building and knowledge sharing	• Organize joint workshops, seminars, and training programs focusing on the technical, operational, and regulatory aspects of the PCS
Shared infrastructure development	• Joint public and private investment in ICT infrastructure, data centers, or cloud-based platforms, ensuring that the system is cost-effective and scalable.
Monitoring & evaluation	• Identify areas for improvement, track progress, and ensure that the system continues to deliver benefits to all stakeholders.

2.1. Developing partnerships and a collaboration mindset

A PCS is a partnership between the public and private sectors, between stakeholders economically dependent on a port. There are many examples of public and private partnerships that have financed PCSs. No PCS can be developed without strong collaboration between the public and private sectors. Partnership is at the heart of a successful PCS.

Government agencies responsible for trade, transportation, and maritime affairs should work together to create a conducive policy environment and provide necessary regulatory support for the implementation of a PCS. This can include updating or harmonizing existing legislation, regulations, and procedures to facilitate smooth system adoption and operation. Port authorities, Customs, immigration, and other relevant bodies, need to agree on standardized data formats and protocols for efficient data collaboration within the PCS.

A collaborative mindset is critical to creating a successful PCS. The World Economic Forum (WEF) published a briefing paper,[3] which said that data collaboration among well-coordinated ecosystem partners generated new business models, enhanced operational efficiency, improved customer experiences, and promoted growth and innovation. PCSs are based on coordination within the port ecosystems, and port communities are well poised to reap the benefits of data collaboration. However, PCSs must overcome defensive attitudes towards collaboration. There is insufficient understanding about the disadvantages of working in isolation, and the benefits of large-scale collaboration. To overcome the reluctance of port community members, the leadership must become fully aware of the untapped business value in the maritime trade ecosystem, and how port community members could greatly benefit from collaboration. Visits to ports that have not yet implemented PCSs can help community members gain insights from the pioneers of data collaboration. Data collaboration can take multiple forms, some involving direct interchange, and others, less risky alternatives that don't require transferring data between organizations. The less risky options, such as vessel and cargo visibility, and business process synchronization, can also add business value to community members. The five principles highlighted by WEF are: (i) Stakeholder engagement. (ii) Data governance. (iii) Data orchestration. (iv) Change management. (v) Long-term financial sustainability.

The most important PCS partnership is between the port authority and customs administration. This partnership can help identify who should spearhead the PCS project. Port and customs authorities need to collaborate systematically to facilitate the smooth and efficient movement of vessels, vehicles, cargo, and people through a port. Customs are responsible for enforcing customs laws and regulations, including collecting duties and taxes on imported goods, and ensuring that they meet the destination country's requirements. Customs law usually designates the entire premises and facilities of the port as a 'Customs area' and movements into and out of the premises are under 'Customs control'. Port authorities, on the other hand, are responsible for the overall management and operation of a port, including the infrastructure, equipment, and personnel needed to handle the flow of goods. Collaboration between port authorities and Customs agencies is crucial because it helps ensure that Customs' processes are integrated into the overall flow of goods. In addition, the partnership between these organizations can help to ensure compliance with Customs laws and regulations, which can help to prevent smuggling and other illegal activities.

The most important part of their collaboration is shared use of data. To exercise authority under the law, both port and Customs require shipping lines, freight forwarders and other agencies to provide data. Customs law requires all ocean-going vessels to obtain Customs permissions to enter or leave the 'Customs

territory', and dock at the port's facilities, to discharge and load cargo. The vessel's fuel, its stores and the crew's effects are also subject to Customs controls. The port authority (and its tenants/franchisees, namely the terminal operators, and warehouse operators) are licensed under the Customs law to hold goods in temporary storage upon unloading, and prior to loading on vessels. For this reason, Customs law requires shipping lines and ship operators to submit electronic data about the vessel, its voyage, what it carries, and who is on board. The immigration authorities, environmental agencies, security agencies, terminal operators, port services etc also need some of that data. While terminal operators and other freight-businesses need the data out of operational necessity, Customs and other regulatory agencies have the legal authority to demand the data from shipping lines, freight forwarders and other businesses supporting port logistics, with Customs needing the largest and the most comprehensive dataset. This is the essence of the synergy between regulatory agencies and logistics operators, with the former using the regulatory powers to facilitate the availability of operational data securely to the rest of the stakeholders. The regulatory powers under the Customs law gives the agency an extraordinary role in ensuring the PCS's success, and harmonized data requirements between Customs and port authorities is of great advantage to the private sector. Conversely, the lack of alignment between the port authority and Customs will severely undermine or scupper a PCS.

2.2. Strategic alignment with other trade facilitation initiatives

Agreement between the port authority and Customs on the benefits of forming a PCS and on its leadership are critical. The next step is to ensure strategic alignment with other trade facilitation initiatives, such as including the PCS in the country's trade facilitation roadmap. Calls from stakeholders to modernize trade procedures and introduce transparency can often prove a catalyst for greater alignment. The National Trade Facilitation Committee (NTFC) driving the country's trade facilitation programs must be informed about plans to create a PCS. The NTFC can play a central role in galvanizing support for the PCS. It can ensure the PCS fits into the NTFC roadmap and the country's wider trade, investment, and logistics improvement programs.

2.3. Visioning

A common vision is essential. It is a crucial first step in the systems development process. It helps define the project's overall direction and goals. A clear vision provides a roadmap for the project team to follow and helps to ensure that all stakeholders are aligned and working towards a common goal. Having a vision

3   Unlocking Greater Insights with Data Collaboration,
https://www3.weforum.org/docs/WEF_Unlocking_Greater_Insights_2022.pdf

Box 1. Example 1: Portbase

Our ambition is to make the logistics chains of the Dutch ports as attractive as possible through a one-stop shop. Portbase connects all parties in the logistics chains of the Dutch ports to this end. Via the Port Community System, Portbase facilitates data sharing between companies and information exchange with governments in order to work faster, more efficiently and at lower costs. Together with our growing community, Portbase is making data sharing increasingly valuable. With the aim of making the Dutch port community and thus the ports, the smartest in Europe. Portbase is neutral in the port community and has no profit motive.

Source: Based on Portbase's description about itself on its website.

Example 2: MCP plc (Port Community System of Felixtowe)

Our mission and objectives: Our mission is to establish Maritime Cargo Processing as the leading supplier of port community information services in the world through objectives based on the following criteria:

- Primary - to provide a cost effective and efficient service to stakeholders.
- Secondary - to provide a financial return to our shareholders.

"Our aim is not to be the biggest or the only, but the port community system supplier of choice."

Source: Mission statement as described on its website.

Example 3: The Northwest Seaports Alliance envisions that a PCS will:

- Provide a neutral and trusted 3rd-party platform for the exchange of data and information.
- Reliably and securely connect supply chains and logistics for our local, national and international stakeholders.
- Make use of existing, and be able to seamlessly integrate evolving and future, IT infrastructure.
- Use APIs to connect to existing systems.
- Simplify the processes needed for user authorization and data exchange.
- Be tailored and flexible to the needs of the NWSA and its stakeholders.

Example 4: Indian Port Community System

Vision: To seamlessly integrate all members of the Port Community electronically into a global transportation network that links all shipments from cargo origin to destination.

Mission: To establish a centralized/uniform Port Community System covering all major ports, as a part of collective, collaborative, and co-operative approach to EDI implementation, for the benefit of all the member of the Indian Port Community.

Aim: The proposed system will connect all members of the Port Community to facilitate the secure exchange of accurate and timely information with each other resulting in improvement in the overall efficiency of maritime trade and transportation.

allows stakeholders to identify the critical business objectives the platform intends to support and the key features and capabilities it will need to meet those objectives. The vision allows the project team to focus on the most critical aspects of the project and prioritize the development of those features that will impact the business the most. In addition, a vision for the PCS platform can guide the selection of a systems development approach. Different development methodologies are better suited to varying projects and goals, and a clear understanding of the vision for the PCS platform can help the project team choose the most appropriate methodology for their needs. The port community is the most important part of a PCS. The community must "feel involved, consulted, and valued" in the process of implementation.[4] PCSs are increasingly being implemented for a cluster of ports or even for all ports of a country. This trend should be kept in mind while developing a PCS vision.

---

4   Hans Rook, Chairman of the International Port Community Systems Association (IPSCA), Port Technology - Edition - 2021

Box 2. Visioning Workshops

Where the World Bank Group assists a country on collaborative cross border regulatory platforms like the Trade Single Window, it holds a 'Visioning Workshop', where participants are exposed to the key principles of TSW. A facilitator provides guidance to the workshop participants on how to develop a vision. The output of the workshop is a Vision Statement that all participants can endorse. This should include a decision on the broad scope and goals of the system. An in-principle decision may also be taken on the lead agency – i.e., which institution or authority should take on the role of promoting and supervising the implementation of the TSW and for reporting to government. While that decision need not figure in the Vision Statement, the Visioning Workshop is an excellent opportunity to conduct consultations with the stakeholders early on to try and get a sense for what may be the likely decision.

A vision statement for a PCS should clearly articulate the reason for building it, its primary users and beneficiaries and the benefits it aims to provide. The vision statement must outline the system's boundaries and the areas it seeks to impact. It should briefly describe the future state that the PCS aims to bring about and the impact it hopes to have on its stakeholders. It should reflect the values and guiding principles shaping its design, development, and operation. It should specify the target date or time frame for achieving the vision. A good vision statement for the PCS should be inspiring, achievable, and relevant to the needs and interests of the system's stakeholders. It should provide a clear direction for the development and evolution of the system and serve as a guiding light for decision-making and action.

3. PCS: Key decisions for implementation

The PCS aims to streamline and optimize the exchange of information between different parties involved in the port and maritime industry. Implementing a PCS requires careful planning and collaboration. The 'blueprint process' described in Section 1.2 captures the critical decisions the port community needs to make to create the PCS. Each of the tasks to develop the blueprint are important. This publication dedicates a chapter to each to explain the following aspects in detail:

3.1. Governance and operations

It is helpful to develop the governance and operations model for a PCS keeping in mind the requirements of the three phases: the preparatory phase, development and implementation phase, and the ongoing operations phase. The tasks of governance for each phase have a different focus. The governance model for developing a PCS will depend on the country situation and the needs and goals of the port community. Still, there are some common elements that the stakeholders may consider:

- Establish a steering committee or governing body responsible for setting the overall direction and priorities for the system. This committee may include representatives from stakeholders within the port community, such as shipping companies, customs authorities, terminal operators, and other government agencies.

- The steering committee would be responsible for arranging the system's financing and revenue models, establishing the system's scope and functional and technical architecture, and developing the guiding principles for technology selection.

- The main task of the Steering Committee would be to appoint the PCSO. In terms of the IPCSA's definition a PCS operator:

  - Is either a public, private, or public/private organization that operates and maintains the PCS.
  - The PCS represents the core of that operating organization's business.
  - The operator is a neutral entity, its interests are not partial to any of the PCSs stakeholders.
  - Has a board, or some form of steering committee, described above.
  - Establishes "service level agreements" with PCS users that govern its services.

In the operational phase, the governance process will include:

- A set of policies and standards that outline the system's acceptable use and the technical and security requirements that must be met.

- A process for managing change requests, including a system for prioritizing and approving changes to the system.

Figure 4. PCS in Action: from Development to Implementation

Number of Meetings	Total Time of Meetings
158	632 h

Redesigned Macroprocesses	Number of Maps
10	20

Number of Participants	PCS Solutions
+700	959

(Trade process improvement is a collaborative effort)

Vessel's Arrival and departure

PORT OF RJ. SANTOS & SUAPE

AS IS MAP — TO BE MAP

ACTIVITIES 968 — 38.63% — ACTIVITIES 594

IMPROVEMENT OPPORTUNITIES 378 — SOLUTIONS 378

37.57% — 223 activities involving the PCS

14.47% — 86 interconnections between PCS and PUCOMEX

Inbound End-to-end Cargo Management at the Port

PORT OF RJ. SANTOS & SUAPE

AS IS MAP — TO BE MAP

ACTIVITIES 775 — 46.06% — ACTIVITIES 418

IMPROVEMENT OPPORTUNITIES 282 — SOLUTIONS 282

68.42% — 286 activities involving the PCS

16.26% — 67 interconnections between PCS and PUCOMEX

(Opportunities for vessel and cargo process improvements identified)

Source: CIP - IPCSA/CIP Webinar. April 21,2021 – PROCOMEX, Brazil.

- A system for monitoring and measuring the performance and effectiveness of the system, as well as a process for regularly reviewing and updating the performance management model to ensure it remains adequate and relevant.

- A system for managing PCS user access to the system, including procedures for registering new users and granting permissions to access different parts of the system.

- A system for handling data privacy and security, including policies and procedures for protecting sensitive PCS data and ensuring compliance with relevant regulations.

- A process for resolving disputes or conflicts that may arise within the port community, such as disagreements over the use of the system or the accuracy of the data it contains.

3.2. Optimizing trade processes & harmonizing data

A PCS helps optimize trade processes at a port by simplifying and standardizing information exchange between different parties, reducing the need for manual communication and paperwork. The PCS enhances the visibility and transparency of the entire supply chain by providing a single platform for all stakeholders to access real-time information on cargo movements, vessel schedules, and port operations. In cases where a PCS is involved in submitting electronic Customs declarations and other documentation, it can expedite the clearance process and reduce waiting times for cargo. By automating and standardizing documentation processes, a PCS minimizes the administrative burden on all parties involved in the trade process.

A PCS cannot automatically identify inefficiencies and opportunities to improve trade. Collaboration among key stakeholders in a business process and data harmonization working group can help to achieve this.

The above figure describes how the maritime community in Brazil worked diligently to identify such opportunities. As part of a study to develop a PCS, several teams of experts developed the AS-IS and TO-BE business process maps. Over 700 participants held 158 meetings to develop 20 process maps covering 10 macro processes. The teams identified 959 distinct solutions and 650 distinct opportunities for improvement. They included business processes at the port level. Additional simplification and optimization would be possible by including the interface with Receita Federal, the Brazilian Customs service.

Optimizing business processes in a maritime environment involves identifying inefficiencies, implementing solutions, and leveraging technology to streamline operations, reduce costs, and improve overall performance. Some strategies to optimize business processes include embracing digital technologies to eliminate paper and relying only on electronic information, using the Internet of Things (IoT) to automate manual processes, and relying on data analytics and AI to improve decision making. Chapter 7 deals with Trade Process Efficiencies in detail.

3.3. Enabling legal and regulatory framework

The PCS Operator must be established with a solid legal basis. The entity running the PCS must be a valid legal entity and should have the legal authority to develop and run the PCS. The legal

authority to operate the PCS boils down to a module-wise analysis to determine whether existing legislation supports those operations. The PCS leadership team must assess the adequacy of existing legislation to check whether it meets the port's and the country's needs. The analysis will reveal gaps that the PCS lead agency must arrange to close. The government may have to enact a new law to establish a PCS. Alternatively, existing law may allow the lead agency to set up such a facility, with regulations or the executive authority of the government nominating and establishing the PCS Operator and defining its operational responsibilities and obligations. The other legal instruments that are necessary to operate a PCS involve the setting-up of a formal relationship between the PCS as a service provider and PCS users as consumers. This may take the form of Service Level Agreements (SLA) and Service Level Obligations (SLOs).

E-transaction laws encourage the use of electronic means for conducting business, which can result in increased efficiency and reduced costs. Online transactions need a legal basis because it helps to ensure the validity and enforceability of electronic contracts and other agreements. Without a legal framework, there might be uncertainty and lack of clarity about the rights and obligations of the parties involved in an electronic transaction, leading to disputes and legal challenges, which can be costly and time-consuming to resolve.

A legal framework for electronic transactions also helps to promote confidence and trust in using electronic means for conducting business. It allows PCS users and stakeholders to feel secure knowing that the courts will recognize and enforce their electronic contracts and agreements. Chapter 5 deals with the enabling legal and regulatory framework in detail.

3.4. Costing and revenue structures for PCS

Whether or not a PCS will be established depends critically on how it is funded. There are three types of PCSO: (i) Privately operated. (ii) Public-private partnerships. (iii) Publicly owned and operated. The type of PCS operator also influences the PCS's financial model. A study carried out by IAPH in 2011 suggested that the shareholders of the PCS fund the initial development, and establishment of the facility. Where the PCSO is a public entity, it is funded by a government owned body, an agency of the government, such as the Customs authority or port authority. In some instances, it has been co-financed by an international organization, such as the EU. The IAPH Benchmark Study on PCSs revealed a wide range of variation in costs. The costs grow with PCS implementations that cover a cluster of ports, or for national implementations covering all ports. The initial costs of development will depend on the number of PCS modules on offer. With the advent

of cloud technologies and modular, service-oriented architecture, most of the PCS solutions are now offered as Components Off the Shelf (COTS), which implies a low level of effort in the initial development of the platform. Most of the effort is in the customization of solutions to the local requirements. Major cost, time and effort might go towards bespoke tasks of integration.

The typical cost of annual ongoing operations may range from 20 percent to 33 percent of the initial costs. Where a PCS is implemented in a cloud environment, it is characterized by low initial capital expenditure (CAPEX). Most ports charge a combination of subscription and transaction fees. According to literature, some PCSOs charge transaction fees only on the carriers and Customs brokers. There are different models. User fees (if any) may be charged based on transactions, TEUs, consignments, voyages, and overall subscription. There are numerous examples of PCS operators that run PCSs as a public service, with no transaction fees. Chapter 3 deals with a Costing & Revenue Structures in detail.

3.5. Functional & technical architecture

Investment in technology infrastructure is critical to the success of a PCS. The technical design of a PCS must respond to the functional requirements defined for it by its stakeholders. There are five key aspects that a PCS technical infrastructure must support.

First and foremost, the PCS is a communication gateway designed to handle electronic messages between the members of the port community and to realize the interaction between them. Through the platform, the systems of different institutions (Customs, port authority, immigration), logistics nodes (terminal operators, dry port, container freight stations, warehouse operators), carriers (shipping line, pre- and onward carriers connecting the hinterland), exchange data with each other. As a message exchange hub, the PCS should have the capability to move standardized electronic data, in real time and in a reliable and auditable manner. To ensure rapid adoption of the platform by the members of the port community, the PCS platform must adopt globally recognized electronic data standards.[5] That way, the PCS can ensure that the data viewed and used by the members of the community is structurally sound and semantically valid. Legacy data standards using UN/EDIFACT remain prevalent in most PCSs. However, PCSs are increasingly using open Application Programmatic Interfaces (APIs) that provide real-time exchange of information. The PCS platform must also support a broad range of modern internet-based communication protocols.

Second, there are a number of core digital systems and services that the PCS platform relies upon. Digital services of the PCS are built based on electronic identification and authentication using digital signatures and certificates. The benefits of using

---

5   Organizations such as the International Maritime Organization, United Nations Center for Trade Facilitation & Electronic Commerce [UN CEFACT], the World Customs Organization, and International Standards Organization develop and maintain global electronic data standards.

PHOTO BY: © PCS OPERATOR | PORTNET, MOROCCO

digital signatures and certificates are clearly recognized by the wider community. PCS uses these technologies for its electronic services. The PCS incorporates an electronic payment platform to allow the PCS users to make online payments for services provided by the port authority, terminal operator, shipping line, freight forwarder, trucker, and other providers. A PCS may be connected to one of more payment gateways. There are generic services such as service desks, Customer Relations Management (CRM) modules, document management systems, content management systems, process and workflow management systems, and database management systems. The workflow management creates the defined process path to complete a task. In a PCS, it will ensure the interorganizational processes are handled automatically and efficiently.

Third, the users of the PCS platform access it through the gateway layer. Most PCS platforms provide multiple types of machine-to-machine communication protocols, but invariably include a web portal. The PCS portal acts as the window for end users. As a web portal, the PCS provides the say to onboard, authenticates, and provides user service and support. The portal provides a way to share data, track and trace the status of the physical assets (e.g., vessels, trucks, containers), digital transactions and online payments. PCS offers access to users through single sign-on capabilities for the users requiring them to authenticate only once. Modern online platforms include integration services that deliver connections to functions and data from multiple systems in a single view. In a PCS, this can be valuable, as users can access data from multiple data sources and systems. Portals can be customized to provide users with a personalized dashboard. With the advent of 'Big Data', PCSs have begun to provide value added services to users. PCSs and terminal operators generate Big Data that is captured by the sensors and programmable logic controllers affixed to automated cargo handling equipment and Internet of Things (IoT) devices affixed to cargo. The 'treasure trove' of

data generated during operations is then analysed and presented to PCS users on the portal. The value of big data analytics in ports includes diagnosing delays, energy intensity and inefficiencies in operations and forecasts of trends to provide customers with predictive analytics. PCS users can benefit from the KPIs generated continuously through the use of advanced analytics and AI. Synchronization of operations, ensuring the optimum use of infrastructure and vehicles are some of the other benefits.

Fourth, the PCS technical infrastructure must be resilient, reliable, and available. Once the PCS is in place, the port's operation and the entire port community will come to depend on it. Unavailability and outages will impact port operations severely. To prevent such occurrences, the PCS must adopt modern, cloud-based technologies that are used by contemporary digital platforms, such as e-commerce applications. Virtualization of infrastructure, platform and software services ensures that there is no single point of failure. Infrastructure can scale up or down according to load. In a cloud environment, infrastructure is geographically spread out to insure against natural calamities or other forced outages.

Fifth and last, the PCS platform must guarantee the security of data. Governments consider PCSs as part of the critical national information infrastructure. PCS operators must follow the government's guidance on critical and coordinated response procedures to cybersecurity incidents and threats. Data security includes privacy and confidentiality of data. It is authentic and is attributable to its source. Integrity of data means that it has not been altered except through a rightful process. It is also non-repudiable, ensuring that the sender cannot backtrack or disown the electronic message. The PCS platform should not only be secure internally, but also protect against the threats of cybersecurity. Chapter 8 deals with the enabling legal and regulatory framework in detail.

4. Change management

Acceptance of change is crucial to the introduction of complex technical platforms like a PCS. Stakeholders must be on board from the start. Ports need experienced facilitators with a solid understanding of technical transformation to supervise stakeholder participation properly. The facilitator can explain how stakeholders can prepare and use their operations and systems correctly and effectively during a transition. The PCS is modular. Each module has prerequisites for participation with expected benefits. Facilitators must tackle potential issues quickly and transparently during a transition. As a change management process, the transition to a PCS is structured.

Change management in establishing a PCS begins by identifying the PCSO. The governing entity, the board or a steering committee consisting of representatives from different stakeholders, leads the change management process.

In complex projects like the PCS, experts recommend a change management strategy on the methodological principles of the Change Management Framework (or ADKAR – Awareness, Desire, Knowledge, Ability and Reinforcement), a widely accepted change management methodology.[6]

The PCS operator prepares for the change management process with a stakeholder analysis. The PCS will impact each stakeholder differently. Therefore, the change needs to be analyzed and defined in all its dimensions, and, as this is done, the lead agency must identify the Critical Success Factors (CSFs). The analysis includes the assessment of the key change dimensions for each stakeholder, i.e. the degree of change being introduced, the degree of anticipated (or actual) resistance, the density and spread of impacted population, implications of not changing, the timeframe in which change needs to be introduced, the availability of experts, and the mutual dependency between the organization and the individuals.

Box 3. Communicating Change: Some key principles and success factors

1. Clarity of mission, vision, goals, and objectives
2. Establish the need for and importance of the change. Build a sense of urgency.
3. Establish the vision and understand how the vision will impact those affected by it.
4. Set short as well as long term goals- celebrate and recognize short-term improvements along the way.
5. Establish a strong and senior guiding team.
6. Establish a capable change team and empower them to provide necessary support, training and encouragement to those who need it.
7. Integrate change management with project management and support all the impacted individuals.
8. Be persistent – maintain progress and continue momentum.
9. Keep "a finger on the pulse" of the individuals on whose actions and participation are crucial for success.
10. The task of change management continues beyond the implementation of PCS. The governing entity must continue to articulate the relationship between new behaviours and organizational success.

A successful change management approach follows a simple sequence of change interventions. This includes creating awareness of the need for change by highlighting the mutual benefits, goals, and objectives to create the desire to join the change

Awareness of the need for change	Desire to support the change	Knowledge of How to change	Ability to demonstrate skills and behavior	Reinforcement to make the change stick
Creates	Increases	Encourages	Enables	Institutionalize
Interest	Participation	Stepping up to take on responsibility	Deliver results	Sustained behavior • New status quo

Source: Prosci.

---

6   The Prosci ADKAR Model created by Jefferey Hiatt the founder of Prosci

endeavor. It also includes imparting the needed knowledge to create the ability to participate as well as reinforcing sustained high levels of performance by providing reward and/or recognition to those who contribute the most to the project activities.

To create the demand for a PCS and a desire for change, the strategy must address the human element of change and the project leadership must act as the main change propagator. In most cases, the stakeholders may not have the knowledge needed to appreciate the advantages of the change. The PCS steering committee/board must release information, tools, knowledge, and skills to help reinforce desired behavior by either open recognition of issues or plug capacity gaps by targeted change interventions.

5. Conclusions

Creating a PCS is complex and collaborative. It involves many port and maritime stakeholders. Success hinges on tackling technical, legal, regulatory, and social challenges.

People, process, technology, and collaboration are critical components of success. An implementation framework helps to set out the crucial steps stakeholders must take on the road to success: the smooth adoption and operation of the PCS. The preparatory phase is essential. It involves the collective adoption and articulation of a vision, nomination of the program leadership, and the development of a 'Blueprint for Implementation'. The blueprint includes a governance and operating model, the financial model, legal and regulatory framework, a business process and data model, technical and functional architecture, and a detailed implementation plan. Each of these components of the blueprint demands intense, and sometimes, lengthy periods of collaboration led by specialized teams drawn from among port community members. The blueprint process must be facilitated by experts and supervised by a steering committee that is empowered to decide on behalf of the port community. Depending upon the strength of the leadership and the spirit of collaboration, the consultative process in the preparatory phase could take several months, and up to a year and beyond. The 'go forward' of a PCS project depends entirely on whether or not the program leadership takes the decisions required under the blueprint process.

To develop a roadmap and a blueprint for a PCS, governments should consider hiring experts, either in the form of a professional consultant or a consulting firm. Consultants with expertise in the maritime and port sector can provide valuable insights into the best practices and latest technologies. They can assess the current state of the port community, identify gaps, and recommend improvements to optimize operations and meet international standards. A PCS requires robust information technology infrastructure and systems integration. Professional consultants or consulting firms can provide project management expertise. External facilitators can help create the needed buy-in from all stakeholders, facilitate communication, build consensus, and manage expectations throughout the project lifecycle. Introducing a PCS often entails significant changes to existing processes, systems, and workflows. Consultants with experience in the overall design, development, and implementation supervision can help. Particularly with change management, external consultants can help develop strategies to mitigate resistance, train staff, and ensure a smooth transition to the new system.

The implementation framework for a PCS should ensure that the project team designs a robust and scalable system architecture that can handle the data exchange and interoperability requirements and adapt to future growth and technological advancements. The team should establish data standards and protocols and implements modern integration technologies while ensuring cybersecurity. The implementation framework includes a technical process that must also feature robust legal and regulatory measures to ensure compliance with the relevant data protection standards and intellectual property regulations. It must define and allocate liabilities and responsibilities among stakeholders in case of errors, system failures, or breaches in the PCS. It is also a collaborative social process involving intense stakeholder engagement in the planning, development, and implementation to ensure their buy-in and commitment to the PCS. Ultimately, the implementation of a PCS is a change management project under which the PCS operator 'holds it together' for and on behalf of the entire port community.

FINANCING THE DEVELOPMENT AND OPERATIONS OF A PCS

MODELS FOR SUSTAINABLE FINANCING

Executive Summary

Key Takeaways

- Solid financial foundations are critical for the success of a PCS.

- To host or to outsource ICT infrastructure is one of the most critical cost and operational decisions in creating a PCS.

- Deciding whether to develop a bespoke PCS or adapt an existing solution from an independent solution provider is another major decision with significant operational and cost implications.

Maritime trade and ports are big business. Creating a PCS requires significant financial investment. For a PCS to survive and thrive it must have financially sustainable operations. There are a range of options to ensure smooth and sustainable financial management and revenue generation.

While there is no "one-size-fits-all" approach, there are some critical steps stakeholders can take to safeguard the sustainability and success of their investments.

Prudent financial management is particularly critical for low and middle-income countries seeking to establish a PCS for the first time amid rising inflation, higher interest rates and lending constraints.

Key decisions for PCS stakeholders will include whether to host ICT infrastructure on site or whether to outsource, their revenue generating model and the revenue split between the Port Authority (PA) and the PCSO.

It is crucial to invest strategically in the preparatory aspects, to help bring the port community together and establish a common understanding of the roadmap and the blueprint.

Given the potentially costly technological nature of creating a PCS, two of the biggest questions stakeholders must initially ask are: (i) Should we develop a bespoke PCS or adapt an existing solution from an independent solution provider? (ii) Should we host the ICT platform or outsource hosting?

Working out the best revenue model will also prove critical to the long-terms financial success of the PCS.

Taking these steps will put the PCS on a strong financial footing as it seeks to transform fortunes through more effective and efficient maritime trade.

1. Introduction

A PCS strives to make ports more efficient, resilient, and competitive. Getting financing right is crucial to the success of such a venture. Proper and prudent planning of capital and operating expenditure is critical to ensure the benefits of creating a PCS outweigh the costs.

The financial model for a PCS must consider the complexity of the ecosystem of stakeholders and the services offered. The greater and more complex the services, the higher the costs. While an estimate of the overall establishment costs is necessary, the breakdown of various costs and benefits associated with the system needs to be assessed module-wise and allocated fairly and equitably among the stakeholders.

PCS development and maintenance can be expensive, requiring significant software, hardware, and other infrastructure investments. The financing model must identify and allocate these costs sustainably, ensuring that the system remains financially viable in the long term.

A sustainable funding model for a PCS must consider various aspects of people, processes, technology, and governance/collaboration. The financing model must identify and prioritize revenue sources, such as transaction fees, subscription fees, or government subsidies. These revenue sources must be sufficient to cover the ongoing costs of the system while remaining affordable for the stakeholders. Since PCSs are seldom mandatory for community members, the financing model must incentivize stakeholders to participate in the system, such as lower transaction fees or other benefits. Carefully designed incentives can ensure widespread adoption and usage of the system, leading to greater efficiencies and cost savings for the stakeholders. This chapter does not provide a costing guide for a PCS. Instead, it offers a check list of options for a PCSO. It also spells out their potential implications when designing a PCS project.

The chapter is divided into four sections: (i) The Preparatory Phase (ii) The Development Phase (iii) Operational Phase (v) Revenue generation.

Blue print finalized	Contracts assigned and agreements finalized	Implementation phase over	Normal operations	Development

Preparatory phase	Development and implementation phase	Operational phase

Transition Point 1 — *Transition Point 2*

(i) Funding the Preparatory Phase (ii) Funding the Development Phase (iii) Funding the Operational Phase

(iv) Revenue Generation

2. Preparatory phase

The preparatory phase (see section 1.1 of Chapter 2 for the details) needs to be funded. Briefly, it involves a needs assessment, a feasibility study, a visioning workshop, digitalization gap analysis, the development of a roadmap and a 'Blueprint for implementation.' Stakeholder engagement to explain the concept of a PCS, its functions, and benefits, and to get community buy-in is going to be an important part of this phase. To familiarize the stakeholders with the functioning of a PCS, exposure visits may be undertaken to select destinations. To establish a collaborative framework, agree on a shared vision of the PCS, put in place a legal framework, tie-up the organization and financing issues, deliberate on the future business process models and the norms

of data collaboration will require extensive consultations over a long period of time. The preparatory phase involves an open-minded exploration of the PCS concepts and the ideal 'to-be' states. PCS projects during this phase often encounter prolonged deliberations and uncertainty because of the complex nature of exchanges involved between stakeholders. For that reason, finding dedicated public funds for this may prove to be challenging.

Countries might like to approach international financial institutions and standards organizations to fund this phase of the project. The development of blueprints and roadmaps cost between US$ 400,000 to US$ 1 million.[1]

---

1   Based on World Bank's experience with the development of blueprints/roadmaps for Trade Single Windows, a PCS and an Air Cargo Community System.

3. Development phase

A PCSO must draw up a business plan to manage the financial success of the PCS. Case studies reveal that development costs of a PCS can vary widely. As chapter 2 showed, the development cost of a PCS in small ports may be less than $10 million but can increase to over $50 million in medium ports. For large ports this can double to over $100 million. For a cluster of regional or national ports the costs can go much higher. The difference in costs will reflect the size of the port, the technology it uses and modules and functionality it offers.

Stakeholders need to take several critical decisions to shape a successful PCS business plan. They need to find answers to major questions with significant cost implications.

Firstly, will the technology be purpose-built or customized using an existing system by an Independent Software Vendor (ISV) or a system integrator? This decision has cost and time implications. Typically, the former takes more time than the latter. In-house development of a bespoke solution can take two to five years before going online. Choosing the second option can save time with a PCS in production mode in two to three years.

Secondly, what is going to be outsourced for the design, the development, the operations, and the hosting of the PCS? And will this be fully or partially outsourced? As a rule, there are three steps to successful and sustainable financing of a PCS. They involve both CAPEX and operational expenditure (OPEX).

The first step is at the start of project, which is based on the preparatory activities. The second step is during the design and build of the PCS. The third is taken during the operational phase. The start of a PCS is crucial. This is when major decisions are taken about development and operations. International experts can prove invaluable in paving the way to a strong start for a PCS. Among the early decisions to make are:

1. Whether to develop a bespoke PCS or adapt an existing solution from an independent solution provider.

2. Whether the ICT platform will be hosted by the port or outsourced.

3. Both decisions have staffing and cost implications in the short, medium, and long term. This chapter examines five scenarios that help to navigate these choices.

3.1. Five Scenarios

The table below examines five approaches from around the world. They have different pros and cons, including technology and staff costs. While there is no one-size fits all approach, the first approach is the most dominant. Around half of operational

Table 1. Sample development costs for the case study PCS

PCS	Indicative CAPEX To date	Source of funding
Portnet, Morocco	28.0 million US$	Initially by the National Ports Authority, then by Portnet once incorporated
Djibouti	5.5 million US$	Partly under debt financing
SEGUCE, DR Congo	Not disclosed	PPP
Busan, South Korea	2.0 million US$	Busan Port Authority
New Caledonia	Not disclosed	
Jamaica	10.0 million US$	Port Authority of Jamaica
India	Not disclosed	India Ports Association funded the development of the PCS
Netherlands	120 million €	Rotterdam Port Authority, Amsterdam Port Authority, and port stakeholders
Valparaiso, Chile	16.5 million € in three phases (phase 1 4M€, 7.5 M€ for phase 2 and 5M€ for phase 3)	EVP (Valparaiso Port Authority)

PCSs run on this model. Examples of ports operating using this model include Portbase (Netherlands), Dakosy (Germany) and APCS (Belgium). Djibouti, developed with Crimson Logic, is an example of the second model. Valparaiso, with Indra, is an example of the third. Jamaica, with SOGET, is an example of the fourth. New Caledonia, with MGI, is representative of the fifth category.

3.2. Specialist support

From the beginning of a PCS project, external assistance can prove invaluable.

This support can include:

I. A legal advisor who will review legal and regulatory considerations.

II. An international financial advisor (such as PWC, EY, KPMG, or Deloitte) to support development and certification of a business plan.

Table 2. Pro and Con of decisions in the development and operations of a PCS

#	Bespoke or vendor solution?	Design	Operations	Hosting	PROs	CONs
1	Bespoke	All in house by operator	All in house by operator	All in house by operator	Internal capacity building	High risk of failure Long timeline before operations, typically three to five years
2	Bespoke	Partially outsourced with oversight from operator	Partially outsourced with oversight from operator	Partially outsourced with oversight from operator	Internal capacity building Cost effective Mobilizes expertise from contractor	Medium risk of failure Long timeline before operations, typically over three years
3	Bespoke	Fully outsourced to contractor	Fully outsourced to contractor	Fully outsourced to contractor	Reduced risk Project Cost Control Mobilizes expertise from contractors	Low internal capacity building Reliance on contractor Risks of increase costs over time Risk of low functional & ICT evolution
4	Independent vendor solution (ISV) or system integrator	All implementation is based on an existing PCS solution to be customized	All in house by operator	All in house by operator	Efficiency Project could be deployed in 2 to 3 years Expertise from Contractor	Reliance on contractor Risks of increase costs over time Risk of low functional & ICT evolution
5	Independent vendor solution (ISV) or system integrator	All implementation is based on an existing PCS solution to be customized	Totally or partially managed by ISV or System Integrator	Managed by vendor	Efficiency Project could be deployed in 1 to 2 years Expertise from Contractor	Reliance on contractor Risks of increase costs over time Risk of low functional & ICT evolution

III. An International Strategic and Technical Advisor to support inception, design, build and initial deployment.

3.3. Staffing levels

People are critical to the success of a fledgling PCI. Getting the right staff at the right time is important and will fluctuate between inception, development, and operations. Development stage staffing considerations are listed below:

- The need for a project management team using international practices, such as from PMI, including a project director and project manager.

- The need for services design, including Business Process Reengineering (BPR). This requires senior and junior functional analysts and legal experts to review the regulatory framework related to business processes.

- The need for Technology Architecture design that includes on-premises or cloud services, software, network, telecoms, IoT,

security, application, and database specifications. This entails staffing, such as technology architects, disaster recovery experts, cybersecurity architects and business continuity architects.

- The need for development of services related to the PCS scope and road map requiring staff such as UI/UX engineers, software developers and SQA analysts.

- The need for implementation of Technology Architecture requiring staffing, such as systems engineers, front and back-end engineers, service and interoperability engineers, database engineers, network, and telecoms engineers.

- The need for change management to drive BPR, legal and regulatory frameworks, engagement and collaboration with all public and private stakeholders, ongoing communication with the PCS environment.

- The need for a handover to mark the completion of the development stage and the operational acceptance. This requires training of PCS operator staff, pilot stakeholders, go-lives, and acceptance tests.

Figure 1. Intensity of staffing needs for the PCSO under according to design and built options

#	Services design	Technology architecture design	Services development	Change management	Hand-over
1	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
2	■■■	■■■	■■■	■■■■■	■■■
3	■	■	■	■■■■■	■
4	■	■	■	■■■■■	■
5	■	■	■	■■■■■	■
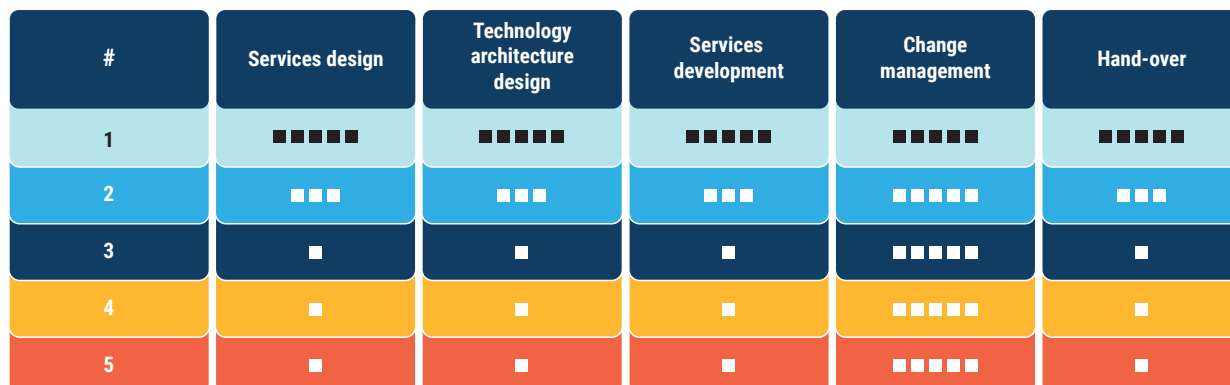
Figure 1 illustrates, from the PCSO perspective, the level of staffing required in-house to perform or oversee the main tasks. It is important to note that, irrespective of the options selected, the change management requires intensive stakeholder engagement to review and streamline the existing processes.

3.4. ICT infrastructure

When it comes to ICT technical infrastructure, the question is whether to outsource? Do you keep data servers, application environments and telecoms on the premises or outsource them? Clearly there are cost implications in making these decisions. Paying for on-site ICT infrastructure does not come cheap.

Support facilities include dedicated rooms with controlled temperature. It includes security, such as Tier 2 or Tier 3 data centers. In low and middle-income countries operators may also need to budget for emergency power supply. A disaster recovery site is now also considered mandatory. In addition to equipment, initial investment is likely to include license fees for third party software.

3.5. Adaptation costs for the PCS users

3.5.1. Participating to the review of the processes

The decision of port stakeholders to create a PCS holds the promise of greater efficiency and competitiveness. The transition provides an opportunity to streamline and simplify processes before automating them in a new system. This can be time consuming for stakeholders, particularly smaller ones with less time and resources at their disposal.

It is, for instance, common for the BPR Committee to require that trade and industry associations appoint at least two official representatives to the committee and sub-working groups.

To illustrate the level of input required by the port community, in a presentation to IPCSA in April 2021, PROCOMEX shared insights on the business process reengineering efforts: 158 meetings, totaling 632 hours, and involving over 700 stakeholders, exclusively from the private sector, resulted in the redesign of 10 processes.[2]

3.5.2. Upgrading IT and training staff

The digital divide in low and middle-income economies is real. It is particularly pronounced between larger and smaller businesses. That poses challenges for both the private and public sectors as they strive to create unitary, digital systems for ports.

Among border management agencies, Customs are often the only agency with an automated system to handle trade procedures. UNCTAD's ASYCUDA system is commonly used. Although terminal operators, particularly container terminals, large C&F agents, and most shipping agents have shifted to automated systems that is not necessarily the case for smaller operators. Many still rely on paper or unformatted emails to communicate with the rest of the logistics chain.

2   https://portalcip.org/wp-content/uploads/2021/04/Apresentac%CC%A7a%CC%83o_PCS_v.07-1.pdf

Box 1. Stakeholders involvement in the Pakistan PCS

The World Bank Group financed a feasibility study for the Pakistan Port Community System, which included an estimate of the training needs for the port community. The figures are indicative and should be included as a dedicated component of any PCS project.

- Around $30,000 to cover the participation of the port community in the BPR.

- Around $60,000 to cover training of the different categories of stakeholders in the use of the PCS (civil servants from the border management agencies, shipping agents, freight forwarders and customs brokers, transport sector operators, terminal operators, port authority team notably.)

The feasibility study also estimated the cost of developing ad hoc interfaces or interoperability for operators' existing automated systems at a few thousand dollars per operator.

4. Operational phase

Information on the costs of operating a PCS remains scarce. Often it is difficult to assess the gap between the cost of providing the service and its actual cost to the users. As a rule, the range of costs (similarly to the reported CAPEX) is extremely wide. Costs at the operational stage will often be determined by the decisions taken around whether to outsource ICT.

On-site data hosting requires dedicated staff to manage and maintain ICT equipment. Opting for cloud-based solutions elsewhere can drastically reduce costs and the need for in-house ICT equipment and staff.

The OPEX for telecommunications can be considerable and expensive in developing countries. This may include fiber, encrypted guaranteed bandwidth lines, leased lines and VSAT. CAPEX and OPEX will also need to be allocated to protect critical infrastructure amid potential cybersecurity threats.

Figure 2 illustrate the staff intensity, from a PCSO perspective, for each of the primary functions, according to the development scenarios listed in Table 2. The primary functions correspond to:

- Services maintenance and evolution. Once developed, PCS services still need to evolve, particularly when it is a phased development that integrates new functions and services over time.

- ICT infrastructure management refers to the technical staff needed to service the data centers and the telecom facilities under service level agreements. This relates to the decision to host on-premises or outsource. Even if the hosting is not delegated to an ISV or system integrator, the emergence of cloud-based options increasingly offers operators the possibility to control hosting. And they can do this without needing a large team of in-house technical staff to maintain ICT infrastructure.

Figure 2. Intensity of staffing needs for the PCSO under according to operations options

	Services maintenance and evolution	ICT infrastructure	Customer service	Stakeholder engagement & Communication	Admin & Finance	Management
1	■■■■■	■■■■■ or less	■■■■■	■■■■■	Variable	■■■■■
2	■■■	■■■	■■■■	■■■■■	Variable	■■■■■
3	■	■	■	■■■■■	Variable	■■■■■
4	■	■■■■■ or less	■■■■■	■■■■■	Variable	■■■■■
5	■	■	■■■	■■■■■	Variable	■■■■■
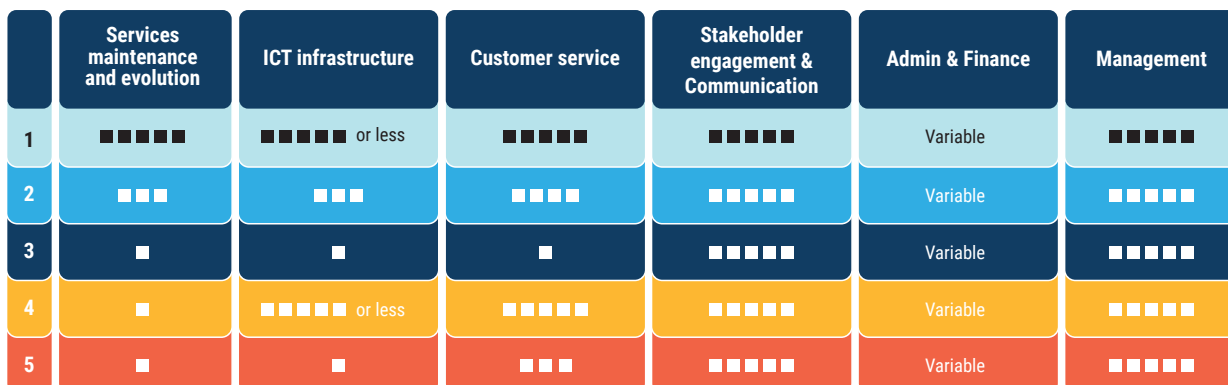
Figure 3. Revenue streams for a PCS

| User fee | + | Membership fee | + | Public funding | = | PCS Revenue |

- Customer service refers to assistance to achieve interoperability between new stakeholders, providing training as necessary and a 24/7 help desk. If a significant portion of the development of the system has been outsourced to an ISV or a system integrator, the interoperability dimension is more naturally transferred to that provider instead of the PCSO. In any case interoperability CAPEX can be important in the context of customs and the trade single window.

- Stakeholder engagement and communication is equally important in the production stage as it is in the development stage. It enables the PCS to evolve and adapt to the changing needs of the port community. This is particularly relevant in phased implementation of the PCS where additional functions are added over time.

- Administration and finance prove particularly critical when the PCS is financed through payments by users. Some payment methods may require more PCSO involvement than others. For instance, fixed annual subscription per connected user or perception through 3rd parties, such as a Customs Authority for declaration-based fees, are far simpler to implement and require less personnel than complex tiered subscriptions.

Table 3. Fee structure for the case study PCS

PCS	User fee	Membership fee	Public funding	Remarks
Portnet, Morocco	Yes	Yes	Yes	Initially, flat annual fee of around 350$ per user, but recently introduced differentiated rate per category of user, and the possibility of a per transaction fee without subscription
Djibouti		Yes for some operators (Free Zone companies and shipping agents)	Yes Free for all mandatory declarations linked to FAL-46	DPFZA is still heavily subsidizing the operations of the PCS
SEGUCE, DR Congo	Yes, 100$ per Customs declaration (Incl VAT)		No	Fee set by Govt. Decree
Busan, South Korea	Free	Free	Yes	
New Caledonia	8$ per Customs declaration	2000$ annual subscription per connected user		
Jamaica	20$ per declaration introduced February 2022		Publicly funded and free for users prior to February 2022	Only a limited number of declarations qualify for payment, based on nature of trader and customs value
India	Free	Free	Yes	Entirely funded by IPA, no payments by users
Netherlands	Option for pure transaction-based fee or monthly subscription plus per transaction fee	One-time initial connection fee of 249.50€ After, option for pure transaction-based fee or monthly subscription plus per transaction fee		
Valparaiso, Chile	Free	Free		EPV is assessing the option of charging user fees

PHOTO BY: PORT AUTHORITY OF JAMAICA

- Management is also key. Often, the CEO is the most critical person for the PCSO, as the principal person leading the change and engaging the public and private stakeholders of the port community. He or she must have deep knowledge of the maritime supply chain, and typically have a background in a port authority, Customs, terminal operator, shipping lines or logistics.

4.1. Mobilizing revenue

There are different ways of mobilizing money to bankroll the creation of a PCS. Table 3 shows that often, for the PCSOs that were reviewed, different sources of revenue are combined. The mix can evolve over time.

4.2. Public funding of PCS

PCSs are often publicly funded because well-functioning ports are considered a public good and worthy of taxpayer investment. They boost the competitiveness of the economy, create jobs, and attract foreign investment. In the European Union (EU), PCSOs have tapped public funding, including the EU Pandemic Recovery Plan, to fund their PCS roadmaps.

In low and middle-income countries, the World Bank Group (WBG) and other international financial institutions have provided funding to support smarter and more sustainable ports. Those programs include support for digital solutions as part of a drive to foster trade facilitation. Among the cases studied, PCSs in India and Israel are fully publicly funded. Air Cargo Community Systems (ACCS) in India, however, charge a user fees.

4.3. Transitioning to user pay model

Revenue generation can evolve over time. Jamaica's PCS took several years to roll out a user-pay revenue model and consulted port stakeholders before doing so. It launched pay per transactions in January 2022.

4.3.1. User-pay funding of PCS

A **user fee per transaction** is a common way for a PCS to generate revenue. It is the typical transaction used as a unit for payment is the Customs declaration. Typically, the number of Customs declarations handled in ports is in the hundred thousand to millions. Portbase (Netherland) recorded 145 million transactions (all types, not only Customs declaration) for 2021, generating an annual turnover of €20.4 million. But even in much smaller ports, like in New Caledonia, 72,000 Customs declarations with an $8 fee generate sufficient revenues to cover PCS operating costs. On a transaction-based fee, the fee is paid by only one stakeholder, the clearing and forwarding agent, which can then bill the fee to the consignee.

Knowing the number of declarations that could be processed by the system and that could constitute a basis for charging a transaction fee is critical to the business plan for a PCS. The business plan needs to ascertain the number of declarations per office and per year, as well as the recent evolution of that number. It is also important to know whether the use of the PCS will be mandatory. That, for example, is the case in the Democratic Republic of Congo (DRC) where it is imposed by decree. In several of the case studies the imposition of the mandatory requirement was introduced only when the system was sufficiently developed to cover all types of transaction. For instance, in New Caledonia,

this occurred after the Customs code was revised to impose the mandatory use of the PCS in January 2022.

In the **subscription model**, all connected users contribute to the operations of the PCS. In some cases, there are different subscription levels, either according to the nature of the user (clearing agent or terminal operator or trader), or according to the annual transaction volume.

A blend of the two solutions, a fixed annual subscription fee, combined with a fee per transaction, is found in several of the case studies, as shown in Table 3.

The Indian ACCS provides a unique example of regulatory oversight on user fees. After the launch of ACCS in 2016 in Mumbai, some users approached the Airports Economic Regulatory Authority of India (AERA) and argued that the digital services provided by the portal were part of the overall terminal processing activity and should be treated as 'aeronautical services', which are subject to AERA oversight. AERA ruled that:

1. ACCS-related digital service charges are subject to regulatory oversight. The service provider should regularly file the schedule of charges with it.
2. ACCS charges should be arrived at through a transparent process of consultation and approval.
3. Notwithstanding the AERA decision, questions remain about whether terminal operators can make it mandatory for users to subscribe to value-added ACCS services.

The Indian ACCS case illustrates the impact of fees and charges on adoption rates and point to the need to establish a consultative process that ACCS operators need to follow while fixing fees and charges. While cargo terminal operators need to charge user fees to recover the cost of system development and deployment, there may be the need for regulatory oversight when such charges are made mandatory.

4.3.2. PCSO at SIDS

Chapter 11 will address the financial sustainability of PCS operators in small island developing states. Twelve SIDS out of 58 (UN members, non-UN members and associated members of the regional commissions) have created a PCSO. One example is Mayotte in the Comoros.

4.3.3. PCSO vs Port Authority revenues

Three case studies shed some light on different revenue models used by different ports around the world. The first is the Port

Box 2. Morocco subscription fee structure

Morocco Subscription Fee Structure

Portnet,[3] in Morocco, is using a complex tiered fee structure per type of user for a range of transactions per calendar year:

- Traders, several levels from a base tier allowing a maximum of three transactions per year for 1,920 DH (185 US$), to the top tier for an unlimited number of transactions for 9,600 DH (925 US$)

- Banks, base tier at 20,000 DH (1,925 US$) for a maximum of 2,000 transactions, up to top tier at 300,000 DH (28,888 US$) for an unlimited number. Twenty banks are connected to Portnet.

- Shipping agents, from a base tier at 6,000 DH (578 US$) for a maximum of 20 transactions, up to top tier at 160,000 DH (15,407 US$) for an unlimited number. 163 shipping lines / agents are connected to Portnet.

- Stevedoring companies, base tier 70,000 DH (6,741 US$) for 100 transactions, up to top tier at 500,000 DH (48,147 US$) for unlimited number. 75 companies are connected.

- Clearing and forwarding agents, base tier at 3,180 DH (306 US$) for maximum of 50 transactions, top tier at 5,580 DH (537 US$) for unlimited. 361 agents are connected.

- Port authorities, base tier at 50,000 DH (4,815 US$) for 500 transactions, top tier at 300,000 DH (28,888 US$) for unlimited.

Authority of New Caledonia. The second is the National Port Authority of Morocco. The third is the Ports of Rotterdam and Amsterdam. It provides a revenue split between the Port Authority (PA) and the PCSO in all three cases. This initial analysis highlights that the financial expenditure of the PCSO is marginal compared to the financial footprint of the port authority and that the PCSO's financial expenditure could be also supported directly by the port authority with limited impact on annual net profit for a large port authority.

---

3   Full tariffs are available at https://portnet.ma/fr/grille-tarifaire-nouvelle-tarification (French version of the site, the tariffs in the English version have not been updated). The number of users connected per category is extracted from the case study material.

Table 4. Annual Revenue USD4

Annual Revenue	Port Authority (PA)	PCS Operator (PCSO)	% PCSO/PA
Rotterdam - Amsterdam (2021/2021)	1,010,735,280 €	21,984,480 €	2.18%
Morocco (2019/2018)	227 099 047 €	8 890 517€	3.91%
New Caledonia (2017/2018)	14 253 897 €	602980€	4.23%

5. A few take aways

- The success of a PCS rests on strong financial foundations.

- While there is no one-size-fits-all approach there are several critical steps stakeholders can take to ensure their business and revenue plans put them in the best position to turn their vision from aspiration into reality.

---

4   Based on information the following sources (i) Infogreffe Bilan GIPANC (ii) Source Chambre Territoriale des Comptes de Nouvelle Caledonie (iii) Portnet (iv) APN (v) Portbase

CHAPTER 4

GOVERNANCE & OPERATING MODELS

Executive Summary

A Port Community System Operator (PCSO) is the entity responsible for establishing, managing, and enhancing the PCS. It serves as a trusted third party, enabling public and private data collaboration and facilitating the seamless exchange of information among the port community. The role of a PCSO encompasses overseeing the design, development, integration, and management of digital port infrastructure within a single platform. This involves working closely with port stakeholders to ensure effective data collaboration, legal and regulatory compliance, and the adoption of new processes and technologies. The operator is responsible for managing the day-to-day operation of the system, port community management, customer service, maintenance, service level agreements and evolution of the PCS.

The PCS initiation phase could be either championed by the chief executive officer of the port authority, the Commissioner of the Customs Administration or the president of the port community association. A key responsibility of the champion is to engage stakeholders, building trust within the public sector and the private stakeholders. Equally important will the role of public sector executives of line ministries, such as the minister of transport or the minister of finance. Their engagement will be a key asset to the PCS project to drive change management at cabinet level.

The PCS initiator and operator could be the same or different entities. In most cases, the PCS is initiated by the port authority, with the intention of improving trade facilitation and the efficiency of port operations. In other cases, a PCS is initiated by the private sector by an entity seeking to streamline operations and reduce costs. Regardless of who initiates the PCS, it may be operated by the initiator itself or by a third party.

PCS operator models are clustered around three schemes. The PCS can be operated by either public or private entities or via a Public-Private Partnership (PPP) scheme. When operated by a government, it leads to increased public oversight and unfolds opportunities for leveraging existing public financial and human resources. The privately operated PCS could be more flexible and responsive to market demands. The PPP operator model balances public policy objectives and commercial interests, promotes joint involvement in the decision-making process and leverages technical expertise and financial resources across the board.

Significant capital and operating finances are needed. Capital expenditures are investments made in long-term assets, such as IT infrastructure, PCS application and offices. The amount of capital investment required depends on the size and complexity of the port, as well as the scope of the PCS system. Operating expenditure refers to ongoing costs of running the PCS and includes the salaries of employees, such as management team, data center and telecom engineers, customer service, marketing, communications, finance, and administrations, as well as costs associated with ICT infrastructure management and maintenance, cybersecurity, business continuity and evolution of the PCS.

The financial sustainability of operators ensures the long-term success of a PCS. Even though PCS development, maintenance and evolution costs could be included in the port authority's budget

or privately funded, many ports request the involvement of International Financial Institutions (IFIs). Their financial assistance could be coupled with upstream technical assistance to develop a digital gap analysis of the port sector to "lay the land" to develop a PCS road map, to design PCS functional and technical specifications, and advise during the procurement process. The latter can be crucial in supporting low and middle-income countries, as it allows them to develop PCS in situations where transaction volumes are modest, and the full cost might otherwise hinder competitiveness.

Risks can adversely affect the PCS development. Risks associated with initiating a PCS are summarized in five categories. They include legal and regulatory, institutional, public, and private stakeholders, and business planning risks. The PCSO must be aware of the challenges, apply effective risk management strategies to mitigate these risks and improve their performance. Tools they have at their disposal include the adoption of robust risk management strategies which encompass legal and regulatory compliance, effective public and private collaboration, cybersecurity, and business continuity.

Operators encounter resistance to change during the design, implementation, and evolution stages. Stakeholders may be hesitant to adopt new business processes and technologies, feel threatened by the potential loss of control, while- in many cases- the culture within the port community values tradition and established ways of working. The PCS initiator and operator should always pay attention to the legal and regulatory framework, develop clear digital strategies, foster stakeholder engagement, prioritize key areas for a PCS roadmap, select the right technology solutions, and measure overall progress. By using these tools and strategies, the operator can minimize resistance to change and ensure the PCS's success in the short to medium term.

A robust governance framework is essential, especially during the design and implementation stages. Without a governance structure, there is a risk of fragmentation, duplication, and conflicting priorities which could lead to delays, inefficiencies, increased costs, and failure. A robust governance structure helps to mitigate significant project development risks by establishing clear roles and responsibilities, decision-making processes, and mechanisms for resolving disputes and conflicts.

Human capital is fundamental for the efficient operation of a PCS. This refers to the skills, knowledge, and abilities of the people who initiate, operate, and use the PCS. The PCS project implementation team will require a wide range of expertise starting from maritime supply chain, functional and technical, legal, and regulatory, financial, and business planning, communication, and negotiations.

When established, the PCS's top management will play a crucial role in developing and implementing strategies, allocating resources, managing public and private stakeholders, monitoring performance, and driving innovation and continuous improvement.

1. Introduction

1.1. The Context

The evolution of PCSOs began in the early 1980s. This marked the onset of a voyage that has led to significant developments within the industry on a global scale. Over the years, PCSOs have adapted to the changing demands of the port sector by embracing technological advancements and refining their operational models to better serve their port communities. Today, the affordability of technological solutions, the mounting pressure for improved operational efficiency and effectiveness and regulations have spurred a vast number of ports across the globe to consider the development and implementation of a PCS.

The development of PCSOs matches rapidly evolving industry demands. The need for specialized knowledge and skills necessitates dedicated professional management of these systems. The establishment of dedicated entities ensures better coordination and integration among stakeholders, streamlining the flow of goods and information, enables innovation and maximizes the use of available technology. PCS operating companies also allow for better governance and regulatory compliance by enabling focused oversight and implementation of policies and allocation of resources to maintain the security and integrity of these systems.

The increased need for collaboration is a key driver in the development of PCSOs. In the past, each stakeholder in the port community operated in silos, using their own proprietary systems. This led to inefficiencies, delays, and increased costs for all stakeholders. PCSOs have been crucial in promoting collaboration among stakeholders in the port community. They have helped break down the silos that existed between stakeholders, by providing a single platform for all stakeholders to exchange information and collaborate in real-time. This has led to improved communication and coordination among stakeholders, leading to more efficient and effective port operations.

Fast-paced technological evolution has a significant impact on the development of PCSOs. These advancements made it increasingly complex and challenging for port communities to develop, implement, maintain, and enhance a system on their own and paved the way for PCSOs to provide more comprehensive and sophisticated solutions. By leveraging cutting-edge technologies, such as cloud computing, AI, ML, IoT and blockchain, these companies address the evolving needs of port communities and help them stay ahead of the curve. As technology progresses on a global scale, PCSOs are anticipated to adapt and improve their operational modalities.

The rapid growth of the PCS has led to the emergence of a new market for solutions and service providers. The intense competition among members of this burgeoning market serves as a catalyst for best practices, and technologically innovative PCS solutions. This competitive market is expected to drive down costs associated with PCS systems, making them more affordable and accessible for a wider range of ports. With lower barriers to entry, an increasing number of port communities can take advantage of the numerous benefits that a PCS can offer.

Operating models are not yet fully understood. Despite clear advantages of effective implementation, PCS initiators often find themselves grappling with the challenge of determining which operator model (public, private, or public-private partnership) is most suitable for their specific needs. This lack of knowledge can hinder their ability to make informed decisions and fully capitalize on the benefits of a PCS. Consequently, many initiators turn to international financial institutions for guidance and support in navigating the complex landscape of PCSO models. As the PCS industry continues to expand and evolve, it is becoming increasingly important for initiators to develop a better understanding of the various operator models available. By doing so, they can make informed choices that not only align with their unique requirements but also maximize the benefits of implementing a PCS in their respective port communities.

1.2. Outline and boundaries of the chapter

In this chapter we provide an in-depth analysis of operating models and the governance of a PCS. We examine management and administration aspects of models employed across various ports worldwide. We also define the PCSO and outline its role in the design, implementation, operation, and evolution of the PCS. This section analyzes the various models of PCSOs, including private operators, public operators, and hybrid models, and explores the advantages and disadvantages of each model. It also looks at typical risks that PCSOs face, including functional, technical, legal, regulatory, financial, and reputational risks, along with the strategies that PCSOs can use to mitigate them. However, our intention is not to present in detail the project cycle and procurement process of a PCS as this could be a very lengthy topic to cover.

Finally, it delves into governance issues, such as the role of different stakeholders, the need for collaboration and coordination, and the challenges of ensuring effective governance in a rapidly evolving technological environment. This chapter draws on case studies and is informed by real-world experiences, including emerging and developing countries which provide valuable insights into the challenges and opportunities.

2. The PCS Operator

A PCSO is responsible for the implementation, operations and management of a PCS. It provides a data collaboration platform that facilitates the exchange of information and coordination among different port stakeholders and serves as a neutral intermediary, ensuring that all parties can access the platform according to their roles and responsibilities in the maritime supply chain and that the system operates in a fair and transparent manner. A successful PCSO must have a deep understanding of the port industry, including the needs and challenges of different stakeholders. It must also have strong technical expertise and be able to manage complex systems which can handle large volumes of data in real-time. Finally, the management and staff of the PCSO must have excellent communication and collaboration skills to work effectively with different port stakeholders and ensure that the platform is continuously meeting their needs.

2.1. Role and Responsibilities of the PCSO

It has become increasingly common for PCSOs to lead the design, development, operation, and evolution of the PCS. This approach to PCS implementation offers numerous benefits, particularly in terms of customization and cost-efficiency. By entrusting a single entity with the responsibility of designing, building, and operating the PCS, ports can ensure that the system is tailored specifically to the unique requirements of their operations and stakeholders. This bespoke approach allows for seamless integration of the PCS into the existing port infrastructure, leads to significant economies of scale and facilitates continuity between the different phases of the project, enabling a more cohesive and unified system.

The role of a PCSO ranges from the design and development of the platform to its day-to-day operation, maintenance, support, and evolution. The operator must ensure that the platform meets port stakeholders' needs and provides value to the entire port community. Some of the key responsibilities of a PCSO include:

- **Management:** It requires strong leadership from the top management, expertise in the maritime supply chain and collaboration with the public and private sectors to drive change management. Capacity to manage complex situations at all levels is key.

- **Design and Development:** Strong technical expertise is required to design and develop a platform that is efficient, reliable, and secure. The system should be seamlessly integrated into the existing port digital infrastructure. The operator must be able to keep up with new technologies and continuously improve the system to meet evolving technology requirements.

Box 1. IPC as PCS Initiator

Israel is one of the cases where the development of a PCS has been a result of an orchestrated government action.

The 2005 Israeli port reform divided the Israeli Port Authority into four government-owned companies and one administration, namely the : (a) port companies of Haifa, Ashdod and Eilat, whose role is to operate commercial ports; (b) the Israel Ports Company (IPC), the ports landlord; and (c) the national regulator, the Administration of Shipping and Ports (ASP)

To avoid the risk of having different procedures and data requirements among the four port companies, IPC management decided to take the digital developments to the next level and set up the Israeli Port Community System (IPCS).

To achieve maximum cooperation from the stakeholders it was decided to establish a port community Steering Committee to approve the IPCS roadmap and annual plans. A Working Forum was also formed to discuss and harmonize procedures, set digitalization standards and coordinate IPCS implementation steps.

Most importantly, it was decided that the organization, which will design, develop, operate, and maintain the PCS is IPC. IPC CIO was assigned as the project manager, reports to the steering committee and acts as the head of the Working Forum.

Source: Israel Port Company.

- **Operation:** Effective, accurate and secure handling of vast amounts of data flowing through the system daily is a critical responsibility for PCSOs. This meticulous data management involves regularly updating records and time stamps to reflect the most current information, which is crucial for smooth coordination between different parties within the port community.

- **Maintenance, and Support:** Once the platform is up and running, the PCSO must provide ongoing maintenance support. This ensure that the system always remains operational. This includes monitoring the system for any issues, promptly addressing them, and providing customer service and technical support to users as needed. It must also ensure that the system is regularly updated with the latest security patches and software updates and includes a change control board to manage any changes to the system.

- **Sustainability:** A PCS is generally rolled out over time, with new services and extension up to a multimodal and national environment in some cases. Introduction of new services and business processes may be driven by new regulations and private stakeholder requirements. The PCSO is a short to long term project where human capital, project financing, digital infrastructure, legal and institutional frameworks need to be assessed regularly.

The PCS is a data orchestrator. To ensure that the PCS is effective, it should not be developed in isolation from other digital systems already operating in the port and maritime sector.[1] Instead, the PCS should play the role of digital integrator and orchestrator. This means that the PCS should be designed to be interoperable with existing port, maritime and border management back-office systems, leveraging their functionalities. Moreover, the interoperability of the PCS with other single window platforms, such as MSW and TSW, can help to streamline trade and transport facilitation processes further,[2] It is important that the PCS designer conducts digital mapping and a gap analysis to achieve these goals. In many cases, the World Bank has provided technical assistance to identify the scope and functionalities of existing digital port infrastructure and identify gaps that can be filled by single window platforms such as a PCS.

The PCSO provides critical information infrastructure. Ports are critical infrastructure in national security. As a result, PCSOs are also considered critical information infrastructure. They play an important role in the resilience of the maritime supply chain nationally and globally. As a result, this requires ad hoc compliance to ensure the resilience of that critical infrastructure.

A successful PCSO must have several qualifications. These include deep technical expertise, superb communication skills, and a willingness to continuously innovate. A successful operator must have a deep understanding of the technical systems and processes used in port operations, including data management systems, software applications, and hardware infrastructure. It must also be familiar with the different standards and regulations related to the industry, international trade laws and customs processes and procedures. It is imperative to be able to communicate clearly and efficiently with all stakeholders in the port community and to possess the ability to meet their needs. Finally, as the port industry constantly evolves with new technologies, regulations, and novel business practices, a successful PCSO must be willing to continuously seek out new and innovative solutions to improve. This can involve everything from exploring new business processes, software applications and hardware solutions to developing new communication protocols and data management systems.

The PCSO plays a critical role in leading change management and overcoming resistance to change. With the support of the appropriate governance framework (discussed later), the PCSO can manage change effectively and ensure that the digital transformation delivers value to all stakeholders. PCSOs face intense resistance to change. Some stakeholders may be hesitant to adopt new processes or technologies because they are unfamiliar with them and uncertain about how they will affect their work. Others fear loss of control, which is particularly true in a port community context, where some stakeholders have established legacy modus operandi which offers them power and control over others. Finally, if the culture within the port community places a high value on tradition and established ways of working, stakeholders may be reluctant to embrace new technologies or processes.

The PCSO is a change leader. The PCS is not only about technology but about people who drive change and are ultimately more important than the system itself. Given the nature of day-to-day operations, the PCSO can take concrete actions to lead change management by developing a clear change management plan, communicating effectively, and building a culture of continuous improvement. By building a strong coalition of stakeholders, the PCSO creates buy-in and ensures that all parties are aligned and committed to the change management process. This effort also yields opportunities to communicate the benefits of change, highlights potential benefits for each stakeholder, and provides regular updates on progress and next steps. The PCSO should develop a road map and plan that outlines the specific steps needed to improve efficiency, enhance data management systems, and implement new technologies. The plan should also include KPIs for measuring progress and evaluating business impact on the supply chain. The PCSO can take the lead in promoting a culture of continuous improvement that values innovation, experimentation, and learning. This includes creating opportunities for stakeholders to share feedback and ideas and encouraging experimentation with new solutions. When a PCSO opts to sub contract part of its operations, such as the development of PCS services, it must still recruit a workforce ready to take over at the time of hand over and organize the knowledge transfer as part of the procurement process.

While technology and infrastructure are critical components of a PCS, human capital is also essential for the efficient operation of a PCSO. Human capital refers to the skills, knowledge, and abilities of the people who manage, operate, maintain, and use the PCS. Staffing will include executive management and employees of departments, such as port community relations, operations in charge of the technical infrastructure and application infrastructure, customer service, communication, finance, administration, and human resources. Depending on the size

---

1   Such as Terminal Operating System (TOS), Customs Information Systems (CIS), Vessel Traffic Management System (VTMS), Terminal Truck Management System (TTMS) or Warehouse Management System (WMS) to name a few.
2   More information on the relationship between PCS, TSW and MSW is found in Chapter 9

of the national economy and the PCSO model, PCSO staff may range from 2 to more than 200 people. This excludes external staff from sub-contractors, notably for the initial design and development of PCS services.

The role of the CEO in the development and operation of a PCS is crucial. He or she is responsible for setting the vision and direction of the organization and ensuring that the PCS is aligned with overall business strategy and values. As leader, he or she must have expertise in the maritime supply chain. His or her capacity to manage complex situation at all levels is vital. CEOs

can contribute to the development and operation of a PCS by providing strategic guidance and overseeing the implementation of technology solutions. Equally important, they must hire the right management team and staff. It is important to highlight that the success of a PCS ultimately depends on the people involved, rather than just the technology or systems used. Effective collaboration and communication among stakeholders is essential for the development and operation of a PCS. Therefore, top management should prioritize building relationships and fostering a culture of collaboration among all parties.

3. The spectrum of PCSO models

3.1. Initiation of the PCS project and the PCSO

3.1.1. The role of key executives as champions of the PCS Project

Successful PCS projects are rooted in strong leadership. Their capacity to engage and to collaborate with public and private stakeholders for the common good of the port community is essential. Their motivation must be driven by various pain points and bottlenecks that the port, Customs, port community, shippers, and cargo owners have been facing for the last four decades. The engagement of the CEO of the port authority, the Commissioner of Customs and the President of the Port Community Association at the inception stage have been essential:

- **Rotterdam:** The early driving force for the establishment of Port Infolink PCSO (that later became Portbase) was the chief operating officer (COO) of the Port of Rotterdam. He understood that isolated different individual initiatives would not lead to a broad-based and the whole port encompassing answer to the digitalization challenges. The Port of Rotterdam Authority, having a neutral status, was chosen by the COO to pioneer a broad structural solution because it was the only entity accepted by the maritime port environment to do so.

- **Jamaica:** The Director General of the Shipping Association of Jamaica built momentum in the 2000s with the private and public sector. Then, the Commissioner of Jamaican Customs became a key catalyst by the end of the decade, along with the Shipping Association of Jamaica and the Port Authority of Jamaica. The PCS became a key driver for the implementation of the WCO SAFE Framework of Standards to Secure and Facilitate Global Trade. One important action that drove the future of Jamaica's PCS was that the Commissioner of

Customs led a PCS European tour with key stakeholders. This created a common vision and understanding of the impact of PCS on trade. It also demonstrated how collaboration could build trust between the parties. This was critical to the success of the PCS. The Commissioner later handed over to the CEO of the Port Authority of Jamaica to de-risk and implement the project.

- **Mauritius:** The Comptroller of Customs, just a couple of weeks after endorsing the SAFE Framework of Standards at the WCO Council in 2005, engaged the Director General from the Mauritius Exporter Association to co-lead the way forward of the PCS project. MEXA's Director General engaged key shippers, trade associations of the port community, and key ministers on the port community digitalization agenda. The Director General drove the inception phase of the PCS project until the creation of MACCS, the PCSO of Mauritius. The Director General's capacity to dialogue, collaborate, build consensus and, above all, involve the ministers and their permanent secretaries proved the foundations of true public partnership.

- **New Caledonia**: The President of the Freight Forwarder Association was the champion of the PCSO in New Caledonia, bringing not only stakeholders gradually around the table, but also taking over the project by financing through the private sector to make the PCSO a reality. Over time, the collaboration with Customs enabled an amendment to the Customs code, providing critical provisions such as the mandatory use of a PCS to comply with customs requirements.

Change leaders are required to drive PCS projects from inception to implementation and operation. Executives at public and private bodies (listed above) have proved critical as both visionaries and leaders of change. They have served the interests of their port communities, boosting domestic and international trade.

Figure 1. PCS initiator typology

Ministry of Transport	Ministry of Foreign Trade	Ministry of Finance	Shippers Association	Port Community Association
Port Authority	Foreign Trade Agency	Customs	Logistics Association	Shipping Association

Source: Authors.

3.1.2. Initiation of the PCS Operator

Public agencies have a leading role in PCS initiation. There is a widespread misconception that the creation of a PCS is the sole result of a private sector initiative. This is not entirely accurate. Public agencies have a leading role in the envisioning and conceptualization of a PCS. Port authorities, and to a lesser extent Customs authorities, play a multifaceted role in the development of a PCS. They provide leadership and strategic direction to bring all the stakeholders together. This helps to create a framework for collaboration and facilitates the formation of partnerships between the private sector and government agencies. In distinct cases, they also provide the necessary funding and

resources to develop the digital platform. Figure 1 presents a few examples of PCS projects initiated by governments:

The only purely private sector PCS initiators were the ones founded early on in Europe. These include the ports of Hamburg, Bremerhaven and Felixstowe. These are the oldest PCS solutions globally. DAKOSY was the first PCSO in the world in 1982. It was created by port community associations at the Port of Hamburg: DIHLA shipping agents association, DIHS freight forwarders association and DHU terminal and CFS operators' association.

Relationships between PCS champions and operators may vary. Their relationship varies depending on the specific circumstances

Figure 2. Examples of PCS projects initiated by government entities

2000	2005	2010	2012
The Authority of the Port of Rotterdam took over the leadership of the PCS project at the Port of Rotterdam, by creating a specific purpose vehicle for the PCS operator known as INFOLINK to initially digitize the core processes, as well as accompanying and communication flows in Dutch Ports. Currently, the PCS is called Portbase.	Mauritius Revenue Authority Customs was the promoter of MACCS PCS, to provide advanced electronic in timefor adequate risk assessment in the context of the brand new WCO Safe Framework of Standard to secure and facilitate global trade, Customs early engaged the Mauritius Exporters Association (MEXA), since trade logistics digitalization was critical for the garment supply chain.	The Ministry of Maritime Economy and Port Infrastructure of Benin was the owner of the PCS project at the port of Cotonou, paving the way to the first ever DBFOM concession of a PCS operator to facilitate and accelerate cargo dwell time for Benin and corridors to NIgeria, Ghana, Burkina Faso and Niger	The Jamaica Port Authority, in a partnership with the Jamaica Customs Agency and the Shipping Association of Jamaica took the lead to design, implement, operate and finance the national PCS. Jamaica PCS was the first PCS Operator in the Caribbean beyond existing PCS operators from the French overseas territories that started operations in 2001.
Netherlands	**Mauritius**	**Benin**	**Jamaica**

2012	2020	2020	2022
One of the four port authorities in Indonesia, Pelindo II, established the first PCS in Tanjung Priok. This was achieved through the creation of Indonesia Logistics Community Service (ILCS), a state-owned enterprise and telecoms operator.	In the Port of Callao, the Ministry of Foreign Trade and Tourism (MINCETUR), together with the Ministry of Transport and Communications (MTC), through the National Port Authority (APN) has embarked on an initiative a process to implement a PCS to streamline and accelerate the logistics and port processes. The MINCETUR of Peru is also the lead agency for the Trade Single Window of Peru.	In the current decade, SAT Customs of Guatemala is the promoter of the national PCS at the Ports of quetzal, SantoTomas de Castilla and Barrios. Its aim is to simplify and automate processes, reduce times and costs and eliminate the physical presence of people; therby, reduce discretion, mitigate fraud and other crimes.	Under the Cabinet Decision and the leadership of the Ministry of Finance of Namibia - the Namibia Port Authority (NAMPORT) was appointed as the lead agency for the implementation of the national single window environment which includes the PCS, the MSW and the cross border regulatory TSW.
Indonesia	**Peru**	**Guatemala**	**Namibia**

Source: Authors.

of each port. In some cases, the champion and operator may be the same entity, such as a CEO of a port authority leading the initiative and the port authority that envisions, designs, builds and manages the PCS. Similarly, the PCS initiator may also be the president of the port community or shipping association. Figure 2 presents various entities that may be considered as engaged at the PCS initiation stage. When the initiators represent different entities, it is essential to establish clear lines of communication and collaboration to ensure that the PCS project functions effectively.

3.2. Exploring PCS models

There are different PCS models to explore: Public, Private, and PPP. A PCSO can be developed based on the following three operating models: the public, the private, and the public-private partnerships. The core characteristics of each model, the criteria behind the selection, the common elements shared by the three, and the most popular model among members of the International Association of Ports and Harbors (IAPH) and the International Port Community Systems Association (IPCSA) are outlined in the following paragraphs. A schematic representation of the operational models is found in Figure 3 below.

A Government-Led Approach to the PCS: The public model of a PCS is characterized by its complete ownership, funding, and management by a governmental body. Under this model, the PCS is viewed as a public good or utility, serving the needs of all stakeholders in the port community without discrimination. The government is responsible for the development, maintenance, and enhancement of the PCS, and it can act as an impartial and unbiased authority to address any potential conflicts or issues. The public model is often chosen by countries where the government plays a significant role in the economy or wants to have direct control over the port infrastructure for strategic or regulatory reasons.

Private management of the PCS: The private model of a PCS, on the other hand, is owned, financed, and managed by private entities or consortiums, often comprising key stakeholders, such as port community associations, freight forwarders' associations, Customs brokers' association, shipping agents' associations and terminal operators. This model is driven by the need for operational efficiency and the potential to generate profit based on invested capital. It often results in a competitive landscape, fostering innovation and encouraging the adoption of cutting-edge technology. The private model is typically selected by countries with a strong market-driven economy or where the private sector has demonstrated expertise and capacity to manage complex port operations efficiently.

Sharing Responsibilities under the PPP Model: The public-private partnership (PPP) model of a PCS is a hybrid approach, where the government collaborates with private entities to share the responsibilities and risks associated with the development, management, and financing of the PCS. This model aims to leverage the expertise and efficiencies of the private sector while maintaining public oversight and control to ensure that the PCS serves the broader interests of the port community. The PPP model is often chosen by countries seeking to strike a balance between public and private interests and capitalize on the strengths of both sectors.

How PPPs empower PCS: Many argue that the most appropriate operating model for a PCS is PPP as the one that strengthens collaboration among the members of the port community. In fact, the PPP model fosters a collaborative environment, which is crucial for the success of a PCS. A PCS requires the participation of various stakeholders and by bringing both public and private entities together, the PPP model creates a platform for these stakeholders to collaborate and share the responsibilities of implementing and managing the system. This collective approach encourages open communication and trust among the parties, leading to a more effective and efficient PCS.

Figure 3. Spectrum of PCS Operating Models
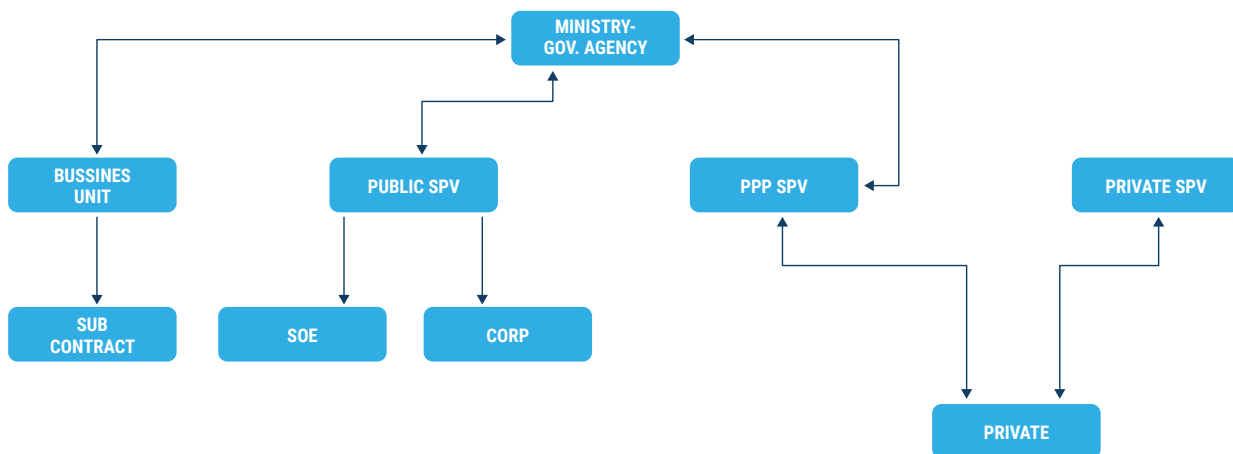
Source: Authors.

Additionally, the PPP model combines the strengths of both public and private sectors, which can lead to a more successful and sustainable PCS. The public sector provides regulatory support and ensures that the PCS complies with national and international standards, while the private sector contributes technical expertise, innovation, and capital investment. This combination of resources results in a more robust and resilient PCS that can adapt to the changing needs of the maritime industry.

Model commonalities and global preferences: Despite the differences among these models, there are several common elements shared by all three. Each model aims to optimize the flow of information and goods, enhance collaboration among stakeholders, and improve overall port efficiency. Additionally, all three models must abide by international regulations and standards to ensure the security, safety, and environmental sustainability of port operations. Among members of the IAPH and IPCSA, the historical popular operating model is the public-private partnership. But in the last decade the public sector, led by port authorities, is increasingly playing a leading role.

Port Authorities can foster trust and collaboration: The role of a port authority in managing PCS data is of paramount importance. They act as neutral and trusted third parties and as a "data steward" ensuring the confidentiality and security of shared information. This is mainly attributed to their impartiality, as they are not directly involved in commercial transactions or competing with the stakeholders who rely on the PCS. This neutrality allows them to act as unbiased facilitators, ensuring that the exchange of data and communication within the PCS is carried out transparently and without prejudice. Port authorities, under certain conditions, could reduce the risk of PCS project implementation. The port authority's clear role is even empowered as the resilience of the critical information infrastructure becomes a mandatory requirement around the world.

Gaps in understanding PCSO models remain: The different operating models for a PCS are not yet fully understood, leading to the creation of challenges for initiators in determining which model is most suitable for their specific needs. The lack of understanding hinders their ability to make informed decisions and benefit from PCS advantages. As a result, initiators often seek guidance and support from international financial institutions to navigate the complex landscape of PCS operator models. With the PCS industry expanding and evolving, it is increasingly vital for initiators to develop a better understanding of the available operator models. By doing so, they can make informed choices that align with their unique requirements and maximize the benefits of PCS implementation in their respective port communities.

3.2.1. *The public model of Port Community Systems*

Public model ownership and control: The public model serves as a crucial framework for managing the exchange of information and communication among port and maritime industry stakeholders. Under this model, the government (or a public entity such as the port authority) is responsible for establishing, funding, and maintaining the PCS, ensuring that the system aligns with national interests and public policy objectives. Ownership and control in the public model rest with the government or a public agency, which guarantees that the system adheres to national interests, public policy, and regulatory requirements. The initial investment and ongoing operational costs are funded through public resources, such as taxes or government budgets. This stable funding source can provide long-term support for the development, maintenance, and evolution of the system. The public model is the most predominant of the past decade.

Development under a ministerial or governmental agency business unit: Under the fully public model, the PCS is considered a public good or utility, serving the needs of all stakeholders in the port community without discrimination. The government assumes full responsibility for the development, maintenance, and enhancement of the PCS, and it acts as an impartial and unbiased authority to address any potential conflicts or issues. This model provides the government with direct control over the port infrastructure, allowing it to oversee the implementation of regulatory frameworks, promote public safety and security, and ensure the long-term sustainability of the port operations.

The Special Purpose Vehicle (SPV) for a PCS in public hands: An SPV is a legal entity created for a specific purpose or project, often used in infrastructure projects where there is a need for dedicated funding, management, and operation. In the context of a PCS, a fully public SPV model is one where the platform is owned, funded, and managed entirely by a government body, typically a port authority. Under this model, the PCS is viewed as a public good or utility, serving the needs of all stakeholders without discrimination. The government through the SPV is responsible for the development, maintenance, and enhancement of the PCS, and it can act as an impartial and unbiased authority to address any potential conflicts or issues. In this way, the fully public SPV model can provide a stable and reliable platform for collaboration among various stakeholders, ensuring that the PCS serves the broader interests of the port community.

There are two formations of the public SPV PCS:

The fully public SPV model can take two forms: a state-owned enterprise (SOE) or a corporatized entity.

- **A state-owned enterprise:** In the context of an SOE, the PCS is owned and managed directly by the government, and it operates as a public service. This model is often chosen by countries where the government plays a significant role in the

PHOTO BY: PCS OPERATOR | DPCS, DJIBOUTI

economy and has direct control over port infrastructure for strategic or regulatory reasons.

- In the **corporatized entity model**, the PCS is owned by the government but managed and operated by a separate legal entity, such as a public corporation i.e. a corporatized port authority. This model allows for more flexibility in terms of management and operation, as the PCS can operate under a separate governance structure with more autonomy in decision-making. Additionally, a corporatized entity can access private sector expertise and funding, which can help to drive innovation and efficiency in the PCS.

Aligning a PCS with public policy objectives: One of the primary advantages of the PCS public model is the alignment with public policy objectives. Since ownership and control in the public model rest with the government or a public agency, the system is designed to adhere to national interests, public policy, and regulatory requirements. This ensures that the PCS serves the broader interests of society and the economy. Additionally, the government's involvement in the development process ensures that the system aligns with broader national strategies, such as promoting trade facilitation, boosting economic growth, and enhancing national security. Another advantage of the public model is the stable funding source provided by public resources, such as taxes or government budgets. This provides long-term funding support and ensures that the PCS remains operational even during times of economic uncertainty. However, several public PCSOs are defined as a public service to the maritime supply chain.

Government oversight and trust: The public model also provides a high degree of control and oversight to the government or public agency responsible for its management. This ensures that the system operates in compliance with regulatory requirements and public policy objectives. The government's involvement in the development process also helps to address potential issues related to privacy, security, and data management. This level of control and oversight contributes to the trust and confidence stakeholders have in the system and its operations. Furthermore, the public model fosters a collaborative environment that encourages open communication and collaboration essential for effective decision-making, problem-solving, and resource sharing.

Challenges of the public PCS model include political influence: However, the public model faces several challenges, including bureaucratic inefficiencies, limited resources, and potential political interference. The decision-making process is often subject to bureaucratic procedures and political influence, which may slow down the implementation of new features or system upgrades. This can result in a system that is less responsive to the rapidly evolving needs of the port community. Furthermore, government budgets can be constrained by competing priorities, which may limit the resources available for investing in and maintaining the PCS. This may lead to outdated technology, inadequate system maintenance, or a lack of necessary upgrades, ultimately reducing the overall effectiveness and efficiency of the PCS. Moreover, the public model is susceptible to political influence, which could result in decisions that prioritize short-term political gains over long-term efficiency and effectiveness. This could lead to a lack of innovation and stagnation within the PCS, preventing it from

keeping pace with the evolving needs of the port community and global technological developments.

Improving the Public Model of PCS: Despite these challenges, there are opportunities to improve the public model of PCS. Streamlining decision-making processes and implementing more efficient procedures can help to reduce bureaucratic delays and ensure that the PCS remains responsive to the needs of the port community. Engaging with private sector expertise can drive innovation and efficiency within the public model while maintaining public accountability and oversight. Lastly, exploring alternative funding models, such as user fees, can help to ensure the long-term financial sustainability of the PCS.

Case studies: In the last part of the Global PCS study we are introducing PCSOs championed by the public sector, aiming at the creation either of a new business unit, such as Jamaica's PCS at Port Authority of Jamaica, Silogport PCS at the Port of de Valparaiso or Busan PCS; or a nonprofit private corporation, such as Portbase in the Netherlands for the Port of Rotterdam and Port of Amsterdam and an SPV, such as Djibouti PCS and the India Port Association PCS.

3.2.2. The private model of Port Community Systems

The private PCS model represents an alternative approach to managing information and communication between stakeholders in the port and maritime industry. In contrast to the public model, the private model entrusts a private company or consortium with the responsibility of developing and managing the system. Under the private model, ownership and control of the PCS lie with a private entity or a group of private stakeholders. This allows for more flexibility and adaptability in responding to industry trends and stakeholder needs. The initial investment and ongoing operational costs are financed by the private entity or consortium, with profits generated through user fees or subscription-based services. The pricing strategy adopted by private PCS models is typically market-driven, which could lead to higher costs for certain stakeholders. Access to the system may also be limited based on contractual agreements or membership criteria. Decision-making in private PCS models tends to be more agile and responsive to market demands, with accountability primarily to shareholders and stakeholders, and less emphasis on public scrutiny and procurement processes.

The strengths of the private model are manifold. First, the model encourages innovation and efficiency, as private companies are motivated by profit and competition to develop and implement cutting-edge solutions. This can lead to the rapid introduction of new features, system upgrades, and improvements in response to changing industry demands. Second, the private model benefits from agile decision-making processes that are not encumbered by bureaucratic procedures and political influence that can slow down public systems. This allows the private PCS to

Box 2. DAKOSY's PCS Transforms the Port of Hamburg

The Port of Hamburg, one of the busiest ports in Europe, utilizes a port community system (PCS) developed and operated by DAKOSY AG. DAKOSY, a private company, also operates the Cargo Community System for Frankfurt and Hamburg airports,

The Hamburg PCS has played a vital role in streamlining the port's operations by facilitating the exchange of information among port stakeholders.

To foster this collaborative environment, DAKOSY has established a governance structure that includes representatives from key stakeholder groups. This approach ensures that all parties have a say in the decision-making process and that the PCS evolves to meet the changing needs of the maritime industry

As a private company, DAKOSY has the flexibility to invest in cutting-edge technology and innovative solutions. They offer a range of services through their PCS, such as cargo tracking, customs clearance, electronic documentation, and container management. By providing these services, the PCS enhances the efficiency of port operations, reduces administrative burden, and minimizes errors.

Moreover, DAKOSY continually invests in research and development to stay ahead of industry trends and technological advancements. This enables the company to provide scalable and adaptable solutions that can meet the growing demands of the Port of Hamburg and other ports using their PCS

Source: DAKOSY.

be more responsive to the needs of stakeholders and to adapt quickly to changes in the market. Third, the private model can attract investment from the private sector, which can help drive technological advancements and expand the capacity of the PCS.

The private model may prioritize short-term profits over long-term public interests, potentially compromising regulatory compliance or national security concerns. Private companies may also prioritize more lucrative customers or restrict access based on membership requirements. This can result in unequal access to the PCS for smaller or less well-funded stakeholders, potentially impeding cooperation, and coordination within the port community. Additionally, the market-driven pricing strategies employed by private models may lead to higher costs for certain stakeholders, impacting affordability and adoption rates.

Figure 4. Examples of PPP contract types

Extent of private sector participation

LOW ← → HIGH

| Design-Build contract for new road | Management contract for power plan | Affermage for water utility | Design-Build-Finance-Maintain contract for new hospital (government pays conditional on availability | Independent Power Producer (Design-Build-Finance-Operate-Maintain) for new wind plant (government owned off-taker pays for electricity supplied) | Airport concession (Design-Expand-Finance-Operate-Maintain) via ("user pays" landing fees and retail and other revenues) | Licensed, regulated energy distribution company |

■ PUBLIC

Public-private partnership

PRIVATE

Case studies: In the last part of the Global PCS study we are introducing PCSOs championed by the private sector, such as in Singapore and GIPANC in New Caledonia. These are similar to early adopters of PCSOs in Germany and the UK in 1980s.

3.2.3. Public-private partnerships in Port Community Systems

Partnerships for successful PCS implementation: The implementation of a PCS has been recognized as a mutually beneficial approach, bringing savings and value to all stakeholders involved. However, the process of establishing a PCS can be both challenging and costly. The risks associated with large-scale ICT projects must be considered, along with the need to align the regulatory procedures of all participating government agencies. Public-private partnerships (PPPs) have been used effectively to implement PCS solutions in different regions and economies. PPP represents a collaboration between government entities and private companies or consortia, with the aim of sharing the responsibilities of developing, financing, and maintaining a

PCS. There are several PPP types that can be applied, as shown in Figure 4.

In the context of PCS development, the most popular type used is the design-build-finance-operate-maintain (DBFOM) model. Overall, the PPP model offers a balanced approach, ensuring that the PCS remains aligned with public policy objectives while benefiting from private sector expertise and market-driven innovation. Table 1 offers a list of countries that implemented a PCS under the PPP model.

Advantages of the PPP Model: A key advantage of the PPP model is the shared ownership and control of the PCS. This allows the system to benefit from both government oversight and private sector agility. By involving both public and private stakeholders in decision-making processes the PCS can better address the diverse needs and priorities of the port community, while ensuring compliance with national regulations and public policy goals. Funding is another crucial aspect where the PPP model strikes a balance. Under this model, both the public and private partners contribute to the initial investment and ongoing

Figure 5. Degrees of private sector participation

Degree of private sector risk

PPP models

- Privatisation
- Concession
- DBFM-operate
- Design buil finance maintain
- Build andfinance
- Operate and maintain
- Design and build

Degree of private sector involvement

Source: Canadian Council for Public-Private Partnerships.
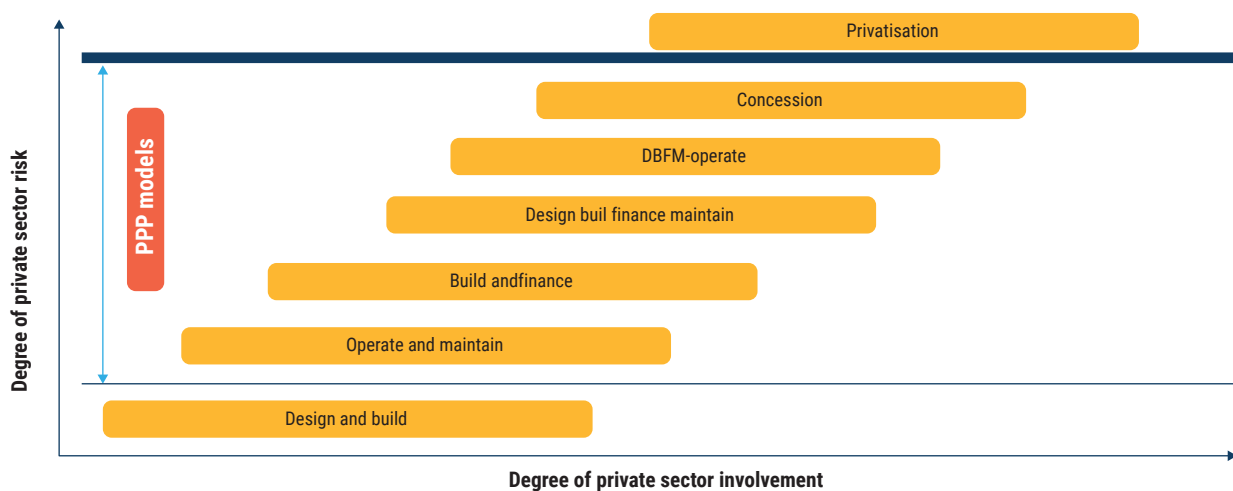
operational costs. This shared financial responsibility reduces the burden on taxpayers and provides a more sustainable funding structure.

Furthermore, private sector involvement can help attract additional investment, which may be crucial for PCS development and expansion. In terms of access and pricing, the PPP model, when structured right, aims to ensure equitable access to the PCS for all port stakeholders, while adopting a competitive pricing strategy that maintains financial sustainability. Additionally, this model makes decision-making more efficient and transparent. Decision-making benefits from the agility of private sector management, while remaining accountable to public interests and regulatory compliance. The inclusion of private partners in the decision-making process can lead to faster and more efficient implementation of new features and system upgrades. At the same time, public accountability ensures that the system operates transparently and in the best interest of all stakeholders.

Challenges of the PPP Model: The PPP model is not without challenges. It requires careful negotiation and well-structured agreements to ensure a fair distribution of responsibilities, risks, and rewards among the partners. Moreover, the success of the PPP model depends on maintaining a strong working relationship between the public and private partners, built on trust, communication, and a shared vision for the PCS.

One of the most obvious challenges of implementing PPPs for the development of a PCS is the complexity of the project itself. A PCS involves integrating various systems, including logistics, Customs, and security, and requires the participation of multiple stakeholders, such as shipping lines, freight forwarders, and terminal operators.

The coordination and alignment of the interests of all these port, maritime and border agencies can be difficult to achieve, especially where private partners may have conflicting goals with the public sector. In addition, these projects are often long-term, which means that changes in technology and the business environment can change during the project's lifespan. Therefore, PPP agreements must be flexible enough to allow for adjustments and adaptations to keep up with the changes in the business environment.

Another challenge is ensuring that costs and benefits are equitably distributed among partners, since private partners seek to maximize their profits, while the public sector prioritizes the overall development of the port community. Therefore, it is crucial to set clear objectives, incentives, and accountability mechanisms that balance the interests of both parties. While PPPs have become an attractive option for financing and managing infrastructure projects, developing a PCS through PPPs requires careful consideration of the challenges and risks involved. The success of a PPP for developing a PCS depends on careful negotiation and well-structured agreements that ensure a fair

distribution of responsibilities, risks, and rewards among the partners. The knowledge gap is usually found on the public sector side. Often it seeks technical assistance and expertise from international organizations to negotiate the PP contract. The World Bank has provided upstream support to government partners for the development of PCS and other single window platforms.

However, some forms of PPPs have faced challenges related to anti-trust laws in the last decade. This is the case when port community professionals are shareholders in a PCSO.

Despite this success, questions remain regarding the right approach to PPP implementation for a PCS. It is crucial to consider the essential points when contemplating a PPP option, including risk management, clear objectives, and mutually beneficial outcomes for all stakeholders involved. By taking these factors into account, implementing a PCS through a PPP can create a beneficial system for all parties involved.

Case studies: In the last part of the Global PCS study we are introducing PCSOs as PPPs, such as Portnet Morocco and SEGUCE DRC.

3.2.4. Concessions

The first PCSO concession agreement was developed in the early 2010's, based on terminal operator concession practice. Successful concessions are based on fair balance between the Concessioning authority and the Concessionaire and sometimes not all improvements in ports have been passed on to the shipper in terms of lower prices or better services. For this reason, the PCSO concessions need to be better planned and implemented. This section will introduce key guidelines about PCSO concession agreements.

A specific case of PPP for a PCSO is when it is managed by a specific purpose vehicle (SPV) under a public-private partnership, that is responsible for PCS design, building, finance, operation and maintenance, under a concession agreement. Both public and private shareholders contribute to the financing and assets are transferred back to the concessionaire at the term of the concession, or by a private corporation under a public-private partnership principle, that is responsible for PCS design, build, finance, operation, and maintenance under a concession agreement and assets are transferred back to the concessionaire at the term of the concession.

Commonly, the concessioning authority put in charge by the government could be a government ministry, such as the Ministry of Transport, or the national port authority. It is given the power to design, build, finance, operate and maintain operations among other things. Its main purpose is to facilitate and secure the country's trade.

Table 1. Country examples of the PPP business models for a PCS

Barcelona (1999)	PORTIC	Port Authority of Barcelona Banc Sabadell Caixa Bank Chamber of Commerce of Barcelona
Mauritius (2007)	MACCS	State Investment Corporation Mauritius Port Authority Cargo Handling Corporation Mauritius Exporter Association Mauritius Chamber of Commerce and Industry Shipping Agents Association Customs House Brokers Association Freight Forwarders Association SOGET
Morocco (2011)	PORTNET	National Port Authority MARSA Maroc Other Private Operators (tbc by Youssef)

Source: Authors.

The concession agreement should grant the concessionaire a sole and exclusive right to the design, build, finance, operation, and maintenance (DBFOM) of the PCS, as well as providing services for the duration of the concession period.

For this exclusive right and obligation, the concessionaire should pay concession fees to the concessioning authority. The concessionaire would accept the concession and agree and undertake to implement the project at its own cost and risk in accordance with the project requirements, the applicable laws, and the provisions of the concession agreement.

The concessioning authority should implement a competitive bidding process. After evaluating all the proposals received by it from the applicants, it should award the concession to the successful bidder. The successful bidder would be required to incorporate a special purpose company to undertake the concession.

Understanding key assumptions will ensure the concessioning authority can make a detailed evaluation of the financial offers from the bidders for the life of the project. Benefits and pitfalls should be considered when determining the applicable business model for the concession when it comes to procurement of concession, implementation, and acquisition of shares

Finally, a PCSO concession is an opportunity for international financing institutions to participate in the project by financing. This was the case for terminal operator projects in the last 20 years in Latin America, Africa, Middle East, and Asia Pacific. The concession advantages related to the procurement of concession implementation are listed below:

Royalty: The Concessionaire would be granted the concession for the period stated in the request for proposal. As compensation for the concession, the Concessionaire would pay the Concessioning Authority periodic royalties, being a percentage of the turnover achieved by the Concessionaire. The royalty payments would ensure a consistent cash flow to the concessioning authority.

Project Risk: The Concessionaire carries the full risk of the project and the concessioning authority's risk is limited to a decrease in royalty payments and replacing a Concessionaire in case the incumbent Concessionaire is not performing in terms of the concession.

Limited Oversight Requirements: The concession takes the form of a DBFOM project, which means that the Concessionaire would take full responsibility for the operations of the PCSO. Accordingly, limited oversight would be required from the concessioning authority: namely, to review the periodic operational reports and financial statements presented by the Concessionaire. The concessioning authority would lead the institutional and legal governance framework.

Procurement Process: The procurement process can be undertaken under a public procurement process or a private internal procurement act. This means that the concessioning authority may use the procurement process or utilize the national public procurement processes, as legislation may dictate. The concession disadvantages related to the procurement of concession implementation are listed below.

Lack of Operational Transparency: The Concessionaire would have full operational control of the PCSO and would provide operational reports and financial statements periodically to the concessioning authority. Accordingly, the concessioning authority would not have detailed insight into the daily operations of the PCSO, which could cause a lack of transparency.

Transfer of Business: At the end of the concession period, the Concessionaire would be required to transfer the PCS environment to the concessioning authority. This would include the transfer of intellectual property, third party licenses and data center services. The transfer would also require the co-operation of third parties. Such cooperation can be specified as a contractual obligation for the concessionaire. However, enforcement against third parties, if required, would not be seamless.

If the shares in the Concessionaire can be transferred directly to the concessioning authority, the intellectual property, third party licenses and data center services and other contracts with contractors will automatically be transferred with the shares.

Benefits and pitfalls should be also considered when determining the applicable business model for the concession, when it comes to share acquisition by the concessioning authority in the Concessionaire. Concession advantages related to share

PHOTO BY: PCS OPERATOR | DPCS, DJIBOUTI

acquisition by the concessioning authority in the concessionaire are listed below.

Board Representation: If the concessioning authority acquires shares in the Concessionaire, the concessioning authority can request a seat on the board of directors of the Concessionaire. Board representation will provide the concessioning authority with detailed insights into the operations of the Concessionaire and promote transparency.

Dividends: As a shareholder of the Concessionaire, the concessioning authority would be entitled to dividends if the Concessionaire makes a profit and decides to distribute dividends to its shareholders. The receipt of dividends may provide a tax advantage to the concessioning authority. However, this position would need to be confirmed with a tax expert, taking into consideration the entire financial model of the concession.

Transfer of Shares: At the conclusion of the concession period, the Concessionaire would have the obligation to transfer the PCS environment to the concessioning authority. If the transfer is implemented through the transfer of a 100% shareholding in the Concessionaire to the concessioning authority, it minimizes the risk of requiring the cooperation of third parties contracting with the Concessionaire.

Additionally, as the concessioning authority was already a minority shareholder and held a seat on the board of the Concessionaire, it will have an insight into the operations of the Concessionaire. It will minimize the risk of taking ownership of the Concessionaire by the concessioning authority. Concession disadvantages related to share acquisition by the concessioning authority in the concessionaire are below.

Capital Contribution: As a shareholder in the Concessionaire the concessioning authority may be required to make capital contributions to the Concessionaire. This happens when capital is required from the shareholders of the Concessionaire. To the extent that the concessioning authority is not able to contribute its portion of capital, this may lead to a threat of equity dilution or the creation of unequal shareholder loans, which will both have a direct impact on future dividend distributions.

PPP Legislation: Should the concessioning authority obtain an equity interest in the Concessionaire, the risk in the project will be shared between the Concessionaire and the concessioning authority which could define this project as a public private partnership. In such an event, public private partnership legislation may be activated, which would govern various aspects of the project and increase the bureaucratic processes required to implement the project.

It is not uncommon for a public entity to take an equity interest in projects of national interest. For purposes of the procurement process, bidders may be requested to address the following as part of their financial proposal to the Request for Proposal, namely free carry shareholding in the Concessionaire available to the concessioning authority and additional shareholding in the Concessionaire available to purchase by the concessioning authority throughout the Concession Period.

When the concessioning authority decides to acquires shares in the Concessionaire, it is important that a shareholder's agreement is concluded between them. This helps to reduce various risks. It may be prudent to include a template shareholders agreement as part of the Request for Proposal.

Finally, the concession agreement should address at least the following subjects:

- Definitions and interpretation.
- Concession.
- Conditions precedent.
- Performance guarantee.
- Scope of the project.
- Obligations of the parties.
- Transaction fees chargeable by concessionaire.
- Payments to the concessioning authority.
- Shareholding.
- General rights, duties, and obligations.
- Security of network and information systems.
- Intellectual property rights.
- Change In law.
- Force majeure.
- Events of default.
- Termination of the concession agreement.
- Transfer on expiry of transfer date.

- Dispute resolution.
- Representations and warranties.
- Miscellaneous provision.

The PCSO concession agreement should include the appendices related to the PCS project requirement: Project management and work plan, transaction fees, business plan, performance guarantees, government authorities, key personnel, list of contractors, performance standards, reporting requirements, governance framework, business continuity plan, change management plan, software quality assurance plan, transfer plan, warranty, maintenance and SLA plan, hand-over plan from implementation to operation, and a stakeholder interoperability plan.

As in any concession agreement, all sections are important to a fair balance between the concessionaire and the concessioning authority. The concessionaire should be compensated only for the financial risks, based on an objective return on investment that is agreed.

In the PPP SPV scenario one question is whether the concessioning authority should be directly or indirectly asking for voting rights and board rights. Asking the following question helps to inform the decision: does the authority have the financial capacity to invest equity in the joint venture or bring intangible assets to the table?

Finally, the transfer of the PCSO at the expiry of the concession through the transfer of shares or assets should be carefully defined in terms of the respective obligations to be performed or discharged. This will allow a smooth handover and peaceful possession of PCSO assets and shares. It ensures the concessioning authority can get organized well in advance in terms of human resources and contracting environments.

4. PCS Risk Management

The PCS risk management strategy described in this section has been established based on two decades of real life experience globally, particularly in emerging and developing countries on all continents.

4.1. PCS Initiation Risks

Champions of a PCS project may face various challenges when initiating the PCS project, such as:

Legal framework: The most important legal and regulatory risks arise when some governmental agencies may not be willing to update their respective framework to enable the PCS. If a

PCS is not mandatory by regulation or law the risk of adopting the PCS by all stakeholders is quite high. Not achieving high level adoption makes the project failure prone. It could also reduce the efficiency of the governance structure described in the next section dealing with the business plan. Mitigation strategies include addressing the review of legal and regulatory frameworks early on. This should occur at the time of the of the "As Is-To Be" analysis. Driving reform is an important step forward to ensure a quick win and a sustainable environment. Preparing the required instruments early on to make the PCS mandatory is key.

Institutional framework: The most important structural risk when initiating a PCSO is the lack of collaboration between the port

and the Customs authority and between the public stakeholders and the port community.

Mitigation strategy: It is vital to address differing perceptions of the public and private sectors among both groups of stakeholders. This helps to build trust for data collaboration. Customs and ports can benefit from the upcoming guidelines from the World Customs Organization and the International Association of Ports and Harbors, where a strong focus is given to strengthening cooperation between customs and ports, the convergence of digital systems and the enhancement of supply chain security.

Public and private stakeholders: Initial risk is related to the need for business process reengineering between public and private stakeholders. This includes digitizing a poorly designed manual processes. This may include removing red tape and eliminating wasteful expenditure. Sometimes there is a gap between the public and private sectors when it comes to digitalization and telecommunications. There can be big differences in terms of telecommunication infrastructure, including bandwidth, coverage, pricing, and quality of service.

Mitigation strategies: A digital transformation is required to optimize and automate business processes through business process reengineering. This means addressing the regulations associated with the strengthening and expansion of the telecommunication infrastructure. This ensures it is efficient enough to meet the needs of the PCS for safe, stable, and secure critical infrastructure.

Public sector: The public sector risks pose a significant challenge to the effective implementation and functioning of a PCS. When certain members of the public sector, particularly trade and transport regulatory and compliance agencies, are not institutionally ready to collaborate or equipped to exchange data with other community members, the efficiency and reliability of the PCS may be compromised. The lack of technical and financial expertise of key entities, such as Customs, quarantine, or standards agencies, required to exchange data through the PCS platform can hinder the seamless flow of information. This ultimately affects the smooth operations of the port community and the overall success of the platform.

Mitigation strategies: To mitigate readiness risks, it is essential for PCSOs and public stakeholders to invest in capacity building and knowledge transfer initiatives. By enhancing the technical capabilities of the stakeholders, the PCS can ensure a more efficient and secure data exchange process, thereby improving overall operations and performance. To address financial constraints, it is crucial for PCSOs and public stakeholders to explore alternative funding mechanisms, including public-private partnerships, grants, or other financial support programs from the IFI community (including the World Bank) that can help bridge the gap in resources and facilitate the integration into the PCS ecosystem.

Private Sector: The role of terminal operators can also prove risky. This is applicable in countries where a terminal operator either has the monopoly or where an association of terminal operators is willing to become a PCSO. While terminal operators are key stakeholders in the maritime supply chain, they are not neutral third parties when it comes to the basic principle of data collaboration.

Mitigation strategies: The role can be played by the port authority or by the port community itself in cases where such a community is institutionalized.

Business Planning: The financial sustainability of a PCS hinges on sound business planning and strategy, encompassing business models, pricing strategies, revenue generation, and resource allocation. Without sound business planning and strategy, effective business models, and well-designed pricing strategies, the PCS may struggle to maintain its viability and competitiveness in the market.

Mitigation strategies: Addressing these risks is essential. It is imperative for PCSOs to draw on expertise from international auditors in addressing business planning risks. This proactive risk management approach ultimately contributes to the success of the PCSO. It is crucial, however, to make the use of the PCS mandatory by regulation or decree. This will ensure the overall and financial effectiveness of the PCS project.

Human capital risks: High skills are required to initiate a successful PCS. Lack of resources at line ministries, in governmental agencies or among private stakeholders can create bottlenecks.

Mitigation strategies: Recruitment, talent attraction, and capacity building shall be considered fundamental aspects of any PCS project in the short to long run.

Five categories of common risks have been identified: the legal framework, institutional framework, public stakeholders, private stakeholders, and business planning. Risk mitigation measures for each risk description are also provided to assist governments and port authorities in Table 2.

4.2. PCS Operational Risks

PCSOs face various challenges when running the PCS, ranging from compliance with legal requirements to managing relationships with diverse stakeholders. Additionally, they must navigate technological and infrastructure complexities, protect their systems from cyber threats, and maintain operational continuity in the face of unexpected disruptions. Attracting and retaining skilled personnel, ensuring financial stability, and managing their reputation are also essential for the long-term success of a PCSO. To maintain the smooth operations of a PCSO and boost stakeholder trust, it is crucial for a PCSO to develop comprehensive risk management strategies to address these diverse challenges

Table 2.

#	Risk Category	Risk Description	Risk Mitigation
	Legal Framework	Inexistence of regulation or law for PCSO.	Technical Assistance with a hybrid national legal and international legal team to draft regulations or laws.
		Inexistence of digital law.	Technical Assistance with a hybrid national legal and international legal team.
		Lack of Amendment to Port and Maritime CBRAs, regulations and laws.	Technical Assistance with a national legal part of BPR.
	Institutional Framework	Lack of a strong champion.	Political will.
		Lack of inter-ministerial leadership.	Political will.
		Lack of governance.	Political will.
		Lack of engagement of public stakeholders.	Change management strategy.
		Lack of engagement of private stakeholders.	Change management strategy.
	Public Stakeholders	Business process reengineering issues at Customs & CBRAs Costs of business process reengineering.	Collaborate to Implement international best practices. Anticipate national budget planning Leverage customs IT Tax.
		Lack of digital infrastructure at CBRAS.	Anticipate by assessing digital maturity level.
		Go slow	Change management strategy.
		Lack of human, technical and financial resources dedicated to the project	Anticipate yearly budget and human resources required.
	Private Stakeholders	Lack of human, technical and financial resources dedicated to the project	Anticipate yearly budget and human resources required.
	Business planning	Lack of data and data quality for financial modelling	Collaborate with Customs.
		Informal economy	Change management strategy.
		Quality of infrastructure	Anticipate with Telcos and Power. Companies.

effectively. These risks, if not properly managed, can lead to financial losses, operational disruptions, reputational damage, and loss of trust among stakeholders.

Below, we outline the broad risk categories PCSOs face together with mitigation actions. A more structured list is provided in Table 3:

- **Legal and Regulatory Risks**: The PCS operates within a complex web of international and local laws and regulations, including data protection, privacy, and cybersecurity legislation. In addition, they must also comply with border, port, and maritime national laws and regulations, which are influenced by international agreements and conventions.[3] Navigating this intricate legal and regulatory landscape is

essential to ensuring the smooth operation and long-term success of a PCS.

- **Mitigation strategies:** To address the legal and regulatory risks, it is crucial for PCSOs to develop robust compliance programs. These programs should encompass ongoing monitoring of regulatory changes and regular compliance audits, enabling the organization to remain up to date with the latest legal requirements and best practices. By proactively identifying and addressing potential compliance issues, PCSOs can mitigate the risk of financial penalties, litigation, and reputational damage. Given the unique characteristics and requirements of each PCS, it is essential for operators to tailor their compliance programs to the specific needs of their organization. Factors such as the nature of the data being

---

3   Such as the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT), International Maritime Organization-Facilitation of International Maritime Traffic (FAL Convention), World Customs Organization (WCO) SAFE Framework of Standards, and the World Trade Organization (WTO) Trade Facilitation Agreement (TFA) to name a few

Table 3. PCS Operational Risks Categories and Mitigation Actions

Risk Category	Risk Description	Risk Mitigation
Legal & Regulatory	Non-compliance with international regulations and legal frameworks	National legal and international legal teams to draft respective regulations or/and law.
	Inadequate data protection and privacy laws	
Institutional	Resistance to change by port community stakeholders (public stakeholders)	Change management strategy. involving stakeholders in decision-making processes
	Lack of human, technical and financial resources dedicated to the project	Anticipate yearly budget and human resources required.
	Limited Engagement of Port Community Members.	Change management strategy.
Technology & Infrastructure	Cyber threats	Plan and implement tailored cybersecurity measures
	Business Continuity	On going evaluation on risks
Human Resources	Skills gaps	Develop recruitment and talent attraction strategies and plans Train and build capacity of existing employees
	Retaining specialized employees	Adopt competitive compensation plans Improve working conditions

Source: Authors.

processed, the jurisdictions in which the PCS operates, and the potential vulnerabilities of the system should be considered when designing and implementing compliance initiatives. This customized approach ensures that the compliance program effectively addresses the unique legal and regulatory challenges faced by the PCS, ultimately contributing to a more secure and resilient operation.

- **Institutional Risks:** Absence of an active PCS governance structure hurts effective collaboration and communication. A well-defined governance structure outlines the roles and responsibilities of each stakeholder and establishes clear lines of communication. When functioning properly, it can provide a stable foundation for collaboration and cooperation among stakeholders. More analysis on the PCS governance structure is provided in a separate section of this paper

- **Mitigation strategies:** Equally important is for PCSOs to involve stakeholders in decision-making processes in the medium to long term This can be achieved by establishing regular channels for communication, such as meetings or structured forums, where stakeholders can provide their input and feedback on key decisions and initiatives. Also, fostering transparency and accountability are vital for maintaining stakeholder trust and addressing institutional risks. This involves openly sharing information about the operations, performance, and decision-making processes of the PCS with stakeholders, as well as holding them accountable for their actions and decisions. These actions promote a culture of openness and trust among stakeholders.

- **Technology and infrastructure risks:** PCS operations depend on secure, reliable, and scalable IT infrastructure. To mitigate technology and infrastructure risks, PCSOs must maintain and upgrade existing systems but also invest in emerging technologies. Establishing partnerships with technology providers and collaborating with stakeholders to identify technological challenges can further enhance the resilience of PCS operations. Cybersecurity risks include unauthorized access, data theft, and system damage. Implementing comprehensive cybersecurity measures and incident response plans, as well as regularly training employees on cybersecurity best practices, can help to reduce these risks and maintain stakeholder confidence.

- **Mitigation strategies:** Continuous monitoring of the PCS's IT infrastructure is essential to identify and address potential cybersecurity vulnerabilities. By employing effective monitoring tools and conducting regular assessments, PCSOs can detect and address issues before they escalate into larger problems. This proactive approach helps maintain the security and reliability of the system while ensuring that any necessary upgrades or changes can be implemented in a timely manner. Therefore, investing in emerging technologies and solutions and incorporating them into their systems, PCSOs can improve the efficiency, security, and adaptability of their IT infrastructure. This forward-thinking approach allows operators to be better prepared for future challenges and opportunities. PCSOs can forge partnerships with technology providers and collaborate with port community stakeholders to identify technological challenges contributing to a more resilient and secure PCS ecosystem.

Human Resources Risks: Attracting and retaining skilled personnel is crucial for the success of a PCSO. Human resources risks can emerge from various factors, including employee turnover, skills gaps, lack of specialized IT employees, as well as the absence of capable managers with strong communication skills and the required authority to engage high-level community stakeholders. A PCS also faces high mobility of IT employees who may seek better opportunities elsewhere. These risks negatively impact an organization's ability to operate effectively and could potentially result in operational disruptions or even financial losses.

Mitigation strategies: One of the key strategies for addressing these risks in PCS operations is the implementation of employee training and development programs which ensures that the workforce remains up to date with the latest technologies and trends. Also, succession planning is another essential aspect of addressing human resources risks, particularly in the context of management positions. The PCSO can identify potential future leaders and provide them with targeted development opportunities. Finally, by fostering a supportive work environment and corporate culture that values employee contributions and offers opportunities for growth, PCSOs can reduce the likelihood of staff attrition and maintain a skilled workforce.

4.3. Concession Risk

Duration of the concession period: Another critical risk is the duration of the concession period. Since the breakeven point is dependent on a variety of potentially unpredictable factors, the duration of the concession period could pose a significant challenge for the concessionaire to achieve their return-on-investment goals.

Mitigation strategies: Annual reviews and terms of the concession may be reviewed to address the breakeven point and return on investment in a fair and transparent manner. Therefore, both

parties must be vigilant in managing this risk throughout the concession period to ensure a successful outcome for all stakeholders involved.

Transfer: Another risk for the concessioning authority that must be considered is the lack of skilled staffing to take over the operations at the end of the concession period. That could impact the efficiency of the maritime supply chain.

Mitigation strategies: Furthermore, it is important for the authorities to gradually build up the necessary skilled digital workforce over the course of the concession period to ensure a smooth transfer of assets to the concession authority at the end of the term. This process is crucial for ensuring the concessionaire can deliver on their contractual obligations and that the assets are properly maintained and handed over to the concession authority. Therefore, both parties must be vigilant in managing this risk throughout the concession period to ensure a successful outcome for all stakeholders involved.

Transaction Fees: In the case of a PCSO which has been awarded a concession contract, a separate set of risks emerge. Thorough analysis of these risks goes beyond the scope of this paper. However, in our attempt to touch upon a couple of those risks, we identify extortion as a potential risk associated with outsourcing the operation of PCS via a concession contract. This can occur when the management of transactions or contracts is not aligned with the actual investment and operating expenditure or when the rates are determined solely based on the CIF value of goods.

Mitigation strategies: In practice, the concessionaire should only receive compensation for financial risks that are objectively agreed upon, such as the return on investment, as is the case with terminal operators. Therefore, it is crucial to ensure that the terms of the concession contract are well-defined and that there is proper oversight of the concessionaire's activities as described above.

5. The Governance Structure

Governance has a crucial role to play in implementing and operating a PCS. A governance structure is necessary for the development of PCS to ensure effective collaboration and coordination between port stakeholders involved in the development of the system, but usually working in siloes. Without a governance structure, there is a risk of fragmentation, duplication, and conflicting priorities which could lead to delays, inefficiencies, and increased costs and failure. A robust governance structure helps to mitigate significant risks associated with the implementation of such systems by establishing clear roles and responsibilities,

decision-making processes, and mechanisms for resolving disputes and conflicts. Furthermore, a well-designed governance structure for a PCS can help to ensure that the system is aligned with the strategic objectives of the port community, promotes transparency and accountability, and facilitates the sharing of benefits among stakeholders.

A governance framework is essential to provide a clear structure for decision-making, roles, and responsibilities. It also ensures that the PCS aligns with the strategic objectives of the

Table 4. PCS Concession Risk and Mitigation Measures

Risk Description	Risk Mitigation
Resistance to change	Governance and institutional framework. Change management as key driver of business process re-engineering.
Risk of underperformance	Driven by deliverables. SLA and KPIs into the concession agreement. Non-performance penalties.
Financial sustainability over the concession period	Detailed financial business plan. Sustainability as part of the concession agreement. Legal framework to regulate operations.
Loss of control of core activities	Concession agreement based upon best practice. Conduct due diligence of preferred bidder before award.
Loss of control of critical infrastructure	Critical national infrastructure for national security. Technical assistance in drafting national policy on Critical national infrastructure and their resilience.
Data Security & Storage	PCS operator as trusted third party. Data storage to be hosted by Government. Legal framework for data governance.

Source: Authors

port community. This section outlines the typical elements of a governance framework for PCS development, including the Inter-ministerial Committee, Steering Committee, Business Process Committee, and Working Groups. It describes their roles and responsibilities and how they contribute to the success of the PCS project. A schematic representation of the governance structure is offered in Figure 6.

Therefore, a typical governance framework is comprised of the following four elements:

- **Inter-Ministerial Committee:** The Inter-Ministerial Committee is a high-level committee that comprises representatives from relevant ministries. Its role is to provide strategic direction, oversight, and coordination for the development and implementation of the PCS. The committee is responsible for approving the overall PCS vision, policy, and legal framework, as well as providing guidance on funding, prioritization, and monitoring of the project.

The range of multisectoral, multidisciplinary responsibilities encompassed in an initiative of this type requires the establishment of an appropriate cabinet-level board forum, chaired by the prime minister or president's office in supporting the champions of the PCS project and in avoiding competing interests between line ministries and governmental agencies The committee will focus on the strategic coordination and the legal, regulatory, and policy issues. Appendix 1 outlines recommended participants and the responsibilities of the Inter-Ministerial committee as well as frequency of the committees. More details about

the responsibilities of the Inter-Ministerial committee can be found in Annex 4

- **Steering Committee:** The Steering Committee is an executive-level committee responsible for guiding and supervising the PCS project. Its role is to ensure that the project is progressing according to plan, and it has the authority to make decisions on project direction, scope, and budget. The committee comprises representatives from Customs, the port authority, terminal operators, shipping lines, and other stakeholders. It is responsible for reviewing and approving project plans, monitoring project progress, and ensuring that the project is aligned with the overall PCS vision and strategy.

The Steering Committee should comprise the director generals of the public agencies and the presidents and secretary generals of private stakeholder organizations and associations. The role of the committee is to lead the implementation of the PCS and play an instrumental part in the long-term for the sustainability of the PCSO. All key stakeholders must be included in the committee, and each must have an equal voice. In strategic leadership roles, the committee chair and vice chairs will work to empower collaboration while leading the project and demonstrating their neutrality. The core public partners invited to the committee should include the port authority, maritime authority, Customs authority, and foreign trade authority.

When a national Port Community Council (PCC) exists, the steering committee could be implemented within the context of a PCC. When there is a national Maritime Transportation

Figure 6. Typical PCS Governance Framework

Source: Authors.

Facilitation Committee, per FAL Convention recommendation, the steering committee could as well be implemented within the NMTFC. When a National Trade Facilitation Committee existsv, the steering committee could also be implemented within the NTFC. The strategic objective of steering will be to close the gaps and to establish trust between cross-border regulatory agencies and between CRBAs and private stakeholders, to facilitate trade and secure the supply chain.

The steering committee could be chaired by the port authority and or co-chaired (or vice-chaired) by the Customs authority. The chair will need to demonstrate the joint leadership on trade facilitation and supply chain security of the two authorities, and their neutrality towards the public and private stakeholders. Table 6 outlines the proposed composition, scope of responsibility, and suggested frequency of meeting of the steering committee.

- **Business Process Committee:** The Business Process Committee is responsible for developing and reviewing the business processes and procedures that underpin the PCS. Its role is to ensure that the PCS is designed to streamline and optimize port operations, and it aligns with industry best practices. The committee comprises representatives from port stakeholders, such as Customs, shipping agents, freight forwarders, and terminal operators. Its responsibilities include identifying process improvements, developing and implementing new processes, and ensuring that the processes are integrated into the PCS. This committee should comprise representatives of all public agencies and private stakeholder organizations involved in the project. Each public agency and private stakeholder organization should nominate at least two people who are recognized as a business process expert in their own organizations. The committee will participate in business process analysis, optimization, automation,

and reengineering. The committee will have a key role in the long term for the ongoing evolution and sustainability of digital business processes.

- **Working Groups**: Working Groups are responsible for developing specific elements of the PCS, such as business processes per stakeholder type, interoperability and cybersecurity protocols. The working groups comprise subject matter experts from all stakeholder groups. Their responsibilities include developing technical specifications, testing, and validating PCS components, and ensuring interoperability with other systems. Working groups provide technical input to the Business Process Committee and Steering Committee and play a critical role in ensuring the success of the PCS project.

More details about the responsibilities of the Business Process Committee and Steering Committee can be found in Appendix 1, 2 and Appendix 5 and Appendix 5. It is important to note that the governance structure presented in this paper may look different on the ground. This will depend on the economic and business environment of the country and the structure and operational specificities of the port. Design also differs slightly between a developed country and an emerging or developing country. However, variations of these structures are found in most of the ports around the world which have already adopted a PCS or are doing so. The guiding principles of the generic governance structure should be applied as global best practice.

Value-added in the design and implementation phases. The governance structure described above contributes to the implementation of the PCS as a public and private data collaboration platform.

Box 3. The pivotal role of Port Community Councils in enhancing port operations and digitalization

While designing and implementing a Port Community System relies on well-established technical standards, as a practical matter its ultimate success depends in good part on securing the buy-in of the local port and shipping community at large. An effective way to achieve this is to mobilize the community using the Port Community Council as its official representative body.

As part of its generic mandate, the port community council has a critical role to play in improving the transparency of port operations, for the benefit of all users and final customers of port services, including shippers. In this regard it represents an adequate platform to bring forward new projects of mutual interest to private actors and public administrations, and to reach consensus on their design and implementation methods. It must be a formal instance, with an explicit mandate and working arrangements. It will hold regular meetings, typically on a monthly basis, and barring any special circumstances, its deliberations will be made public.

Most existing port community councils are consultative entities, which are obviously valuable as a conduit between port authorities and their professional environment, but this status could be enhanced by making them an official channel to table questions from port customers about, for instance, the implementation of a new Port Community System. To make it an effective process this channel must be part of a customer feedback loop defined as such in the port

Institutional and contractual arrangements.

In the case of Mauritius, the Port Users Council set up by the Mauritius Ports Authority as part of the port sector modernization program in the late 90's had, among other duties, to advise on port regulations, procedures and practices, documentation systems and other related matters. In this context it was later instrumental in helping implement the new Port Community System, the Mauritius Cargo Community System Ltd (MACCS). The MACCS is a public-private partnership that has been appointed by the Government of the Republic of Mauritius to build and manage the Cargo Community System. MACCS operates an information system ensuring the data collection and the processing of information in relation to the import and export of goods, as provided and received by the professional interacting in the cargo and/or the air cargo sectors.

On a more recent occasion, the new Port Sector Law being drafted for Lebanon, in the wake of the blast that devastated the port of Beirut in August 2020, includes specific provisions to set up formal port communities to be represented by a dedicated Port Community Council in each port of national importance. This appears all the more important in this specific case that until now the overall legal and governance framework of the sector was only very loosely defined, with no voice officially given to all private economic actors and customers. As the draft law also establishes the legal basis for a broad digitalization agenda, including comprehensive PCS, one can expect that the establishment of the Port Community Councils will facilitate the development and progressive implementation of the local PCS, which should prove to be, in this particular instance, a genuine exercise in transparency as well as in improvement of operational efficiency for the benefit of all port users and customers.

Authored by Marc Juhel (former Sector Manager, Transport WBG)

It requires: (i) Stakeholders' engagement. (ii) Data governance establishment. (iii) Data orchestrating. (iv) Change management. (v) Long-term financial sustainability.

This governance is needed during both the design and implementation phases.

During the **initiation phase** it provides a framework for collaboration and coordination among the various parties. The Steering Committee and Business Process Committee play critical roles in defining the scope of the project, setting strategic objectives, and ensuring that the PCS meets the needs of all stakeholders. The working groups also contribute to the **design phase** by providing technical guidance and recommendations on specific aspects of the system, such as data standards and interoperability.

During the **implementation phase**, the governance structure helps to ensure that the PCS is implemented in a coordinated and effective manner. The Steering Committee oversees the implementation process, ensuring that the project progresses according to plan

and that any issues or risks are addressed in a timely manner. The Business Process Committee helps to ensure that the PCS is aligned with the business needs of all stakeholders, and the working groups contribute by providing technical support and guidance.

The governance framework during the operational and maintenance phase helps support day-to-day operations. Once the PCS is developed and implemented, it enters the operational phase, where it is used to support the day-to-day operations of the port community. During this phase, the governance structure helps to ensure that the PCS continues to meet the needs of all stakeholders and that it operates efficiently and effectively. The Inter-Ministerial Committee continues to provide oversight and ensure that the PCS complies with applicable regulations and policies. The Steering Committee remains responsible for setting strategic objectives, overseeing project progress, and resolving any issues that may arise during the operation and maintenance phase. The Business Process Committee continues to ensure that the business processes are integrated into the PCS over the roadmap and that they remain aligned with the needs of stakeholders. The Working Groups focus on maintaining the functional and technical aspects of the system and implementing any necessary improvements and releases.

The complementary nature of the PCS governance framework and Port Community Council (PCC). The governance framework and the PCC are related, but they serve different purposes. The governance framework is responsible for providing guidance and oversight for the development and implementation of the PCS. On the other hand, the PCC is a broader stakeholder platform that brings together all the key stakeholders involved in the port community, and serves as a forum for collaboration, coordination, and information sharing. Its main objective is to promote the efficient and effective functioning of the port community. However, as mentioned above, in some cases, the PCC may undertake the role of the Steering Committee or complements its activities.

The role of board of directors of the PCSO.: The board of PCSO will act as the operational layer of the PCS governance framework. The structure of the board will reflect that of the PCSO, whether public, private, or public-private partnership. The role of the board is to set the strategy and oversee the management. In some cases, such as in the Netherlands, the PCSO may establish a strategic advisory board to reflect the strategic landscape of the national port and maritime community.

6. Lessons learnt and the way forward

This chapter delves into a comprehensive analysis of the governance structures and operational models of a PCS. We investigate the management and administrative facets of models used in various ports around the globe. Additionally, we outline the responsibilities of PCSPs in overseeing the IT infrastructure, creating new services and applications, and guaranteeing the overall efficacy of the system. This section scrutinizes the diverse models of PCSPs, encompassing private, public, and hybrid models, and examine the pros and cons associated with each model. Furthermore, it considers the common risks encountered by PCSOs, such as technical, legal, regulatory, financial, and reputational risks, as well as the tactics operators could employ to alleviate these risks.

Based on this analysis, we summarize below the key takeaways of this chapter.

1. A PCSO manages and maintains the PCS, promoting public-private data collaboration within a local or nationwide seaport ecosystem. It ensures seamless information exchange, legal and regulatory compliance, and the adoption of emerging technologies by closely collaborating with port stakeholders.

2. The role of public executives from port and Customs authorities with strong leadership, and their capacity to engage and to collaborate with public and private stakeholders for the common good of the port community is essential from the inception to implementation of the PCSO.

3. Champions are essential to the inception of the PCS project. This includes the CEO of the port authority and the Commissioner of the Customs administration. It can also include the President of the Port Community Association, who seek to streamline their operations and reduce costs. Regardless of who initiates the PCS, it may be operated by a range of entities, including the port authority or a third-party operator with expertise in PCS management.

4. The financial sustainability of operators ensures the long-term success of a PCS. Even though many governments include PCS development and maintenance costs into the port authority's budget and others seek private capital, there is still room for the involvement IFIs. Their financial assistance could be coupled with upstream technical assistance to improve the enabling environment. They can help define functional specifications and technical specifications and advise during the procurement process.

5. Operators of a PCS face several risks that can adversely affect their performance from initiation to operations stages. Effective risk management strategies and a port community centric approach can help them mitigate these risks and improve their performance. Tools they have at their disposal include the adoption of robust risk management strategies which encompass political will, business planning, change management, compliance monitoring and critical information infrastructure.

6. A governance structure is necessary for the initiation and the implementation of a PCSO. This ensures effective collaboration and coordination between port stakeholders involved in the development of the system. Without a governance structure, there is a risk of fragmentation, duplication, and conflicting priorities which could lead to delays, inefficiencies, increased cost, and failure.

7. Operating and governance models are not yet fully understood. Despite clear advantages of effective implementation, PCS initiators often find themselves grappling with the challenge of determining which operator model (public, private, or public-private partnership) is most suitable for their specific needs. This lack of knowledge can hinder their ability to make informed decisions and fully capitalize on PCS benefits.

Appendix 1. Responsibilities of a representative Inter-Ministerial Committee

Inter-Ministerial Committee	
Participants	• Ministry of Transport • Ministry of Finance • Ministry of State-Owned Enterprises • Ministry of Foreign Trade • Ministry of Immigration • Ministry of Health • Ministry of Environment • Ministry of Agriculture • Ministry of National Security • Ministry of Defense • Ministry of Digital Economy
Chair	• Prime Minister or President's Office • Vice-chair by lead line Minister(s)
Responsibilities	• Facilitate PCS project • Facilitate stakeholder cooperation • Drive policy reform and policy making • Review laws and regulations • Drive public-private data collaboration • Supervise PCS implementation • Improve supply chain security • Improve safety • Drive sustainability • Drive innovation • Drive human capital and capacity building • Promote emerging technologies
Frequency	• Quarterly

Appendix 2. Responsibilities of representative Steering & Business Process Committees

	Steering Committee	Business Process Committee
Participants	• National Port Authority • Maritime Authority • Customs Authority • Ministry of Foreign Trade • Ministry of Immigration • Ministry of Health • Ministry of Environment • Ministry of Agriculture • Ministry of Digital Economy • Ministry of National Security • Terminal Operators Association	• Shipping Lines Association • Airlines Association • National Logistics Association • Freight Forwarder Association • Clearing Agents Association • Truckers Association • Rail Operators Association • Importers Association • Exporters Association • Insurance Association • Banking Association • Chamber of Commerce
Chair	• Port Authority	
Co-Chair	• Customs & Maritime Authority	
Responsibilities	• Review project status report • Follow up on milestones • Follow up on deliverables • Follow up on action items • Follow up on issues • Discuss outstanding problems • Discuss proposed actions to be taken • Take corrective actions • Resolve deviations from schedule • Evaluate impact on safety, security, and sustainability • Assess risk management • Assess change management • Review the legal framework	• Review project status report • Follow up on milestones • Follow up on deliverables • Review as-is business process • Review to-be business process • Digitize all manual processes • Digitize all processes within international trade community • Redesign all business processes as needed • Foster best practices • Introduce and review new business procedures • Implement standardization • Focus on safety, security, and sustainability • Imagine use cases for emerging technologies • Foster best practices • Support in-change management activities related to implementation or introduction of new and redesign processes
Frequency	• Monthly	• Monthly and on demand for working groups

LEGAL & REGULATORY FRAMEWORK

Executive Summary

A legal and regulatory framework is crucial for implementing a Port Community System (PCS) to ensure standardized data exchange, protect stakeholders' interests, and maintain security and privacy. Additionally, it provides clear guidelines for operations, fostering trust and collaboration among port and logistics players. The key elements of a legal framework for a PCS involve defining the rights, obligations, and liabilities of all stakeholders (including the PCSO) and ensuring that data exchange adheres to privacy, intellectual property, and contractual laws. It also provides mechanisms for dispute resolution and safeguards against misuse or unauthorized access to information.

International organizations around the world have played a crucial role in the development of regulatory frameworks for the PCS.

IMO, WCO, UNECE and IAPH have provided governments with the information they need to establish regulations and draft laws related to a PCS to shape the future of maritime trade around the world. Specifically, the UNCITRAL Model Laws offer internationally recognized standards and guidelines that can serve as a foundation for countries to develop their national legal frameworks for a PCS.

Governments in turn have enacted laws and regulations to put PCSs and PCSOs at the heart of secure supply chains and maritime trade. The *IMO SOLAS, chapter XI-2 ISPS Code* and WCO SAFE Framework of Standards have helped to shape regulations to establish PCSOs. *IMO MSC-FAL.1/Circ.3/Rev.2 and IMO FAL.5/Circ.42/Rev.2* also have helped to shape legal instruments to protect PCSOs as providers of critical infrastructure. The European Union has also contributed significantly to reforming and revising regulations to address critical infrastructure, cybersecurity, and the resilience of critical infrastructure.

Emerging and developing countries have harnessed a variety of legal options to cement the pivotal role of PCSs and PCSOs in domestic and international trade. They have created single regulations or issued presidential decrees to put PCSs and PCSOs at the center stage of trade facilitation and supply chain security. Decrees have also been used to create governance frameworks for public and private collaboration. Cooperation between port and Customs authorities fostered respective acts have been amended to include the PCS in the national legal framework. National legal frameworks have been revised to reflect the digitalization of increasingly complex maritime trade.

The existence of the PCS in national legislation is a key requirement. The potential vulnerability of a PCSO is highlighted when it is not established in law. States creating a PCS and using a Maritime Single Window (MSW) need to pay careful attention to the IMO 2024 regulation on the MSW while shaping their domestic regulations.

Business Process reengineering is the opportunity to review CBRAs legal and regulatory framework to enable the digital transformation of the maritime supply chain and get rid of obsolete practices. Port and customs authority cooperation is a key driver for reforms.

The range of foundational laws related to electronic records and transactions, privacy and data protection laws are vital in the establishment of a PCS. The review of regulations related to telecommunications concessions is required in developing countries to ensure efficient and resilient infrastructure is available for local or national roll out of a PCS. Finally, the establishment of Service Level Agreements from implementation stage to operational stage will drive successful customer experience and operational efficiency of the ports.

1. Introduction

The main objective of this chapter is to focus on legal and regulatory aspects of the PCS implementation and the PCSO. Establishing a legal and regulatory framework is a critical pillar of change management nationally. It is also a prerequisite for a successful PCS. Guidance provided in this chapter on navigating laws and regulations is based on realistic business cases, good practices, and analysis.

2. Enabling International and Regional Environment

In the last two decades, international organizations have been the driving forces in providing instruments to enable the existence of the PCS in national legislation.

2.1. International Association of Ports and Harbors (IAPH)

In May 2011, the IAPH released the first PCS benchmarking study at the Busan World Port Conference.[1] The study noted that a *"PCS is a change management project, not an IT project."*

In the same year, European PCSOs from Barcelona, Le Havre and Felixstowe, pillars and thought leaders of IAPH Trade Facilitation Committee and PCS Committee along with their peers from Rotterdam, Bremerhaven and Hamburg, founded the European Port Community Systems Association (EPCSA) with a mission statement to influence public policy at the European Union level to achieve e-logistics throughout all European ports, operating as a key element of the EU maritime and shipping industry. EPCSA later became the International Port Community Systems Association (IPCSA) and was instrumental in developing a common understanding of the PCS in Europe and the wider world, including within the EU Commission, WCO, UNECE, UNES-CAP, UNCTAD and IMO. International organizations amended their guidelines and standards to reflect the role of PCSs in trade facilitation, supply chain security, trade logistics digitalization and interoperability.

In 2020, IAPH transformed its Trade Facilitation and Port Community System Committee into a strategic Data Collaboration Committee and embraced a larger maritime supply chain community with IPCSA, ITPCO, DCSA, BIMCO, TIC 4.0 and Cargo Owners as members, along with other international organizations such as IMO, UNCTAD, WCO and The World Bank.

In 2021, IAPH said that PCSOs should be recognized in the domain of "national critical infrastructure" and within "national security." That means cybersecurity requirements apply to PCSO laws, regulations, codes, guidance (from regulatory and advisory bodies, whether mandatory or not), international and national standards. They apply to sanctions relating to security of network and information systems and security breach and incident reporting requirements. These include: *The International Association of Ports and Harbours Cybersecurity Guidelines for Ports and Port Facilities,*[2] *IMO MSC-FAL.1/Circ.3/Rev.2 Guidelines on Maritime Cyber Risk Management, EU Cybersecurity Directive (EU) 2016/1148),*[3] *the upcoming* EU directive on the resilience of critical entities[4] *and the retained EU law version of the General Data Protection Regulation (EU) 2016/679.*[5]

IAPH outlined in cybersecurity guidelines the emergence of a next-generation cybersecurity operation center, like the Port Community Cyber Resilience Center in the Port of Los Angeles.[6] It is the first of its kind, enabling port community stakeholders to enhance cyber threat information sharing and recovery measures to reduce risk of disruption flow.

2.2. UNCITRAL

The United Nations Commission on International Trade Law (UNCITRAL) has curated a set of international tools to bolster trade in the digital arena. PCSs may benefit from some of these laws as nations implement a foundational legal framework ensuring the validity of online transactions, enforceability of electronic contracts, and the legal acceptance of electronic records and documents in courts. To safeguard against malicious activities like data breaches or unauthorized alterations, these laws should have punitive measures to act as a deterrent. Below is a table outlining these tools and their objectives.

1 https://www.iaphworldports.org/n-iaph/wp-content/uploads/2020/11/ReportOnPCSBenchmarkSurvey_TFPCS_Jun2011.pdf
2 IAPH-Cybersecurity-Guidelines-version-1_0.pdf (sustainableworldports.org)
3 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L1148&from=FR
4 https://data.consilium.europa.eu/doc/document/ST-15623-2022-INIT/en/pdf
5 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679&from=EN
6 Port of Los Angeles Launches First-of-its-Kind Cyber Resilience Center | News | Port of Los Angeles | Port of Los Angeles

Table 1. UNICITRAL Instruments for International Trade Transactions

Instruments[7]	What it Supports
Conventions:	
United Nations Convention on the Use of Electronic Communications in International Contracts (New York, 2005)	To facilitate the use of electronic communications in international trade - Contracts concluded electronically are legally valid and enforceable in the same way as paper-based contracts.
Model Laws:	
UNCITRAL Model Law on Electronic Transferable Records (2017)	To enable the legal use of electronic transferable records that are exchanged nationally and across borders.
UNCITRAL Model Law on Electronic Signatures (2001)	To enable and facilitate the use of electronic signatures – provides technical criteria for equivalence between electronic and hand-written signatures.
UNCITRAL Model Law on Electronic Commerce (1996)	To enable and facilitate commerce conducted by electronic means
Legislative Guides:	
Recommendations to Governments and international organizations concerning the legal value of computer records (1985)	Recommends governments to adopt laws and legal texts that are amenable to processing trade data in automated data processing systems.
Explanatory Notes:	
Promoting confidence in electronic commerce: legal issues on international use of electronic authentication and signature methods (2007)	Contains an analysis of the legal issues arising out of the use of electronic signatures and authentication methods in international transactions.

Source: UNICITRAL.

2.3. World Customs Organization (WCO)

In the 1980's, the World Customs Organization (WCO) started to have a clear understanding of the role of the PCS in trade logistics. The chief executive officer of Maritime Cargo Processing (MCP) plc, the PCSO at Felixstowe was a former Customs officer at HM Customs & Excise, with twelve years at various UK ports, including the Port of Felixstowe. He had a key role to play in the evolution of PCSs by making Customs a key strategic partner in the PCSO.

In 2005, the WCO issued the *Safe Framework of Standards,*[8] introducing the role of the PCS in dealing with Authorized Economic Operators (AEOs) and advanced cargo information.

Section 2.6 sets out the following: *"The ICT Guidelines also recommend the possibility to use economic operators' commercial systems and to audit them to satisfy Customs' requirements. In the context of the Authorized Supply Chain, the possibility for Customs to have online access to the commercial systems of the parties involved, once any confidentiality or legal issues have been resolved, would provide enhanced access to authentic information, and offer the possibility for far-reaching simplified procedures. Another example is Cargo Community Systems (CCS) where in* ports or airports all parties involved in the transport chain have established an electronic system by which they exchange all relevant cargo and transport related data. Provided that these systems contain the necessary particulars for Customs purposes, Customs shall consider participating in such systems and extracting the data required for their purposes."

MRA Customs in Mauritius in 2008 drew on the SAFE *Framework of Standards* in a Customs Cargo Community System regulation to enable risk management. The importance of collaboration between Customs and port authorities is addressed in chapter 6. In 2018, WCO introduced the last version of Single Window Compendium,[9] including Port Community System as a typology of the single window, earlier introduced in the UN/CEFACT ECE/TRADE/C/CEFACT/2017/10 *Technical Note on Terminology for Single Window and other electronic platforms*. The WCO Compendium is e-based on UN/CEFACT standards and assumes that a PCSs could satisfy five key elements of the definition of Recommendation 33: (i) Parties involved in trade and transport. (ii) Standardized information and documents. (iii) Single entry point. (iv) Fulfilling regulatory requirements. (v) Single submission of individual data. The WCO compendium also addresses the market positioning of the PCS versus the cross border regulatory single window.

---

7   Texts of these instruments and other details may be found at https://uncitral.un.org/en/texts/ecommerce
8   https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/safe-package/safe-framework-of-standards.pdf
9   https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/single-window/compendium/swcompendiumvol1parti.pdf

PHOTO BY: PORT AUTHORITY OF JAMAICA

2.4. United Nations Economic Commission for Europe (UNECE)

One year after the establishment of EPCSA, in 2012, UNECE introduced the *Trade Facilitation Implementation Guide*.[10] It noted that "*most major ports have systems for the exchange of information between clients and national Customs and other authorities. Port Community Systems are a form of Single Windows for Trade, and are similar to Airport Community Systems". The* UNECE's guide aimed to provide policymakers and implementers with ways to identify relevant trade facilitation measures and instruments for dealing with issues, such as avoiding waiting times at border crossings, setting up a Single Window for exports and imports and using modern information technologies for trade facilitation.

2.5. International Maritime Organization (IMO)

As of 2005, Le Havre's PCSO implemented its second-generation PCS. It benefits from the new International Ship and Port Facility Security Code that entered into force under SOLAS, chapter XI-2, on 1 July 2004. Under ISPS regulations, cargo entering any restricted area had to be notified in advance through the PCS.

PCSs were introduced into the IMO's Guidelines in 2018 through for Setting up a Maritime Single Window FAL.5/Circ.42. In the lasted revision of FAL.5/Circ.42/Rev.2,[11] the guidelines outline, in sections 3.2.3, 3.4.4 and 3.4.5, that the PCS is a domain type that a single window can take to manage the vessel side. Below are some important sections of the guidelines.

- Section 3.2.6, on port call process: "A holistic integration of the port call is bringing administrative, nautical and operational information and data into the common port environment, including PCS, maritime single windows, terminal operating systems and others (see other parts of section 3.4 for descriptions of these systems), which will ensure the quality of information provided and delivered."

- Section 3.4.4, on port single window: "A single window environment that provides information at a local level about a vessel to the authorities at that level, usually a single port. PSW systems should, where possible, be connected to a higher-level NSW or MSW. In the latter case, PSW systems may function as a single point of access for NSW regarding reporting formalities. PSW can also be part of the wider Port Community System (PCS) in a port."

---

10   https://tfig.unece.org/contents/port-community-systems.htm
11   https://wwwcdn.imo.org/localresources/en/OurWork/Facilitation/FAL%20related%20nonmandatory%20documents/FAL.5-Circ.42-Rev.2.pdf

- Section 3.4.5: "PCS is defined by IPCSA (International Port Community Systems Association) as a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholder to improve the competitive position of the sea and air ports- communities; and optimizes, manages, and automates port and logistics processes through a single submission of data and connecting transport and logistics chains. FAL.5/Circ.42/Rev.2 Annex, page 9. A PCS is a modular system with functionality designed to provide all the various sectors and players within a port community environment with tools specific to them, thus delivering a tightly integrated system. Developed for port users by port users, a PCS encompasses exports, imports, trans-shipments, consolidations, hazardous cargo, and maritime statistics reporting. PCS covers Business to Business (B2B), Business to Government (B2G) and Government to Business (G2B) and in some cases Government to Government (G2G) exchanges".

- Section 3.2.6 on the port call process says the port call process may be included in the scope of a PCS. Particular attention should be paid to the IMO's 2020 Just in Time Arrival Guide,[12] which aims to provide both port and shipping sectors with practical guidance on how to facilitate just-in-time arrival of ships. Consequently, BIMCO released the "Just in Time Arrival Clause 2021[13] in 2021 for use in voyage: "Charter parties where owners and charterers have agreed to operate a just in time arrival scheme that permits charterers to ask

owners to optimize the speed of the ship to arrive at a destination at an agreed time." This clause may also be used with the BIMCO Port Call Data Exchange Clause 2020[14] which has been designed to encourage wider application and use of the IMO data model framework for the harmonized exchange of ship/port information."

2.6. European Union

The European Commission has been a front runner on essential and critical information infrastructure providing a series of instruments such as the EU Network and Information Systems Directive 2016 (EU 2016/1148[15]), the EU Network and Information Systems Directive 2022 (EU 2022/2555[16]). The latest directive provides measures for a high common level of cybersecurity across the Union and imposes stricter requirements with regards to risk management, reporting, and information exchange in the area of cybersecurity. The Directive on the resilience of critical entities (EU2022/2557[17]) aims to ensure that services essential for the maintenance of vital societal functions or economic activities are provided in an unobstructed manner in the internal market and to enhance the resilience of critical entities providing such services.

European PCSOs have engaged since 2016 with their national security agencies to get organized and comply with European directives.

3. Existence of PCS into national legislation

3.1. Europe versus the rest of the world

Early PCSOs in Europe were launched by private stakeholders in port communities in partnership with local port authorities and with Customs. Comprehensive legal frameworks were not pre-requisites. But things have changed. Today change management is central to establishing a PCSO in emerging and developing countries. Establishing a comprehensive change management plan should be considered from the start.

The change management plan should cover a wide range of areas, such as stakeholders' engagement, business process

reengineering, technology architecture, capacity building, communication plans, cultural change, and the legal and regulatory framework. The change management plan should also be integrated into the project risk management plan. A detailed and specific risk management plan should include identification of the risks, risk assessment, risk mitigation, risk monitoring and risk review related to the legal and regulatory framework.

Emerging and developing countries have also embarked on a legal and regulatory journey with all stakeholders to enforce the existence of the PCS and PCSO as the only way to facilitate trade and secure the supply chain.

12 https://wwwcdn.imo.org/localresources/en/OurWork/PartnershipsProjects/Documents/GIA-just-in-time-hires.pdf
13 https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/just-in-time-arrival-clause-for-voyage-charter-parties-2021#
14 https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/port-call-data-exchange-clause-2021
15 http://data.europa.eu/eli/dir/2016/1148/oj
16 https://lexparency.org/eu/32022L2555/
17 https://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!CELEXnumdoc&lg=EN&numdoc=32022L2557

A review of case studies in section 4.6 describes the key actions of different countries. These include Peru, Jamaica, Democratic Republic of Congo (DRC), Morocco and New Caledonia to include the PCS in national legislation. It provides insights into the initiation stage for establishing future legal and regulatory frameworks for establishing a PCS in new countries.

The cases address the importance of PCS regulation, specifically on the cooperation of customs and ports authorities related to the SAFE *Framework of Standards* to facilitate and secure trade. It looks at the role of decrees and regulations in creating and operating PCSOs and highlights the main features of legal and regulatory framework updates:

a. Incorporation of the PCSO and PCS into national law (Peru, Jamaica, DRC, Morocco).

b. Collaboration between the PCSO and the Customs administration (Jamaica, Mauritius, Morocco, New Caledonia).

c. Mandatory use of the PCS by all private stakeholders (DRC, Jamaica, Mauritius, Morocco, Peru, New Caledonia).

3.2. Critical relationships between MSW and PCS

While PCSs were first set up in Europe as port community-based initiative, things are not as simple as they were in their early days. Today European PCSOs face more and more issues in relation to the existence of PCSOs within the national legal and regulatory framework related to the new European Maritime Single Window Environment and the recent regulation on the EUs Single Window Environment for Customs.

The new European Maritime Single environment will apply from 15 August 2025. It required a legal review of the relationship between the MSW and the PCS. This review was led by Frans van Zoelen, former chairman of the IAPH Legal Committee and lead Legal Emeritus of the Port of Rotterdam Authority. It outlines the potential vulnerability of PCSOs not embedded in formal legislation. States implementing a PCSO and a maritime single window should pay careful attention to this review in the context of IMO 2024 regulations on the Maritime Single Window.

The EU Directive 2010/65/EU[18] obliges each EU member state to ensure that the reporting formalities for ships arriving in and/or departing from ports of EU states are requested in a harmonized and coordinated manner in each country. Member states shall accept the fulfillment of reporting formalities in electronic for and their transmission via a single window. In the Netherlands, local port regulators have a certain room for maneuver in setting up their Harbor Master notifying processes, based on local legislation from which local port regulations emerge, such as Harbor Master notification requirements. In the Dutch situation, Portbase PCS is, along with Harbor Master notifications based on local regulation, also instrumental in reporting the requirements of the Maritime Single Window, as elaborated in EU Directive 2010/65/EU. This will lead to further optimizing the single entry and submission functionalities, and further adding to the overall information position of the PCS as a whole.

The relationship between a Port Community System and the Maritime Single Window is always a consideration. This is because the Maritime Single Window is a formal system based on legislative requirements (EU Directive 2010/65/EU and the implementation into Dutch legislation), whilst the (Dutch) Port Community System is the result of an informal bottom-up approach.

Portbase is engaged by Harbor Masters in the delivery of notifications which concern two types of messages: (a) Notifications related to local nautical regulations. (b) Notifications related to the seven items related to EU Directive 2010/65/EU (MSW-notifications). For the latter, the Dutch opted to designate the Harbor Master of seven main ports as the recipient of these notifications. In this way they covered the whole port landscape.

The relationship between the Maritime Single Window and the PCS becomes more fundamental if a PCS emerges locally but then gains national coverage. This raises the question whether both systems should be "merged" to gain more efficiency and become more cost effective.

This is not a decision taken lightly. The mandatory requirements of the Maritime Single Window are defined by G2B, B2G and G2G. Allowing the PCS to be a part of the Maritime Single Window could reduce B2B functionalities. If the Maritime Single Window becomes an integrated part of the PCS, that raises questions about whether the PCS can offer the special governance associated with a mandatory governmental system.

The technical merger of platforms hinges on a definition of engagement rules for different entities active in the same technical framework. It must also safeguard the specific functionalities of these processes. Although challenging, these are not uncommon issues.

EU Directive 2010/65/EU prescribes a notification process for ships arriving in and/or departing from EU ports to be implemented in each EU member state through an electronic Single Window to make maritime operations more efficient and cost effective. Practice shows that EU Directive 2010/65/EU did not lead to the envisaged reduction of administrative burdens and

---

18 Directive 2010/65/EU of the European Parliament and of the Council of 20 October 2010 on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/ECText with EEA relevance (europa.eu)

costs for the maritime sector. That is because each EU member state implemented the directive differently.

The European Commission decided to start a remediation project. This resulted in Regulation EU 2019/1239/EU,[19] which establishes an electronic European Maritime Single environment. This will apply from August 15, 2025. This regulation prescribes in more detail and at a technical level how the reporting and notification processes should be set up: (a) Harmonized rules for the provision of the information that is required for port calls, particularly by ensuring that the same data sets can be reported to each Maritime National Single Window (MNSW) in the same way. (b) Facilitation of the transmission of information between declarants, relevant authorities, and the providers of port services in the port of call, and other member states, and to make sure that the required information is to be reported only once per port call. The result will be that ship operators meet the same notification procedures in each member state.

The major menace of this development for a non-formal PCS is being positioned "behind" the formal Maritime Single Window environment. The bottom-up approach did gradually result in commitment and trust in the relevant environment and in turn led to a maximum upscaled PCS by the different users. At the same time, as the PCS is not embedded into formal legislation —be it European legislation— there is no formal clearance position for this system if reporting requirements evolve in the formal context of the Maritime Single Window. This could be perceived as a vulnerability. Here is a task for the political system, to appreciate accurately the economic benefits of a PCS when relevant legislation is in the design stage.

An increasing number of countries are considering creating PCSs. That means they must meet IMO Maritime Single Window obligations. This analysis highlights the need to consider the MSW as part of the scope of the port call service of the PCS. As governments accelerate digitalization of the maritime supply chain, they should also consider the following: (i) Providing shipping lines with one single point of submission of data related to vessels, crew, passengers, and goods. (ii) Establishing the formal inclusion of the PCS into the national legal and regulatory framework.

One gets a sense that while a smooth connection between the two provides optimal benefits, any failure in the interfacing could pretty much ruin the whole approach. We should underscore even further the fact that the usual bottom-up approach to building a PCS provides a genuine opportunity to mobilize the whole port community and secure mutual ownership between public and private actors. This is, in itself, a valuable benefit that should be protected.

The Dutch case study related to a PCS and the MSW legal environment highlights the paramount importance for emerging and developing countries to amend their legislation to include the PCSO in the national maritime supply chain.

4. Exploring national legal frameworks

While Europe is the first home of the PCS and European countries have extensive legal and regulatory frameworks, implementing a PCS in an emerging or developing country is another journey. Sometimes the right legislation on cloud computing, digitalization or cybersecurity is not in place. Table 2 provides a roadmap for these countries to tackle critical legal and regulatory frameworks for the development of a PCS.

digital transformation of the port call will require early on an As-Is business process analysis that will map the legal instruments associated with the vessel clearance process. Part of this first analysis, a To-Be analysis should highlight other legal instruments that should be considered, such as an electronic transaction act, data protection act, critical infrastructure act, and cyber security act as described in table 1

4.1. Cross borders agencies

The director of legal affairs of a port authority or relevant government ministry have a key role to play in creating the right legal frameworks for a PCS. A recent analysis of two international financial institutions projects highlights that the port call legal framework could impact 18 laws, decrees, and regulations in a large South American state and 11 legal instruments in one of the Small Island Developing States (SIDS) in the Pacific. The

4.2. Telecommunication Act

Many emerging and developing countries are still struggling in the implementation of digital infrastructure due to a lack of suitable telecommunication infrastructure nationwide and/or at the port community level. That means the review of regulations related to the telecommunication infrastructure is critical. Public management or private concessions of telecommunication infrastructure are expected to ensure good connectivity

---

19 Regulation (EU) 2019/ of the European Parliament and of the Council of 20 June 2019 establishing a European Maritime Single Window environment and repealing Directive 2010/65/EU (europa.eu)

Table 2.

Government	Topics	Legal Framework
Line Ministries & Governmental Agencies	Existence of PCS in the national legislation Mandatory use of PCS by all public and private stakeholders Removing hard copies Stopping human interactions Data collaboration with all Concessionnaires	Port Act Port Security vt Maritime Act Customs Act Immigration Act Health Act Agriculture Act Environment Act Biosecurity Act Carriage Good at sea Act Concessions
Digital Ministry	Data Governance	Data Governance Act Digital Government Act Electronic Transaction Act Data Protection Act Transparency Act Ecommerce Act Open Data Act
National Security	Resilience of critical infrastructure	Cybersecurity Act Critical Infrastructure Act
Telecommunications Regulator	Enabling high performance and resilient infrastructure Cloud, Fiber, 5G	Regulations Cloud Act

services throughout the national territory. However, given the increase in the demand and consumption of these services, in some countries, mainly developing countries, there are problems with the quality of the service, for example, poor signals for cell coverage, need for greater bandwidth of Internet, including fiber.

Where a PCS generates an increase in the use of telecommunication infrastructure in a region it is important to take regulation into account. This is vital to strengthen and expand telecommunication infrastructure to meet the needs of the PCS and its hinterland. A review of the telecommunication act can take place as part of reviews of a cybersecurity act and the resilience of critical information infrastructure.

4.3. Concessionaires

When implementing a PCS, there is an opportunity for the port authority or the government to review existing concession agreements with terminal operators and other services operators to ensure that data collaboration, and cybersecurity is embedded in these agreements. This ensures data governance is established for the terminal operator to make reliable data available and exchanged data with the PCSO to enable supply chain resilience and foster collaboration.

4.4. Data governance

Equally important to the legal and regulatory framework, is the national framework of acts, laws or regulations for paperless trade and electronic transactions. The PCS requires a legal and regulatory environment that encourages the use of electronic transactions, recognizes e-signatures, and enables paperless trade. Jurisdictions that have dedicated resources to implement trade single windows under the WTO's Trade Facilitation Agreement and other allied international treaties should have already adopted such regulations.

Provisions relating to electronic transactions usually prescribe that electronic communications are legally valid and have the same legal effect as paper-based documents. Legislation with such provisions has been introduced all over the world and usually contain terms such as "Electronic Transactions" or "Electronic Signatures" or "E-Commerce" in the title.[20] Within the context of the PCS, such provisions could enable recognition by the PCSO of digital contracts, such as freight forwarding service agreements, or even e-certificates carried by shippers to prove compliance with maritime laws. If such legal provisions already exist, the PCSO would be prohibited from demanding hard copies of these digital documents. Further, legislation relating to electronic transactions also provides details on admissibility of e-documents as evidence in litigation or regulatory proceedings, adding an additional layer of security to digital transactions.

A whole host of legal regulations are required to ensure the reliability of e-signatures. Apart from recognizing the validity of e-signatures, legal infrastructure also needs to prescribe approaches for the recognition of e-signatures produced abroad. To adopt the typology developed by the UNESCAP,[21] three distinct legislative approaches have emerged with respect to recognition of electronic signatures:

a. The Minimalist Approach: all technologies for electronic signature may be recognized on an equal basis if it satisfies basic requirements laid out in the legislation.

---

20   See generally, Electronic Transactions Act (Belize), Law on Electronic Signatures (Honduras), Electronic Transactions Act (Jamaica), Electronic Transactions Act (Singapore).
21   United Nations ESCAP, Electronic Single Window Legal Issues: A Capacity-Building Guide (2012) 25-29.

b. The Two-Tiered Approach: legal validity of different e-signature methods is recognized but certain technologies offering higher levels of security are given stronger legal status.

c. Prescriptive Approach: demands the use of a specific technology.

E-signature technology lies at the heart of the PCS, as the data collaboration platform will provide the basis for many contracts relating to port services, such as pilotage or tugboat services. Given the prevalence of three approaches to recognition of e-signatures, any lack of specific regulation in this area would increase the uncertainty relating to e-signatures, which will impede smooth functioning of the PCS.

The exchange of transferable records[22] such as bills of lading, bills of exchange, promissory notes, and warehouse receipts amongst port community stakeholders is essential to get imports and exports across the border. The legal infrastructure relating to "paperless trade" relates to provisions operationalizing the electronic transmission of such transferable records. Compared to provisions on e-signatures and electronic signatures, legislation on paperless trade is rarer.[23] UNCITRAL's Model Law on Electronic Transferable Records of 2017[24] provides a blueprint of paperless trade legislation. It recognizes the functional equivalence of electronic transferable records to paper documents and the requirements to establish reliability of an electronic transferable record.[25] Per the Model Law, electronic transferable records should be treated on a par with transferable records when: the electronic transferable record contains the requisite information and where a reliable method is used to identify the electronic record, to render the electronic record subject to control and to retain the integrity of the electronic record.[26]

In the likely event that the jurisdiction has not already enacted legislation on paperless trade, the PCS operator could enact such norms through bilateral agreements with other authorities or frame regulations governing the subject. The ability of the PCSO to implement such rules will depend on the structure of the operator (for example, concessionaire or statutory body), an issue which will be discussed later in this chapter.

4.4.1. Data governance issues: Ensuring data quality, protection, retention, and access

As discussed in Chapter 1, the PCS will perform two roles: (a) Data collection by operating a reporting gateway for Customs brokers, freight forwarders, shipping agents, carriers and other stakeholders. (b) Data distribution to authorities, such as Customs officers, port health authorities, immigration, port, and maritime security officials.[27] The data handled by the PCS might include commercial information relating to cargo, personal information regarding crew members, financial information, and confidential business information regarding services provided by carriers and other operators. Such information, and specifically sensitive or personal data is likely to trigger obligations under national law relating to privacy and data security.[28]

While the scope of obligations imposed on data processors and data controllers varies considerably all over the world, PCSOs should anticipate compliance with the following basic obligations:

- Enacting a comprehensive policy which states the purpose of collecting sensitive information and its usage and limiting collection to what is necessary for that purpose.

- Obtaining consent of the data subject for collection, processing, and retention of information.

- Implementing appropriate technical and organizational measures, such as pseudonymization and encryption to protect rights of data subjects.

- Informing data subjects of any possible security breaches.

- Not retaining the information longer than required for the purpose for which it was collected.[29]

Data-related issues might arise for the PCSO due to legal obligations as well as commercial or operational necessities. For ease of understanding, such issues can be grouped into four categories: ensuring data quality, protection, retention, and access.[30]

---

22 Transferable documents are defined by UNCITRAL as "paper-based documents or instruments that entitle the holder to claim the performance of the obligation indicated therein and that allow the transfer of the claim to that performance by transferring the document or instrument". Article 2, Model Law on Electronic Transferable Records of the United Nations Commission on International Trade Law, Resolution adopted by the General Assembly on 7 December 2017, on the report of the Sixth Committee (A/72/458).

23 As per the World Bank's Digital Trade Regulatory Readiness Index, only 16% of the Central American countries studied (Belize, Costa Rica, El Salvador, Honduras, Nicaragua, Panama, Dominican Republic, Haiti, and Jamaica) had provisions relating to Paperless Trade. All Central American countries had provisions relating to electronic documents.

24 Model Law on Electronic Transferable Records of the United Nations Commission on International Trade Law, Resolution adopted by the General Assembly on 7 December 2017, on the report of the Sixth Committee (A/72/458).

25 Articles 9 & 10, Model Law on Electronic Transferable Records of the United Nations Commission on International Trade Law, Resolution adopted by the General Assembly on 7 December 2017, on the report of the Sixth Committee (A/72/458).

26 Ibid.

27 This description borrows from the description of national single windows in Commission Staff Working Document Impact Assessment Accompanying the document Proposal for a Regulation of the European Parliament and of the Council establishing a European Maritime Single Window environment and repealing directive 2010/65/EU.

28 See, for instance, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [2016] OJ L 119/1

29 Articles 24, 28 and 32, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [2016] OJ L 119/1; Information Technology (Reasonable security practices and procedures and sensitive personal data or information) Rules, 2011 (India).

30 United Nations ESCAP, Electronic Single Window Legal Issues: A Capacity-Building Guide (2012) 32-37.

Maintaining data quality, or the accuracy and integrity of data will be crucial for all PCS stakeholders. After all, a PCS will not be used unless every stakeholder has complete trust that all data on the platform is complete and reliable. Maintaining data quality will require formulating guidelines for interoperability between the stakeholders and the PCSO and the procedure for rectification of incorrect data.

Data protection by the PCSO will involve a determination of what data needs to be protected and the kind of information security measures to be adopted.[31] Biographical details of the crew and passengers are always likely to be regulated sensitive personal information under national data and privacy laws. The PCSO will need to establish guidelines to determine which class of data needs to be protected. PCSOs may be under an obligation to encrypt or pseudonymize the data under national law.[32] Further, national laws that criminalize unauthorized access to a PCS databases may add to data security. Other best practices on data protection include establishing secure user authentication protocols, routine monitoring of systems for signs of unauthorized access, utilizing firewall or operating system security patches.[33]

Since PCSOs will be collecting information for regulatory authorities, it is likely that they will be under a legal obligation to retain such information for regulatory scrutiny and audits. Unless the legal regime pertaining to electronic records governs the issue, the PCSO will have to establish technical guidelines for storing of files and ensuring authenticity of records upon retrieval.

Lastly, the access and data exchange processed by the PCSO will need to be defined for three different types of entities. First, the PCSO will need to determine which types of governmental entities can access the data. While it may seem efficient for the same dataset to be used by different governmental agencies, recall that data processing and collection is limited to the original purpose of collection under most national regimes. Further, even where access by multiple governmental agencies is deemed necessary, memoranda of understanding will need to be negotiated so that subsequent users of data observe the same standards of data security and confidentiality observed by the PCSO. Secondly, the PCSO may need to determine what type of private entities have to exchange data and access the data, as well as the role and responsibilities of specific users and whether such access to data compromises the neutrality of the PCSO or leads to a conflict of interest between private parties. Thirdly, when data is shared and accessed with authorities from other countries, an inter-governmental arrangement may be necessary.

4.5. Essential agreements for effective functioning of a PCSO

The roles and responsibilities of various stakeholders and service providers in the PCS will need to be captured in contracts, to ensure predictability and enforceability of obligations. While different kinds of contracts will depend on the structure of each individual PCSO, at least three different types of agreements will be required:[34]

a. A service level agreement ("SLA") for the implementation of the PCS platform: This contract will capture the commercial conditions for establishing the data collaboration platform and the underlying technical infrastructure, such as third-party solutions (with various layers for messaging, message transformation, persistence, application server, database, and operating system), maintenance services and post-implementation services.

b. SLA for the PCSO: This contract will capture the obligations relating to contract management, quality planning, control and assurance, overall service administration, and security services etc.

c. Statement of Service Level Objectives: This document communicates the organization's guarantee of good customer service to the public. It identifies the service providers and states the intent of the project. Further, it provides guidance for the list of services offered by the PCSO as well as the standards of service in terms of quality, timeliness, reliability, and accessibility.

d. End User Agreement ("EUA"): Standard form agreement that will be executed when the users sign up for the platform. The EUA will contain the rights and responsibilities of the PCSO, other service providers, such as freight forwarding agents, Customs brokers, carriers, terminal operators, multimodal operators, or proprietors of bonded warehouses and shippers and cargo owners.

Apart from the agreements mentioned above, different governmental entities will need to execute memoranda of understanding which outline their roles and responsibilities with respect to the PCSO.

It is possible for the SLA for the operation and implementation of the PCS platform to be executed with a private sector entity. The next section will discuss the governance of the SLA operator, i.e. the advantages or disadvantages of governing the SLA operator

---

31   Ibid.

32   Article 32, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [2016] OJ L 119/1.

33   United Nations ESCAP, Electronic Single Window Legal Issues: A Capacity-Building Guide (2012) 32-37.

34   This sub-section is based on the guidance provided in the World Bank, Lao PDR Preparation of a National Single Window: A Blueprint for Implementation (Report No, 78553-LA) 2013 [Hereinafter, "Lao PDR Blueprint"].

through a concession agreement or through the legislation dealing with public private partnerships in the country. This section will deal with the standard commercial terms contained in each of the SLAs and common issues to keep in mind for governments setting up a PCS.

4.6. PCS Implementation SLA

The implementation phase involves setting up the PCS platform from scratch. The PCS implementation SLA will have two parties: first, the main governmental entity, which may be the Customs or port authority, on the one hand, and a private sector entity specializing in technology solutions for border management operations.

The PCS Implementation SLA should capture the following core responsibilities of the PCS Implementer:[35]

a. Comprehensive project management services, including project planning, monitoring, control, and reporting.

b. System integration, including total integration of application software, technical infrastructure, physical infrastructure, and other services.

c. Management of the team of experts for implementation tasks and services.

d. Maintaining the escrow holding of the PCS data collaboration platform. All software and software engineering artefacts should be held by the governmental entity so that the governmental entity or the PCSO can take over possession if required.

e. Configuration, data conversion and data take-on: including data conversion for reference data such as tariff, country codes etc., initial access control tables for each governmental agency.

f. Training: Training should be role based, for personnel at governmental agencies as well as traders.

g. Acceptance assistance: draft an acceptance test plan which contains the acceptance test environments, and scenarios.

h. On-site technical and operational assistance for an initial period.

i. On-call support for an extended period of perhaps five or more years.

j. Support and maintenance of the physical and technical infrastructure and the application solutions for an initial period of 2 years or more years.

k. Ongoing cost-plus services available for evolution and additional system design, development, and implementation.

The SLA should be easy to understand, and the services provided should be measurable. To aid measurability, service levels should be identified in terms of quantity, quality, timeliness, and cost. Further, these measurements need to be "baselined" i.e. the governmental entity needs to measure performance metrics in the status quo, both in terms of transactions, as well as certificates issued.[36]

Apart from these commercial terms, the SLA would also cover standard legal provisions, such as commencement date, fees, and credits, monitoring and reporting, termination provisions, indemnities, conditions precedent, representations, and warranties, as well as dispute settlement.[37]

4.7. PCS Operation SLA

The PCS service level agreement (SLA): The SLA is a contractual agreement between a port community system operator and its customers, which outlines the level of service and support that the operator will provide. The SLA typically includes a range of components, such as service descriptions, performance metrics, service level targets, remedies for non-compliance, customer responsibilities, and support and maintenance services.

The signing parties of an SLA for a PCS can vary depending on the specific circumstances. The SLA for a PCS is a critical document that helps to ensure that the operator and its customers have a shared understanding of the services that will be provided, the performance targets that will be achieved, and the responsibilities of each party. By having a clear and comprehensive SLA, PCSOs can establish trust and confidence with their customers and provide high-quality services that meet their needs.

The table of contents of a sample SLA is provided in Annex 1.

Signing parties: Typically, the PCSO will be the primary signing party, as they are responsible for providing the services outlined in the SLA. The customer or customers using the PCS to manage their supply chain operations will also be signing parties. In some cases, the SLA may involve multiple customers, such as shipping lines, freight forwarders, and Customs brokers, who are all using the PCS to coordinate their activities.

35   World Bank, Lao PDR Preparation of a National Single Window: A Blueprint for Implementation (Report No, 78553-LA) 2013 41.
36   World Bank, Lao PDR Preparation of a National Single Window: A Blueprint for Implementation (Report No, 78553-LA) 2013 283.
37   World Bank, Lao PDR Preparation of a National Single Window: A Blueprint for Implementation (Report No, 78553-LA) 2013 282.

Formal outline of service to be provided: The SLA for a PCS is designed to establish clear expectations between the PCSO and its customers. It outlines the specific services that the PCSO will provide, such as cargo tracking, vessel scheduling, and customs clearance, as well as the performance metrics that will be used to measure the effectiveness of these services. The SLA also sets out the service level targets that the PCSO will aim to achieve, which are typically based on industry standards and best practices.

In addition to the standard terms covered in the PCS Implementation SLA, the PCS Operation SLA should capture the following core commercial responsibilities of the PCSO:[38]

a. Short, medium, and long-term business planning.
b. Contract management.
c. Quality planning, control, and assurance.
d. Overall service administration: including start and close of jobs according to schedules, restart of services when required, data backup tasks and recording operational service levels.
e. Security services including ensuring physical security of infrastructure as well as ensuring safety of different data sets.

f. System and network administration.
g. Configuration management.
h. Cybersecurity
i. Business continuity, including the maintenance of data back-ups.
j. Operation of physical sites and facilities, technical infrastructure, and application services.
k. Help desk services.
l. Support and maintenance.
m. Service enhancement.
n. Liaison with third party suppliers including: PCS Implementer, data communications carriers, suppliers of support and maintenance services.
o. Capacity planning and response (typically modifying or enhancing facilities or resources, or equipment quantities or capacities).
p. Liaison with PCS governmental entity concerning billings, revenue sharing, SLA setting, SLA monitoring, SLA consequences (for meeting, exceeding or failing), and PCS service modification and enhancement.
q. On going liaison with stakeholders in the context of the institutional framework addressed in chapter 4, to discuss experiences regarding service usage and to solicit opportunities for enhancements.

---

38   World Bank, Lao PDR Preparation of a National Single Window: A Blueprint for Implementation (Report No, 78553-LA) 2013 257.

5. Countries Review

5.1. Jamaica

On February 27, 2012, Jamaica's cabinet took decision No. 08/12[39] approving the establishment of a PCS and requesting the Port Authority of Jamaica and Jamaica Customs to implement the PCS for the shipping industry. It was created as a public-private partnership (PPP) together with the Shipping Association of Jamaica. A competitive tender process for the selection of a suitable partner was part of the plans.

In 2015, the first key action of the Port Authority of Jamaica —taken just after signing the agreement with a technology partner to design, build and maintain the PCS— was to issue in the gazette, under the aegis of the Minister of Finance and Planning, a regulation under Port Authority Act as Port Authority (Port Management & Security) Regulation 2015[40] including the PCS.

According to section 2 of the regulation: "Port Community System" means a facility for the electronic transfer of information in connection with port facilities and "user fee" includes fees for security services, Port Community System services, registration fees, authorization fees and facilitation fees."

According to section 3: "The use of port facilities by authorized importers and exporters shall be subject to the Port Community System and the user fees applicable thereto."

According to section 4: "Every importer who imports or proposes to import goods or equipment into Jamaica shall apply to the Authority to be designated as an approved importer for the purposes of the Port Community System."

It ensures compliance with Jamaica's Customs requirements, data harmonization across Customs, terminal operators and public bonded warehouses, and full interoperability of the PCS with ASYCUDA World. The Jamaica PCS was designated as an authorized Customs Electronic Communication System —pursuant to Section 206A[41] of the Customs Act (as provided by Section 11 of the Customs [Amendment] Act 2014)— for the single point of submission of maritime cargo manifests prior to the arrival and departure of vessels.

5.2. Mauritius

In 2008, the Minister of Finance of Mauritius gazetted a comprehensive regulation under section 163 of the *Customs Act*, known as the *Customs (Cargo Community System) Regulations* 2008,[42] introducing under section 2 the definition of "authorized economic operator", "cargo community system" and "risk management" to enable the implementation of the PCS in Mauritius. CCS regulation covers not only the operational context of the CCS, but also the CCS operator, transaction fees and return on equity for a fair cost to the Mauritian consumer.

Under section 2, the regulation refers to the fact that *"economic operator"* means: *"any importer, exporter, manufacturer, freight forwarding agent, broker, carrier, port operator, airport operator or proprietor or occupier of bonded warehouse; and includes any party involved in the international movement of goods in whatever function, registered with the Director-General under regulation 5 to use the cargo community system; and that CCS means the electronic network system for the submission of advance information relating to cargo before the cargo is either imported into, or exported from, Mauritius by any mode of commercial transportation".*

Section 3 of the regulation refers to the fact that: *"No organization shall operate the cargo community system unless it is approved by the Minister"* and *"Where an organization is approved under paragraph (1), the approval shall be for a period of 10 years as from the date of the coming into operation of the cargo community system and may be renewed for one or more periods not exceeding 5 years, subject to such terms and conditions as the Minister may determine."*

Under section 4, the regulation refers to the fact that: *"(1) No economic operator shall, for the purposes of section 16A(b) of the Act, import into, or export from, Mauritius any cargo, as from such date as may be determined by the Director-General, unless he submits advance information relating to cargo through the cargo community system. (2) For the purposes of paragraph (1), the cargo community system shall interface with Trade Net and the Customs Management System, on such terms and conditions as may be mutually agreed by the parties operating the systems".*

Under section 10, the regulation refers to the fact that: *"Every economic operator shall first register with the Director-General in such form and manner as may be determined by the Director-General specifying (a) his full name and address; (b) the location of*

39   https://www.portjam.com/pdf/P.A.%20ANNUAL%20REPORT1.pdf
40   https://www.portjam.com/paj-act/The-Port-Authority-Port-Management-and%20Security-Regulations-2015.pdf
41   https://www.jacustoms.gov.jm/sites/default/files/docs/Legislation/339_THE%20CUSTOM%20(AMENDMENT)%20ACT%202014.pdf
42   https://www.mra.mu/download/CargoCommunitySystemRegulations2008.pdf

his computer system; the full name and designation of each of the persons authorized to operate the cargo community system".

Under section 11, the regulation refers to the fact that: *"Any fee or charge imposed by the organization for the supply of services to economic operators shall: (a) not exceed 325 rupees per electronic declaration during the 3 years following the date of the coming into operation of the cargo community system; and thereafter, not exceed such amount per electronic declaration, as may be determined by the Director-General by taking the rate of return on equity calculated at Repo rate plus 2 per cent".*

Undersection 12, the regulation refers to the fact that: *"No manifest or report of cargo shall be submitted to the Director-General unless it is submitted through the cargo community system within such time as the Director-General may determine".*

Under section 14, the regulation refers to the fact that: *"The economic operator shall be solely responsible for his login and password for all transactions made through the cargo community system and all consequences arising from its use or misuse."*

Under section 15, the regulation refers to the fact that: "*Any person who contravenes any of these regulations shall commit an offence and shall, on conviction, be liable to a fine not exceeding 200,000 rupees and to imprisonment for a term not exceeding 5 years".*

5.3. Peru

In 2020, the President of the Republic of Peru gazetted the presidential decree N° 008-2020-MINCETUR,[43] as a regulation to enforce the provisions of Law No. 30860 for Strengthening the Single Window for Foreign Trade, including the PCS and the Maritime Single Window.

Under article II, paragraph 5: *"Public and private entities …must collaborate with each other for process improvement of foreign trade services and transactions."*

Under article II, paragraph 23: *"The port call includes all the activities since arrival, stay and departure of the ship."*

Under article III, paragraph 15: *"Port Community means a collective made up of private and public actors participating in the logistics chain of a port, as it appears from the definition of Law No. 27943, Law of the National Port System National, and the National Port Development Plan. Port Community is also understood as the Maritime Port Community."*

Under article III, paragraph 4: *"Port Community System means an open and neutral electronic platform able to interact with any operating system, for the electronic integration of public or private actors linked to the maritime port domain, in accordance with the provisions of the numeral 12.1 of Article 12 of the Law. In the international context, as recognized by the International Association of Port Community System, a Port Community System is an open and neutral electronic platform that optimizes, manages, and automates interoperability of logistics processes through a single submission of data, which enables intelligent exchange and information security between the parties involved in public and private sectors."*

Under article 67: *"The Customs Administration shall transmit to the foreign trade single window, the information of the maritime cargo manifests, deconsolidated ocean cargo manifests and, consolidated, and the river cargo manifests received from carriers or their representatives or agents of international cargo for their respective use by the competent entities and other users of the Port Community System, if applicable".*

Under Article 88: *"The scope of port community is in accordance with article 12 of the Law. The PS allows public actors and companies that are part of the port logistics chain to optimize, digitize and automate their processes and procedures, facilitating the reuse of data and the secure exchange of information, safely, between them".*

Under Article 89: *"The users of the port Community System are a. Port managers, b. Regulated foreign trade operators by the General Customs Law, approved through the Legislative Decree No. 1053, c. Providers of complementary services to the cargo, ship and passengers, d. The consignees and / or owners of the cargo, as well as financial and insurance entities related to foreign trade operations, and. SUNAT, SENASA, APN, DICAPI, Immigration, DIRESA Callao and all public entities with responsibilities in the control of the entrance or exit of ships, crew or passengers, activities related to the stay of the ships or to the general management of the logistics chain".*

Under Article 90: *"The services of the Port Community System among others [are] a. Electronic system of coordination and interoperability between operators to optimize the flow of entry and exit of cargo and transport ships… [and] eliminate the use of paper…[and] physical processes that require face-to-face procedures, where appropriate, b. Traceability of cargo and activities, and c. Interoperability with the foreign trade single window, the systems of Customs Administration, or other entities, if applicable, as well as between the systems of the actors involved."*

Under Article 91: *"MINCETUR exercises the management of the Port Community system, in accordance with article 4 of the Law*

---

43 https://cdn.www.gob.pe/uploads/document/file/1537066/DS%20N%C2%B0%20008%20-%20Aprueba%20reglamento%20de%20la%20Ley%20N%C2%B030860%2C%20 Ley%20de%20fortalecimiento%20de%20la%20ventanilla%20%C3%BAnica%20de%20comercio.pdf.pdf?v=1610127379

and article 12 of these Regulations. The port communities recognized by the relevant legislation, such as collaborative forums in the logistics chain, shall cooperate with MINCETUR and the National Port Authority in the implementation and improvement of the system."

Under Article 92: *"The use of the Port Community System is mandatory for actors related to the maritime port domain, and its implementation is gradual according to the provisions established by the MINCETUR. The actors of the Port Community must make the necessary adjustments in their processes of exchange of information, without implying the alteration of their business models."*

5.4. Morocco

In 2010, the Prime Ministerial decree No. 2-10-146[44] was gazetted, related to the establishment of PORTNET PCSO under the aegis of the Ministry of Finance and Economy, as a specific purpose vehicle based on public-private partnership between the national port authority of Morocco and the port community. The decree states that the private company has equity of 6 million Dirhams and capital expenditure of 41 million Dirhams and an estimated internal rate of return on equity is 11.5%.

In 2015, the Minister of Industry and Commerce decree No. 1675-15[45] was gazetted, regulating the mandatory use of PORTNET for maritime trade logistics import and export processes.

Decree 1675-15 —recalling the 1992 Law 13-89 related to foreign trade, amended and supplemented by Law No. 3-96 in 1993, the Decree n° 2-93-415 related to foreign trade and the 2007 Law No. 53-05 related to the electronic exchange of legal data— establishes in Article 1: *"The subscription of the import commitments and import licenses provided for in article 2 of the decree n° 2-93-415 referred to above must be done electronically, on the computer system of the company Portnet, under the conditions provided for by Law No. 53-05 referred to above and its implementing texts."*

Decree 1675-15 establishes in article 6: *"The application for an import license must be presented by the importer through the computer system of the company Portnet. This request is transmitted electronically to the Ministry responsible for foreign trade."*

Decree 1675-15 establishes in article 16: *"The electronic subscription of the export license by the exporter must be done through the computer system of the company Portnet."*

5.5. Democratic Republic of Congo

In 2014, the government of the Democratic Republic of Congo selected and granted a consortium to design, build, finance, operate and maintain a national multimodal port community system (air, road, and sea) as a trade logistics single window and a cross-border regulatory single window into one single window environment, known as SEGUCE DRC. Additionally, it gradually created a legal framework to support a concession agreement, the implementation, and the operation of the PCS and the CBRSW environment as outlined in paragraphs 48 to 54.

Under Prime Minister's decree No. 014/20 of August 2, 2014, the concession agreement was agreed for the design, build, financing, operation, and maintenance of SEGUCE DRC.

Under Prime Minister's decree No. 15/018[46] of October 14, 2015, was established the institutional framework for SEGUCE DRC with an inter-ministerial oversight committee composed of the Ministers of Commerce, Finance, Budget, Economy and Transport, representatives of the President's Office, representatives of the Prime Minister, and a steering committee including all key public and private stakeholders.

Under Prime Minister's decree No. 15/019[47] of October 14, 2015, was established SEGUCE, the Single Window for Foreign Trade.

Under inter-ministerial decree No. 035 CAB/MIN/FINANCES/2016[48] and No. 005/CAB/MIN-COM/2016 of March 23, 2016, was introduced SEGUCE DRC, annual of harmonized procedures.

Under Inter-ministerial decree n°005/CAB/MIN/FINANCES/2016[49] and n°002/CAB/MIN/COMMERCE/2016 of 13 February 2016, was established SEGUCE DRC transaction fee.

The inter-ministerial Decree No. 001/CAB/MIN-COM/2016/005[50] and No. CAB/MIN/FINANCES/2016/004 of February 16, 2016, amended previous decrees related to SEGUCE DRC Steering Committee.

Under Ministry of Commerce Circular Note No. 001/CAB/MIN-COM/2016[51] of 19 April 2016, was established the mandatory use of SEGUDE DRC.

---

44   https://rabat.eregulations.org/media/d%C3%A9cret%20cr%C3%A9ation%20portnet.pdf
45   https://www.mcinet.gov.ma/sites/default/files/Arretes/arrete_13-89.pdf
46   http://www.leganet.cd/Legislation/JO/2015/Numeros/JO.15.11.2015.pdf
47   http://www.leganet.cd/Legislation/JO/2015/Numeros/JO.15.11.2015.pdf
48   https://www.segucerdc.com/Content/documents/49f0d0f7010c4ac8944c993b2a333691.pdf
49   https://segucerdc-panel.azurewebsites.net/Content/documents/05fed766982d4e76b04be90756271a40.PDF
50   https://www.droitcongolais.info/files/651.02.16-Arrete-du-16-fevrier-2016_Guichet-unique_Comite-directeur.pdf
51   https://www.leganet.cd/Legislation/JO/2017/Numeros/JOS.27.04.2017.pdf

5.6. New Caledonia

In January 2022, the parliament of New Caledonia adopted Law 2022-3[52] containing amendments to the customs code and supplying critical provisions on port digitalization related to the implementation of ASYCUDA World and the Port Community system. It introduced the mandatory use of a PCS defined as a seaport and airport logistics information system to comply with customs requirements: *"Persons required to carry out the formalities provided for in this title shall use the port or airport logistics information system deployed at the customs office responsible for the customs operation, in accordance with the terms of the Government of New-Caledonia."*

Law 2022-3 redefines in chapter I, the pre-clearance customs process by providing trade logistics and temporary storage information through the PCS.

In November 2022, the parliament of New Caledonia adopted Law 2022-13 as the new custom code under Law 2022-13,[53] related to the increasing trade logistics digitalization of impacting customs procedures. To streamline customs procedures in compliance with latest international standards, the New Caledonia Customs law had to be entirely revised to be also compliant with the WTO Trade Facilitation Agreement, impacting 459 articles both in the regulatory section and the legislative section. Specific provisions in the new customs code will ensure that the customs authority plays a leading role in the port digital transformation.

The new customs code is also introducing PCS as a seaport and airport logistics information system in article Lp 231-1: *"Persons required to carry out the formalities provided for in this title shall use the seaport or airport logistics information system deployed at the Customs office responsible for the Customs' operation, in accordance with the terms of the Government of New-Caledonia"*.

52   Documentation juridique NC - JOnc 2022 (gouv.nc)
53   https://douane.gouv.nc/sites/default/files/atoms/files/lp_2022-13_du_03-11-2022_partie_legislative_cdnc.pdf

Appendix 1. Sample SLA Table of Contents

Introduction
1.1. Purpose of the SLA
1.2. Scope of the Agreement
1.3. Parties Involved
Service Description
2.1. Overview of Port Community System (PCS)
2.2. List of Services Provided
2.3. Service Levels and Performance Metrics
Service Availability
3.1. System Uptime
3.2. Scheduled Maintenance
3.3. Unscheduled Downtime and Incident Management
Support and Maintenance
4.1. Helpdesk and Support Channels
4.2. Incident Reporting and Resolution
4.3. Maintenance Schedules and Procedures
Security and Compliance
5.1. Data Security Measures
5.2. Privacy and Confidentiality
5.3. Compliance with Relevant Regulations and Standards
Disaster Recovery and Business Continuity
6.1. Disaster Recovery Plan
6.2. Business Continuity Procedures
6.3. Backup and Data Restoration
Reporting and Monitoring
7.1. Performance Monitoring and Measurement
7.2. Regular Reporting and Review Meetings
7.3. Continuous Improvement Process
Escalation and Resolution Procedures
8.1. Incident Escalation Process
8.2. Dispute Resolution
8.3. Contractual Remedies
Terms and Conditions
9.1. Contract Duration
9.2. Termination Clauses
9.3. Liability Limitations
9.4. Confidentiality and Intellectual Property
Annexes
10.1. Technical Specifications
10.2. Data Security Policies
10.3. Additional Supporting Documentation

THE ROLE OF CUSTOMS-PORT COOPERATION IN IMPLEMENTING A PCS

Executive Summary

Key Takeaways

- *Cooperation between Customs and port authorities is critical to the success of a PCS.*

- *Safe, secure, sustainable, and digitalized maritime trade is underpinned by international instruments. These instruments provide a framework to support the operations of a PCS.*

- *Customs and port authorities are kingpins of digitalization and must ensure interoperability of their systems.*

- *Customs take stewardship among cross-border regulatory agencies. Port authorities lead the effort amongst maritime agencies.*

- *Port authorities and Customs must agree on standard policies, procedures, and guidelines that encourage data collaboration and support a matrix of services.*

- *A port authority's responsibility for safety, security, efficiency, and compliance must be matched with and supported by Customs' role in enforcement and trade facilitation.*

- *Customs and port authorities must work harmoniously to achieving a common goal: smooth trade across borders while ensuring compliance with global trade laws.*

The success of a PCS hinges on successful cooperation between Customs authorities and port authorities. They are the kingpins of port and maritime digitalization, determining the policies, processes and procedures that turn a port's digital transformation from vision into reality. Together they ensure safety, security, efficiency and compliance with domestic and international rules, regulations, and laws. A harmonious relationship between Customs authorities and the port authorities is the bedrock on which a strong, secure, and stable PCS is built.

Cooperation between Customs and port authorities is also crucial for accelerating the digitalization and sustainability of maritime supply chains. Close collaboration between Customs and port authorities is vital for the successful implementation and operations of a PCS. Ports and Customs share operational space and facilities and work in a coherent regulatory environment. Their business processes are intertwined, and data requirements are alike. The two authorities share a mutual goal of ensuring safe, secure, and efficient operations.

While port and maritime authorities typically champion the development of PCSs, Customs have a crucial and determining role. There is hardly a PCS that succeeded without the active backing and stewardship of Customs authorities. The involvement, trust, and full participation of Customs in a PCS is vital for its success.

This chapter covers the four pillars of cooperation between ports and Customs: (i) Legal and regulatory. (ii) Institutional and governance. (iii) Business processes and data. (iv) ICT systems and interoperability.

Several international instruments underpin the regulatory environment to support the design and operation of a safe, secure, sustainable, and digitalized maritime trade environment. Countries have adopted these instruments and integrated the commitments made into their national legislation to harmonize the implementation of their respective ICT systems for Customs, trade, port, and logistics systems. Governments are also collaborating with their trade partners at a regional level to promote and implement regional harmonization.

The institutionalization of cooperation between port authorities and Customs is foundational to building trust between them and other port community members. While the National Trade Facilitation Committees focus on the broader issues of cooperation at the national level, the port community needs a dedicated consultation and collaboration platform to work together on issues affecting its members. Local institutional arrangements at each port may involve discussing tactical and operational concerns. At the central level, it may mean dealing with strategic and policy issues. Increasingly, PCSs are being developed for a cluster of ports, or nationally for all ports in a country. Likewise, countries come together to deal in regional groupings to set-up harmonized regulatory requirements and establish and institutionalize regional cooperation.

Port authorities and Customs (along with other border control authorities) must collaborate on the business processes for the clearance formalities of vessels and cargo. Ports and Customs must synchronize their regulatory procedures and clearance formalities, while also ensuring that the operations are optimized and remain efficient. A PCS helps ports and Customs 'to be on the same page' and implement joined-up procedures based on shared data.

Finally, ICT systems of ports and Customs must interoperate to cover the complement of port operations. Several entities are situated at the port in their capacity as contractors (tugboat operators, bunker fuel suppliers, ship chandlers) and concessionaires (e.g., terminal operators). The automated systems operated by these entities also links in the handling of vessel, cargo and passenger operations. Likewise, apart from Customs, there are several other regulatory authorities such as immigration, health, security and environment that must work closely to support automated handling.

1. Introduction

1.1. The context

Customs and port authorities share the infrastructure of trade facilitation. Ports provide the backdrop in which customs and other cross-border regulatory agencies implement their regulations. Those regulations cover a wide range of topics including taxation, health, safety, security, and the environment. Legislation drives the oversight of the regulatory agencies. Ports and airports host and support the physical and operational infrastructure for the movement of goods, passengers and means of transport (vessels/barges/aircraft/trains/trucks) and crew. Building a strong collaboration between the port authorities and Customs is vital.

1.2. Outline and boundaries of the chapter

In this chapter we briefly examine the relationship between port authorities and Customs and the rationale for collaboration for the development of a PCS. The chapter does not discuss the detailed technical, legal, and business model aspects of the PCS. We look at the main motivations for the port and Customs to collaborate in implementing a PCS, namely: (i) To ensure that a port remains safe, secure, efficient, and economically competitive. (ii) To facilitate trade by simplifying and streamlining the bureaucratic procedures at ports.

2. PCS and the complementary roles of Port Authorities and Customs

Ports constitute critical infrastructure for trade. They are often the beating heart of their region's economy. Ports serve at the national frontiers. Therefore, protecting the ports and their operations constitutes vital national security interest. The port authority provides infrastructure and facilities port operations and supports regulatory inspections for cargo control. They also provide digital systems for processing and communicating information about cargo and transportation. The port authority assists with regulatory inspections that are conducted in designated control areas for veterinary, waste, or dangerous goods controls. Port operators must comply with measures related to plant protection, phytosanitary controls, animal and veterinary controls, food and feed safety, and sanitary measures. The port authority ensures that regulatory inspections are coordinated and conducted in a simultaneous manner.

Discontinuities or disruptions to port operations will have major ramifications for the associated supply chains and in the case of major ports, can seriously impair economic activity. Customs are the gatekeepers at the port, as they nearly always take the final decision on the release of the goods from the port, with a responsibility to protect the economic frontiers of the country. They must exercise control over the flow of all means of transport (vessels/ barges/aircrafts/trains and trucks) and goods entering or leaving the port to ensure that they conform to regulations and do so without impacting the efficiency of port operations. Port authorities also have some regulatory responsibilities. The following table briefly compares the responsibilities of the two organizations:

To implement the respective mandates, it is necessary to have close and trustworthy co-operation between ports authorities and Customs. Under the principles of border agency co-operation, Customs liaise with other government regulatory agencies (OGA's), such as immigration, sanitary, veterinary, phytosanitary, health authorities to ensure that vessel and cargo clearance formalities are followed. Usually, Customs coordinate the final notifications of release or hold on behalf of various border control authorities. Typically, Customs authorities ensure that if the cargo or vessels are to be inspected or controlled, they are carried out synchronously and in a coordinated manner.

Customs operations take place in the infrastructure and facilities provided by port authorities either directly or through their contractors or concessionaires. A port authority works with and through terminal operators, storage yards, warehouses, tank firms, and cargo inspection facilities. On the regulatory side, port authorities must work with the harbor master, port and flag sate control authorities, port safety, fire protection services and marine security and other government agencies. Port and/ or maritime authorities or their concessionaires manage ICT facilities to handle vessel and cargo related information for the movement to the foreland or the hinterland.

Terminal operators are entities appointed by the port authority (often operating under a long-term lease agreement) and are the most important stakeholders in the context of collaboration between Customs and ports. They are responsible for holding cargo securely in temporary storage, protecting against unauthorized access, tampering, or pilferage until Customs decides to inspect cargo or permits its release. Terminal operators manage cargo flows into, out of and through the terminal's premises that are located inside the port. Terminal operators are Customs

Table 1. The collaborative complementary role of Ports Authorities & Customs

Objective	Port Authorities	Customs
Cargo Clearance	Through the port & cargo terminals: Verifying the identity of goods and entities bringing and taking out those goods; Responsibility for the inventory of goods in bonded areas;	Verifying the accuracy and completeness of import, export and storage; documentation, including bills of lading, commercial invoices, and packing lists; Calling port terminals to account for goods, passengers; Customs and port authorities work together to facilitate the movement of goods across borders, by ensuring that import, storage, export and exit procedures are clear and streamlined, and that customs inspections are conducted efficiently.
Safety & Security	The implementation of the SOLAS convention and the International Ship and Port Security (ISPS) Codes; Customs, OGA's and port authorities collaborate to assess the risk associated with different shipments, including the likelihood of smuggling or the presence of prohibited items.	Security and safety measures before the entering or exiting of the goods Customs and port authorities work together to ensure the security of the port and its surrounding areas, by screening visitors and monitoring the movement of goods and people. Customs may also take action against money laundering and terrorist financing; Customs processing of General Declarations, Passenger manifests, Vessel Security Reports.
Health & Safety	Inspecting ships for food safety and infectious disease control; public and environmental health checks; Implementation of Occupational Safety & Health (OSH) Standards for all Personnel at ports including customs officers.	Regulatory restrictions and prohibitions, phytosanitary and veterinary requirements, goods compliance with the safety and health standards intellectual property rights preservation; Drugs, precursors, weapons, marshal goods controls implemented in close cooperation with OGA's.
Taxation & Revenue	Port authorities collect port dues, other fees for the use of port facilities and services.	Customs authorities are responsible for collecting customs duties and other taxes on imported goods
Environmental protection	Intervention of environmental restrictions, waste management services and controls; MARPOL Convention; Port reception facilities; control and safe handling of dangerous goods; For dangerous goods, customs and port authorities work together to inspect cargo to ensure that it complies with relevant regulations.	Enforcement of regulations to control the transboundary movement of waste; protection of trade in endangered wildlife products; control of nuclear and other hazardous material; Customs, OGA's and port authorities collaborate to ensure that shipments comply with environmental regulations, and that the port and its operations do not negatively impact the environment.

temporary storage (bonded) facilities and can be called to properly account for the cargo they handle. They are required to assist Customs and port authorities in the event of an inspection. Implementing a PCS requires terminal operators to be users of and linked to the PCS and to collaborate very closely with Customs and ports. The Customs and port authorities by virtue of their legal powers must effectively persuade terminal operators to collaborate with port community members.

Port Authorities play a facilitating role in the performance of controls assigned to cross-border regulatory agencies (often referred to as OGA's) such as sanitary, veterinary, hazardous waste, dangerous goods etc. Port authorities provide areas designated for the control of such goods. In coordination with Customs, port authorities seek to facilitate joint and simultaneous regulatory inspections in the interest of cost savings and efficiency.

Customs and port authorities need to cooperate closely for effective supervision and law enforcement at ports. Mutual recognition of supervision and coordination of law enforcement can reduce repetition and operating costs for enterprises, as well as reduce input of resources and administrative costs for

both agencies. Coordinated law enforcement can integrate the strengths of both agencies and form a stronger law enforcement force to avoid the negative consequences of disjointed and random law enforcement actions.

Port and Customs authorities highlight the importance of information in the risk-based model for secure international supply chains. Digitalization of maritime cargo information is seen as a common goal for law enforcement agencies, port service providers, and economic operators. Digitalization requires solid relationships and mutual understanding between port and Customs authorities. Pivotal investments into digitalization, such as the PCS and MSW projects, are costly and require long-term planning, and port and Customs authorities must ensure the compatibility and interoperability of various digital systems and conformity with governmental policies. Legislative requirements and restrictions may pose challenges. Factors such as organizational, technical, and financial resources need to be assessed for successful implementation. Data confidentiality and privacy protection policies also need to be considered. Achieving alignment in cybersecurity requirements and standards among various authorities and economic operators is a complex and long-lasting effort.

3. Complementary legal & regulatory powers

Maritime and Customs laws require Customs and port authorities to collaborate closely right at the beginning of a port's inception. That collaboration must continue throughout the port's existence. Customs law typically defines the territorial boundaries of a country for Customs purposes and allows Customs to authorise ports and cargo reception facilities and which locations and facilities can handle cargo under international trade procedures. This principle is defined under Standard 6.1 of the Revised Kyoto Convention, which requires that: "All goods, including means of transport, which enter or leave the Customs territory, regardless of whether they are liable to duties and taxes, shall be subject to Customs control." To maintain physical control on the flow of goods, Customs authorities establish the port facilities as 'bonded' premises that can securely hold imported and export goods that are under Customs control. Customs authorities also specify reporting formalities (including declarations) that ships must submit to facilitate controls.

The time-bound implementation of the IMO FAL Convention provides a unique opportunity to foster Customs port collaboration. The IMO FAL Convention combines the reporting formalities that a visiting ship must comply with and covers all data required by all government agencies situated on shore. The Convention requires contracting parties to provide facilities to receive the regulatory data needed from a calling vessel under various laws to be delivered at a single point of entry ("Maritime Single Window") using a standardized electronic format. By January 2024, the Contracting Parties to the convention must implement the digitalization of the IMO FAL reporting formalities, including the concept of a "Maritime Single Window". At a global level, the WCO and the IMO have partnered to harmonize the IMO FAL Compendium ("The IMO Compendium on Facilitation and Electronic Business") with the WCO Data Model. The updated Compendium has established the global standard on the submission of maritime data. In line with this 'apex-level' collaboration, Customs and port authorities must coordinate locally at the country and port levels to align the legal requirements under their respective Maritime and Trade Single Windows. In a PCS context, a dialogue on the mechanism to implement the FAL requirements provides the ideal framework to cement collaboration between a port and Customs.

To implement a PCS, Customs and port authorities must closely collaborate in providing the enabling legal framework. The two organizations have a common cause in promoting the foundational e-transaction laws that digital logistics platforms, PCSs and trade single windows share with one another. The critical elements of the enabling legal framework for electronic commerce and digital logistics platforms include: (i) Data privacy and security and measures to ensure that personal data is protected, and data breaches are minimized. (ii) The legal framework should recognize electronic signatures as valid and legally binding. (iii) The law should recognize electronic records and transactions, and the courts must ensure their enforceability. (iv)

Box 1. Customs Trade Partnership Against Terrorism (CT-PAT)

The Customs-Trade Partnership Against Terrorism (CT-PAT) is a voluntary program that relies on collaboration between the public and private sectors. It acknowledges that the most effective way for the US Customs & Border Protection can ensure cargo security is through close partnerships with key players in the global supply chain, including the port authorities, importers, carriers, consolidators, licensed customs brokers, and manufacturers. The Security and Accountability for Every Port Act of 2006 established a legal framework for the CT-PAT program and mandated rigorous oversight.

The legal framework should protect intellectual property rights in the digital environment. (v) Contracts entered electronically should be valid and enforceable. (vi) The affected parties should be able to resolve their liability issues and disputes (including the use of arbitration). (vii) There should be adequate consumer protection for PCS users.

Laws enabling the use of private sector data for Customs control are an important aspect of Customs port cooperation in the context of a PCS. PCSs offer the opportunity for Customs to use private sector data to manage Customs controls. PCSs can be an effective platform for cooperation, and regular and systematic consultation between Customs authorities and the port authorities, and by implication, with the members of the private sector that are a part of the port community. The World Customs Organization's SAFE Framework of Standards (FoS) recognizes and recommends the possibility of Customs authorities accessing and using economic operators' commercial systems and to audit them to satisfy customs' requirements. Under the SAFE FoS, customs have online access to the commercial systems of the parties involved. Once the issues of confidentiality are resolved, the arrangement should provide enhanced access to authentic information and offer the possibility for far-reaching simplified procedures.

By aligning with Customs norms under the WCO SAFE FoS, ports can contribute positively to the integrity, safety, and security of the international supply chain. Customs laws and regulations require port authorities and terminal operators to play their part, and PCSs can provide crucial information for achieving those objectives. When a port's facilities fulfil the standards set out by Customs under its Authorized Economic Operators (AEO) regulations, they can become a part of the 'Authorized Supply Chain'. The concept of Authorized Supply Chains refers to the

PHOTO BY: PCS OPERATORS | PORTNET, MOROCCO

possibility that all participants in an international trade transaction are approved and trusted by Customs as observing specified standards in the secure handling of goods and compliant with the relevant regulatory norms. Transactions under an authorized supply chain receive guaranteed and reliable facilitation in cargo clearance with no or far reduced regulatory hold-ups or Customs inspections. The WCO SAFE FoS also mentions Cargo Community Systems (CCS) as a facility wherein ports or airports, and all other parties involved in the transport chain, agree to establish, and operate, an electronic system by which they exchange all relevant cargo and transport related data. "Provided that these systems contain the necessary particulars for Customs purposes, Customs shall consider participating in such systems and extracting the data required for their purposes." The port authority and terminal operator are important elements in the trade chain and should consider accrediting themselves under their respective national AEO programs.

The PCS can help to improve the efficiency and effectiveness of the Advance Cargo Information (ACI) process by providing a single platform for the exchange of information and coordination of activities among the various stakeholders involved. ACI is a Customs requirement under the WCO SAFE FoS that requires the submission of detailed information about cargo and related entities (such as shippers, consignees, and carriers) to a country's Customs authority before the arrival of the cargo. This information includes the description, value, and quantity of the goods and information about the parties involved in the shipment. ACI aims to enhance border security and facilitate trade by allowing Customs authorities to identify high-risk shipments and conduct risk assessments before the cargo arrives. ACI enables Customs officials to identify and prevent the entry of goods that may threaten public safety or security, such as illegal drugs, weapons, or hazardous materials. ACI requirements vary by country, but generally, they apply to all goods shipped into a country. Failure to comply with ACI requirements can result in penalties and delays.

The breach of maritime security poses severe challenges to the resilience and business continuity of port operations, and to meet these challenges effectively, the ISPS Code offers a structure for collaboration between ships and government agencies. The Code helps identify and prevent activities that endanger maritime security. It enables Customs and ports authorities to come together as partners to meet the challenge by facilitating the recognition and prevention of security risks globally. Under the Code, governments are responsible for disseminating security-related information to ships and port facilities. The Code mandates governments to collect and evaluate data regarding security threats and share this information with internal agencies and partner countries. The IMO has harmonized the data requirements under the vessel security report covered by the ISPS code by including them as part of the FAL Compendium. Customs and port/maritime authorities are the main recipients of these reports, and a PCS could facilitate the receipt and dissemination of the security-related reports to all concerned agencies. Individuals working on ships and port facilities must know about security risks and report such concerns to relevant authorities for evaluation. If those individuals are PCS users, they can process the information in a timely manner. Implementing the Code necessitates the creation of an entirely new culture among those engaged in the routine operations of the shipping and port sector.

4. Shared institutional & governance space

Customs and ports must join hands to underpin the governance and institutional framework for implementing a PCS. The institutional basis for Customs-port collaboration must exist at the national, and regional/port levels, because each level must address a different set of problems. To prioritize actions leading to a PCS implementation, port authorities and Customs should work together at the National Trade Facilitation Committee (NTFC) that governments have formed in compliance with the WTO TFA.

Considering the need for a sharp focus on Customs-port collaboration in PCSs, the World Bank and the IAPH recommend the creation of a body that will eventually be subordinate to the NTFC called the National Port Community Council (NPCC) (please refer to chapter 3).

The NPCC can help establish trust between port community members and facilitate trade while securing the supply chain.

The NPCC should have a two-tiered governance framework consisting of steering and business process committees. The steering committee should comprise heads of governmental agencies and trade association presidents, whereas the business process committee should include business process and legal and ICT experts from all members. The steering committee should be responsible for initiating and launching any digitalization initiatives and driving the evolution of the legal framework. The business process committee should review and reengineer business processes, digitize manual processes, implement standardization and cybersecurity, and foster best practices and innovation. The national port or maritime authority and Customs may co-chair the NPCC to signal collaboration and joint leadership on trade facilitation and supply chain security. The patterns of institutional collaboration between Customs and port authorities can be best understood through country examples, some of which are illustrated below:

Box 2. Example 1. United States – Collaboration between FMC and CBP

The Federal Maritime Commission (FMC) and Customs & Border Protection (CBP) are the two federal agencies that share the responsibility to ensure secure and facilitated international trade in the maritime sector. The two agencies enjoy a close working relationship and collaborate extensively toward ensuring greater security, compliance, and facilitation of cargo in the maritime environment. CBP and FM have a complementary mission and objectives. While CBP's mission is to protect and safeguard the country's borders, and to enhance the country's economic prosperity through secure and efficient trade and travel, FMC's mission is "to foster a fair, efficient and reliable ocean transportation system and protect the public from unfair and deceptive practices in the maritime sector." There is a longstanding collaboration between the two organizations to ensure port security and compliance with the Safe Port Act and assist the FMC in fulfilling its regulatory responsibilities under the Shipping Act. FMC and CBP have entered into an MOU to transfer data from CBP's Automated Commercial Environment (ACE) and other systems directly to the FMC to help the latter fulfil its statutory and regulatory duties and responsibilities.

The digital collaboration of customs and ports is reflected in the digital collaboration between CBP's ACE and port terminals at the US's ports. ACE provides a centralized platform for importers, exporters, carriers, port terminals and other trade partners to submit documentation and receive real-time updates on the status of their shipments. ACE is the U.S. government Trade Single Window for processing trade-related import and export data required by government agencies. Through ACE's digital interfaces with ocean carriers and MTOs, CBP helps streamline port logistics while ensuring border security at US ports. ACE ensures that any government agency hold, or release is transmitted as digital messages to inform the carriers and the nominated marine terminal operator (MTO) about movement authorizations, including the physical release of cargo from the marine terminal and to implement holds on cargo movements. The FMC has anchored other collaborative initiatives that require close collaboration with CBP. The most important ones are:

1. Maritime Transportation Data Initiative

2. Ocean Shipping Reform Act of 2022 (OSRA) Implementation

3. Supply Chain Innovation Initiative.

Source: CBP and FMC Websites.

Box 3. Example 2: China's E PORT System as the platform for Customs Port Collaboration

China's digitalization of port processes reached the take-off stage in 1998 with the introduction of the E-Port platform, which provides a unified information system for "one-stop clearance, one-stop logistics, one-stop foreign trade". The platform works at two layers the China E-Port at the national level and the local E-Port serving at the port level. The facility covers the twin functions – the regulatory function of clearance and enforcement at ports, and the window to offer and consume local logistical services. In some respects, E-Port can be considered as a hybrid between a TSW an MSW and a PCS. The institutional framework governing E-Port is similar to the National Port Community Council (NPCC) described above. At the apex level, China's E-Port implementation is driven by the State Council's Inter-ministerial Joint Conference on port Administration, with the Vice Premier of the State Council as the convenor of the joint conference, and the specific tasks are carried out by the General Administration of China Customs (GACC) as the leading department of single window program, with the relevant units jointly to form the Single Window Implementation Working Group with 25 ministries and commissions participating in it.

Chinese government has established tha National E-Port Coordinating and Stering Committee, cordinate the resolution of mayor issues during the building of E-Port.
Administrative office under this committee to be responsible for its day-to-day affairs.
Dedicated body to build the E-Port Systems. It is responsible for the design, development daily operation, maintenance and management of the E-Port systems and networks.

Source: Presentation on "Development & Application of E-Port in China ——Workshop on Single Electronic Window Development for CAREC"

5. Collaboration in business process & data

Customs and port authorities collaborate to manage an array of business processes covering cargo and passenger clearances. Lack of coordination between the port authority, the terminal operator and Customs can potentially delay cargo operations. The following are a couple of examples:

I. *Permission to unload*: A time gap may arise between the berthing of a vessel and the commencement of vessel operations if Customs boarding formalities are not completed, and permits are not granted on time. In some countries, the permission to unload is linked to the completion of boarding formalities, which includes an officer physically boarding the vessel and reviewing documentation received from the vessel's master, and the inspection of the vessel's stores.

II. *Sharing the results of risk assessment*: Customs' risk assessment based on advance cargo information helps generate the list of containers to be released on arrival, sent for inspection or to the x-ray station for scanning. The terminal operator, which develops a tentative unloading plan prior to a vessel's arrival, needs to know about these details sufficiently in advance to finalize the offloading sequence, yard storage plans and delivery plans.

Box 4. Example 3: India- EDI/eTrade provides the platform for Customs-Port collaboration

India's PCS implementation is the product of close collaboration between the port authorities and customs. As the PCS operator, the Indian Ports Association (IPA) front ends the views of the port sector. The 'major ports' of the public sector and other large private ports are IPA members. PCS began its initial implementation in 2008. Before that, customs and port authorities collaborated at the port level, with an installation of the Indian Customs EDI System (ICES) functioning at each port. ICES exchanged electronic messages with the port authorities' systems through local Message Exchange Servers (MES). The message set was developed in the early 2000s. In 2008, Indian customs centralized its ICT platform to cover all ports. ICEGATE, the customs' central EDI Gateway, became the single interface with all external partners and began exchanging electronic messages with the PCS, which acted as the single point interface for all Indian ports.

For nearly two decades, customs and port authorities (led by IPA) worked on the data interoperability framework developed under the government's umbrella "mission-mode projects" (MMP) called Electronic Data Interchange (EDI) For Trade (eTrade). The Cabinet Secretary's office monitored MMPs to ensure high-level stakeholder coordination, focusing on promoting collaboration in the port, aviation, banking and regulatory sectors. In the port sector, the significant effort involved the implementation of the definition and implementation of standard electronic messages between customs, port authorities, terminal operators, NVOCCs, shipping lines (mainline operators) and ship's agents. High-level monitoring of customs-port authority collaboration continues to date and extends to implementing Advance Cargo Information, Direct Port Delivery, and the tracking port dwell time. The National Committee on Trade Facilitation, also headed by the Cabinet Secretary, closely monitors the implementation of the National Trade Facilitation Action Plan 2020-23. The Action Plan includes 66 action items and about a fifth of the action items involve close cooperation between customs and the port sector led by the Ministry of Shipping.

The above examples illustrate the need for mutual understanding between the main stakeholders at a port. The responsibility to resolve such issues rests jointly with Customs and port authorities.

The integration between Customs, the PCS, and the Terminal Operator Systems (TOS) is crucial for the port's cargo entry and evacuation. The PCS is a comprehensive system of information sharing between stakeholders covering: (a) The ocean-going vessel's entry to exit cycle. (b) Cargo import and export cycle. (c) The management of hinterland transport by rail, road, and inland waterways. (d) Payment management for services provided and consumed in the port and terminal process. Customs needs to obtain the most upstream data directly from the commercial and transport sources to be subsequently passed on to the PCS, or alternatively submitted by the information source directly to the PCS where Customs can access it online. Customs has the legal powers to demand and receive advance data on vessels, cargo, crew, passengers, dangerous goods, and ship stores. A port's operations depend on these data streams, which serve as the lifeblood of its operation. In theory, exchanging agreed information and messages between Customs, port authorities, and terminal operators should be automatic and seamless. In practice, this goal takes a lot of work to accomplish and require a collective appreciation of the interlinkages in a port's business process. The collaborative business processes shared by port authorities, terminal operators, and Customs is briefly illustrated below:

5.1. Vessel-related operations

I. Vessel operations begin with the shipping line, or the ship's agent registering a vessel by submitting a detailed vessel profile to the PCS. Port authorities and terminal operators need this data for navigation and vessel docking. The PCS may share a subset of the vessel profile data with Customs because customs must use it to validate the conveyance level data it receives in a conveyance or cargo report.

II. The shipping line or the ship's agent registers scheduled vessel voyages at ports, announcing them on the PCS to inform the entire port community, including ports and customs, who can prepare for the port call's regulatory and commercial aspects and plan the whole port call process.

III. One of the foundational functions of a PCS is the assignment of the stay reference number. The stay reference number is the link that ties up all data and processes surrounding a vessel's call. Upon the request of a ship's agent or shipping line, the port typically assigns a stay reference number to a ship when it arrives at a port. The port authorities, Customs, terminal operators, port services and the rest of the port community use this number to track the vessel's life cycle of operations for the port call. Unless Customs and port authorities agree to share this number as the common identifier, efficient port operations are impossible. By tracking vessels through a unique identifier, like a stay reference number, port authorities can better manage

Table 2. Truck Appointment System via PCS – based on the India PCS Case study

1	**Transport Booking –** The Customs Broker/ Freight forwarder/Container Freight Station/Importer/ Exporter books Trucking company based on the manifest line numbers (in case of imports) and Stay Reference Number (VCN) (in case of an export).	*Action performed on the PCS's web portal*
2	**Transport Booking Acknowledgement –** The Transporter views the Transport Booking Request and approves or rejects the booking request. Once the Transporter approves the booking and allocates truck and driver against that booking.	*Electronic messages exchanged via PCS: TPRORD- Transport Order and PRGMSG- Pre gate information*
3	**Delivery Gate Schedule –** The Terminal Operator/ Port Authority via the PCS shares the Delivery Gate Schedule with all the Transporters who have accepted the booking (for import).	*Electronic messages exchanged via PCS: DGTSCH- Delivery Gate Schedule*
4	**Gate Open Report –** Terminal Operator/ Port Authority share the Gate Open Report to all the Transporters who have accepted the booking (for export).	*Electronic messages exchanged via PCS: GOCOFR- Gate Open cut off Report*
5	**Gate Appointment Booking –** Once the Transporter receives the Delivery Gate Schedule or Gate Open Report, the Transporter completes the Gate Appointment Booking. Transporter allots the time slot to the Port/Terminal.	*Electronic messages exchanged via PCS: GTINAP- Gate In appointment Booking*
6	**Gate Activity –** The driver shares the URN (Unique Reference Number) with the Port gate person. Port gate person verifies the URN. If the verification is successful, the vehicle is allowed to Gate- in or Gate- out from the Port.	*Action performed on the PCS's web portal*
7	**Equipment Interchange Report –** The Terminal Operator shares the Equipment Interchange Report with the Customs Broker/ CFS.	*Electronic messages exchanged via PCS: EIRMSG- Equipment Interchange Report*

the flow of ships in and out of the port, coordinate the use of resources, like berths and cranes, and ensure that all vessels are complying with local laws and regulations. Through stay reference numbers, customs ensures that all vessel calls (and, through them, the cargo they carry) are accounted for. Vessels calling at a port may carry out multiple operations at one or more terminals. To track a ship's schedule and movements, port authorities and Customs may assign rotation numbers to uniquely identify and track the vessels activities. Port and Customs may also use these identifiers to remain on the same page on the vessel's operations, shared via the PCS.

5.2. Cargo operations

I. The implementation of Advance Cargo Information (ACI) is an important area for Customs-port collaboration. Customs administrations worldwide are implementing the ACI process to receive, risk assess and process cargo clearance before the cargo's arrival. ACI enables Customs to identify high-risk cargo and perform targeted inspections, reducing the risk of security breaches. When Customs introduce ACI as prescribed under the SAFE FoS, it helps streamline customs workflows, support pre-clearance, and conclude compliance verification almost as soon as the consignments leave the last port of call. A port terminal can also benefit in several ways from ACI mandates

of Customs. With ACI, port terminals can better plan for the arrival and handling of cargo. ACI allows Customs to pre-notify shipments that require inspection before release, allowing terminal operators to plan their operations, helping reduce the overall processing time and improving the terminal's productivity. Customs prenotification on a PCS also enhances the ability of the shipping lines, freight forwarders, trucking companies, and Customs brokers to plan the uplift and delivery of cargo from port terminals.

II. It is not possible to automate cargo delivery through the gates of port terminals without close collaboration between Customs and port authorities. Terminal gate automation,[1] which is one of the most important modules implemented under a PCS, requires the two organizations to be on the same page and act in unison to ensure that all other members of the port community fall in line with the requirements.

• The terminal operator must provide the infrastructure and technology to automate truck movements at the terminal gates. Gate automation requires a complex array of hardware and software systems, and includes automated boom barriers, RFID readers, automated numberplate recognition systems, smart card solutions, self-service consoles, CCTV systems and integrated vehicle inspection facilities. Customs and port authorities need to agree, preferably at a national level, to set the standards for all terminal operators so that all

---

1 Terminal Gate automation is part of the Terminal Operating System (TOS). Port Gate automation is part of the PCS. Closed ports will have 2 sets of gates: at terminal and port level. Open ports (e.g. Marseille-Fos and Antwerp) have only Gates at Terminal level.

terminal operators provide the necessary data and interfaces to support the automated truck movement system.

- PCSs register truckers, trucks and crew that operate across terminals in a port, and across multiple ports. PCSs can help Customs and port authorities implement the agreed technical and security standards that truck fleet operators and crew must follow. All participants must adhere to standards that enable automated gate operations. For example, Customs and port authorities may require truckers to fix an RFID tag on the truck's windscreens, drivers to undergo security clearance and hold identity cards of a particular technical specification. Together, they must ensure that members of the port community are trained to implement the solutions. Customs and port authorities can create a framework to register trucks that visit the port.

- It is now a global norm in Customs to implement advance cargo information. EU-driven procedures, such as the Import Control System and Export Control System, ensure that authorities have the required advance information for all activities, including truck appointment systems. Customs and ports can collaborate and develop priority services for AEO clients via the PCS. In consultation with Customs, ports can introduce concepts such as fast lanes, dedicated AEO Gates, separate cargo holding areas and priority pathways for AEO clients. Gate automation accompanies a series of exchange of messages between Customs, shipping lines, terminal operators, trucking company, and freight forwarder. The following table captures examples depicting business processes and accompanying exchange of messages:

6. Interoperable ICT framework

Port authorities and Customs spend significant money on ICT and must co-ordinate their investments in the interest of interoperability, economy, synergy, and efficiency. A pattern of longstanding and close collaboration to promote interoperability between port/maritime authorities and Customs is behind every PCS's success story. As kingpins in the digitalization space, Customs and port authorities together provide a large tent to cover the PCS community members, and a partnership between them is vital in establishing and managing interoperability among them. Customs takes the stewardship among cross-border regulatory agencies whereas port authorities lead the effort amongst maritime agencies.

Customs and port authorities may refer to the European Interoperability Framework (EIF), which provides comprehensive guidelines for public authorities implementing collaborative digital platforms. EIF recommends the adoption of a common architectural framework, which may include a set of technical specifications, standards, and guidelines for developing interoperable solutions. For ports and Customs to promote interoperability in a PCS environment, they must adopt EIF's principles of using open standards, reusable solutions, aligned business processes and harmonized data standards across different public authorities and private sector operators. The EIF promotes a governance framework that supports the development and implementation of interoperable solutions. Port authorities and Customs must agree on standard policies, procedures, and guidelines that encourage data collaboration and support a matrix of services. For PCS to promote interoperable solutions, the EIF fosters developing and adopting standard vocabularies, data models, and application programming interfaces (APIs). A community metadata registry and conceptual data model are vital artifacts that support semantic interoperability in PCS implementation.

Customs and port authorities emphasize the need to provide quality data in line with regulatory obligations. Stakeholders submitting the regulatory reports are not owners of the data and therefore only passing on data received from others. This has a double negative effect: first of all, for the competent authorities (Customs, OGA's and port authorities) the low data quality has an effect on the use they can make of it (risk analysis, decisions on actions to undertake, reporting and statistics, etc.) and secondly on the side of trade it could be the source of delays and even penalties or legal liability. A PCS can connect to the relevant stakeholders to receive the data directly. Quality data leads to better risk management, improved controls, and efficient operations.

To enhance and maintain interoperability, Customs and port authorities may develop models using facilities ranging from groupware to sophisticated modelling tools. The various elements of interoperability require working with and through the interoperability of different types of models (business process models, data models, and architectural models). Models are vital for managing the process of developing (and sharing the results of). Models promote efficient communication, information sharing, coordination, and collaboration. Tools that enable teams to work in real-time or asynchronously via a centralized platform (groupware) can assist with communication and cooperation to keep track of goals of interoperability. While models can be represented as text or spreadsheets, the complexity of the transport and international trade environment shows that the usage of modelling standards such as Business Process Modelling Notation (BPMN) or Unified Modelling language (UML) in combination with a dedicated charting tool (open source or proprietary) has many advantages in terms of efficiency, maintenance of models and quality assurance. For instance, to support an interoperable architecture, experts may use TOGAF (the Open Group Architecture Framework) standards and the ArchiMate modelling language

Figure 1. The linkage between business processes (in yellow) and IT services (in blue)
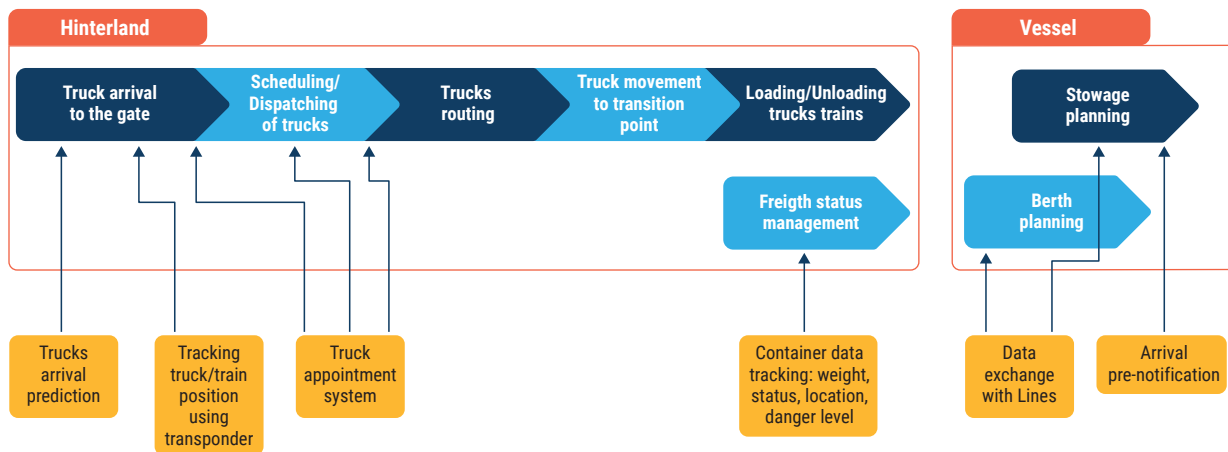
for Enterprise Architecture. The following is an illustration of a diagram describing Vessel-related processes - berth planning and stowage planning and how these processes can be supported by IT-services, covering data-exchange with ocean liners.

It is also commonplace to use diagramming to share interoperability artifacts for business processes. UNESCAP developed the Business Process Analysis Guide[2] that captures a simple methodology to elicit, document, and analyse the existing "as-is" business processes involved in international trade, as well as aid in developing recommendations for further improvement. Likewise, to depict shared data models, PCS participants may collaborate on data models that show the structure and relationships of the standard data elements.

With port authorities and Customs in the lead, all participating organizations must converge on the applicable cybersecurity and data governance rules. When Customs and port authorities come together to implement a Trade Single Windows and PCS, a cyberattack on either system could bring all port transactions to a halt. This would be a significant national security issue. Both authorities should collaborate on cybersecurity and create a joint disaster recovery and business continuity plan. Port authorities are transitioning their PCSs into the cloud to promote resilience and business continuity. The WCO, IMO and IAPH have produced their respective cybersecurity and business continuity guidelines. Customs and port authorities may follow and adapt these guidelines for implementation at Customs and port facilities, such as the PCS.

7. Conclusions

Port authorities and Customs have an important relationship regarding the movement of goods and people across international borders. Port authorities are responsible for managing ports, providing infrastructure, and overseeing the movement of ships, cargo, and passengers while ensuring compliance with relevant regulations. Customs is responsible for regulating imports and exports and collecting taxes on the government's behalf. They also enforce trade regulations to protect countries from illicit goods or harmful substances entering their borders.

PCSs are the living examples of close collaboration between port authorities and Customs. PCSs can contribute to ensuring that all goods and people moving into or out of a port are properly documented and declared legally according to established

rules by both parties involved. Regular dialogue between the two organizations helps ensure a steady flow of trade without any disruption due to miscommunication or misunderstanding on either side. This efficient coordination helps ensure that all processes related to shipping run smoothly without hindrance from unexpected delays caused by improper paperwork handling. This could lead to costly consequences in terms of time wasted waiting at ports before being allowed entry into another country's jurisdiction. A port authority's responsibility for safety, security, efficiency, and compliance must be matched with and supported by Customs' role in regulation enforcement. This means they can work together harmoniously to achieving a common goal: a smooth transition through international boundaries while maintaining strict adherence with laws governing global trade.

---

2   https://www.unescap.org/resources/business-process-analysis-guide-simplify-trade-procedures

FOSTERING PORT PROCESS IMPROVEMENT

Executive Summary

Key Takeaways

- The development of a PCS is linked to the simplification, standardization, and digitization of port logistics processes.

- Process improvement initiatives take the form of simplification, streamlining and standardization of port tasks and activities.

- Port business process re-engineering may be conducted during the design phase or after the adoption of the PCS.

- Public-private consultation mechanisms are a prerequisite for the sustainable and effective process improvement.

- Rapid technological developments allow the utilization of existing big data gathered in the PCS platforms for accurate process mapping and modeling.

This chapter provides an in-depth analysis of the relationship between Port Community Systems (PCS) and Port Process Improvement (PPI). This connection is presented from the perspective of a set of global experiences. It highlights the complex nature of port processes, the need for procedural improvement as a prerequisite for successful PCS implementation, and the benefits of PPI in terms of operational efficiency, trade logistics cost reduction, and trade facilitation.

Port processes cannot be easily defined as each port offers different services. The form and scope of port processes depends on the port's organizational nature across dozens of public and private entities, including port and maritime logistics companies, government agencies, and border agencies delivering interdependent and interconnected activities. It should be noted that port processes can be clustered into operational and compliance processes, the latter imposed by Customs and other border inspection agencies.

Process complexity leads to high logistics costs for port users. More and more ports are leading efforts towards improvement of their processes. Procedural improvement is primarily reflected in the simplification of cumbersome workflows- usually achieved via the elimination of redundant steps- which leads to the reduction of process completion time and removal of associated logistics costs. Once simplified and streamlined, processes are standardized, boosting supply chain predictability. Other benefits of PPI include the optimization of cargo movement, reduction of port congestion, and quick cargo clearance.

PPI is conducted prior to or after the development of a PCS. There is a direct linkage between the PPI and the PCS project cycles. Process identification and mapping tasks usually occur at the design stage of a PCS project cycle. Process simplification and re-engineering are inseparable components of the PCS design process and are proactively done upstream. However, in some cases, PCS developers have settled with just digitalization of processes, while re-engineering tasks are moved to a later stage and after the full adoption of the system when procedural inefficiencies emerge.

Improvements of port processes require substantial institutional support. There is a need for the establishment of robust organizational mechanisms fostering systematic consultations with the entire port community for the systematic and inclusive process identification and discovery. In this context, enhancing the role of existing public-private consultation mechanisms, such as the Port Community Councils (PCCs) and the National Trade Facilitation Bodies (NTFB), is of paramount importance as they allow smooth procedural adjustment to either old but streamlined or newly introduced processes.

Technologically advanced tools allow more accurate and less time-consuming process mapping and modeling. Exiting software allows automated or manual process modeling often by using port big data that exists in PCS or other trade and maritime single windows.

1. Introduction

1.1. Context

The trade logistics industry, especially in the developing world, faces long delays when they use ports to import or export their cargoes. This occurs despite large investments in terminal infrastructure and equipment which has increased the ports' capacity to handle more traffic and reduced dwell times. Port logistics interruptions are attributed to the complex processes and procedures of Customs – and other border inspection agencies- as well as to the absence of coordination between land and maritime operational activities.

Lack of data and information-sharing among the port community leads to miscommunication, delayed decision-making, limited collaboration, and inefficient planning. Port stakeholders soon realized that to improve coordination, it is essential to prioritize data collaboration. Coordination efforts also take place at the procedural level. The PCS has the capacity to store and process vast amount of data received from members of the port community. Therefore, it not only facilitates coordination among its members but also digitizes manual tasks while offering opportunities for procedural simplification, streamlining and standardization. PCS development and port process improvements go hand in hand.

Procedural inefficiencies are understood differently by different port stakeholders. For instance, the port and maritime industries, consider procedural bottlenecks in the context of port call optimization. Shipping lines experience long waiting times at anchorage and slow turn-around times once they move to berth, allowing disruptions to lead to accumulated delays to succeeding ports. Similarly, ineffective, and time-consuming, repetitive, or redundant Customs clearance processes have a significant impact on delays at ports. Border controls can be particularly problematic for perishable goods, as delays can result in spoilage and loss of value. It can also cause issues for businesses that rely on just-in-time inventory management, as delays can disrupt their supply chain and lead to lost revenue. Simplification of border processes and procedures is one of the building blocks of the World Trade Organization's Trade Facilitation Agreement (WTO-TFA).

Big data collected at the PCS servers can be used to identify, analyze, and improve the performance of port processes. PCSs,

being a de facto data collaboration platform, can effectively optimize operations and improve efficiency through reduction of procedural delays and wait times for ships and cargoes at ports. For instance, when shipping lines have access to real-time information on port congestion, vessel traffic, and other factors that could impact their operations, they can adjust their schedules and routes accordingly to minimize delays and ensure on-time delivery of cargo. Similarly, by exchanging data on cargo volumes, shipping schedules, and other relevant information, ports and Customs authorities can work together more effectively to streamline clearance processes, assess the risk of non-compliance activities and eventually reducing delays and costs for compliant businesses.

The rise of PCS solutions has enabled the port community to increase its focus on process re-engineering and improvements. Modern software tools allow the mainstream process modeling and analysis. Such systems enable the processes automation and reduce the need for manual intervention and minimizing errors. They also provide greater visibility into the supply chain, enabling businesses to track cargo more effectively and identify potential bottlenecks or delays. The challenge has moved from data availability to big data utilization towards cost-efficient, quick, and safe port operations.

1.2. Outline and boundaries of the chapter

This chapter focuses on the importance of process improvement in the context of PCS development. We first define port processes in contrast to the concepts of port operations and services. Then we describe the negative impact of complex port processes on logistics efficiency, both in terms of increased costs and time for the trade industry. We analyze the concept of port process improvement (PPI), we explain what it means for the port sector and what is the contribution of electronic data exchange among port community stakeholders. We also examine the institutionalization of PPI and monitoring and examine lessons learnt from international best practice. Finally, we assess how technology can further advance the process improvement agenda through the availability of cost-effective software solutions.

2. The complexity of port processes

Port services, processes, and flows: To ensure the efficient operation of seaports, it is essential to have well-designed and executed processes. These are often hard to identify and categorize, as they largely depend on the physical and institutional structure of the port as well as the services it offers. Port processes can be grouped into three main clusters. Each one refers to different phases of the port and maritime supply chain and include:

1. **Port Operations**: The first reflects the most critical processes related to the core port business, such as (a) Cargo handling, including loading, and unloading of cargo from vessels. (b) Storage and warehousing (inside or outside the port), including open yards and specialized storage facilities, such as refrigerated storage for perishable goods. (c) Transportation and logistics services to move cargo within the port facility.

2. **Border Control Compliance**: These are linked to cargo clearance and release processes. It is related to import and export compliance regulations, including actions to obtain necessary approvals and permits from border authorities. This process can be complex and requires high levels of coordination between multiple parties, including Customs brokers, Customs officers and other border inspection agencies (i.e., sanitary-phytosanitary, standards, food safety and other agencies).

3. **Vessel Traffic Management**: Finally, essential seaport processes are related to vessel management and operations. These include activities such as pilotage, berthing, and departure of vessels and require coordination with multiple stakeholders, including vessel owners, pilots, and port authorities. Accurate planning and execution of vessel operations are critical to minimizing turnaround times and ensuring the timely movement of vessels and subsequently of goods.

Efficient design of processes is critical to the smooth operation of seaports. Ensuring the smooth movement of vessels and cargo and maintaining the competitiveness of the seaport sector in a global marketplace depends on the successful execution of these processes. However, in order to do so, there are some concepts that need conceptually and practically defined.

Defining port services, processes, flows and operations: In the port business and organizational management, the terms service, operation, and process are closely related. Yet, they constitute different concepts with distinct meanings.

- Port services are a particular set of business offerings executed by the port to serve their customers or clients.[1]

- Port operations refer to the actual activities performed at the port to produce the expected port services.

- Port flows refer to the movement or transfer of goods, information, and financial resources within the port and between the port and its external environment.

- Port processes are a series of steps or procedures needed for the effective execution of operations.

Therefore, a port process is a more granular concept. It is more detailed and involves a chain of events, steps and activities followed in a specific order. In contrast, port operations are more general and describes the overall activities corresponding to business and compliance services that take place in the port. In summary, port operations are comprised by a set of activities involved in creating and delivering port services while a port process is a set of interrelated activities for the fulfilment of port operations. Both services and processes contribute to the movement of capital, information, and cargoes in the form of flows.

High interdependency of port flows: Port flows are compliant with the three flows - cargo, information, and payment identified in the theory of supply chain management. Their deep interdependency[2] is apparent in the port logistics context. Complex information flows directly influence the smooth movement of cargoes and the handling of financial transactions. For instance, in the process of releasing a container at the transshipment port, a container is only released (physical flow) if the freight has been settled (financial flow) and Customs confirms the completion of all administrative procedures (information flow). Inefficient information and payment flows can result in bottlenecks and delays in the physical movement of goods. Optimizing port flows reduces cargo movement times, cuts logistics costs, and enhances port efficiency and competitiveness. Port flows cannot be improved without the implementation of concurrent procedural improvements.

Processes as the backbone of port logistical flows: Processes serve as the fundamental backbone of port logistical flows, ensuring that operations run smoothly and efficiently. From the moment cargo arrives to when it's dispatched, it's the well-structured processes in place that dictate the flow, timeliness, and efficiency of movement. However, flows should not be confused with processes. While "port flows" emphasize the movement or

---

1   The terms "client" or "customer" are generally used interchangeably in the context of port operations. In some cases, the term "client" may be used to refer to a more formal, ongoing relationship, while "customer" may refer to a more transactional, one-time interaction.
2   Ascencio, L. M., González-Ramírez, R. G., Bearzotti, L. A., Smith, N. R., & Camacho-Vallejo, J. F. (2014). A collaborative supply chain management system for a maritime port logistics chain. Journal of applied research and technology, 12(3), 444-458.

transfer of resources in the port, "port processes" focus on the activities or steps carried out to manage and facilitate those flows. Although it is much easier to classify and describe the types of port flows, it is much more difficult to categorize the types and average number of port processes. This difficulty becomes a serious challenge if one does not distinguish the business and regulatory nature of processes.

Business and regulatory processes: A clear distinction exists between business processes and regulatory processes. Business processes pertain to tasks and activities undertaken by terminal operators or other private logistics companies, encompassing operations such as cargo handling, warehousing, and logistics management. These processes are driven by profit maximization and efficiency in the commercial supply chain. On the other hand, regulatory or compliance processes are mandates set and overseen by border agencies and port and maritime authorities. These are concerned primarily with either cargo or vessel clearance, ensuring adherence to safety, security, and other legislative requirements. While both types of processes intersect and interact within the port's operational framework, the former revolves around commercial objectives, and the latter emphasizes regulatory compliance and governance. For the purposes of this paper, we will collectively refer to both these categories under the term 'port business processes.' Regardless of their business or regulatory nature, processes are de-facto characterized by high levels of complexity.

The inevitable complexity of port processes: The complex nature of port operations is reflected into their processes which makes it difficult to clearly distinguish and analyze them. There are a number of contributing factors that lead to the complexity of ports (see Figure 1). The most significant one is the diverse range of business and compliance activities which require specific procedures, equipment, and expertise. Also, port activities involve numerous public and private stakeholders, each one with its own objectives and priorities often making coordination and collaboration a challenging task. Another factor adding to the process complexity is the handling of a diverse range of cargo, including containers, bulk cargo, and liquid cargo. In addition, ports are subject to a range of compliance regulatory requirements from border agencies. This inevitably adds complexity to port processes. The factor which contributes most to port process complexity is that port processes are interdependent. This means that the success of one process depends on the success of others. For example, delays in cargo handling can result in vessel delays, and delays in Customs clearance can result in delays in logistics. This becomes apparent on a process and sub-process levels.

The build-up of sub-processes to processes: The definition of port processes is contingent on the predefined spectrum of services each port strategically provides. Therefore, the concept of "port process" is, in reality, the compilation of several sub-processes. Each service is associated with at least one operation. Each operation is comprised of a number of processes. Ports that provide more than one service need to design respective

Box 1. Types of port flows

There are three distinct types of port flows: cargo, information and financial. Each flow is inter-organizational as it has an impact on the operations of more than one entity-member of the port community. It also corresponds to its own distinct process, defined by the unique geographic, administrative, and managerial parameters of each port. Port flows and respective processes are dynamic and occur simultaneously aiming at overlapping and-some-times-conflicting business outcomes.

The abovementioned types of flows are all interconnected and play a crucial role in the movement of goods through a port:

- Cargo flows refer to the physical movement of goods through a port. The handling and movement of cargo involves a range of private stakeholders and government agencies. Yet, these flows are very much dependent on the physical characteristics of port territory. Existing IT systems may enhance the port's capability to increasing the speed of cargo movement.

- Information workflows refer to the exchange of data and documentation related to the movement of goods through a port. Effective exchange of information ensures that all stakeholders involved in the cargo movement process can complete their required tasks in a timely manner. Inefficient information flows often lead to unnecessary bureaucracy and red tape.

- Financial flows refer to the payment of fees and charges for cargo clearance and port related services. These flows can be complex, especially when transactions involve multiple currencies and stakeholders from different countries including banks, insurance companies, and other financial institutions. Overall, lean financial payments' workflows lead to time and cost reductions associated with the cargo process.

Source: Authors.

numbers of operations and align their processes accordingly. The above definition of port processes is in alignment with the holistic or supply chain approach of port operations. According to this approach, port processes occur both within and beyond the port territory. Therefore, the port operating system covers both nautical and landside operations. The latter can be further split into terminal and non-terminal operations. These operations require the development of complex processes and workflows at a granular level. In this context, the role of IT becomes of paramount importance.

Figure 1. Complexity factors of port business processes
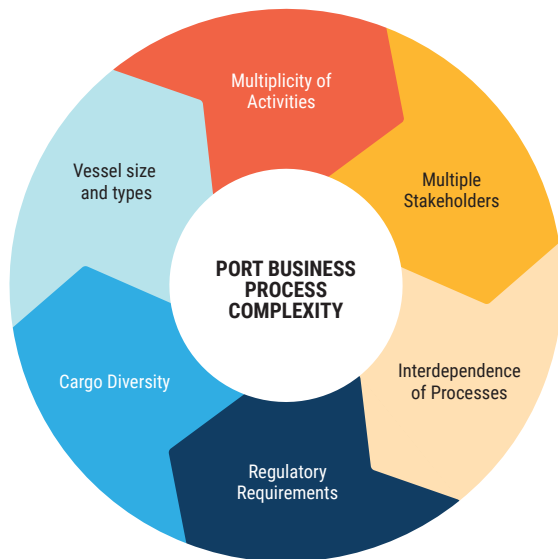
Source: Authors

Integration and the role of information technology: ICT systems enhance the port's capability to coordinate the different stakeholders operating along internal and external chains. Inter-organizational data exchange systems are known to promote instant information flows, reduce process complexity and decrease transactional costs. In the port sector, the most emphatic example of inter-organizational IT system is the PCS. These types of systems allow real-time track and tracing of goods within the port moving from one stakeholder to the other, but also reveal inter-organizational procedural inefficiencies. Well- structured PCS systems allow users to gain high net benefits and gain a competitive advantage over other port stakeholders outside the community.[3] Most importantly, they enable a more holistic approach to port process management.

Inclusive approach to port processes: It is important to mention that port operations should include all tasks that contribute to the fulfilment of a process. In this context, port operations should not be considered only tasks that aim at the movement but also the inspection and clearance of cargoes. This dimension is quite important when looking at the port from a trade logistics point of view. Customs and other technical inspection entities, including sanitary-phytosanitary, quality control, safety and security and standards agencies, actively contribute to the seamless flow of cargoes within the seaport supply chain. In practice, while port operations are conducted by distinct decision-making units, port processes and sub-processes are executed by more than one entity.

Tailoring and tuning port processes: In conclusion, port processes are comprised of several sub-processes and are different for each port. Port processes depend on the strategic goals adopted and the key services provided. Port operations, defined in the broader sense to terminal, maritime and compliance activities, are designed in a way to support the realization of the processes. In practice, port processes are not lean in structure, and they could benefit from increasing their level of efficiency by removing vital bottlenecks that hinder the smooth flow of cargoes, information, payments.

3. Unleashing port potential with process improvement

The strategic influence in streamlining port processes: Continuous port process improvement is a strategic approach dedicated to refining and enhancing the various operational activities. Recognizing the multifaceted and intricate nature of port operations, process improvement initiatives seek to improve efficiency, reduce delays, and optimize resource allocation. By methodically assessing current workflows, pinpointing inefficiencies, and implementing targeted improvements, they foster more agile and responsive port services. When effectively applied to the port sector, process improvements not only reduce operational overheads but also position ports favorably in an increasingly competitive global maritime environment, ensuring they stay at the forefront of efficiency and innovation. This justifies port process improvement (PPI) projects globally.

An increasing number of ports undertake PPI initiatives: The concept of PPI encompasses efforts to improve the performance of a distinct set of processes linked to the production of port logistics services. It refers to the systematic analysis and statistical control of existing business and regulatory processes towards continuous or incremental process performance improvement. PPIs refer to a variety of efforts to make operations more efficient, cost-effective, and responsive to customer needs.

Some examples of these projects include the:

1. **Automation and digitalization**, via the implementation of hardware and software technology systems to streamline

3   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 and Management, 19(January 2015), 51–64. https://doi.org/10.1016/j.rtbm.2016.03.009

and standardize operations, reduce errors, improve security, and increase speed and cost-savings.

2. **Reengineering and simplification** through the adoption of lean principles, such as the identification and elimination of workflow waste and unnecessary steps, processes streamlining, and improvement of overall efficiency of seaport operations.

3. **Collaboration and exchange of information** between the port community members, contributes to both business and compliance process streamlining leading to the reduction of delays and turn-around times for vessels and hinterland transport operators.

4. **Re-designing and optimization of port's physical infrastructure facilities**, thus contributing to the elimination of bottlenecks and the optimization of investment decisions in physical infrastructure. This approach has attracted ports to develop strategic partnerships aiming at the streamlining of trade flows between them. Box 1 presents the collaboration between the Hamburg Port Authority (HPA) and the port of Los Angeles.

Distinct Strategies to Enhancing Processes: When it comes to enhancing processes, a multifaceted approach emerges, encompassing three distinct strategies, each possessing a unique focus and promising specific outcomes. Process simplification, streamlining and standardization strategies offer tailored solutions to ports allowing them not only to optimize their operations but also adapt to changing market demands. These strategies serve as the compass guiding ports toward efficiency, innovation, and ultimately, success in an ever-evolving landscape. A more detailed description of the above-mentioned concepts is offered below:

- **Simplification** means processes developments that are easy to understand, learn and use, either by starting a new process from the beginning or by transforming an existing complex process. It centers on making processes more straightforward and intuitive. By reducing complexity, the goal is to design processes that are not only easy to understand but also user-friendly. This clarity ensures that users can quickly learn and adapt to the system, leading to faster adoption rates. Simplification often entails eliminating unnecessary steps, merging tasks that can function together, or even starting with an entirely new process design. The goal is to ensure a procedure is as uncomplicated as possible without compromising its functionality or intended outcome.

- **Streamlining**, refers to the elimination of unnecessary work-related tasks to improve the port's processes efficiency via the use of modernizing technological tools and techniques. It is rooted in efficiency, focuses on refining processes to ensure they run seamlessly from start to finish. By eliminating any wasteful elements or steps that don't add value,

Box 2. chainPORTs avoid unnecessary future investments in physical assets

chainPORT is a transnational partnership between the world's leading ports initiated by the Hamburg Port Authority (HPA) and Los Angeles. In a joint exchange on innovations or strategic topics, the members learn from each other and share their best practices. For example, there is an ongoing wide-ranging debate about the impact of the digital revolution on ports. Another central topic of the exchange is the efficient use of existing port infrastructure and the associated optimization of investment decisions.

ChainPORT members aim at the:

- Reducing fragmentation in the maritime supply chain through increased connectivity

- Achieving best-in-class cyber resilience standards

- Stronger positioning in the design of maritime logistics, with the chainPORT ports speaking with one voice to political decision-makers and other relevant maritime stakeholders

- Involvement of employees and port stakeholders in the digital change process through training, development, and participation

ChainPORT strives for a well-founded debate about the effects of the digital revolution on the ecosystem of ports. In this way, chainPORTs want to avoid unnecessary future investments in physical systems.and promote the moto" First Digitally, Then Physically"

Source: https://www.hamburg-port-authority.de/de/chainport

streamlining ensures that each part of a process contributes positively to the end result. A significant part of streamlining involves the incorporation of modern tools and technology, which can automate and expedite tasks. The result is a swift, smooth flow from one process stage to the next, reducing bottlenecks and ensuring greater overall efficiency.

- **Standardization** is related to the organization, formalization and documentation of consecutive tasks, activities and administrative steps linked to a process. It is the anchor of consistency within processes. By establishing uniform procedures and guidelines, there's a cohesive approach to how tasks are executed across an organization. This involves

meticulous documentation of every step and procedure, providing a reference blueprint for how processes should be consistently carried out. The beauty of standardization lies in its ability to reduce variability. With a clear standard in place, teams, regardless of where they are or what specific tasks they handle, can operate harmoniously, ensuring there's no discrepancy in process execution, leading to predictable and reliable results.

- **Optimization** pertains to the systemic evaluation and refinement of port-related operations to enhance efficiency, throughput, and service quality, by balancing the dimensions of time, cost, and reliability. Unlike simplification, which aims to make processes as straightforward as possible, or streamlining, which focuses on eliminating redundancies, port process optimization entails a holistic view of the entire logistical chain. It incorporates elements such as terminal operations, vessel turnaround time, Customs procedures, and intermodal connectivity. Optimization strategies may involve mathematical modeling, data analytics, and real-time monitoring to make evidence-based decisions.

Recognizing the need for a holistic and continuous improvement: The port organization is not a single, monolithic entity but rather as diverse and dynamic community or business ecosystem. This is comprised of numerous stakeholders, with often conflicting interests. Despite the fact that PPIs offer solutions for streamlining and re-engineering, they don't go beyond the scope of a defined set of processes out of the many that occur within the port jurisdiction. In other words, it represents the micro (unit or functional) rather than the macro (inter-organizational or intra-organizational) dimension of process enhancement. The inter-organizational nature of ports requires a holistic management approach which covers the entire spectrum of business and compliance processes and reflects the complex dynamics between public and private entities. Adopting this approach allows the realization of PPI's benefits and the maximization of its impact., as outlined below:

4. The impact of improved port processes

The power of processes in elevating port performance: Adopting Port Process Improvement (PPI) is a strategic decision for ports, supporting their operations in an environment characterized by high complexity and interdependence. The resultant effect is a holistic enhancement in the port's performance, where activities no longer function in isolation but harmoniously intertwine. The benefits aren't abstract but manifest as measurable outcomes like quicker ship turnarounds during the port call process[4] efficient cargo movement and maximized resource utilization. Direct and indirect benefits of PPI have a positive impact on a port's competitiveness and efficiency while they contribute to both decongestion and trade facilitation.

Carving out a competitive edge for ports: While inherent features like geography and infrastructure are undeniably important, the competitive edge in today's maritime industry often hinges on the quality of processes and the efficiency of collaborations within the port. PPI methods meticulously examine and refine these processes, ensuring that intra-port services are seamless, rapid, and aligned with global best practices. By enhancing collaborative ties and ensuring a smooth flow of information across different organizational units within the port, PPI directly boosts customer satisfaction and solidifies the port's reputation as an industry leader. The synergy between PPI and advanced digital tools, like the PCS, ensures that ports are poised to respond agilely to the dynamic needs of global logistics, thereby cementing their competitive stature.

Streamlining processes for maximum efficiency: PPI is integral to enhancing port operational efficiency, directly addressing the complexities inherent in port functions. Ports are bustling with varied activities, from cargo handling to managing vessel arrivals and coordinating inland logistics. Each of these operations requires a seamless flow of processes, often overlapping and interdependent across multiple organizations and entities within the port's ecosystem. PPI steps in to meticulously dissect and refine these intricate workflows. By doing so, it bridges any gaps and ensures that even if a single entity drives a particular logistic service, the redesigned processes foster acceptance and cohesion among all stakeholders. In essence, PPI doesn't just propose changes. It builds consensus around them. By providing a systematic approach to analyzing and enhancing processes, PPI ensures that ports achieve peak operational efficiency, even in the face of intricate inter-organizational dynamics. Through PPI, ports can navigate the complexities of multi-entity operations and emerge more streamlined, responsive, and efficient.

The PPI approach to decongestion: PPI plays a crucial role in alleviating port congestion, directly contributing to enhanced port performance and efficiency. The essence of PPI is to streamline, re-engineer and standardize operations, a principle

---

4 World Bank. 2023. The Container Port Performance Index 2022: A Comparable Assessment of Performance Based on Vessel Time in Port. CPPI. © World Bank. http://hdl. handle.net/10986/39824 License: CC BY 3.0 IGO.

Figure 2. The Impact of BPI
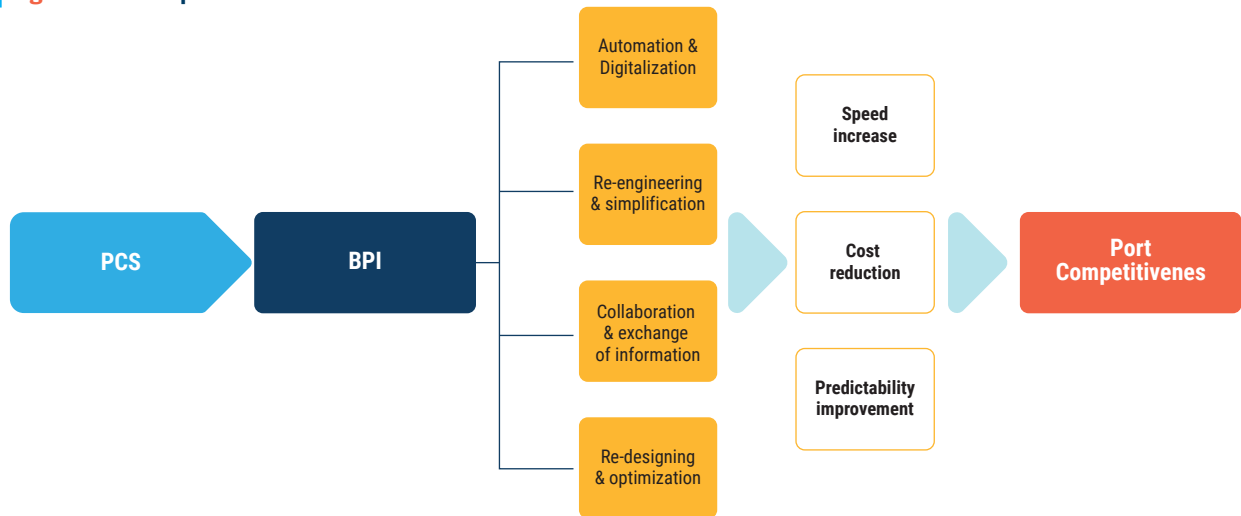
Source: Authors.

that when applied to port activities, can significantly reduce bottlenecks, and improve traffic flow. One of the standout benefits of integrating PPI into port management is its potential to expand capacity without immediately resorting to costly and time-consuming physical infrastructure projects. For instance, by refining the processes associated with truck movement and cargo handling, ports can markedly reduce the dwell time of trucks. This seemingly simple improvement means trucks spend less time idling within the port's premises, freeing up considerable space and resources. Such enhancements not only improve port turnover rates but also optimize the usage of existing infrastructure, demonstrating how PPI can be a cost-effective strategy to bolster port decongestion and operational efficiency.

PPI as the catalyst for efficient and compliant trade operations: Trade Facilitation, a vital component in the modern maritime ecosystem, heavily relies on the optimization of processes and

operations, which is where PPI comes into play. PPI, with its structured approach to enhancing workflows, directly supports the goals of trade facilitation by ensuring smoother, faster, and more compliant trade operations. The overarching objective of trade facilitation is twofold: to bolster the profitability of port activities and to ensure strict adherence to international regulations. Both of these goals necessitate streamlined processes and heightened efficiency — hallmarks of PPI. With the increasing complexity of trade regulations, particularly those stipulated by the World Trade Organization's Trade Facilitation Agreement (TFA), ports are under mounting pressure to conform to international standards. PPI aids in this by not only refining existing processes but also integrating advanced digital solutions that make compliance both achievable and efficient. The commitment of both public and private entities to trade facilitation underscores its importance, and through the lens of PPI, ports can navigate the intricate maze of trade demands, ensuring they remain at the forefront of global commerce.

5. The PPI Cycle

Distinct stages of process improvement: The role of PPI transcends mere operational adjustments. The maritime world is in a state of constant flux, influenced by ever-changing trade volumes, technological innovations, stringent environmental protocols, and geopolitical shifts. In this dynamic landscape, the success of ports hinges on their agility and adaptability. PPI fosters this adaptability, serving as an ongoing commitment rather than a one-time initiative. By instilling a culture of consistent evaluation and refinement, ports can remain attuned to the evolving needs of the maritime sector. This continual evolution ensures they not only respond to the immediate challenges but also anticipate

and prepare for the future, solidifying their significance in the global trade framework. The management of business processes follows a cyclical methodology which comprises six distinct stages: process identification, discovery, analysis, redesign, implementation, and control (Figure 2). The mapping of "as-is" and "to-be" port processes play a central role in the discovery and analysis stages.

The process improvement cycle is recognized in the context of trade single windows: Although different in scope, the above-mentioned PPI cycle is consistent with guidance provided

Figure 3. The six stages of PPI
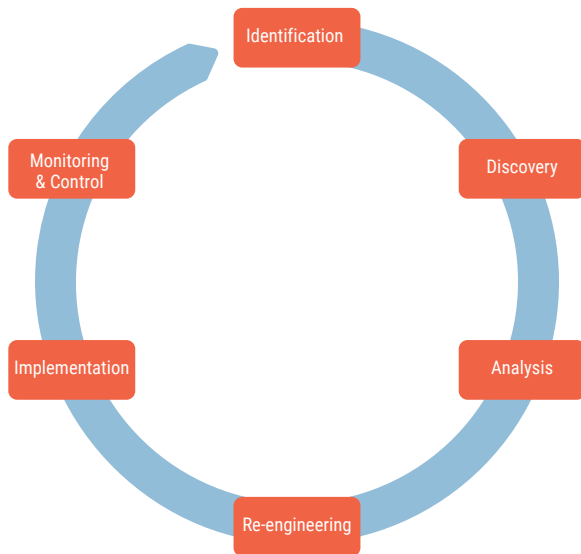
Source: Authors.

around the implementation of trade single windows. During their design phase, business process identification and analysis is being conducted in order to identify opportunities for business process transformation. A key development component of the single window is Business Process Analysis and Simplification.[5] The clear objective is to: (a) Analyze existing business processes. (b) Identify bottlenecks. (c) Redesign, simplify, and propose new business processes (see Table 1). The development of as-is and to-be business process maps is an approach that is adopted in the design phase of all single window forms, including the maritime single window.[6] The respective map of the

vessel clearance process at the port of Suva in Fiji is presented at Annex 1.

The PCS and development of process maps: There is a plethora of methods, techniques, and tools to support the design, enactment, management, and analysis of operational processes. Frequent concepts are the ones of process discovery of the "As-Is" workflows and process re-engineering which represent the desired "to-be" stages of the process improvement cycle. The practical question for countries seeking to implement a PCS is at which stage of the development cycle the "As-Is-To-be" process maps should be developed. In several projects, these maps are generated at the inception stage. Good examples of this approach are Brazil, Peru, and Sri Lanka. It should be highlighted though, that at the time of the contract award to design and build the PCS, the contracted developer generated its own due diligence including "As-Is-To-be" mapping analysis. This has led to repetitive mapping of processes which leads to PCS project cost overruns. Therefore, it is advised that process re-engineering should be conducted at the time of the PCS implementation (design and built). Several modeling techniques are being used in this regard.

Using modeling techniques to identify logistics bottlenecks: Port process modeling involves the development of a systematic visual representation of the various processes and procedures involved in the operations of a port. Its main objective is to improve the efficiency and effectiveness of operations by identifying areas for improvement and optimization. By analyzing and modeling the processes involved, ports can identify bottlenecks or redundancies, and detect areas for regulatory reforms and operational improvement. Due to the complexity of port operations, modeling often covers only a subset of the larger universe of processes i.e., terminal operations or vessel clearance process. However, more and more ports are looking into

Table 1. Business process analysis and simplification

Components	Objectives	Activities	Deliverables/Expected Results
Business Process Analysis and Simplification	• Analyze existing business processes • Identify bottlenecks • Redesign, simplify, propose, and seek approval of the relevant business processes	• Elicit, document, and analyze the existing a export, import, and transit business processes as well as corresponding information flows and the trade documents used • Develop business case scenarios and analyze potential benefits to convey to stakeholders • Develop, propose, and seek approval for efficient business processes and a list of actions required to be carried out prior to adopting them • Start initial activities to establish an enabling legal infrastructure for Single Window	• Analysis of Business Processes and documents used by the Government agencies and private sector • Agreements on simplification of processes and related documents • Agreements on the business processes and data to be automated

Source: UNNExT (2009), Business process analysis guide to simplify trade procedures.

---

5   United Nations Network of Experts for Paperless Trade and Transport in Asia and the Pacific (UNNExT) (2009). Business process analysis guide to simplify trade procedures. Retrieved from: https://hdl.handle.net/20.500.12870/5059
6   see Chapter 9 for more details

Box 3. Process mining as a modelling method

Process mining is a possible means by which this data can be used and overcoming these constraints by using artificial intelligence. This is a new field of work particularly when it comes to port process improvements.

However, more and more information about port processes is recorded by agency-level information systems in the form of so-called "event logs". A wide range of process-aware information systems (PAISs) log detailed information about events in a structured manner and record events as they are taking place. However, limited use of PAISs in the port sector leads people to have an oversimplified and incorrect view of the actual business processes.

Therefore, process mining techniques attempt to extract non-trivial and useful information from event logs. One aspect of process mining is control-flow discovery, i.e., automatically constructing a process model describing the causal dependencies between activities. The basic idea of control-flow discovery is very simple given an event log containing a set of traces automatically construct a suitable process model "describing the behavior" seen in the log. Such discovered processes have proven to be very useful for the understanding, redesign, and continuous improvement of business processes.

So far, only a few terminal operators have experimented with process mining tools. Their full and effective application across the entire range of port services and processes is hindered by the lack of a unifying digital platform which can collect and analyze data from various sources. Process mining could be in particular beneficial to existing PCS operators to move forward to their next generation of PCS. Nonetheless, the expected exponential growth of PCS will facilitate port communities to utilize these tools for their collective benefit.

Source: Authors.

---

the adoption of more universal strategies, incorporating border management process into the modeling exercise. Gathering and analyzing data can be done either manually or via the use of specialized software.

Manual or automated process modeling? Different techniques are used to better understand its steps, inputs, outputs, and stakeholders. The availability of hard data in port IT systems combined with the use of advanced technology has allowed the easier and more accurate representation of port processes.

Today, both manual and automated are being used.

- *Manual process modeling* involves creating process diagrams and flowcharts using tools such as pen and paper or Microsoft Visio. This method is typically used for smaller projects or when there are only a few stakeholders involved. The advantage of manual modeling is that it is relatively quick and easy to create and does not require any specialized software or technical skills.

- *Automated process modeling*, on the other hand, uses software tools to create process models. These tools typically include features such as drag-and-drop interfaces, pre-built templates, and the ability to collaborate with multiple stakeholders in real-time. The advantage of automated modeling is that it is more efficient and scalable, especially for larger and more complex projects. It also allows for greater collaboration and communication among team members.

Process mining as the upcoming process modeling method. Process modeling can be achieved through simple drawing tools such as paper and pencil, daily use office software (e.g., Microsoft PowerPoint, OpenOffice Impress, iWork Keynote), and basic diagramming software 6 (e.g., Microsoft Visio, OpenOffice Draw, SmartDraw, Bigazi). Process analysts may consider using an off-the-shelf tool that has been designed specifically to facilitate not only the modeling of process models, but also the management of process model repository (e.g., Enterprise Architect, MajicDraw, StarUML). The widespread development of a PCS and the existence of unused big data at ports, opens up the door for the utilization of the process mining tools. The vast data collected via the PCS is in many cases not used. Next to the overall issue of a lack of trust in the supply chain and therefor a reluctant position towards data sharing by data owners, this has also partly to do with lack of internal capacity, as well as lack of clarity of what key questions the data is mean to answer.

Overall, the choice between manual and automated process modeling depends on the specific needs of the organization, the size and complexity of the project, the availability of hard data and the technical skills of the team members involved. The existence of data exchange platforms and storage of large amounts of electronic data facilitates the use of automated modeling systems. However, in some cases, a combination of both approaches may be used to achieve the best results. In this context, the Business Process Model and Notation (BPMN) is a widely used process modeling standard used for modeling and designing processes. However, the availability of big data in

existing automated systems, including in a PCS, has led to the mainstream use of process mining as the preferred modeling method. The critical question then becomes whether the process mapping and re-engineering activities should be conducted prior to or after the adoption of the PCS solution.

5.1. PPI & PCS: Ex ante or ex post re-engineering?

Linking PCS and PPI: The impact of the PCS on PPI begins to apply particularly in the context of the pre-project implementation phases when the As-Is process maps relevant for the project are undertaken. This element of the project is either carried forward by the same company or entity developing the system, or alternatively, this is undertaken by separate entities specialized in doing so.

Does PCS lead to PPI? One of the key questions is whether PCS leads to process re-engineering or the other way round. The answer to this will clearly vary on a case-by-case basis. Furthermore, the two are tightly linked. On the one hand, the implementation of a PCS is intended to lead to more efficient processes by means of digitalizing certain tasks. Digitalizing certain tasks by definition involves changing the way these are carried out and may therefore involve process changes. On the other hand, reengineering of the port processes may be carried out as a specific exercise in the context of, and before, PCS solutions are implemented. In addition, this question has to do with the extent to which the objectives related to the reengineering of port processes in a manner that streamlines the submission and communication of information needs to be balanced with the need to achieve the project in the allocated time and budget. The reason why this needs to be considered is the fact that process reengineering may require changes in

legislation and regulation that in turn, take time to be achieved, therefore potentially delaying the successful implementation of the PCS.

Connecting the PCS and PPI project cycles: The project cycle for a PPI project involves a number of steps, including understanding and analyzing As-Is processes, determining where the bottlenecks are, and developing a changed process that seeks to minimize or eliminate the identified bottlenecks. The tools used to understand and analyze the As-Is process may differ. The fundamental objective is to record and document the multiple processes that are involved in ultimately delivering the internal or external service being rendered. PPI projects can run independently from the PCS, but it is highly recommended to translate results which require digitalization and/or optimization using digital information exchange on a port-wide level, to the PCS project. When this is done, it usually occurs on an agency level: distinct agencies or port logistics companies are interested in improving their own performance. This piecemeal approach has limited positive impact in the procedural performance of the entire port community. While improvement actions may occur, in practice PCS projects constitute an excellent opportunity to identify, map and possibly improve some or all port processes for a variety of port stakeholders.

The ex-ante re-engineering approach: The PCS development implies the de-facto detection of port services offered and the detailed mapping of their respective processes as part of its typical project cycle. After the initial concept inception and during the PCS design stage, implementing entities – usually in collaboration with the port community - identify, discover, and analyze existing processes. The above are in alignment with the upstream stages of the typical process management cycle, which is shown in Figure 4. Adoption of digital solutions and

Figure 4. PCS and BPM project cycles

Source: Authors.
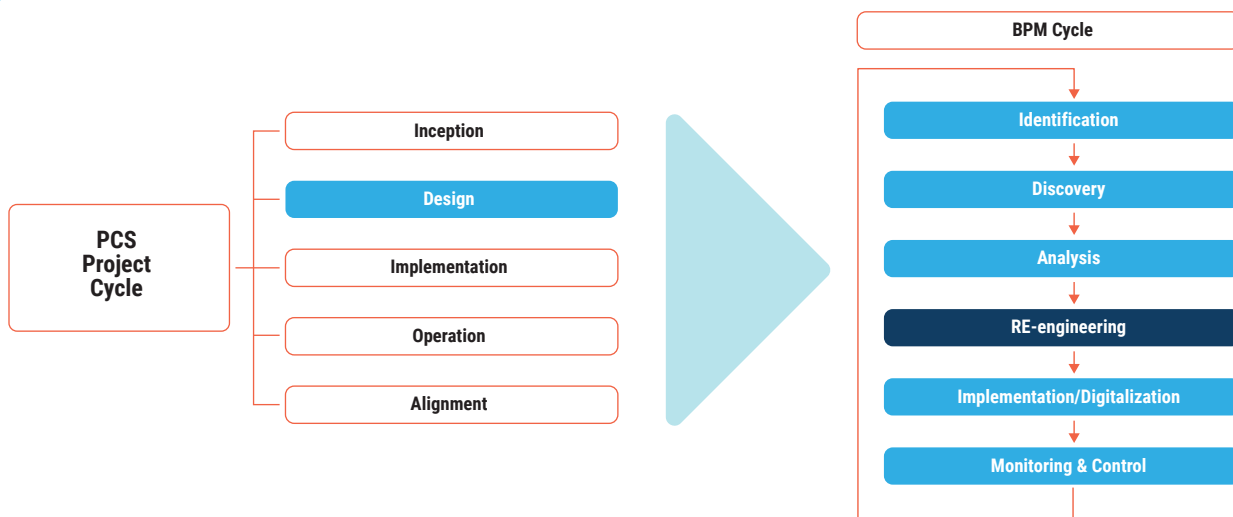
Box 4. Port of Valencia process re-engineering risks and opportunities

The Port of Valencia's strategic approach was to focus on process re-engineering activities prior to the adoption of PCS. In the view of the Autoridad Portuaria de Valencia, this approach leads to clear and measurable benefits, as:

- The expected value of PCS is realized much faster if port processes are streamlined prior to digitalization.

- Once PCS scope and coverage reflects more agile and mature processes, this eliminates any needs for future software adjustment costs

- Process re-engineering eliminates, from the outset, inefficient practices, duplicate steps, overlaps and any other forms of imbalances that may be occurring.

However, the core challenge of this approach lies in the difficulty of overcoming resistance-to-change, and difficulties adapting to the new paradigm. This is explained by the fact that the end-user faces dramatic changes in terms of the process modality (paper vs. digital), but also in terms of process structure (new sequence of steps and actions) in a relative short period of time. To overcome these risks, training and good communication strategy are key.

Source: Autoridad Portuaria de Valencia.

---

port PPI can exist separately but are usually generated around the same time, during the design phase of the PCS project cycle. Once port communities or the PCS operator build capacity to systematically monitor, adjust, and improve their processes then process management activities develop their own independent existence. Thereafter, these activities may be institutionally placed in separate business units and led by different teams within the organization of the port or the PCSO. Each of them will likely have different targets and objectives.

Upstream discovery vs upstream re-engineering: According to the IPCSA Guide "How to Develop a Port Community System", the identification of core processes is one of the twelve key requirements for setting up a successful PCS. The guide recommends that the port community agrees on the community's core processes, identifies key challenges related to existing processes and outline benefits of a simplified electronic approach. It also highlights that one of the most important reasons for developing a PCS is to reduce inefficiencies in port processes. Therefore, in the course of the PCS inception and design stages, implementing entities have the opportunity to assess the level of the overall port procedural efficiency, identify administrative overlaps, and potential duplicative steps leading to bottlenecks and unnecessary bureaucracy. As a result, they have the opportunity to improve or re-engineer their processes prior to the PCS installation. However, this does not inevitably mean that all ports take advantage of this opportunity.

The ex-post re-engineering approach: Some ports, especially in the developing world, prefer to partially defer the re-engineer processes until post-PCS adoption. This can appear to be a lost opportunity. Reluctance to simplify prior to digitization could be attributed to the higher-than-average complexity of

administrative procedures and the sluggish manner in which required operational, legal, and regulatory simplification reforms are implemented. Linking the PCS implementation with upstream reforms, often delays the completion of the project. This, in turn, leads to high risks passed on to the solution developers. Ports which defer the re-engineer process usually argue for speedier adoption of more cost-efficient PCS solutions.

The value addition of upstream re-engineering: In contrast, those ports that decide to re-engineer their processes in the context of PCS project development, argue that the value of digital transformation is not in digitizing manual and outdated processes but in disrupting these processes through the use of new technology. In this sense, they choose to focus on the discovery of potential efficiency gains rather than on converting existing processes into digital format. This strategic approach encapsulates both opportunities for maximization of PCS benefits but also addresses challenges that need to be overcome. The example of Valencia Port, shown in Box 2, is indicative. Having said that, it is important to differentiate the approach European ports are taking, capitalizing on the multiyear port digitalization journey, compared to the ones from the developing world that embark on the PCS development within a short time horizon.

In practice, the re-engineering of some processes during the design and implementation phase of the PCS is inevitable. In many cases, developers find the opportunity to integrate new, streamlined processes. Therefore, the risk of implementation delays is partially or completely mitigated. Such an example is the case of South Korea. The Port of Busan was able to implement a new PCS solution at the port in parallel with the implementation of a new process which has led to further optimization of terminal operations (see Box 5).

Box 5. Introduction of new business process at the Port of Busan

The key process improvement reform was related to the trucking procedures and included the integration of the Terminal Operation System (TOS) with the new vehicle booking system (VBS). Before this change, truck drivers who did not pre-book cargo receival would wait inside the terminal waiting for the cargo therefore leading to queues. Priority was given to those who pre-booked and arrived at the terminal on time. The integration of the TOS with the VBS system allowed a smoother operation.

Today, when the truck enters the terminal, an eSlip is issued. This includes container location information as well as the VBS compliance and pre-booking status, a component of the gate operation system, which was earlier not included in the slip. This change also required the system modification of the TOS and the Transport Management System to facilitate transshipment group orders. To further the efficiency of the system, the BPA is considering implementing a discretionary incentive scheme soon to increase participation of stakeholders.

Source: Busan Port Authority

The benefits of streamlining prior to PCS adoption: Based on PCS development experiences, it is safe to argue that process reengineering should ideally occur before their actual digitalization.

- The reasons for early process reengineering can be summarized in the following points.

- Firstly, early understanding of the procedural structures and adjustment capabilities allows a more sustainable PCS design. This ensures that the PCS's can swiftly accommodate future port services and operations.

- Secondly, without prior process reengineering the PCS system will be unnecessarily complex and difficult to use. User acceptance is vital for the success of a PCS project, and it increases when the system is simpler to use.

- Thirdly, preceding process reengineering will reduce the costs associated with the PCS maintenance by reducing the functions and scope of the modules required.

A hybrid way of working regarding process reengineering can also be explored. Under this model, processes that require simplification can first be digitized and later be reengineered while processes that are less cumbersome to reengineer can be changed before or during implementation of the PCS.

6. Institutional support

The institutional dimension of the PPI: While PPI initiatives apply in the context of specific projects, there is a set of questions that quickly emerge in terms of how to ensure that: (a) Efficiency gains are maintained and are not lost to "habit" or due to the return of earlier methods of doing things. (b) Reengineering processes and procedures are followed. (c) The drive to seek efficiency improvements via process changes is continued further beyond the PCS project implementation. In this context, establishing the necessary institutional mechanisms to manage process improvements is a prerequisite for a successful PCS implementation. It can also be used in the long run to continuously monitor and improve port processes whether digitalized or not. Institutional support to PPI, in the context of PCS development, allows the transformation of an ad-hoc approach to process improvement to the adoption of robust, systematic process management. More details of the PCS Governance & Operating Models are found in Chapter 4.

PPI requires central process orchestration: There are several examples of ports (i.e., such as the ports of Busan, Valencia, and Valparaíso) that recognize the value of improving their processes. However, so far, these PPI initiatives reflect efforts to improve distinct workflows on a granular process level. Naturally, the initiators of these initiatives are usually corporations which have linked the simplification of their individual processes with either increased profitability, competitiveness, market access or any other financial benefit. This explains the fact that many PPI projects were initiated by private terminal operating companies. The complexity of collaborative port processes prevents their discovery, modelling, improvement, and overall management. This challenge could be tackled by the adoption of a centrally located institutional mechanism mandated to improve all port processes systematically and holistically. The PCSO, given its neutrality, can be the ideal candidate to play this role, working in conjunction with the various forms of Port Community Councils

(PCCs) or/and the National Trade Facilitation Bodies (NTFB), wherever they exist.

Striving for continuous and sustainable PPI: Process improvement requires a systematic identification and discovery approach due to continuously evolving port operations. The best way to achieve this is via systematic consultations and contributions collected from the entire port community. This is necessary as the port processes are cross-organizational by nature. This means that they cover not only the operations of private companies (i.e., terminal operating companies, warehouses, distribution, transport logistics companies etc.) but also transport regulatory and border agencies, involved in the movement of cargoes along maritime and port supply chains.

Collaboration between private and public sector: Therefore, the role of public-private consultation committees is crucial. This becomes even more significant because port services – and their corresponding processes – are not cast in stone but transform over time, both in terms of scope and nature. As port's performance largely depends on its ability to adjust its services to the continuously changing needs of its customers and users, port authorities are incentivized to modify their business strategy, generate new services, and simplify the processes of existing ones.

Utilization of existing collaborative committees: Already existing committees are often used for hosting process consultations. The most frequently met forms are the: PCCs and the NTFB:

- PCCs are vehicles for dialogue and communication about port related issues and operate as councils where transport regulatory, port industry, community representatives and other port-related stakeholders meet with the port authority to identify concerns and provide input on port projects and activities.

- An NTFB is a formally constituted body where all public and private-sector parties, interested in the country's international trade, multimodal transport, transit, logistics, finance, border management, health, electronic business, and related topics can present their respective views and problems, and seek,

through consultation and consensus, mutually agreeable solutions. NTFBs are defined as per UN/CEFACT Recommendation N.4 and can take different forms as shown in Figure 5.

Tailoring of institutional solution to the port's needs: The selection of the most appropriate public-private consultation group varies among ports and depends on a variety of factors. For instance, some ports have functioning NTFCs in place which they use to discuss port process simplification ideas via the establishment of dedicated working groups. Others, have a well-functioning legacy NTTFC in place. They are de-facto more inclusive as they cover both transport and trade firms and agencies. Under these structures, process subcommittees or working groups are developed. Finally, many ports have developed PCCs, which allow them not only to focus on the challenges of the specific port – particularly important in countries with more than one major ports- but also directly link them to process improvement actions, such as re-engineering and subsequent digitalization. Chile's Valparaíso Logistics Forum (FOLOVAP) is an example of such as forum which operates at strategic, tactical, and operational levels with the objective of improving information exchange and communicational dynamics of agents in the port logistics chain (Box 6).

Typical mandate of PCCs: An integral part of PCCs overall mandate, through their respective committees and working groups, is linked to the identification, discovery, analysis, and re-engineering phases of the PPI project cycle. Therefore, in this context, its goal is twofold and focuses on the:

- Systematic collection of information to define the scope of new processes or re-assessing the structure of old ones, which were recently altered.

- Procedural mapping and pinpointing of inefficiencies and "hotspots" along selected port logistics processes. To the degree that is allowed by its mandate, PPFs can be used as the body responsible for process reengineering. This means that they are responsible for the design and implementation of process reform actions leading to improved simplification, streamlining and standardization.

Figure 5. Overview of Different National Trade Facilitation Bodies

WTO NATIONAL TRADE FACILITATION COMMITTEES (NTFC)	**NATIONAL TRADE AND TRANSPORT FACILITATION COMMITTEES (NTTFC)**	**NATIONAL MARITIME TRANSPORTATION COMMITTEE**	**PRO-COMMITTEES**
NTFCs are established under Article 23.2 of the WTO-TFA., NTFCs are platforms where representatives from the public and private sector consult, inform, coordinate and engage in the implementation of the TFA.	NTTFCs cover trade and transport issues. They act as consultative inter-institutional bodies to promote facilitation, study international trade and transport regulations, prepare recommendations and create transparency on major trade and transport issues.	The IMO and ICAO require governments to establish facilitation committees, based on their respective international conventions. They encourage the adoption of facilitation measures between port authorities and ship-owners as well as between airport and aircraft operators	Inspired by the FAL Committees, PRO committees deal with facilitation of procedures across all modes of transport, identify bottlenecks to trade and promote solutions. PRO committees are the main driver for the implementation of UN/EDIFACT.

Source: Authors.

Box 6. Valparaíso Port Logistics Forum

The Valparaíso Logistics Forum, (FOLOVAP) is a platform that allows the consultation, discussion and collaboration between the different actors that are part of the Valparaíso port system. Its goal is to facilitate Chile's Foreign Trade carried out through the port, via the infusion of innovation and actions strengthening of the port competitiveness and efficiency.

Since its creation in 2004, FOLOVAP, is comprised of three committees: **1) Strategic,** focused on defining the guidelines of the management model identifying trends and local and global opportunities, establishing priorities and objectives; **2) Tactical,** as a collaborative work platform for the discussion, decision and diffusion of new initiatives for the optimization of the management model, solving the necessary technical and political bottlenecks; and **3) Operational,** to coordinate the realization of tactical decisions.

These committees act at different integration scales– from work niches to relations between public and private institutions – to improve information exchange and communicational dynamics of agents in the port logistics chain. FOLOVAP sets a common framework for assessing the different perspectives of port processes and identifying each agent's position in the port logistical flows. It also generates informal linkages that fortify the idea of a Port Logistics Community, capable of modulating the territorial and operational contexts in which it is deployed. FOLOVAP supports the seamless operation of the Valparaíso Port Community System, SILOGPORT, and ensures that port stakeholders' inputs are incorporated.

Source: Valparaíso Port Company.

Regardless of the form they take, PCCs need to establish the necessary mechanisms in place to ensure a cross-organizational environment of trust, transparency, and collaboration. Therefore, related working groups and committees benefit from the establishment of collaboration methodologies that all parties follow.

The challenge of coordination: The complexity of organizing multiple stakeholders is a challenge. This is especially true when PCCs deal with processes involving many stakeholders simultaneously. To avoid excessively large and unproductive meetings, PCCs initially organize specific sessions with each group to understand their perceived challenges and proposed interventions. The level of participation varies. Invitations could be extended beyond the narrow business port community. For instance, the Port of Le Havre organizes a communication platform where citizens, representatives of the port users and universities can exchange ideas and hear each other's vision for smart port developments. The communication platform seeks to inform society about the role of the port, change the industry's perception about universities and generate knowledge that can lead to new solutions.[7] They then also organize joint meetings to validate the As-Is or the To-Be process maps. To orchestrate these meetings, it is quite common than PCCs appoint a senior officer who acts as a "mediator," preparing the sessions, guiding the discussions, capturing the insights, and translating them into a functional document that is then shared and iterated with the whole group.

The emerging establishment of dedicated business process units: When it comes to the digitalization of identified processes, whether this occurs prior to or after the PCS implementation, international best practice favors the establishment of dedicated business process units (BPU). These entities are quite often embedded in the organizational structure of the port authorities which, in the medium to long run, translates to the development of in-house expertise to monitor and improve process efficiency. This is apparent in cases where continuous process improvement and digitalization is part of the port authority's strategy and where direct information linkages to the PCCs are maintained. In some ports, these are placed under the IT department which enables the direct process modeling via the use of dedicated software and hardware and its digitalization as part of the PCS project cycle. In other ports, these units are directly linked to the business management department. Their organizational placement demonstrates the importance the port authority places on BPUs and whether they regard them as a technology or a management tool. For instance, in the Port of Valparaiso in Chile, the organizational structure of the port authority, EPV, has favored the process of continuous improvement, through a structure within the Logistics Management Department of this company, comprised of three teams working in a coordinated manner (See Annex 1). The teams include the:

- Logistics Systems & Processes Unit which, in addition to its own IT challenges, performs a permanent modelling of

7   Cyril Chedot, Head of Land use planning Department at Port of Le Havre, "Preparing the Speed – Smart Port Ecosystem manifesto: Building trust amongst Smart Port Ecosystem stakeholders: the role of a communication platform where incipient ideas and fears can be openly debated", www.smartportsecosystem.com

the port logistics processes and continuously looks for new technologies and solutions that can be analyzed to determine opportunities to provide solutions towards enhancing more efficient port logistics operations.

- Logistics Management Unit which offers continuous feedback and oversees the day-to-day operational matters of the port.

- Competitiveness & Sustainability Unit which oversees coordination matters with the Valparaíso Logistics Forum (FOLOVAP) and enables the port authority to keep track

of the improvement opportunities and requirements of the port logistics operations, as well as the design and early implementation of short, medium, and long-term improvements.

A strength derived of the organizational structure of the port authority corresponds to the coordinated and daily interaction that exists between the Logistics Management and the Logistics Systems & Processes units, which makes it possible to immediately detect requirements and work on them with the process design team, so that they can be subsequently analyzed with the task force of the port community FOLOVAP.

7. Lessons learnt and the way forward.

This chapter explains the relationship between PCSs and ports' procedural improvement. We used information collected from various PCSs around the world and discussed their experiences around the PCS, PPI, and trade facilitation. Some of the key takeaways, include:

- A PCS improves a port's procedural efficiency, resulting in the simplification, standardization, and digitization of port logistics processes.

- Port process re-engineering is an integral part of all SWs and of the PCS and could be conducted either during the design phase or after the adoption of the PCS.

- Public-private consultation mechanisms, such as Port Community Councils (PCCs) and National Trade Facilitation Bodies (NTFB), are a prerequisite for the accurate mapping of existing processes and a pragmatic discussion and sequencing of re-engineering activities.

- Upcoming process mining technology, once applied in the port sector, will simplify the process mapping phase via the utilization of existing big data gathered in the PCS platforms.

Appendix 1. Vessel clearance business process mapping in Fiji
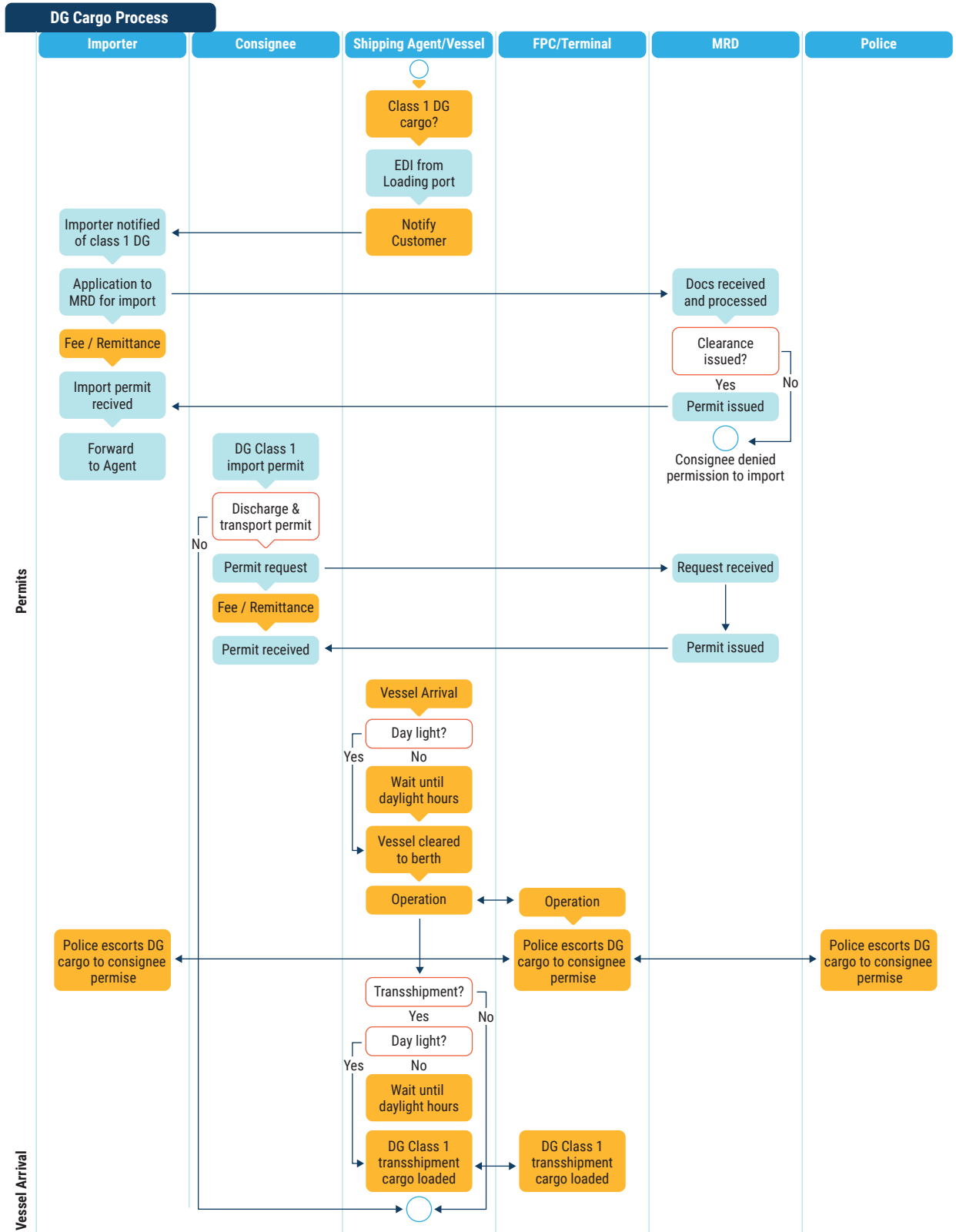
Appendix 2. Organigram Port Authority of Valparaíso


```
                        ┌──────────────┐
                        │    Board     │
                        └──────┬───────┘
            ┌──────────────────┼──────────────────┐
     ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
     │Internal Audit│   │              │   │  Prosecutor  │
     └──────────────┘   │              │   └──────────────┘
                        ┌──────────────┐
                        │General Manager│
                        └──────────────┘
```

Board

Internal Audit — Prosecutor

General Manager

Planning, Control and Managament | Legal Unit | Concessions and Port Development | Logistics Management | Finance and Administration | Communications

Logistics Management:
- Logistic Systems and Processes Unit
- Logistics Management Unit
- Competitiveness and Sustainability Unit
- Industrial Protection Unit
- Maritime Relationship Unit

Source: Valparaíso Port Company (https://www.puertovalparaiso.cl/epv/site/docs/20220622/20220622184207/2022_10_28_organigrama.pdf)

Appendix 3. Peru PCS AS-IS and TO-BE Business Process Maps – Import Container Process

Papel / Mail

Recibir el pago de la mercancía → Fin de exportación

Recibir la documentación

¿El banco requiere el B/L como garantía?
- Sí → Endosar B/L al nombre del banco → Entregar el B/L endosado → Físico → Recibir el B/L endosado → Gestionar trámites previos al desembarque
- No → Efectuar el pago por la mercancía → Gestionar trámites previos al desembarque

¿Cumple las condiciones?
- Sí → Pagar al banco del exportador
- No → Rechazar la documentación y no paga

Recibir y revisar la documentación

Remitir la documentación

Remitir la documentación y confirmar el cumplimiento de condiciones

Papel / Mail

Recibir el pago y pagar al exportador

Recibir el pago → Fin

Entregar la documentación

Físico

Recibir el pago de la mercancía → Fin de exportación

Recibir la documentación → Efectuar el pago por la mercancía

Físico → Recibir el B/L endosado → PCS_CO_IM_1.2 Gestiones previas del Agente de Aduana

Recibir y revisar la documentación (B/L electrónico) → Remitir la documentación y confirmar el cumplimiento de condiciones → Papel / Mail

Recibe el pago del importador y reembolsa al banco del exportador

SWIFT → Endosar B/L electrónico a nombre del importador y entregárselo

Recibir el pago y pagar al exportador

Recibir y revisar la documentación contra reglamentaciones internacionales

¿Cumple las condiciones?
- No
- Sí → Solicitar subsanación de incongruencias

Físico → Solicita reembolso Swift MT 754 y enviar documentos por courrier

FUNCTIONAL AND TECHNICAL ARCHITECTURE

Executive Summary

Key Takeaways

■ The essential needs of all stakeholders in the port community are identified, prioritized, and addressed by defining the technical and functional requirements of a Port Community System.

■ PCS design begins by identifying the needs of the port's stakeholders, such as shipping companies, cargo owners, customs authorities, and terminal operators.

■ The design must identify specific requirements for information exchange and communication.

■ The functional specifications of a PCS must be defined in a way that ensures complementarity with the various specialized systems in the port environment, noting that a PCS plays an indispensable role.

■ It is important to develop and agree to a set of guiding architectural principles that serve the stakeholders in a port community.

■ The adherence to technical standards is foundational to an interoperable technical design.

■ Cyber security is a vital element of PCS design and operations. Cyber-attacks on the maritime industry are more common than acknowledged. Seven of the world's top ten container carriers reported having been victims of such attacks.

The most important aspect of defining the technical and functional requirements of a PCS is to ensure that the essential needs of all stakeholders in the port community are identified, prioritized, and addressed. Preparing the value proposition of a PCS involves identifying gaps in the functionality offered by existing systems and developing a proposal that meets some of the significant challenges the port community members face.

In a port environment, there are at least five different systems. These are, the Port Management Information System (PMIS), the Vessel Traffic Management Information System (VTMIS), the Terminal Operating Systems (TOS) (one for each of the port's terminals), the Trade Single Window (TSW)/Customs Automated System (CAS) and (most recently) the Maritime Single Window (MSW).

These systems offer numerous non-overlapping services to port community members. There is a significant role for a PCS despite these systems supporting a broad range of users. That is because the PCS: (i) Serves as the electronic messaging switch board between existing systems. (ii) Orchestrates and executes business processes that span functional boundaries of different stakeholders. (iii) Collects, integrates, and presents a comprehensive view of operations beyond what is possible in the individual systems. (iv) Provides comprehensive analytics based on the

collected data. In its broadest vision, a PCS project impacts almost all the stakeholders' existing ICT systems and all of their important functions. Therefore, the most challenging part of a PCS project involves defining the project scope, developing a benefit profile, and obtaining stakeholder buy-in. The PCS project leadership has its task cut out.

The design and development of a PCS has been challenging due to stakeholders' diverse and incompatible information exchange systems. Integrating these disparate platforms into one cohesive system is sometimes difficult due to legacy investments, interfaces, and business practices. The past decades of technological development have made it easier to architect, design and develop PCSs. These developments notwithstanding, the members of the port community must agree to common interoperability principles (openness, transparency, and user-centricity), interoperability guidelines (recommendations on how to design and implement interoperable systems and services), and interoperable standards and specifications (a common language to communicate and exchange information). To meet all stakeholders' needs and that their concerns are addressed, it may be necessary to create community artifacts that create trust and instill confidence. These include an interorganizational information model, business process model, information security model, service level obligations, and ICT services management model. It is useful to also develop and agree to a set of guiding architectural principles that serve the stakeholders in a port community.

Semantic data standards are the most important factors that affect interoperability. PCSs developed by fully adhering to them will enjoy a less painful path while integrating with external systems. Ad hoc data and messaging standards create an extra burden because of the effort required to develop and maintain bespoke interfaces. Fortunately, five decades of standards building led by the UN, ISO, WCO, IMO and other international organizations ensured that there is now an all-encompassing stack that PCS developers can rely upon.

PCSs are developed against the backdrop of technological advancements. The current framework of PCS technology architecture is best understood as a layered concept. The architectural components are divided into different layers (access, gateway, security, application, data, and infrastructure layers), because they provide a structured approach to organizing complex systems such as a PCS. Each layer provides a specific set of functionalities and services.

Secure and reliable data collaboration between stakeholders is the primary function of a PCS. The Electronic Data Interchange (EDI) technology was developed decades ago to support maritime trade. Until now EDI and UNEDIFACT remain the dominant mode. The increased popularity and growth of Open API (Application Programmatic Interfaces) has attracted the attention of PCSOs worldwide. There are distinct advantages to using API and EDI, and for the time being, members of the port community must remain invested in both.

The growth of IoT technologies, Big Data Analytics, and AI has given birth to the concept of Smart Ports. The smart handling of big data generated through IoT devices and their harvesting to optimize, predict, plan and schedule operations underpins the Smart Port concept. In a Smart Port environment, the complementary role of PCSs in integrating the different segments of the port's function is further highlighted.

1. Introduction

PCSs are information and communication hubs that facilitate the exchange of data between public and private stakeholders involved in port operations. PCSs provide a platform for all participants to coordinate activities, improve efficiency, reduce costs, and ensure security in the supply chain. PCSs enable ports to optimize their resources by providing real-time access to critical information and documentation. With PCSs ships can spend more time at sea instead of waiting in the harbor for their turn to berth or alongside to complete the formalities. Trucks carrying cargo in and out of ports can make more trips, wait fewer hours between operations, run fewer empty trips, save fuel, and contribute to a reduction in emissions. PCSs have become increasingly popular over recent years due to their ability to streamline port processes and have been adopted in multiple countries.

The PCS has an overarching role that spans the entire length and breadth of the port ecosystem. It is the only system that connects the port terminal with the foreland and the hinterland. Only a PCS can 'talk' to all of the port's systems simultaneously, allowing the stakeholders to access information in real time. It helps with faster decision-making and problem-solving within the port environment. PCSs may vary in their functions, covering a range of operations supporting a vessel's turnaround, and cargo movement between the port and the hinterland. The ability to receive and exchange data securely and methodically is at the heart of a PCS.

When stakeholders agree to develop a PCS, they appoint a Steering Committee and a lead agency. The designing of a PCS begins with identifying the needs of the port's stakeholders, such as shipping companies, cargo owners, customs authorities, and terminal operators, and their specific requirements for information exchange and communication. The scoping of the PCS involves decisions regarding the inclusion of business processes, stakeholders, and data to be exchanged. The development of the broad scope should be a part of the visioning exercise. The scoping of activities sets the stage for a technical and economic analysis of the PCS project. The analysis captures the costs and benefits of implementing the PCS and prepares the ground for the investment decision.

The PCS's technical and functional requirements must incorporate end user expectations of functionality. The functional specifications will define the PCS software's functional features, and technical specifications contain the details of the how the

Chapter Layout
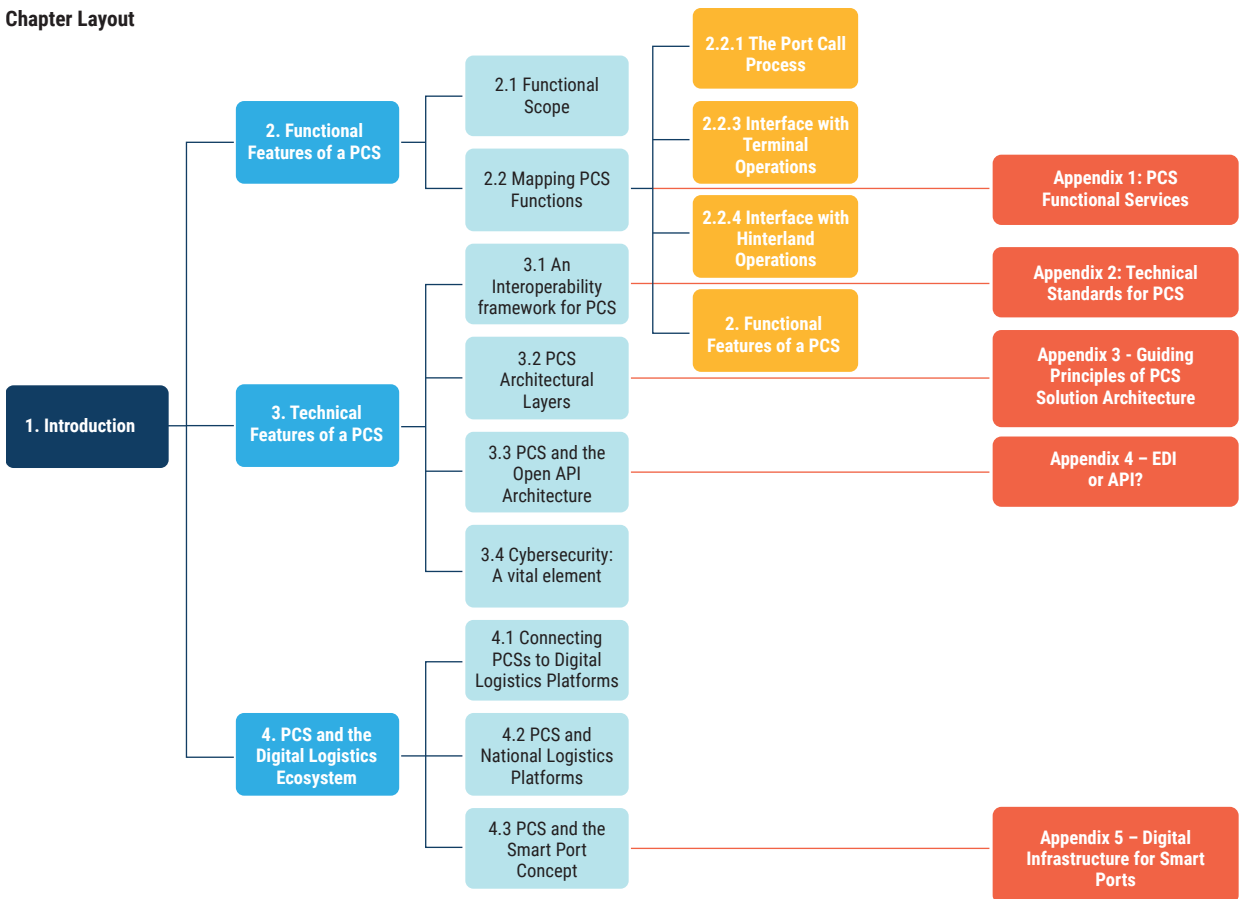
functional features will or can be achieved. The requirements are not developed in isolation but are a part of a suite of documents covering the PCS's governance and operations model, the legal framework, and the financial model. These models are inspired by the overall vision that the stakeholders adopt.

1.1. Outline and boundaries of the chapter

To begin with, this chapter will examine how to carve out the functional scope of PCSs keeping in view the diversity of systems that operate in a port environment. After examining PCS implementations worldwide, the chapter presents a summary of functional features that a PCS must consider (Appendix 1). There are important lessons to be drawn from the development of PCSs over the past decades. These learnings will be used in capturing the factors influencing the design of a PCS's functions. The chapter will also capture the latest technological developments that provide the background for the design of contemporary PCSs. The small and medium ports constitute most of the locations where PCSs have not yet been implemented. Technological developments that simplify and facilitate PCS implementations will be explored. PCSs serve as nodal hubs in the flow of information in global and regional logistics networks and need to be viewed as a part of the larger ecosystem of digital platforms supporting logistics and supply chains. This chapter will capture the key trends in the digital collaboration between PCSs and other partners. The chapter will conclude with the implications of the introduction of the 'smart ports' concept.

2. Functional features of a PCS

2.1. Functional scope

In any port environment, there are multiple information systems in place. When consultations begin on a proposal to implement a PCS, often, the executive sponsors will be confronted with claims that the functionality of the proposed PCS is superfluous. Stakeholders with incumbent systems, namely, the harbor masters, port managers, terminal operators, Customs authorities, and providers of other ICT based platforms operating in the port environment will likely question the necessity and added value of a PCS. They will either suggest that they are already offering (or have plans to offer) the proposed PCS functionality. Besides, the interconnection between existing systems might already be in place, being actively planned or implemented. Some of the functionality offered by a PCS can be demonstrably achieved in different ways, albeit not optimally. Therefore, the foundational challenge of the PCS project leadership is to analyze and grasp the existing situation and provide a lucid view of the As-Is state that exists without a PCS and the To-Be states brought about by it. It is also a key change management task facing the project leadership very early in the PCS journey.

Before considering the functional scope of a PCS, it is essential to distinguish between PCSs and other ICT facilities that operate in a port environment. Understanding these systems' distinct functions and roles is useful because of the proximity and interrelatedness of activities and a shared user base. The executive sponsors/ or the lead agency may engage business analysts or architects to map existing systems and systematically analyze their coverage. The idea should not be to challenge the position held by a stakeholder or to push for an ICT solution that is being contested or resisted, but to develop a consensus around a proposed path with a clear knowledge of its advantages, costs, and pitfalls.

A quick survey of ports suggests that the following types of systems operate at a port. They can be known by different names but essentially feature the following six systems:

a. Maritime Single Window (MSW)

b. Trade Single Window (TSW), (also called National Single Window (NSW), Customs single windows or Cross-border Regulatory Single Windows (CBRSWs). These operate at the country level.

c. Terminal Operating Systems (TOSs) (may include Gate Operating Systems)

d. Port Community System (PCS).

e. Port and Harbor Management Systems. This is sometimes called - Harbor Authority System (HAS). Harbors Information & Control System (HICS), Port Management Information Systems (PMIS), Port Management System etc.

f. Vessel Traffic Management Information System (VTMIS). VTIMS is an information utility that collects vessel traffic data from a variety of sensors, such as rad*ars.

The table 1 clarifies the roles played by the different systems:

One might ask why there are so many systems when they have a shared user base. A closer look will clarify that despite having common users, these systems fulfil certain critical functions

Table 1. ICT Systems at ports and their role

Characteristics ➜ System ⬇	Who operates?	What are the main functions?	Who are the users?
Port Management System	Port Authority/ Maritime Authority	• manage the various operations and activities that take place within the port • enables port and maritime authority to control traffic and manage port infrastructure, such as port calls, automated port dues, journal, incidents, waste, dangerous goods, planner, cargo, inspections, permits, services, security and assets. • interfaces with other systems, such as traffic control systems, navigation, and port security. • Management of vessel scheduling, cargo tracking, • Management of port services, payments and financial management • real-time monitoring and control of vessel movements and analytics tools;	• Harbor master's office, stevedores, pilot services, shipping lines, ship's agents, consignors, consignees, customs, and port safety authorities; maritime security agencies;
Port Community System	Usually Port Authorities; Other empowered bodies	• connects various stakeholders' systems in the port ecosystem, offering them operational data intended to propel the port processes. • modules for managing vessel and cargo operations, finance and accounting, customs clearance • manages inter-terminal movements. • provides an integrated view of port operations to a port's stakeholders • provides comprehensive end-to-end visibility of the means of transpor t and cargo	• Shipping lines, truck/fleet. Rail, barge operators, freight forwarders, terminal operators, customs authorities, customs brokers port authorities, shippers, consignees, and other logistics service providers
Maritime Single Window	Port authorities/ Customs/	• a platform that allows various stakeholders in the maritime industry to submit the required regulatory information electronically, through a single portal. • Facilitate the management of Port Call – the regulatory, administrative, nautical and operational data related to the part call). • aims to handles all crucial data required for providing regulatory clearances for vessels, cargo, passengers and crew • co-ordinates the permitting responses to stakeholders • Note: The Maritime Single Window is a concept that may be realized as an independent facility or is part of another system functioning in the port.	• ship lines, ship's agents, consignors, consignees, customs, maritime, immigration, Sanitary, phytosanitary, human/animal health, environmental and port safety authorities; maritime security agencies;
Terminal Operator System	Terminal Operators	• helps terminal operators manage the various operations and activities that occur within a terminal. • Functions can be broadly divided into berth operations, yard operations, warehouse operations, and terminal gate operations. • Covers unloading/loading of all incoming and outgoing means of transport at the terminals; • Monitors and controls terminal equipment, cargo inventories • Interfaces with other systems as needed;	• Terminal Operators, Freight companies, rail companies, inland waterways, marine surveyors, insurance companies, fleet operators/trucks, shipping lines, Customs
Trade Single Window/ Customs System	Customs/ Other empowered bodies	• receive required information electronically, through a single portal • Ensures coordinated response on the release and clearance of goods. • Supports information and documentation at the border and before the border; coordinated risk assessment • streamline and simplify the process of submitting and receiving information related to the import, export, and transit of goods within a country.	• Customs, Sanitary and Phytosanitary authorities, Pharmaceutical and medical equipment authorities, food safety authorities, Customs brokers, freight forwards, terminal operators, shipping lines and airlines.
VTMIS	Port/ Harbor Authority or Maritime Authority	• Provides ship-to-shore-to-ship communication for safety, and navigational purposes. • Provides automatic identification of ships for navigation and safety purposes.	• Port Authority, harbor authority, Maritime security agencies; Ship operators

Source: Authors' compilation.

Figure 1. Various systems in operations and their coverage. PCS serves across the maritime supply chain
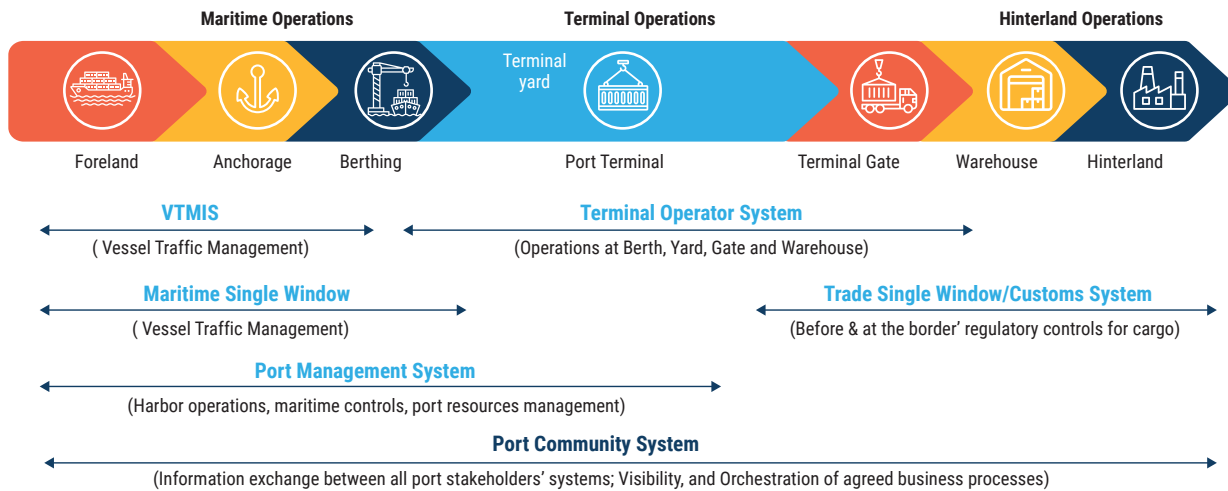
Source: Authors' Illustration.

for their respective owners. The systems owners (port authorities, terminal operators, Customs authorities etc.) have distinct mandates and therefore have business reasons to run their respective systems. The terminal is a well-defined entity with a clear physical and business boundary, and functional responsibility. The PMS is confined to fulfilling the port manager's responsibilities of safe and secure navigation, and the management of the port's facilities. TSWs and Customs automated systems are focused on the regulatory control of goods – the collection of duties, taxes and fees, border inspection of goods and associated documentation. A PCS is quite different from these responsibilities but can serve to enhance and synergize the functions of these other systems.

Terminal Operators can collaborate with a PCS to ensure timely availability of information to Terminal Operating Systems. A PMS and PCS can collaborate to create an integrated and efficient solution to manage a port. Similarly, PCSs can be used in conjunction with TSWs to streamline and synchronize the regulatory and commercial release of cargo. Furthermore, by ensuring that shipping lines submit maritime regulatory data to a single-entry point, the maritime single window concept can greatly facilitate the implementation of a PCS, and other systems at the port. VTMIS and a PCS can collaborate to have full visibility on what and who is on board of the ship during the port passage. To conclude, the PCS is focused on facilitating communication and collaboration between various stakeholders in the port ecosystem. Such collaboration includes integration with systems existing at the border, namely the TOS, PMS, TSW and MSWs.

Depending on the port, these systems may exist in different configurations, automated in full or in part, but together with the PCS, they can help build an integrated and efficient system for the management of resources of the port and ensure an

integrated and seamless operation of the port as a crucial node of the global supply chain.

2.2. Mapping PCS functions

While defining PCS functions, stakeholders' minds are principally focused on the objectives of operational efficiency, trade facilitation and supply chain security. The functions performed by a PCS can vary from port to port, and modules may be defined differently, but the high-level PCS functions may be divided into three broad categories: (i) Interface between the Ship and Port. (ii) Interface with Terminal Operations. (iii) interface with Hinterland Logistics. PCS platforms are generally developed in a modular fashion, with each module covering a specific function. Depending upon the scope, ports may prefer to implement the entire range of PCS functions or only a part.

PCSs are concerned with several regulatory and administrative functions, and several PCS modules may depend on the shipping lines, freight forwarders and other logistics parties for submitting regulatory data concerning safety, security, health (plant/animal, human), environment, immigration, and border controls on goods. Regulatory data received in PCS modules is considered 'upstream data' because such data is required by law to be received in advance of the arrival, and before the departure of the vessel. Data supporting a port authority or Customs authority's regulatory functions are extremely useful for the downstream B2B functions. A PCS adds value by following the 'single window' principle which states that the required data input must be submitted only once. The 'maritime single window concept' established under the IMO FAL convention, and ISO 28005-1 on the Security Management Systems for the Supply Chain – Electronic Port Clearance adopts the same principle.

Figure 2. Maritime Supply Chain processes and Services. The figure illustrates the simultaneous delivery of regulatory/administrative, transport/logistical services

	PORT CALL PROCESS	TERMINAL OPERATIONS PROCESS	HINTERLAND OPERATIONS PROCESS
Regulatory & Administrative Services	**Vessel Clearance:** • IMO Regulatory Reporting • Customs, Maritime & other authority Clearances	**Cargo Clearance:** • Regulatory Goods & Cargo Inspections • Customs Release	**Cargo Pre-clearance:** • Advance Declarations • Pre-arrival Processing
Transport & Logistical Services	**Vessel Services:** • Pilot, tug, drayage • Berthing, Unberthing • Bunkering, supplies, repairs	**Terminal Services:** • Loading/ unloading; • Stowing & Yard Management • Gate management	**Multimodal Logistics Services:** • Freight Booking, Gate Appointment • Empty Return/Provisioning • Stuffing/Stripping

MARITIME PCS COVERS THRADSUPPLY CHAIN PROCESSES -ILLUSTRATIVE

Source: Authors' Illustration.

2.2.1. The Port Call process

A port call includes processes linked to the arrival of a ship, the stay of a ship, and the departure of a ship. Managing the port call process efficiently ensures that ports are not congested, and vessels don't get stranded at the harbor waiting long for their turn and optimize their cruise speeds to arrive 'just in time'. Just in time arrivals are a win-win proposition, having been proven to reduce carbon emissions and operational costs. The International Taskforce on Port Call Optimization (ITPCO) defined the standard port call process, which was shared as part of the IMO proceedings. This includes the nautical, operational, administrative and regulatory requirements. The port call process involves maritime trade and transport parties, commercial banks and insurance companies, regulatory and administrative authorities, navigational and vessel operations professionals. These

Table 2. How a PCS can help manage port calls efficiently

Stage	What it involves	How a PCS can help
Planning	Ships's agent registers vessels and schedule of voyage.	PCS registers vessel, annouces scedules; notifies the members of the port community
Pre-Arrival	Ships's agent provides advance notice of its arrival time and the cargo it is carrying;	PCS transmits to members of the port community, including authorities; PCS assists community members with ship's arrival and plan for the necessary resources, such as labor, equipment, and storage space;
Arrival	Harbor pilot and tugboat services guide the ship safely into the port;	PCS tracks the ship's movements; provides real-time status; Enables members of the Port Community to coordinate their activities more effectively;
Berthing	Ship, safely moored, allows various service providers to begin the loading and unloading of cargo.	PCS tracks progess and keeps the relevant parties informed. For example, terminal operators can use the PCS to monitor berth assignmenta nd manage cargo movements.
Clearance	Customs and other government officials inspect the cargo and verify regulatory compliance	PCS facilitates transmission of cargo location, schedules appointments for inspection, securiy shares documentation and communicates cargo relase status to parties concerned.
Departure	Ship prepares to depart after completing loading and unloading operations, and fulfilling other purposes of the port call	PCS coordinates activities are concluded in a timely manner e.g., refueling, waste disposal, etc, ensures all parties have the necessary cargo documentation, all vessel-related port dues, fees and charges are collected, and all the required regulatory and commercial releases are obtained, collated and transmitted.

Source: Author's compilation.

Figure 3. The Port Call Process, as Illustrated in DCSA (2021

| Berth arrival planning | → | Pilot boarding place arrival and services planning | → | Pilot boarding place and berth arrival execution | → | Start cargo operations and services | → | Ser ices and port departure planning | → | Port departure execution |

are the same parties that typically use a PCS. The following table provides a simplified explanation of how a PCS can greatly simplify communications in the management of the port call process:[1]

2.2.2. The ship-port interface

The ship port interface includes the 'port call process' and refers to the steps taken by a vessel for its arrival, stay, and departure. It is broadly divided into two service categories: (1) Nautical and Operational Services. (2) Administrative and Regulatory Services. The port call[2] begins with the announcement of the vessel's schedule, registration of the vessel at port, notification of a vessel's arrival, obtaining permission from regulatory authorities to enter the port, the payment of required fees or charges for using the port, such as port fees, pilotage fees, or mooring fees, completion of Customs and immigration procedure, anchorage and berthing, loading and unloading cargo, providing for the needs of the vessel and the crew. As regards the ship-port interface, PCS may offer these services directly or collaborate with other stakeholders' systems, such as the automated customs systems, port management information systems, harbor management systems etc. It is up to the PCS lead agency, the port authority, and the stakeholders to specify the PCSs role. At a minimum, the PCS should provide an integrated view of a vessel's physical position, the status of nautical services, regulatory clearances, and the status of vessel related payments.

The role of a PCS in collecting payments for port-related services received by ship is not to be underestimated. A vessel can receive a wide range of services from multiple service providers while it is at a port, and the ship operator/ shipping lines must pay for those services. These may be berthing/anchoring, loading/unloading, special cargo handling, transshipment, ship chandlers providing for the supply needs of the crew and the ship, bunkering, energy supplies, repair and maintenance, ballast water, waste disposal etc. In addition, the ship operator must defray the regulatory fees and charges. A simplified billing and payment interface can offer massive savings for the shipping lines.

An indicative list of PCS functions to support the Ship-Port interface is in **Section A of Appendix 1.**

2.2.3. Interface with terminal operations

Terminal operators perform a range of functions concerning the loading and unloading of vessels, and receipt and delivery of inbound and outbound cargo in the terminal, storage, and evacuation of cargo in the terminal's yards. Terminal operators must ensure the availability of equipment and facilities to support these operations. With a PCS interface, terminal operators can access and exchange information with other parties involved in the cargo handling process, such as shipping companies, customs officials, and trucking companies.

For the quay side operations, the PCS interface facilitates the terminal operator's access to information about the vessels using the terminal, including vessel arrival and departure times, cargo loading and unloading details, dangerous goods, and other relevant information. With faster and accurate information, terminal operators can plan and coordinate the loading and unloading of vessels.[3] An important simplification achieved through the interface between a PCS and a terminal operator is the management of transshipment operations through barges and railways. In the absence of a PCS, terminal operators must rely on separate interfaces with port authorities, navigational services, regulatory authorities, and a host of other port-based service providers. That might mean multiple phone calls, text messages and ad hoc communication patterns that slow down or compromise the safety and effectiveness of operations.

For the yard operations, the Terminal Operating System (TOS) has the principal role of automating the process of trucks picking up and dropping off containers, and the operation of the terminal's specialized equipment and technology to handle the moves of the container. However, the PCS can play a crucial role in the sharing of accurate operational information with all stakeholders about: (i) The arrival of the truck and the truck driver at the terminal (as a part of the port entrance processing), and its direction to the designated area for container pickup or drop-off. (ii) The identity, location and release status of the container. (iii) Authenticate the identity of the truck appointment, truck and chassis and registration, and crew. (iv) Equipment interchange. (v) Notification to the insurance surveyor. Communication with PCS could help improve the efficiency and accuracy of container handling at the terminal and reduce the risk of errors or accidents. It also allows

---

1   Note: DCSA defines the 5 stages of the port call processes to include – (i) Berth arrival planning (ii) Pilot Boarding Place (PBP) Arrival Planning (iii) PBP and Berth Arrival/Start Cargo Operation (iv) Cargo Completion & Port Departure Planning (v) Cargo Completion & Berth Departure

2   The International Maritime Organization's (IMO) Maritime Single Window (MSW) Guidelines version 2022 contained in FAL.5-Circ.42-Rev.2.pdf (imo.org) contains a brief description of the port call process. It was mapped in detail by the International Task Force Port Call Optimization (ITPCO)

3   ITCPO, IMO and DCSA have defined the timestamps for Port Call optimisation and JIT

for faster turnaround times for trucks, which can help to reduce congestion and improve the overall flow of cargo through the terminal. Port terminals in large ports specialize in multi-modal operations, offering extensive reach to and from the hinterland via rail connectivity, road, and inland waterways. PCSs in Western Europe such as in Le Havre, Antwerp, Rotterdam, and Hamburg are excellent examples of multimodality. A special case where a PCS can play a crucial role is when containers must move between terminals.

An indicative list of PCS functions to support the interface with terminal operations is in **Section B of Appendix 1.**

2.2.4. *Interface with hinterland logistics*

The interface between the PCS and hinterland logistics operator supports the efficient and secure movement of inbound and outbound cargo. In the case of transshipment, it involves movement of the cargo from the port to its last destination. The PCS also facilitates the coordination and communication between the various parties involved in the process. Goods can move in and out of terminals with clearance from Customs (and other regulatory agencies). Interface between a PCS and Customs becomes vital. Regulatory release is a necessary

but not sufficient condition for moving the cargo. The freight forwarder must obtain a shipping line's commercial release and a release from the port authority and terminal's perspective. The PCS's unique capability to link-up these three parallel release processes come together to allow the movement in and out of terminal gates. The PCSs role in the interface with the hinterland logistics operator and regulatory authorities, such as Customs, is vital for trade facilitation.

A terminal's operations may require a high-level of digital interactivity between the shipping line and TOS due to the highly complex and specialized process of optimizing stow plans and yard plans. Many terminals have argued for the necessity for shipping lines to maintain direct connectivity with the TOS. Ports that have a single terminal, and terminals run by port authorities, have argued against the need for a PCS. PCSs, however, can provide several benefits that can help to improve the efficiency and security of the cargo handling process. PCS services, as a part of this interface, also benefit container depots and external warehouses which can use the same processes as a port terminal, the only difference is that the latter has also a seaside operation.

An indicative list of PCS functions to support the interface with hinterland operations is in **Section C of Appendix 1.**

3. Technical features of a PCS

Foremost, a PCS must be designed to meet non-functional, technical, and architectural requirements. A PCS is an open, large-scale ICT platform, and considerations of scalability, reliability, security, flexibility, usability, maintenance, and cost-effectiveness should guide its design. Apart from these technical features, interoperability is foundational to a PCSs success.

3.1. An interoperability framework for PCS

An interoperability framework[4] is essential for PCS projects because it provides a standardized way for different systems, devices, and software applications to communicate and exchange data. Interoperability frameworks are vital: (i) They enable different systems to integrate and work together seamlessly without requiring extensive custom integration efforts. (ii) They can encourage innovation by making it easier for developers

to build new applications that can interact with existing systems. (iii) They help ensure the quality and consistency of data by establishing standard data formats and exchange protocols. The European Interoperability Framework defines four interoperability layers:

- **Legal interoperability**: Legal, policy, and regulatory frameworks define the scope of interoperability, particularly for data exchange and requirements for privacy and data protection.

- **Organizational interoperability:** For interorganizational-interoperability, federation, or mutual recognition of ID systems, organizations must define trust frameworks and process standards around the identity lifecycle (e.g., the eIDAS[5] standards).

- **Semantic interoperabilit**y: To ensure that the meaning of exchanged data and information is consistent, systems must

---

4   The European Interoperability Framework (EIF) is a set of guidelines that promotes interoperability between European public administrations. The EIF can be applied flexibly to large scale integration projects such as the PCS. For World Bank's guidance on the development of the key requirements for an interoperability framework. See here - https://id4d.worldbank.org/guide/interoperability-frameworks

5   eIDAS defines the standards across the EU for electronic identification (eID), electronic signatures, time stamps, electronic seals, and other proof of authentication that give electronic transactions legal validity equivalent to paper documents.

Figure 4. Timeline of the digital transofrmation in modern seaports

First Generation — Paperless Procedures

- Containerization starts
- Mayor Structural transformation of seaports
- Rapid growth of containerized transport
- Mayor advances in ERP systems
- Increasing demand for value-added logistics in seaports

1960 — 1980

- Development of EDI
- Development PCS 1983: Dakosy
- Development of commercial TOS 1988: CITOS 1989: Navis
- Development of UN/EDIFACT standards for the maritime industry
- Transformation to electronic shipping documents

Second Generation — Automated Procedures

- Development of automated terminals development 1993: ECT Delta Terminal 2002: CTA
- First global carrier alliances
- First severe traffic and environmental problems
- Dot-com bubble
- Increased interest in single winndow systems
- Global economic crisis

1990 — 2000

- Adoption of laser technologies
- Adoption of automatic identification (e.g., RFID) and positioning systems (e.g., GPS)
- Adoption of OCR technologies
- Development of global e-marketplaces for the marine industry 2000: INTTRA
- Development of truck appointment systems
- Single window recommendations

Third Generation — Smart Procedures

- Traffic and environmental problems continue to rise
- Growing demand for a better visibility and decision support in port operations
- Cooperation between ports and universities 2010: Erasmus Smart Point
- MPA announces to leverage the ongoing revolution in IT sector

2010 — 2015

- Mayor advances in sensor-based measurement in seaports
- Development of mobile cloud platformsto allow real-time information exchange 2010: HPA starts SLP project
- Development of SaaS port applications
- Development of mobile port applications
- Crowd-sourcing events to investigate innovative solutions in the areas of decision analytics, big data, internet of things, etc. 2013: First global port hackathon 2014: smart port hackathon by MPA

Source: Leonard Heilig, ·Eduardo Lalla-Ruiz.

adopt the same data standards or construct data dictionaries. PCSs often develop and manage data dictionaries used within the community.

- **Technical interoperability**: To enable machine-to-machine communication, systems must adopt the same technology standards for software, physical hardware components, systems, and platforms.

PCSs depend on harmonized and standardized data models to promote a shared understanding of the information that is exchanged between ICT systems. The importance of standardization and global harmonization of data used in international trade is widely acknowledged as the basis for interoperability. Where PCS users don't meet data and message standards, the PCS can offer "translation services" for a defined period or permanently allow stakeholders to interchange information with each one maintaining a different standard.

Appendix 2 provides a short collection of data standards that are relevant to a PCS application.

3.2. The technological evolution of PCSs

Building the technology architecture for a contemporary PCS requires an understanding of the state of the art, while gathering lessons learnt from the technology investments of the past. In the Figure 4, the authors provide a retrospective view of the major implementation milestones and their technological underpinnings up to 2015. The authors delineate the three main generations in the digitalization of the maritime sector: (i) Paperless procedures. (2) Automated procedures. (3) Smart procedures.

Since 2015, several technological developments have influenced the contemporary PCS architectures of maritime digitalization. Numerous industry milestones mark the advent of those technologies, enabling the development of more efficient, safer, and environmentally friendly shipping systems. The following are vital technologies for the current generation of PCS users and applications:

Internet of Things (IoT): IoT enables the integration of sensors and devices on ships, containers, and trucks to collect and transmit data in real-time. IoT developments have allowed technology architects to conceive of intelligent transport systems (ITS) that optimize performance, enhance safety, and reduce fuel consumption. Essential PCS functions, such as terminal gate automation,

cannot function without ITS technologies. Digital Twins make use of IoT technologies as well as PCS timestamps that are generated in real time. Drones are used for surveillance and supply chain security. Drones become an even more powerful tool when used within a PCS. PCS timestamps could help initiative drone inspection, enhancing preventive vigilance at ports.

AI and Big data analytics: ITS and other technologies generate large volumes of data leading to increased use of data analytics to produce decision-making by providing real-time insights into ship performance, route optimization, and cargo management. Contemporary PCSs offer users an additional service layer, including advanced data analytics. AI is a technology in its own right, with applications in predictive analytics.

Cloud Computing: The ability of cloud computing platforms to provide application hosting facilities helped countries dramatically cut short the implementation time. Prominent PCS solution providers have started offering their solutions on the cloud. PCS implementers can begin with a few PCS modules on the cloud and grow them as they achieve scale.

Blockchain of Distributed Ledger Technology (DLT): Not in the same league as the above three categories of proven technologies, blockchain/DLT, nevertheless have the potential to help manage the transfer of records in a transparent and trust-worthy environment. Blockchain, by enabling data collaboration, ensures the creation of immutable records, establishing transparency, trust, security, visibility, and supply chain integration. Blockchains are ideal when a large community of users is involved, there is a limited amount of trust between them, but there are clear incentives to work together, and if data needs to be immutable. Other than Busan Port, to date, there exist several applications in the maritime domain, but there are no known 'blockchain native' PCS applications.

3.3. PCS architectural layers

The PCS provides an integration environment allowing different systems to work together to deliver a service to business and authority end-users. It is therefore suggested that the development of a PCS should follow a common set of architectural, design and technological guiding principles (see Appendix 3). In the absence of those guiding principles, the PCS will result in a patchwork of disparate and incompatible systems. In developing a PCS, ports must follow a layered technology architecture[6] to ensure modularity, flexibility, and scalability. A layered architecture is a design approach that separates a system into layers, with each layer performing a specific set of functions and communicating with the layers above and below it. Simply put, there are three architectural layers – the presentation layer that

interacts with users, the business logic layer that implements the business rules, automates business processes, and implements workflows. The data storage layer stores and manages business data. A layered architecture enables the PCS to scale more effectively by allowing different layers to be deployed on separate hardware or software platforms. Layers improve the maintainability of the system.

In Figure 5 (above), the box on the top titled '*Individual PCS Users*' captures various types of PCS users, who may access the PCS application through a variety of devices and access channels. The box on the left lists the various '*External Systems*' that connect digitally via interfaces provided with the PCS. The '*Gateway Layer,*' which is in the box to its right, includes various technical services that help establish the required interfaces. All external access to PCS application modules (situated in the '*Application layer*') should be controlled through the crucial '*Security Layer*': the vertical box in the middle. The PCS software application follows a modular and component-based architecture, aligned to processes that conform to established open standards, with components that are independent of the physical topology of the system. To support PCS applications, there is an '*Infrastructure Layer*' that is independent of the applications. The 'Data Layer' holds the data assets belonging to the PCS. There is a '*Metadata Management Layer*' that serves an important role in PCS data governance.

The layered architecture approach allows for modularity (PCS application modules listed in the box are self -contained units of functionality), scalability (layers are independent of one another and can scale), resilient (provides redundancy in components for each service within a layer and allows the isolation of failures in the participating components). Thus, a layered architecture provides a flexible and adaptable approach for migration to cloud platforms.

The functional modules should be defined to meet the functional requirements described in section 2 and Appendix 1. The PCS modules should be designed to be complementary to the functionality offered by Trade Single Window, Customs Systems, Port Management Systems and TOS. PCS software could be a bespoke development or a customization of an existing solution or a combination of both. In either case, the requirements of the PCS must be defined first. The PCS solution architecture should deal with several requirements that are sometimes contradicting and overlapping. The overlap/contradictions may be because it deals with the requirements of common clients.

At the core, the PCS is driven by application integration technologies, and must have the general capabilities (listed in the '*Gateway Layer*') that enable communication and data exchange between different applications, allowing them to work together

6   Inkinen, T., Helminen, R., & Saarikoski, J. (2021). Technological trajectories and scenarios in seaport digitalization. Research in Transportation Business & Management, 41, 100633. https://doi.org/10.1016/j.rtbm.2021.100633

Figure 5. Architectural layers of a Port Community System
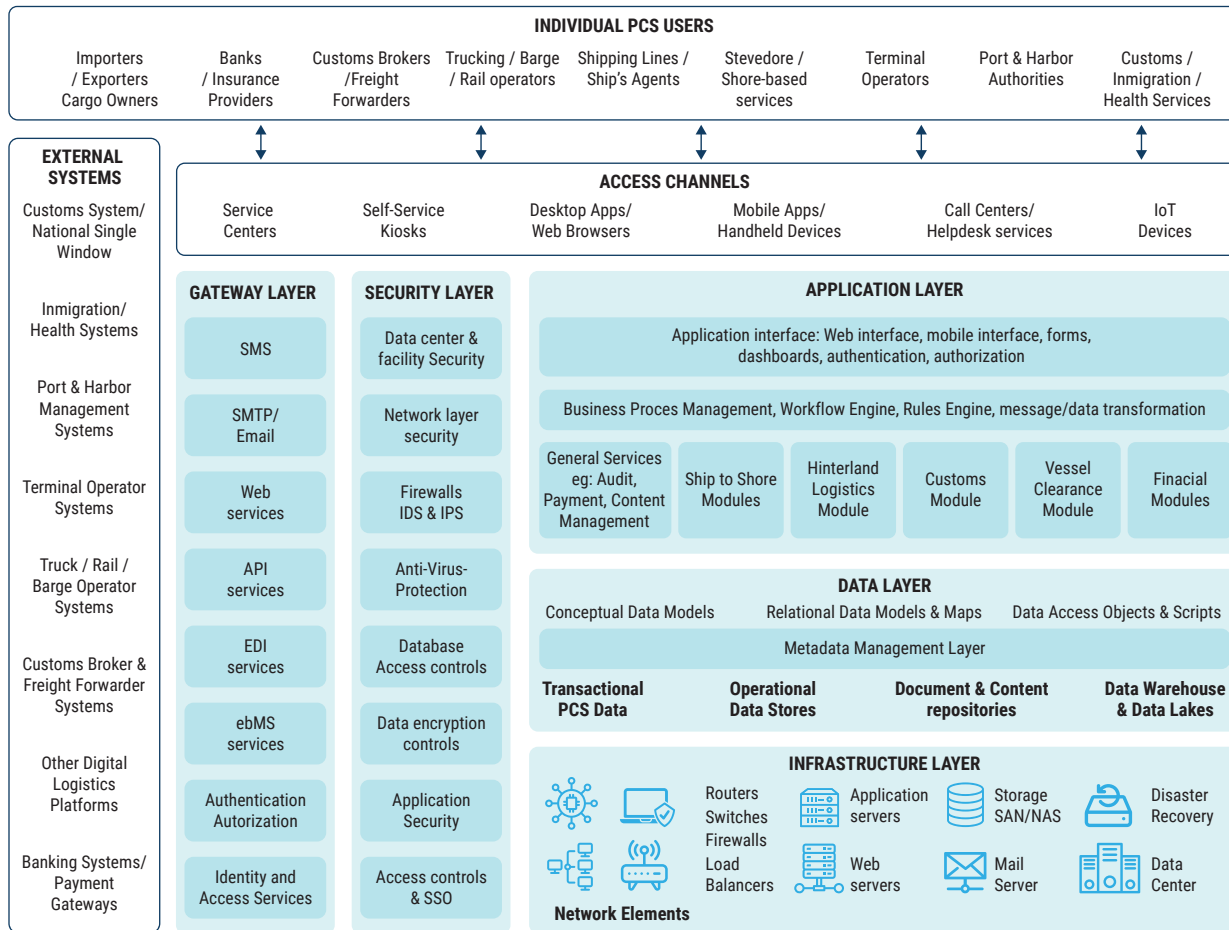
Source: Authors' composition.

Table 3. Technical Challenges faced by a PCS and strategies to adopt

Technical Challenge	Strategies /Responses
Integration with PCSs is a moving target because stakeholders are also constantly updating their systems	Traditional software engineering (waterfall) methods may not work. PCSs will have to develop software in an 'agile' mode of work in short lifecycles.
PCSs need to serve a diverse collective of public and private entities that are of different sizes and nature of business	Develop a technical and functional model that would be good business fit to each type of organization regardless of size and type. To the extent possible, rely on non-proprietary and open technologies.
At threshold, PCSs must integrate with legacy systems that present difficulties due to technical interoperability.	Establish a technology architecture that accommodates platforms and vendors from different generations. This includes putting in place a versatile stack of integration middleware.
PCSs usually start with a few users and a limited number of services. As applications and users grow, the PCS must scale rapidly.	To ensure scalability PCSs should be architected at different levels. Beginning with the software architecture (using microservices), application architecture (containerization), cloud computing infrastructure (storage, server, networking, and load-balancing), the applications must be designed to scale. Notwithstanding technology, PCSs should adopt appropriate monitoring and alerting to begin the upscaling on time.
PCSs need to have Data updates. In a PCS data should be synchronized to ensure real-time capabilities	To ensure that PCS receives data updates in real time, adopt technologies such as WebSockets, Server-Sent Events (SSE), Long Polling, Message Queues, Publish/Subscribe, and Change Data Capture (CDC) To ensure faster, real-time updates, modern PCSs are increasingly adopting Application Programmatic Interfaces (APIs) that use a request/response model as opposed to EDI that uses a store-and-forward model.

Source: Authors' compilation.

and collaborate on information. The PCSs of the current generation follow the microservices-based architecture that conform to standards of interoperability allowing seamless exchange of information, the reuse of data models and inter-changeability of data across systems. These include a set of standards and protocols for exchanging data and information between applications over the internet, such as web services, APIs (Application Programming Interfaces), and Message-oriented middleware (MOM). The enterprise service bus (ESB), a software architectural feature, enables the integration of applications and systems within an organization. It acts as a central hub for communication and data exchange between different systems and applications. Finally, the principles of information security should drive a PCS's technical architecture. The principles should cover authentication, enforcement of security policies, levels of security, security management, etc. The PCS application should support the user authentication framework at all levels and across all applications within the PCS.

The technology architecture should be based on user requirements and expectations, which the PCS operator will define contractually with PCS users in SLA (Service Level Agreements). The technological design must meet the performance (response times, uptime, and throughput) and availability (and resilience to failure) expectations. Maintenance aspects, including the frequency of updates, patches, and tasks, must be carried out in an environment that minimizes disruption. Users might expect updates to be made available regularly. A refresh of the systems should be achieved without business disruptions. Table 3 captures some of the challenges faced by PCS users and strategies to respond to them.

3.4. PCS and the open API architecture

The purpose of a PCS is to communicate electronically with other systems operating in a port environment. PCSs have traditionally relied upon Electronic Data Interchange (EDI) technologies. They may continue to rely on the technology for the bulk of their messages. Although EDI continues to dominate the landscape, the industry has decidedly moved towards adopting an Open Application Programmatic Interface (API) infrastructure.

There are several reasons for this shift. Most PCS application providers and advanced ports with PCSs are increasingly offering API-based alternatives to EDI message specifications. The development of the 'Smart Port' concept (discussed in the following section) requires the openness and interconnectivity of data. The industry body 'DCSA' has established a set of standardized open data models, and the main framework follows the OpenAPI Specifications. The open data concept needs APIs to connect the data among various container carriers (Shipping Lines). In addition to enabling digitalization and interoperability for stakeholders, APIs can also help port operators effectively track and manage passengers/freighters, exhibiting the strength of Smart Port. Open API, also known as a "public API" or a "web API," is a software interface that allows external systems to access and use the functions and data of a software application or platform. Governments are seeking to create open stacks to allow dynamic and low-cost collaboration between stakeholders in the freight and logistics communities.

Several PCSs have introduced API based integration options. *Portbase PCS Rotterdam* provides one of the most comprehensive

Box 1. IAPH Cybersecurity Guidelines for Ports and Port Facilities

The World Bank together with IAPH have set cybersecurity in the maritime sector as an ongoing priority. In 2021, IAPH released the first ever Cybersecurity Guidelines for Ports and Port Facilities that have been considered by IMO MSC 104 and FAL 46 committees and will be included in the IMO Guidelines on Maritime Cyber Risk Management (MSC - FAL.1/Circ.3/Rev.2). IAPH guidelines shall be considered in the context in the implementation of the critical digital infrastructure such as Maritime Single Window and PCSs. The IAPH guidelines are intended to be used by any member state and maritime and port authorities to recognize the importance of managing cyber risk and to instill an understanding that it is a responsibility that starts at the top of authorities, organizations, despite the digital divide among the ports, worldwide. The guidelines are mainly focused on developing the business case for the executive committee to determine "how much enough is enough?" as reasonable level of investment in cyber risk management and to gain insights into how a cyber event could impact a port or port facility's ability to function, along with the cost of disruption.

These guidelines also address the need for the maritime and port authorities' management team to develop a cyber risk management strategy. According to IAPH, the Guidelines provide a plan to achieve and sustain a defense-in-depth posture, key insights on cyber threat landscape, and include insights into the impacts of cyberattacks against integrated port systems. Specific considerations address organizational structures, identification of key stakeholders, reporting mechanisms, data flow and network mapping, characterizations of critical activities that are performed, and the identification and analysis of critical data, systems, assets, and infrastructures. Insights are provided for executives about how to assess risk and vulnerabilities in their port operations and how to adopt a holistic approach that will enable them to organize and manage their cybersecurity program by implementing customized cybersecurity protection, detection, and mitigation measures. Best practices for cybersecurity information sharing, communication and coordination are key to reduce cybersecurity risks are also provided. The guidelines provide also with practical assistance in developing port and port facility cybersecurity assessment and plans, in a complementary approach of ISPS framework but also envisioning the management liability for cybersecurity risk management.

Source: https://sustainableworldports.org/wp-content/uploads/IAPH-Cybersecurity-Guidelines-version-1_0.pdf

collections of OpenAPI specifications covering a variety of services. Operator APIs cover voyages, visits, and handling for barges, road, and rail models. Terminal APIs include visits and handling on the terminal side. Forwarder APIs cover declaration, processing, forwarding, and the registration of release to parties. Tracking APIs allows a broad range of PCS users to receive even small and real-time updates about changes on voyages, visits, or handlings. To supply correct data and codes to Portbase, PCS users can use the Reference Data API to retrieve the standard values such as barges, shipping companies, handling size types, terminals.

The Digital Container Shipping Association (DCSA), a consortium of shipping lines, lists the top 3 reasons for switching from EDI to API as: real-time data exchange, faster innovation, and great customer experiences. Since data models drive both the content of electronic messages, the EDI message specifications can be adapted for use in APIs. There are tools now available to transform UN/CEFACT standards into OpenAPI 3 specifications that are based on JSON via a RESTful interface.

While the industry is abuzz with enthusiasm about the potential benefits of APIs, EDI still dominates. EDI is said to represent 85% of supply chain transactions. The EDI global market is expected to double between 2019 and 2027 to $49 Billion, according to

estimates from Insight Partners, while the API market should be worth around $13 billion, according to the verified market research. API is real time. But it is not suitable for mass data transmissions, which EDI does well. PCS implementors will invariably face the choice between EDI and API options.

Appendix 5 provides a comparison of features of API and EDI implementations.

3.5. Cybersecurity: A vital element

No computing device is inherently secure. As countries approach PCS development cybersecurity should be uppermost in their minds. The maritime trade sector carries a significant proportion of the global economy on its shoulders and its resilience is vital for the world's growth and well-being. The maritime transportation system is not a single entity, it is a system of systems, with ICT systems at their core. The global ICT systems are interconnected, and a system coming down somewhere can have ripple effects on the entire trade chain. Therefore, governments consider maritime transportation systems as a part of critical national infrastructure. Cyber-attacks on the maritime industry are more common than acknowledged. Seven of the world's top ten container carriers reported having been victims

of cyber-attacks.[7] There are severe physical and financial consequences of cyberattacks not just on the intended victims but also the rest of the maritime transportation systems. There can be ripple effects up and down the supply chain. As data exchange hubs and the nodes of the world's busiest ports, PCSs are some of the most vulnerable targets.

The European Cybersecurity Agency (ENISA), examines critical scenarios[8] in which there is a targeted attack on the systems used for exchanges between all PCS stakeholders. For example, attackers might seek to disrupt port services by falsifying information, causing financial loss to the ports. The attackers may exploit the vulnerabilities offered by the numerous machine-to-machine connections. PCSs are increasingly being connected automatically, interconnected with external systems (via API, EDI exchanges) that use third parties' software. For example, PCSs provide access to users through web applications, which may have vulnerabilities that the attackers might exploit.

The core PCS functionality involves data exchanges through a variety of interfaces, and that amplifies the cyber risk. The PCS is an open platform for all stakeholders and as such it's services and the way to connect is usually publicly available, helping the new stakeholders of the community but, unintentionally, also the cyber attackers. Since most solutions in PCS are based on comparable technologies, they also share relatively similar cybersecurity vulnerabilities. Therefore, not only should PCSs be built for security, but they should also work collaboratively to protect each other from the ever-present cyber threats.

4. PCS and the digital logistics ecosystem

Ports are located at the interstices of global supply chains and connect to networks supporting international flows of goods and accompanying data. As regional centers[9] ports take on three distinct roles:

1. Transshipment points.
2. Centers for value-added logistics, including aggregation and distribution.
3. Hosts (in some cases) for industrial activities within the port area.

4.1. Connecting PCSs to digital logistics platforms

For regulatory authorities, ports are stations for carrying out regulatory controls and for commercial stakeholders, ports provide the space for the interchange of goods and commercial documentation. Viewing ports as embedded in global networks allows designers of digital logistics platforms to visualize the origin, destination, and direction of information flows.

Evidence from the newly emerging platforms suggests that the PCS concept is beginning to integrate with the information systems and platforms in the hinterland and the foreland. The integration involves connecting with supply chain stakeholders outside the scope of port operations and collecting information from business processes that occur before or after the port handling process. At present, transport and logistics operators on land and in the sea are generating data on supply chain events through sensors embedded into logistical nodes, transport equipment and transport means. PCSs currently use this collected data to perform routine cargo processing operations. Increasingly, however, this data is also being used innovatively in applications concerning the prediction of flows, schedules, prices, disruptions, and unforeseen delays. The predictive capability of these types of applications helps stakeholders to make decisions not only about optimal and resilient performance but also informs decisions about the choice of routes, modes, and aggregation. Here are some examples:

There is a growing trend towards automating various maritime transport processes, such as cargo handling, vessel navigation, and maintenance, using digital technologies such as sensors, robots, and artificial intelligence. Shipping companies are looking to use digital methods to manage and optimize routes, track vessels and cargo, and automate tasks such as invoicing and documentation. The maritime industry is adopting blockchain technology to improve transparency, security, and efficiency in moving goods and transferring ownership and documentation. New IoT technologies generate large amounts of data from various sources, such as vessel tracking systems, cargo sensors, and port infrastructure. Logistics service providers use this data to improve decision-making, optimize routes and schedules, and identify cost savings and efficiency improvement opportunities. Integration between logistics systems requires the development of standardized and interoperable digital systems and technologies in the maritime industry to facilitate the exchange

7   https://thetius.com/cyber-attacks-who-targets-the-maritime-industry-and-why/
8   See page 35 https://www.enisa.europa.eu/publications/port-cybersecurity-good-practices-for-cybersecurity-in-the-maritime-sector
9   A. W. Veenstra, "The role of ports in global supply chains," Report commissioned by the Port of Rotterdam Authority, 2006

Figure 6. Ports as a part of the global logistics network[10]

Legend

🔴 Shippers Recipients 🔵 Logistic Service Providers 🟡 Transshipment & Storage 🔵 Forwarders & agents 🔴 Banks & Insurance 🔵 Authorities
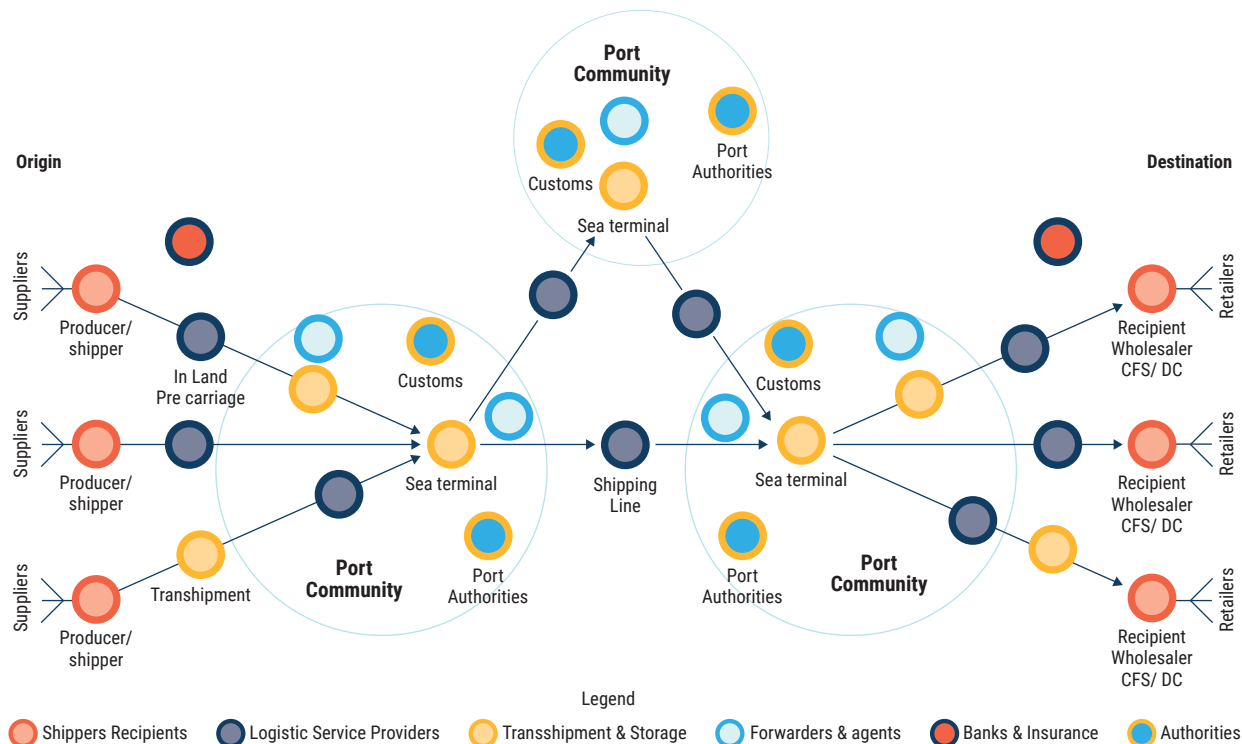
Source: Baalen, Peter J. & Zuidwijk, Rob & Nunen, Jo.

of information and the integration of different systems and processes. Overall, the digitalization of maritime transport is expected to bring significant benefits, including improved efficiency, reduced costs, increased transparency and security, and a more sustainable and competitive industry.

4.2. PCS and national logistics platforms

Taking into account the economic prospects of digitalization and its role in driving modern logistics business, many countries (particularly the advanced economies) have established policies, processes and strategic documents to meet the challenges of current and future scenarios and identify and capture the gains from technological progression. In these initiatives, 'digital' ports are expected to play a significant role given their position as nodes of multimodal transport and supply chains. Here are some examples:

- The United States government launched the Freight Logistics Optimization Works (FLOW) initiative[11] to address supply chain vulnerabilities and congestion, and to increase the

speed of cargo flow and to reduce logistics costs. The initiative covers a range of supply chain actors, but port authorities are playing a central role, with the participation of key port clusters - namely Port of Long Beach, Port of Los Angeles, and Georgia Ports Authority. The aim is to reduce port dwell time and alleviate port congestion. This comes on the back of a federal Maritime Transportation Data Initiative to assess and streamline data standards and data access protocols.

- The government of South Korea announced the 'National Logistics Basic Plan (2021-2030)' on July 1, 2021, establishing a blueprint for the development of the logistics industry in the coming decade. The accompanying document – the '2030 Port Policy and Implementation Strategy' lays the foundation for establishing smart logistics through the digitalization of port logistics using Industry 4.0 technologies.

- In September 2020, Italy's Ministry of Infrastructure and Transport established a steering committee of the National Logistic Platform. The steering committee aims to establish digital linkages between the modal interchange nodes: ports, dry ports, freight, and logistic centers. Italy is developing the 'National Logistics Platform (PLN – Piattaforma Logistica

10   Baalen, Peter J. & Zuidwijk, Rob & Nunen, Jo. (2008). Port Inter-Organizational Information Systems: Capabilities to Service Global Supply Chains. Foundations and Trends in Technology, Information and Operations Management. 2. 10.1561/0200000008
11   Fact Sheet: Biden-Harris Administration Announces New Initiative to Improve Supply Chain Data Flow

Table 4. Examples of Digital Logisitcs Platforms integrating with PCSs

Platform	Usage and user base	Functions
IPCSA's Network of Trusted Networks (NOTN) https://notn.ipcsa.international/	Global	• The International Port Community Systems Association (IPCSA) is undertaking a trial of the innovative concept for enabling port-to-port and cross-border data exchange. • Called the Network of Trusted Networks (NoTN), it aims to connect PCSs and NSWs all over the world. This trial aims to demonstrate the network's capability to provide predictability, visibility and certainty within the supply chain and to show that it can respond in real-time to requests from traders and logistics companies for end-to-end information on their shipments. • IPSCA is using the technical services of the platform provider NxtPort from Port of Antwerp technical provider for the NoTN proof of concept is API first, data sharing platform offered by NxtPort. • As an industry association of PCS operators, IPCSA seeks to attract its members' participation as the provider of a trusted and neutral solution.
e2Open /INTRRA https://www.inttra.com/	Global	• Ocean shipping's e-marketplace where for shippers and shipping lines ocean shipping efficiency and increased logistics insight • Data integration services connecting to ports. • Ocean schedules dataset using API technology. • solution for container forecasting and allocation help shippers drive real-time capacity management for global MQC splits between different service loops and deliver immediate benefits to their business operations • Global trade Site (https://www.e2open.com/global-trade/) Customs declaration self-filing, comprehensive trade compliance information.
NxtPort https://www.nxtport.com/	Ports of Antwerp and Bruges, Europe	• Uses open APIs (https://github.com/NxtPort/API) to help connect with APICS (the Port of Antwerp PCS) and port call optimization platforms like Port+ (https://portplus.be/) • Secure and optimized cargo release and container pick-up process; • A digital link in the digital port infrastructure of the Port of Antwerp-Bruges. (For example: the 'Import Consignment API' allows the absorption and reuse of consignment data as it is received by customs in the cargo report (CUSCAR) messages from the Shipping agent. • Real-time monitoring, access to customs information, fully digital release process • Creating a new layer of value-added data on the existing information that could be used for marketing and match-making.
Nextlogic https://www.nextlogic.nl/	Port of Rotterdam.	• Neutral and integrated planning to match supply and demand for inland container shipping; Portbase (PCS) and Nextlogic are working together • Barge Operators, Shippers, Terminal Operators and Container Depots are its users • Barge operators lodge their data in advance on rotation, calls and cargo information in Nextlogic. Container terminals and empty depots provide their available handling capacity in real time. • Relies on open APIs e.g. Hinterland Container Notification (HCN) Barge API • Publicly funded - financed by the Port Authority and Rijkswaterstaat (waterways authority)
Inuits/Hakka EurTransCon	European	• ride exchange platform Eurotranscon allows transport companies to work together using the Happa API.
Avandita (Part of e2Open) https://platform.avantida.com/	Global	• Carriers and logistics service providers use Avantida API to optimize the use of their Returnable Tramsport Items and reduce empty runs, while shippers can streamline their logistics operations • Avantida can help ports to track the use of RTIs and collect data on their movement and utilization.
PLN – Piattaforma Logistica Nazionale or National Logistics Platform, Italy		• Aims to make the means of digitalising the movements of passengers and goods by the individual Port Community Systems interoperable with each other and with the National Logistics Platform. • flexible and integrated digital technologies to logistics to create a paperless tracking and management system for vehicles and goods that arrive at ports and are then transferred to rail and road transport. • implementing buffer zones for goods and trailer interchange areas, automation systems to speed up loading and unloading operations

Project44, cargo visibility provider https://www.project44.com/	Global	• project44 is a cloud-based supply chain visibility platform. It provides:
		   • real-time, end-to-end visibility into global transportation networks.
		   • enables shippers, carriers, and logistics service providers to track and analyze the movement of goods
		• project44's technology connects with numerous carriers and provides real-time shipment tracking and predictive analytics. It could provide interesting complementarities with PCS.

Source: Authors' compilation based on the individual sources.

Figure 7. How the Industrial Internet of Things (IoT) devices are creating a culture of data-driven innovations -
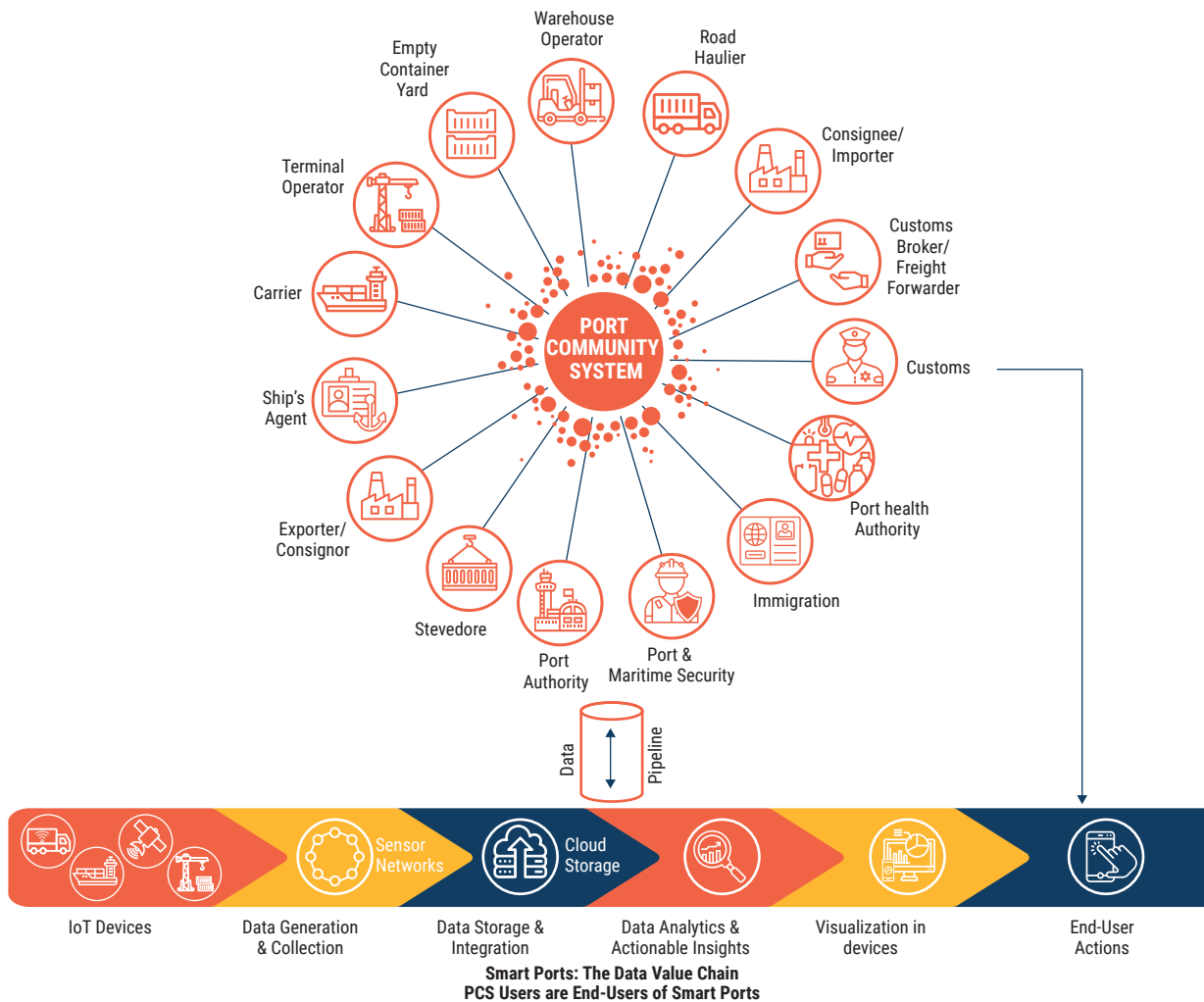
Source: Authors' presentation.

Nazionale)', which will improve logistics efficiency by developing new digital services such as a paperless tracking and management system for vehicles and cargo.

- In September 2022, India announced its National Logistics Policy aimed at creating a trusted, robust, cost-effective, technologically enabled, integrated, and integrated logistics ecosystem. One of the main aims of this policy is promoting standardization and digitalization for greater integration and inter-operability. The policy notes that incomplete digitalization and procedural inefficiencies have led to suboptimal equipment utilization and high cargo dwell time.

- The Indonesian government proposes[12] to build a National Logistics Ecosystem (NLE) with 14 seaports and airports to support and promote the logistics and distribution industry

in the country. It proposes to use an OpenAPI Collaboration concept, with the Director General of Customs and Excise (DGCE) and the port authority as key players.

4.3. PCS & the Smart Port concept

A 'Smart Port' is a port that leverages advanced technologies and data-driven solutions to optimize its operations and enhance its overall efficiency, productivity, and sustainability for all stakeholders in the port ecosystem. The technologies that Smart Ports use, such as Internet of Things (IoT), big data analytics and artificial intelligence (AI) are crucial for the modern PCS concept. Smart ports leverage PCSs to enable the seamless exchange of information and data between stakeholders in the port ecosystem, allowing them to work together more effectively and efficiently.

---

12 https://setkab.go.id/en/govt-creates-national-logistics-ecosystem-to-reduce-cost-to-17/

Figure 8 . The potential impact of adopting smart port logistics sytem
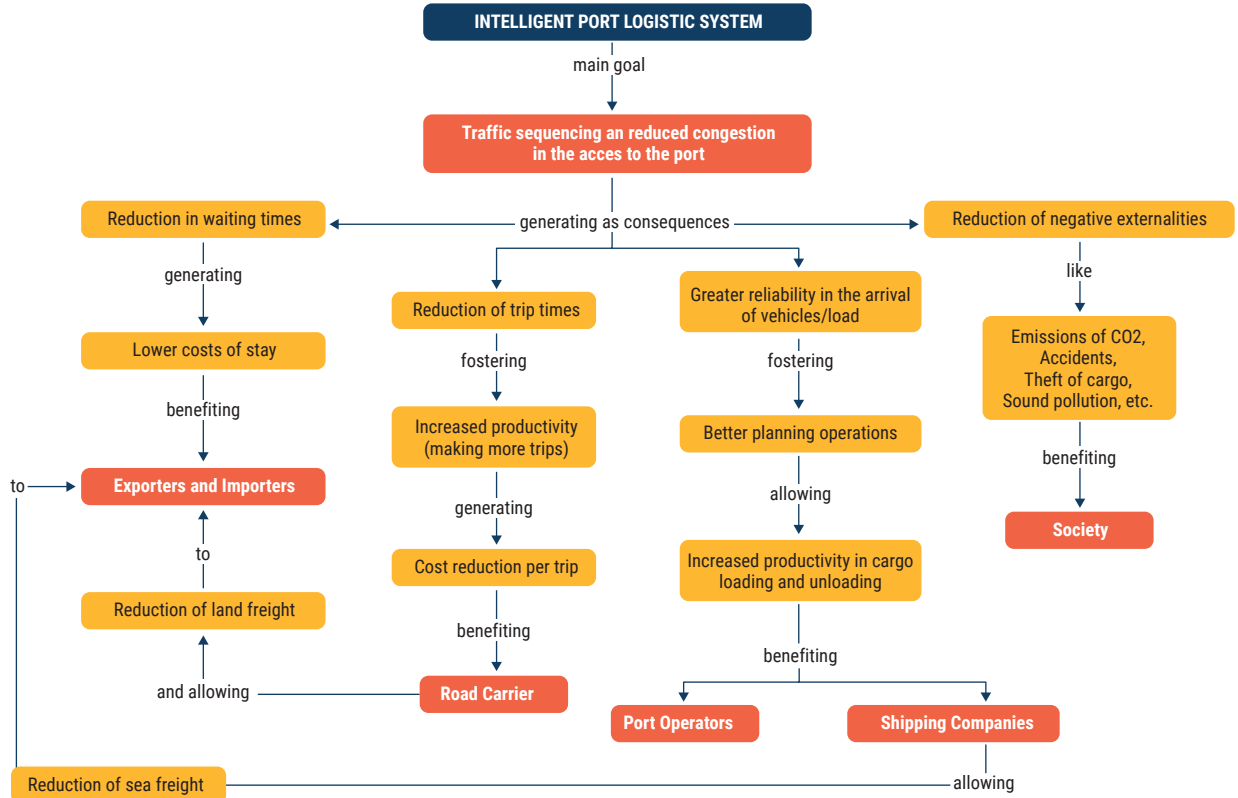
Source: Triska, Yuri & Santos, Juliana & Mattar Valente, Amir & Souza Silva, Lucas & Martínez-Moya, Julián & Mendes Constante, Jonas & Frazzon, Enzo. (2019). Smart port-hinterland integration: conceptual proposal and simulation-based analysis in Brazilian ports. International Journal of Integrated Supply Management. 12. 1. 10.1504/IJISM.2019.10024097.

There has been recent growth of smart containers in reefer fleets among carriers and in all the dry fleet at Hapag Lloyd. Some smart containers also come with embedded IOT devices. This shows there is a clear opportunity for smart container interoperability with PCS platform and other digital systems for triangulation dedicated to supply chain security.

A direct application of the Smart Port concept is when it achieves integration with the hinterland operations. The goal of this integration is to improve vehicles' access to the port area and reduce congestion. Its implementation enhances the reliability of the logistics system and decreases waiting times, travel times, and negative externalities like CO_2 emissions, accidents, cargo theft, air and noise pollution. This can adversely affect surrounding urban areas, particularly in developing countries. Congested approach roads and slow gate processing ensure that vehicles form long queues. Trucks and their loads must undergo inspection upon entering and leaving the port, resulting in waiting periods when the resources required for a specific operation are in use. Depending on the port environment's geographic configuration, these queues may extend and interfere with the city's road system, leading to congestion and service level deterioration. This situation has negative implications for the safety, security, and comfort of port users and those living in the surrounding areas.

Waiting lines of trucks at various points in the port-hinterland result in inefficiencies and increased transport and logistics costs. As logistics and supply chain management consider these costs as a crucial factor, ports, along with regional and national governments, must act dynamically to enhance hinterland integration and consider various modes of transport. A summary of the anticipated effects in Figure 8 based on the analysis conducted on the system's design and implementation scope.

By utilizing advanced technologies and data-driven solutions, Smart Ports can optimize operations, enhance productivity, and provide better customer service. Smart Ports provide better visibility and transparency to all stakeholders through a centralized platform, enabling them to make better-informed decisions and take timely action. Here are some examples of how Smart Ports use PCS to improve their functions.

The vision of a Smart Port operation will not be realized overnight. Ports must follow a gradual path of technology absorption. The table below depicts this path covering good practices, involved technologies and dependencies at each stage. All port systems begin with paper-based and semi automated systems (SBO 0). With digitalization, paperless workflows are introduced (SBO 1). As the automated systems of the strategically aligned

Smart Port Applications		PCS Functionalities.
Ship to Shore operations:	IoT assisted navigation, mooring, fendering, & docking Improve safety and security at the port, such as monitoring container movements and detecting potential security threats.	Vessel scheduling, Provisioning of pilot and tugboat services.
Terminal operations	Using real-time data analytics to optimize terminal operations, including berth allocation, yard planning, and cargo movement	Advance Planning of loading and unloading operations, scheduling and sequencing of terminal deliveries, monitoring and controlling of terminal operations
Hinderland operations	System recognises in biometrics, RFID tag and OCR camera images to check and automatically validate information collected from the vehicle - truck license plates, ISO container and vehicle driver code, appointment time window. Validation automatically opens the boom barrier.	Automating cargo handling, sharing customs clearance information, and reduces delays and increases efficiency.

partners within a port community get linked-up, PCSs emerge (SBO2). The PCS and other interorganizational systems help minimize duplication and ensure the economical use of data and optimize business use operations (SBO 3). The integration of data sources, and automation of functions set the stage for centralized management of operations through control centers and real-time monitoring of performances (SBO 4). Technological advances such as blockchain facilitate automatic exchange of data while keeping security and privacy concerns at the forefront. (SBO 5). With the introduction of concepts such as digital twins and big data and artificial intelligence, members of the port community can work on a decision making framework that is based on predictive analytics (SBO 6) and intelligent operations that further minimize operational losses (SBO 7). At the cutting edge of implementation, the leading Smart Ports of the world have moved to machine-driven, AI enabled operations (SBO 8). Although the figure shows that there is a linear progression from lows levels of maturity to the highest levels, ports can achieve a quantum leap if they work on the technologies involved.

Table 5. Smart Business Operations and the path to digital maturity.

Level	Best Practice	Definition	Involved Technologies	Dependencies
SBO 8	Machine-Driven	Completely automated AI-driven operations	• Artificial Intelligence • AI-driven C2 Architecture and related system	• Completely automated operations • AI C2 Architecture
SBO 7	Intelligent	Minimizing loss in operations through tracking technologies	• IoT	• IoT related functionality
SBO 6	Predictive	Required inputs & outputs can be predicted; Changes can be modeled in secure environment	• Digital Twin • Big Data	• Predictive functionality • Supporting data
SBO 5	Secure / Transparent	Border/transaction data is secured in transparent process	• Blockchain • RFID	• RFID and Blockchain-enabled functionality
SBO 4	Centrally Managed	Operations managed from a central office; command & control enabled	• Control Center • Real Time Data Vis • Performance Monitoring	• C2 Architecture
SBO 3	Optimized	Optimized processes reflected; Redundancies eliminated	• Data/System Changes	• Optimization Activities
SBO 2	Integrated	Data flows as desired throughout the processes	• Data/System Integration	• Architecture • Data-Integration • Protocols/Devices
SBO 1	Digitized	Paperless, entirely data/system-based workflows	• System-based Processes	• Stable power • Networks • Bandwidth
SBO 0	Disparate	Mixture of paper-based and digital stand-alone systems	• Manual Processes • Stand-alone Systems	• Labor intensive • Legacy knowledge

Source: Triska, Yuri & Santos, Juliana & Mattar Valente, Amir & Souza Silva, Lucas & Martínez-Moya, Julián & Mendes Constante, Jonas & Frazzon, Enzo. (2019). Smart port-hinterland integration: conceptual proposal and simulation-based analysis in Brazilian ports. International Journal of Integrated Supply Management. 12. 1. 10.1504/IJISM.2019.10024097.

Appendix 1. PCS functional services

The table below is an indicative list of services offered by a PCS. The table could serve as a checklist for the scope of an existing or proposed PCS system. The checklist could be used to map functions of existing systems along with remarks. The PCS may be involved in either offering the service or exchanging information about it with other stakeholders and their systems.

Table A1. A compilation of functional features of a PCS

Service		Description
A	**Ship-Port Interface**	**Port Call and Vessel Clearance processes**
1 Nautical and Port Services		
1.1	Port Call Process	From Notice of Arrival to inward and outward Vessel Clearance, including nautical, operational, administration information and data.
1.2	Vessel Profile Information/ Vessel Register	Shipping line provides vessel profile for all their vessels that will call on the port
1.3.	Voyage Information	Shipping line provides information on scheduled voyages and obtains a unique reference number for the call; Port authorities share this information with all stakeholders (Customs, terminals, trading, transporting and forwarding community);
1.4	Berthing	Shipping lines request for berthing, un-berthing and re-berthing. Port authority confirms and transmits to all of the port's auxiliary services including Customs for action or information
1.5	Pilot Boarding/ and Pilot memo	Shipping Line requests harbor master/port authority for pilot services
1.6	Confirm ETA, PTA, ATA, RTA	Harbor authorities confirms actual time of arrival to Terminal, Customs and other shore-based service providers
1.7	Vessels services	Shipping Line requests harbor master/port authority for tugboat, linesmen, bunkering, diving, technical inspection, ship repair, supply and other wharf-related services;
1.8	Stevedoring	Shipping Line requests stevedoring services
1.9	Boarding	Coordinated boarding by port authorities, Customs, health, immigration and maritime safety.
1.1	Master Data Management Services	Services to share master data (vessel code directories; call signs, LOCODE, MLOs carrier codes, NVOCC codes, identifier lists for forwarder, trader, Customs broker, truck registration and truck crew, master for NDG Code and IMDG Codes;) between PCS/NSW and other port user organizations;
2	Regulatory Services	Ship-port services related to regulatory clearances
2.1	Conveyance Report	Reporting to Port authorities and Customs regarding the call of a vessel, contains miscellaneous regulatory requests and permits concerning the purposes for which the vessel is calling; may be used/ IMO FAL form 1
2.2	Vessel Clearance	Authorities grant clearance for vessel to enter or leave harbor premises. Multiple authorities/clearances are involved.
2.3	Dangerous goods on board	Shipping Line notifies port authority or harbor master regarding dangerous goods on board. Dangerous goods list - IMO FAL -7; IFTDGN report
2.4	Sharing of Dangerous goods info with terminal Operators	Special handling requirements and other dangerous goods information shared with Terminal handling groups and port authorities
Customs bonded supplies		
2.5	Bunkering	Customs clearances for ordering and loading of bunker fuel
2.6	Bonded stores/ Ship Supplies	Customs clearances concerning loading/unloading of bonded ship stores, ship spares, fitments and all other ship supplies and crew effects – IMO FAL 3 – FAL 4
2.7	Supply of Repairs/fitments	By convention, ship parts and fitments supplied to ocean-going vessels are typically imported duty-free and supplied as an 'export' much like other bonded ship stores;

Service		Description
Maritime/Immigration/ Security		
2.8	Submit Vessel Security Report	Ship data provider submits a report to the port it seeks to call regarding the 'security level' at which it has operated through the last 10 ports of call, Mandatory IMO SOLAS Convention requirement
2.9	Passenger List/ Crew List	Shipping Line/ Cruise Line submits passenger list and Crew Lists to Immigration Authorities and Customs; that latter perform controls and uses data to process passenger/crew clearance and shore leave, crew changes – IMO FAL 6 - FAL 5
2.1	Vessel Traffic Service	Interoperability with VTMIS for Harbor Master mission
Financial		
2.11	Notification of Port Dues, including light house dues	amounts paid or payable against regulatory services provided by the port authority/harbor master
2.12	Centralize Billing and Payment	Single invoicing and payment port community stakeholders
Health		
2.13	Declarations under IHR; Maritime Declaration of Health	To be submitted by Master of the vessel to competent health authorities on shore
2.14	Certificate of Free Pratique	Port authority issues a Certificate of free pratique stating that a ship that is without infectious disease or plague on board. This is linked for some ports' requirement for entry of vessels for unloading and permission for crew to disembark;
Environmental services		
2.15	Ballast Water discharge	Authorities require vessels to report number of ballast water tanks, each tank's volume, and origin of the ballast water to be discharged (concern for invasive species and maritime pollutants in ballast water).
2.16	Waste Disposal	Service by which Shipping Line notifies to port authority or harbor master regarding waste disposal;
Agriculture		
2.17	Declaration for import	Authorization to disembark
B	**Terminal Operations**	
1 Cargo handling within Terminal		
1.1	Cargo reporting; Includes empties and freight remaining on board;	Shipping lines or other ship data providers reporting to Port authorities, Terminals Operators and Customs regarding the cargo brought by a vessel, it is the cargo manifest and can be combined with multiple regulatory requests concerning further disposal of cargo ; Preliminary Manifest, Final Manifest
1.2	Share stowage position with terminal operator	Shipping Line shares stowage position of containers on board vessel
		BAPLIE EDIFACT message; helps terminal operator plan unloading of vessel
1.3	Cargo status information	Real time status information, Bill of Lading or container number wise regarding unloading and loading operations at the terminal;
1.4	Advance Import List/Advance Export List	Shipping Line informs terminal operator and customs regarding the list of containers and stow position – IMO and WCO Advance Cargo Information (Import control system / Export Control System
	Loading/Unloading	Shipping lines informs terminal and customs regarding the unloading list and loading of containers
1.5	Discharge completion Summary	Terminal Operators inform shipping lines of the completion of discharge of containers
1.6	Discrepancy List	Reporting from Terminal Operator to shipping agents and customs
1.7	Other Cargo	Beyond Container, management of Dry Bulk, Break Bulk, Liquid Bulk, RORO…
1.8	Gate Management	Gate In/Out Process. Truck Appointment system
1.9	Main Gate Management a Port	Gate In/Out Process. Interoperability of Main Gate Truck Appointment system with Terminal Operators Systems. Main Gate to be decentralized as outer dry port.

	Service	Description
2 Regulatory services		
2.1	Notification of verified gross mass	Terminal uses in line weigh bridges to measure the weight of the trailer truck with container and after the unloading of the container to verify/ report VGM; covers both inbound, outbound and transshipment containers
2.2	Scanning Services	Fixed or Mobile Scanner operated by customs or private operators
2.3	Inspection Services	Request for Inspection from Governmental Agencies at Port Terminals
3 Transshipment Logistics		
3.1	Trans-shipment Manifests; associated amendments;	Shipping Line submits trans-shipment manifests to Terminal Operator; the latter acknowledges and plans stacking of containers accordingly; transfers manifests to Customs, which treats it as a request from the shipping lines for a trans-shipment procedure
3.2	Transship permits; re-warehousing	Customs updates Liner bonds and grants transshipment permit to shipping lines and informs terminals; including conclusion of bonded movement and re-warehousing
3.3	Inter-terminal movements	In a special type of transshipment permit or due to a maneuver for other reasons,
C	**Interface with Hinterland Logistics**	
1 Inbound Logistics		
1.1	Notify ETA of incoming vessel	Shipping Line informs forwarder/importer regarding ETA; requires manifest data from the port of loading; manifest should have Importer, coded/forwarder/broker; and/or Notify Party;
1.2	Shipping Agent issues unloading instructions to Terminal Operator	Shipping Agent issues instructions to the Terminal operator to unload containers, against which terminal will expect payment; Terminal operator compares the shipping agent's request with the BAPLIE to check if the request was in respect of containers reported in the BAPLIE message;
1.3	Create Transport Order	Consignee or forwarder arranges with the transport company (in case of Merchant haulage)/(Shipping Line arranges with the transport company in the case of carrier haulage);
1.4	Share transport order created by the forwarder with terminal operator	In the case of merchant haulage -shipping agent shares the transport order created by the forwarder with the terminal operator; this allows the terminal operator to take the container into account in the load planning for the targeted ship that will be berthed.
1.5	Registration by Transport Company for container pick-up	Terminal operator knows which truck is going to be loaded with which container and at what time.
1.6	Load Inbound hinterland means of transport	Terminal receives Container Release message (commercial release message from shipping line and / Customs release message from Customs) to container is loaded on the means of transport exiting terminal (truck/rail/barge)
1.7	Container release authentication at terminal gate	Representative of terminal operator or freight company taking cargo out of terminal receive a PIN code (or another mode of authentication) to allow release of container
1.8	Register containers for pick-up	The shipping company or its shipping agent informs terminal operators with COPARN; A means by which transport operator or forwarder informs the Terminal about containers being delivered or picked up shortly.
1.9	Container Status messages (CSM)	Shipping Lines to report to Customs to update Container status (including empty, LCL and full containers);
1.10	Track and Trace of containers	Allows all parties concerned to be informed about the exact location of the container
1.11	Creating electronic invoices	Electronic invoices
1.12	electronic payment	Shipping Line can create electronic invoice for the forwarder to collect documentary Bill of Lading and other charges;
1.13	Share Delivery Order	After the confirmation is received, shipping line generates delivery order online on PCS and shares it with the forwarder and the Terminal Operator
1.14	Notify Delivery	Transport Operator can share information about delivery and stripping of container with forwarder and Shipping line
1.15	Smart Container	Track and Trace containers with smart device or container security device (CSD)

Service		Description
1.16	Temporary Storage	At Customs bonded Warehouse, Container Freight Stations (CFS). Shipping Lines and Logistics Operators to provide house manifest to Customs. Authorized Economic Operators
1.17	Terminal Operator Empty Depot	Terminal Operator managing empty depot for the need of shipping agent. Transport Order from Shipping Agent. Gate in/Gate Out Process. Customs Inspection Process
1.18	Inland Container Depot	Logistics Operator managing empty depot for the need of shipping agent. Transport Order from Shipping Agent. Gate in/Gate Out Process. Customs Inspection Process
1.19	Multimodal Management	Truck Manifest / Rail Manifest / Barge Manifest
1.2	Waterways Management	Interoperability with River Information System. Inland River Terminals management. Track and Trace. Last mile delivery
1.21	Logistics Center	Trucking logistics Center as Ante Port
1.22	Air Cargo Corridor	From Air to Sea, Sea to Air corridor
1.23	Corridor Management	From seaport to land border crossing (rail, truck, barge)
1.24	Weighment of Trucks	To verify the maximum weight allowed for trucks. With this information the port/depot operator releases from his yard trucks avoiding overweight
2	**Outbound Logistics**	
2.1	Transport Booking Request	Shipper or forwarder reports a request for a transport booking on a shipping line (or in multi-line portals);
2.2	Booking Confirmation	Shipping Line records confirmation of booking of space
2.3	Locate Empty Containers	Forwarder/Shipper seeks empty container availability status with Liner's empty container yards; Possible to have Multi-liner services to report empty container status in respective yards
2.4	Container Status messages (CSM)	Shipping Lines to report to Customs to update Container status (including empty, LCL and full containers); There are over 12 status codes and covers end-to-end container logistics;
2.5	Shipping Instructions	Forwarder/Shipper provides information (or reuses - information provided at the booking stage)
2.6	Register containers for delivery	The shipping company or its shipping agent informs terminal operators; A means by which a shipping company/agent or forwarder informs the Terminal about containers being delivered for exports shortly.
2.7	Registration by Transport Company for container delivery	Terminal operator knows which truck is bringing which container at what time; allows services such as terminal gate appointment for trucks and electronic queuing of trucks at terminal gate;
2.8	Report Cargo arrival at Terminal	This function allows trader to inform customs office regarding the physical arrival of goods/containers at the terminal.
		Terminal Operator or PCS can receive the data from exporter and take-up the responsibility on behalf of the exporter to inform Customs.
2.9	Creating electronic invoices	Outbound logistics related invoicing
2.10	Dangerous Cargo	The formalities for dangerous cargo, from packaging until port authority approval of dangerous goods loading in to the vessel
2.11	Electronic payment	Shipping Line can create electronic invoice for the forwarder to collect documentary Bill of Lading and other charges; (of course, e-payment can work against any of the invoicing situations presented above);

Source: Authors' compilation based on major PCS implementations.

Appendix 2. Technical standards for PCSs

There is no single compendium of standards published specifically for PCS's to adopt. This Appendix provides a select list of technical data standards that are most relevant to PCS implementations.

a. Core Standards for Code lists and Identifier

ISO 3166-1,	Codes for the representation of names of countries and their subdivisions – Part 1: Country code
ISO 3166-2	Codes for the representation of names of countries and their subdivisions – Part 2: Country subdivision code
ISO 4217-	Currency codes (UN Rec 9 – Alphabetic Code for the Representation of Currencies)
ISO 8601	Date and time format
	Codes for Units of Measurement used in the International Trade
ISO 639	Language codes
ISO 6346	Freight containers – Coding, identification and marking
ISO 6709	Standard representation of geographic point location by coordinates
ISO 7372	Trade data interchange – Trade data elements directory
ISO 9711-1	Freight containers – Information related to containers on board vessels – Part 1: Bay plan system
UN Recommendation 5	Abbreviations of INCOTERMS
UN Recommendation 10	Codes for the identification of Ships
UN Recommendation 16	LOCODE Code for Trade and Transport Locations
UN Recommendation 17	Payment Abbreviations for Terms of Payment
UN Recommendation 19	Code for Modes of Transport
UN Recommendation 20	Codes for Units of Measure Used in International Trade
UN Recommendation 21	Codes for Passengers, Types of Cargo, Packages and Packaging Materials (with Complementary Codes for Package Names
UN Recommendation 23	Freight Cost Code (FCC)
UN Recommendation 24	Trade and Transport Status Codes
UN Recommendation 28	Codes for Types of Means of Transport
World Customs Organization (WCO) HS Code	Harmonized Commodity Description and Coding System (HS)
IMO ship identification number scheme	The IMO number is a permanent number assigned to each ship for identification purposes, to enhance maritime safety, security and environmental protection, and to facilitate the prevention of maritime fraud. Inserted in the ship's certificate, it would remain unchanged upon transfer of the ship to other flag(s).
Some IMO Standard Codes in FAL Compendium	1. Crewmember rank or rating, coded 2. Dangerous goods IMO hazard class and Dangerous goods subsidiary risks, coded 3. Dangerous goods marine pollutant type, coded 4. Reason why ship has no valid ISSC or interim ISSC, coded 5. Ship security level in a previous port, coded and Ship current security level, coded 6. Ship security measures, coded and Ship additional security measures, coded 7. Waste type, coded (MARPOL Annex I – related) 8. Ship satellite service provider, coded 9. Service, coded 10. Certificate issuer type, coded 11. Company ISM certificate ship type, coded 12. Ship reporting system, coded and Ship reporting system for relay, coded

Some IMO Standard Codes in FAL Compendium	13. Report type, coded 14. Remarks type, coded 15. Ship defects and limitation types, coded 16. Ship company role, coded 17. PSC MoU or regime, coded 18. Reason why no ballast water management was conducted, coded 19. Ballast tank type, coded 20. Method of ballast water management, coded

b. Standard Data Libraries

I. UNTDED-ISO7372 - The United Nations Trade Data Element Directory (UNTDED) is a Directory comprising a set of data elements intended to facilitate an open interchange of data in international trade. These data elements can be exchanged with any means, paper or electronic, in particular they can be used within a certain set of interchange rules, e.g. UN/EDIFACT.

II. UN/Core Component Library (CCL) - The United Nations Core Component Library (UN/CCL) is a library of business semantics in a data model which is harmonized, audited and published by UN/CEFACT.

c. Domain Data Models, Data Standards & Electronic Messaging Standards

III. ISO 28005: The ISO 28005 standard defines the requirements for electronic port clearance (EPC) systems, which are used by customs authorities to process the arrival and departure of vessels and their cargoes. The standard specifies the data elements that must be included in EPC messages and the protocols for their exchange.

IV. IMO Reference Data Model[13] based on their standards. The standards of the respective Parties for the electronic exchange of information related to the FAL Convention are: (a) the WCO Data Model; (b) UNECE Core Component Library; and (c) ISO 28005 series of standards. Standards package includes UN/CEFACT IMO eFAL and WCO – IMO Message Implementation Guide

V. WCO Data Model - It is a compilation of clearly structured, harmonized, standardized and reusable sets of data definitions and electronic messages designed to meet the operational and legal requirements of Customs and other cross-border regulatory agencies (CBRAs) responsible for border management. It is consistent with other international standards, such as the United Nations Trade Data Elements Directory (UNTDED).

VI. UN/CEFACT Buy-Ship-Pay Reference Data Model: It describes the requirements for a generic reference data model supporting the trade and transport-related processes involved in the cross-border supply chain and covering, at a high-level, the involved business areas, the main parties and the information involved. It provides the framework for any cross-border transport-related business and government domains to specify their own specific information exchange requirements1 while complying with the overall processes and data structures.

VII. DCSA JIT Port Call Data Definitions 1.1: It includes standards for the port call inbound, alongside and shifting, and outbound processes. It includes timestamps, interface standards and opensource API specifications for collaboration between the key stakeholders in a port call with the aim of providing operational transparency for mutual gain. It is followed by DCSA OpenAPI specification for Just in Time Portcalls

VIII. digitalOCEANS Port Clearance API specifications (v1.0) - standardizes the technical implementation for port clearance related data between data consumers and providers. Streamlines the implementation efforts by port authorities and the industry to enable interoperability between various systems.

IX. DCSA Interface Standards for Track & Trace: API based standards for customer-facing track and trace events in containerized shipping

d. Electronic Message Standards

X. UNTDID, United Nations Directories for Electronic Data Interchange for Administration, Commerce and Transport. This is available as Part 5 on https://www.unece.org/cefact/edifact/welcome.html

XI. A selected UN EDIFACT Messages used in a PCS

---

13 Partnership agreement between the IMO, WCO, UN ECE, and ISO concerning the standardization of the IMO Reference Data Model. https://unece.org/sites/default/files/2021-03/UNECE-IMO-WCO-ISO.pdf

Table A2. UN/EDIFACT Standards used in Port Community Systems

Standard EDIFACT Message	Name of the Message	Potential Use in a PCS
Container related messages		
CODECO	Container gate-in / gate-out report message	Terminal operators and ICDs/CFSs use CODECO about containers that have reached or left the container terminal
COPARN	Container announcement message	Inform terminal operators notifying that containers are to be delivered or picked up
COPINO	Container pre-notification message	An inland transporter notifies the terminal operator about picked-up /dropped off container
COARRI	Container discharge / loading report message	Terminal confirms loading or unloading of containers to the shipping company.
BAPLIE	Bay-Plan Information	Shipping line informs terminals about the exact stowage positions of cargo on board a seagoing vessel
COPRAR	Container Loading Order Message	A Shipping Agent notifies a Terminal Operator that the containers specified have to be loaded on ship
Booking related messages		
IFTSAI	International multimodal status report message;	To transmit forwarding and transport schedule and availability information message; Helps accessing liner sailing schedules; Helps stay informed of the status of a shipment
IFTMBF	Firm Booking	Shippers/forwarders can book the estimated space on a ship with the shipping company or the shipping agent.
IFTMBC	Booking confirmation	Liner may use this message to a shipper/ forwarder confirming a booking
IFTMAN	Arrival Notice	A shipping company or shipping agent uses this to announce a ship's arrival
IFTMIN	Instruction Message	To pass shipping/other instructions on one shipment to the next party in the supply chain.
IFTMCS	Instruction Contract Status Message	Transporter/forwarder issues instructions about offered services stating the actual details, terms and conditions (charges when applicable) of the service and of the consignment involved
IFTFCC	Freight Costs and other Charges	The various parties in the supply chain can exchange freight and handling costs.
IFTDGN	International Forwarding and Transport Dangerous Goods Notification message	The party responsible to declare the dangerous goods (e.g. carrier's agent, freight forwarder) uses this message to report to the party acting on behalf of the local authority performing the checks on conformance with the legal requirements on the control of dangerous goods. Aligned with IMO FAL Form 7 requirements.
INVOIC	Invoice Message	The various parties in the supply chain can exchange commercial invoices with each other with INVOIC.
Customs/ Regulatory related messages		
CUSREP	Conveyance Report	IMO General Declaration (FAL Form 1) — as well as customs conveyance report announcing the purposes of call and seeking various official permissions ; Also adapted to the IMO Vessel Security Report
CUSDEC	Goods Declaration	Importer, exporter and customs broker submit customs declarations
CUSCAR	Cargo Report	FAL Form 2 — IMO Cargo Declaration(On arrival & On departure); Customs Manifests Also for Advance Cargo Information, Ship Stores; FAL Form 3 - IMO Ships Stores Declaration (Option 1 - INVRPT)
PAXLST	Passenger List	Shipping Lines use this message to report passenger manifests, crew list and crews effect; satisfies requirements for IMO FAL Forms 4, 5 and 6.
CUSRES	Customs Response	A response received from customs authorities to CUSREP, CUSDEC, CUSCAR & PAXLST conveying approval/ rejections, release notifications, clearance, and instructions.

ISO 15000 Series - Electronic business eXtensible Markup Language (ebXML).

UN/CEFACT XML, Message Schemas have been published for various business processes.

Appendix 3. Guiding Principles of PCS Solution Architecture

S N0	Principle
1	**Do not repair something that is not broken** The architecture is "a picture of the desired future". However, whatever works now should be kept in place until core functionalities of the PCS fall into place.
2	**Inclusion and fairness** The PCS solution architecture should not exclude authority and private sector organizations and users regardless of the level of their technology adoption.
3	**General accessibility** A user's accessibility of the system should keep in mind users' disability.
4	**Multi-language** PCS user interface should allow the configurability of language.
5	**User interface guidelines** User interface design is a discipline of its own and should not be left over to the technical designers but executed by specialized resources. There should be well defined UI/UX guidelines.
6	**Responsive design** The design should ensure access regardless of the device, the UI automatically adapts to screen resolution, size or orientation of the device. The user interface should be rendered naturally regardless of device of form factor, without the need for redevelopment.
7	**Benefit Profiling.** As PCS modules get developed and implemented, the corresponding benefits must be documented and actively pursued.
8	**Legal compliance** The systems must comply with the national and international law related to trade and maritime regulatory requirements.
9	**Share the technology architecture with the ecosystem.** Since PCS is an interorganizational system, PCSs technology architecture should share characteristics other systems it interacts with.
10	**Technology standards** Not only is the use of the proven technology recommended, but above all the same technology stack for all systems. Thus, a list of technology standards should be established. This is typically a task for enterprise architects. Technology tends to change rapidly, and it is important to keep up to date. Updates to more recent versions of the standards must be planned together with "functional" releases. Finally, the list of standards is also of great importance if the decision is to buy a PCS rather than develop one.
11	**Reuse of TSW common systems** The TSW environment contains a number of systems that are accessible from within, or exchange information with other core systems.
12	**Library of reusable common components** Making use of the same components in all systems will highly reduce the development, test and especially maintenance cost because bugs will have to be solved only once. What "components" actually means depends on the solution architecture (e.g. if opting for a SOA architecture, components would be services). The use of reusable components can also speed up the planning. The components can be built by a team of skilled architects or even bought and integrated into the different systems. This principle is also applicable to the data access layer by sharing the same data objects with all systems.
13	**Security** Systems must be developed to ensure the highest levels of security.
14	**Digital signatures** All documents retrieved from the system will be digitally signed, avoiding hard copy signatures and stamps unless required by the law.
15	**Loose coupling** Loose coupling is an architectural paradigm to interconnect the systems of the PCS so that they depend on each other to the least extent possible. Without respecting this principle, a change in one system would induce a cascade of changes in other systems and components of the PCS architecture. The integration of the systems in a message-based infrastructure is the best guarantee to respect this point. Integration on the level of the databases violates that principle.

S N0	Principle
16	**Messages are atomic in nature** The timing and content of submitting is completely different for different pieces of information. Consider e.g. a pre-arrival message reporting the ETA and a gate-out message reporting the container number. We cannot wait until all information is available before submitting everything. Therefore, information is submitted in separate atomic messages. Each message should contain the "header" to understand the context of the message. This is best done by including a voyage ID. A voyage ID in turn contains the visit ID. A visit of a ship contains at least one incoming voyage, one outgoing voyage and potentially a number of shifts in the port.
17	**Audit trail** All messages over the message bus and all changes to the databases are logged.
19	**Data privacy** All users will have an obligation to protect personal privacy, commercial secrecy and security of data. PCS will follow the risk management approach to manage data security risks.
20	**Data model** A data model describes the way data elements are structured in entities and the relations between these entities. It is advisable to establish a data model at the outset that will be used across the port community.
21	**Data dictionary** A data dictionary contains the definition of the data elements in the data model, such as the technical name, the data type, is this a required field, etc.
22	**All systems in the PCS environment share Common master and reference data** For each database, there is an authoritative database and an organization maintaining it. For example, the ship database should be maintained by the port authorities.
23	**The only once principle** As in the case of a trade single window, in a PCS, data and information already reported should not be reported again to reduce and potential mistakes.
24	**Monitoring and control** Key users and management get aggregated information about performance and data quality, to take the appropriate actions to correct deterioration in performance.

Appendix 4. EDI or API?

API (Application Programming Interface) and EDI (Electronic Data Interchange) are both technologies that enable different systems to communicate with each other, but they are used in different ways and have different characteristics. It is not necessarily the case that one is better than the other, as the choice of which technology to use depends on the specific needs and requirements of the system.

Table A3. Comparison between EDI and AP

Feature	API	EDI
Purpose:	Designed to allow different software systems to interact with each other and exchange data.	Designed to exchange standardized messages often representing business documents between organizations
Protocol:	A variety of protocols, such as HTTP, HTTPS, and WebSockets, to transmit data	A range of legacy protocols (X.400) and modern internet-based protocols such as Applicability Statement (AS) (AS1, AS2, AS3, AS4, ebMS, and SFTP)
Data exchange:	APIs typically use a request/response model, in which a client sends a request to an API and the API returns a response.	EDI uses a store-and-forward model, in which one system sends a message to another system and the message is stored until the recipient is ready to receive and process it.
Flexibility	APIs are generally more flexible than EDI, as they can be used to exchange a wide variety of data types and formats.	EDI is more structured and is typically used to exchange specific types of business documents.

Source: Authors' compilation.

Appendix 5. Digital Infrastructure for Smart Ports

The following are four key technologies that constitute digital infrastructure for port and maritime logistics. These technologies are general services and any ICT application in a port including a PCS can use them effectively.

1. **Digital Infrastructure for Navigation:** Information systems in the maritime industry often use independent information utilities that can support vessel tracking and navigation. Global Navigation Satellite Systems (GNSS), such as the GPS provide precise location, speed, and time information to a receiver on the vessel. The Automatic Identification System (AIS) uses transponders on vessels to transmit and receive information, such as vessel name, location, course, and speed. AIS systems also help identify vessels within specific geographic boundaries. Vessel Traffic Management Information Systems (VTMIS) provide information on vessel movements and situational awareness for the captain or pilot of the ship so they can make informed decisions while navigating through congested waters safely. Electronic Chart Display and Information Systems (ECDIS) use electronic charts and other navigation information to provide a visual display of the vessel's position, course, and intended route. ECDIS also has collision avoidance and route planning capabilities.

2. **Intelligent Transport Systems:** Intelligent transport systems (ITS) are technologies used to improve transportation systems' efficiency and safety. These technologies often involve using information and communication technologies (ICT) to gather and process data about transportation systems and control and manage the flow of vehicles and people. Traffic management systems use sensors, cameras, and other technologies to monitor traffic flow and adjust traffic signals to improve the efficiency of road networks. Public transportation systems use real-time information and communication technologies to help passengers plan their journeys, find their way around, and make travel decisions. Vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication systems allow vehicles to communicate with each other and with infrastructure (such as traffic signals and road signs) to improve safety and efficiency. Overall, the goal of ITS is to improve the efficiency, safety, and sustainability of transportation systems, while also improving the travel experience for users. Intelligent transport systems (ITS) can improve logistics connectivity and visibility in a port environment in GPS tracking and sensor-based systems to provide real-time visibility into the location and status of cargo and vehicles within the port. Such data can help logistics companies and port operators to manage the flow of goods better and optimize the use of available resources. V2X (vehicle-to-everything) communication systems can improve communication between stakeholders within the port, including cargo owners, carriers, customs authorities, and port operators, enhancing coordination, and reducing the risk of delays and bottlenecks. By collecting and analyzing data from various sources, ITS can provide valuable insights into trends and patterns that can help port operators and logistics companies to forecast demand, optimize routes, and improve efficiency. ITS technologies, such as advanced surveillance systems and access control systems, can

help improve port safety and security by detecting and preventing potential threats. The U.S. Maritime Administration (MARAD)[14] and the American Association of Port Authorities (AAPA) investigated the levels of investment required in the oceanside and landside infrastructure and estimate that nearly 44% of the investments would involve ITS technologies. The idea involves using trucks and trains in a bounded network in the port area transportation network (terminal approach roads, gate access management, staging information at terminals, parking information, reservation for container delivery or evacuation for road and rail). ITS can also be used in a regional context, such as surrounding road and rail networks near to a terminal impacting port operations.

3. **The physical internet (PI)**[15] is an emerging concept that draws upon advances in technology to improve practices, logistics and supply chain management (SCM). PI envisages an integrated digital layer to be used for analysis, planning and optimization of supply chain processes. This digital layer enables the creation of an open logistics system that the supply chain participants can use to improve. The PI concept is technology agnostic but is based on the principles of open data collaboration and represents blue sky thinking in port logistics networks as industry seeks steps for greater efficiency with resilience. Modular elements, like ships, shipping containers and container handling equipment, allow PI-based approaches to exploit multimodality. Although the idea still needs to be fully developed or understood, it points to new developments in the public-private collaboration space.

5G technologies and Multi-access edge computing (MEC): Some of the key problems in the port include adapting port capacities to variable loads, creating preconfigured and customized alerts to enable safe and secure operations, enabling the safe movement of people and machinery, and creating reliable dashboards for rapid responses and decision-making. This requires port systems including IoT embedded devices to be connected reliably and at high speed and low latency. 5G technology and multi-access edge computing (MEC) can provide high-speed, low-latency connectivity. MEC involves computing resources closer to the devices and sensors that need to communicate with each other, thereby reducing latency and improving the real-time performance of automated systems in ports. MEC can enable real-time data processing and analytics allowing for faster decision-making and more efficient automation in ports. For example, MEC can be used to analyze sensor data in real-time to optimize the movement of cargo through the port or to detect potential problems in automation systems before they occur. MEC is more resilient to cyberthreats because processing occurs at the edge of the network rather than in a central location. This can help protect the port facilities against cyber threats and ensure the integrity of automated port processes. It is likely that many ports have tried out or are in the process of piloting these technologies to improve their operations. In 2020, China Mobile, Huawei, and ZPMC (a Chinese port machinery manufacturer) announced that they had completed a 5G-based intelligent terminal pilot project at the Shanghai Yangshan Deep Water Port and reported major improvements in the efficiency of container handling and yard operations. Earlier, in 2019, Ericsson, Telia, and the Port of Gothenburg announced a 5G pilot project focused on optimizing container handling at the port. The Port of Rotterdam has been in partnership with AT&T and Ericsson to introduce 5G pilots. The Algeciras Port Authority (APBA) together with Vodafone, the 5G provider, implemented a solution to enhance the safety and security of operations.

---

14 A primer prepared by the US Department of Transportation/ MARAD explains in detail the role of different Internet of Things technologies.
https://www.pcb.its.dot.gov/t3/s190502/s190502_ITS_ePrimer_Port_Operations_presentation.pdf
15 How the 'physical internet' could revolutionise the way goods are moved – Published on February 15, 2021 in the Horizon – The EU Research & Innovation Magazine

THE ROLE OF TRADE AND MARITIME SINGLE WINDOWS

Executive Summary

Key Takeaways

- Interconnectivity and interoperability between platforms represent the next wave of the digital transformation of ports.

- Three systems - Port Community Systems (PCS), the Maritime Single Window (MSW) and Trade Single Window (TSW) – are critical to increased interconnectivity and interoperability.

- Boundaries between different platforms are starting to break down, paving the way for true single-submission and data collaboration across trade and transport supply chains.

- More countries are expected to reinforce interconnectivity and interoperability between the three platforms.

- Putting in place the necessary legal, regulatory, and institutional pillars to support the development of single-submission platforms is critical to the successful adoption of any digital platform.

Rapid technological improvement has led to the adoption of a variety of port data collaboration platforms both in the developed and developing worlds. Apart from the PCS, trade, and Maritime Single Windows (SW) operate in the same port logistics operational environment. The concept of SW is associated with facilities that allow trade and transport parties to lodge standardized information and documents to fulfil all import, export, and transit-related regulatory requirements. PCSs are access points which allow traders to exchange electronic information in a standard format and related to a specific activity, with relevant private parties and with regulatory government agencies.

Essentially, the scope and mandate of data collaboration platforms largely depends on the incentive used for their adoption. When motivation is compliance to the provisions of international agreements, these platforms are structured in a manner to conform to specific regulatory requirements. In this category, we include the Trade Single Window (TSW) which, as per the WTO's Trade Facilitation Agreement (TFA), enables traders to submit documentation and data requirements for importation, exportation, or transit of goods to participating regulatory authorities or agencies. Similarly, the Maritime Single Window (MSW), as a mandatory requirement under the IMO's FAL Convention, aims at the intelligent and secure exchange of ship-to-shore information related to regulatory requirements for the arrival, stay, and departure of vessels.

The boundaries between the three platforms are often blurred. For instance, in many cases, the PCS encompasses MSW or TSW functionalities. Regardless of their scope, all platforms share common features. The most fundamental one is the "single entry" which supplemented with the "single submission" feature, means that data submission is only performed once, and the system

offers a single point of access to its users. Also, standardizing the format of shared information and the use of a common data reference model, enables interoperability and allows data exchange in a way that all connected systems can understand and manage. Gains for the trade community are clear as it benefits from the reduction of red tape as well as from the establishment of faster and more accurate operational workflows and compliance processes. This, in turn, lowers logistics costs, improves transparency, and increases supply chain predictability at a micro level and improves trade competitiveness at a macro level.

International experience provides no evidence to support which platform should be developed first. In countries with a strong port and maritime private sector, PCSs were developed first. In other countries, top-down government initiatives to comply to either the FAL or WTO-TFA provisions have led to the initial development of respective SWs with pure regulatory compliance focus, while PCSs were developed at a later stage. Whichever the sequence, it is important to assess and analyze the existing trade and transport digital solutions ecosystem prior to the design and implementation of a new platform. Taking this under consideration, PCS development requires high levels of coordination with the government to avoid overlaps and ensure procedural coverage complementarity.

Interconnectivity and interoperability between the PCS and the various SW compliance platforms will constitute the next wave of port sector digital transformation. This type of initiative will eventually break down the boundaries between the existing triptych and pave the ground for true single-submission and data collaboration along the trade and transport dimensions of international supply chains. Although the financial and economic benefits from the digital integration and holistic supply chain treatment have already been acknowledged, there are still a number of important prerequisites for successful implementation, including the political will of the government and the relevant governmental trade and transport authorities to: (a) Enhance coordination with the maritime and port logistics business community. (b) Develop the basic legal framework, including the introduction of privacy laws and rules providing privacy and security in the exchange of information. (c) Develop common data reference models in support of interconnectivity and interoperability.

1. Introduction

1.1. The Context

During the past few decades, the adoption of modern techno-logical solutions in the port and maritime sector has improved its overall performance and operational efficiency. Software and hardware solutions were adopted not only by private companies, terminal operators, trucking companies, warehousing, and distri-bution companies but also by government agencies with regu-latory or compliance mandates. The initial positive impact was restricted by the operational boundaries of adopting entities. For instance, the adoption of terminal operating systems (TOS) has undoubtably improved terminals' operational efficiency. Similarly, warehouse management systems (WMS) improved the way stor-age companies store, handle and distribute their cargo units. At the same time, government compliance and regulatory agencies have adopted their own management information systems i.e., Customs management system focusing on the cargo clearance process, while port management information systems (PMIS) enable a port authority to control traffic and manage port infrastructure.

The automation of port logistics entities and the subsequent digitization of their respective workflows permitted inter-orga-nizational data collaboration, initially via EDI systems and later through single-submission platforms. The PCS concept was one of the outcomes of this development since port logistics service providers – especially terminal operators - realized the benefits of sharing digitized information with each other. They quickly real-ized that this could lead to better operational orchestration and cost savings via workflow simplification and lean supply chains. In addition, border agencies with the mandate to inspect and clear inward and outward cargoes also seized the opportunity. The development of national trade single windows (TSW) was enabled by the digitalization of Customs compliance operations with the concurrent automation of other border agencies such as sanitary-phytosanitary (SPS), standards or national security agencies, among others with mandates to control cargo flows at national borders. Finally, increased use of technology by shipping lines and their agents has allowed the electronic exchange of data from ship-to-shore. The MSW focused on vessel arrival, stay and departure processes at the port of entry.

In practice, these three platforms have many common data elements, which sometimes makes their boundaries blur. For instance, a cargo declaration is one of the standardized FAL declarations. It must be submitted as part of the MSW ship-to-shore electronic data exchange platform. The same data submis-sion requirement is part of the TSW, especially when Customs have the mandate to process pre-arrival information and even proceed to pre-arrival clearance. The two referred declarations may not have the exact same form but include several common data elements which are submitted twice in each of the plat-forms. Therefore, in many cases although some data elements are submitted once to the PCS and effectively shared between its members, the same element must be submitted again to either MSW or TSW. This is the result of lack of interconnectivity between the distinct platforms that sometime exists even in developed countries.

However, policy decision makers still wonder whether there is room for the concurrent operation of all three platforms or whether, for instance, PCS or TSW can slightly extent their scope to cover all trade and transport operational and regulatory requirements. Another practical challenge, that developing but also many developed countries face, is how to fit SW platforms into port digital ecosystems in which a PCS already exists. It is recommended that SWs are architecturally designed to reflect PCS functions and coverage. It is also recommended that the legal, regulatory, and institutional enabling environment that will allow the development of single-submission platforms is put in place prior to the adoption of any digital platform.

Looking into the future, the core question seeking an answer is how many "single" windows can operate in the port sector and whether there are possibilities for deep integration or systems' mergers. As technology rapidly advances towards more afford-able software and hardware solutions, port communities will not stop investing in their systems' upgrade, thus allowing the utilization and analysis of available big data. To the extent that SWs remain initiatives of distinct public entities i.e., maritime or port authorities or Customs, the odds for developing one single window to serve holistic trade and transport facilitation purposes remain slim as well as chances for the complete merger of existing platforms. However, is highly likely that more and more countries will try to find ways to reinforce interconnectivity and interoperability between the three platforms. This implies that the legal, regulatory, and institutional frameworks and respective provisions, necessary to enable data-sharing between platforms, will be in place.

2. Data Collaboration Platforms at Ports

PCS is not the only port electronic data exchange platform: There are several data platforms at ports, especially in the developed world. Currently, one may encounter trade or maritime single windows or cargo community systems, sometimes operationally linked to seaport service and processes. Each one of these solutions is championed by a public entity or private company, which may often represent a larger group of organizations. For instance, Customs authorities, on behalf of the border agencies group, lead the development of TSWs. Similar leadership roles are also sometimes undertaken by terminal operators in the case of PCSs as well as the port and maritime authorities with respect to the MSW. The different nature of the above agencies and the fact that each platform reflects different trade and transport processes explains the fact that most countries end-up with more than one single-submission platform.

Single windows are important in the trade and transport domain: A single window in the context of trade and transport facilitation serves as an integrated platform that encompasses various configurations but nonetheless exhibits several universal attributes. It engages stakeholders who are instrumental in both trade and transport sectors, thereby fostering a collaborative ecosystem. The platform is engineered to manage standardized information and documents, thereby streamlining the informational architecture, and enhancing data interoperability. Central to its design is the use of a singular entry point, which simplifies user interaction and expedites transactions. Furthermore, it is geared to comply with extant regulatory frameworks, ensuring that it serves not merely as an informational repository but also as a compliance tool. Importantly, the single window system is predicated on the principle of single submission for individual data sets, thus eliminating redundancies and improving operational efficiencies. Overall, a single window represents a synergetic convergence of multi-stakeholder involvement, information standardization, regulatory adherence, and streamlined data submission mechanisms.

The crucial role of a single-entry point in single window systems: The concept of a "single entry point" emerges as a pivotal mechanism within single window systems for trade and maritime logistics. It stipulates that economic operators should submit requisite data exclusively through this singular platform, thereby streamlining administrative processes and eliminating duplicative data collection efforts. In tandem with this, the single window system is endowed with the authority to discharge a comprehensive array of regulatory functions pertinent to both trade and maritime sectors. This indicates that the SW system operates under an explicit mandate from the governing authority, effectively acting as a proxy for government in administering trade and transport regulations. Hence, the principles underlying the "single entry point" hold salient implications across the spectrum of trade and maritime single windows, harmonizing procedures and fortifying the governance structure.

Border agencies rely on trade single windows: Development of single windows for trade are recommended in the WTO-TFA. In article 10.4 of the agreement, it is stated that WTO member-governments should establish a single window, via the use of information technology, if possible, to enable traders to submit data requirements for importation, exportation, or transit of goods through a single-entry point to relevant government authorities or agencies. According to UN/CEFACT, the SW concept refers to a facility that allows parties involved in trade and transport to lodge standardized information and documents with a single-entry point to fulfil all import, export, and transit-related regulatory requirements. If information is electronic, then individual data elements should only be submitted once. The above definitions are used to describe a single window at a national level which facilitates data exchange between border agencies for the sole objective of allowing the quick and efficient cargo clearance process.

The pivotal role of maritime single windows: In alignment with the International Maritime Organization's (IMO) Facilitation of International Maritime Traffic (FAL) Convention, Maritime Single Windows (MSWs) serve as indispensable regulatory architectures that facilitate electronic data interchange to optimize vessels' clearance procedures. Deployed as a critical component of trade and port logistics, these MSWs are instrumental in streamlining the bureaucratic formalities associated with the international ships' arrival, sojourn, and departure processes. By offering a centralized, digital conduit for the requisite legal and procedural documentation, MSWs effectively ameliorate systemic inefficiencies, thereby promoting an expedited and more seamless flow of maritime trade across international borders.

Can multiple port data-exchange platforms exist? In the evolving landscape of port logistics and trade facilitation, the prevalence of multiple digital platforms within a given port ecosystem can indeed foster enhanced operational efficiency, provided these platforms exhibit non-overlapping scopes and cater to distinct dimensions of maritime, trade, or port-side operations. However, this compartmentalization of digital solutions runs the risk of engendering data silos, thereby allowing repetitive data submissions across these disparate platforms. Such redundancy runs counter to the overarching objective of streamlined international supply chains and poses a challenge to the holistic advancement of trade and transport facilitation agendas. Therefore, it is imperative to infuse these platforms with interoperability features to facilitate seamless data-sharing across various trade, maritime, and port-side operations. This would obviate the need for multiple submissions of identical data elements, thereby engendering a more integrated, efficient, and resilient supply chain ecosystem. The strategic alignment and integration of PCSs with maritime and trade single window systems are vital in fortifying this interoperable infrastructure, thus contributing substantively to the consolidation and elevation of trade and transport facilitation paradigms.

3. The Maritime Single Window

3.1. MSW under the FAL Convention

The birth of the MSW concept: The FAL Committee at its 40th session in April 2016 adopted resolution FAL.12(40) on amendments to the Annex of the FAL Convention, which made mandatory the requirements for the electronic data exchange to assist ship clearance processes in ports. This puts the responsibility of establishing systems for the electronic data interchange on governments from April 2019.

FAL 46 approved the guidelines for setting up a maritime single window (FAL.5/Circ.42/Rev.2), enabling intelligent and secure exchange of information between public and private stakeholders related to the arrival, stay, and departure of ships nationwide. The deployment of a MSW shall be nationwide, including any vessel at any ports of entry related to international traffic and could also be extended to any domestic vessel.

Focus placed on vessel clearance process improvement: The objective of the MSW is to facilitate ship clearance processes in ports for ships on international voyages. It is a public-private data collaboration platform that allows the submission through a single-entry point of standardized and harmonized information related to the electronic exchange of information required on the arrival, stay and departure of ships in ports and harbors (Figure 3). It covers maritime regulatory procedures, but could be extended to other administrative, nautical, and operational procedures and other related information shared between private sector and public authorities at the port.

Standardization of documentation requirements: One way the FAL Convention facilitates maritime transport is by simplifying and minimizing complex formalities and documentation requirements linked to arrival, stay and departure of ships. Based on this guidance, regulatory authorities are encouraged to use a specific number of standardized documents (*Table 1*), eliminate redundant documents and ensure that data required is not submitted more than once. Simplification of formalities is a prerequisite for the successful adoption of the MSW, and in line with the "simplification prior to digitization" mantra which prevents the automation of repetitive procedures. According to FAL 46, maritime authorities should ensure that MSW includes at least thirteen FAL regulatory requirements. The maximum information required by public authorities for the declarations in section 2.1 is described shown in the Annex of FAL Convention (2022 edition).

Securing interoperability via IMO's Reference Data Model: To share, exchange and understand the data, ships and ports need to use international harmonized standards as different groups of stakeholders have different objectives and different work processes. Therefore, more than one standard is used for ship

Box 1. The FAL Convention

For international shipping, a unified, global approach to FAL is vital. These activities are regulated and streamlined by an international treaty called the FAL Convention. It's been in force since 1967 but is kept continually amended and updated by Governments at the FAL Committee of IMO – which meets once a year at IMO's London Headquarters.

The FAL Convention contains standards and recommended practices and rules for simplifying formalities, documentary requirements and procedures on ships' arrival, stay and departure. Under the FAL Committee, IMO has developed standardized FAL documentation for authorities and Governments to use, and the FAL Convention urges all stakeholders to do this.

The FAL Convention will make it mandatory for ships and ports to exchange FAL data electronically and encourages use of the so called "single window" concept in which all the many agencies and authorities involved exchange data via a single point of contact.

Source: IMO.

reporting. In this context, IMO—in partnership with WCO, UNECE, and ISO—have agreed on an IMO reference data model known as the IMO Compendium which refers to a set of standards for the submission of maritime related data. IMO encourages all stakeholders to adopt the IMO Compendium when building their digital systems as it allows interoperability, as no matter which standard or system is being used data can be exchanged. Enabling interoperability reduces the administrative burden. For example, the Compendium allows single windows to integrate, enabling closer coordination between Customs and maritime authorities during cargo and vessel clearance processes.

Streamlining the vessel clearance process: Vessel clearance refers to the process of obtaining permission for a vessel to enter or exit a port or waterway. It involves the completion of various formalities and documentation requirements to ensure that the vessel complies with all applicable laws and regulations and is safe to operate. Vessel clearance typically involves obtaining clearance from several different authorities, such as the port authority, Customs, immigration, environment, and health authorities. The specific requirements for vessel clearance may vary depending on the country or region, as well as the type of vessel and the cargo it is carrying. In most ports in the developing world, the process is cumbersome and repetitive, thus adding

Table 1. List of required FAL Documents

General Declaration	Special declaration for postal items as described in the Acts of the Universal Postal Union currently in force
Cargo Declaration	Maritime Declaration of Health as required under International Health Regulations
Ship's Stores Declaration	Ship Sanitation Control Exemption Certificate, Ship Sanitation Control Certificate, or extension, as required under Article 39 of International Health Regulations
Crew's Effects Declaration	Security-related information as required under SOLAS regulation XI-2/9.2.2
Crew List	Advance electronic cargo information for customs risk assessment purposes as set out in the WCO's Safe Framework of Standards.
Passenger List	Advanced Notification Form for Waste Delivery to Port Reception Facilities
Dangerous Goods Manifest	

Source: IMO.

unnecessary steps for shippers, port operators, traders, and their agents, which lead to additional costs of doing business. Some of the key factors that may impact vessel clearance include the vessel's size, draft, and overall condition, as well as the cargo it is carrying and any potential safety or environmental concerns. In many cases, vessel clearance may also involve the payment of various fees and charges, such as port fees, pilotage fees, and Customs duties.

The incentive of port call optimization: The positive impact of MSW extends beyond the mere vessel clearance and captures the broader port call process.[1] Today, one of the strongest arguments in support of the MSW adoption lies in its contribution to the optimization of port call process which, in turn, leads to the facilitation of just-in-time arrival of vessels.[2] One core value coming out of port call optimization is enhanced predictability which is an important foundation for port and shipping lines' scheduling and planning processes. Beyond the direct positive effect on port operators' and shipping lines' cost-effectiveness, other benefits include trade facilitation and environmental dimensions of trade and transport. Port call optimization needs to be regarded from two different business logics and should be balanced between: (a) A port-centric approach which raises the concern of the port with its operators to optimize the utilization of their resources.

(b) A ship-centric approach which raises the concern of ensuring high utilization of the ship paying visits to multiple ports.

MSW leading to port call business process improvement: Similarly, to the PCS, the adoption of single window platforms has a direct positive impact on the business processes they cover (see chapter 7). The port call process is based on the high-level business process of port calls, which is based on IMO regulations, BIMCO contracts, and specific requirements of port authorities and other stakeholders. It was created by the industry through the International Task Force on Port Call Optimization (ITPCO).[3] The port call brings together into a common port environment three types of data: (i) Nautical data used for safe navigation. (ii) Administrative data submitted by ships to authorities based on legislation or regulations. (iii) Operational data submitted to non-authority parties as part of operational planning and execution. By reducing the overall dwell time of ships at ports, the port call process becomes an important element of safe and efficient port operation, coordinated border management for vessel clearance and inspections, and trade facilitation. The FAL 46 Committee informally extended the scope of MSW[4] beyond regulatory information to the port call process, including administrative, nautical, and operational data that may be exchanged through the MSW to address the above. Port call is also included in the guidelines for setting up a maritime single window (FAL.5/Circ.42/Rev.2).

3.2. The European MSW environment

Perceived benefits of MSW: The MSW concept in the EU is a result of a long process which started in 2010 and is still going on. The generating factor behind it was the facilitation of electronic exchange of data related to administrative procedures that the shipping industry faces when arriving and/or departing EU ports. Early legislative acts that were passed in 2010, although they understood the impact of simplification and harmonization measures on maritime shipping cost reductions, just-in-time port logistics and port call optimization, were drafted with maritime safety in mind as a primary goal and how this can be enhanced by improved port call processes. This explains the mandate given to the European Maritime Safety Agency (EMSA) to lead the effort on the maritime single window development. However, as the concept develops and adjusts to national and regional needs and requirements, more attention is being paid to its impact on trade and transport facilitation. Overall, the European MSW environment concept is based on the principle that all member states facilitate their own Maritime National Single Window (MNSW) interconnected at the EU community level.

---

1   Port call is defined by EU Regulation 2019/1239 on establishing a European Maritime Single Window environment for the arrival of a ship at a maritime port in a member state, its stay in the port, and departure from said port
2   https://www.iaphworldports.org/just-in-time-arrival-of-vessels
3   https://portcalloptimization.org/
4   Port call references were added to the MSW guidelines but not mentioned in the FAL Convention. The goal of the addition is to highlight the need to consider both operational and regulatory data to achieve port call optimization.

Figure 1. MSW Coverage of Vessel clearance processes
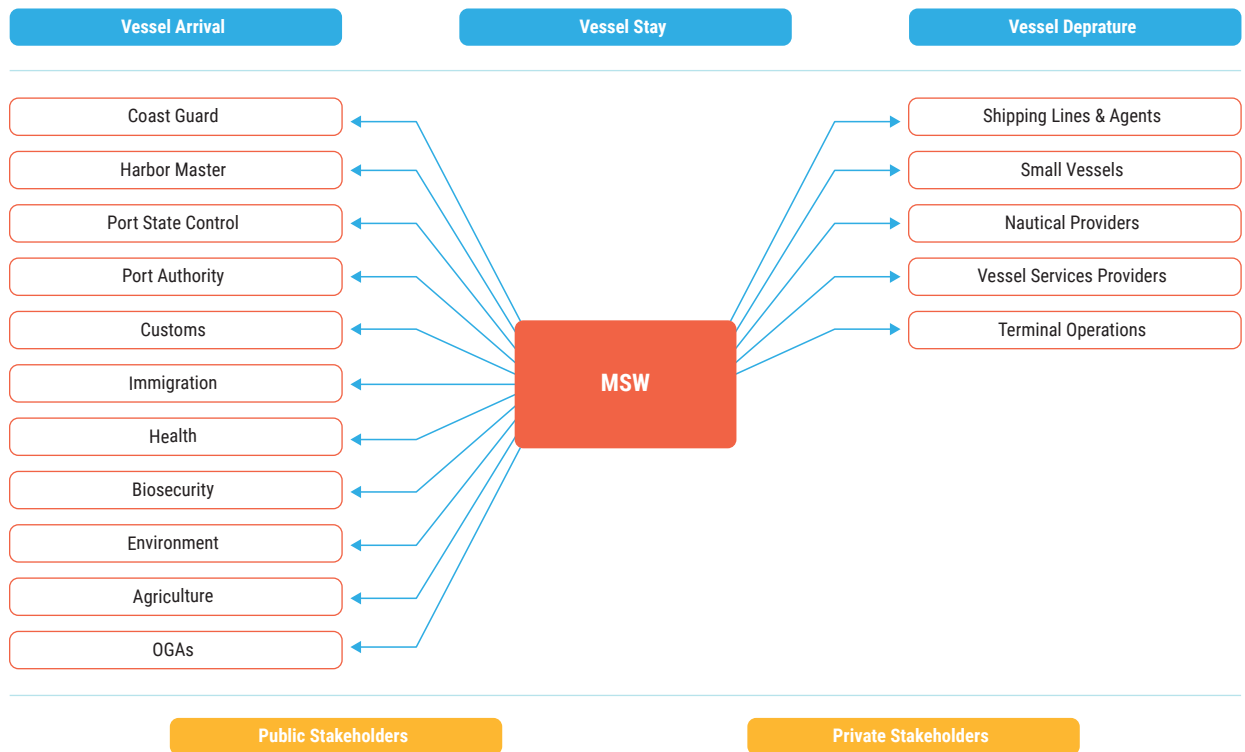
Source: Accelerating Digitalization: Critical Actions to Strengthen the Resilience of the Maritime Supply Chain. Washington, D.C. IAPH & World Bank.2020.:.https://documentsinternal.worldbank.org/search/32775900.

European MNSWs are still works in progress: The first attempt to develop a legal framework in support of the MNSW was in 2010. However, after nine years of limited success, it was recognized that the framework was vague in many of sections. An in-depth evaluation of the program revealed the need to update and upgrade sections, especially those related to guidelines for development of MSW at a national level, harmonization of reporting interfaces and coordination of MNSWs at a community level. The EU MSW is expected to be continuously evaluated on a regular basis and improved, based on its performance. As of now, it is the most advanced regional initiative of interconnected national MSWs.

The twin development goal at national and community levels: The challenge of the program is how the MNSW concept can evolve and produce anticipated results both at a national and EU regional levels. Actually, the operational success of the MNSW constitutes a prerequisite for the success of the EU-wide MSW. For instance, the proper application of the "only-once" principle largely determines whether the MSW reduces or increases maritime administrative bureaucracy. Therefore, the development of the European MSW environment aims at the monitoring of national progress while at the same time providing technical guidelines for interoperability and proper regional scale-up.

3.2.1. National reporting formalities for ships (Directive 2010/65/EU)

Reporting formalities for ships within the EU: A number of concrete measures have been launched by the European Commission with a view to establishing a European maritime transport space without barriers aiming at the reduction of administrative burdens and facilitation of maritime transport between ports in the EU. Directive 2010/65/EU on reporting formalities for ships arriving in and/or departing from ports of the member states was one of the core regulations for establishing a single maritime transport space without barriers. The purpose of its adoption was "to simplify and harmonize the administrative procedures applied to maritime transport by making the electronic transmission of information standard and by rationalizing reporting formalities." Consequently, it only regulated the methods of collecting and exchanging information and simplifying and harmonizing the procedures for exchanging it, without prejudice to the nature and content of the information requested. The scope of Directive 2010/65/EU is defined in such a way that it applies to the reporting formalities applicable to maritime transport for ships arriving in and ships departing from ports in EU member states.

The EU Maritime National Single Window (MNSW): Within Directive 2010/65/EU, EU member states are required to establish a

Maritime National Single Window (MNSW), linking SafeSeaNet, e-Customs and other electronic systems. The MNSW constitutes the place where all information is reported once and made available to various competent authorities. The master or any other person duly authorized by the operator of the ship should provide notification of the information required at least 24 hours in advance. In 2015, EMSA developed, together with six member states, a MNSW prototype to enable data flows between the shipping industry and authorities in a member state, and between member states, via SafeSeaNet. This prototype is based on international standards and EU requirements and thus allows reporting of all formalities required by Directive 2010/65/EU. It is also adaptable to different national administrative set-ups, procedures, and legislation. It also enables EU member states to use it as a complete solution or to use any of its components to comply with the directive requirements.

Alignment to FAL Convention requirements: Directive 2010/65/EU considers the decisions of the International Maritime Organization (IMO), namely the Convention on Facilitation of International Maritime Traffic (FAL) and the application of IMO FAL forms. Accordingly, it was necessary to define the interrelation of these forms and systems for electronic data exchange at the level of the European Union. EU ports should accept FAL forms for the fulfilment of reporting formalities for carrying out the official ship registration procedure. It should be noted that the directive must refer to the version of the FAL forms that are currently in force, so that the Commission should continually monitor the work of The Facilitation Committee of the International Maritime Organization (IMO) and propose amendments to the directive itself.

Implementation challenges on a national level: However, the adoption of the directive in the national legislation and the practical implementation in each of the EU member states faces several obstacles. According to a recent in-depth evaluation,[5] the directive's outcomes fall short of expectations due to: (a) Lack of its full implementation, including difficulties in getting all national authorities properly connected. (b) Poor system design. (c) Lack of mandatory technical specifications ensuring harmonized MNSW. (d) The continued reporting by separate entry points outside the MNSW.

3.3. The EMSWe (Regulation 2019/1239/EU)

The European Maritime Single Window environment (EMSWe): The EU recognizes that the administrative burden for shipping companies and the procedures for fulfilment of reporting obligations should be further simplified and harmonized via the

adoption of data exchange solutions. Therefore, it introduced Regulation 2019/1239/EU.[6] The main aim of this regulation is to lay down harmonized rules for the provision of the information that is required for port calls, in particular by ensuring that the same data sets can be reported to each maritime national single window in the same way. The regulation establishes a framework for a technologically neutral and interoperable European Maritime Single Window environment ('EMSWe') with harmonized interfaces, in order to facilitate the electronic transmission of information in relation to reporting obligations for ships (Figure 4). The same provision defines the scope of reporting obligations for ships arriving at, staying in, and departing from an EU port. This regulation introduces a much clearer definition of the MNSW, described as "a nationally established and operated technical platform for receiving, exchanging, and forwarding electronically information to fulfil reporting obligations".

Setting out the universe of formalities to be submitted: The ultimate list of forms, notifications, declarations, and other formalities required for submission from ship-to-shore is also defined. Three subsets of formalities are outlined: (a) Reporting obligations stemming from legal acts of the Union. (b) FAL documents and reporting obligations stemming from international legal instruments. (c) Reporting obligations stemming from national legislation and requirements (Figure 5). This way, it is secured that the declarants comply with all levels of formalities required: national, regional, and international. The risk of submitting the same data elements in different forms and declarations is mitigated by the "only-once" principle. In the same context, governments are required to define and report centrally all data elements into a regional EMSWe Data Set, which constitutes a complete list of data elements stemming from all member states' reporting obligations. All member states notified the Commission of any reporting obligations stemming from national legislation and requirements, as well as of the data elements to be included in the EMSWe data set.[7]

Ring-fencing the "only-once" submission principle: Governments should ensure that declarants are requested to provide required information only once per port call, and that the relevant data elements of the EMSWe data set are made available and reused for the purpose of fulfilling the reporting obligations at arrival to the next port. In addition, any relevant data elements of the EMSWe data set received in accordance with this regulation is made available to other Maritime National Single Windows via the SafeSeaNet. Therefore, the commonly identified risk of submitting the same data element more-than-once, especially in single windows with regional application, is mitigated via the adoption of national legislation. This legislative action is critical for the success of the EMSWe.

---

5   Evaluation of the Directive 2010/65/EU on reporting formalities for ships arriving in and/or departing from ports of the Member States (https://transport.ec.europa.eu/system/files/2018-05/swd20180234-eval.pdf)
6   The implementation date of Regulation 2019/1239/EU is August 2025.
7   Submission deadline was 15 February 2020

Figure 2. The European Maritime Single Window Environment
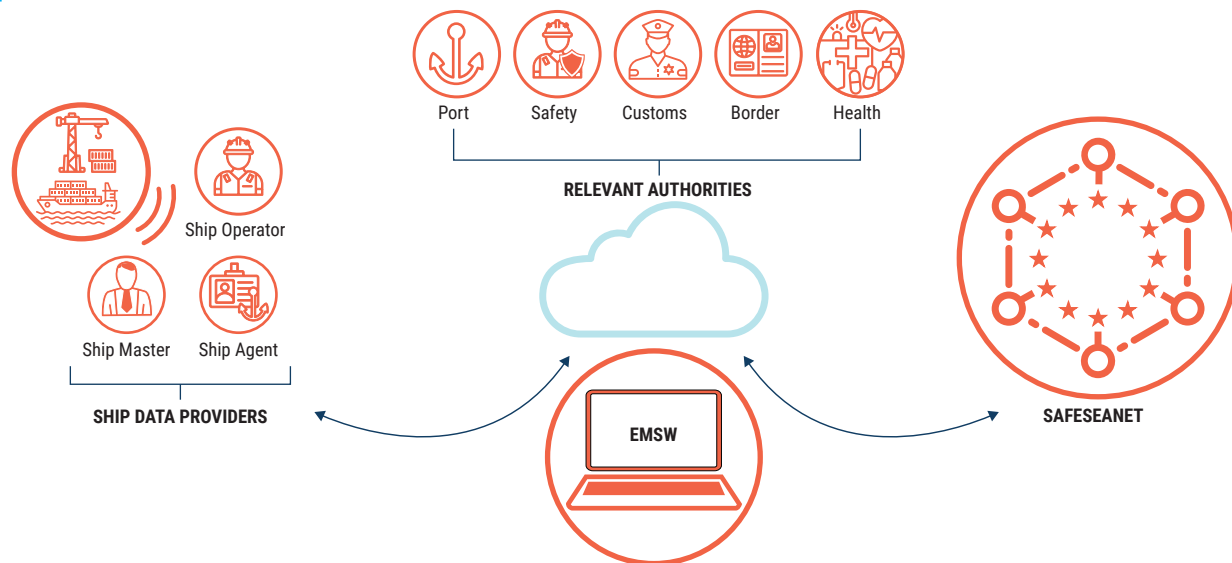
Source: European Maritime Safety Agency.

3.4. MSW as a trade facilitation instrument

Simplification of formalities and documentation requirements: Compliance with excessively complex maritime transport formalities and the obligation to repetitively submit the same data to different agencies leads to high transaction logistics costs. Efforts towards documentation standardization, according to regional or international standards, ensures that: (a) Only the necessary documents are submitted. (b) Data embedded into these documents is only submitted once. In addition, paper forms and documents already submitted electronically are identified, formally become redundant and are legally eliminated. This implies that governments review national reporting requirements to ensure that data requested has not been already submitted through the regional or international standardized forms. When conducted correctly, simplification of formalities leads to reduction of bureaucracy for government agencies and reduction of costs and time spent by shipping lines and their agents to fill out and submit unnecessary documents, often in paper forms as it is the case in most of the developing world.

Streamlining of the vessel clearance process: The sight of several vessels waiting at anchorage outside the port water territory is quite common in the developing world. One of the core reasons leading to it is the fact that required information is submitted upon arrival and in paper form. In countries that use the MSW, documents and processes that cover the ship's arrival, stay and departure from a port are digitized. Therefore, required data elements capture the entire workflow of inbound and outbound vessel clearance which leads, by definition, to its streamlining and re-engineering as some of the workflow steps are no longer needed. The use of the MSW also allows required

data to become available even before the vessel's arrival, which allows the pre-arrival processing of the vessel information. This, in turn, leads to a more predictable, reliable, and quicker vessel clearance process. In addition, regulatory and control agencies have more time on their hands to conduct risk-based inspections required for clearance from a safety and security point of view.

Optimization of the port call process: Linking the maritime and the port operational processes, a streamlined and effective vessel clearance process may lead to the optimization of the port call process, if following respective corrective measures on the port side. By reducing the overall dwell time of ships at ports, the port call process becomes an important element of safe and efficient port operation, coordinated border management for vessel clearance and inspections, and trade facilitation. The port call brings together into a common port environment the administrative, nautical, and operational information that includes three types of data: (i) Nautical data provided by hydrographic offices that are used for safe navigation. (ii) Administrative data that are submitted by ships or other non-authority parties to authorities based on legislation or regulations. (iii) Operational data submitted to non-authority parties as part of planning or execution of certain operations. Both the EU and IMO view the MSW concept via the lenses of port call improvements. The main aim of Regulation 2019/1239/EU is to lay down harmonized rules for the provision of the information that is required for port calls, in particular by ensuring that the same data sets can be reported to each MNSW in the same way.

Enables collaboration between trade and transport agencies: The vessel clearance process is not solely the responsibility of the maritime or the port authorities. As seen in Figure 2 there are a number of government agencies involved in the process.

Figure 3. Reporting Obligations
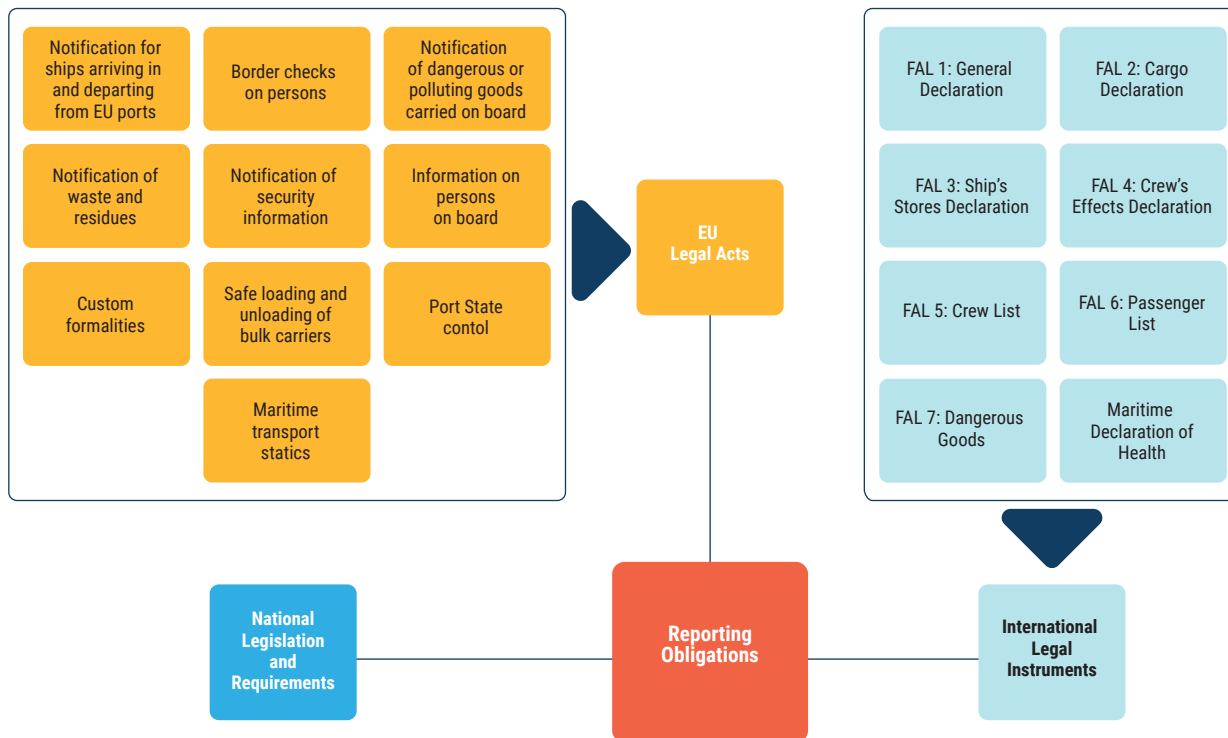
Source: Authors based on information from the European Maritime Safety Agency (EMSA).

This includes but is not limited to Customs, immigration, health, agriculture, standards, national security, and other agencies. Coordinated trade and transport facilitation is key to unlocking opportunities for the reduction of logistics costs and cutting down dwell times at the ports, while improving predictability of maritime supply chains. Improving collaboration between maritime, port and border compliance agencies may result in moving and clearing vessels faster and more efficiently. This requires efforts at an institutional level to: (a) Operationally coordinate activities of different national trade and transport agencies in connection to the sea and at the port side of operations. (b) Enable electronic data and information exchange among them to verify ship's stores and cargo declarations.

3.5. MSW and PCS complementarity

The MSW is not a distinct platform, isolated from the rest of the digital port infrastructure that exists in the port and maritime sectors. In some cases, it is developed as an independent body but with strong linkages to the existing IT solution, even to existing single window platforms. The latter may be either a PCS or a TSW. In other cases, the MSW is so much embedded into other solutions that it is considered one of their integral components.

The MSW could also be the vessel module[8] of the PCS such as in Peru, Portugal, Israel, and other countries. This conceptually makes a lot of sense given the strong linkages between the maritime and the port operations and processes.

MSW in the context of digital ports initiatives: The MSW is only one of the many digital solutions offered in the port and maritime ecosystem. This is particularly obvious in developed countries which base their economies on international trade and invested in technology to simplify and automate procedures. A good example is the port of Singapore. Being one of the largest transshipment ports in the world, Singapore has dramatically reduced the time of administrative procedures, especially those related to the ship arrival, stay and departure. The vessel clearance process at the port of Singapore is completely automated, thus allowing ship masters or their agents to fulfil regulatory port entry requirements by electronically submitting required information to the Maritime and Port Authority of Singapore (MPA), the Immigration and Checkpoints Authority (ICA) and the National Environment Agency (NEA) for clearance respectively.

The impact of the Singaporean MSW: The development of the Singapore digitalPORT@SG™ MSW platform in September 2020, prevents the submission of repetitive information and separate

---

8   The vessel module of a PCS primarily deals with activities related to the management and tracking of vessels entering, docking, and leaving the port.

Box 2. Port Call optimization

The port call process is based on the high-level business process of port calls, which is based on IMO regulations, BIMCO contracts, and requirements of port authorities and other stakeholders. It was created by the industry through the International Task Force on Port Call Optimization (ITPCO) and validated during industry roundtable sessions organized by the IMO Global Industry Alliance (GIA) to Support Low Carbon Shipping.

The Port Call process consists of one physical execution part involving the navigation of the ship and the handling of cargo, supplies and services; and one business process part that among several other things includes the digital exchange of information related to the port call.

The Port Call business process has two main phases: (i) the contractual phase that includes information on the sale of goods (bulk) or carriage (container), hiring ships, and terminal service; and (ii) the operational phase that includes passage planning, berth planning for arrival, port planning for arrival, vessel and cargo service planning, and port planning for departure.

Source: International Task Force on Port Call Optimization (ITPCO).

communication with the three agencies for their clearance application status. digitalPORT@SG™ has streamlined up to 16 different submission forms into one application that is processed and updated by all three agencies centrally. Therefore, shipmasters and ship agents from more than 550 shipping companies can now submit, track, and receive approval for arriving and departing ships through the portal. As a result, the industry saves up to 100,000 personnel-hours per year.

Linking port and maritime processes: digitalPORT@SG™ has been recently enhanced to a single integrated digital platform for the industry to facilitate the booking of marine services from service providers. It also provides Just-In-Time (JIT) services from a port-centric approach for all stakeholders in the maritime value chain. This way it facilitates direct berthing for arrivals and on-time departures thus: (a) Reducing wait time at anchorages. (b) Enhancing ship turnaround time in the planning and scheduling of port resources. digitalPORT@SG™ also enables the sharing of ship and port documents between port administrators and maritime stakeholders, facilitating data convergence in the global maritime transport value chain.

Transforming a maritime information system to MSW in Chile: In Chile, the MSW referred to as "VUMAR" is being gradually developed by the Ministry of Transport and Telecommunications (MTT) and the Maritime Authority of Chile. Prior to VUMAR, the related procedures were done in the system of the Chilean maritime authority, the Sistema Integral de Atencion a la Nave (SIAN). However, SIAN did not provide notification of process completion. It also did not provide real-time status updates, leaving the shipping lines and their agents with the option of telephone or email. The goal of VUMAR is to support all required procedures related to the arrival, stay and departure of the vessel. The users of VUMAR are either public agencies involved in the approval process, including the validation of documents or certificates required for the vessel call, or shipping lines required to submit

documents and fulfil the required procedures, based on the IMO provisions and national legislation. On the recipient side, the port authority and terminal operating companies receive the information which they use for planning and coordination purposes on the land side of port operations. Additionally piloting service providers may use the respective MSW module for the oversight and monitoring of piloting and tugging maneuvers. Figure 7 illustrates the main modules of VUMAR, that consists of the reception and dispatching of the vessel, the pilotage, and the module to coordinate information with ports and their port terminals.

Chilean PCS and MSW integration: In terms of the integration of SILOGPORT PCS with VUMAR, it is important to notice that SILOGPORT does not handle information related to the vessels as it is more focused on the landside coordination. The SIAN now provides the information related to the estimated time of arrival (ETA) and estimated time of departure (ETD) of vessels to SILOGPORT, but this is not transmitted in real-time. For instance, the pilot ends the maneuvers and registers the operations when he/she arrives at his/her office. Once the VUMAR may be fully implemented and integrated with SILOGPORT, such information will be transmitted by VUMAR to SILOGPORT. VUMAR' integration with other automated systems is a work in progress. There are currently plans for the integration to be carried out with the Integrated System of Foreign Trade (Sicex) of the Ministry of Finance, to allow the connection with public services such as SAG, Health, Sernapesca and Customs, thus facilitating the operations and internal analysis of each service in relation to those covered by VUMAR.

VUMAR's positive impact: Among the benefits of VUMAR, it is possible to list a shorter time for procedures, the traceability of operations, authorizations, online notifications, a 24/7 operation, the standardization of public service processes as well as access to statistics, and historical information. VUMAR

Figure 4. Singapore PCS and MSW Linkages

E-Navigation
- 'digitalSHIP' — Ship-shore Harmonisation and Interoperability Project
- Contribute to international work on data standards and harmonisation

Port Community Systems
- Enable true interoperability via system-to-system API calls versus online form-based submission in typical national single windows
- Facilitate JIT for ships that call at Port of Singapore

G2B

digitalPORT@SG™

G2G

Bilateral/Multilingual Agreements
- Work with authorities e.g. other national Single Windows, exchange of e-documents (eg. e-Certs) to facilitate ease of port clearance & other e-Services
- Enable data sharing to eliminate the need for "double port-entry submissions" by vessels, such that submitted documentation to one port will be conveyed to the next pot of call

Supply Chain Digital Platforms
- Enable true interoperability via system-to- system API calls versus online form-based submission in typical national single windows
- Facilitate track and trace of cargo

B2B2G

Source: MPA Singapore.

Figure 5. Chilean MSW (VUMAR)

Reception
- Vessel pre-arrival
- Arrival
- Reception
- Authorization

Dispatching
- Dispatching Request
- Sailing

SIAN

VUMAR CHILE

Port Coordination
- Vessels waiting to be moored
- Dangerous cargo of the vessel to be moored

Pilotage
- Maneuver Monitoring
- Sailing
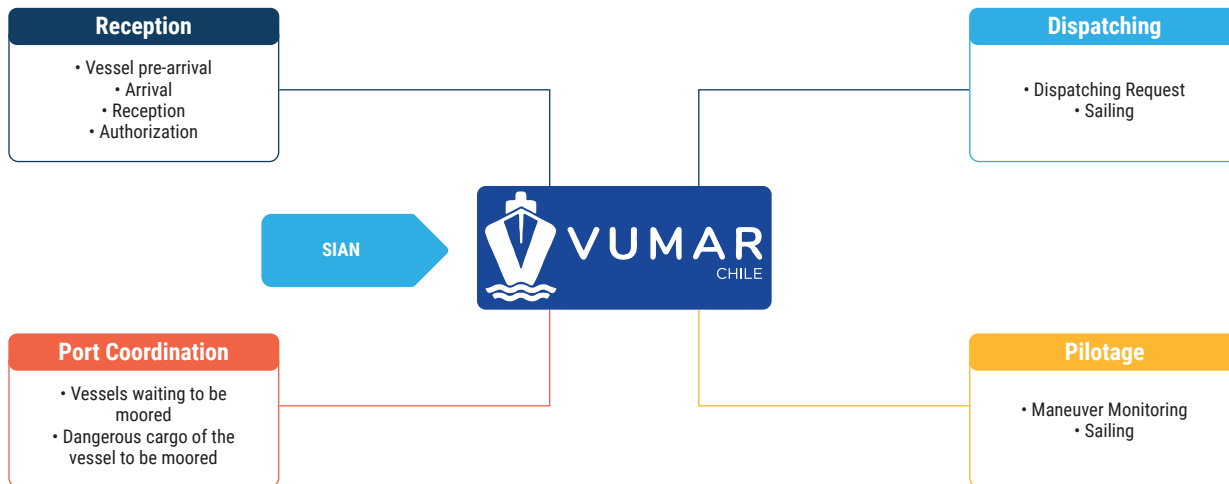
Source: Authors.

generates significant savings associated with the elimination of paperwork and operating expenses. Once VUMAR is fully developed, MTT estimates that 425,000 paper documents will no longer be issued annually (including forms and certificates) and the 62,500 hours currently allocated by the different stakeholders that are part of this process will be saved. Furthermore, the time spent with payments, especially those required to be done physically, will be also saved.

4. The Trade Single Window (TSW)

Data exchange focusing on cargo clearance process: The Trade Single Window (TSW) enables an environment for traders and transport service providers to interact efficiently with cross-border formalities in international trade. Traders and their agents benefit from the convenience of transacting with these agencies electronically via the TSW. Procedures are simplified and streamlined since Customs and other trade regulatory agencies (OTRA) operate in a coordinated manner, automated data exchange eliminates the need for submission of duplicate information, and automated processing speeds up end–to–end processing of import and export transactions. Regulatory agencies benefit from tighter border control, improved efficiency, and greater ability to monitor performance against service-level agreements. The TSW's objective is to reduce the time and cost of international trade transactions. The definition used by the lodge standardized information and documents with a single-entry point to fulfil all import, export, and transit-related regulatory requirements. If information is electronic, then individual data elements should only be submitted once".

Increasing number of countries adopt TSW but global figure remains low: The development of a Trade Single Window (TSW) is a mandatory requirement for member-countries of the WTO. The Article 10.4 of the Trade Facilitation Agreement (TFA),[9] states that its members should endeavor to establish or maintain a single window, enabling traders to submit documentation and data requirements for importation, exportation, or transit of goods through a single-entry point to the participating authorities or agencies. However, as seen in Figure 8 this digital solution is fully adopted primarily in the developed world. The Trade Single Window (TSW)[10] is the TFA measure with the lowest rate of implementation globally. It ranks 36th out of 36 TFA measures with a mere 53.1 percent implementation rate. Especially in least developing countries (LDC) and developing countries member group implementation rate figure drops to 38.8 percent according to the notification data (Annex 2).

Customs are leading the TSW development: There is no specific provision that defines the most appropriate agency to lead the establishment and operation of a TSW. In practice though, Customs could be seen as the agency best suited to lead its development and implementation. This perception is based on the pivotal role they play at the borders, ports included, to receive and coordinate the flow of information related to the fulfilment of all cross-border regulatory requirements. It is also true that over the past decades, Customs agencies worldwide have modernized their operations via the application of specialized software and hardware.[11] Therefore, they generally understand and appreciate much more the benefits of automation ad digitization, especially compared to the rest of the border agencies.

There are three official TSW models but many more in practice: There are three common models for a TSW, as suggested by UN/CEFACT Recommendation No 33 : (i) The **'single authority'** model, whereby an entity co-ordinates between all the relevant agencies to ensure that the logistics chain remains unhindered. (ii) The **'single automated system'** model, whereby an automated information system processes information or co-ordinates with a group of systems that process the data to be received or sent. Such systems could be further categorized as **integrated systems**, in which the single automated system serves as a processing hub for individual users from all the agencies concerned, or as **interfaced systems**, where the single automated system develops and utilizes interfaces with systems belonging to other agencies to complete a transaction. There could also be a hybrid of integrated and interfaced approaches to the single automated system. (iii) The automated information transaction system, that serves as a transaction hub and is integrated with all the authorities.

Technology mismatches between Customs and OTRAs often determine the TSW model: In countries with strong Customs agencies – both in terms of institutional power and capacity- and OTRAs, the **"single automated system"** model is the preferred solution. In such cases, the Customs information system (usually some form of ASYCUDA) acts as the coordinator of the rest of the border agencies' systems. This model is frequently found in the developing world. Also, low automation of OTRA's operations often lead to a TSW with only one or two agencies connected beyond Customs. It is recommended that an adequate number of OTRA's automate their operations and business processes prior to the design and implementation of a TSW. Among the most important border agencies that need to modernize are sanitary and phytosanitary (SPS) agencies, food safety, standard authorities, national security, and others.

As opposed to PCS, TSW is largely a government initiative: The adoption of the single window benefits both regulatory and compliance agencies and the trade logistics industry. Nonetheless, its conceptualization and design is mainly a government affair. In most cases, initiatives for the adoption of the systems are taken either by Customs agencies or, in fewer cases, by Ministries of Trade,[12] which quite often view the TSW adoption through TFA compliance lenses. Frequently, the two parties are locked into power struggles over the design, operation, governance, and

---

9   WTO Agreement on Trade Facilitation, Ministerial Decision of 7 December 2013
10   The term used in the WTO-TFA to describe the TSW is NSW.
11   These may range from simple Customs declarations systems to e-payment systems for Customs duty or
12   Or with Ministries responsible to officially notify the WTO Committee on Trade Facilitation of their SW operation

Figure 6. Trade Single Window implementation rate

0-40%

40-70%

70-100%

100%
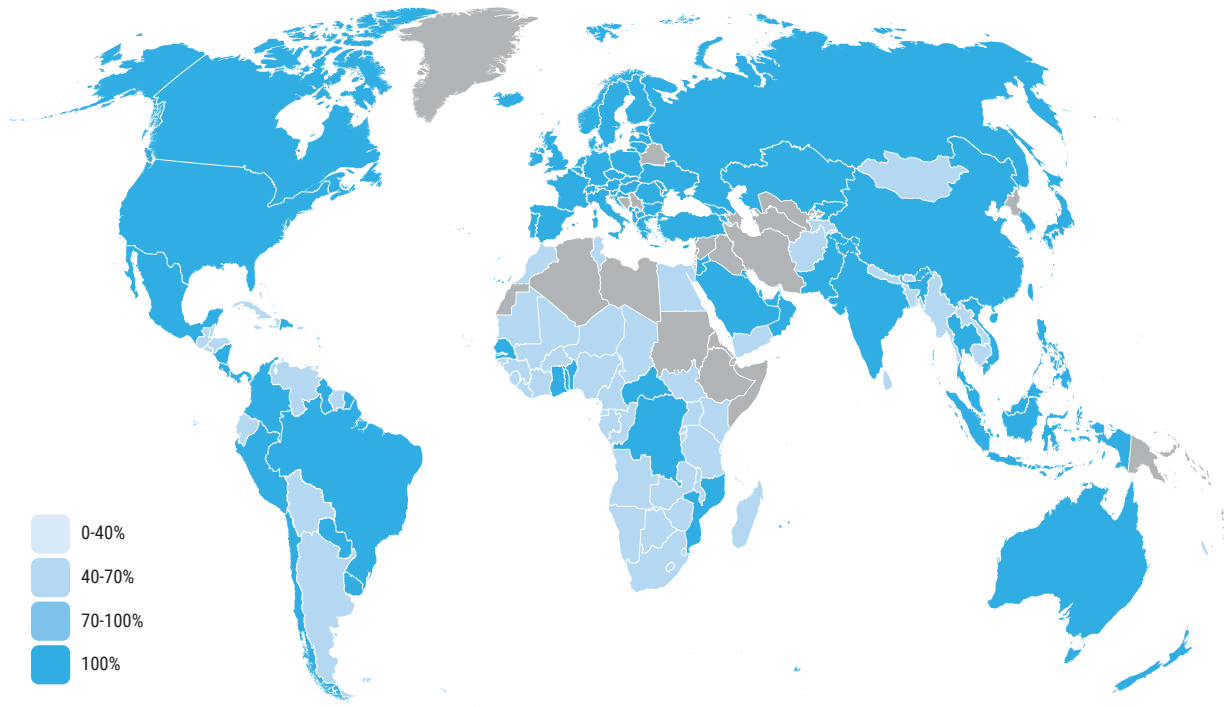
Source: Ministry of International Trade and Tourism, Peru.

overall ownership of the SW solution. Regardless, it is recommended that:

a. The conceptualization and visioning of the TSW is conducted via a series of public-private dialogue sessions and under the institutional umbrella of the National Trade Facilitation Committee.[13]

b. The design and implementation of the preferred solution is led by a strong government entity with the necessary legal authority, political backing, financial resources, and influence on Customs and OTRAs.

International organizations, like the World Bank, have not only assisted interested developed counties to develop enabling legislative and institutional environments for the TSW but also provided financial resources.

Economy-wide versus geographically bounded single window solution: The coverage of a TSW is rather thematic than geographic. In its typical form, it enables the exchange of trade regulatory data thus enabling cargo clearance processes in all types of border crossings (land, port, airport etc). In contrast to the PCS which, at least until the recent past, it was linked to the operations of a specific port, TSWs cover the entire network of

border crossing where Customs and OTRAs are present. Therefore, TSWs could be seen as a larger initiative compared to either the MSW or a PCS.

Opportunity to streamline cargo clearance processes: Like in the case of the PCS (see Chapter 7), the TSW offers ample opportunities for the simplification of trade processes and required documents. As part of the solution design process, it is required that border agencies review such formalities and documentation requirements. This review exercise includes the development of:

a. As-Is maps reflecting current import, export, or transit processes.[14]

b. To-Be maps which represent the desired simplified versions of existing ones.

This review exercise allows border agencies to simplify and harmonize formalities and procedures prior to the adoption of the TSW digital solution. Eventually, it leads them to better define the scope and coverage of workflows to be digitized. This way, they avoid the digitization of inefficient trade regulatory processes and procedures. Measures are aligned with the WTO-TFA, which calls for the minimization the complexity of import, export, and transit formalities and the simplification of import, export, and transit

---

13   As per Article 23 of the WTO-TFA

14   An example of an AS-IS business process map of the import process at the port of Acrra, Ghana is offered in Annex 4

Box 3. The Korean UNI-PASS

The UNI-PASS platform is the backbone of international trade in Korea and serves as the information hub for the entire trading community. It connects all stakeholders involved in trade clearance processes and provides automated end-to-end processing of all trade transactions.

The most recent available data states that UNI-PASS connects 169 government entities, including customs, ports, warehouses, banks and 27 OGAs, and a total of 260,000 different private sector entities covering importers, exporters, customs brokers, shipping lines, etc.

In Korea, governance of UNI-PASS comes under the purview of KCS. The Commissioner of Customs reports to the Prime Minister but has decision-making authority over all UNI-PASS-related issues. A working group, led by KCS, with members of all 27 connected OGAs feeds into this process.

Through UNI-PASS some 21 million import declarations are processed annually, and revenue collection of USD 52 billion. Moreover, 25 million TEUs of cargo are handled, and, through the platform's intelligent risk management features, some USD 7 billion of illegal trade is prevented.

Source: Authors based on various presentations on UNIPASS.

documentation requirements.[15] It should also be highlighted that the review and re-engineering actions require institutional coordination between all border agencies and deep collaboration on a technical level.

TSW adoption requires a number of prerequisites: The adoption of the data-sharing hardware and software infrastructure does not guarantee its proper functionality. The TSW journey is less about installing a single system and more about developing an efficient, inter-connected ecosystem. Even in advanced countries, this is an on-going process. Successful TSWs have a strong legislative framework supporting their functionalities (Box 4). However, in many cases, lack of the appropriate legislative and regulatory frameworks has prevented the TSW from ever becoming operational. In other cases, the lack of laws or regulations securing the mandatory character of the TSW, has led traders to submit twice in both digital and paper-based forms. Increasing numbers of countries now recognize the importance of the enabling environment for the TSWs effective operations and treat the development journey of this digital solution as an opportunity for shifting the culture of border inspection agencies and how to best manage institutional change.

Substituting documents with data entries: Ultimately, the adoption of the TSW will, at a minimum, lead to the reduction of paper documents required for submission. Once the single window system is adopted, compliance requirements are more related to data entries as opposed to documentation submission. Being a single-entry data exchange platform, the TSW has the technical capability to repeatedly use data entries submitted once by traders or their designated agents. Lessons learned from international experience do not yet support the argument that national single windows lead to a complete trade paperless environment. However, the elimination of even a minimum number of documents, allows border agencies to shift their culture towards less bureaucratic and more efficient processes.

Big data analytics and evidence-based management of risk: TSWs generate vast volumes of data, sourced from Customs but also from the OTRAs. National single windows offer the ability to turn otherwise scattered data points into a coherent single repository, so Customs and other border inspection analysts can query all the data together to gain insights into embedded risks. This creates a unique opportunity for border agencies to collectively analyze this information to identify and appropriately manage risks in the movements of cargoes across borders. Given the size and scope of TSW data, this could be a challenging exercise unless border agencies proceed with targeted investments in human resources by hiring IT professionals to manage and assess large volumes of data and by investing in appropriate data analytics software.

15 Especially with all sections of Article 10: Formalities Connected with Importation And Exportation and Transit

Box 4. VUCE's legal framework

Peru's legal environment provided the impetus to drive necessary government reforms and to establish a TWS to support trade facilitation. There are several regulations forming the basis for VUCE. Some of which include, but is not limited to:

1. Supreme Decree No. 165-2006-MEF, granting status by law to the creation of a single window for foreign trade, through the Supplementary Provision of Legislative Decree No. 1036 under the administration and maintenance of the Ministry of Trade and Tourism (MINCETUR). Specifically, it is to be managed by the Vice Ministry of Foreign Trade.

2. Legislative Decree 1211 endorsed measures aimed at integrating public services and encouraging the exchange of information through a single window. It determined the rules for implementing a single window, for exchanging information between parties and for interoperability instruments. The decree also stated that the adoption of relevant technologies can occur over time (OECD, 2016).

3. Law No. 28977 enabled the formation of the Special Committee to oversee the implementation and functioning of VUCE (OECD, 2015). The Committee is comprised of 27 institutions: 17 from the public sector, nine business associations for foreign trade and one port administrator.

4. Digital Certificates and Signatures Law No. 27269 provides the legal status to digital or advanced electronic signatures. For digital certificates to be recognized, certain standards need to be met by the certification provider.

Source: Study on Single Window Systems International Interoperability: Key Issues for Its Implementation, APEC Policy Support Unit, August 2018.

Box 5. Jamaica interoperability

Jamaica is home to one of the region's largest transshipment terminals in the Caribbean A key factor od success was the development of Jamaica's PCS and its integration with ASYCUDA along with the National Single Window (NSW).

The PCS was seen as part of a wider initiative by the Government focused on improving the national Logistics & Trading environment. The latest strategic project related to improving the trade environment is the National Single Window (NSW), implemented in 2020.

The PCS and Customs solutions are interoperable and integrated to provide seamless transactions for cargo processing. This exchange was made possible by the signing of an MOU between the two entities. eSAD Declarations are sent to the Customs' ASYCUDA World and manifests sent to the PCS. Both systems validate the information that is sent. The PCS also disseminates specific manifest information to customs, terminals, and regulatory agencies in the required format. Once cargo is cleared and released by all the major stakeholders, the PCS provides confirmation and then generates an electronic release.

Benefits of Jamaica's PCS include faster more efficient Customs clearance, more streamlined standard processes, and faster turn-around of gate in-gate out operations with less gate congestions.

Source: Jamaica Port Authority.

4.1. Linkages between PCS and TSW

Border operations at ports are still a challenge: The widespread adoption of private sector participation in global terminal operations has dramatically improved their operational performance. This is reflected in reduced dwell times and increased predictability of cargo movements at the ports' terminals. However, especially in the developing world, these improvements do not necessarily lead to quicker release of cargo from the port. Quick and efficient stevedoring, stripping, stacking and other port logistics services are largely offset by lengthy and complex cargo clearance processes, leading to longer than necessary stays of containers at the ports. This mismatch increases uncertainty for importers and exporters and impacts the trade industry's perception of a port's effectiveness. Improving collaboration between Customs and ports has been recognized as a priority

Figure 7. Integration Schema VUCE2.0
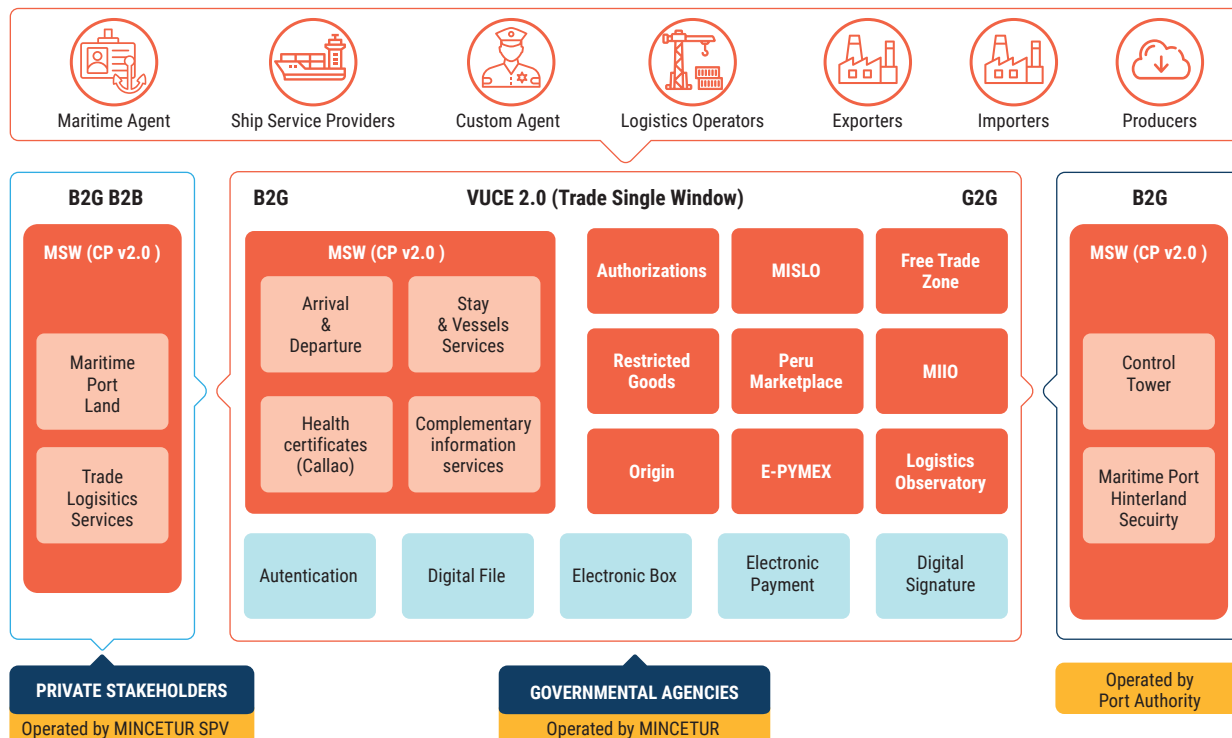
Source: Ministry of International Trade and Tourism, Peru.

and several initiatives are underway.[16] In the center of this agenda is the: (a) Identification and measurement of benefits from digital collaboration. (b) Actions towards the convergence between TSW and PCS.

Formalizing the Customs-ports digital collaboration: An increasing number of countries have proceeded with the signing of memorandums of understanding (MOU) to define and formalize digital collaboration. Recently, the Maritime and Port Authority of Singapore, Singapore Customs and the Singapore Shipping Association signed an MOU on digitalization of trade and maritime documentation in the industry. Through this collaboration, the parties aim to promote digitalization, by showcasing gains in productivity, time, and cost savings. The focus areas of this MOU include:

- Collaboration with multiple industry stakeholders to digitalize the documentation required across the maritime industry.

- Leveraging suitable technologies, such as distributed ledger technology, to achieve greater assurance of trust and integrity of the shipping documentation passing through the supply chain players.

- Development of standards for the digitalization of maritime-related documentation with industry partners.

Similarly, in the port of Rotterdam, an alliance was formed between Portbase[17] and Customs, which allowed a technical alignment for the ICT-challenges of both organizations. In the developing world, Jamaica is a good example of formal collaboration which has led to the integration of the PCS and TSW (see Box 5).

A top-down approach may untie the knot: Achieving high levels of coordination and data collaboration between Customs and ports is often difficult. They report to different government ministries with different priorities. This leads them to work in isolation. Therefore, instructions for collaboration should come from the highest levels of the government. Such a top-down approach has been successful in Morocco. Here it enabled a comprehensive approach to the implementation of PORTNET, which includes both functionalities of an TSW and PCS. The project was initiated in a top-down manner as part of an overall planning and implementation of reform initiatives: all focused on improved transport efficiency and trade facilitation. The National Port Authority of Morocco took charge of project management and was able to

---

16 In November 2021, WCO and IAPH embarked on a dialogue to strengthen the partnership between Customs and Port authorities for smoother and more efficient supply chains.

17 PORTBASE is the entity that runs the PCS of the Port of Rotterdam

convince partners in the port community of the effectiveness of moving towards a PCS.

Towards the end of multiple "single windows"? Interconnectivity and interoperability between the PCS and the various SW compliance platforms will constitute the next wave of port sector digital transformation. Some countries, such as Peru, have taken steps in this direction (Figure 10). This type of initiatives will eventually break down the boundaries between the existing triptych and pave the way for a true single-submission and data exchange along the trade and transport dimensions of international supply chains. Although the financial and economic benefits from the digital integration and holistic supply chain treatment have already been acknowledged, there are still a number of important prerequisites for successful implementation, including the political will of the government and the relevant governmental trade and transport authorities to:

a. Enhance coordination with the maritime and port logistics business community.

b. Develop the basic legal framework, including the introduction of privacy laws and rules providing privacy and security in the exchange of information.

c. Develop common data reference models in support of interconnectivity and interoperability.

On a regional level, experience from the EU suggests emphasizing the importance of a robust regulatory framework for the successful interoperability between PCS and Trade or Maritime Single Windows. For instance, the EU Customs code makes it legally difficult for data received by Customs, via the TSW, to be re-used by the PCS for the purpose of B2B services.

5. Lessons learnt and the way forward

This chapter focused on the presentation and analysis of the maritime and trade single windows and on the identification of linkages between them and the PCS concept. International experience shows that there are no guidelines on which of the three solutions should be developed first. Preferred system's design and development should reflect the needs of the port logistics industry and should be customized to fit the specific structure of the market.

The key takeaways are:

I. There is more than one data collaboration platform operating in the modern port and maritime sector. PCSs could be accompanied by MSWs and TSWs, which are specific purpose single windows. Both of them are compliance-based, government-initiated solutions, as opposed to efficiency-driven PCSs, and foster trade and transport facilitation in international supply chains.

II. A rough method for distinguishing a PCS from either the MSW or a TSW is by identifying the process they cover. While the first two focus on the port, maritime and hinterland side of operations, the latter covers the regulatory procedures for the clearance of imported or exported cargoes. However, conceptual boundaries between the three are not always very clear and, in reality, they tend to overlap both procedurally and administratively.

III. PCSs quite often co-exist with MSWs. This is true especially in the context of the EU. Linkages between the two are quite strong and – in many cases – the vessel clearance process is an embedded module of the port community system platform. In cases where the port and maritime

authorities are one entity these linkages are even greater and more durable. The mandatory adoption of a MSW, as defined by the IMO FAL Convention, is easier for countries that already have a functioning PCS in place.

IV. Despite a slow start, an increasing number of countries are adopting TSWs, in compliance with the provision of the WTO-TFA. In big ports that act as national trade gateway ports, maritime authorities, terminal operators, and shipping lines are linked to the TSW. In these cases, the trade platform incorporates several of the port operational processes, which are important for the cargo clearance process.

V. Ports looking into the development of PCS, should take under consideration the existing single windows already in place. PCS developers should assess in-depth the port digital ecosystem and ensure that its architecture complements rather than overlaps with the respective MSWs and TSWs design. The role of public-private consultation groups is expanded and becomes instrumental as they are mandated to identify the trade industry's core challenges and convert them into policy reforms.

VI. Looking into the future, technological advances and the development of affordable software and hardware solutions will improve interoperability and interconnectivity capabilities and will eventually lead to real-time, seamless exchange of data between the three-core data collaboration platforms. It is unclear whether this will lead to the complete merger of the systems. However, it is at least expected to prevent the repetitive submission of the same data elements across the board. .

Appendix 1. Port Call Process

Ships Abbreviations and introduction (See 1)	Sale of Goods contract (bulk) -3 months to -3 weeks	Contract for hiring ships -3 months to -3 weeks	Sale of Goods contract (bulk). Carriage contract (container). -3 months to -3 weeks	Terminal contract -3 months to -3 weeks	Departure Passage planning to port A -3 weeks	Berth planning arrival -48 hours
Ship operator	Sale of Goods contract (bulk) (See 2)		Sale of Goods contract (bulk). Carriage contract (container). (See 6)	Contract terminal (See 7)		
Ship charterer		Contract for hiring ships (See 3)				
Berth planner		Berth information (See 5)			Berth information	Berth information / Berth planning (See 12) RTA Berth
Port planner		Port information (See 4)		Port dues land lease contract (See 8)	Port information	
Hydrographic service provider						
Ship manager Arriving ship					Nautical charts and publications (See 10) / Port passage plan (See 9)	ETA berth (See 11) / PTA berth (See 13)
Ship manager Departing ship					PTD berth	
Nautical service providers						
Vessel or Cargo service providers						
Authorities						

⬤ Nautical Information   ⬤ Operational Information

Source: ITPCO

Port planning arrival	Berth / Port arrival	Vessel / Cargo service planning	Port planning departure	Berth / Port departure
-3 hours	0 hours	+24 hours - +72 hours	+24 hours - +72 hours	+24 hours - +72 hours

Administrative Information

Appendix 2. Global Implementation of WTO TFA Article 10.4 Single Window

Top 5 measures with highest implementation rate

Based on implementation commitments by all WTO Members
Measure: 10.4 - Single window
Ranked 36 out of 36 measures
Rate of implementation commitments to date: 53.1%

Art. 9 - Movement of goods	1 Today 93.3%
Art. 5.2 - Detention	2 Today 92.6%
Art. 10.5 - Preshipment inspection	3 Today 92.3%
Art. 10.9 - Temporary admission...	4 Today 90.2%
Art. 10.6 - Use of custom brokers	5 Today 89.6%
Art. 10.4 - Single window	36 Today 53.1%

Legend:
- Developed members
- Category A current commitments
- Category B current commitments
- Category C current commitments
- Category B future commitments
- Category C future commitments
- Unknown

TFAD (Trade Facilitation Agreement Database) www.tfadatabase.org

TODAY 22 Feb 2017 - 29 Mar 2023 **38.8%**	2023 - 2024 30 Mar 2023 - 31 Dec 2024 **52.0%** +13.2%	2025 - 2027 1 Jan 2025 - 31 Dec 2027 **68.0%** +16.0%	2028 - 2050 1 Jan 2028 - 31 dec 2050 **87.2%** +19.2%

Status of implementation commitments

Implementation commitments according to notification data
Groupings: LDCs, Developing members
Measure: 10.4 - Single window

Today 38.8%

% TFA implementation commitments

- Category A commitments for implementation to date: 19.6%
- Category B commitments for implementation to date: 8.8%
- Category C commitments for implementation to date: 10.4%
- Category B commitments for future implementation: 2.4%
- Category C commitments for future implementation: 54.8%
- Unknow: 4.0%
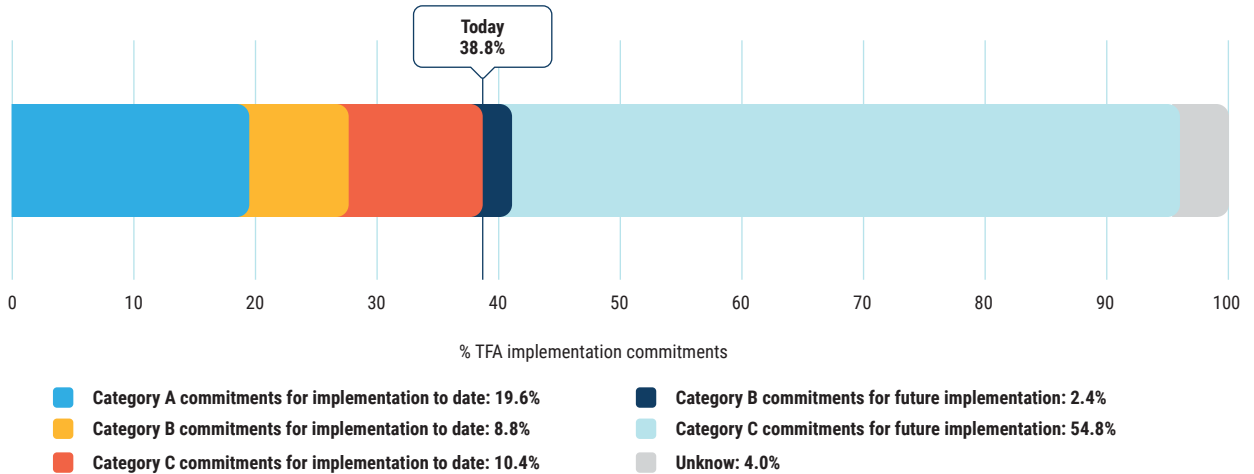
TFAD (Trade Facilitation Agreement Database) www.tfadatabase.org

Appendix 4. Import Cargo Clearance Business Process Map at the Port of Accra, Ghana
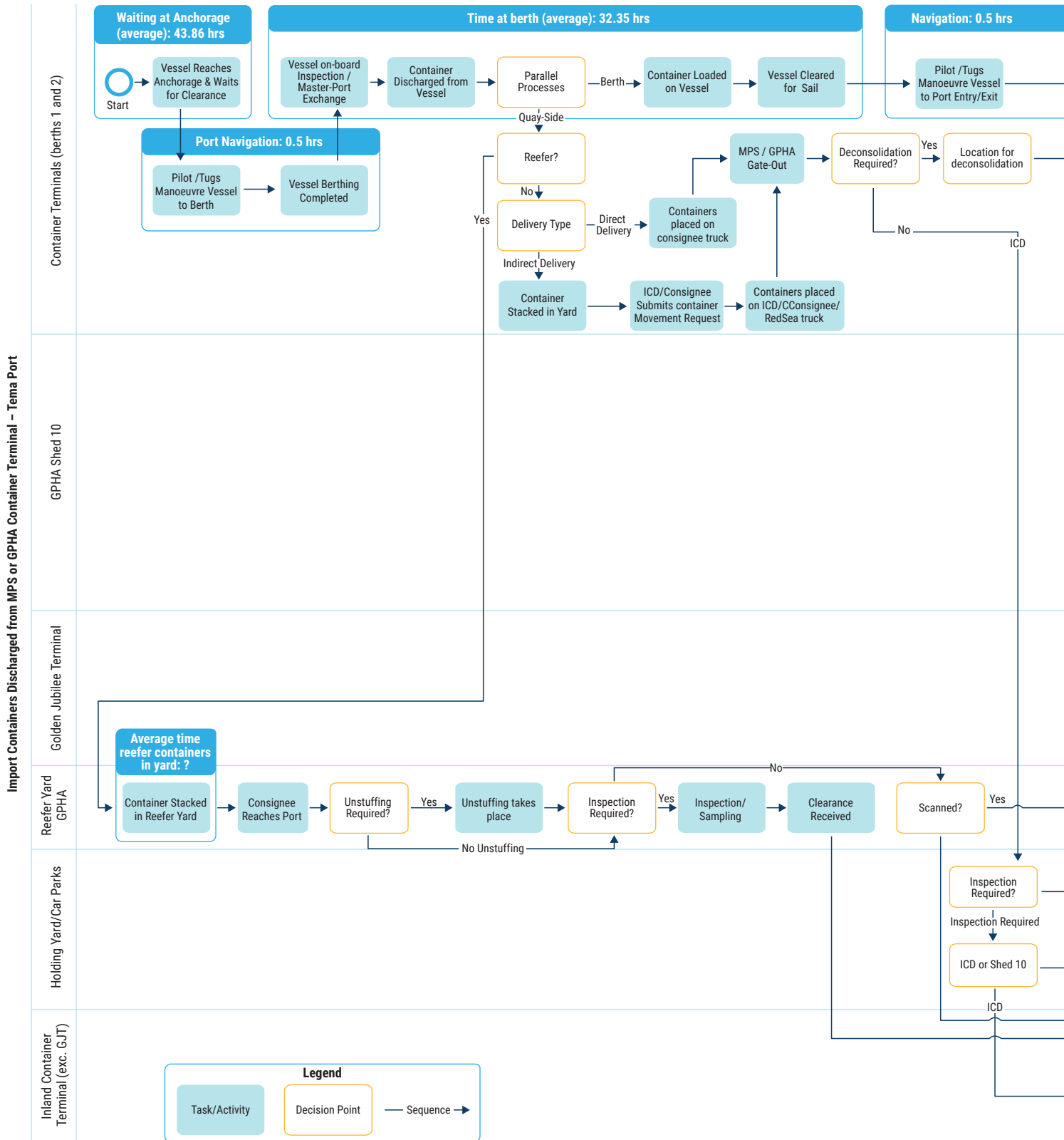
Source: World Bank.
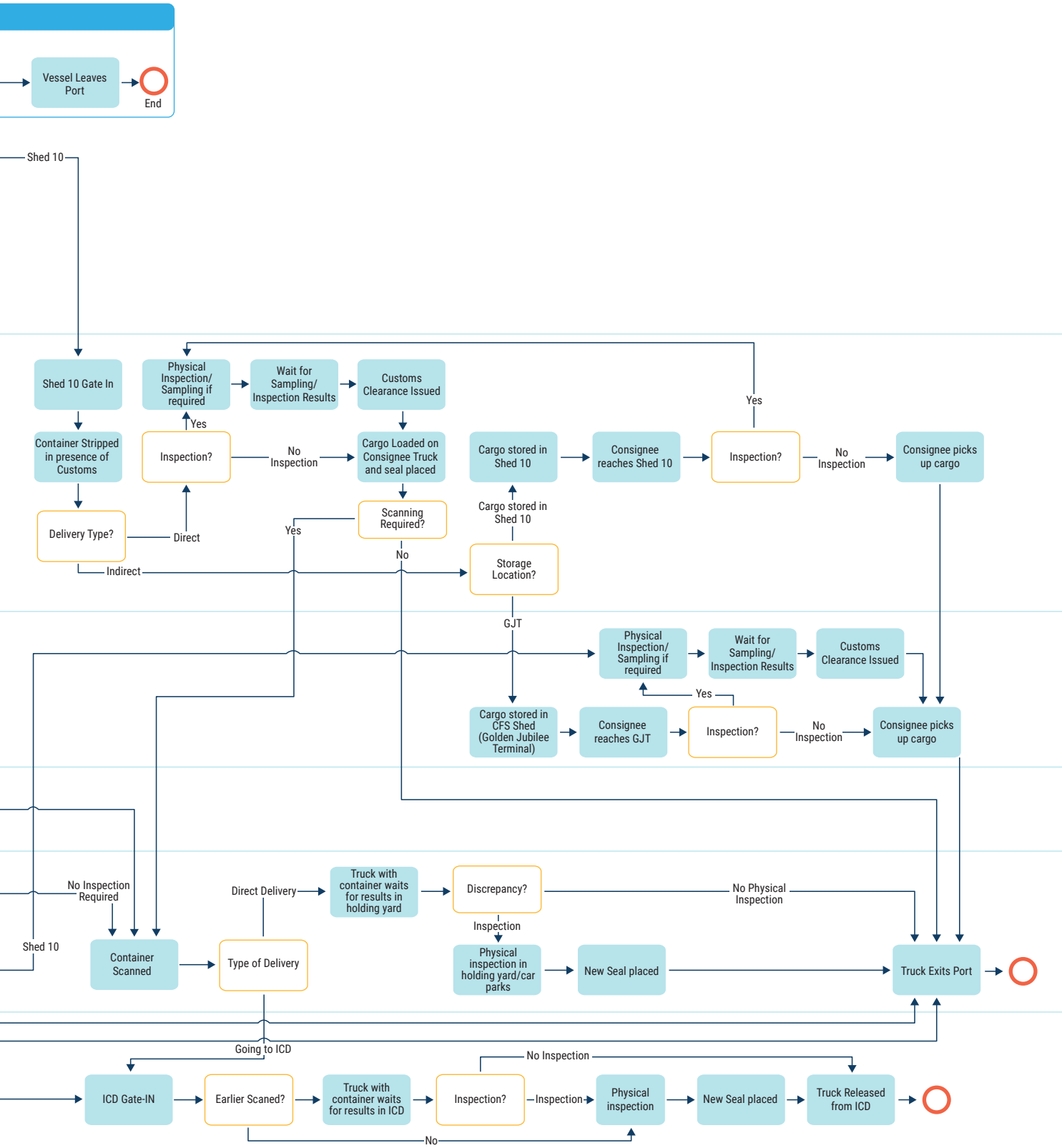
IMPACT ON TRADE & INDUSTRY

Executive summary

Key Takeaways

- Creating a Port Community System (PCS) has the potential to reduce costs, increase efficiency and close the digital divide between large and small operators.

- Setting up a PCS also holds the promise of increasing compliance by combating the risk of bribery and extortion.

- The PCS creates opportunities to mine vast amounts of data which can be harnessed to improve the performance of companies and organizations. It can also be used to help governments make better informed policy decisions.

Setting up a Port Community System (PCS) has the potential to transform the effectiveness and efficiency of a port. It can cut costs, increase efficiency, and close the digital divide between large and small operators. In addition, its digital platform can increase trust and transparency, boost compliance and reduce the risk of bribery and corruption.

The benefits of closing the digital divide are particularly important in low and middle-income countries. In these countries, greater use of IT by logistics operators of all sizes can contribute to reducing the digital divide between large and small operators.

The adoption of PCSs also increases visibility for shippers across the supply chain. This visibility is increasingly prized by the industry since the disruptions and delays caused by the COVID-10 pandemic.

The PCS also presents a valuable opportunity to streamline processes, reduce red tape and increase efficiency by removing redundant or unnecessary communication.

One study in the Netherlands showed that the creation of a PCS reduced the need for about 30 million phone calls and resulted in 100 million fewer emails a year.

The degree to which a port and the maritime and logistics industry is already digitalized will determine the costs and benefits of creating a PCS.

1. Introduction

The creation of a PCS tends to yield three major benefits. Firstly, it cuts costs. Secondly it increases compliance. Thirdly it boosts efficiency. In their paper 'How port community systems can contribute to port competitiveness: developing a cost-benefit framework',[1] the authors propose a classification of the benefits of a PCS and suggests methods for their measurement that is data intensive:

- Cost reductions in handling the documentation stem from the suppression of duplicate data entry, resulting in time savings, not only by suppressing multiple entries, but also because it requires less correction and validation of the data.

- Increased efficiency stems from early availability of information that enables advance planning of operations and reduces idle time between them.

- Increased compliance can be facilitated by providing advance information that allows for better risk management, and traceability of the data which makes it easier to reconcile information.

Portbase (Netherlands)[2] reported that its PCS yields the following benefits, annually: added value for companies of up to € 245 million, 30 million fewer telephone calls are needed, 100 million fewer e-mails are sent, and 30 million truck kilometers are avoided.

In their 2016 publication[3] on 'Costs and benefits of speeding up reporting formalities in maritime transport', Carlo Vaghi and Luca Lucietti studied two Italian ports: Venice, and Bari. They estimated cost savings and compared them with the development and operation costs of reengineering the PCS. The staff related savings for the logistics operators are estimated at respectively € 1,654,318 in Venice Port and € 1,612,833 in Bari Port per year (2015), while the costs savings for the shippers, through dwell time reduction, are estimated respectively at €112,345,251 n Venice Port and €5,169,298 in Bari Port per year (2015).

While these savings were generated in European ports, savings of a similar magnitude may also be possible elsewhere. Beyond savings for individual operators there are also potential industry-wide benefits.

Firstly, a PCS can promote greater use of IT by logistics operators of all sizes, contributing to reducing the digital divide between large and small operators. This divide is often pronounced in developing countries. Secondly, a PCS can increase visibility across supply chains for shippers. This is particularly important during times of delay and disruption caused by a global shock, such as COVID-19. Finally, digitalization of port operations creates a vast amount of data that can be synthetized in KPIs. It can also be mined to inform policy decisions for improving trade and logistics.

2. Steps to secure cost savings

Studies of PCSs show cost savings can be realized in several ways: (i) Staff time saved by simplifying documentation preparation and processing. (ii) Faster release of goods through reduced dwell time at ports. (iii) Better traffic management to reduce congestion at the gates of the port and within the port.

Many trade and logistics operators, however, still struggle to realize cost savings due to upfront and recurring expenses.

There are costs for stakeholders forming a PCS. These may include upfront costs for interoperability with the PCS: IT equipment, staff

training or recruitment. The upfront costs may be higher in low or middle-income countries than in advanced economies where IT systems have been used in trade and logistics for longer.

Some countries will need the support of assistance programs from IFIs to adapt to new technologies. Costs of adaptation will vary between users, big and small. Large entities, such as Customs and large freight forwarders, will have automated many activities already. Smaller entities in trading, logistics and border management agencies may still be relying on manual processes. For more on PCS fees and recurring costs see chapter 5.

1   Carlan Valentin, Sys Christa, Vanelslander Thierry. How port community systems can contribute to port competitiveness : developing a cost benefit framework. Research in transportation business & management - ISSN 2210-5395 - 19(2016), p. 51-64 https://doi.org/10.1016/J.RTBM.2016.03.009
2   https://www.portbase.com/port-community-system/voordelen/
3   https://doi.org/10.1016/j.trpro.2016.05.057

3. Steps to boost efficiency and performance

Automation has not always benefited traders or logistics service providers in low-income countries. There are two main barriers to realizing the benefits of automation: the first barrier is automating inefficient procedures. The second barrier is incomplete automation with paper-based processes retained.

That often reflects the limited human and financial resources of the sector to take full advantage of technology to streamline operations. Chapter 5 makes clear that replicating paper-based inefficiencies should be avoided. Nonetheless, a PCS can help expand the automation of transactions and interactions incrementally.

From the shippers' perspective, reduction in port dwell time may not be a priority. A World Bank study on dwell time in African ports[4] showed that long dwell time are associated with shippers' behavior and strategies,[5] and not necessarily inefficient processes. In that case, reducing the time to release the goods may simply shift the time from the pre-release portion of the port dwell time to the post release removal, without significantly modifying the total time.

4. Steps towards greater compliance

A PCS, like other digital solutions for trade, promotes compliance by: (i) Removing extortion/ bribery opportunities by minimizing face to face interaction between the personnel of logistics operators and border management agencies. (ii) Enabling document tracing that prevents changing the characteristics of the goods. (iii) Providing control agencies with advance information that can improve risk management and prompt them to develop green channels for compliant operators.

Case studies show benefits linked to compliance. For instance, in Jamaica, terminal operators receive manifest that are less subject to amendments, allowing for better planning of the operations.

In Morocco, users reported the elimination of unjustified privileges and preferential treatment. In Djibouti, traders and Free Zone operators reported a more transparent process.

5. Steps to reduce the digital divide

In addition to the digital divide between small and large stakeholders, there is also a divide between port users linked to international logistics groups and local companies. The PCS should level the playing field to make everyone more efficient. This should allow local operators to compete more effectively.

Users of a PCS can be far and wide. A few examples:

- Jamaica has over 3,600 users made up of Customs agents, shipping agents, brokers, freight forwarders, truckers, terminal operators (airport and seaports) and warehouses.

- In Djibouti, all 27 shipping agents, all the 105 freight forwarders, as well as 668 Free Zone companies and 56 trucking operators, are using DPCS.

---

4   Why Does Cargo Spend Weeks in Sub-Saharan African Ports? Lessons from Six Countries, by Gael Raballand, Salim Refas, Monica Beuran & Gozde Isik
     https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-9499-1
5   Typical examples cover utilization of grace period for storage in the terminal yard for traders lacking adequate warehousing facilities, or business practices in which traders try to resell the goods before clearing them.

6. Steps to increase supply chain visibility

Finally, a PCS can also increase supply chain visibility. Supply chain resilience has become a watchword of the shipping industry since the pandemic. It is central to reduce risks to their business. As a result, shippers looking for visibility and predictability at any port of destination or departure can play an increasingly important role as stakeholders in a PCS.

"Where is my cargo?"

That is the most common question from shippers and Beneficiary Cargo Owners (BCOs) right now. Most of the time no one in the supply chain was able to answer that question. That's because rolling cargo and poor data quality was the norm. BCOs are either dealing with ocean carriers or logistics operators. But they do not have contracts with terminal operators and port authorities.

In 2022, IAPH asked North American BCOs at the World Port Conference in Vancouver to provide insights to port authorities about their pain points and to assess how ports could assist. As an outcome of WPC,[6] BCOs key requirements related to availability of data such as:

- **Speed**, comprising the following information: Vessel Arrival, Cargo discharge and availability, Empty release, Empty receiving, Grey-Poll Chassis Access, Connectivity to Rail, Inland Waterways, Dry Ports.

- **Predictability**, comprising Vessel work schedule, Cargo receiving window, Cargo availability dates, Truck appointment, Gate hours.

Basic and high-quality data are needed by shippers and BCOs. This can be provided by PCSOs to feed Shippers and BCOs Transportation management system (TMS) such as:

- **Imports**, comprising Arrive at Port of Destination (ATA), Container discharge, Container departure (Gate out).

- **Exports**, comprising Container gate in, Loading on vessel, Vessel departure (ATD).

Gaps in knowledge are being filled. The Global Shippers' Alliance (GSA) published a manifesto for a bill of cargo rights on minimal service levels in maritime container transport, a potential game changer. It included the following:

- Contracts terms should be fair and balanced between carrier and shipper. They should be respected by both parties.

- Reliability of the sailing schedules is the essence of container maritime transport.

- Sharing data on forecasts of carrier's capacity and shipper's demand in a transparent way should be implemented.

- Any kind of deviation in the service calls should be accurately and swiftly reported to the shipper.

- Consequences to carriers of no shows by shipper and consequences to shipper of roll-overs by carriers, beyond agreed tolerance, should be considered, and proportionately compensated.

- Imposition of surcharges by carriers should be limited to unforeseeable temporary external events beyond carriers' control. Duplication of surcharge billing by carriers, i.e., charging shipping firms for costs either already included in rates or also invoiced to third parties, should be prohibited.

- Detention and demurrage should be appropriately evidenced by carriers and should not be applied when sailing out of schedule exceeds a reasonable delay time.

- The quality of empty containers delivered by carriers should be compliant with standards and meet the requirements of shippers.

- Trustable carbon footprint information and digital documentation, according to DCSA standards, should be provided as far as achievable by the carrier.

The new frontier for the industry is data collaboration. That data collaboration is between shippers/BCOs and PCSOs. This not only can cut costs, increase efficiency, and boost compliance. It can close the digital divide between bigger and smaller players in a port and level the playing field between domestic and international maritime and logistics operations in developing countries.

---

6   https://issuu.com/portsandharbors/docs/p_h_july-august_2022-lr, pages 6 to 9.

THE POTENTIAL OF A PCS IN SMALL ISLAND DEVELOPING STATES (SIDS)

Executive Summary

A few PCS operators have widened the scope of their PCS beyond the seaport to airports to include air cargo. This is the case in Mauritius and Jamaica.

The adoption of the PCS remains the exception rather than the rule for Small Island Developing States (SIDS). Just 12 SIDS out of 58 (UN members, non-UN members and associated members of the regional commissions) are "PCS ready".

Small Island Developing States (SIDS) stand to gain significantly from better trading and maritime connections with the rest of the world. This is the case across the Caribbean, the Atlantic, Indian Ocean and Oceania. Sea locked states are highly dependent on their ability to connect seamlessly with the wider global economy. As a result, maritime trade is critical to their economic fortunes with the PCS offering these states the potential to streamline the efficiency, effectiveness, and competitiveness of trade. For now, however, only about one in five SIDS are "PCS ready."

The secrets of success are not so secret.

Firstly, getting the right people on board, particularly the Prime Minister and senior cabinet ministers, is critical to the successful establishment of a PCS in Small Island Developing States.

Secondly, getting the right financial support, particularly from IFIs, also plays a pivotal role.

Thirdly, getting international technical and legal assistance at inception is necessary to underpin the project and interoperability between different systems operating in a maritime and port environment.

Finally, port and Customs cooperation will be a critical. Both authorities should become PCS champions.

Understanding how a PCS operates is a good starting point. There are plenty of good regional examples for potentially interested ports to study and visit in the greater Caribbean, Macaronesia, the Indian Ocean, and Oceania. Understanding the important role of leadership in the inception process of a PCS is also critical. As a rule, there are five key people involved:

- The Chief Executive Officer of the Port Authority.
- The Commissioner of Customs.
- The Minister of Transport.
- The Minister of Finance.
- The Prime Minister.

Despite low levels of PCS adoption there are some shining lights among SIDS. The Caribbean has been at the forefront of PCS adoption. Guadeloupe was a pioneer. It was the first non-UN SIDS and associated member of the regional commission to establish a PCSO in 2002. In 2006, the CEIBA PCS operator of Guadeloupe launched the CLOVIS initiative, co-financed by the EU Interreg program. It aimed to provide capacity building to SIDS for the development of port communities and port community systems within the greater Caribbean. In Africa too there were early adopters. Mauritius was the first UN SIDS member to establish a PCSO in 2008. It did so by drawing on the World Customs Organization (WCO) SAFE Framework of Standards to Secure and Facilitate Global Trade in the supply chain by establishing a Customs PCS regulation.

There have been some noteworthy successes. In 2020, Jamaica's PCS received the Maritime Awards of the Americas from the Organization of American States (OAS). It was the first PCS in the cloud, developing a strong business case for port and customs cooperation for the greater Caribbean. Leveraging experience of early adopters in each region will have a ripple effect on sharing best practices and overcoming misconception in states.

SIDS are sea-locked states. They are on the periphery rather than the center of global maritime trade. They act as spokes rather than hubs like Rotterdam and Singapore. The pace of change and wider adoption could be forced by regulation and cost pressures. With digital connectivity to hubs becoming a mandatory requirement, the case for digitalization is becoming greater with each passing day. With digitalization promising to cut costs there is also a growing economic imperative for PCS adoption in SIDS.

Early engagement of IFIs is also important to build capacity and provide adequate resources to launch a PCS. Bringing international technical and legal assistance on board at inception is vital, particularly for risk mitigation.

Compliance with international regulations is often an incentive for wider digital efficiencies. The IMO's 2024 mandatory requirements to establish a single window is a case in point. In Sint Maarten the vessel clearance process has become the first service of a PCS. As a first step, establishing a Maritime Single Window (MSW) as the first PCS service is often a good way forward for all SIDS. The 2023 WCO-IAPH Customs & Port Authorities Cooperation Guidelines can create momentum for reform, including the establishment of a legal, regulatory, and institutional framework for the convergence of digitalization and supply chain security.

1. Introduction

No port, island or state is too small to enjoy the significant benefits of a PCS. Small Island Developing States (SIDS) have set up PCSs for over two decades, starting with Guadeloupe and Martinique in the 2000s. Mauritius followed suit in 2008, New Caledonia in 2011 and Jamaica in 2015.

Today around 12 of SIDS are "PCS ready."

- Out of the 38 SIDS UN members,[1] 7 states have implemented a PCS (Dominican Republic, Jamaica, Cape Verde, Comoros,[2] Mauritius, Saint Kitts and Nevis and Singapore).

- Out of the 20 SIDS Non-UN and Associates members of the regional commissions, 5 have implemented a PCS (French Polynesia, New Caledonia, Martinique, Guadeloupe, and Sint Maarten).

- That means there are just 12 PCS operators out of 58 SIDS members.

- Table 1 gives details of operations in Jamaica, Mauritius, and New Caledonia and their respective PCSOs.

Jamaica stands out as a pioneer by launching a national PCS in 2015. It was the first country in Latin America and the Caribbean to do so. In 2020, Jamaica's PCS received international

Figure 1. Jamaican PCS Building

recognition for its endeavors and was given the Maritime Awards of the Americas, from the Organization of American States (OAS). This recognized strong cooperation between Customs, the port authority, and the port community, but also that it was the first PCSO to move to the cloud.

Irrespective of SIDS or other developing states, digitalization is becoming a pre-requisite for future sustainability and efficiency in ports and an integral link in the overall supply chain.

Table 1. SIDS PCS early adopters

2020 Data	Jamaica	Mauritius	New Caledonia
GDP(Billion)	13.81	10.92	9.43
Population	2.973.463	1.266.060	272.620
Port calls	3.224	1.421	1.171
Tonnage	24.456.512	7.421.764	1.492.653
TEUs	1.611.637	438.078	111.875
PCS Operator	Jamaica PCS	MACCS	GIPANC
PCS Operator scenario	1B-Public	3A-PPP	4-Private
PCS Operator establishment	2015	2008	2011
Customs PCS regulation	Yes	Yes	Yes
Port Authority PCS regulation	Yes	No	No
Customs Management Systems	ASYCUDA World	CMS	ASYCUDA World
Terminal Operating System	Navis Tideworks Advantum	Navis	TGI Tideworks

---

1   https://www.un.org/ohrlls/content/list-sids
2   Assumption in the context of the PCS global study to consider Mayotte as part of Comoros archipelago

2. Setting the scene

SIDS are small, sea-locked countries. They rely on maritime supply chains for more than 90 percent of goods. Despite their reliance on maritime trade, that is no guarantee that there is immediate consensus about creating a PCS in port communities.

SIDS act as spokes of transshipment hubs. They need to be connected to hubs, physically and digitally. The shift to data collaboration between ports and their hubs represents a major potential maritime transformation for SIDS. It would not just open the gateway for advanced vessel and cargo information to enable pre-clearance. It also creates the opportunity to transform economies and societies.

A PCS can make a real difference to the fortunes of a country, no matter how big or small. The two smallest islands operating a PCS are St. Kitts and Nevis, in the Caribbean, and Mayotte in the Comoros archipelago.

St. Kitts and Nevis has a population of 47,606, vessel traffic of 488 port calls and cargo traffic of 562,000 tons and 13,500 TEUs.

With a population of 270,000 people, vessel traffic of 183 port calls and a cargo traffic of 572,000 tons and 28,000 TEUs in 2020, Mayotte established ICM+, their PCSO in 2012. ICM+ migrated to the 2nd PCS generation based in the AWS cloud in 2020.

Maritime trade is a lifeline for SIDS. SIDS are fragile economies which rely on the import and export of cargo.

Imports of essential and critical goods are key to the economy and to the population. The number one priority is often the import of fuel by tankers, like in the Solomon Islands in the Pacific, where every four days a tanker sails from Malaysia or Singapore to refill depots, enabling the airport to operate. Number two is medical supplies. Number three is construction materials.

SIDS do not have the luxury of time to wait for the vessel clearance of other ports to enable ships to arrive just-in-time and to wait for vessel clearance and cargo clearance of essential and critical goods at their ports. SIDS share a set of common social, economic, and environmental characteristics, making them a unique case for sustainable development. Vessel arrival and cargo clearance are social and economic pillars of sustainable SIDS.

All SIDS rely, to a greater or lesser degree, on the efficiency of ports, for both timely imports and exports. Despite the critical role ports play in their economies, only 20 percent of SIDS have established a PCSO as part of accelerated digitalization to boost the resilience, efficiency, and effectiveness of their ports.

Resilience is particularly important in the face of climate change, rising sea levels and extreme weather. In addition, these states also face the risk of natural disasters and cybersecurity threats. The creation of a PCSO can help to mitigate many of these risks. A case in point is the decision by Jamaica to use a cloud service for its PCS.

2.1. Barriers to adoption remain

SIDS care about their global competitiveness, logistics performance, container port performance and other measures, which benchmark them against economies worldwide. While improving trade logistics is a priority, progress has been uneven.

2.1.1. Key barriers

A big barrier has been a lack of coordination in border management, excessive reliance on paper documentation and limited financial and human resources.

Ports in SIDS generally have limited space for port infrastructure. That makes yard management a challenge. The creation of a PCS presents an opportunity for Customs and port authorities to lead trade facilitation by enabling the development of temporary storage and container freight stations in the hinterland, managed by the PCSO. Port Terminals are also often owned and operated by port authorities. For ports without dedicated cruise ship infrastructure, cargo is often left waiting in line behind cruise ships. That can cause delays of more than 12 hours at a time.

Another unique characteristic of ports in SIDS is that ports are chained ports. SIDS depend on the port performance of their regional hubs. The pandemic demonstrated the real impact on states, including the availability of empty containers for exporters. Once a port clearance is delayed at one port it has an impact on all other ports. This was particularly prevalent during the COVID-19 pandemic. While the PCS is not a silver bullet it does create a digital platform. That platform connects ports that can share port clearance from previous ports and estimated time of arrival of the vessel. That can have a major impact on improving scheduling, planning and efficiency. SIDS are part of a hub and spoke environment. Feeder vessels connected to transshipment hubs play an important role. Sometimes feeder vessels services related to larger states — such as Miami and Manzanillo in the Caribbean, Durban in the Indian Ocean or Brisbane and Sydney in Oceania— act as hubs.

In some countries, port legislation has not been reviewed for more than 50 years. Change of legislation or revising old legislations might present a daunting task, which may impede implementation of new systems. Engaging line ministers and the Prime Minister's Officer becomes a priority at the inception stage.

Level of digitalization is required in some SIDS as many ports lack even the basic IT infrastructure and systems to run ports efficiently. There are also existing gaps in the automated operational systems due to limited port infrastructural support of sometimes less prioritized stakeholders, such as immigration, health authorities and truckers. Progress is being made. Limited automated systems have been implemented in SIDS. Commonly,

Box 1. DR Trade Implementation Framework

The genesis of the initiative to establish a Port Logistic Community System within the Dominican Republic emanated from the Trade Facilitation Committee of the American Chamber of Commerce. This catalyzed the establishment of DR Trade, a private operator that boasts the prominent participation of the country's leading terminal operators, namely Haina International Terminals and DP World Caucedo. This synergistic partnership commands dominion over an impressive 90 percent of the nation's containerized cargo volume.

DT World, the international arm of Dubai Trade, provided PCS design and implementation. Firstly, an exhaustive GAP analysis was performed, and the PCS was precisely tailored to address the unique demands of the DR landscape, and its seamless integration with the operational systems of both terminal operators ensued.

The onset of the pandemic expedited the requirements for PCS implementation, as the imperative to bypass physical visits to terminals and prolonged queues at counters attained paramount significance. Noteworthy challenges emerged in the effort to standardize services and processes through a singular interface, as the distinct procedures inherent to each port warranted accurate consideration. A pivotal hallmark of DR Trade's value proposition lies in its capacity to offer a unified and consistent user experience, regardless of the chosen terminal operator or shipping agent.

Complementing these private-sector synergies, the Port Logistic Community System has garnered the engagement of Customs authorities. This has boosted collaboration within the community and enhanced visibility for end-users. Collaboration by private and public sectors has increased information sharing and strengthened cargo traceability.

Currently, the roster of registered companies within DR Trade surpasses the 4,000-mark, encompassing an extensive array of over 20 services tailored to facilitate inquiries and transactions targeted towards the terminals. Services include: Vessel Inquiry, Container Inquiry, Gate In/Gate Out Reporting, Vehicle Booking System, Verification Requests and BCO Billing.

The inception and maturation of the Dominican Republic's Port Logistic Community System has been built around visionary private-sector collaboration, thoughtful digital deployment, and an unwavering commitment to harmonizing processes within a multifaceted maritime ecosystem.

Delays and inefficiencies: Most ports in SIDS still do not have a full understanding of the costs of delays and inefficiencies. An exercise to develop a cost-benefit analysis and to quantify the costs of delays due to inefficiencies to the local economy would be beneficial. This could form part of the inception stage of a PCS.

Digitalization is considered "taboo" in some SIDS: This is due to the fear of automation and associated redundancies. Addressing change management at the inception phase is vital to focus on human capital and manage the transition towards the future of work.

Customs have implemented the ASYCUDA World Port Management System. Other cross border agencies may have limited systems or no systems at all.

In most SIDS, IT literacy is at a low level. That may result in as a familiarization with the PCS taking a longer time.

2.1.2. Need for change management

Streamlining business processes is a priority: Most of the time, trade processes are much more complex in SIDS, as they do not meet international standards and the lack of coordinated border management leads to cumbersome and lengthy processes. Before the PCS implementation in Jamaica, Jamaican customs required seven hard copies of transshipment manifests, requiring 630 minutes per operation for shipping agents, according to

Jamaica's PCS. A recent World Bank gap analysis in Fiji outlines that the vessel clearance processes require 73 non-standardized documents to be exchanged between six governmental agencies and shipping agents. However, vessel and cargo management have strong common denominators at the business process level, and standards play an important role through IMO and WCO Data model, and the historic role of UN/CEFACT in transport and logistics.

PCS is not only about technology: A PCS is not just about technology or enabling collaboration by implementing SharePoint or SAAS-IASS solutions. It is about change management: institutional, business process reengineering, legal frameworks and building trust for collaboration between public and private stakeholders and within the public sector. Each port is unique. That means each PCS has a different scope depending on its needs, priorities and environment.

3. Ports and Customs authorities cooperation

Port and Customs cooperation is vital in SIDS. It provides the foundations for building trust in the country and was addressed in chapter 8.

Jamaica is a prime example of the benefits of cooperation in the creation of a PCS. The Jamaican government took decision No. 08/12[3] on February 27, 2012, to establish a PCS. It asked the Port Authority of Jamaica and Jamaica Customs to implement a PCS for the shipping industry. It also called for a competitive tender process for the selection of a suitable partner.

The Jamaican example highlights the benefits of cooperation between Customs, port authorities and the Shipping Association of Jamaica. That cooperation was enabled by legal amendments to the Port Act and Customs Act. This allowed the PCS to be incorporated into the Customs Act and facilitated interoperability between the PCS and ASYCUDCA. Tariffs were also addressed with a Jamaica Custom Form to specifically handle maritime transactions that are part of the Jamaica Customs Agency's import commercial declaration form and payable to the Jamaica Customs Agency.

Figure 2. Jamaica PCS JCA Transaction fee

3.1. The role of public stakeholders

In SIDS and small port communities, border agencies are often exclusively focused on enforcing the law. Digitalization is often perceived as a threat to their power: a power based on the culture of paper. However, clearance of vessels and goods are both dependent on borders agencies, living in a siloed environment which does not facilitate coordinated border management.

The awareness and engagement of border agencies for reforming practices, in the context of the IMO Maritime Single Window requirement, is a prerequisite for the establishment of a PCS in SIDS. It also enables greater efficiency for the arrival, stay and departure of ships. However, there are also gaps in automated operational systems due to limited port infrastructural support which is sometimes less of a priority for stakeholders, such as immigration and health authorities.

Critical players who can help to drive the inception of a successful PCS in SIDS, include the CEO of the Port Authority and the Commissioner of Customs. These two organizations play a vital role. Often the Port Authority is not just in charge of a maritime port but also the airport. That puts the authority in charge of some of the most significant capital spending in the country. It also makes the authority are major employer. Customs too are major players. Customs are often the largest contributor to the country's budget.

In the first phase of setting up a PCS, the leaders of these two organizations can draw on international support. They can benefit from the World Bank IAPH PCS global study and the new WCO IAPH guidelines on Customs and port authorities' cooperation. These documents can provide a solid foundation for government policy and strategy in PCS creation.

In a second phase, government needs to be brought on board, including the Prime Minister, Minister of Transport, and the Minister of Finances, as well as their respective permanent secretaries. The Prime Minister has the clout to drive reforms across all governmental agencies working with vessels and cargo. Introduction of supporting or modernization of existing legislation in support of PCS systems needs to be prioritized, especially in the case of government controlled air and seaports.

Policy makers have a critical role to play in setting PCS strategic objectives. This is likely to include increasing global competitiveness, through compliance and standardization; attracting foreign trade investments; increasing revenue collection through overall transparency; empowering export through digitalization as an engine of growth; and enhancing sustainability through just-in-time arrival of ships to cut greenhouse gas emissions.

---

3   https://www.portjam.com/pdf/P.A.%20ANNUAL%20REPORT1.pdf

Compliance	Reduce trade costs and bureaucracy	Reach high levels of service efficiency	Enhance supply chain Resilence	Improve Sustainability
Remote trade transactions	On documentary compliance	Holistic tracing of vessel dwell time	Advanced cargo information	Port Call optimisation
Avoid physical contacts	Get rid of red tape	Efficiency of compliance services	Predactibility	Just in Time
Transparency and accountability	Impact Assessment	Skateholder coordination	Suppy Chain Resilence	GHG Reduction

Beyond strategic objectives, there are wider benefits of creating a PCS. These include compliance and reducing trade costs and bureaucracy. That in turn raises port service efficiency and enhances supply chain resilience and sustainability. Below are some of the benefits of creating a PCS in SIDS:

- **Compliance:** Maritime digitalization increases trust in government by boosting transparency and accountability. Digitalization enables remote trade transactions and prevents physical contact between public and private stakeholders, which could possibly lead to unlawful practices. Big data analytics and individual performance-based indicators, such as average processing time by inspectors, can also highlight red tape to be cut.

- **Reducing trade costs and bureaucracy:** Business process digitalization reduces transaction costs for traders. The adoption of a partial or complete paperless environment reduces red tape, eliminates non-harmonized and standardized documents, eliminates redundant paper-based documents and PDFs, and makes trade cheaper and faster. Combating bureaucracy and reducing trade costs will contribute to private sector development.

- **Reaching high levels of port service efficiency:** Port efficiency is measured beyond the mere cargo-handling capability of container terminals. Time is of the essence for a shipper or beneficiary cargo owner. Focus on their needs can result in measures to reduce time vessels and cargo spend at port. This is influenced not only by the productivity

of cargo handling, but also by the efficiency of border agencies for the vessel clearance process and operational vessel services, as part of the port call. Digitalization improves the efficiency and effectiveness of vessel services. This is because the single electronic submission of data allows stakeholder coordination on advance vessel information, inspection, and release.

- **Enhance supply chain resilience:** This can be achieved by increasing supply chain predictability for critical goods. Shippers are increasingly aware of the need to provide ports with information in real time about the status of vessels, containers, cargo, and trucks. Predictability around estimated time of vessel arrival is one of the potential benefits of digital systems. Clarity on estimated time of completion at the terminal is another benefit. Both can improve planning and the availability of imported goods used by the economy, including tourism. A PCS cannot eliminate all delays in the shipping sector, such as transshipments. However, it would offer a level of predictability needed by port authorities and the stakeholders.

- **Increased sustainability:** Data and digitalization can also boost sustainability. Digitalization allows stakeholders to gradually improve their business processes through data analytics based on estimated time of arrival, planned time of arrival, and required time of arrival. It can help shipping lines to optimize the speed of the vessel for a just-in-time arrival, the allocation of port call resources and reducing GHG emissions.

4. The role of governance

Governance and change management are critical to the success of a PCS as outlined in chapter 4. The champion of a PCS project has a pivotal role to play in creating a neutral platform for dialogue and collaboration. This champion may

be a Port Community Council, National Maritime Transportation Facilitation Committee, or a National Trade Facilitation Committee. Jamaica (Box 2) provides a best practice example.

Box 2. The Port Authority of Jamaica

Port Community System
Governance Framework

A Port Community System (PCS) is an electronic platform which connects the multiple systems operated by a variety of organizations (public & private) that make up a seaport, airport or inland port community.

The PCS implementation is an opportunity to substantially encourage and promote more efficient and effective trading practices, while reducing the cost of doing business; therefore marketing/positioning Jamaica as a global logistics hub for the region.

Given Jamaica's historically poor ranking with the World Bank's Doing Business and Logistical Performance Index reports, the Government of Jamaica (GOJ), in 2012, mandated that the Port Authority of Jamaica and Jamaica Customs:

1. Implement a PCS for the Shipping Industry as a Public-Private Partnership (PPP)

2. Engage the competitive tender process for the selection of a suitable investment partner.

The Shipping Association of Jamaica (SAJ) was also seen as a strategic partner in the project, as they represented significant institutional knowledge and had also been the fore runners in the feasibility of a PCS for Jamaica.

Ultimately, the business model for the PCS was changed, but the governance factors established have remained consistent throughout the acquisition and have contributed to the successful implementation of the project.

To undertake the executive level mandates, a PCS Steering Committee was established from project inception and has played a critical role in all phases of the project. This steering committee comprised of both government and private sector stakeholders who played a vocal role in the strategic decisions taken for the project.

A few of the main factors to be highlighted are:

3. Identification of a Project Champion who plays an active role within the project.

4. Transparent and consistent communication with all stakeholders

5. Executive and operational buy-in of processes and scope

6. Close and honest working relationship with Customs

It should be noted that for PCS implementations, it is a change management project and not an ICT project; this is very important as the stakeholders must understand fully that business process re-engineering will be a critical component of the project.

It must also be noted that a champion for the project must be identified early that will be able to communicate and command respect from various stakeholders form within the Government and private sector; these are all critical components of a successful project. Operational Project Governance Concerns that were identified and addressed included:

- Inclusion of all stakeholders at every stage of the project.
- The project was implemented in various phases.
- Business Process Re-engineering is a major component for each phase/module.
- Electronic documentation processing has been critical to the success of the project.
- Change Management and Training of the sector will be equally important.
- System Maintenance and Support
- Customer Service and Technical Support

5. Initiatives & sponsors

5.1. The role on International Financial Institutions (IFIs)

IFIs play a major role in accelerating digitalization and sustainability in maritime trade. One example is the World Bank and IAPH report[4] on strengthening the resilience of the maritime supply chain and projects in Belize, Fiji, Africa, Malaysia, and Indonesia.

The International Monetary Fund was a key driver of reforms in Jamaica in 2013. The Jamaican authorities requested a fund arrangement[5] in support of a four year economic program, seeking to avoid immediate crisis risks and creating the conditions for sustained growth through a significant improvement in its fiscal balance, debt position, and competitiveness. The Jamaica growth strategy envisaged an initial phase of reforms to improve dynamic efficiency, including —among other reforms— the establishment of a PCS to electronically integrate and streamline export and import procedures. The IMF's quarterly reviews included the PCS project inception, procurement, and implementation process. In chapters 4 and 5, we addressed the inception of a PCS project from a governance and operator perspective and from a legal and regulatory perspective.

As a PCS project is a change management project and not just a technology project, it is highly recommended to request technical assistance from IFIs to de-risk the project during the inception phase.

Capacity building could range from in-state knowledge sharing workshops, meetings facilitation with other PCSOs, bringing on board international technical advisors and international lawyers to address the implementation of the PCSO and its legal and regulatory framework —in coordination with local lawyers and legal experts— and, finally, implement best practices. Capacity building will enable executives to boost the knowledge and skills of staff who would be involved in the project. It is also important to draw up a risk management strategy and risk mitigation measures from inception.

At diagnostic of the status of current IT systems and policy impediments at inception is important. A road map to implement the PCS is also essential as circumstances, capacities and technology is different in each case. Coordination between SIDS is critical to avoid overlapping projects. This can have a negative impact during inception, development, implementation and operation of single windows and PCS projects.

5.2. The role on regional cooperation

In the four regions, the role of regional cooperation and regional programs for the development of a PCS should be designed and implemented with institutions such as the Caribbean Community (CARICOM), the Association of Caribbean States (ACS), the Indian Ocean Commission (IOC), The Pacific Community (SPC), IAPH, regional port management associations and committees. It can also involve partnerships with IFIs.

5.3. The role of France & French Island Territories

In the Caribbean, Indian Ocean and Oceania, France has played an important role in the development of PCSs. This is the case not only within the French Territories of Guadeloupe, Martinique, Mayotte, New Caledonia, and Tahiti, but also in all neighboring SIDS. A major program launched in 2006 was the CLOVIS initiative sponsored by Interreg, an instrument of the EU to support cooperation across borders. The CLOVIS initiative aimed to provide capacity building to SIDS for the development of port communities and PCSs within the greater Caribbean. While French Island Territories are not full UN members among SIDS, they are members of SIDS regional commissions. New Caledonia and Polynesia are autonomous territories with their own parliaments, governments and Customs. As a result, France has played an instrumental role in the roll out of PCSs in the Caribbean, Indian Ocean, and Oceania.

The first implementation of a PCSO was in Guadeloupe in 2002. Back in 1993, the French Customs Management System SOFI was creating the possibility for establishing a third party Customs clearance system. The Customs Brokers and Freight Forwarder Association of Guadeloupe created UDB Guadeloupe, a customs clearance unit, with 16 shareholders. In 1997, the Port Community Association of Guadeloupe (UMEP Guadeloupe) was created to further collaborate on digitalization. The President of the Customs Brokers and Freight Forwarder Association was elected as the 1st President of UMEP Guadeloupe. As 90 percent of maritime trade in Guadeloupe is related to the Port of Le Havre in mainland France, UMEP decided to assess from 1997 to 2000 the feasibility of implementing in Guadeloupe the PCS established in Le Havre early in the 1980s.

The PCS project was jointly initiated by UMEP Guadeloupe and the Port Authority of Guadeloupe. The Port Authority contracted the feasibility study to the PCSO of Le Havre. In 2000 the decision

4   https://thedocs.worldbank.org/en/doc/773741610730436879-0190022021/original/AcceleratingDigitalizationAcrosstheMaritimeSupplyChain.pdf
5   https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Jamaica-Request-for-an-Arrangement-Under-the-Extended-Fund-Facility-40549
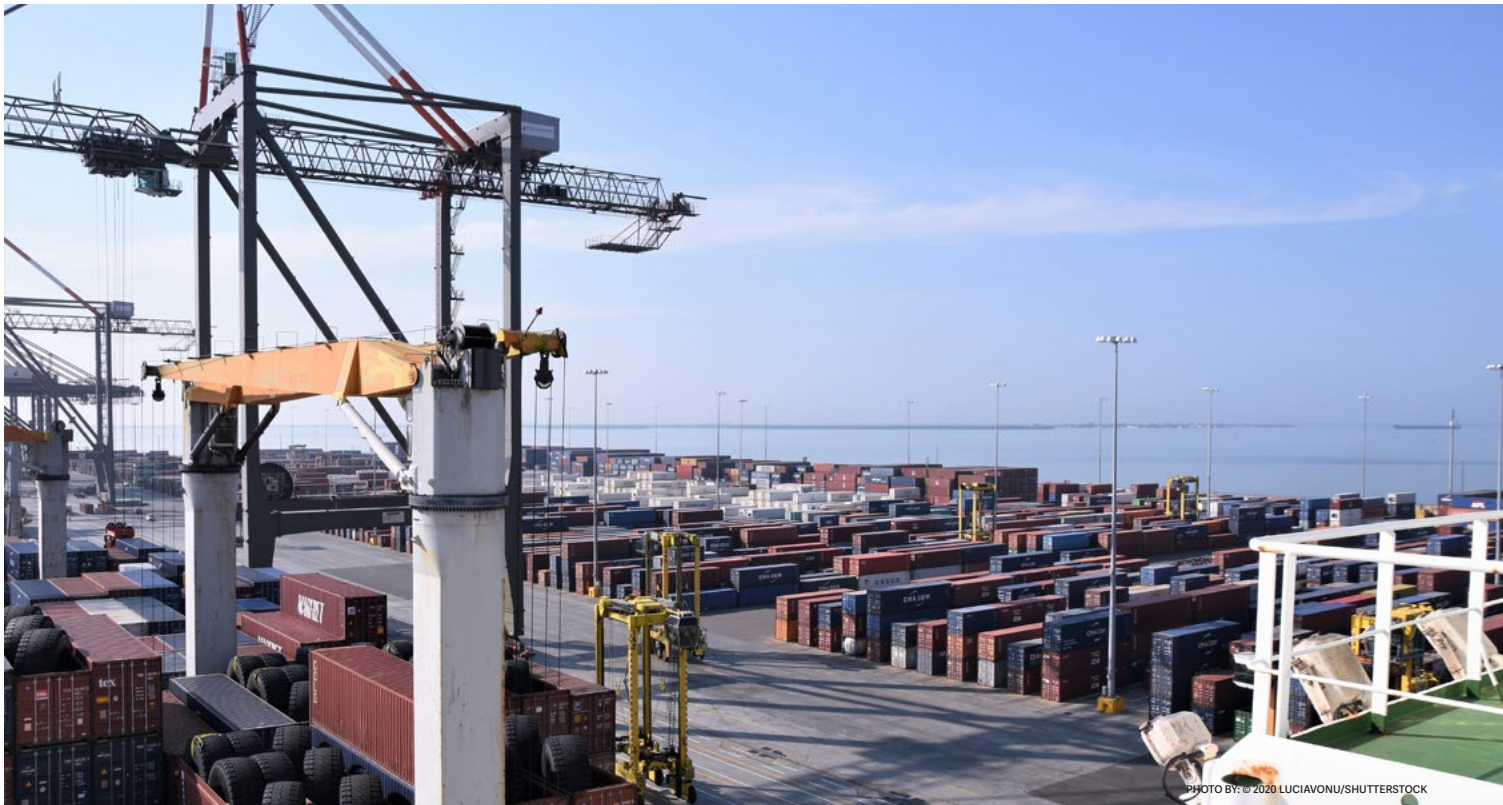
PHOTO BY: © 2020 LUCIAVONU/SHUTTERSTOCK

was taken to implement the PCS in Guadeloupe and in 2001, UDB Guadeloupe was transformed into the CEIBA PCSO. The President of UMEP also became President of CEIBA. The financing of the PCS implementation was enabled by: (i) The Customs Brokers and Freight Forwarder Association. (ii) The EU European Regional Development Fund (ERDF). In 2001, a steering committee was set up with UMEP Guadeloupe and Customs to start the implementation process.

CEIBA relates to scenario four in chapter 4, where the PCSO is led by a private initiative in partnership with the port authority and customs administration. As was the case in mainland France, one of the key drivers of the Guadeloupe PCSO, which later spilled over to all French territories, freight forwarders understood early on that the PCSO was an opportunity not only to improve performance but also for a new business model to generate revenue and dividends funded by private capital. PCS services were billed through transaction fees to the Custom broker and the freight forwarder. The latter was then billing the service with a margin to the importers and exporters. In Guadeloupe, the PCSO was generating in 2017 a revenue of €1.86 million and a net income of €0.2 million, with a staff of 12 people. CEIBA is operating the seaports and airport in Guadeloupe. The Port of Authority of Guadeloupe includes four ports on Pointe à Pitre, Jarry, Basse Terre and Folle-Anse with 1,142 port calls in 2020, 3.5 million tons and 220,233 TEUS.

An initial impact assessment of the first generation of the PCS Guadeloupe showed that the total cost of operating the PCS in Guadeloupe was marginal. It represented less than 0.001 percent of any product in a store, according to CEIBA. Cargo dwell time is more efficient. That is thanks to the integration of port logistics operators. The clearance and exit of goods can now take just 5 to 10 minutes after the discharge of the container.

5.4. The impact of the CLOVIS initiative

A major program launched in 2006 was the CLOVIS initiative sponsored by Interreg, an EU initiative supporting cooperation across borders. The CLOVIS initiative aimed to provide capacity building to SIDS for the development of port communities and PCSs within the greater Caribbean.

CLOVIS helped to foster a common understanding of PCSs in the greater Caribbean over the past 15 years. This in turn helped to pave the way for the first regional implementation of a PCS in Jamaica in 2016. Others have followed suit. The Dominican Republic, Barbados, Belize, Suriname and Trinidad and Tobago have embarked on a PCS journey with the support of regional and international organizations, such as the Inter-American Development Bank, the World Bank, CAF Development Bank of Latin America, the Caribbean Development Bank, the Latin America Caribbean Economic System, the Association of Caribbean States, the Organization of American States, the Port Management Association of the Caribbean, the International Association of Ports and Harbors and the Caribbean Shipping Association.

Table 2. 5 key stakeholders to engage to start with at SIDS

Priority	
1	Find your PCS Champion
2	Engage Customs & Port Authority Cooperation
3	Engage Minister of Finance and Minister of Transport
4	Engage Prime Minister
5	Engage IFIs to provide technical assistance and capacity building

Table 3. 5 key priority actions to engage to start with at SIDS

Priority	
1	Establish project inception team
2	Learn from other SIDS in your region
3	Leverage 2024 IMO MSW mandatory requirement as PCS first service
4	Focus on PCSO from day one
5	Address legal and regulatory framework needs

5.5. Leveraging early adopters

Across all four regions there are plenty of examples for others to emulate. These include Jamaica in the Caribbean, Cape Verde in Macaronesia, Mauritius in the Indian Ocean, and New Caledonia in Oceania. Cooperation between Customs and the port community has been a key driver of success for all of them.

It is important to leverage any PCSO experiences in any SIDS region, including sharing knowledge, meeting with regional peers, understanding how the PCS improved efficiency and supply chain resilience while reducing costs. An existing PCSO in any region should have a ripple effect on other SIDS. This can potentially lead to interoperability and create digital corridors between regional trade lanes. A leading regional PCSO could build, with the help of IFIs, regional common good practices, such as the initiative of Jamaica's PCS with the Inter-American Development Bank (IDB).

Table 1 above identifies five critical actions to consider in starting a PCS in SIDS.

6. Interoperability

The establishment of a PCS should enable connected ports regionally to address the need of visibility and predictability of the vessel's time of arrival and departure. It should enable port call optimization and just-in-time arrivals of ships, notably for better management of critical goods, such as bunkering, medical supplies and construction materials. Port call optimization[6] and just-in-time arrivals are some of the key IAPH data collaboration pillars in partnership with the International Task Force on Port Call Optimization and the Digital Container Shipping Association.[7]

SIDS PCS interoperability with hubs should be a priority for ingoing and outgoing vessels to increase nautical, operational, and administrative efficiency. Interoperability should be an opportunity to establish regional green and digital corridors, as was recently announced between Singapore and Rotterdam[8] and between Singapore and Los Angeles' Long Beach.[9]

Interoperability between automated systems is addressed in chapter 8. Examining functional and technical architecture helps to understand the integration mechanism of a PCS because many applications are built on different platforms. Robust middleware architecture is required due to the complexity of other applications. They must be integrated seamlessly.

---

6   https://portcalloptimization.org/
7   https://dcsa.org/
8   Maritime and Port Authority of Singapore and Port of Rotterdam to establish world's longest Green and Digital Corridor for efficient and sustainable shipping | Maritime and Port Authority of Singapore (mpa.gov.sg)
9   https://www.mpa.gov.sg/media-centre/details/maritime-and-port-authority-of-singapore-port-of-los-angeles-port-of-long-beach-and-c40-cities-to-establish-a-green-and-digital-shipping-corridor

AIR CARGO DIGITALIZATION: FROM EDI TO COMMUNITY SYSTEMS

Executive Summary

Key Takeaways

- International air cargo shipment times have remained stubbornly high for four decades despite significant advances in technology and cross-border trade.

- Legal issues, legacy practices, lack of regulatory backing and the absence of neutral champions of digitalization have held back progress, especially in developing countries.

- There is still significant data duplication and manual paperwork in air freight, leading to inefficiencies, delays, and congestion.

- Several top-down "global" initiatives emerged in the early 1990s to tackle digitalization challenges in the air cargo supply chain: Global Air Cargo Community Systems, Cargo Media, and E-freight.

- Airport Cargo Community Systems (ACCS), digital platforms connecting stakeholders in the air cargo supply chain around a specific community, have boosted collaboration and efficiency.

- The emergence of over 10 new ACCSs, mainly in the EU and United States, highlight a growing trend towards the development of participatory platforms.

- COVID-19 and cloud computing have been catalysts for increased digitalization in air cargo handling.

In the 21st century the primary business of most airports is getting people - not products - from A to B. For ports, it is the other way around. Despite rapid advances in technology and digitalization around the world, international air cargo shipment times have remained stubbornly high for four decades.

Legal issues, legacy practices, and lack of regulatory backing have held back digitalization, especially in developing countries. There is still significant data duplication and manual paperwork in air freight, leading to inefficiencies and delays. Much remains to be done to reduce complexity and cost.

Process complexity and data fragmentation is seen as one of the main culprits: end-to-end delivery times for international air cargo shipments average 6-7 days. Cargo can spend about 3 days on average at the destination airport. Variability in delivery times is also significant.

From airlines and ground handlers to Customs and freight companies, there are many players in moving cargo across our skies. There are also many processes, permits and much paperwork.

The air cargo supply chain involves multiple private and public stakeholders, including airlines, ground handlers, freight forwarders, consignors, and customs.

Electronic messaging is still the workhorse of digital air cargo cross-border transactions. This is because in most cases, the import processes are accomplished by at least four independent entities, each of which usually operates its own IT system: airline, ground handler, Customs, and destination freight forwarder.

But maritime ports are just as complex. The big difference has been that cooperation – championed by a neutral operator – has been more common in maritime ports than at airports, at least until recently.

While moving cargo has been central to most ports, it has traditionally been seen as peripheral at most airports. All too often, air cargo is seen as an issue for "tenants" that lease airport space from the airport "landlord."

Several top-down "global" initiatives emerged in the early 1990s to tackle digitalization challenges in the air cargo supply chain: Global Air Cargo Community Systems, Cargo Media, and E-freight.

Airport Cargo Community Systems (ACCS), digital platforms connecting stakeholders in the air cargo supply chain around a specific community, have boosted collaboration and efficiency. And they are gaining traction in developed countries. The emergence of over 10 new ACCSs, mainly in the EU and United States, highlights a growing trend towards the development of participatory platforms.

Both "top-down" and "bottom-up" solutions to digitalize air cargo handling have had mixed results. The digitalization of air cargo has often been driven by regulation, from advanced filing requirements to a government's commitment to phasing out paper to replace red tape with more effective and efficient digital cargo handling.

Standard-setting institutions like the International Air Transport Association (IATA) work jointly with other international bodies to pursue standards harmonization. However, they can only produce recommendations for industry users to implement. They do not have the powers to enforce adoption.

The Montreal Convention of 1999 (MC99) establishes the legal framework allowing airlines to make use of electronic documentation for air shipments, without impacting the airline's ability to rely on liability limits. However, some 60 of the 191 ICAO Member States have not adopted the norm.

COVID-19 has increased the role of airports in cargo handling. They are shifting from being "landlords" to becoming "orchestra conductors." Cloud-based systems are also projected to change the digital landscape globally for air cargo. While air cargo has experienced "waves" of top-down (global) and bottom-up (local) digitalization, there is no one-size fits all solution to expedite digitalization.

At the end of the day, the pace at which digitalization transforms air cargo handling hinges on the benefits it provides to the whole community.

And that, for now, remains a work in progress.

1. Introduction

The pace of digitalization and automation has picked up since the internet emerged for the public three decades ago. Globalization has deepened and value chains lengthened. The logistics industry has harnessed IT platforms and digitalization. While some industries and sectors have been quick to embrace the power of technology and digitalization, others have been slower to act. In air cargo, both digital success stories and laggards coexist, creating a more fragmentary environment for supply chains.

The air cargo supply chain is complex and fragmented, involving the exchange of at least fifteen documents and additional permits and licenses for border clearance. Even though air shipments are priced at a premium, and conceived to provide speed to market, legacy procedures are not necessarily conducive to ease the flow of goods

Electronic Data Interchange (EDI) is the foundational piece of air cargo digital information flows, as it involves several independent entities, each operating their own IT system. However, challenges exist in the cross-border movement of air cargo due to legal issues, legacy practices, and lack of regulatory backing, hindering the adoption of digitalization initiatives, especially in developing countries.

Processes are still burdensome and inefficient, with a disruptive double-entry process based on manual entry, making data recapture impossible, and border control agencies requiring non-standard data that slows the process. Advanced cargo information is not fully used, and EDI standardization and quality still generate issues, causing errors and delays that propagate across the entire chain of custody of the cargo.

Advanced cargo information regulatory filing requirements, in large destination markets like the United States or the European Union, will drive adoption of digital tools.

Several top-down "global" initiatives emerged in the early 1990s to tackle digitalization challenges in the air cargo supply chain: Global Air Cargo Community Systems, Cargo Media, and E-freight.

Globally, air Cargo Community Systems (CCSs) provide value by making connections and providing translation services. They were designed to serve mostly one stakeholder in the chain, which causes them to narrow their scope to concentrate on Value Added Network functionalities – such as translation and relay of messages.

The E-freight program was launched in 2005 to increase the use of digital documents in the air cargo industry. The goal was to convert about half of the industry's documents to electronic messages, seeking to introduce efficiencies and creating roughly $5 billion in annual savings for shippers, forwarders, and airlines. However, early concerns from stakeholders and the magnitude of the ICT implementation work delayed widespread implementation. To achieve critical mass, the program was narrowed to focus on digitizing the Air Waybill document.

The top-down global digital initiatives for air cargo were not always suitable for "local" airport markets, as they would not cater to their specific problems or the pace of adoption. This led to the emergence of Airport Cargo Community Systems (ACCS). ACCSs are digital platforms that connect various stakeholders in the air cargo supply chain around a specific community, allowing for collaboration and improving efficiency of operations. ACCSs are airport-specific in nature and offer a range of functionalities based on the needs and priorities of that community.

Local initiatives in the air cargo industry vary in their approach to defining the community they serve, their strategic objectives, neutrality and ICT governance, and their initial motivation for creating the initiative. Successful initiatives have a clear and measurable strategic objective that motivates the community. ACCSs also differ by the local challenges that they are aiming to overcome -from truck slot management to regulatory control transparency. Neutral leadership is one of the main issues that seemingly define the success of these communities. Moreover, whereas some communities and their platforms have grown organically from a strong belief of their value proposition, other cases have been rather motivated by exogenous mandates by regulators to digitalize partly or wholly the processes around the airport.

The latest ACCSs are taking a more integrated approach by combining legacy elements with new technologies. The emergence of over 10 new ACCSs, mainly in the EU and United States, shows a growing trend towards the development of participatory platforms. These platforms have a wide range of services provided. The latest ACCSs are now powered by advanced technologies, such as Blockchain, AI, and modular user apps, which allow for customization of user needs. Using a Software as a Service (SaaS) approach, small communities benefit from paying only for what they use.

Local airport cargo community systems and platforms have adopted various governance models, mainly: (i) For-profit independent vendor. (ii) Subsidiary operator of large community member. (iii) Community-controlled non-profit. (iv) Statutory single provider.

Subsidiaries of large community players were responsible for early attempts to set airport cargo community systems. Due to leadership neutrality issues, adoption by community users was typically compromised. For-profit providers have also emerged to combine the community needs with a robust business model, which includes the airport authority and the ICT provider of the local ACCS. Key to this arrangement, is to transparently identify

benefits for all stakeholders and implementation costs, which are typically the pain points that thwart user adoption.

The comparison of the different experiences is useful to distill common "traps" or issues that have thwarted the success of airport cargo community systems in the past:

- **Bias toward one type of air cargo stakeholder**: Initiatives that strengthen one stakeholder at the expense of another, or even appear to favor one stakeholder, jeopardize the chances of success. To avert this, a coalition of winners is needed. The benefits and costs for all and how they will be distributed and when must be transparent.

- **High/uncertain costs**: If costs are uncertain, participants will likely assume the worst-case scenario, which may delay a decision to adopt indefinitely.

- **Not thinking about user adoption from the start:** Past experiences show that few participants are quick adopters, while some are slow followers, and most are change-averse. The community must think about adoption schemes early, build critical mass with champions and incentivize participation.

- **Weak ICT governance:** A for-profit ICT vendor will not necessarily deliver the best outcomes, especially if it is a non-neutral party (e.g., subsidiary of a dominant industry player).

- **Leaving laggards behind:** The solution to be implemented should be aware of the different levels of technology adoption across the entire stakeholder base. Ensuring solutions are available to laggards can help to drive a fragmented user base that is not IT-enabled.

Some final observations are useful to identify commonalities with the seaport environment.

Seaports have traditionally been more active and successful in implementing digitalization initiatives. This has been aided by having port authorities which are seen as neutral community leaders in initiating a PCS. Airports, on the other hand, have traditionally viewed cargo as a subsidiary business and struggled to find a neutral party to oversee wider coordination between different stakeholders in freight.

This is slowly changing, especially since air cargo became a lifeline during the pandemic.

Increasingly, coordinating 'landside' (truck) operations is increasingly important, reflected by the demands of new communities on the ground.

Congestion naturally occurs in compressed time frames and reduced physical space. Pre-loading screening regulations (e.g., ACAS or ICS2) will probably also change the landscape as the use of digital tools will be needed for compliance purposes – in

a similar manner as advanced cargo information had when introduced after the September 11 terrorist attacks.

This chapter looks at the evolution of digitalization in air cargo. It also looks at barriers and gateways to local and global digital initiatives which support the global movement of goods by air.

1.1. Basics of the air cargo supply chain

The air cargo supply chain is a mix of many private and public stakeholders. The main private stakeholders include airlines, freight forwarders, ground handlers, consignors, importers, customs brokers, and border control agencies, among others. They interact around business processes for the import, export and transshipment of cargo hauled by air. Public entities usually conduct border compliance functions, above all (but not only) customs.

Historically, the air freight industry has operated under the freight forwarder-airline relationship. Essentially, the air carrier takes over the airport-to-airport haulage, and the freight forwarder arranges shipment consolidation and handles all the logistics services related to the transport of cargo before and after the airport. They often act as the clearing agent for the customs release of goods and provides other formalities on behalf of the shipper or the importer (e.g., producing payments, insurance, etc.). When the scale of operations of an air carrier does not justify allocating its own assets and personnel at a specific airport, a ground handling agent is nominated to act on behalf of air carriers. They carry out activities related to the processing and handling of physical and information flows for shipments, including storage and regulatory filing with border control agencies, among others. In some geographies, the role of the customs brokers and bonded warehouse operators is also central in handling physical and information flows. A more detailed description of the roles along the air cargo supply chain can be found in the box below. Express carriers or integrated carriers, in contrast, combine all functions above providing all services within a single vertically integrated company.

The organization of legacy cross-border air cargo supply chains is complex and fragmented. Even though air movements are priced at a premium, and conceived to provide speed to market, legacy procedures are not conducive to ease the flow of goods across borders transported by air. **Figure 2-1** shows the movement of physical and information flows of a typical international air shipment. This involves information exchange contained in some 15 documents or more, between commercial, transport, trade, and regulatory documents (see Appendix, **Table 5-4**). This does not reflect additional permits and licenses needed to obtain border clearance at the destination.

Process complexity and data fragmentation is seen as one of the culprits of elevated lead times and unreliability in air cargo supply chains. End-to-end delivery times for international air

Figure 1. Air cargo supply chain process
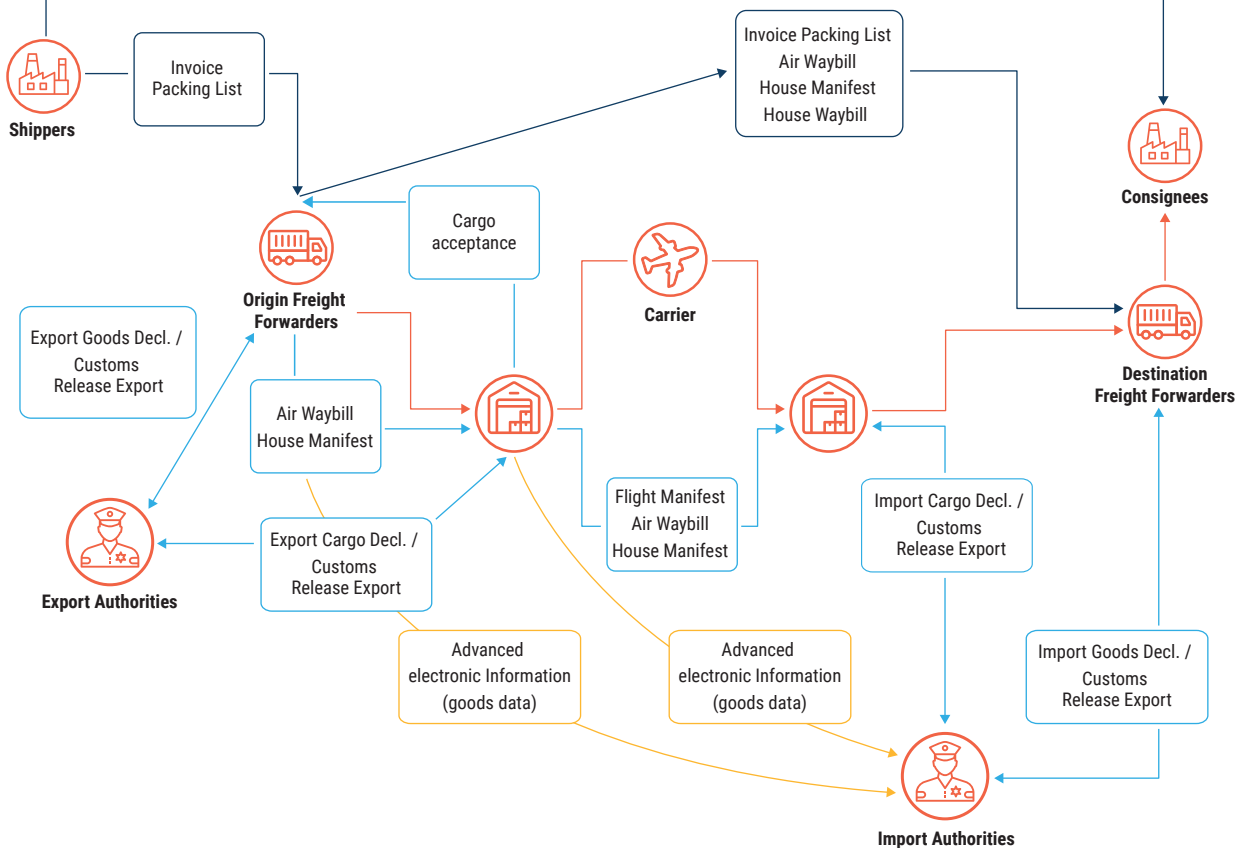
Source: IATA.

cargo shipments have remained stubbornly high in the last four decades, averaging 6-7 days. However, dwell time at the destination airport averages about 3 days, waiting to comply with the local requirements which, for the most part, hinder the process of freeing goods. In the worst third performing destination airports, cargo idles for approximately 6 days until it is released. Moreover, the variability in dwell times for 75% of all air shipments is about 5 days.[1] The latter figures provide a sobering picture of the operational performance of air cargo supply chains, considering that its main value proposition is "speed to market" and "time definite" delivery at a significant premium. A succinct description of the cross-border air cargo procedures is useful to highlight the relevance and delineate the functions of each stakeholder in the chain:[2]

- The origin freight forwarder, when acting as a customs agent or broker, prepares and sends an export goods declaration to customs, using the information provider by the consignor. After goods are released by customs, the origin freight

forwarder prepares the house manifest as well as the master air waybill, which is sent to the air carrier.

- Advance Cargo Information[3] (and where applicable pre-loading information) is sent to destination customs by the airline or the origin forwarder, to perform an advance risk assessment.

- The origin freight forwarder may send a pre-alert to the destination freight forwarder and prepare customs clearance in advance. The pre-alert may include the invoice, packing list, house waybill, house manifest, and master air waybill, or other required documents. The origin freight forwarder presents the cargo 'ready for carriage' to the air carrier.

- In lieu of an air carrier, a GHA can accept the freight on its behalf, and later transmit an export cargo declaration to the origin customs to release the cargo for departure. The air carrier manifests the flight and transmits cargo information

---

1   Logistics Performance Index 2023, World Bank
2   Moving Air Cargo Globally. Second Edition. Montreal. ICAO, WCO, volume 36 (2016)
3   Advance Cargo Information is part of WCO's SAFE Framework of Standards. For air shipments, the time limit for the submission is at time of "Wheels Up" of the aircraft, in the case of short haul flights, and 4 hours prior to arrival at the first port in the country of destination, in the case of long haul flights. Available at: https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/safe-package/safe-framework-of-standards.pdf

Box 1. Non-exhaustive description of key roles in the air cargo supply chain

- **Broker:** A broker is an independent agent who helps facilitate the movement of goods from the seller to the buyer. They help with customs requirements and arrange for air transport, among other things. They may be integrated with forwarding and warehousing functions within a single entity.

- **Buyer:** The buyer is the purchaser of the goods in international trade. They are also known as the importer. The buyer may clear consignments on their own or use a broker to assist with various requirements of border regulatory agencies.

- **Consignor:** The consignor is the entity or individual who initiates the movement or transport of the goods. In other words, it is the sender. The term 'shipper' is often used to describe the entity or individual who initiates the trade in goods. Consignor and shipper have separate roles but can be the same entity or individual.

- **Consignee:** The consignee is the party designated on the invoice or packing list as the recipient of the goods at the end of the transport movement. They are the ones who will receive the goods from the transport operator or freight forwarder.

- **Freight Forwarder:** A service provider which fulfills the dual role of (indirect) air carrier and shipper. To the shipper the air freight forwarder is an indirect air carrier because it receives freight for reward yet does not actually operate the airplanes. A freight forwarder and logistics service provider may offer a service relating to the preparation, storage, carriage, handling, packing, and final delivery of goods, including the applicable documentary and facilitation formalities. Ancillary services offered include customs clearance and fiscal matters, procuring insurance, and collecting or procuring payment or documents relating to the goods.

- **Ground Handling Agent:** Ground handlers are third-party companies that provide ground handling services for freight forwarders and/or aircraft operators. These services can include the acceptance, handling, preparation, tagging, loading/unloading, transit, and storage of cargo and mail. Ground handlers are responsible for dealing with operational aspects, based on the instructions of freight forwarders and aircraft operators.

- **Airport Operator:** They are responsible for the provision and security of the airport infrastructure. They establish a secure environment through which goods move and may also be responsible for the provision of 'on airport' cargo services. In some cases, an airport operator will be the party responsible for the protocols for dealing with incidents resulting from a positive identification of a physical threat in air cargo.

- **Aircraft operators:** They provide air transportation for goods through a transport contract called an air waybill. The air cargo may be transported on passenger aircraft or all-cargo aircraft, and in some instances, particularly for short distances, aircraft operators may also transport air cargo by road.

- **Express carriers or integrated carriers:** These combine the work of a broker, freight forwarder, ground handler, and aircraft operator into one single company or group. Express carriers manage end-to-end multimodal supply chains, operate sophisticated track-and-trace information technology systems, and typically transport high-value-added, time-sensitive cargo with a time definite delivery.

Source: Moving air cargo globally, Second Edition, World Customs Organization and International Civil Aviation Agency.

---

at "wheels up" as a pre-alert to the destination forwarder and/or local representatives of the airline. Prior to flight arrival, some national customs authorities may require additional information, that can be performed by ground handling agents on behalf of the operator.

- At or before a flight's arrival, the air carrier at the destination transmits to destination customs an import cargo declaration and receives a response to release the cargo to be delivered

to the destination freight forwarder. The destination freight forwarder collects the freight, where applicable, and transmits the import goods declaration (often prepared in advance) to import customs to clear the goods (physical and fiscal release).

- When the goods are cleared, the destination freight forwarder ensures that the goods are loaded on to the means of

Box 2. Electronic Data Interchange (EDI)

EDI is the direct computer-to-computer exchange of standard formatted business transactions between one or more mutually agreeable business partners. EDI standards are agreements between users of EDI on how data is to be formatted and communicated. Standards provide a common syntax, set of rules, and procedures for their maintenance and enhancements. In general, EDI formatting standards address the following issues: (i) What documents can be communicated electronically; (ii) What information is to be included; (iii) What sequence the information should follow; (iv) What form the information (i.e., numeric, ID codes, etc.) should use; and (v) The meaning of the individual pieces of information. There are two main standards used in air cargo: CargoIMP and CargoXML, both developed by IATA (International Air Transport Association).

The CargoIMP standard was first introduced in the early 1990s and has undergone several updates and revisions and became the workhorse in the industry. In 2014, it was decided that no more revisions (after version 34) would be made, but instead a transition to CargoXML, a new standard, would be made. While CargoIMP uses a fixed-length message format (each message has a specific number of characters and fields, and these fields must be filled in a specific order) CargoXML is a flexible, XML-based messaging format that allows for more detailed and customized data to be included in each message.

CargoXML also includes features such as digital signatures and encryption, which enhance the security and integrity of cargo data exchanges. Both standards, on the other hand, are based on UN/EDIFACT, although largely designed for the specific use of the air cargo industry. CargoXML has also been made compatible with ASYCUDA Customs Systems, within the scope of the UN/CEFACT, to promote trade facilitation.

Source: IATA.

---

transport that delivers the goods to the final consignee or to another identified delivery place.

- The best practice for cross-border air cargo movements still makes heavy use of EDI. Despite the spread of shared data platforms and APIs, electronic messaging is still the main workhorse of digital air cargo cross-border transactions. This is because in most cases, the import processes are accomplished by at least four independent entities, each of which usually operates its own IT system: airline, ground handler, customs, and destination freight forwarder. A detailed description of EDI messages typically used is provided in **Table 5-5**.

Digitalization today is a basic management tool. Electronic messaging standards have been adopted across much of the world. Despite widespread EDI use, air cargo still faces barriers to the smooth rollout and adoption of digitalization. This is especially, but not exclusively, the case in developing countries. Legacy practices, or lack of regulatory backing, are still hampering wider digitalization.

1.2. Main barriers to digitalization of air cargo

Paper documentation and old practices persist in air cargo. Legal issues and legacy practices of border control agencies require paper documents or do not accept electronic messages (EDI). The Montreal Convention of 1999 (MC99) establishes the legal framework allowing airlines to make use of electronic documentation for air shipments, without impacting the airline's ability to rely on liability limits. Some 60 of the 191 ICAO Member States have not adopted the norm. The mandatory use of paper (either the original matrix form or a printed laser copy) airwaybill is still common (see **Figure 1-2**). Whereas border control agencies have generally embraced digitalization many still do not accept electronic messaging, from the airlines or the importing party.

Figure 0-2: Customs acceptance of Air waybill (imports)

Source: IATA, December 2017: Note: Traditional AWB refers to the color, matrix printed physical form that includes the original and eight copies and contract conditions printed in the back. Laser copy is a message-generated or scanned image of the AWB which is laser printed.

Data recapture is typically not possible, causing duplication. Due to the lack of EDI implementation, a disruptive manual double-entry process usually persists, preventing data recapture. The carrier or its agent at destination receives the manifest and waybill documents from the airline's origin office, either by printing off a scanned file that was emailed to them, or by printing off the documents from the airline's computer system. In either case, the destination staff manually recaptures the data, typing again the document contents in the customs system web interface. This can take at least 1-2 hours per flight and creates significant risk of errors that will later delay the shipments.

Border control agencies require non-standard data that slows the

Figure 2. Customs acceptance of Air waybill (imports)

- N/A
- Traditional AWB Required
- Laser copy
- eAWB enabled
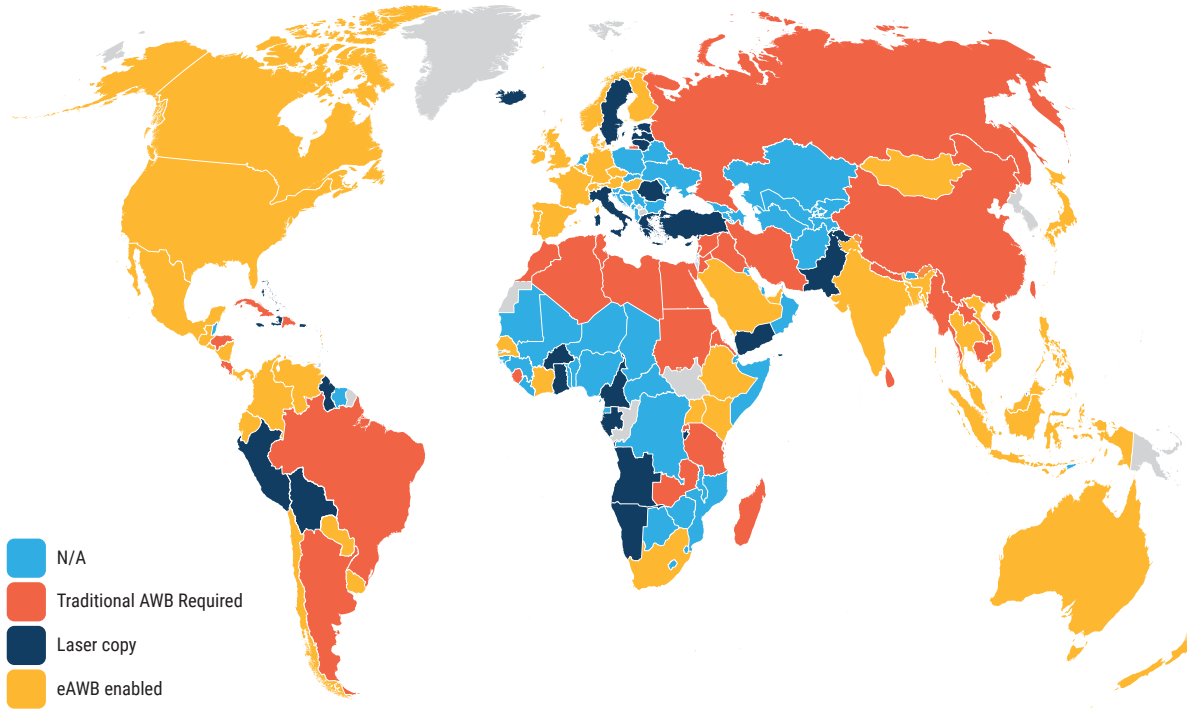
Source: IATA. Note: Traditional AWB refers to the color, matrix printed physical form that includes the original and eight copies and contract conditions printed in the back. Laser copy is a message-generated or scanned image of the AWB which is laser printed.

Figure 3. Advanced cargo implementation (ACI) (left) and standards use (right) in LAC

ACI implementation
- Finalized
- In progress
- Not started

ACI message Standards use
- Cargo XML
- XML compatible
- Not used/not compatible
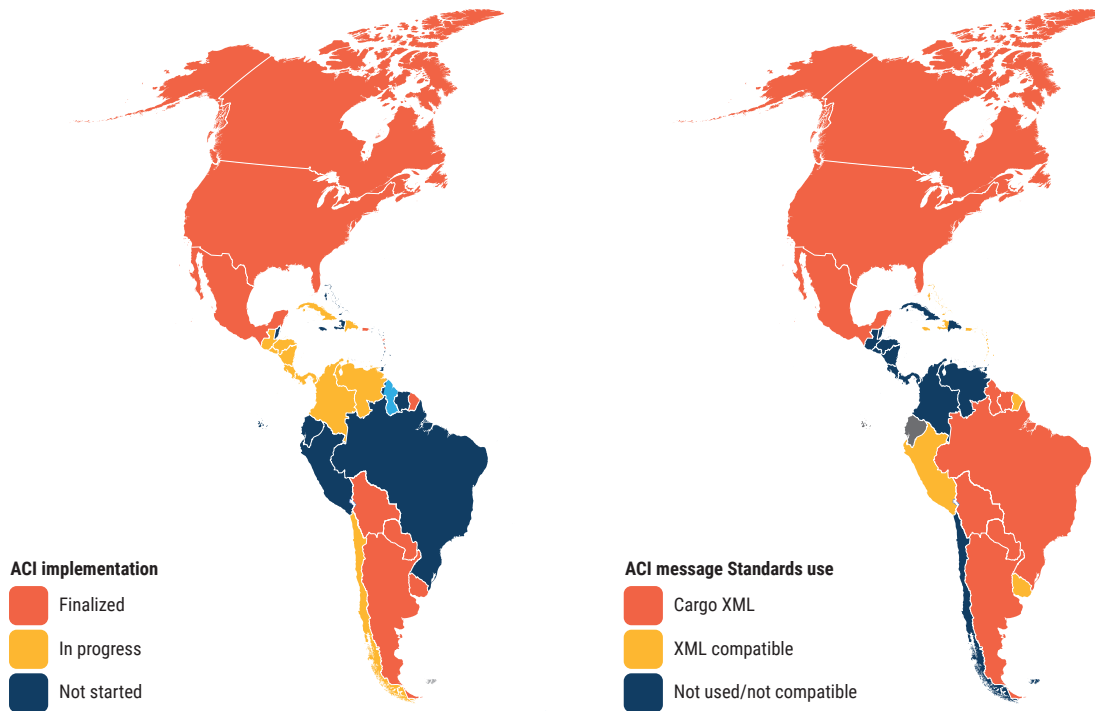
Source: IATA.

process. Even when Customs do have EDI capabilities, it is not uncommon that the carrier or its agent are required to produce information that is not part of standard data models. An example is to ask for the tax ID number of the consignee. This may cause delays as additional data fields need to be updated, while airline staff or its agent obtain this information. This information can be incorporated earlier if participants know this requirement in advance, using flexible message data fields – something that does not always occur. The EDI messages are transmitted to Customs, but after several hours of delays.

Advanced (pre-arrival) cargo information is not fully implemented. Despite being part of WCO SAFE Framework of Standards, advanced cargo information has not been implemented across the board (see the example of Latin America in **Figure 1-3**). When border control agencies receive pre-arrival data, whether via EDI or via manual entry by airline staff into the customs website, the norm in the developing world is that this data is not really used for faster clearance upon arrival. This negates the benefits of transmitting such information early, so that time is saved downstream.

EDI standardization and data quality still generates issues**.** Standard**s** harmonization issues create obstacles and elevate costs for different parties. A considerable number of electronic messages are still exchanged in CargoIMP standard, that was developed 30 years ago for airline-to-airline messaging. Many versions of this standard exist. This presents limitations in the type and size of data elements that can be incorporated into it. Full conversion to Cargo XML, its successor, can be a costly endeavor for many parties, or alternatively done through "translator" services (see Section 3.1 on "Global Air Cargo Community Systems"), as direct communication is not an industry-wide

reality. Moreover, data quality and message integrity still cause errors and delays that propagate across the entire chain of custody of the cargo. One element to consider is that standard-setting institutions like IATA, who also work jointly with other international bodies (e.g., WCO, UNECE, FIATA, etc.) to pursue standards harmonization, can only produce recommendations for industry users to implement, and do not have the powers to enforce its adoption. The role of governments in the adoption and enforcement of international standards is key to the digitization of air cargo.

IT capabilities and adoption costs can play a large role in blocking digitalization. Whereas large firms are IT-capable, smaller outfits might struggle with the investments needed to phase out legacy use of physical documents. In addition, the relative cost of labor to IT software is such that in some regions, the financial equation favors the use of manual procedures instead, or outsourcing such functions to the carrier.

Regulatory requirements will increase the pressure on the supply chain and will likely create a new push to "go digital". The same way that the pre-arrival manifest filing created (and continues to do so) a push towards digitalization since 2005/6, the Pre-load advance information (PLACI) requirements by the largest importing countries (ACAS in the United States, ICS2 in the European Union) will create additional pressure to keep up with upstream formalities. This will encourage the industry to embrace digital tools for compliance reasons. In practice, this requires that unitized cargo is already deemed "OK for boarding" when tendering the cargo to the air carrier or its agent at the airport. Moreover, the air carrier or handling agent, in turn, will not proceed to physical build up of Unit Load Devices until pre-loading clearance is received.

2. Historical initiatives on air cargo digitalization

Several initiatives emerged in the early 1990s to tackle digitalization challenges in the air cargo supply chain. There are three initiatives that deserve our attention: (1) "Global" Air Cargo Community Systems; (2) Cargo Media; (3) E-freight. Meanwhile, Section 5 deals with *airport-specific* initiatives that we will call collectively "Local Initiatives".

2.1. "Global" Air Cargo Community Systems

"Global" Air Cargo Community Systems ("GACCS") emerged in the early 1990s. GACCS introduced electronic messaging to air cargo transactions. Back in the early 1990s, Electronic Data Interchange (EDI) was cutting-edge technology. The quality of telecommunications improved sufficiently to carry data

transmissions (without expensive, dedicated telephone lines). The software for electronic data interchange (EDI) to connect separate and independent ICT systems became widely available. EDI was widely used for coordinating supply chains in retail and automotives.

GACCS provide connections and translation services. For many air cargo stakeholders, it is not possible to maintain an ICT team that can build connections to every business partner (airline, forwarder, ground handler, customs, etc.). By contracting with a GACCS operator, a party can have a single connection (to the GACCS), leaving it up to the GACCS to re-transmit data to/from the operator's business partners in multiple locations – hence its "Global" denominator. In addition, the GACCS provides 'translation services' to convert messages into whichever standard/format is required by the system of the other parties along

Figure 4. Schematic view of GACCS architecture
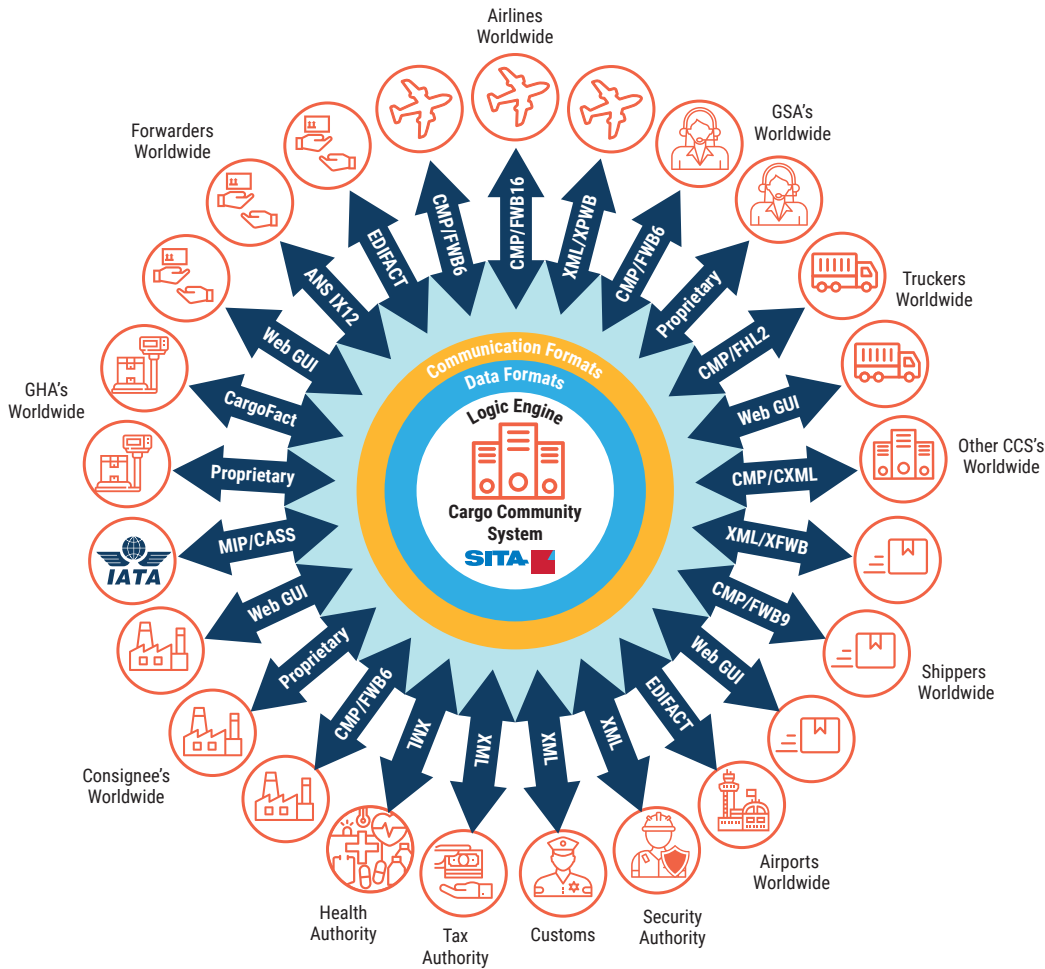
Source: SITA CHAMP Brochure.

the chain. These services of "transmission and translation" remain very valuable even today, so GACCS still send millions of messages each year to/from airlines and other stakeholders, both B2B and B2G.

The GACCS were not originally designed to serve the community at large, but rather centered around one stakeholder in the chain. The GACCS emerged not long after the airline Global Distribution Systems (e.g., Sabre), which radically altered passenger travel business. Seeing this success, the cargo industry looked for similar ICT feats. When launched, different stakeholders showed resistance because they feared that the GACCS' controlling parties (e.g., mostly large legacy airlines) would disrupt commercial relationships with their clients (e.g., bypassing forwarders to deal directly with shippers), or misuse their pricing power in future – which also slowed adoption in smaller cargo carriers.

Originally, GACCS formed a network of regional systems. Each regional system would be owned and controlled by the dominant carriers of that region. In 1990, four global legacy air carriers signed an MOU to form a "Global Logistics System", with one European franchise and one Asian franchise, owned by the participating carriers domiciled in each region. SITA's Champ eventually acquired the European franchise and remains a recognized name in this segment.

GACCS narrowed their scope to concentrate on Value Added Network (VAN) functionalities, acting as data relays. When GACCS first appeared, one goal was to achieve "door-to-door functionality," transmitting a wide array of information about schedules and availability to shippers, forwarders, etc. However, early reluctance by the freight forwarding community to adopt the tool, due to its perceived lack of neutrality, led GACCS to abandon the door-to-door "goal" in 1992.[4] Instead the focus

---

4   Ellen Christiansee, John Been, and Tonja van Diepen, "Factors Determining the Failure of Global Systems in the Air Cargo Community," *Proceedings of the 29th Annual Hawaii International Conference on System Sciences,* 1996, page 422.

was put on EDI translator and data relay functionalities. This approach does not necessarily incentivize high usage rates (e.g., over 80 percent) necessary to enable process redesign in a specific airport. Therefore, it is outside their scope to invest in customized solutions where there is limited critical mass (e.g., smaller markets).

2.2. Cargo Media & CargoIQ

The industry concentrated on standard-setting and adoption rather than digitalization. By 1995, GACCS operators realized that the pace of digital tools adoption in the industry was stagnating. Moreover, the different data standards used by the GACCS created a new barrier to smooth interactions. Industry groups (e.g., IATA) sponsored the "Cargo Media" initiative. Around 20 air carriers were on board when it was first created. Cargo Media's goal was to improve the usage of 4 electronic messages (related to bookings and status update), by adopting a single global format and promoting the use of that format. The group quickly adopted a format, and by the end of 1996 they had achieved their goal among their airline members.

Motivated by this success, industry groups adopted a grander vision to digitalize air cargo supply chains. IATA members and Cargo Media's carriers aimed to reinvent the non-integrated (e.g., all airlines barring FEDEX, UPS, DHL) supply chain to emulate the integrators, thereby giving shippers time-definite delivery commitments, using detailed routing instructions and real-time piece-level tracking. To achieve the vision, airlines and forwarders would jointly develop and adopt new operating procedures, radically expand the use of EDI to collaborate, and affix bar codes to every piece to track its movements.

To achieve that vision, a sector-broad coalition was formed, under the banner "Cargo 2000." Air carriers recognized that such vision could not be achieved if the airlines alone designed the solutions and then asked freight forwarders to adopt them. To attain their input and buy-in, airlines invited the forwarding community to participate. Ten of the largest global freight forwarders joined. The scope of Cargo2000 was wide and sometimes exceeded the needs/capabilities of some participants (e.g., piece-level tracking) at the time. Moreover, the events of September 11, 2001, and the dot-com crash slowed adoption as the sector experienced a marked contraction. Cargo2000 continued to push forward and was rebranded to CargoIQ later, gradually incorporating more members to expand beyond the "airport to airport" movements.

2.3. E-freight

In 2005, the "E-freight" concept was launched to increase the use of digital documents. Airlines and forwarders realized that the GACCS would not lead the industry toward paperless supply chains. So, they joined forces under IATA's leadership to introduce "E-freight" as a multi-year program to create benefits from digitalization for the entire supply chain. The vision was ambitious: convert about half of the industry's documents to electronic messages, creating $5 billion in annual savings for shippers, forwarders, and airlines.[5]

E-freight was focused on global standards and EDI messaging: The first push of the E-freight program was to work towards global messaging standards for the documents used the most. This meant aligning multiple standards that had developed over the years or creating new ones. The program assumed that all stakeholders would turn to the use of EDI messages, whether via a GACCS or via direct peer-to-peer communications yet avoiding advocating for specific ICT solutions or providers.

As with the GACCS initiative, strenuous concerns from some stakeholders delayed the widespread implementation of E-freight: Reluctance to participate in the program was related to the short-term implementation costs, and the distribution of the benefits. Freight forwarders, at the time, believed that E-freight would give productivity improvements to the recipient of the data (e.g., airlines), and even raise the costs of the sender of the data (e.g., software development expenses or GACCS charges). A deadlock persisted until 2010, when the Global Air Cargo Advisory Group (GACAG) was formed, including a wider based of stakeholders. They included forwarders, airlines, and shippers. E-freight was then restructured into phases to balance efforts and rewards.

Stakeholders struggled with the ICT work needed. Many supply chain participants have made sincere efforts to adopt E-freight standards yet struggled with the magnitude of the ICT implementation work. It was expected that E-freight would have a global, top-down implementation, with the largest carriers and forwarders moving first to get the industry to critical mass. While the very determined players have the finances and ICT skills to drive the project to completion, others either cannot independently make changes to their ICT (because the software is vendor-controlled) or they cannot afford to pay for ICT changes. Without common systems or common operating processes, each stakeholder must reengineer and pay for ICT changes to replace paper with digital processes.

---

5   A pilot project by Cathay Pacific showed benefits for carriers. The carrier pushed E-freight in its home hub of Hong Kong (HKG), where Cathay enjoys a market share of approximately 35%. In 2010, Cathay announced to its forwarders that for exports from Hong Kong it would only accept electronic Air Waybills, effective January 1, 2011. The few forwarders who refused to comply were denied access to Cathay's space, and within days their resistance cracked. With 100% of the Air Waybills coming electronically, Cathay reengineered processes and reduced staff. In 2012 they published a paper describing that they had improved productivity in their offices by at least 19%, which is a great result. Moreover, a pilot project by Kuehne & Nagel has shown that E-freight has great benefits for forwarders too. Building on Cathay's success in HKG, K&N developed paperless processes downstream to the airline (Cathay) but also upstream to their shippers in HKG. K&N reported that their productivity savings were in the range of 28% to 44%, depending on how many documents they were able to send digitally to the airline.

Figure 5. Monthly Electronic Air Waybill volumes transmitted and Penetration
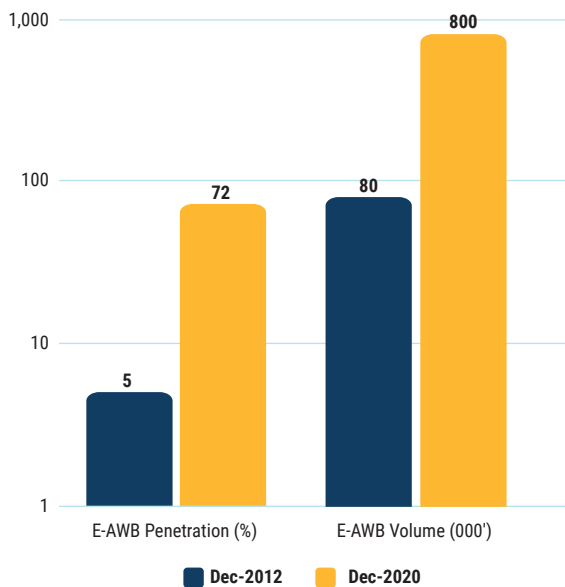
Source: IATA; Note: December. Penetration is computed as the transmitted electronic Airwaybills as percentage of total electronic Air Waybills in enabled O-Ds.

To achieve critical mass, the scope of E-freight was narrowed. Out of the 40 documents exchanged during the entire process to move cargo from origin to destination, the program was reduced to focus on just one to achieve critical mass: the Air Waybill. It is the common denominator between forwarders, airlines, and ground handlers – hence the top candidate to digitize.

Despite the early challenges, e-AWB usage increased significantly in the past decade: According to **Figure 3-2**, e-AWB use increased between December 2012 and 2020, from 5 to 72 percent. Meanwhile, the volume of AWBs transmitted electronically expanded tenfold, from 80,000 to 800,000 in "enabled" routes. This only takes into consideration those routes, where parties at the origin and destination are enabled to conduct electronic AWB transmissions from a legal standpoint. Hence, the penetration rate might not be informative of the pace of digitalization in less developed economies, as compared to more advanced regions. Today China is the largest origin country in terms of transmitted e-AWBs, and responsible for about 10 percent of the total volumes, increasing tenfold between 2015 and 2020.

Box 3. Forward-looking industry-wide initiatives – IATA ONE Record

In 2017, the IATA ONE Record initiative was first conceived by the International Air Transport Association (IATA) to simplify and standardize data sharing across the air transport industry. ONE Record's objective is to move from a peer-to-peer messaging model to a data sharing model that creates a "Virtual Shipment Record", i.e. a single record view of the shipment. There are three pillars under the ONE Record concept:

- **Data model**: provides the air cargo industry with a standard data structure for data exchange that facilitates data integration with existing and new data services.

- **API**: specifies the interface and interaction that allows airlines and their partners to connect their system directly using best in class web technologies.

- **Security specification**: uses an industrywide and federated trust network to manage identification and authentication of data sharing systems and ensures data privacy and confidentiality for all parties.

Whereas many businesses have switched to APIs, most air cargo stakeholders – forwarders, airlines, ground handlers – still use old electronic data exchange technologies to share data. In contrast to legacy systems and messaging standards, APIs are relatively easy to develop and maintain, and based on technology standards that are agnostic in terms of programming language Entities of the cargo supply chain need to share and access different types of data, such as bookings, ULD identifiers, documents, addresses, etc. In ONE Record, these are referred to as Logistics Objects. To retrieve the data related to a Logistics Object through the ONE Record API, the client only needs the unique identifier of that object. Currently, over 40 large industry participants have joined the initiative. The stated objective is to achieve full implementation of the standards by 2026.

Source: IATA.

3. "Local" air cargo digitalization initiatives

While global digital initiatives were heavily promoted, some industry participants perceived that the top-down approach would not satisfy all their needs. In many local airport markets, the time-definite applications (e.g., piece-level tracking) promoted globally were not a priority. Similarly, in other locations the top-down scope did not address local procedures and problems that needed customized solutions (e.g., truck congestion management, perishable goods tracking, and interface with regulatory agencies). Lastly, some air cargo communities sensed that they could move further or faster toward achieving "critical mass" by pursuing their own "local" initiatives. Early movers, no wonder, emerged at the largest and more mature global air cargo hubs.

There is no single standard definition of what an Airport Cargo Community System (ACCS) is. However, for simplicity, we refer to an ACCS as a "local" initiative (herein used interchangeably), consisting of a digital platform that connects stakeholders in the air cargo supply chain of that community (e.g., airlines, freight forwarders, ground handlers, road freight operators, customs authorities, etc.). It allows these stakeholders to collaborate more efficiently to improve the speed, accuracy, and reliability of air cargo operations. ACCSs provide a centralized data hub where all stakeholders can share information on cargo status, documents, and shipment details in real-time. They might also provide additional services, such as cargo tracking, connecting with regulatory agencies, landside operations coordination (e.g., trucking slots) and data analytics to optimize operations. One of the main value additions of the ACCS is the reusability of information, which eliminates redundancies and delays in obtaining information already in the system. In addition, some of the ACCSs combine commercial functionalities (e.g., rate quotes) as well as payment handling. The gamut of functionalities offered by the ACCS is (and should be) directly related to that local community's needs and priorities. A sample of the functionalities can be found in the **Table 3-1**

3.1. Comparison of key features

All the local initiatives are airport specific. Local initiatives are independent of each other and focus on a single airport, despite those having a common ICT provider. In some cases, the airport is the only major cargo airport in the country (e.g., HKG). Even when there are other major airports in the country, the local initiative restricts its activities to that airport (e.g., BOM). No matter which stakeholder is the leader (airline, ICT vendor, government agency), each local initiative is aiming to create benefits for the community at-large and for each stakeholder. *A non-exhaustive comparison of legacy* ACCS is presented in **Table 3-2** for a sample of large air cargo airports. An update of more recent developments (e.g., FRA, HKG, AMS) is also presented in this section.

ACCS are flexible and differ heavily in approach. Some local initiatives were inspired by the GACCS movement, while others were inspired by E-freight. None of them are necessarily restricted to the vision or scope of predecessors. Each local initiative is at liberty to pursue its own development. Although their visions might be similar, their approaches vary widely in the aspects of "community", scope, leadership/neutrality, and ICT governance.

Local initiatives differ on how they define and approach 'community': some have a clearly defined and broad community while others take a 'user group' approach. Those who have defined the community broadly have extended invitations to all government and commercial stakeholders, including border control agencies, shippers, forwarders, handlers, airlines, truckers, etc. For these community members, there are communications channels to learn about the status of the initiative, and there are forums to give feedback. Other initiatives may have a community vision but continue to rely on their "user groups". This is especially true when there are rival ICT providers/solutions present.

ACCS differ by the local challenges that they are aiming to overcome. In the case of HKG, the market has a stakeholder that is not present in other markets (e.g., co-loaders) so the ICT solutions in HKG needed customization to account for this. In the case of BOM and DXB, the traffic flows peak at certain times of day, so the technology solutions needed to accommodate dock scheduling management and truck permits. In the case of AMS, many shipments involve flowers and live animals, each of which require special procedures and notifications to regulators that may be irrelevant in other markets. A clear, measurable, and attainable strategic objective that motivates the community is a common feature of successful initiatives.

The initiatives differed on neutrality and ICT governance. Some communities have invested substantially and endured challenges to create neutrality, via community-ownership, advisory-board decision-making, or other schemes. On the other hand, some initiatives feature a leader who is profit-motivated, whether acting at arm's length from the main air cargo stakeholders or not. In some cases, the community clearly controls or influences the behavior, planning, and pricing of the ICT provider. In other cases, the ICT provider independently defines terms.

The initial motivation is also heterogenous. Some communities and their platforms have grown organically from a strong belief in their value. Others have been prompted by regulations promoting the partial or complete digitalization of airport processes. In addition, there are cases of profit-motivated providers who incentivize community building, typically sponsored by one anchor stakeholder. Finally, communities have preemptively moved in their "self-interest" when facing a perceived "greater harm" – such as government plans to introduce systems that were not well suited for that environment. The success of such transitions

Figure 6. Sample features of ACCS

Scenario before ACCS implementation

Scenario after ACCS implementation
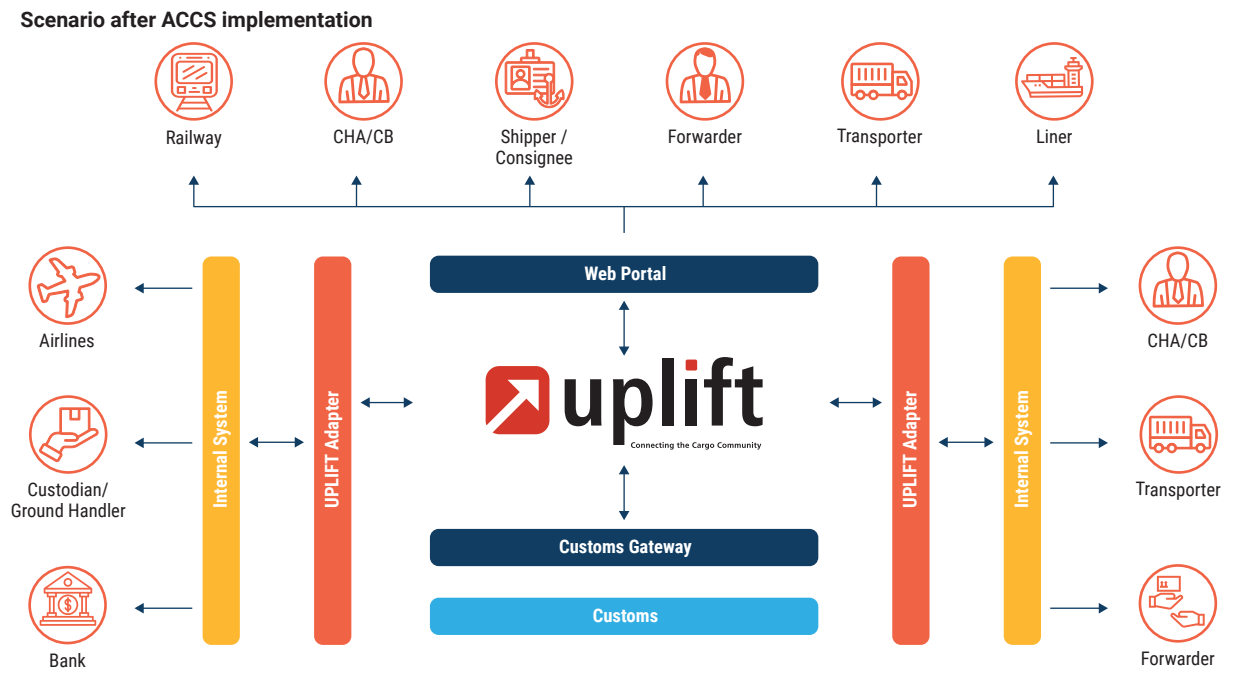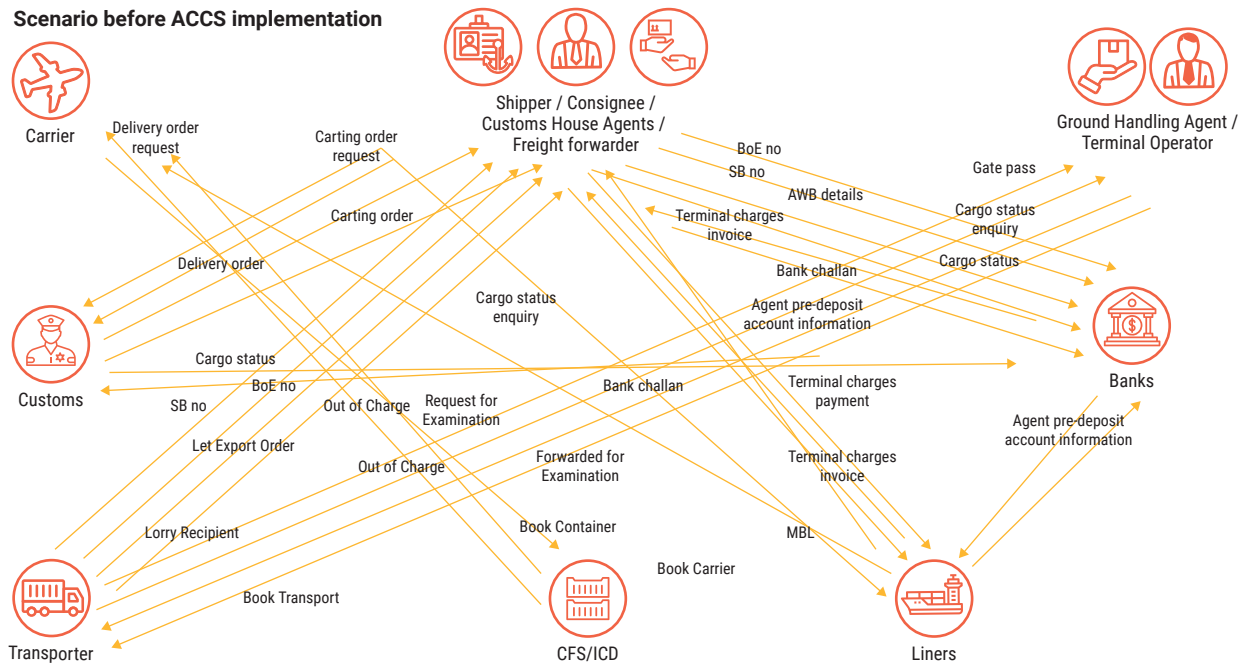
Sample features by stakeholder

Shipper
- Online booking
- Documents generation
- Status updates
- Online document transfer
- EDI between Shippers and Forwarders (Invoice, Packing List, SLI)

Forwarder
- View airlines schedule/rates
- Creation of AWBs
- Filing of AWBs & Manifest
- Label printing
- Customs declaration filing
- e-Docket facility
- EDI between Forwarders and Carriers (e.g., FWB, FHL, MBL, HBL)
- Online booking
- Documents generation
- Status updates
- Online document transfer
- EDI between Shippers and Forwarders (CI, PL, SLI)

Airline
- Receive booking/quotation
- Receive AWB data
- AWB stock allotment
- Manifest filing w/Customs
- Timely status updates to forwarders
- EDI between Forwarders and Ground Handlers (FHL)

Customs
- EDI Between Customs and Forwarders / CB
- (e.g., customs declaration documents, Customs, Queries, Consol manifest) |
- EDI Between Customs and Carriers (e.g., manifests)
- EDI Between Carriers and GHA (e.g., FFM, FBL)

Ground Handler
- Online receipt of validated shipment data
- Proactive milestone alerts
- Terminal charge creation
- Online auctions
- Vehicle management

Source: adapted from Kale Logistics brochure.

Table 1. Non exhaustive comparison of legacy ACCSs

KSF	Amsterdam (AMS)	Mumbai (BOM)	Hong Kong (HKG)
Visible Community?	YES. 100% partiapation by all AMS-based commercial parties, airport authority, regulators, and national government departments (e.g. Police).	YES. (1) ICT provider works via agent's association (ACAAI) to 1800 members. (2) Pilot project involved 5 airlines, 5 forwarders (agents), 5 brokers, BOM airport, 1 base. ground handler, 2 exporters, 2 importers, 1 bank, Customs.	NO. No efforts to bring entire community together: Each stakeholder (GIS, Cathay, etc.) interacts with its own customer
Neutral leader?	YES. Board of community-owned ICT provider.	MAYBE. Partnering between agents association and ICT provider gave appearance of neutrality.	NO. For-profit companies are rivals, each pursuing e-business for their own benefits: Cathay, GIS, TradeLink, etc.
Flexible Scope?	YES. Cargonaut pursues solutions that are unique to AMS community.	YES. Kale provides solutions that are unique to the BOM community.	NO. Vendors have been slow to pursue custom solutions to local problems.
Adoption Plans?	YES. Community ownership of Cargonaut promotes adoption because new developments reflect community's wishes.	YES. Offered long free-usage period to stimulate trial and generate critical mass.	SOME. Cathay forang every forwarder to use e-AWB is a strategy, although it is disliked.
ICT governance?	YES. Co-op (community-owned non-profit)	UNCLEAR. Consultative process agreed between ACAAI and Kale is being tested by introduction of agent-paid fees in November '14.	n/a

KSF	Singapore (SIN)	Frankfurt 2011-13 (FRA)	Dubai (DXB)
Visible Community?	NO. No broad community group because there are rival ICT camps.	NO. Fraport worked mostly with its handling austomer base, not the entire community New initiative launched in 2014 is broad-based).	MOOT. Users of monopoly handler = Community.
Neutral leader?	YES. Civil Aviation Authority (CAAS) via an initiative named e-freight@Singapore	NO. Airport Authority (Fraport) owns a for-profit handler, and they have Lufthansa execs on their board, so they are not neutral.	MAYBE? ICT vendor is a monopolist, but its leader is popular and well-known in the community.
Flexible Scope?	YES. Consortia are able to pursue solutions as they see fit.	N/A. Never reached this stage.	YES. From its beginnings, the Calogi team has felt empowered to find austom solutions to local problems.
Adoption Plans?	NO. Rival consortia each have their private marketing plans, but no community-wide adoption plan	N/A. Never reached this stage.	YES. For each function, there is a benefit to the user. For example, users of the truck scheduling function get access to peak times.
ICT governance?	NO. ICT vendors run the consortia, and are believed to be at liberty to set prices, determine direction.	N/A. Never reached this stage.	NO. ICT vendor is a monopolist.

Source: World Bank own analysis.

often hinges on how robust the "community" is. More outreach work will be required with "candidate" communities that might want to adopt such platforms, to align their expectations with the capabilities of these platforms, and their primary objective.

Several local initiatives have been successful. In DXB, the local initiative has achieved 90% adoption, and has created several solutions for local problems, such as efficiently scheduling trucks during peak times at the handler's warehouse. In BOM, the local initiative handles more than a million messages a year, and has several local customizations to accommodate advanced shipment information (ASI) to the handlers and airport, the approval of carting order process, payment of export & import fees, making paperless deliveries (an initiative called D-cube – Digital Document Delivery), scheduling truck docks at the handler warehouse, etc. In AMS, the local initiative handles many messages, including

images of documents (through uploads of scans), plus the community has developed several industry-leading innovations such as a paperless/touchless truck admittance process (e.g., E-Link, Milk Run) which in real-time verifies the truck driver's identity, the security of the trailer, and assigns the truck to a dock at the warehouse. Each of these examples show that local initiatives can tackle real issues and develop valuable solutions.

The latest wave of ACCS is combining legacy elements with new ones. In the last few years, more than 10 airport community systems emerged, mostly in the EU and United States. Their scope (range of services provided) is mixed. This raises questions about the nature and scope of the ACCS. Among those that made an appearance there are global cargo hubs and cargo-intensive airports, such as:

- Ahmedabad International Airport (ASI, e-payments, e-acceptance and delivery, tracking, full data sharing)
- Atlanta International Airport (ATL) (truck congestion management).
- Bengaluru International Airport (BLR) (ASI, e-payments, e-acceptance and delivery, tracking, full data sharing).
- Brussels International Airport (BRU) (full data-sharing platform).
- John F Kennedy International Airport (JFK) (Truck Congestion Management).
- London Heathrow (LHR) (cargo intelligence and truck load consolidation).
- Liege International Airport (LGG) (full data-sharing platform).
- Paris Charles De Gaulle (CDG) (electronic data exchange platform for Customs tracking).
- Vancouver International Airport (YVR) (Truck Congestion Management, e-docket, ASI).
- Vienna International Airport (VIE) (truck congestion management).
- Other airports such as Philadelphia International Airport (PHL), Chicago Rockford International Airport (RFD), Hyderabad International Airport (HYD), Lucknow International Airport (LKO), Ted Stevens Anchorage International Airport (ANC), Sharjah International Airport (SHJ), Goa International Airport (GOI) have also launched their community system initiatives.

"Third generation" ACCS are emerging: Whereas the first ACCS were portals enabling EDI messages, or just displaying flight and cargo statuses, new platforms are now powered by Blockchain, Artificial Intelligence, and modular user apps. These will take advantage of user adoption to incorporate logistics e-marketplace and sea-air corridors (e.g., backhaul load search). Moreover, the use of the cloud is increasingly changing the approach towards data sharing platforms that remain more flexible, as well as modular apps that allow for customization of user needs. The latter approach takes advantage of the digital capabilities of firms in more advanced economies, that do not need to back-end system integration to the Community System, as they already have those. The flexibility of these new systems allows

---

Box 4. More recent initiatives in Hong Kong, Frankfurt, and Singapore

- **Hong Kong**. The Airport Authority has launched the HKIA Cargo Data Platform as a neutral and open data sharing platform. The platform aims to enhance shipment traceability, unifies communication and information exchange, synchronizes and standardizes process workflow and enables a paperless working environment. The Platform supports the International Air Transport Association's (IATA) One Record.

- **Frankfurt**. The launch of FAIR@Link as a neutral data platform in 2015 was a milestone for the digitalization of air freight handling in Frankfurt. Together with investor Fraport (airport operator), the Forwarding and Logistics Association Hessen-Rheinland-Pfalz (SLV), the Association of Air Cargo Handlers Germany (VACAD) and the customs office responsible for freight at Frankfurt Airport, DAKOSY has implemented the FRA/OS module, which builds on the FAIR@Link communication platform, and includes important site-specific features. With the FAIR@Link Slot Booking module, forwarders and truckers can also manage trucking slots to save time and money.

- **Singapore**. Launched in June 2020, the Changi ACCS is an open ecosystem of collaborative and community-based applications underpinned by an information-sharing platform that aggregates data from all parties involved in the cargo handling process, to optimize operational efficiencies and enable end-to-end digitization of the air cargo supply chain.

Source: DAKOSY, Hong Kong International Airport, Civil Aviation of Singapore.

---

a Software-as-a-Service (SaaS) approach. That means small communities can use and pay for what they use instead of the full development of IT.

Airports are slowly embracing new role in respect to cargo, from "landlords" to "orchestra conductors" –COVID-19 helped to catalyze this trend. Airports have gradually shifted away from the traditional "landlord" model for cargo and recognized the need to step up as neutral leaders to break down silos and address coordination market failures. Although the drive towards digitalization precedes the COVID-19 pandemic, the need to maintain goods flowing across borders, and the complete standstill of passenger flights helped cement the relevance of cargo as a strategic imperative from an airport perspective. The role of the

Box 5. Legal and regulatory basis relevant for air cargo community platforms

International Conventions and organizations

- **Montreal Convention of 1999 (MC99)**. The Convention for the Unification of Certain Rules for International Carriage by Air is a multilateral treaty adopted by a diplomatic meeting of ICAO member states in 1999. MC99 establishes the legal framework that allows airlines to make use of electronic documentation for domestic and international shipments.
- **ICAO Annex 9 (Fifteenth Edition).** Standard 2.9 and 4.13 of ICAO Annex 9 urge the use of electronic means over paper for formalities. Recommended Practice 4.17.1 and 4.17.2 request from member countries best endeavors to use/set up single entry electronic points; and in Recommended Practices 4.9.1 and 4.30.1 to set Authorized Economic Operator schemes and provide facilitation benefits to them.
- **ICAO Annex 17:** Standards provide the basis for security custody chain and e-CSD.
- **WCO Framework of Standards**. Standard 1.3 establishes the basis for Advance Electronic Information filing and Pre-Loading Data for Security for air cargo shipments.
- **IATA**. As standard-setting body, IATA not only establishes messaging standards and recommends its adoption but also is the platform for the Multilateral E-AWB Agreement (IATA Resolution 672) that provides the legal basis to conclude cargo contracts electronically with all other participating parties, with the signature of one single agreement.
- **WTO**. Trade Facilitation Agreement establishes standards and recommendations for the treatment of expedited cargo, and the use of electronic supporting documentation.

Advanced filing initiatives for imports in key import markets

- **Pre-Loading Security Clearance.** These programs in the United States (ACAS – enforced since 2018) and EU (ICS2 – to enter into force in March 2023) mandate the electronic filing of cargo information before loading the goods on the aircraft, for all consignments to be shipped from overseas.

National regulations

The national legislative basis associated with ACCS operations, are not necessarily specific to it, but those that involve digitalization of international trade operations in general. The airport environment might be less subject to intervention on a regulatory basis, as compared to the seaport example, nonetheless, the following instruments should be considered:

- *National Customs Acts:* Dictates the disposition/accounting procedures for the cargo.
- *Air Codex, Airports Law, or Edicts:* Should it be necessary to entrust or legally define, delegate functions, or entrust legal powers to existing or new actors involved in the cargo transportation or handling.
- *Competition Law:* Competency of competition law might be invoked when the nature of the service provided by the ACCS operator is deemed subject to economic regulation as the single point of entry to conduct international trade activities through an airport.
- *National AVSEC Program*: Deals with secure supply chain participants and implementation of electronic Cargo Security Declaration (e-CSD).
- *Other (general) legal Acts:*

  - *Data Protection Act*
  - *Digital Act; Digital Government act*
  - *Cybersecurity Act*
  - *Intellectual Property Rights (IPR) Act*
  - *Transparency Act*
  - *PPP Act*

pandemic in breaking the resistance to embrace digitalization, as contactless operations became a must, has not been uniform. The feedback from some industry participants is that, as activities returned to normalcy, this element of "forced" digitalization has not receded. However, certain geographies have been seemingly less resolute to address this issue for good. Sanitary goods (e.g., vaccines, PPE) were given priority and facilitated processes, yet improvements lasted only during the COVID outbreak – as many governments still rely on paper-based processes.

Technology can power interconnected global digital corridors. Cloud-based systems are projected to change the digital landscape globally for air cargo. An interconnected global data stream can be achieved not by a single system but by interconnected ones that speak one single language and provide full transparency. The blockchain-powered Digital Air Freight Corridor between airports in India and the Netherlands has been developed to provide transparency through exchange of real-time status of consignments and streamline processes. These initiatives should consider principles of public-private data

collaboration: stakeholder engagements, data governance and orchestration, change management, and financial sustainability.

3.2. Governance models

Local airport cargo community systems and platforms have adopted various governance models. A survey of air cargo communities shows that there are four main models: (i) For-profit independent vendor. (ii) Subsidiary operator of large community member. (iii) Community-controlled non-profit;.(iv) Statutory single provider. **Table 3-3** presents a comparison of these models, including the main pillars of governance, risks, and attractive features.

Subsidiaries of large community players were responsible for early attempts to create airport cargo community systems. In most airports, the hub air carrier occupies a dominant position. Subsidiaries of large airlines were the first to try to create ACCS. The benefits of this approach include shorter start-up times

Table 2. Governance Models commonly seen in "local" air cargo communities

Model	Governance details	Attractive feature(s)	Risk(s)
For-profit, independent service provider (e.g., BOM)	Vendor owns the product, invests, sets prices (subject or not to regulatory approval), has strong voice in product development Initial motivation is either from vendor, the community, **or as part of government mandate to drive digitalization** Vendor liaises with an existing community organization or forms an Advisory Board with community members	Accelerates start-up because vendor brings investment, experience, skilled ICT staff	Adoption may be slowed if community members object to costs/pricing Innovation could be deferred due to vendor issues: distraction to other projects; merger/acquisition, etc.
Subsidiary of large community member (e.g., HKG)	The large player summons the community, defines requirements, invests in the ICT, etc., just as a vendor would Subsidiary sets up an Advisory Board to communicate with the community, sets prices (subject or not to regulatory approval), drives adoption efforts	Accelerates start-up because subsidiary knows community Better ICT product, because subsidiary knows business, can customize	Adoption largely compromised because community members object to subsidizing a competitor or fear a disruption in their commercial relationships with the end client
Community-controlled non-profit (e.g., AMS)	Community organizes a Steering Committee, forms Working Groups to define requirements, set prices, etc. Community either creates non-profit company to develop the ICT, or creates a non-profit entity to procure services from vendors (e.g., a purchasing co-op)	Community leadership maximizes buy-in, contributions Increases adoption by removing sources of hesitation	Start-up can be delayed (or fail) if "champion(s)" not available to motivate others, push project during start-up Slower to launch and innovate because time needed to build community support
Statutory single provider (e.g., DXB)	Gov't/single provider organizes community discussions to identify problem, define requirements, etc. Gov't/single provider then invests, manages the ICT development, drives adoption, etc.	Faster startup because gov't/single provider can cover investment Fastest, **highest adoption because usage can be mandated, or operator is statutory single provider**	Innovation slowed if mandate causes resentment

Source: World Bank.

and potential better ICT. Adoption by community users can be seriously compromised because they object to subsidizing a competitor or fear a disruption in their commercial relationships with their end client.

For-profit providers have also emerged to combine the community needs with a robust business model. Such providers could include the airport authority and the ICT provider of the local ACCS. Like in any profit-motivated business, the users might be fearful about how balanced the benefits of introducing this solution are among all stakeholders, and if the pricing of such services is reasonable. The leadership must balance the interests of all community members. Community members must also understand how the proposed project will benefit for-profit providers. Transparency is key.

Single statutory providers in ground handling or terminal custodians have a unique position. In this case, adoption is straightforward, because the statutory single provider can simply dictate the new business process and the charging mechanism. Since there will be no resistance to the new process or charges, the provider can procure ICT services as they see fit, and then "distribute" these services (and user fees) as they would for any other service they provide. Unreasonably high fees, however, might cause discontent.

3.3. Usual pitfalls and possible remedies

There are common "traps" that thwart the success of airport cargo community systems, according to users, providers and experts. They are summarized below:

Pitfall 1: Bias toward one type of air cargo stakeholder. The non-integrated supply chain is, by definition, an industry that has several independent, for-profit parties collaborating to deliver a single service. If any initiative strengthens one stakeholder at the expense of another, or even *appears* to favor one stakeholder, then that initiative will be seriously jeopardized.

Suggested preventive remedies include:

- Form a coalition (community) to steer the initiative.

- Define scope so that all parties benefit, to answer the question "What's in it for me?"

- Create a transparent fee schedule that is "fair" to all participants. This is especially crucial if the operator is a for-profit ICT vendor, or is aligned with another stakeholder (e.g., subsidiary of an airline).

Pitfall 2: Insufficient benefits to one stakeholder type. Any industry-wide initiative that needs cooperation from multiple parties must give each party meaningful benefits within a short time.

This pitfall of 'insufficient benefits' was shown pointedly by the E-freight project. Here the forwarders resisted the initial scope of the project because it would create additional work for them, without clear benefits to compensate for that additional work.

Suggested preventive remedies include:

- Define scope so that every party sees meaningful benefits in the short run.

- Have explicit discussions about benefits. Make it clear that the benefits might not be equal. Help members to see that their expected benefit is meaningful, yet not identical to others.

- Make all costs known up-front. If costs fall disproportionately on one stakeholder/party, a compensation mechanism could be negotiated.

Pitfall 3: High/uncertain costs. An initiative will lose critical support if the costs are deemed too high, or the costs are uncertain. If the costs are uncertain, participants will likely assume the worst-case scenario, which may delay a decision indefinitely.

Pitfall 4: Not thinking about user adoption from the start. Some initiatives take the approach "if you build it, they will come." Stakeholders believe the new functionality will be sufficiently appealing to attract users. Past experiences show that few participants are quick adopters, while some are slow followers, and most are change-averse. The community must think about adoption schemes early, in tandem with forming the community, setting the goals and scope, and procuring the ICT.

Suggested preventive remedies:

- Include all target users ("adopters") in coalition/community from Day One.

- Define scope so that every party sees meaningful benefits in short order.

- Do not proceed until "critical mass" of members makes firm commitments to adopt. This might be a "coalition of the willing" and not necessarily all stakeholders.

- Incentivize "leading adopters."

Pitfall 5: Weak ICT governance. Some sector participants think that a for-profit ICT vendor will produce the best outcome for a community project. This is rooted in the belief that such an entity will be more motivated to invest in high-quality, innovative software. While this might be the case, that benefit is almost always negated by the presence of a for-profit ICT provider that is the subsidiary of a dominant industry player (e.g., airline, ground handler).

Box 6. Cargonaut - Amsterdam's ACCS history and development

In the early 1980's, the Netherlands national government developed the "Mainport" strategy: betting on the country's airport as a transit point for goods, with a leading role in ICT and logistics planning. In 1986, the airport authority sponsored the "Schiphol 2000" study, advocating infrastructure investments, and speedy customs handling through digitalization between customs and commercial parties. The airport authority sponsored a pilot project to allow airline-forwarder e-communication, and later developed an IT system for import goods declarations, and an interface that allowed all commercial parties to interact with the customs system. By 1989, the system was widely adopted by most of the community, giving Cargonaut a broad "user base" for which to develop additional tools.

Several airports attempted to launch local CCSs, defining their own messaging standards, but those attempts failed. Cargonaut was already up-and-running with its services, giving it experience and the user base needed to be a fast adopter of IATA Standards. Cargonaut quickly became a full ACCS offering translation services and continued innovating by launching pre-arrival airline manifests in 1993 (more than ten years before WCO SAFE). This gave customs time to conduct risk assessments in advance, to speed up release of the goods upon arrival. This airline-customs IT service was very popular and was quickly adopted by most airlines.

Cargonaut became an independent company in 1996. For its first ten years, Cargonaut was operated by the ICT department of the airport authority. Then, in 1996 was partially privatized by distributing shares to the community, based on their usage of Cargonaut's services (cash was not paid to acquire the shares). Until recently, the airport authority owned 37%, KLM owned 15%, and another 13 shareholders own a combined 48% of Cargonaut. The Amsterdam community has been always broad and comprehensive. The community includes passenger airlines that carry cargo, express airlines, freighter airlines, freight forwarders, general sales agents, handling agents, truckers, and ICT providers. All these stakeholders are united by a single community organization called Air Cargo Netherlands ("ACN").

 A project can be led by any member organization, and the structure of the project will be determined by the participants. This decentralized structure can support numerous projects at one time and address a wide variety of business goals that benefit the community at large. Earlier projects included E-link (touchless truck slot management), Milk Run (truck pooling), Smartgate (speeds import clearances by enabling multiple regulators to make their release decisions), European Green Lanes (speedy export clearances via Amsterdam), and Venue (simplified pre-declaration for e-commerce). An idea can come from: a single member or sector councils but must earn support from the community to both win investment for development, but to also ensure adoption of the idea after the development is finished. Once an idea becomes a project, progress is shared transparently by the project manager to the overall community via the ACN organization.

Projects can receive funding from a variety of sources, often including government. The community organization (ACN) does not fund all the projects; it has only limited ability to contribute to project development, mostly by contributing employee time to help with project management. Sometimes the large, motivated members (like KLM or Rhenus, a large forwarder firm) will contribute staff time to a project, but they are never the single source of cash funding. Cargonaut may contribute substantial staff time to develop new software tools, especially when it expects to have its investment repaid after launch by user fees. One government entity that is a frequent funding contributor is the airport authority, which can tap its general fund for cargo projects. Lastly, the national government, through a variety of departments, invests in projects regularly.

Cargonaut is involved in most community projects, but it is never the leader. Cargonaut is involved in almost all projects, because almost all projects require ICT support. Nevertheless, Cargonaut is never used as the project leader. Based on members' opinions, while Cargonaut is an essential player in almost any project, Cargonaut must play a subordinate role of ICT service provider. Furthermore, even if ICT is needed for a project, it is not guaranteed that Cargonaut will be selected as the ICT provider (yet has almost insurmountable advantages because most new projects re-use existing information and they leverage the already-shared digital infrastructure).

Cargonaut also offers a regulatory Single Window. Cargonaut includes all trade-to-trade connections plus links to other enforcement agencies including Immigration, Health Care Inspectorate, the Inspectorate for Health Protection and Veterinary Public Health, National Inspection Service for Livestock and Meat and the Plant Protection Service. Because of this broad set of connections, it serves more than 600 customers, and deals with 70 million electronic messages annually. Cargonaut's B2G connections are not granted on exclusivity.

Box 6: Cargonaut - Amsterdam's ACCS history and development (continued)

Despite the community-based nature of the endeavor, different members expressed dissenting views about how costs are distributed, considering that largest members receive some form of "volume discounts". Some actors believe that innovations move too slowly, because the community prefers to see everyone move forward together (the "polder" model) rather than letting the most motivated parties drive the developments (the "front runner" model). Lastly, some are concerned that Cargonaut could lose focus on local developments. Consensus and high participation rates are the result of efforts by Air Cargo Netherlands (ACN), making it a pivotal player in the project. Nevertheless, there are two downsides to this drive for consensus. The first is slowness, because it takes a great deal of time to generate community consensus. Second is ACN's inability to drive projects forward, mostly because ACN needs to maintain its neutrality and avoid pushing/offending any members. To find project leaders, the community generally looks to the airport authority, or commercial organizations (airlines, forwarders, handlers) who wish to be a "front runner" and push the project forward.

All CCSs used to set their prices like phone companies, using the principle "sender pays" and varying the charges according to the number of messages and the size of the messages. Since then, the internet has removed the telephony costs from the equation, and websites run by forwarders, airlines, and others permit free-of-charge data entry. Given these developments, local ACCSs like Cargonaut now aim to set prices based on value delivered. That has been difficult to implement, because one company's price decrease must be another company's price increase. Pricing issues are a challenge even for a mature community like Amsterdam and a community-focused non-profit service provider like Cargonaut.

Cargonaut has undergone major restructuring. The main motivation was that the authorities sensed that the airport's strategy needed profound changes to reflect the critical role of data and its shared use. To that end, large investments were needed – that could best be undertaken by a public partner. Hence, the Royal Schiphol Group (a management company wholly owned by the government) took full ownership of Cargonaut in 2020. This was driven by the government's new digitalization strategy, which could not be achieved if the ACCS remained privately owned.

Box 7. Recorded Benefits of ACCS in India

According to Kale Logistics, the ACCS provider at Indian airports, several parameters can be compared before and after the implementation of the platform at Mumbai International Airport, as a proof of the benefits brought to the community at large. According to the statistics provided by the above-mentioned ICT vendor, the following benefits attributed to the project could be identified:

- The *number of documents handled* (copies included) dropped from 100 to 25

- *The average queue time* for document/payments was reduced from 1h to nil

- The *number of airport counters* required to process documents dropped from 9 to 1

- The *average time per export/import document* handling dropped from 22-28 minutes to a third of that

- *Accuracy of data* increased from 85 to 94 percent

- *Dwell time for export trucks* was reduced from 2 hours to 30 minutes

Source: Kale Logistics website.

Box 8. pre-existing conditions to successfully implement an ACCS

Pre-condition #1: Border control agencies (especially customs) are motivated and capable. Previously, we noted that Amsterdam in the 1980s had at least three government entities that were supportive. Among those, having a motivated and capable customs department (above others) is a pre-requisite. Other government support is helpful, such as from the national government, the provincial government, or the airport authority, and that support is especially helpful if funding is availed to support local digitalization initiatives. Nevertheless, this additional government support is not a pre-condition.
Pre-condition #2: Local champion exists. Any successful project has a champion behind it. A cargo community ICT project needs someone who can bring together the stakeholders, help them to agree on a vision/strategy, and then line up resources to make the project a reality. In the Amsterdam case, their champion was at the airport authority, which was a neutral (non-commercial) party that already had access to all the stakeholders.

Pre-condition #3: Air cargo supply chain participant want to improve. Both government and private parties must be motivated to either solve a common problem or seize a benefit. That motivation will drive the formation of a community organization and the selection of a goal. Perhaps, like Amsterdam, the airport participants feel the need to compete with a regional rival airport. Or perhaps they want to attract new foreign firms (and jobs) to the airport area, and the way to do that is to have faster exports or imports. Regardless of the specific goal, the participants at the airport need to desire improvement.

Suggested preventive remedies:

- One possibility is to consider creating a non-profit entity, owned by the community, to develop and manage the software (e.g. Amsterdam model). Such a non-profit would have a Board of Directors that represents the entire community.
- Create a strong community committee to govern the for-profit ICT vendor.
- At a minimum, a steering group must exist to control development priorities and costs.

Pitfall 6: Leaving laggards behind. The solution to be implemented should recognize the different levels of technology adoption across the entire stakeholder base. Whereas large players might have budgets to transform and lead IT investments, smaller players (especially in the more fragmented parts of the industry like forwarding, trucking, or brokerage), may not. Limited access to IT tools can jeopardize adoption by this wide base of users. Participation in a new system must not disrupt business continuity for big or small firms. The cost recovery of this development should be passed to users until investment costs are recouped.

4. Final Observations

4.1. Commonalities and differences with the seaport environment

4.1.1. Neutrality of community leaders

Cargo is the principal business of most maritime ports. For airports the opposite is the case. Transporting people is their principal business. This explains, in large part, why air cargo digitalization lags maritime cargo digitalization. There are only a few successful air cargo initiatives against a much longer list in the maritime sector.

Port authorities have played a much more active role in digitalization than their airport counterparts. In maritime trade they have driven the creation of the PCS as neutral parties representing the interests of all the port community as PCSOs. That has not been the case for airports. Far from cargo being central to business – as is the case in most maritime ports – cargo is often considered peripheral by airport operators and airport authorities. Cargo is frequently seen as an issue for "tenants" that lease airport space from the airport "landlord."

On the one hand, digitalization of air cargo operations has been held back by the lack of natural, neutral leadership in airport cargo community systems. On the other hand, change is often driven in response to regulation rather than voluntary adoption.

4.1.2. Coordination of physical movements

While airside operations are not covered by ACCS, landside operations are. As a result, landside access coordination and congestion are increasingly influencing the ACCS digital environment. Airports operate under shorter time windows. Facilities are limited by land availability and narrow access to landside and airside operations, creating major truck congestion. As a result, digitalization of truck queueing slots is quickly gaining ground. "Local" communities are striving to reduce truck process times to reduce congestion and costs. Major hubs like Amsterdam (and more recently Atlanta) have implemented such systems to control and organize truck traffic.

4.1.3. Time constraints and advance filing requirements

Airports face tighter turnaround times than ports. Even long-haul flights take hours to reach their destinations. Ships take days or weeks. That gives the maritime sector more time to transmit regulatory and other information. At airports the time between departure and arrival of cargo is much shorter. That increases the stress and strain on airports and supply chain participants. The increased atomization of shipments, motivated by the e-commerce boom, increases the challenge of dealing with documentation for the handling of the goods at airports.

Pre-loading filing requirements entering into force in the largest import markets will shake up procedures. This will also drive the use of digital intermediaries to comply with these new requirements. This could eventually become a catalyst for more and broader digitalization for ai cargo.

4.2. Trade-offs between global and local focus

Air cargo has experienced "waves" of top-down (global) and bottom-up (local) digitalization.

Both global and local initiatives have experienced successes and failures.

Global initiatives have set solid foundations for the industry. They have also been setback by limited adoption "on the ground."

Some "local" initiatives have been highly successful. Others have failed to take off. Fragmentation, a local rather than global approach and a lack of interoperability between systems are just some of the barriers to progress.

4.3. Regulations can also drive progress

The digitalization of air cargo has often been driven by regulation, from advanced filing requirements to a government's commitment to phasing out paper to replace red tape with more effective and efficient digital cargo handling. In fact, the overall success of any local initiative will remain subordinate to regulatory efficiency even in airports that have created successful communities. The experience in Latin America illustrates that this might not materialize until governments decide to (i) Align all actors in the supply chain to provide information under international standards. (ii) Use this data for the decision making and faster merchandise release.

Appendix

Table A1. Global Best Practice for import process

Step	From	To	Action	EDI Messages[6]
1	Airline	Ground Handler	Send all cargo details for incoming flight	At least FFM, FWB, FHL, FZB, FUM.
2	Airline	Customs	Import Cargo Declaration	Usually FFM+ FWB+ FHL; alternate is CUSCAR
3	Airline	Ground Handler	Notification that flight has arrived (movement message)	FSU with status code ARR ("arrived")
4	Ground Handler	Airline	Count pieces and check for damage, but do NOT reweigh. If shipment OK, then notify airline that shipment has been received.	FSU with status code RCF ("received freight")
5	Ground Handler (or Airline)	Customs	Notification of the arrival of the freight and its current location, if required.	Varies depending by Customs agency
6	Ground Handler	Airline	Handler updates tells airline that the paperwork is ready, and airline alerts forwarders via EDI.	FSU with status code NFD ("notified")
7	Forwarder	Customs	Import Goods Declaration and required docs, most often the Commercial Invoice and Packing List.	CUSDEC, INV, PCL
8	Customs	Ground Handler, Forwarder	Notification that goods are cleared, held, etc. Often called 'Customs Release Import'	CSN ('customs status notice') or CUSRES
9	Ground Handler	Airline	Goods loaded onto forwarder's truck, then notification sent that delivery is done.	FSU with status code DLV ("delivered")

Source: World Bank.

---

6   For a list of the most common messages used for air cargo, see IATA's *E-freight Handbook*, Version 4, page 56.

Table A2. **Non-exhaustive list of airport cargo community system platforms**

Airport	Solution	ICT operator	Description
Ámsterdam Schipol, AMS	Cargonaut	Cargonaut	Cargonaut as a community information platform, facilitates parties in the cargo supply chain with accurate, complete, timely and reliable information needed for seamless airport operations as orchestrator of information flows. Cargonaut manages the cargo community information platforms in the Netherlands and France. Working in close cooperation with local communities wanting to improve their airport collaboration and turnaround times. http://www.cargonaut.nl/
Mumbai, BOM	UPLIFT and GMAX	Kale Logistics Solutions	Kale Logistics Solutions Pvt. Ltd. is a leading IT solution provider focused on the Logistics and Airports industry. Its broad solution spectrum ranges from 'Internal Business Automation Systems' to 'Community Solutions' that help various players in the logistics value chain from shipper to consignee to communicate and transact with each other electronically. Kale's solutions help Freight Forwarders, Container Freight Stations, Custom House Agents, and Airport Cargo Terminal Operators achieve faster growth, standardized processes and operational efficiencies. They offer the ACS "GMAX" and also the Community Platform "UPLIFT" to enable a multi-modal unified electronic collaboration platform. http://www.kalelogistics.in/
Hong Kong, HKG	Tradelink	Tradelink (B2G) and Cathay´s GLS subsidiary (B2B)	Tradelink Electronic Commerce Limited is a leading provider of e-commerce services for Hong Kong business community (B2G). It was established in 1988 by eleven corporations. Since 1997, Tradelink has been providing Government Electronic Trading Services (GETS) for the trading community. In 2013, Tradelink set up a new wholly-owned subsidiary, Tradelink E-Biz Secure Solutions Limited (TESS) to take over Digi-Sign's non-digital certification related businesses. http://www.tradelink.com.hk/eng/index.html
Singapore(SIN	Rival consortia	Three consortia: Innosys Pte Ltd, Kewill Pte Ltd and vCargo Cloud Pte Ltd.	The government of Singapore has promoted the implementation of the paperless solutions to increase productivity and enhance the competitiveness of the air cargo industry: e-freight@Singapore. It was championed by the Civil Aviation Authority of Singapore (CAAS). The solution was developed by three consortia selected by CAAS and the Infocomm Development Authority of Singapore (IDA).
Frankfurt (FRA)	FAIR@Link	Dakosy	The CCS operator Dakosy implemetned "FAIR@Link" at Frankfurt airport. The first participants are companies that were involved in the development and test operation during the pilot phase: the global air forwarders DACHSER, Kühne + Nagel and Panalpina, the LUG air cargo handling GmbH and Fraport Cargo Services ground handling agents and Lufthansa Cargo and Fraport AG, the operator of Frankfurt Airport, which has a neutral cargo consignment area (NFÜP).The FAIR@Link platform provides automated process support: Truck Appointment, Customs Process, Security/eFreight and Hazardous Goods Management modules. Dakosy is currently implementing the next expansion to add additional modules. https://www.dakosy.de/en/solutions/ccs-airport/
Dubai, (DXB)	Calogi	Dnata	Dnata is the air cargo operator of Dubai Airport and is a government-owned handler (no other ground handler operates in that Airport). The subsidiary Calogi is a secure internet service portal that gives a one-stop platform for a range of air cargo businesses from around the world to negotiate and sell products and services online. It offers a multitude of services, including flight schedules and space availability, shipment tracking and stock management. https://www.dnata.com/en

Table A3. Historical summary of paperless global initiatives in air cargo

Initiative		Description	Date	Main Drawbacks	Current Status
Cargo Community Systems (CCSs)	Traxon	Lufthansa, Air France, Japan Airlines ("JAL"), and Cathay Pacific formed the "Global Logistics System" in 1990 with Traxon Europe and Traxon Asia. Traxon Europe was sold in 2011 to SITA's Champ. Originally conceibed to offer door-to-door services, but in 1992 abandoned these goals in order to get forwarders on board. It provides services of transmision and translation of messages.	Early 1990	Focused on airlines so the initiative lacks neutrality of the system, and did not involve all the stakeholders of the airport community.	Traxon was sold in 2011 to Sita Champ. Traxon cargoHUB is an engineered platforms (B2B) for worldwide electronic data interchange of the global airfreight community http://www.champ.aero/products/community-integration-services/traxon-cargohub/
				Forwarders opposed to CCS as they feared that airlines would make business directly with the shippers	
				Smaller airlines opposed as they thought that bigger airlines would steal their customers or may charge a fortune for the CCS services	
				Lack of neutrality reduced the CCS to a "Airline Data Relays".	
Cargo Media & Cargo 2000	Cargo Media	Cargo Media was a committee of 18 airlines sponsored by IATA in 1995, once airlines realized the limitations on CCS. The aim of the committee was to selecting one standard for EDI and promoting the adoption of that standard. The goal was to improve the usage of 4 messages (related to bookings and status update), by adopting a single global format and promoting the use of that format	1995	Narrow goals that were achieved quickly and integrated only by airlines	No longer operating. In 1997 the airlines voted to disband it and voted to form Cargo 2000
	Cargo 2000	This is a quality management system that was developed by IATA to assist airlines and freight forwarders monitor and benchmark delivery performance against their service promise, define common processes and procedures, and promote best practices. The C2K Master Operating Plan is an open resource free for airlines to adopt.	1997	A positive aspect is that airlines recognized the need of inviting forwarders as members of the committee. However, the ambitious vision led to a complicated wide scope that was beyond the capabilities of the airlines and forwarders. So, the aim of Cargo 2000 later was trimmed.	In 2016, the group changed its name to "Cargo IQ". Cargo iQ operates as a not-for-profit membership group supported by IATA. It currently has 82 members that include 33 airlines, 14 forwarders, 18 GHA, 11 IT companies, 3 airports and 1 RFS operator. http://www.cargoiq.org/
E-Freight		A multi-year program to create benefits for the entire supply chain and pursue paperless. The aim was to convert industry's documents to electronic messages, focused on global standards for the highest volume of documents and EDI messaging. Prior initiatives to e-freight were the development of the first EDI standard: Cargo-IMP in the 1070s, and the Cargo Paperless Transportation project (CPTP) in the 1990s.	2005	E-freight had the presumption that all stakeholders would use EDI messages either by a CCS or direct peer-to-peer communications. It did not consider a community-owned ICT solution.	The initiative is currently under execution. IATA has published the "e-freight Handbook 4.0" in 2013 as the latest version. http://www.iata.org/whatwedo/cargo/e/efreight/Pages/index.aspx
		A large pilot was conducted in 6 airports. First paperless shipment begin flown in 2007.	2007-2008	There was opposition from the forwarders who slowed the project, as they were concerned on the software development costs or CCS charges.	
		Global Air Cargo Advisory Group was formed as a grand coalition that include FIATA (Forwarders Association), TIACA (The International Air Cargo Association), a pan-industry conference operator and the Global Shippers Forum	2010	Stakeholders struggle with the ICT work needed to achieve E-freight. Without common system or common operating processes, each stakeholder must do his own process reengineering and pay for the ICT changes need to accommodate the new paperless processes.	

Initiative	Description	Date	Main Drawbacks	Current Status
	IATA narrowed the scope to focus on the Air Waybill "e-AWB". Montreal Convention 99 (MC99) and Montreal Protocol 4 (MP4) trade lines allow the use of an e-AWB, accounting for 80% of the cargo volume.	2015	Customs was identified as a major barrier of the implementation due to potential vulnerabilities in terms of the security level of data (Danciou and Franz, 2015). The study consider Ikarus Airways (IKA) and Pegasus Xpress Airways (PXA) as case studies	
	IATA introduced e-AWB360, which is an airport community-based approach to e-AWB implementation that aligns carriers, forwarders, and ground handlers around a common industry standard operating procedure and implementation plan. Schiphol was the first e-AWB360 airport.		IATA's e-Freight is not on-course to reach the developing world.	

Source: World Bank.

Table A4. List of documents required in air cargo supply chain

Air cargo manifest	Air cargo manifest A document issued by an aircraft operator, and available in hard copy or electronic form. This document contains the details of consignments loaded on to a specified flight and provides a list of all the air waybill and master air waybill numbers referring to the goods loaded on to an aircraft. The nature of the goods, weight, and number of pieces composing each consignment on a specified flight, and the unit of loading used, are also identified in this document.
Air waybill	A document prepared by or on behalf of a shipper that evidences the contract between the shipper and aircraft operator(s) for the carriage of goods over routes of the operator(s). Air waybills have several purposes, but their two main functions are as a contract of carriage (behind every original air waybill are the conditions of contract for carriage), and as evidence of the receipt of goods. An air waybill is the most important document issued by an aircraft operator either directly or through its authorized agent (freight forwarder), and covers the transport of cargo from airport to airport. Air waybills have eleven-digit numbers used to make bookings and to check the status of a delivery and the current position of the shipment. The first three digits are the aircraft operator prefix.
House air waybill	A freight forwarder offering a consolidation service will issue its own air waybill to the shipper, called a house air waybill, which may act as a multimodal transport document. The house air waybill and the forwarder's general conditions may be seen as a part of the contract between the freight forwarder and each shipper whose goods have been consolidated. There are two reference numbers on a house air waybill, the number of the master air waybill to which it is linked and the house air waybill number itself, which is always different from one freight forwarder to another, without limitations or standard digits, and which may be used to trace a shipment through the freight forwarder.
Master air waybill	Master air waybills are issued by or on behalf of freight forwarders offering a consolidation service. This document specifies the contract between a freight forwarder (or consolidator) and aircraft operator(s) for the transportation of goods originated by more than one shipper but destined for the same final State, airport or other destination. Master air waybills are linked to several house air waybills, and the master number can be used to trace a shipment with an aircraft operator.
Certificate of Origin	A specific form identifying the goods, in which the authority or body empowered to issue it certifies expressly that the goods to which the certificate relates originate in a specific State. This certificate may also include a declaration by the manufacturer, producer, supplier, exporter, or other competent person.
Consignment security declaration (CSD)	A consignment security declaration is a document used to establish the security status of cargo. It allows tracking of the security status of cargo and mail throughout its movement within the secure supply chain. This document helps to ensure that regulated agents, known consignors, and aircraft operators are held accountable regarding the security controls applied to cargo. A consignment security declaration, which may be in hard copy or electronic form, should be issued by the entity that renders and maintains the cargo secure. A CSD template can be found in the ICAO Aviation Security Manual (Doc 8973 — Restricted)
Customs release export	A document whereby a Customs authority releases goods under its control to be placed at the disposal of the party concerned for export (also called a Customs delivery note).
Customs release import	Same as above but for import
Dangerous Goods Declaration	Document(s) issued by the consignor or shipper to certify that the dangerous goods being transported have been packaged, labelled, and declared in accordance with the provisions of international standards and conventions.
Export cargo declaration (departure)	A generic term applied to the document, also referred to as a freight declaration, providing the particulars required by Customs concerning outbound cargo carried by commercial means of transport.
Export goods declaration	A document whereby goods are declared for export Customs clearance.
House cargo manifest	A document containing the same information as a cargo manifest as well as additional details on freight amounts, etc
Import cargo declaration (arrival)	Same as above but for inbound cargo
Import goods declaration	A document whereby goods are declared for import Customs clearance.
Invoice	A document required by Customs in an importing State in which an exporter states the invoice or other price (e.g. selling price or price of identical goods), and specifies costs for freight, insurance, and packing, as well as terms of delivery and payment, for the purpose of determining the Customs value of goods in the importing State.
Packing list	Documents specifying which goods are in each package

Source: WCO and ICAO, Moving Air Cargo Globally, Second Edition.

| Table A5. Best practices in EDI use for import air shipments

In Step 1, the Airline sends to the GHA all the details about the inbound flight, as if the GHA had direct access to the airline's computer system. The EDI messages usually include: (1) FFM: Flight Cargo Manifest, with flight information and list of air waybills; (2) FWB: Air Waybill information, including shipper, consignee, commodity; (3) FHL: for consolidation shipments, this is the list of "house" AWBs; (4) FZB: House air waybill details; (5) FUM: Container contents (AWBs and piece counts); (6) FSU: Flight Status Updates, with event codes like ARR (arrival).
In Step 2, the Airline makes an "Import Cargo Declaration," made up of three electronic messages: FFM, FWB, and FHL. A few Customs authorities may instead adopt the WCO's Cargo Declaration message, known as WCOCAR (data model 2) or GOVCBR (data model 3). Customs departments start working before flight arrival to identify which shipments will need physical inspection, and which shipments can be cleared after the importing party has filed a goods declaration.
In Step 3, the Airline system notifies the GHA that the flight has arrived. This is done by sending an FSU with the code ARR. At big airports this can be critical to make sure that crews are ready to get the goods off the flight and ready for Customs inspection and release.
In Step 4, the GHA brings the freight to the warehouse and conducts the "check-in process". For each AWB, the GHA employees inspect for damage and then count the pieces to confirm that all the goods have arrived. If the shipment details match the manifest, the GHA updates its computer system, which notifies the Airline by sending an FSU message with the code RCF ("received freight"). Ground handling rely completely on the weights that are transmitted electronically using the FFM (manifest) and FWB (air waybill) messages, although in some countries re-weighing is mandatory on arrival.
In Step 5, the GHA communicates with Customs to let them know that the shipment has arrived and it is available (in a specific location) for inspection. Surprisingly, there is not a global standard message for this activity, because the format is most often defined by local Customs to meet their needs and their coding scheme for warehouses and sub-warehouse locations.
In Step 6, the Forwarder is notified that the goods are on-hand. In the best case, the GHA updates the Airline system (with an FSU message with the code NFD), which transmits an EDI message to the Forwarder. In many cases, the GHA uses telephone or email to alert the forwarder, and then updates the Airline system with the time of the notification.
In Step 7, the Forwarder completes the Import Goods Declaration. This is not a single document; rather, it is a general term to describe all the documents required by Customs. The Import Goods Declaration is often includes these documents: house air waybill, Commercial Invoice, Packing List, and other trade documents. The requirements vary by country and by commodity.
In Step 8, Customs communicates the result of their review, using the IATA message CSN or the WCO message CUSRES.
In Step 9, the Forwarder collects the goods from the GHA's warehouse. When this is completed, the GHA transmits to the Airline an FSU message with the status code DLV for "delivered."

Table A6. Number of activities by use cases of ACCS

Use Case	No	Use Case	No
Track and Trace	12	Operational and Finance Reports	1
Additional functionalities	11	Consignee Master	1
EDI Interfacing	10	Reminder Notice Status	1
RFQ	8	e-docket - Download	1
Reports and Dashboards	6	Send Email	1
e-AWB	6	e-docket - Reject the uploaded documents	1
Payments	6	IGM	1
Vehicle token Management	6	Vehicle movement tracking	1
e-Booking	5	Numbering Master	1
e-Customs	5	Cancel ADO and Generate Credit Note	1
Slot Dock Summary	5	Organization Setting	1
e-Docket	4	SEZ	1
Check-in	4	Agent Credit Limit Configuration	1
AWB Stock	4	Ticker	1
Carting order	3	Reports	1
Delivery Order	3	Cancel CAN	1
ASI	2	ADO	1
Dock Configuration	2	Generate DO - Non Credit Customer	1
Slot Configuration	2	Bank Guarantee Configuration	1
Book Slot	2	Generate ADO	1
My Shipment	1	Status Upload	1
Ancillary Revenue Invoice	1	View Documents	1
Payment Handling Charge Master	1	Tax and GST &Master	1
BOL & DO	1	Weekly/ fortnightly Invoice Payment	1
Hold/ Release ADO	1	Audit Trail	1
ADO Charge Configuration	1	ADO Waive off Charge Configuration.	1
Operational and Finance Reports	1	Generate DO - Credit Customer (Credit)	1
Consignee Master	1	EGM	1
Reminder Notice Status	1	Website Management	1
e-docket – Download	1	Email Configuration Master	1
Send Email	1	e-Signature Master	1
e-docket - Reject the uploaded documents	1	Generate CAN	1

Source: ACCS vendor.

CHAPTER 13

CASE STUDIES: PORT COMMUNITY SYSTEMS

Introduction

This section of the study presents several case studies that were identified and examined for this project. The information presented in each of the case studies has been collected via primary and secondary sources at the time of the writing of this publication. The section presents eleven different cases involving both PCS and ACCS projects worldwide. The purpose of these case studies is to provide information and present some key examples across different types of economies and port environments and include some best practice learnings from each of the experiences.

The selected case studies include PCS and ACCS projects from different regions (Europe, Asia, Americas and Caribbean, and Africa), including small island states (for example New Caledonia). Each case study was conducted using the same terms of reference and broadly aimed to answer some key questions. These include the following.

I. **Project background and development.** The objective of this section is to define the rationale behind the development of the PCS or ACCS, identify the entity that acted as the PCS or ACCS concept ambassador within and outside the port or airport community, as well as the historical evolution and the key drivers of success for its implementation. This includes "soft" requirements, such as political will, and the collaborative (or lack of) culture within the port community.

II. **This section also includes a description of the PCS and ACCS project development before the go-live phase and the current set-up.** It includes, among others, information about the project design and preparation actions, the leading entity/agency, planned and actual timeline of development and deployment, identification of project sponsors and shareholders, length of the concession and other project cycle information.

III. **Legal Framework:** This section provides information on the legal framework within which the PCS or ACCS project was developed and is currently operational. One of the key questions answered in this section is whether new legislation or amendments to existing legislation was required for the implementation of the project and the time that this took.

IV. **Governance and business model.** This section describes the governance and business model of the PCS. It aims to provide insights into the role of various port stakeholders in the operations and management and the decision-making process and criteria used for the selection of the model in place.

V. **Financing and pricing model:** This section describes the financing as well as the operational funding model of the PCS. It covers the cost-coverage pricing model of the PCS and explains the structure and financial importance of various revenue sources i.e., user-fees and shareholders' budget contribution. Where possible, how revenue is allocated between cost-coverage and reinvested for improved operations, maintenance, and future service expansion, is also covered.

VI. Functional and technical architecture: This section describes the data platform architecture of the PCS and the core components of the system, including the: (a) application layer with the services; (b) platform with the facilities common to all services; (c) central database in which all the information that private companies and government authorities exchange via the PCS is gathered. ICT linkages to (a) hinterland ICT systems; and (b) the border management information systems[1] and; (c) Maritime Single Windows (MSW) and National Single Windows (NSW)[2] are also identified and explained.

VII. Benefits and impact. This section outlines the methods used to measure the performance of the PCS and the benefits enjoyed by the port community. The overall acceptance of the system during the different phases of development and adoption rate is also included within the scope of this section.

The way in which each case study has been compiled may differ slightly from the above format. Nevertheless, each seeks to relay the above and some key highlights are presented in the introduction and concluding sections for each. Each case study was restricted to between 6 and 8 pages and therefore only provide a summary snapshot of the projects in their totality.

It should also be noted that the information provided is to date as per the writing of the report and should therefore be taken as a snapshot of the level of development of each system at this time. In addition, the mention of specific operators or vendors or technologies is not implied as a formal endorsement of these systems over others available on the market.

---

1   Including Customs Information Systems (CIS) and ICT systems of other border authorities such as Sanitary Phyto-Sanitary (SPS), Standards Agency, etc.
2   As per the WTO-TFA and the IMO FAL Convention respectively

CHILE
SILOGPORT

Introduction

In brief

This case study covers the phased development of the PCS project at the port of Valparaiso, namely SILOGPORT, in Chile. The PCS in this case study was led by and financed by the Port Authority (EVP), which enabled a relatively high uptake and comprehensive view on the required scope and engagement with stakeholders.

The EVP in Valparaiso in Chile runs the port under a landlord model and is therefore considered independent of private sector interests. The Authority oversees two terminals at the port and the logistic area. The logistic area is called ZEAL (Zona de Extensión de Apoyo Logístico) and is an inland facility that operates as a mandatory stop for cargo and vehicles before entering the port.

The main function of SILOGPORT in the port is limited compared to other PCS solutions and is mainly to support the exchange of information between stakeholders for control of vehicles and cargo flows by the relevant authorities.

Why this case study is important

The case study is interesting for several reasons. The first is due to its focus on the automation and coordination of landside operations and its phased approach. One key system developer was contracted to develop the system over multiple phases yet the role of both the public and private sector in this development changed over time. The public sector gradually allowed more direct engagement by the developer to determine new require-ments for modules and functionalities.

The case study also highlights the importance of a gover-nance model that facilitates collaboration. This aspect was well understood by the EPV as it led the initiative to form the port community Foro Logístico de Valparaíso (FOLOVAP). This fostered cohesion and a common vision for the port among the stakeholders of the port of Valparaíso. This, in turn, supported collaboration on the project.

While an important case study for the region, there are still some limitations to the project compared to the full potential of a PCS. The system today mainly covers export processes rather than both import and exports, and overall cargo traceability remains a challenge.

Project background and development

The project in Valparaiso in Chile was initiated in 2007 by the EPV, namely the Port Authority. At this time, the EVP issued three consecutive contracts for the work. The development of the project was therefore phased, and each phase involved different responsibilities for the developer.

The company selected for all three contracts was Indra. Each contract followed a tender process. The first contract was issued in 2007 and aimed to develop the SI-ZEAL system.[3] The second contract in 2013 was to develop the SILOGPORT.[4] A third contract was then issued.[5] In the case of the third in 2021, the contract went beyond the deployment of the system and covered the development of SILOGPORT functionalities and an upgrade to cloud computing, and equipment deployment.

The EVP financed the project during development, and this was a fundamental factor in determining the success of this project, together with the involvement of the port community through FOLOVAP. Both these factors meant that uptake was relatively high considering that this is one of the first PCS projects in the region, estimated at around 75%.

The Ministry of Transport and Telecommunications (MTT) created a program in 2010 called the Maritime Port Program that is part of the Subsecretary of Transport to support all the aspects related to the articulation and public policies of the sector. The mandate of the program was extended to cover all modes and areas related to cargo transport and it was renamed the Logistics Development Program (PDL)..

Legal Framework

There are two key pieces of relevant legislation underpinning the project. These provided the legal foundation for the project by means of clearly specifying roles and responsibilities in the port environment. The first is the Law for the Modernization of the State Port Sector issued in 1997 (the latest version of the law was published in 2011). This law promotes the creation of the 10 state port authorities and the participation of private port operators or stevedores through concessions of port terminals. Alongside the above, the second is the regulations for the vessel call and quayside utilization. This is based on the Exempt Resolution No. 442 of 1999: Regulation of the Vessel Call and Quayside Utili-zation, RUFA (Reglamento del Uso del Frente de Atraque). This regulation presents the specific guidelines to coordinate vessel call procedures and regulates the utilization of the quayside, defining the priorities of serving categories of vessels.

---

3   https://www.indracompany.com/es/noticia/indra-adjudica-modernizacion-tecnologica-puerto-valparaiso
4   https://www.lainformacion.com/economia-negocios-y-finanzas/indra-gana-contrato-de-7-5-millones-para-modernizar-puerto-valparaiso-chile_ydCO55kgFjVo-YEvPNF6mm1/
5   https://portalportuario.cl/puerto-de-valparaiso-designa-a-indra-para-actualizar-plataforma-tecnologica-de-silogport/

In addition to the above, which remained unchanged for the purpose of the project, the project also benefitted from several procedural changes that were put forward to enable the initiative. These changes directly enabled streamlining of the processes and procedures at the port, which in turn, enabled the PCS to be implemented more effectively.

One of the changes implemented by EPV was related to the entry of cargo to the primary zone in ZEAL in 2008. This change meant that customs was no longer required to inspect cargo at the gates. This facilitated an agile gate-in procedure at ZEAL and the port terminals.

The second change was related to the authorizations given by Customs for the transit of cargo in the corridor between ZEAL and the port terminals.

The third change was related to tag readers. While the systems at the access point to ZEAL read the information from the tags of each truck, existing processes meant that it was anyway necessary to obtain the required authorizations from the Ministry of Infrastructure of Chile. By removing this requirement, the process was streamlined.

The process regarding changing the legal framework was relatively straight forward since the EPV did not need to modify any existing RUFA. These changes, therefore, did not generate delays in the project timelines as was the case in other case studies. All the required modifications and standardization were already possible under the existing set-up. The EPV linked each of the logistical business processes to the RUFA and generated the required procedures as an appendix. Furthermore, they incorporate some incentives to avoid inefficiencies in terms of additional fees. These changes did not require any modification to the existing regulation and the process therefore was faster than would have otherwise been.

That said, and more recently, the EPV implemented some adjustments to the seaside operations applying to the technological development and coordination mechanisms. At present, the EPV is working on the modifications of the coordination procedure to explicitly settle matters related to the truck appointment system, powers and duties when certain procedures are not fulfilled, and other procedures.

Finally, two guidelines for the management of port communities were recently published.[6] These guidelines complement the regulatory framework and provide further input to stakeholders in other parts of the country that want to implement similar projects.

This includes a document with guidelines and standards for the basic implementation of a PCS in Chilean ports and a Smart Port Guidelines report. These initiatives have been led by the Foundation Conecta Logística that is part of the Sub-secretary of Transport, with the support of the Corporation of Production Fostering (CORFO).[7]

Governance and business model

One interesting dimension of this case study is how the role played by the service provider Indra has increased over time. During the initial stages, the EPV governed the PCS and took decisions related to its design, requirements, and functionalities. In the last tender process, however, the role and mandate of the selected service provider, namely Indra, was increased to proactively recommend developments.

The above highlights the fact that while the project is essentially financed and led by the public sector, input from the private sector filters through several institutions. There is firstly a set-up that allows for stakeholder inputs through a "permanent" consultation process with stakeholders of the port community under the scheme provided by FOLOVAP.[8] Plenary meetings of FOLOVAP take place at least twice a year, and there are also regular meetings with ad hoc committees.

Furthermore, representatives of each stakeholder meet to consult on system requirements, which support the development plans of the service. There are also task forces set up to address specific issues and concerns to do with the use of the system by stakeholders.

Finally, there are also ad hoc meetings with stakeholders to discuss specific requirements and negotiate agreements that form the basis of regulations and procedures.

Financing and pricing model

There is no fee for the services and this, in part, explains the high uptake. As highlighted above, the PCS is financed by the EPV with the approval of the Budget Direction of the State of Chile (DIPRES) that belongs to the Ministry of Finance.

Moving forward, the EVP is now evaluating potential revenue sources that in the future could be offered as a "premium" membership with value added information that the stakeholders may pay for. The basic services will however remain free for users of the port.

6   https://comunidades.conectalogistica.cl/documentos/

7   https://www.conectalogistica.cl/transformacion-digital/contenido-destacado

8   FOLOVAP is the first port logistics community established in Chile and it is formed by 28 members that include logistics operators (bonded warehouses or empty container parks), shipping lines, rail and road transport carriers, custom agents, freight forwarders, the operators of ZEAL, TPS and TPV, representants of public agencies such as Customs, SAG and the Maritime Authority as well as two local universities.

Functional and technical architecture

Functional and technical development stages

As noted above, SILOGPORT offers traceability of cargo for the stage between ZEAL and the port terminals. Its scope is therefore relatively narrow. Processes related to the handling of empty container depots or bonded warehouse are not yet included as functionalities of the system. These are part of the new developments to be incorporated in the new version of the PCS, as well as related procedures to the vessel call process and seaside planning.

One of the key elements of the functional and technical developments of the system include the integration of legacy systems into the new PCS. In the first contract with Indra, as mentioned earlier, the systems already in place were integrated into this single platform. This was enabled by the fact that the concession of the operations in this early phase system did not include technological services. The EPV at this stage decided to have control over its development rather than leaving it to the concessionaire.

The above set-up also somehow facilitated the question of if and how to change the business processes covered by the system. The EPV conducted a business process management project under the collaboration with FOLOVAP. Eight logistical business processes were identified and assessed.

The integration of the shipping lines and the empty container depot was some of the most challenging dimensions of the project and applied during the second phase of development. Concerning the shipping lines, the task associated with integrating the booking process was complicated mainly because shipping lines were not aligned with the proposed changes. Although at that time, empty container parks were willing to collaborate, without the shipping lines the change was not possible. Furthermore, the shipping lines at that time did not participate in FOLOVAP that provided the space for consultation and incorporation of the points of view of the different stakeholders during the development of the PCS.

As of today, the latest phase of development, namely SILOGPORT 3.0, has been deployed. This version of the system includes the following characteristics and functions:[9]

I. Software for the PCS and Auxiliary Systems: The main software used is the PCS SILOGPORT 2021, contracted under the SAAS modality (software as a service).

II. Infrastructure to support logistics operations. This includes infrastructure assets such as access and exit gates, new display cameras, traffic management elements, and other elements coming under the category hard infrastructure at the port.

III. Links, networks, communications related infrastructure. This includes Multiprotocol Label Switching (MPLS) links, Internet, virtual private networks (VPN), communications core switch, access points, physical and logical networks, data centre, and cybersecurity mechanisms.

Interoperability (interoperability with customs)

There are several features of the existing system and planned activities that link the PCS with other functional domains such as the marine side activities and cargo flows. The table below summarises with what systems SILOGPORT is connected.

Customs Agents are the key stakeholders that interact with several systems and integration is therefore of particular importance. SICEX[10] is the Trade Single Window that makes it easier for users to process the requirements and procedures of the National Customs Service and other public agencies that participate in export and import operations.

SILOGPORT is currently providing more support to the export process than to importation. This is because there is a physical and logical connection of the truck with cargo at the gates of ZEAL, while for imports the truck arrives empty. The difficulty has been to integrate other processes for import cargo. For exports, SILOGPORT informs SICEX of the cargo loaded to the vessels and all the dispatching orders are validated with the Coarri messages, facilitating some procedures that are carried out by customs agents.

Cargo traceability remains a challenge. At present, there is not a single system in which the users can have traceability for the operations with empty container parks and bonded warehouses, which are aspects that the EPV aims to develop in a new version of the system.

---

9   Executive summary public tender implementation, start-up and support of services associated with the logistics system of the port community of Valparaíso, "SILOGPORT 2021". Public proposal 04/2021. www.puertovalparaiso.cl

10   https://www.sicexchile.cl/portal/web/sicex/quienes-somos

Table 1. Systems at the Port of Valparaíso 2021

Stakeholder	Main ICT System
ZEAL	SILOGPORT is the main system. SIGA for the payment processes related to inspections.[11]
TPS	The Terminal Operating System (TOS) is Navis N4.[12]
TPV	Own developed TOS.
National Customs Service	Customs Information System. It processes all the related documents and authorizations such as the DUS (Unique Exit Document), DIN (Unique Entry Document), Dispatching document (*Guía de Despacho* in Spanish) among others.
Agricultural and Livestock services (SAG by its acronym in Spanish)	*Multipuerto* System. This an online certification system for horticultural, forestry and propagation material exports. The system is enabled for shipments leaving the country.[13] For imports, the Imports System is used for the coordination of the required documents and inspections.[14]
Maritime Authority (Directemar by its acronym in spanish)	SIAN (Vessel Call Integral System) (*Sistema Integral de Atención de la Nave*). Online system that allows maritime users to carry out the necessary procedures required by the Maritime Authority under the trade facilitation agreement of the International Maritime Organization (IMO). Several of the current functionalities will be done by the Maritime Single Window VUMAR (now currently in a testing period).
Other public agencies (the National Fisheries and Aquaculture Services, the United States Department of Agriculture (USDA), etc.), Transport carriers, Customs Agents, Freight forwarders and Shipping lines interact by their own systems.	

Source: Self-elaborated with information from different web sites.

PCS and links with MSW

The Maritime Single Window in Chile is called VUMAR and was started in 2020. As of now, the PCS and VUMAR are only partially linked to one another but by the end of this year there will be a pilot project implemented and it is expected that it will be fully implemented by the beginning of 2024. SILOG-PORT does not handle information related to the vessels although it does have a data centre that keeps track of the vessels and related information. With the current version of SILOGPORT, the SIAN receives ETA and ETD and reports and forwards these to the NSW SICEX. In addition, a new module of seaside planning was developed by the EPV and integrated with Marine Traffic to obtain related data of seaside activities. This module was released in 2022 and will be integrated into SILOGPORT.

Impact of the PCS on performance

The EVP has analyzed the savings in time for the process, but it is difficult to translate it into cost, because some benefits are achieved by different stakeholders. It is difficult to estimate it for the port. Therefore, a formal cost-benefit exercise has not been carried out.

The EPV estimate that since the introduction of the ZEAL and the first system, SI-ZEAL, the logistics model of Valparaíso achieved a 70% of reduction of the performance time of trucks. The improvement on the operation allows the port to have more capacity to increase the volume transferred. It is important to note that geographically, the Port of Valparaíso is very limited in terms of capacity and land is scarce.

- Some of the main KPIs that are measured include:
- Transfer time per ton
- Service time at gates in ZEAL (average, per business process)
- Number of trucks waiting in a queue at the gate of ZEAL
- Number or rejected trucks at the gates of ZEAL
- Truck turnaround time at ZEAL (or permanence time)
- Truck turnaround time at the port system (ZEAL and port terminals)
- Number of trucks per attribute at ZEAL
- Number of trucks per vessel
- Number of escaped trucks
- Occupancy rate of the zone of rejected trucks
- Number of trucks per business process at the access road La Polvora
- Average transit time at the access road La Polvora per business process
- Number of parked trucks at ZEAL
- Arrival rate per business process and type of operation (import or export)
- Empyt trucks dispatched per empty container park
- Variance of the stock of trucks per unit time and process
- Vessel waiting time

---

11   Available at: https://www.silogport.cl/web/silogport/inicio
12   Available at: https://n4cap.tpsv.cl:8443/apex/cap.zul
13   Available at: https://www2.sag.gob.cl/exportaciones/multipuerto/
14   Available at: https://import.sag.gob.cl/Account/Login.aspx?ReturnUrl=%2f

PHOTO BY: © 2020 FELIX_FOTOS/SHUTTERSTOCK

Another KPI that is relevant, but not measured, is the vessel waiting time. This is currently computed manually. The process will be automated with the new module of seaside planning that EPV has recently released (September 2022), and it is expected that in the SILOGPORT 3.0 may be incorporated as another module in the future.

Key takeaways

The PCS in Valparaiso in Chile is a first mover example of PCS projects in the LATAM region. Financed and led by the public sector and particularly the port authority, private sector stakeholders were engaged and involved from the beginning. The role of the private sector increased over time.

While the scope of the PCS is mainly focused on vehicles and cargo flows by the relevant authorities, and mainly supports exports, the scope of the system can be expanded as uptake has been high and the benefits of the PCS at the port have generally been recognised.

Key highlights include the changed role of the PCSO over successive tender contracts and the relatively easier implementation process due to not having had the requirement of major legal changes to allow for the system to be implemented.

DEMOCRATIC REPUBLIC OF CONGO

SEGUCE DRC

Introduction

In brief

The case study concerning the Democratic Republic of Congo (DRC) represents a Trade Single Window (TSW) that includes a Port Community System (PCS) in Central Africa. Besides facing some challenges associated with being a large and geographically diverse country, the DRC also emerged from long-standing and deep social unrest, which in turn, negatively impacted improvements in transport infrastructure and trade facilitation.

Since the end of direct conflict in the country, however, authorities made efforts to improve the business climate by introducing multiple reforms, in particular on the facilitation of business creation by creating the Trade Single Window (TSW) and Port Community System (PCS), namely SEGUCE DRC.

The project to create SEGUCE DRC was launched in 2005 and aimed to reach completion in 2009. As described in the case study, the project faced a number of challenges, particularly related to uptake and coverage. Creating the enabling environment was a fundamental aspect of the project, particularly highlighted by the number of regulatory changes that were implemented to enable and foster the uptake as well as implementation.

Why this case study is significant

The case study provides an example of how a PCS can be developed in a relatively large country such as the DRC and implemented to achieve several objectives. These included fighting against fraud and falsification of documents and strengthening electronic data interchange (EDI) to make data more reliable.

As highlighted below, the implementation of the new system was challenging, partly as a result of the large size of the country. These constraints are multifaceted, and involve regulatory, technical, infrastructural, and security related challenges. Change management was a core element of the overall scope of the project.

In addition, the case study provides a rich account of the regulatory changes that were needed in order to enable the necessary legal and regulatory framework to implement the project successfully. While the changes to the law by no means resolved challenges around uptake in one go, the changes were pursued effectively and speedily, including making the use of SEGUCE compulsory by stakeholders.

Despite the above challenges, the initiative has moved forward, and a set of modules have been deployed. These cover pre-clearance and logistics. Furthermore, the implementation of the TSW and PCS within it is a crucial means to gather important information, which in turn, can be used to steer national policies on foreign trade and trade facilitation as well as to keep track and monitor trade facilitation indicators and performance.

Project background and development challenges

The objective and main driver of implementing a PCS in DRC was to simplify customs clearance operations, facilitate commercial transactions for economic operators and increase the state's revenue. Operations started at the end of 2015 with the pre-clearance module. Two years later, the PCS maritime logistics module for imports was put into service, and in 2020, the maritime logistics module for exports began. The PCS hinterland module on the other hand was deployed in December 2018 in Kasumbalesa, Haut Katanga. Its deployment in Lufu, in Kongo Central, was implemented in 2021. Finally, the air cargo community system (ACCS) module was implemented in September 2021 in Luano (Lubumbashi) and in Ndjili (Kinshasa) in January 2021.

SEGUCE has three components to it: pre-clearance, customs clearance, and post-clearance. The launch of each module is subject to the preparation of the list of requirements, which in turn need to be supported by a legal framework. As is required, the legislative process took place before the installation of the relevant new procedures on the platform. As discussed below, this involved a number of changes leading to delays in the progress of the project.

The development of these modules faced a number of challenges. The first was a change in government officials. It is often the case that after elections decision makers heading ministerial departments change. These developments tend to slow down the process. Despite these delays, the policy and regulatory framework that enabled the development of SEGUCE took two years (from 2014 to 2016). The effective start of activities was in 2016.

The second challenge was the resistance to change by stakeholders. Collaboration and involvement are crucial for the successful implementation of the project. To ensure this was achieved, the use of SEGUCE was made mandatory. Despite this, acceptance of the new system was not complete. Some stakeholders refused to use the system. To foster wider adoption, the Prime Minister has chaired meetings to urge administrations to comply with the regulations in force.

A third challenges was the interoperability between SEGUCE and other administrations. The Interoperability challenge includes a technological component that could be solved if the parties commit to working on the SEGUCE platform. As already noted, this has not been the case for some stakeholders.

A fourth challenge has been electricity outages and internet issues. Cases of electricity or internet interruptions are common in certain regions of the country. The Director General of Customs

and Excise (DGDA) resolved this issue by equipping its offices with generators. In some cases, for example, in Lufu in Kongo Central, solar power is being installed.

Security concerns have prevented the project from reaching all areas of the country. Comprehensive coverage of the entire country will not be achieved when certain areas are inaccessible. The town of Bunagana, in the east of the country, is one such example. Moving forward entities will need to assess the requirements to ensure that the solution reaches these areas.

Legal framework

Legal framework

As noted above the implementation of the system required a change to the existing legal framework in the country. The preparation of these regulatory texts was and is very time-consuming. Delays tend to be common. This preparation involves field missions to observe existing practices and the application of existing regulations. During these missions, personnel analyze the the processes and procedures to be digitalized. A series of meetings and workshops are then organized on site with the administrations concerned. This is also followed by training (concerning user and technical support) with public and private sector players. The new modules are then developed and tested before delivery to production. A pilot phase is planned for each module, by geographical area, site, and actor, before its implementation.

The overall process therefore was lengthy. To summarise, the first step was the implementation of a Government Decree[15] approving the contract for the design, implementation, and management of SEGUCE. Since then, the legal framework has been gradually supplemented by the following regulatory texts, including:

- Prime Minister's Decree No. 15/018 of October 14, 2015, on the creation of support structures for the project of the Single Window for Foreign Trade.

- The Prime Minister's Decree 15/019 of October 14, 2015, established the Single Window for Foreign Trade and established its mandatory use. This decree highlights the importance of SEGUCE through the objectives set out , in particular: i) The facilitation and simplification of foreign trade operations. ii) Securing revenue from the treasury and the various stakeholders. iii) Guarantee of the traceability of operations in the logistics chain. (iv) Transparency in the activities of the various stakeholders. (v) Reducing the costs and delays of foreign trade operations. vi) The reliability of data exchanged between partners.

- An inter-ministerial decree establishing remuneration for the use of the SEGUCE electronic platform.

- Inter-ministerial Order[16] on the harmonized procedures manual applicable to the TSW. This Order supplements the provisions set out by Decree 15/019 of October 14, 2015, establishing a TSW and PCS and adopting the applicable procedures and formalities, contained in the harmonized procedures manual. This manual includes pre-clearance and post-clearance formalities as well as customs clearance. The manual is meant to be regularly updated according to changes in regulations and recommended practices in foreign trade.

- Inter/ministerial orders covering the governance of the system.[17]

- Circular Note No. 001/CAB/MIN-COM/2016 of 19 April 2016 relating to the compulsory use of the platform for any pre-clearance operation for import, export, and transit of goods.

- Circular Note No. 001/CAB/MIN-COM.EXT/2017 of 20 January 2017 relating to the compulsory use of the platform of the Trade Single Window for all pre-clearance, post-clearance, and transit of goods in the Democratic Republic of Congo.

Following the above, SEGUCE was established as the only entry point for all foreign trade operations, namely:

I. All pre-clearance formalities relating to imports, exports and transit of goods in the Democratic Republic of the Congo.

II. The concessionaire, the administrations, services, and economic operators concerned are responsible for training, adapting internal procedures and the network equipment and computer equipment necessary for the optimal operationalization of the TSW.

III. Only the digital documents generated by SEGUCE would be admissible when declaring the goods to customs.

IV. SEGUCE DRC is responsible for reporting monthly to the Monitoring Committee and to the Office of the Minister in charge of Trade.

15 Decree No. 014/20 of August 2, 2014,
16 035 CAB/MIN/FINANCES/2016 and 005/CAB/MIN-COM/2016 of March 23, 2016
17 Inter-ministerial Order No. 001/C1B/MIN-COM/2018 and No. CAB/MIN/FINANCES/2016/004/ of February 18, 2016 amending and supplementing; Inter-ministerial Order No. 011/C1B/MIN-COM/2015 and No. CAB/MIN/FINANCES/2015/0257 of August 27, 2015 establishing a Steering Committee for the implementation and operation of the Single Window;

In addition, Circular Note No. 003/CAB/MIN-COM.EXT/2017 of 07 February 2017 relating to the mandatory use of the platform completed the previous note by announcing that the post-clearance component of SEGUCE was operational on the Matadi Beach and Matadi Gateway Terminal (MGT) sites. It invited the Foreign Trade Community to complete all post-clearance formalities relating to imports at the Matadi Beach and Matadi Gateway Terminal sites using SEGUCE.

SEGUCE DRC facilitation centres were established and are responsible for providing the necessary training to use the platform. This was fundamental in so far as processes and procedures used by stakeholders in the past needed changing. Firstly, shipping agents were required to submit the announcement of all calls on the SEGUCE platform. Secondly, new procedures for the port authority and stevedores included the registration of ship arrivals and departures, the transmission of unloading reports by electronic means, and notification of the collection of the goods needed to be done using the platform. Thirdly, customs brokers needed to follow-up on the status of pre-clearance document submission, customs clearance, fees due and identification of the carrier to collect the goods on SEGUCE directly. Finally, commercial banks were impacted in that the registration of payments due were registered on the platform.

Business Model and Governance

Ownership and shareholders

The management of the TSW was granted under the framework of a Public-Private Partnership (PPP). It was issued to the operating company of DRC Trade Single Window in the form of a public limited company (SEGUCE DRC SA).[18] Its shareholders include: GUCEL S.A.S. (Bureau Veritas Inspection Valuation Assessment and Control BIVAC B.V. and SOGET[19]), and the Congolese State.

SEGUCE operates under a 10-year concession. The objectives set out for SEGUCE DRC include:

- The reduction of risks, costs, and the shortening of processing times, by bringing together all the stakeholders in foreign trade at the same point.

- The reliability of the data exchanges, the guarantee of the traceability of operations in the supply chain and the increase in transparency between actors.

- Improving the efficiency of the foreign trade logistics chain by simplifying and accelerating procedures and formalities for the entry or exit of goods, including in transit and the possibility of working in tight flows.

- Increasing the administrative competitiveness of the DRC (International Trade and Place of Investment) in the processing of cross-border trade.

- Securing revenue from the Treasury and the various stakeholders.

- Improving sectoral visibility for authorities (reliable statistics and reports).

Governance structure

The Prime Minister's Decree 15/018 of October 14, 2015, established the governance conditions of SEGUCE by creating the two main support structures, namely the Oversight Committee and the Steering Committee. The Oversight Committee ensures the strategic management of the project and is responsible for: i) Validating the implementation plan for each phase of the project. ii) Validating the report of each phase of the project. iii) Providing the impetus, guidance and resources necessary for the smooth running of the project by the operator. (iv) Deciding on the measures to be taken and report to the Council of Ministers.

The Committee is composed of the Ministers in charge of i) Trade (ii) Finance (iii) Budget (iv) Economy and (v) Transport. Other participants include: i) A delegate from the Presidency of the Republic. ii) Two delegates from the Prime Minister's Office. iii) The Managing Director of the Commercial Company of Transport and Ports (SCTP SA). iv) The Director General of Customs and Excise (DGDA). (v) The Director General of the Congolese Control Office (OCC). (vi) The Director General of the Multimodal Freight Management Office (OGEFREM). vii) The Managing Director of the Federation of Congolese Enterprises (FEC).

The Steering Committee on the other hand coordinates the launch and monitoring of project implementation and is responsible for: i) Monitoring the implementation of the reform daily and reporting to the Supervisory Committee. (ii) Validating operator reports. iii) Providing technical assistance to the Oversight Committee in the processing of information and data. iv) Preparing draft texts to be submitted to the Supervisory Committee. v) Monitoring the implementation of the decisions and recommendations of the Supervisory Committee. (vi) Exercising the role of facilitator with the various stakeholders within the framework of the implementation of the reform.

The Committee is made up of:

18   *See Decree No. 14/020 of August 2, 2014, following the international call for tenders launched previously*
19   https://group.bureauveritas.com & https://www.bureauveritas.fr & https://www.soget.fr

- A coordinator and a deputy coordinator, appointed by inter-ministerial order of the Ministers in charge of trade and finance.

- A permanent technical secretariat whose members are appointed by order of the Minister in charge of trade.

- A group of experts appointed by the public bodies and associations involved in the SEGUCE project.

Financing and pricing model

SEGUCE DRC is financed by revenue generated by transaction fees. These are determined and regulated by the relevant Inter-Ministerial Order.[20] That said, the business is registered as a non-profit entity and revenues are therefore used to cover the costs of operating the service.

The TSW is based on the SOGET (S) One data collaboration platform, including PCS and TSW. The revenues that are generated are therefore in part used to cover the cost of installing the platform management system (S) One and its maintenance.

Costs are also incurred in the form of training. SEGUCE offers training to private sector users (importers or exporters) on how to use the platform, after which they can connect either from their office or at SEGUCE premises in dedicated rooms. This allows users that may not have access to hardware in their own premises to access the system.

From a governance perspective, costs are also incurred to manage the Oversight Committee. The resources for this come from budgetary allocations from the government, contributions from partners, subsidies, and counterpart funds.[21]

Functional and technical architecture

The functional scope of SEGUCE DRC includes different modes of transport (sea, land, air) and is complex. In addition, as already noted, three modules exist, namely, pre-clearance, customs clearance, and post-clearance.

The applied scope of the deployment testifies to the ability of stakeholders to move forward despite the challenges. These include regulatory constraints, technical (equipment of administrations for interfacing, availability of energy, access to the Internet network, etc.), reluctance of certain actors to change processes, and security issues in certain areas. Examples include the ports of Matadi, which are connected, but have challenges with connectivity. Challenges are also observed at certain

political levels. The implementation of the land module in certain regions encountered resistance for example.

The longer-term objective for the system is that it covers all border posts in the country. The facilitation centres will always remain accessible, given the level of domestic equipment for stable internet connections.

Benefits and Impact

Key stakeholders have reported definite benefits from the implementation of SEGUCE DRC. Firstly, the Office for Multimodal Freight (OGEFREM) suggests that SEGUCE DRC has sped up the time for processing customs documents, by simplifying and facilitating the process for users. This is significant because OGEFREM has recently invested in dry ports inland, which may benefit from the use of SEGUCE as well.

Secondly, the experience of the integration of the Central Bank of Congo, which was directly involved in the project, as well as banks, was also reported to be positive.

Finally, the system enables the collection and monitoring of important information that was earlier tracked. The analysis of this data enables national authorities to monitor the country's various foreign trade flows and take corrective measures if necessary. This includes the following:

a. Analysis of import and export flows

- The number of import and export declarations generated.
- The number of import and export declarations by country of origin.

b. <Analysis by type of actor and customs post

- Number of import declarations generated per city of issue.
- Number of import declarations generated per bank.
- Importers in the DRC.
- Number of import declarations generated by customs post and types of declarations.
- Transaction values per customs entry post.

c. DEB study and analysis by type of actor and customs post

- Number of DEBs generated by bank issuing city.
- Number of DEBs generated per bank.
- Number of DEBs generated per exporter and transaction value.
- Number of DEBs generated per exit post and type of declaration per customs post.

---

20 No. 005/CAB/MIN/FINANCES/2016 and No. 002/CAB/MIN/COMMERCE/2016 of February 13, 2016
21 This is governed by the article. 12 of inter-ministerial decree n°005/CAB/MIN/ FINANCES/2016 and No. 002/CAB/MIN/COMMERCE/2016 of February 13, 2016 cited above

PHOTO BY: © PCS OPERATOR | SEGUCE DRC, DEMOCRATIC REPUBLIC OF CONGO

d. Comparative analysis of import/export flows

- Number of licenses and their values.
- Analysis of licenses taken out by country and by value.
- Comparative analysis of the number of licenses and their values by actors (bank, importers and exporters).
- Analysis of flows by value and by currency.

Key takeaways

The DRC PCS is an example of the challenges posed by implementing a PCS in a large country with multiple often remote border posts. PCS projects with a wide functional and geographical scope face challenges that are unique to these contexts.

A key aspect of the enabling environment is the regulatory framework within which the PCS is implemented. In many developing countries, this regulatory framework does not exist and needs to be developed. A number of legal provisions need to be made and for this, internal alignment within governments becomes a key element of success.

Delays concerning the passing through of the necessary regulatory framework may in turn, lead to delays in project implementation. This is a fundamental risk that needs to be taken account of from the very start of the project and minimised as much as possible by seeking internal alignment from the outset.

While not all sections of the country are covered by the system yet, DRC SEGUCE is an example of how implementing a TSW and PCS has improved trade facilitation internally but also supported the successful implementation of other investments, such as dry ports. This is an important consideration in that not only a TSW and PCS can be seen as a means of improving existing processes and procedures but also enable a better success rate when it comes to future logistics projects.

DJIBOUTI
DPCS

Introduction

In brief

Djibouti has gone through a high-profile and large infrastructure upgrade and expansion in recent years, which included USD 1.5 billion of investments in its ports and free zone infrastructure. This has led to tangible improvements in the operations of the ports. Besides infrastructure, the other important dimension of improvement has been trade facilitation through digitalization and information technology (IT) systems. This is particularly aimed at enabling faster and more efficient exchanges of import and export documentation.

The implementation of the Djibouti Port Community System (DPCS) in 2017 was part of a wider initiative. The project was launched following instructions from the country's President to the chairman of the Djibouti ports and free zones authority (DPFZA) to set up an electronic single submission facility for import/export documentation.

As of today, the platform has been implemented through directives from the port and free zones authority and has involved both private and public sector stakeholders operating at ports in Djibouti.

Why the case study is significant

A key highlight of this case study includes its broad scope, including Maritime Single Window (MSW) functionalities. The solution covers the Port of Djibouti/Doraleh multi-purpose, Société de Gestion du terminal à Conteneur de Doraleh(SGTD), formerly Doraleh Container Terminal (DCT), the Port of Tadjourah, and Horizon terminal (liquid-bulk). It does not connect to any airport or land border ports. It does, however, include MSW functionalities. It has expanded to include exports, as well as imports, both for MSW and PCS functions.[22] For MSW functionalities, export was included later and became operational in 2019. For the PCS functionalities, export was implemented with some amendments requested by shipping agents who preferred auto-approval functionalities to reduce operational requirements on their side. This enabled port fees invoicing for export functionalities to be included and used.

In addition, the governance structure of the system in Djibouti is agile. The benefits include continuous improvement in the efforts of operator. There is no established or formal regulation concerning what the scope of the project should be. DPCS instead works directly with stakeholders to digitalise their services. This process requires integration with the stakeholders'

systems or the implementation of new modules. In both cases, approval and collaboration of the stakeholders is required. As highlighted in the case study, stakeholders may request new services as needed.

The impact of the DPCS has generally been positive and KPIs are in place to monitor this. A particularly interesting example of this is the improvements seen with respect to Harbour Master functions and operations.

Project preparation and development

As already noted in the introduction, the initiative that developed the DPCS began in 2017 was top-down and involved a decision issued by the President of Djibouti. Through this initiative the Port Authority was put in charge of the project. This then began a tender process where several PCS solution providers were identified and selected. At the time, Crimson logic was chosen due to the breadth of functionality offered and the pricing of the solution. Furthermore, the full ownership of the platform was a critical factor in the decision and favorable terms were only at the time offered by this company. Following a successful tender process, a new company, namely, DPCS was created to work with the PCS solution provider on the implementation of the DPCS System. The transfer of knowledge is part of the contract and is covered to enable the DPCS system operator to operate, maintain, and further develop the solution.

The Djibouti Ports and Free Zones Authority took the leadership role in the design and implementation of the solution. By doing so it created the DPCS company to collaborate with stakeholders to implement the solution.

Once the initial core of the system was developed, the government of Djibouti acquired a perpetual ownership license with access to the source code. This meant taking over the full intellectual property ownership of whatever was developed since it acquired the solution.

The development of the DPCS was planned to follow three key consecutive stages, including:

- Phase 1: Maritime Single Window (MSW) modules.

- Phase 2: Port Community System (PCS) modules.

- Phase 3: Other Governmental Organisations (OGA) and Business Intelligence.

As of the writing of this case study, the system has been developed, and integration with Asycuda has been achieved. In

---

22 Stakeholders did not use the PCS for export services until December 2022 (see attached DPCS statistics). However, shipping lines or agents use the MSW for electronic information exchange upon arrival, stay, and departure of vessels in Djibouti's ports (and thus export and import).

addition, shipping agencies, ports and free zones, and freight forwarders, are connected and use the DPCS through the system interface. The respective systems used by terminal operators have also been connected through EDI thus allowing for interoperability between systems. Five banks have also been connected for online payment.

Moving towards the complete implementation of the solution and continuous improvement of the platform, DPCS plans to digitalize stakeholders' services as needed. The services provided either involve the integration of the systems being used by stakeholders with DPCS, or the implementation of new modules. In both cases, approval and collaboration of the stakeholder is required and each implementation will go through the typical process of: 1) A gap analysis. 2) A design phase. 3) A development and build phase. 4) User acceptance and training, before going live.

It has been the case that stakeholders also request new services that are not in the original scope of DPCS. For example, Société de Gestion du Terminal à conteneurs de Doraleh (SGTD) port was able to suggest making the request related to the electronic delivery order (E-DO) module electronic and available through the DPCS. Freight forwarders can use this to request the delivery order online. While the E-DO module was

already available through DPCS, the request was earlier made physically.

Another example is that free-zone companies/operators requested digitalised administrative services, like company registration, visa requests, free-zone gate-passes. These have been made available by DPCS. In such cases, implementation is subject to priorities and capacity. There is no requirement on the solution provider to go beyond the general scope of the project plan.

Governance and business model

The DPCS is a publicly owned company set up as a special purposes vehicle (SPV) owned by Great Horn Investment Holding (GHIH), a public investment holding owned by the Djibouti Ports and Free Zones Authority (60%), and the Djibouti Sovereign Fund (40%).[23]

The platform so far has been implemented through regulation and directives from the port and free zones authority in collaboration with other regulatory entities. A number of Memorandum of Understandings (MOU) were signed with the most notable being:

---

23   Since June 2020, from the reserves built up, in addition to the returns from the portfolio of future projects and the optimization of the assets transferred to the fund, 40% of the shares held by the State in Great Horn Investment Holding (GHIH) were transferred to the sovereign wealth fund, FSD. The latter becomes a new shareholder of GHIH with a 40% stake.

- MoU between the Djibouti Ministry of Infrastructure & Equipment and the Ethiopian Ministry of Transport and logistics on cross-border data exchange.

  - It involved integrating DPCS platform with the Ethiopian logistics systems to exchange real-time information on transit cargo transportation.

- Partnership agreement with the Directorate of Vocational Training of the Ministry of National Education and Vocational training.

  - Introduction of a practical vocational course based on the DPCS platform for the vocational college students in logistics before they join the workforce.
  - The role of DPCS was to train the vocational colleage teachers and set up a clone of the DPCS platform for student training.

- Partnership agreement with the National Office for Statistics.

  - DPCS to provide access to its business intelligence module for the National Office for Statistics staff.

- Partnership agreement with the Association for the Development of Port, Logistics and Transport Professions.

  - Provision of continual DPCS training for the ports and logistics staff.

- In addition, DPCS has SLAs and user agreements in place for all its users.

Public and private sector entities are involved in the governance of DPCS through the board of directors. The composition of DPCS Board is made up of the following:[24]

- DPFZA Chairman.

- Representative from the Ministry of Transport Infrastructure.

- Representative from the Ministry of Digital Economy and Innovation.

- CEO of Djibouti Sovereign Fund.

- CEO of Djibouti Ports Corridor Roads (Corridor Road Agency).

- Chairman of shipping agents' associations.

- Chairman of forwarders' associations.

A port community meeting is held every three months between all port community stakeholders, including Customs. During these meetings, bottlenecks are identified and discussed and those requirements are submitted. A working group is set up to follow each module.

Port operators are represented by Djibouti Ports FreeZones Authority in the DPCS Board of directors. Furthermore, the Djibouti Sovereign Fund is also included. These two entities make up the general assembly of shareholders in all the ports. This is particularly relevant for discussions and decisions related to pricing (i.e., user fees and shareholders' budget contribution, the selection of PCS developers).

The set-up is rather flexible, allowing for an agile work-flow. This is enabled by the fact that DPCS has a contract with all users and integrated parties. Each party in the contract has responsibilities and liabilities where the agreement is breached. This allows DPCS to implement new modules or services without needing the unanimous approval of all the stakeholders on the board.

Financing and pricing model

The cost of the DPCS is estimated to have been approximately USD 5 million. One million of this sum was constituted by shareholder investments and the rest covered by debt financing. Currently, operation costs are subsidized until DPCS can recover all its costs from the platform users.

The fees and charges are first set by the Board of Directors and then negotiated with user groups. Fees do not necessarily cover implementation costs in all cases. As a result, the DPCS prioritizes which module is to be implement based on the value to the port and logistics community regarding cost or time reduction.

Tasks that are regulated to be performed by DPCS (mandatory) are normally free of charge. That said, optional services are charged for at a pre-negotiated fee. For any functionalities to be chargeable, they must first demonstrate a value added to customers' logistics operations. Then the benefitting party will be asked to pay an agreed upon fee.

Applicable fees include back-end integration and licensing fees covering external system integration, which are paid annually. There are also annual connection fees for shipping agents and free-zone companies.

Functional and technical architecture

The functional architecture of the system includes three main areas of activities, namely OGAs, Customs, and hinterland transportation. The integration with stakeholders that are connected to the system takes place through secure application

---

24   The designation of the Board of Directors members was updated at the last General Assembly on January 25, 2023

Table 2. **Scope DPCS**

S/N	Djibouti Port Community Systems - Terminal Operator Services	Status
ARRIVAL REPORT MODULE		
1	Impending Arrival Report (IAR)	Completed
VESSEL MANAGEMENT		
2	Vessel registration	Completed
3	Vessel service route	Completed
4	Vessel schedule	Completed
VESSEL ARRIVAL/DEPARTURE MANAGEMENT		
5	Berth Application	Completed
6	Vessel operation invoicing (marine charges, stevedoring)	Completed
7	Vessel operation request (Piloting, Mooring, shifting…etc)	Completed
8	Dangerous goods déclarations	Completed
9	Crew List	Completed
10	Passenger List	Completed
11	Health declaration data	Completed
12	Hydro Carbon Declaration	Completed
13	Security Declaration	Completed
14	Vessel movement data (anchorage,piloating,shifting etc…)	Completed
15	E-Port clearance	Completed
MANIFEST MODULE		
17	E-Manifest	Completed
18	Co-loader Manifest	Completed
19	Manifest Amendments	Completed
20	Manifest integration with ASYCUDA World (Djibouti Customs)	Completed
21	Custom Waybill Print	Completed
CARGO MANAGEMENT		
22	Electronic Bayplan module	Completed
23	Loading / unloading list	Completed
24	Nomination of second carrier	Completed
25	Electronic Delivery Order Module	Completed
26	Online Port Fees Request Module	Completed
27	Transport Order (Merchant Haulage Mode)	Completed
28	Booking of Delivery / Receiving time slot	Completed
29	Pre- Gate details/print	Completed
30	Equipment interchange Print	Completed

S/N	Djibouti Port Community Systems - Terminal Operator Services	Status
	ARRIVAL REPORT MODULE	
31	Freight booking	Completed
32	Freight booking Confirmation	Completed
33	Container booking confirmation	Completed
34	Delivery of nominated container	Completed
35	Shipping Note	Completed
36	Transport Instruction	Completed
37	Packing List	Completed
38	Container storing order	Completed
39	Release Order	Completed
40	Container Delivery / Receiving Gate Schedule	Completed
41	Customs declaration submission	Pending
42	Integration with ASYCUDA for container release	Pending
	CORRIDOR SERVICES	
43	Corridor permit request/print	Completed
	Free Zones Administrative services	
44	FZ company registration	Completed
45	CNSS Application (Social security)	Completed
46	Visa request	Completed
47	Residency request	Completed
48	Work Permit request	Completed
49	Exoneration request	Completed
50	Administrative invoices	Completed
51	Renewal of license	Completed
52	FZ gate-pass	Completed
	BUSINESS INTELLIGENCE & REPORTING	
53	Business Intelligence Module (Dashboards, data visualisation, reports)	Completed
	track & trace	
54	Vessel Tracking	Completed
55	Gate-in gate-out tracking	Completed
56	Truck tracking corridor	Completed
57	Train voyage Tracking	Pending
58	Invoice verification	Completed
59	Container Tracking Full Details	Completed
60	Manifest operation tracking (documentation tracking)	Completed

programming interfaces (APIs). The scope of implementation for each service is depicted in the following table. As shown below, business intelligence and track and tracing is included in the scope.

Benefits and impact

The perception of stakeholders regarding the impact of the PCS in Djibouti is reportedly positive. For most users, DPCS facilitates the process of sharing the necessary information between traders and authorities. It improves transparency in business, increases efficiencies of business (processes, transport), and minimizes trade transaction costs and time.

A particularly good example of the impact is the way in which performance has improved for the office of the Harbour Master. Before implementation the office lacked an information system. Everything was done manually and communicated by email. After the implementation of the system, operations are better integrated with one another, improving performance. The billing system is also now connected with customers, allowing easier billing. The office also achieved a digitized process with faster response times.

In addition to perception-based evaluations, the DPCS has developed key performance indicators (KPI) to evaluate and monitor its performance. Examples of such KPIs include the average response time of responses by public sector entities and harbour master services.

While the benefits of implementing the system have generally been recognized by stakeholders, there are yet some challenges to full implementation by some stakeholders. In some cases, for example Customs, resistance to change applies and in particular there has been a tendency not to prefer electronic documents over paper since it appears to reduce autonomy over decision making by officers.

In addition, the implications of charging fees for some functionalities represent a barrier to uptake. Using online payment functions, for example, are not free. Shipping agents have expressed interest in using the service but only if it is free or available at a low cost (currently reduced from USD 5 to USD 1).

Key takeaways

The system implemented in Djibouti includes functionalities of a PCS and an MSW. Uptake has been high and the system is used by most ports and freeports in the country. All operational ports (DMP/PDSA, SGTD and Tadjourah Port) and most free zones (DFZ, EAH, UKAB) are integrated.

The way in which the project and PCSO are structured and governed allows for flexibility and continuous improvement. Red tape is eliminated or at least minimised by not pinning down the specific scope of the solution and instead allowing stakeholders to provide feedback and input about their requirements and request new functionalities.

The impact of the DPCS has generally been positive and KPIs are in place to monitor this going forward. A particularly interesting example of this is the improvements seen with respect to Harbour Master functions and operations. Customs, however, has not completely endorsed the digitalisation initiative and work still needs to be done here.

INDIA
AIR CARGO COMMUNITY SYSTEM

Introduction

In brief

Five of the top airports in India have implemented Air Cargo Community Systems (ACCS), covering the bulk of the international air cargo traffic in the country. With some differences in their implementation and facilities, they cover a broad range of services, connecting the shippers, consignees, freight forwarders, airlines, ground handlers, warehouse operators, aviation security and customs. The Indian case study represents the story of a rapidly expanding and relatively mature air cargo ecosystem covering several large airports.

Why this case is important

There has been active sharing of innovations and good practices between airports. The case study charts the development of ACCSs in four major airports: Mumbai, Delhi, Bangalore, and Chennai. The case study illustrates the diversity of players, interfaces, and implementation challenges. The industry benefited from lessons learnt from early implementations in Mumbai. This enabled smooth implementations in Delhi, Bangalore, and Chennai.

The Indian experience underlines the need to implement ACCS at scale. While the airports' cargo flows are secondary to passenger flows from a revenue and business perspective, air cargo in India has achieved scale, requiring close cooperation between stakeholders to coordinate cargo flows across airports. The Indian case highlights the importance of scale in ACCS adoption.

The case also highlights the need for transparency in governance frameworks, especially for setting the user fees. Stakeholders value institutional transparency, fairness, neutrality, and accountability, all of which are fundamental to ensure longer-term sustainability and system effectiveness in ACCS projects.

Government's encouragement with a focus on trade facilitation and paperless trade, and backing at the policy, planning, and administrative level, is crucial. The Government of India backed ACCSs by clearly articulating it in the National Civil Aviation Policy (NCAP). It included ACCS implementation in its National Trade Facilitation Action Plan and engaged high-level executives to monitor the projects under the e-Trade program.

A strong local technology ecosystem, familiarity with EDI, a knowledge base that is rooted in technology and industry (IATA) standards proved to be helpful. The effort to build cargo community systems began in 2010 with the privatization of India's major airports. The impetus to introduce electronic data interchange

(EDI) in the air cargo community began in the early 2000s. This is when the government engaged with the air sector, involving customs, 'custodians', airlines, and consolidation agents to establish an extensive electronic message set. Although it took close to a decade to implement the messages, the industry used this period to familiarize itself with the digital facilities. When ACCSs were introduced at different airports, the transition was not difficult.

Large developing countries with more than one major air-hub may find it difficult to coordinate between multiple local solutions at different stages of development. Replacing these and forcing the transition to new systems can face strong resistance. In the Indian case, this was tackled by making the use of the system compulsory. The effective monopoly held by large airports on the regional air cargo markets meant that the users had to adopt the respective ACCS systems. The Indian experience therefore indicates that market-power of an airport or Cargo Terminal Operator (CTO) can be a major driver for adoption of any solution. Timely intervention and oversight by the Airports Economic Regulatory Authority of India (AERA) ensured that user charges imposed by cargo terminal operators are community determined, reasonable and justifiable.

The annual Time Release Studies (TRSs) published by the government confirm fast release times achieved in airports that have adopted ACCSs. While the overall dwell time of air cargo has improved across the board in India, the airports with ACCS have a clear edge with most cargo getting cleared and delivered within 48 hours of the aircraft's landing.

Finally, wider adoption of ACCS in developing countries may face constraints associated with IT skills of users and financial means. In the Indian case, both issues were catered for. ACCSs provided multiple options to users such as basic web interfaces, IATA CargoIMP messages and API-based integration for more advanced users.

Project preparation and development

The planned implementation of ACCS in India has its roots in the early adoption of cargo terminal operating systems (CTOS) by major cargo terminal operators in the early years of the 2000s. At this time, all major cargo terminal operators/custodians had their own CTOS. Although these systems were broadly capable of digital message exchange in IATA standard Cargo-IMP format[25] with airlines, their functionalities were nevertheless limited. This coupled with the fragmented nature of the solutions together with lagging performance standards in airports in India created the enabling environment for the ACCS projects. As discussed below, however, the fact that CTOS already had systems in place, posed a challenge to the introduction of a more comprehensive and advanced ACCS, partly because processes and procedures

---

25   Cargo Interchange Message Procedures (Cargo-IMP)

had to be changed, and partly because certain revenue streams would have been impacted by the change in systems.

As noted above, ACCS in India was predated by CTOS. These systems were linked with airports as well as with the Indian Customs Electronic Gateway or ICEGATE, which is the national portal of Indian Customs. One of the earliest of such CTOS was ICMS (Integrated Cargo Management System) developed by the Airport Authority of India (AAI). AAI is the public sector airport operator in India which operated some of the major cargo airports, i.e., Delhi, Mumbai, and Bangalore until their privatization[26.]

In 2012 the government set up a working group to examine the overall functioning of the air cargo industry in India and propose reforms[27.] One of the key findings was that Indian airports continued to have higher dwell time for cargo compared to the major air hubs in Asia/Pacific. Another observation was related to developing the institutional frameworks for developing operational and service-related standards for air cargo operations and associated monitoring mechanisms. Other policies also strengthened the case for the ACCS. The National Civil Aviation Policy (NCAP) was published in June of 2016. Of particular interest are paragraphs 20c and 20d of the NCAP[28]. Paragraph 20c states that: "The government will streamline and simplify Customs procedures and ensure a shift to paperless air cargo processing through use of digital signatures for transmission of messages." This was in alignment with Government's overall focus on doing business reforms and trade facilitation and would also be reflected in the National Trade Facilitation Action Plan (NTFAP) announced in 2017[29.]

Additionally, other drivers for the decision to move forward with an ACCS in Indian include the following:

a. Discussions were held at the level of the National Committee on Trade Facilitation (NCTF), which was established as per Article 23.2 of the WTO Trade Facilitation Agreement established in August 2016. Issues related to the working of air-cargo facilities, and associated operational and trade facilitation challenges, and the need to improve performance of major Indian hubs compared to some of the large air hubs in the Asia-Pacific region were discussed in this forum.

b. Another driver was additional revenue streams. Airport operators/custodians quickly realized that the eco-system was largely willing to pay for value-added digital services

for faster and improved services, and this represented a strategic revenue stream. The Airports Economic Regulatory Authority of India (AERA) ruling in 2016 in the case of Mumbai ACCS accepted the principle that such digital systems were in fact an aeronautical service that could be charged to users, albeit in a transparent manner and subject to oversight. Airport operators/custodians, and their technology partners were fully aware that with passage of time better and more customized service to their users would represent an opportunity.

c. Indian airport operators were also aware of the digitalization initiatives in counterpart airports like Singapore, Hong Kong and Busan, and the extent to which these initiatives had helped support business process rationalization and operational efficiency. Digitalization, and associated benefits had been a key topic of discussion in major international forums such as ICAO, AITA, FIATA and UN/CEFACT among others.

d. There were also specific local pressures and challenges faced by some of the Indian airports including congestion and infrastructure constraints that led to revenue leakage.

In view of the above, the Ministry of Civil Aviation set up a Committee on Air Cargo Community Systems in July of 2016[30.] This Committee was tasked with developing key recommendations for the future trajectory of ACCS in India [31.] The key conclusion of the Committee was that a Single Window system for a uniform interface between all air cargo community systems using international standards was highly desirable[32]. However, recognizing that the CTOs had already invested heavily in their individual CTOS, the Committee suggested a more flexible approach towards development of a centralized national ACCS. In conceiving of a national ACCS, the Committee noted that stakeholders have invested in creating their own systems and own community platforms and recommended that "these (CTOS) may be harnessed as much as possible"[33.]

The Committee also recommended comprehensive business process re-engineering to address these gaps. To drive greater harmonization between existing systems, and with future inter-operability among these different CTOS in mind through a national ACCS layer, the Committee recommended that existing industry standards like IATA CarIMP, XML, and WCO data model should be leveraged for its design. Towards that end the UN/CEFACT Model 2 i.e., "Single Automated System for Collection and Dissemination of information via interfaces with existing

26 Delhi and Mumbai airports were privatized in 2006. Bengaluru International Airport was a new PPP development to replace the older government owned and operated HAL airport in that city
27 Air Cargo Logistics in India: Working Group Report, May 2012
28 National Civil Aviation Policy 2016, Ministry of Civil Aviation, Government of India, pg. 28-29
29 NTFAP
30 Constitution of a Committee on Air Cargo Community Systems, July 18th, 2016, No. AV-16026/91/2015-ER, Ministry of Civil Aviation, Government of India
31 Report of the Committee on a National Air Cargo Community System (ACCS), December 22nd, 2016. Ministry of Civil Aviation, Government of India
32 Ibid, pg. 4
33 Ibid pg. 5

systems" be used for the national ACCS. In this model, there is a single system that collects, converts, and disseminates digital data about shipments and the data must be submitted only once. It was the view of the Committee that the existing systems could be interfaced using this model and the new requirements could be built-in/integrated directly in the national ACCS.

Governance, business model, and impact on adoption

While the ACCS implementations brought in procedural benefits and operational efficiencies even in the earliest stages of implementation, some stakeholders opposed its compulsory use and raised a dispute in AERA on the fees charged by a portal. At AERA, some of the users argued that the digital services provided by the portal were part of the overall terminal processing activity and should be treated as 'aeronautical services', which are subject to AERA oversight. AERA ruled that:

a. ACCS-related digital service charges are subject to regulatory oversight. Service provider should regularly file the schedule of charges with it.

b. ACCS charges should be arrived at through a transparent process of consultation and approval.

The above case illustrates the impact of fees and charges on adoption rates and point to the need to establish a consultative process that ACCS operators need to follow while fixing fees and charges. While cargo terminal operators need to charge user fees to recover the cost of system development and deployment, there may be the need for regulatory oversight when such charges are made mandatory.

The Working Group on Air Cargo report in 2012 recommended the formation of an Air Cargo Logistics Promotion Board (ACLPB) that would act as the effective stakeholder community and the National Trade Facilitation Action Plan. The report also recommended that this ACLPB develop appropriate standards and benchmarks for various services offered by CTOs and airports and fund the means for monitoring them to ensure greater accountability. The National Trade Facilitation Action Plan (NTFAP) 2017-20 made this recommendation into an action item[34.]

Functional and technical Architecture

The development of the technical aspects of the system benefitted from the presence of local technology firms and experts that combined domain knowledge of air cargo operations with advanced digital systems proficiency. These firms had the expertise to draw from international technological standards, as well

as process related standards, such as IATA's e-freight initiative and standard messaging frameworks, while also customizing the system functionalities to meet local requirements or address specific local operational issues. These firms also played an important role in building awareness within the larger eco-system about the need and benefits of such ACCS.

The ACCS was developed in the context where digital advancements were taking place across multiple operations and agencies. By 2016 most stakeholders were using and interacting with each other using digital means. The same period coincided with rapid improvements in Indian customs systems. The Indian customs comprehensive single-window project, SWIFT (Single Window Interface for Facilitating Trade) was launched in April 2016, and several of its advanced features started to become operational over the next few years. This included the e-sanchit portal launched in October 2017 that allowed the uploading of digital versions of paper documents required for customs clearance to facilitate a mostly paperless experience.

In addition, like in many other countries, courier operations tend to use their own systems rather than using the generic ACCS or CTOS used for general cargo. In India, global consolidators like DHL, Fedex and UPS have their own dedicate space in Delhi or Bangalore or use a common terminal managed by their industry association, Express Industry Council of India (EICI) in Chennai and Mumbai. Other express companies use the common user facilities of EICI in all of these four major airports. Express customs clearances also take place in a separate dedicated customs system called ECCS (Express Cargo Clearance System). Express operations therefore have minimum interface with airport/custodian managed ACCS, and they continue to use their own dedicated operating systems.

For advanced users, the Indian ACCSs have established sophisticated systems that require different services and functional solutions. For example, some ACCSs have the provision of bulk-data upload for those users who do not or cannot go for API-based integration. Most importantly, Indian ACCSs allow for very basic email-based interaction with the ACCS and submission of pdf documents that can be converted into data using machine learning capabilities available in the ACCS. These features have allowed a wide range of users with different capabilities to work with the ACCS, helping adoption and use. In addition, the availability of multiple features for freight forwarders and other stakeholders underscores that the benefits are not unidimensional, i.e., not designed solely for the CTOS alone.

ACCSs continue to adapt technologically as requirements develop and change. The cargo terminal players in the major airports, i.e., Delhi, Mumbai, and Chennai continued to further enhance the digital capabilities of their systems. Delhi International Airport (DIAL) launched its ACCS (called ACMES) in 2018. Bangalore Airport

---

34 Item no, 30 in NTFAP 2017-20, pg. 23

launched its own ACCS (called CargobyBLR) in phases in 2020, with full roll-out achieved by May of 2022. In Chennai, AAI has been operating its ICMS CTOS since 2002, and carried out enhancements to it during the pandemic. MIAL launched a mobile app version of their ACCS in Mumbai in January 2016. DIAL launched a QR code enabled e-gatepass for truck entry in July 2020.

Benefits and impact

While there have been different opinions on the usefulness of some of the functions of the ACCS in India and discussions on whether the user costs are justified, there is also a consensus that ACCS has led to operational and procedural improvements. These include the following:

The enabling of advance submission of cargo information. This is especially critical in space-constrained urban settings like Mumbai, allowing operational efficiency in the deployment of human resources and equipment. Over time, algorithms and predictive capabilities were developed and applied to optimize the overall throughput of the terminal.

Efficient management of truck entry into cargo terminals. The ACCSs enabled a more organized truck entry process and shorter waiting times for trucks outside terminal gates by implementing an online time slot allocation system. This removed problems related to lack of transparency and of 'fixing' favorable time slots by agents at the expense of others. Having advance information on the number of trucks to expect in given time slots also helped management of internal truck docking bays within the terminal and rationalize the traffic within the terminal. These are critical gains, as the chaotic traffic inside terminals could also be a safety hazard as well as a hinderance to overall operational efficiency.

Online payment of terminal storage and processing (TSP) charges in advance: Online payment reduces the queues, waiting time, and uncertainty regarding payments, and shipments do not have to wait after arriving at terminal for the payment processes being completed before they can be processed. Regular clients of the air cargo facilities also maintain running accounts to manage TSP payments.

ACCS functionalities have benefited freight forwarders and brokers: They manage all their interactions with multiple stakeholders through this single system without having to work through multiple systems. This also minimizes paperwork and rationalizes workflows. Furthermore, this has reduced the potential for errors and increased service levels.

Multiple functionalities have been developed for different stakeholders, avoiding the need for the procurement of third-party services: For example, the system enables freight forwarders to create an electronic Airway Bill (eAWB) and forward that to airlines. Airlines can file the Import General Manifests (IGSs) to customs using the ACCS instead of using third party services for this. Users also have dedicated dashboards and online file management facilities and analytics, including management information system (MIS reports). These features have particularly benefitted smaller players and increased the use of the eAWB and electronic delivery orders (eDO), reducing operational time and transaction costs.

Moving to a digital platform has minimised the need for physical visits to different offices. These functionalities were especially useful during the COVID-19 pandemic when physical movement was constrained. API based integration allows for a seamless experience since users do not need to migrate or modify their own systems.

Key Takeaways

The government's role is vital and irreplaceable in promoting ACCS from a trade facilitation and air cargo promotion perspective. India's government recognized the importance of efficient air cargo logistics in India's economic development and played the role of a promoter, planner, investor, facilitator, and regulator. It brought on board airlines, air cargo terminal operators, ground handling service providers, forwarders, customs brokers, and express service providers. For nearly two decades, the government had implemented EDI between customs, airlines, terminal operators, and consolidation (or 'consol') agents. As a result, the community was ready when ACCS was first introduced in 2013.

Industry knowledge and technical capacity are vital elements in pulling the members of the air cargo community towards ACCS. The India case shows that EDI exchanges and IATA standards dominate the ACCS implementations. The ecosystem of airlines and air cargo agents who are bound by IATA standards play a decisive role in pushing the ACCS implementation.

A transparent mechanism to decide on the fees and charges encourages participation and generates trust in community members. A governance mechanism that is rooted in the airport community, and/or regulatory oversight may be necessary in monitoring costs of ACCS services and quality assurance. The community members should be convinced that the business value generated through the ACCS are commensurate with the fees and charges for such digital services. Even where the use of such services is not mandatory, the users will be drawn to joining the system as willing users. As per current rules, all TSP related charges and their increase are under the jurisdiction of the AERA, the airport regulator.

INDIA
INDIAN PCS

Introduction

In brief

India's Port Community System (PCS) was first introduced in 2008 by the Indian Ports Association (IPA), an apex body as an association for all Major Ports. PCS 1x is a cloud-based system which was launched in Dec 2018 that brings together different stakeholders of the maritime sector on to a common platform. The functionality includes modules covering vessel clearance, cargo, container, and hinterland transport, and payment-related services. It is implemented in 12 major ports and few non-major ports covering around 92% of the total volume of international trade. PCS1x is in process of being implemented with enhancements in the name of Sagar Setu (NLP–Marine) tentatively before end of this year.

Why this case is significant

India's PCS has several unique features and the story of its development and implementation presents several noteworthy lessons. It was one of the earliest examples[35] of a government-led PCS implementation aimed at covering all the country's major ports[36]. From the beginning, the PCS project intended to cover all of India's ports and all major services, rendering the scope of the project rather large and ambitious. Gradually, the project achieved stability as new features were added and it took several iterations of implementation to achieve tangible results.

The PCS project is aligned with India's trade and logistics facilitation objectives and action plan. It has enjoyed the government's consistent support and backing for over 15 years and continues to receive a high-level of attention and monitoring. The National Committee on Trade Facilitation (NCTF), headed by the Cabinet Secretary in its current action plan (2021-23) and the previous action plan (2017-2020) has included several action points for the PCS project. India's National Logistics Policy[37] refers to and aligns with the NCTF's Action Plan. Now, it is a part of the National Logistics Portal- Marine (NLP-M). The PCS also integrates with the Unified Logistics Interface Platform (ULIP). Backed by the National Logistics Policy, ULIP is an Open API based data stack to interface with other digital logistics and regulatory platforms.

India's PCS has evolved with the times, adapting to the business requirements and technological trends. Like most of the leading global solutions, the system was established as an Electronic Data Interchange facility, but with time, it was moulded into a web-based platform with mobility features. Even before the PCS project's conception, IPA together with Indian Customs, was leading the effort to implement electronic message exchange between local ports, terminal operators and customs systems. PCS's establishment 2008, along with the central customs system (the Indian Customs EDI System, ICES 1.5 and Customs EDI Gateway, ICEGATE) paved the path for standardized EDI exchanges at the national level. To absorb some of the web 2.0, mobility and API based technologies, and to transition it from on premises facility to a new cloud-based platform PCS 1.0 was upgraded to PCS 1.x.

The project followed a top-down approach, which meant that the PCS faced some early-stage challenges concerning stakeholder management and integration. The phased approach reveals the importance of taking some key steps early on, including stakeholder consultation and needs assessment. In India's case, this meant difficulties concerning community uptake and use. These challenges were overcome over time, and today, uptake of the system is high, despite there being no legal requirement for using it.

The case also points to the ability of PCS projects to serve a wide range of organizations belonging to the port and supply chain community. PCS and PCS1x have onboarded over 18,000 users from over 27 types of organizations that went online on the system (Please see table below – Stakeholder in PCS1x). This diversified user base as well as a high number of users signals a high success rate of adoption for the PCS, both in terms of uptake as well as opportunities and possibilities to streamline processes at the respective ports, since involving many different types of users also meant the ability to integrate information exchanges and clearance processes applicable to the functional roles of each user in the PCS solution.

The willing participation of stakeholders is crucial for a PCS's success, and in India's case, this is illustrated in the engagement of shipping lines, terminal operators, freight forwarders, truck operators and customs brokers to facilitate cargo clearance. Electronic Delivery Orders (eDOs) played a vital role in speeding up delivery at Port terminals and Private Terminal Operators.

Project background and phasing

The development and phasing of India's PCS presents valuable lessons on the importance of stakeholder consultation to conduct of a thorough needs assessment early in the project. A top-down approach to the implementation in the early phases led to a sub-optimal performance of the system. In the following phases, the stakeholders clarified their needs better and new versions of the PCS modules were developed. These achieved high success rate in terms of the different types of stakeholders using the solution and the number of users.

---

35   China's E Port implementation is another example of a national PCS architecture.
36   Most of the large ports were (and still are) in the public sector. They are governed by the Major Port Trust Act, 1963.
37   https://dpiit.gov.in/sites/default/files/NationalLogisticsPolicy_2022_29September2022_0.pdf

IPA conceived a PCS system to address the needs of its members, i.e., the major ports of India, which included the digitalisation of the ports' internal processes, EDI connectivity between stakeholders and improved visibility and tracking of cargo. The original concept had to inherit the legacy EDI messages between Customs, ports, shipping lines, CONCOR (Container Corporation of India), and terminal operators. Those messages were conceived to comprehensively cover a port's functions. The project was expected to be implemented top-down with strict time targets set for message integration. This led to challenges related to uptake and effectiveness of the system to achieve the objectives that had been set. This approach was later adjusted in favour of a gradual and phased implementation.

The first phase began as early as 2006 when the government nominated IPA as the host for the solution. After becoming operational in 2008, PCS began facing issues relating to lack of coordination and unorganized nature of trade, where a lot of information and documentation was exchanged manually. In the period 2010-2012, deeper questions began to surface including:

- Different Stakeholders such as truck operators, railways, and customs brokers were not linked initially to the existing system.

- Shipping Lines had their own systems and needed solutions that enabled them to exchange information globally, not just locally or nationally.

- Cargo owners and port terminals, rather than receiving and submitting information through the PCS were instead doing so with the systems being used by the shipping lines.

- IPA conducted pilots at JN Port (Nhava Sheva). However, each Indian port is diverse, which resulted in difficulties to extend the pilots to other ports.

The above challenges, in part, were symptomatic of the lack of extensive consultation and of a comprehensive needs assessment having been performed in the early phases. Driven by this realisation, the second phase of the PCS development was initiated in 2016. At this time, the focus shifted to the impact of the PCS on trade facilitation. Upgrading the processes related to the e-Delivery Order (e-DO) became a priority. In 2017, this was then extended to include payment on the PCS. At that time, IPA and customs resolved the data quality issues that PCS was facing in the integration between PCS and Custom's ICEGATE platform for exchange of manifest information.

The third phase began with the implementation of PCS 1X, which became functional in December 2018, which, included the following upgrades[38]:

- Migration of the PCS 1.0 Implementation to a cloud platform.

- Support for application maintenance and implementation.

- Introduction of event-based notifications and alerts at triggers points on key transactions.

- Development of value-added features to PCS 1.0 modules.

- Development of mobile applications.

- Design features to enhance UI/UX (user experience; user interface);

- The set-up of a central 24/7 helpdesk with locational support.

PCS & PCS 1x is a centralized web-based system and was implemented to be used across all major ports, acting as a Single Window to exchange information, data and documents electronically among the port community stakeholders such as Shipping Agent / Lines and Sea Ports. As of today, PCS 1x is used in all major public ports.

The new modules added to PCS 1x include electronic payment (e-Payment), and electronic delivery order (e-DO) for the physical release of cargo by custodians. Additionally, there are on-going integrations with other stakeholders' platforms in the form of latch-on/application programming interface (API) integration. These integrations include linking PCS 1x with Customs ICEGATE, Dashboard[39], other participating government agencies (PGAs), and real time container tracking systems.

Further developments are currently under way as well. Most recent ones include the enhancement of the PCS 1x to the NLP-Marine (National Logistic Portal – Marine) to provide end to end trade facilitation for the shipping ecosystem. The aim is to enable the NLP Marine to integrate all supply chain elements across various modes of transport like roads, railways, etc. PCS is also a component of Maritime Domain Awareness (MDA) and will be integrated into National MDA Centre (NMDAC).

Institutional and regulatory framework

In line with the understanding that the PCS in India began as a top-down initiative led by the Government, several companies specialising in different elements of PCS had to be involved to develop the solution under the general guidance of the key partners governing the project. Even though there is no regulatory compulsion concerning the use of the PCS, uptake has been high, also supported by an order issued by the Ministry of Shipping to all Stakeholders to use the PCS.

38   https://vizagport.com/wp-content/uploads/2020/10/NLPRFPVol2.pdf
39   https://prayas.nic.in/ Prayaas is an online dashboard to support the monitoring of high priority multi-sector projects by the Prime Minister's office.

PHOTO BY: © 2020 ABHISHEK SAH PHOTOGRAPHY/SHUTTERSTOCK

The central government's Ministry of Ports, Shipping & Waterways is the executive sponsor of the PCS, with the Indian Ports Association (IPA) as the PCS operator. The IPA is an apex body of major ports and is under the administrative control of Ministry of Ports, Shipping and Waterways. IPA appointed the National Informatics Centre (NIC), another government entity as its lead technical consultant. The PCSs has a three-tier governance structure. There is a steering committee headed by Chairman, IPA. The steering committee is supported by a national Technical Working Group (TWG), with each port having a Port Level Working Group (PLG) headed by the Chairman or the Deputy Chairman of the Port Trust or port company. The government and industry saw IPA as a natural candidate due to its role as an institution that represents all major public ports in the country.

In 2007, IPA awarded a contract to a Singapore based software firm Crimson Logic to develop and implement PCS at all major ports. Subsequently in 2018, a Mumbai-based implementation agency, Portall Infosystems, was awarded the contract by the IPA to roll out a pan-India PCS by December 2018. Portall in turn collaborated with dbh IT AG and IBM, for functional and technological expertise.

In addition to the project development and implementation, the governance of the project and the regulatory framework for the functioning of the solution was also fundamental. The project benefited from high-level monitoring by the Prime Minister's Office (PMO) in 2018 to promote ease of doing business. High officials continue to closely monitor the PCS's coverage and performance.

The supporting legal environment of the PCS remains a challenge. A panel headed by the Joint Secretary (ports) in the Ministry of Ports, Shipping & Inland Waterways, recommended that a legal framework to make the use of the PCS mandatory be explored. The Ministry has issued an executive order to all stakeholders regarding compulsory usage of PCS 1X for carrying out all trade related electronic document exchange and clearances, with effect from December 2018.

Financing and pricing model

The Indian case presents an example of a PCS that is free to use. There are therefore no financial transactions involved in the process of using it. This in part explains the high uptake as discussed later in the case study. Major Ports funded the development of the PCS and continue to bear the PCS's operational costs. The government also provided the executive and financial support to all stakeholders in the public sector in their effort to integrate with the PCS. The private sector was encouraged to develop their respective systems' interfaces with the PCS.

Functional and technical architecture

The technology for the PCS 1X has been developed indigenously as a part of the 'Digital India' and 'Make in India' campaigns. The list of key technical features is included below. One of the key highlights of the solution is the "Latch On" feature, which is a unique concept built in and delivered with the solution. The Latch On feature facilitates the trade in utilising the features and functionalities that are critical to business but cannot be directly embedded into any PCS Platform. This together with other factors such as the pricing model has led to a high uptake of the solution.

The technical features of the latest version of the PCS include:

- Flexible submission of information in multiple formats like XML, UN/EDIFACT and propriety flat files;

- Message translation from one format to another;

- Web user interface;

- Multiple transmission protocols (HTTP, HTTPS, SFTP, AS2);

- SLA based approach for management of end user issues;

- PCS 1x Infrastructure is hosted in high availability model on MEITY certified cloud infrastructure. BCP Ready with Active Disaster DR Site and Two backup copies.

- Multilayer Security with DDoS, Web Access Firewall (WAF), Firewall, Load Balancer, Identity and Access Management (IAM), PIM, SIEM for continuous monitoring and risk mitigation;

- Periodic Vulnerability Assessment & Penetration Testing VAPT;

- IBM API Connect and API Manager for Stakeholder Integrations;

- Centralized Information database on MSSQL Enterprise cluster repository for Dashboards, Research, Analysis and Reports;

- IBM APP Connect Enterprise Service Bus (ESB) for Business Logic, Message Transformation and Routing;

- End to End Encryption for data security for Data in Rest and Data in motion.

- Hardware Security Module (HSM) for Digital Signature Encryption and Authentication;

- .NET Based Agile Application Development Platform;

- PCS file formats like XML and EDI (TXT) message structures are designed by adopting various international standards like UNeDOCS, UN/CEFACT and UN/EDIFACT;

- Some of the UN standard codes followed in PCS are: UN / LOCODE, Container Type Classification Code(8169), Transport Means Description (8179), Party Function Code(3035), Message Type Function Code(1225), Equipment Status Code (8240), Cargo Type Classification (7085) etc.

In terms of functionalities, 98 messages are currently available in the PCS, of which 55 are in full use. The gap between those available and those being used is attributed to the lack of integration with some stakeholders such as Immigration, terminal operators etc and also improvements needed in message formats etc. So far PCS & PCS1x has onboarded around 90% stakeholders at public ports. Additional stakeholders also include two State Maritime Boards (Gujarat Maritime Board and Maharashtra Maritime board), and DG shipping are in process of on-boarding to PCS1x.

Most significantly, the number of types of users is large, as shown from the table below, and include shipping lines. As highlighted in the introduction, this was a fundamental component that enabled the integration and streamlining of the Delivery Order process in the PCS.

As mentioned above, the latch on system is a key innovative feature of the system which is in progress. This refers to enabling the integration of the PCS with other platforms via a latch-on/ API integration. These includes integrating PCS 1x with custom's ICEGATE, Participating Government Agencies (PGAs), real time container tracking system etc.

An advancement of this concept is enhancement of the PCS as Marine National Logistics Portal which is renamed as Sagarsetu – NLP-Marine to provide end to end trade facilitation for the shipping ecosystem. Sagarsetu NLP Marine is envisaged as the central hub for all interactions. With IPA having initiated the work on the architecture of the NLP-Marine portal, all the messages available with PCS1X will be integrated with the NLP-Marine with enhancements. These messages include cargo handling and delivery documents such as booking orders, Partner Government Agencies (PGA)-related documents such as testing (memo/ report); rail evacuation documents such as forwarding notes and rake arrival intimation; statutory cargo clearance documents such as Certificate of origin, through integration with Customs.

Finally, the Transport module in the PCS1X facilitates to transport a shipment from Port to Container Freight Station/Factory or vice versa. Customs Brokers or Container Freight Station (CFS) submit the booking to their transporter using their Transporter Registration Number. The Custom House Agent or Container Freight Station searches the IGM Number and Line-Item number for Import and Vessel Call Number (VCN) for Export, based on which the relevant shipment details will be fetched automatically. The Transporter has the authority to approve or reject the

Table 3. On-boarding Status

Stakeholder Count - PCS1x			
Sr No	**Stakeholder**	**No of Users**	**Purpose**
1	Port Authority	167	Authority
2	Shipping Lines/ Shipping Agent	4090	Carriers (Container / Cargo)
3	Customs	2	Regulatory body
4	Container Freight Station	167	Custodian (Container / Cargo)
5	Custom Broker	5219	Clearance
6	Importer / Exporter	7187	Trade users
7	Bank	8	Payment
8	Container Agent	584	Container Operator
9	Terminal Operator	65	Custodian (Container / Cargo)
10	Stevedore	278	Special service provides at port
11	Rail Transport Operator	63	Indian Railways
12	Mercantile Marine Department (MMD)	14	Regulatory body
13	Navy/Coast Guard	19	Regulatory body
14	Ships Chandler	113	Provisions
15	Port Health Organisation (PHO)	11	Regulatory body
16	Transporter	25	Road Transport
17	Immigration**	0	Regulatory body
18	Surveyor	18	Survey (Container / Cargo)
19	Tank Farm Operator	1	Liquid Storage at port
20	Inland Waterways	7	Waterways authority
21	Coastal Shipping Operator	18	Carriers (Container / Cargo)
22	Empty Yard	222	Empty container storage
23	Freight Forwarder	38	Clearance
24	Barge Owner / Operator	19	Service provider
25	NVOCC	60	Non vessel line
26	DGLL	1	Regulatory body
27	Inland Container Depot	122	Rail Transport services
	Total	18518	

**Immigration – Immigration department has given consent to integrate with PCS 1x

Transporter Booking request. Once the Transporter approves the booking, a vehicle and a driver are allocated to that booking. After the allocation of vehicle and driver, the port shares the Delivery Gate Schedule for Import and Gate Open Report for Export. Transport Module needs improvements in PCS1x to cope with the operations at Gates of Ports/Terminal operators through automated Gate operations.

One of the challenges concerning the multi-modal exchanges includes the standardisation of information. In this context, the Government of India (GoI) launched the Unified Logistics

Interface Platform (ULIP) to streamline data exchange among all the stakeholders involved from a multi-modal transport standpoint. ULIP proposes to integrate 24 systems via 78 APIs and includes 1454 data elements that are used across ports, shipping, waterways, railways, civil aviation, road transport and highways, the Director General of Foreign Trade (DGFT) and Customs. It leverages the current PCS1X platform for exchanging messages via data application programme interfaces (APIs).

Benefits and Impact

The impact of the PCS on various port stakeholders has been varied. A key example of the positive impacts includes the efficiencies gained on the electronic delivery order (e-DO) process. This was made possible because of the achievement of the PCS to integrate the relevant stakeholders involved in such a process and enable the receipt and processing of the relevant information and issuance of clearance by the same stakeholders at the same time. That said, some challenges however also still apply including some rather common ones namely some stakeholders still need to be integrated in the system as well as the continued use of hard copies in some of the processes despite the implementation of the PCS system.

The e-DO process is an example of a successfully implemented module that is being utilised by all ports. The DO is issued by the shipping lines to the consignee as an acknowledgement of confirmation of submission of documents and payment for delivery of the cargo. Before the implementation of the PCS, the DO was being released through different modes, (i) directly via email to the consignee, (ii) through the shipping line's portal, (iii) through a third-party platform, provided the request has been placed through it, (iv) through the PCS, and (v) and in the form of hard copy at the shipping line's office. The e-DO module made the process faster. The shipping line can issue the e-DO, which in turn, is sent directly to the forwarder, the yard, the Customs Broker, the Consignee, and Importer.

Key Takeaways

The Indian PCS is an example of the need for the government's consistent and unwavering support. PCS projects involve a high degree of complexity and require high-level monitoring.

Not all stakeholders and messages are integrated in PCS 1X. It is one thing to design messages in line with the functional needs of various stakeholders and user friendliness in exchange of message A phased implementation is recommended. Incremental and modular development is the best approach and is a preferred approach. The design can be 'top down' but implementation requires a 'bottom-up' effort along with agile approach.

The use of international standards greatly facilitates PCS's integration with stakeholders. Although the PCS environment in India broadly uses data elements and code-list that broadly align with the UN/ ISO standards, there is a mix of proprietary, UN/ EDIFACT and XML messages are currently in use. For example, there are different formats for Import Advance List (IAL) for different ports and for different terminals within JN Port.

While PCS has been implemented in all major ports in the country, their performance in terms of port dwell time40 is not uniform. This may be due to local factors including dissimilar implementation of PCS modules in different ports.

Industry feedback suggests some benefits along with improvements needed in systems performance. Helpdesk, along with WhatsApp groups have been created for coordination and e-mails. Feedback points to improvements needed in responsiveness.

Neutrality and data protection are vital for a PCSs success: The IPA as the PCS operator is a neutral public body with a wide membership and is trusted by the ports as a neutral platform that can run a port community system. IPA's Service Level Objectives include assurances on data protection measures. The industry underscores the need for the solution provider to operate independently of the systems integrator and administrator.

Getting rid of hardcopy documents from cargo and vessel clearance operations is a priority in itself. Like in other case studies, there are still some hard copy documents used in cargo and vessel operations that can undermine/ create discontinuities in the digital workflows. Regulatory bodies must address their elimination on priority.

PCSs need to build interconnection not just with the regulatory agencies but also with the extended logistics ecosystem. India's PCS has taken steps to enhanced as National Logistics Portal (NLP-Marine) and integrate with the Unified Logistics Interface Platform (ULIP).

---

40 India's "Logistics Data Bank System (LDB System)" provides detailed real time information on container movement at ports and on transport corridors. The LDB System produces Dwell Time monthly port dwell time reports for all ports. https://nldsl.in/

JAMAICA
JAMAICA PCS

Introduction

In brief

The Jamaica PCS solution is a modern technology platform started in 2016. One of its key features includes the strategic decision made by the Port Authority of Jamaica (PAJ) to move towards the Cloud. The Jamaican government provided strong support, through timely cabinet approvals to enable a fast-track development. The Port Authority soon became responsible for all aspects of the implementation – including providing the required funding for implementation.

As is the case with other case studies and examples, the project was originally intended and conceived as a public private partnership (PPP) project. The view on this, however, changed and the project was eventually implemented as a public initiative, financed wholly by the PAJ. This was important to enable high uptake, which may have otherwise been hampered by relatively high fees for users. Another key driver for this was sensitivities around information sharing, particularly Customs related information.

Why the case study is significant

The case study highlights several good practices in Jamaica. Firstly, this case study highlights the extent to which placing a PCS project at the centre of a wider policy drive and framework facilitates engagement and ultimately uptake by different stakeholders. In Jamaica's case, the initial drivers of the PCS acquisition were the Shipping Association of Jamaica – a private body, which ultimately worked with public entities to realize the project. Clarity on who the implementing agencies were, and including Customs as a partner, helped to drive the project forward. It also facilitated integration. Other cases often reveal unfinished integration because of lack of alignment between entities.

Secondly, the implementation was carried out in a modular format, with the systematic rollout of different services. This includes transhipment activities, import and export processes, truck appointments, Air cargo[41] and FAL Forms. This enabled a careful assessment of the need of each, as well as of the costs and benefits of implementing the solution to cover the scope of these services.

Thirdly, Jamaica is home to one of the region's largest trans-shipment terminals in Latin America and the Caribbean (LAC). A key element was the development of Jamaica's PCS and its integration with ASYCUDA along with the National Single Window (NSW). This directly addressed at least two of the six core bottlenecks at the port, namely: (i) The customs process. (ii) timely shipments. Both were well documented by industry players as posing challenges in import and export activities, especially to potential investors and companies looking to Jamaica for opportunities.

Project preparation and development

The PCS project in Jamaica was government mandated and PAJ was identified as the Lead Agency with Jamaica Customs Agency (JCA) designated as a partner. Both were tasked with setting up a PCS in 2012. While PAJ took the role of lead implementing entity, the Shipping Association of Jamaica (SAJ) played a role in the early initiative. It later became a government-led project.

As the lead entity, PAJ was responsible for addressing the key strategic and operational issues covering governance, risk, finance and legal. These tasks, however, were not a completely new enterprise for stakeholders operating in and around the port. The SAJ had earlier pursued exploratory and fact-finding trips to various countries. With help from the Jamaica Promotions Corporation (JAMPRO), SAJ was able to engage an international port community consultant to assist in identifying and developing a suitable PCS solution for Jamaica's port community. The process included research into PCS solutions, site visits to ports in the UK, Kenya, Barcelona, India, Senegal, and France.

Following these studies, SAJ collaborated with PAJ and both planned for the implementation of the PCS. Plans included the inclusion and the establishment of a working committee comprising public and private sector interests. The collaboration with PAJ went as far as making and agreeing budgetary provisions by both the PAJ and SAJ to fund the resources needed to start the project.

The PCS in Jamaican was seen as part of a wider initiative by the government focused on improving the logistics and trading environment. The latest strategic project related to improving the trade environment is the National Single Window (NSW), which went live in 2020. This was very much a strategic initiative by the government to increase Jamaica's trade facilitation and competitive business environment, both of which are critical for realizing the goals of the Global Logistics Hub Initiative.[42] Its implementation also became part of the country's development strategy and was monitored as part of the medium-term socio-economic policy framework 2015-2018[43] by the Planning

---

41 The final modules being implemented are air cargo/import and export along with FAL Forms. The project is slated for full implementation in late 2023, at an overall estimated cost of around US$12m.

42 https://www.jseza.com/jamaica-logistics-hub-initiative/

43 Planning Institute of Jamaica (PIOJ), Medium Term Socio-Economic Policy Frameworks

Table 4. Summary Roadmap to Implementation

27-Feb-2012	Cabinet approval obtained by PAJ.
13-Dec-2013	Cabinet approved the following: The Stage 1 assessment and recommendation to proceed to Stage 2 of the tender process to select the preferred bidder. The Port Community System Public-Private Partnership Transaction (Project) Structure. The Port Authority of Jamaica to be the Regulatory Body/Concession Authority and Grantor of the Port Community System's operations. The approval also included provisions for legislative changes to support mandatory use of the Port Community System by regulations to be vested within The Port Authority Act. Allow for the sharing of trade information with a trusted private partner (Concessionaire) and other government agencies directly dealing with trade transactions via The Customs Act and amendments to the statutes governing the relevant regulatory agencies. Allow for the successful implementation of a paperless environment for the Port Community System within Jamaica.
27-Apr-2015	Cabinet approved a change of strategy from the Public-Private-Partnership (PPP) arrangement to a new competitive bidding model which included: The use of the Limited Tender Procurement Methodology for the procurement of goods and services to establish a PCS and the subsequent creation of a PCSO for the acquisition and operations of a PCS for Jamaica.
28-Jul-2015	Cabinet approved: The award of a fixed five-year contract to the joint venture consortium of SOGET S.A. Bureau Veritas B.I.V.A.C. BV, with the main ICT provider being Microsoft Corporation, for the design, development, implementation, and maintenance of a Port Community System. Cabinet also approved the creation of a Port Community System Operator responsible for the daily operations of the Port Community System within Jamaica and the implementation of a Port Community System Tariff Fee, which will be applied to the Port Community and implemented by way of regulation under the Port Authority Act.

Institute of Jamaica (PIOJ), which is charged with development and implementation of Vision 2020[44] 4 (now expanded to 2030). As explained below, the government also facilitated several legislative changes to both the PAJ Act and Jamaica Custom Regulations, making the submission of all manifests via the PCS mandatory.

In terms of a roadmap, the table below comprises a list of activities approved by Cabinet for the implementation of the PCS by PAJ.

Legal framework and governance

To enable the PCS to legally operate, both JCA and PAJ had to review their existing laws and regulations that govern some of their operations with respect to data sharing and use of paperless transactions. At the heart of the amendments was the Electronic Transactions Act, 2nd April 2007, which made provisions for the legal transactions via electronic platforms. This provided the framework that would assist the necessary legislative changes.

The JCA in November 2014, also passed specific laws which allowed the agency to collect information through a paperless medium, assisting the PCS solution to achieve transactions to be undertaken via a paperless, digital environment.

The PAJ also amended the Port Authority (Port Management & Security) and the Port Authority (Port Management and Security (Amendment) Regulation 2015. The change enabled the implementation and use of the PCS in Jamaica, and to also include the collection of a "user fee."

The PCS today has some mandatory and some optional functions. The submission of manifests through the PCS is mandatory. Optional services, on the other hand, include business intelligence data, that may soon be made available as a value-added service (fee).

From a governance perspective, as already noted, PAJ was the lead agency for the PCS development. To do this, a Steering Committee was set up. Monthly meetings were organised that focused on providing strategic and tactical initiatives. The recommendations that emerged were then approved by the PAJ board and the Cabinet. The committee included:

V. PAJ chair/implementing agency.
VI. JCA co-chair.
VII. SAJ, lead private sector stakeholder, and major port labour provider/trade union. Initially conceptualize/ driver of the development of the PCS, from 1990s (see above).
VIII. Development Bank of Jamaica (DBJ), lead agency/secretariat for all PPP projects/transactions. They later withdrew from the committee when it was no longer a PPP project.

---

44 4https://www.vision2030.gov.jm. The country's first long-term strategic development plan and covers the 21-year period, 2009-2030, up from the original 2020. It embodies the plans and processes for the realization of a collective vision, encapsulated in the statement: *"Jamaica, the place of choice to live, work, raise families and do business."* In 2015, Jamaica adopted United Nations 2030 Agenda for Sustainable Development and its Sustainable Development Goals.

PHOTO BY: © PORT AUTHORITY OF JAMAICA

IX. Ministry of Finance and the Public Services, parent ministry for JCA and for all financial decisions / approval for public entities.

X. Ministry of Transport & Works, the parent ministry at the time for PAJ.

XI. eGov Jamaica Ltd, national single window operator, public sector.

XII. Customs Brokers & Freight Forwarders Association, representing freight forwarding, umbrella entity, private sector.

XIII. Jamaica Society for Customs Brokers, representing custom brokers, private sector.

XIV. Port Trailer Haulage Association of Jamaica, representing port haulage contactors and services, private sector.

XV. Terminal Operators.

XVI. Kingston Wharves Ltd (KWL), private sector, multi-user, multi-purpose cargo terminal operator, Kingston.

XVII. Kingston Freeport Terminal Ltd (KFTL), subsidiary of CMA CGM, the concessionaire and container/trans-shipment terminal operator, Kingston.

XVIII. Port Cargo Handlers (PCH), multi-user, multi-purpose cargo terminal operator, Montego Bay.

XIX. Advantum, IT provider/major port platform and subsidiary of SAJ, private sector.

Financing and business model

A revenue "neutral" model was considered and applied based on the need to receive buy-in by the port community, particularly considering the changes needed to implement the project. PAJ decided to de-risk the project by providing all CAPEX and OPEX from the end of 2015 and the start of 2022, therefore not billing the private sector during that period.

The creation of the business case, economic rationale, analysis of the PPP options and financial model required the engagement of a financial consultant, which was recruited through an international tender process. Extensive work was done to develop a robust financial model with the aid of a local consultant. Factors considered included:

- Trade activities -import/export/trans-shipment.
- Number of Customs declarations.
- Type/number of stakeholders in port community.
- Assessment of subscription services and related fees.
- Assessment of PCS fees and revenue streams globally.

In terms of the overall development cost, the PAJ estimated this as amounting to around US$12 million since 2016. These funds were provided entirely by PAJ.

The current fee structure, started in February 2022, consists of: (a) User fees (@US$20/commercial import declaration). (b) A fixed fee paid by the 3-cargo terminal operators. (c) A portion of revenues set aside for expansion and further developments.

Recently, the PCSO brought forward a public advisory indicating the need for users to pay for PCS services directly to the operator. The mandatory fees is USD 20 to be paid in Jamaican dollars.

Elements that will be potentially developed as value added services include:

I. Providing more business intelligence information to users with specific data being made available online to all or per request. This will lead to greater revenue opportunities via fees and or subscription - per user/per month.

II. Capacity building activities within the region to support PCS adoption rates, such as undertaking advisory and consultancy engagements to small regional states.

III. Technical support, project management and advisory services to other regional ports seeking to implement their own PCS solution.

IV. Additionally, each year a portion of the revenue will be allocated for future expansion of services and added functionalities.

For the PAJ, amendments were also made to facilitate the collection of user fees. This opened opportunities for more fee-based services to be provided to the port community, who themselves are keen to obtain more digitalized processing of tasks.

Functional and technical architecture

From a technical perspective, the platform is an off-the-shelf solution. The solution is hosted within a public cloud service provided by Microsoft Azure. Functionalities include email, web-services, SFTP and options for different messaging formats. Hence up-to-date information is provided through messages (EDI).

The PCS platform is managed internally by a technical team of the PCSO. The PCS application is managed by the application vendor. Data analytics is managed internally.

Regarding interoperability, the PCS and Customs solutions are integrated to provide transactions for cargo processing. This exchange was made possible by the signing of an MOU between the two entities. The eSAD Declarations are sent to Customs' ASYCUDA World and manifests sent to the PCS. Both systems

are integrated and validate the information. The PCS also disseminates specific manifest information to customs, terminals, and regulatory agencies in the required format. Once cargo is cleared and released by all the major stakeholders, the PCS provides confirmation and then generates an electronic release.

The PCS is also integrated with JCA and all three terminal operators' operating systems, namely: KFTL with Navis (Kingston container trans-shipment terminal), KWL with Tideworks (multi-purpose cargo terminal), and PHL with Advantum (Montego Bay multi-purpose terminal[45]).

Steps were taken to ensure the platform is reliable, consistent, resilient, and predictable. The cloud-based infrastructure allows this to be the case via multiple layers of redundancy that have been built into its architecture and supported by teams that continuously monitors system performance.

The PCS also increased data security. This is achieved via multiple layers of protection relying on the security ecosystem upheld by Microsoft and other third-party security solutions.

Benefits and impact

Feedback from the port community has been positive. Terminals now receive manifests via the PCS. Market measures apply to push towards compliance. Manual entries are, for instance, discouraged by means of applicable fees levied by the operators.

Truckers also indicated that they have seen improvements. These stakeholders can book a pick-up via PCS (directly or via agents). Benefits include faster, more efficient customs clearance, more streamlined standard process, faster turn-around of gate in-gate out operations with less gate congestions (no long lines).

Besides notable benefits, there are also two noted challenges. Firstly, manual entry of data continues to apply in the case of the terminal operator. This is due to lack of full standardisation and harmonisation of data formats. Terminal operators therefore still need the solution to provide PCS data in a format that can seamlessly be included in their existing systems.

The second is the continued need to use a broker by the trucking community. Truckers are not allowed to make changes to appointments that they did not create. This means that when brokers make the booking, truckers themselves may face challenges to change these. The PCS enhanced its service so that the broker or importer can check a flag to allow truckers to make updates. This has, however, not been taken up by the community as much as needed.

---

45   Other Features of PCS are well presented and described on the Jamaica PCS website (www.jamaicapcs.com).

Key takeaways

The PCS initiative in Jamaica was implemented thanks to government driven policy. It was part of a broader set of initiatives driven by the need to improve performance in Jamaica's ports and airports. This was for the purpose of positioning Jamaica within the sphere of a global logistics hub. Key leading entities of the initiative included the Port Authority, Customs, and the private sector.

The PCS implementation was a change management project. Business process re-engineering and stakeholder participation were key success factors. The governance framework that was established from the early stages of pre-implementation fostered an environment in which stakeholders were included. They were able to review, provide input and approve all the new processes. This committee continues to meet monthly and actively leads the strategic activities of the PCS for the Jamaican Port Community.

From a macro-perspective, stakeholders had high expectations from the implementation of the PCS. Along with other initiatives, such as the privatization of the container terminal and airports (SIA and NMIA), reform and modernization of the customs via ASYCUDA, the developments of LNG facilities near Port Logistics Industrial Parks, the PCS platform was seen as a core initiative. The aim was to facilitate efficient cargo transactions and support Jamaica's logistics hub ambitions.

One of the key instruments enabling the implementation of the initiative was the MOU signed between the Port Authority and Customs to ensure interoperability of the systems. This enabled an effective integration and smoother user experience. In addition, regulatory changes, including making the use of the PCS for certain information exchanges mandatory all provided the enabling framework for the project.

Another key element of the case study is the shift from an earlier concept of the project being implemented on a PPP basis, to the decision of financing the project through government funding. This allowed for user fees to remain low, at least for the initial period of the implementation. It also overcame potential issues concerning information sharing and sensitivities around this.

Looking ahead, the PCS in Jamaica intends to rollout more value-added services once all the modules have been implemented. It plans to facilitate greater utilization, improve efficiencies, lower costs, and provide more attractive domestic and international logistics and supply chain solution to users of Jamaica's (air and sea) ports.

KOREA
BPA PCS

Introduction

In brief

Busan Port is one of the world's busiest ports. High cargo throughput and capacity constraints mean that the port is congested. Operational bottlenecks include longer dwell times for cargo at terminals, increased re-handling of cargo and equipment occupancy rates, and longer truck waiting times due to a lack of information sharing. This has a direct impact on the cost of trading.

In view of this, the Ministry of Oceans and Fisheries (MOF) in 2018 initiated a research and development (R&D) project with the Ministry of Science and ICT (MSIT) and the private sector to improve container transhipment flows and demonstrate how blockchain technology can be used to streamline the process of tracking containers. Following the completion of this project, the development of blockchain-based platform "Chain Portal" was launched in 2019.

The case study focuses on this Chain Portal solution, which is the third-generation PCS[46] owned and managed by Busan Port Authority (BPA). This is a relatively recent project which, nevertheless, has moved fast in recent years to improve functionalities and the IT architecture of the solution. While more ports adopted the system over time, expanding the scope of the solution to other functionalities beyond trucking logistics has been challenging due to resistance by some stakeholders.

Why this case study is significant

Key highlights of this case study include the use of blockchain technology to overcome the challenges related to the sensitivities around information sharing by multiple operators of the port and logistics domain. It is estimated that there are around three hundred trucking companies, over forty shipping companies and nine individual terminal operators in Busan Port. Implementing an electronic platform that connects multiple actors inside the port domain was challenging. Stakeholders were in part reluctant to share information via a digital platform. The decision to pursue a project based on blockchain technology was instrumental in ensuring acceptance and uptake.

Other key highlights include the impact of the PCS on operational and process KPIs at the port. The project started with the need to improve business processes for trans-shipment and trucking at the port. BPA formed a task force (TF) team which consisted of the MOF, shipping companies, terminal operators,

and transport companies in 2020. These stakeholders agreed to improve the business process and information flows. Obtaining consent from stakeholders to share their data was reported to be a significant challenge for BPA due to a lack of incentives, security concerns, and conflicts of interest between stakeholders. The success of the initiative was notable because of the large proportion of small and medium size enterprises that make-up the logistics services market in Busan. In addition, the challenges of change management were acute for such companies. Nonetheless, the initiative successfully implemented the first two phases of the project. The third is underway as of the writing of this case study.

Project preparation and development

The PCS in Busan was developed in distinct phases. As highlighted in the introduction, the first included the establishment of the Chain Portal Platform in 2019. A single window concept of real-time terminal monitoring system (RTMS) and blockchain-based trans-shipment shuttle system (TSS) was developed in the context of this phase and a pilot was launched to streamline the process of tracking containers utilizing blockchain technology. RTMS allows stakeholders to search and monitor real-time operational data from nine different terminals in Busan. During this stage, open API was made publicly available to interface with the stakeholders' existing system.

The second phase included the Vehicle Booking System (VBS) development and the stabilization of the Chain Portal Platform. This took place between 2020 and 2022. VBS was introduced and two pilot projects were executed to improve the advance booking process and validate the functionalities of the system. VBS began operating at full capacity in 2022.

Three terminal operators and three transport companies participated in the first pilot project, which was completed in August 2021. The second pilot was carried out for every container that entered and exited the Sinseondae and Gamman terminals in December 2021.

Finally, the third phase includes the expansion of Chain Portal. This began in 2023 and will last two years. The BPA aims to improve its stability and interoperability by 2025. Incheon Port Authority (IPA) is currently developing RTMS[47]. Following verification of the effectiveness of the Chain Portal in Busan Port, the BPA will continue to discuss expanding the application to other domestic ports.

Going forward, besides expanding its initiatives to other ports in the country, BPA aims to interface with an inland logistics information system.

---

46   1st Gen is Port-MIS, 2nd Gen is BPA-NET and 3rd Gen is Chain Port.
47   This is expected to be completed in early 2023

Legal framework and governance

There is no legal requirement that makes the use of the PCS in South Korea mandatory. The system is therefore entirely dependent on the voluntarily participation of the stakeholders. That said, data security was an important concern for stakeholders during implementation. The legal framework covering this element of the project therefore needed to be in place. This is particularly the case since the new system required the sharing of operational data via a single platform. Due to incompatibility between the operating systems of the various stakeholders, it was necessary to adopt new business procedures and modify the existing system. In doing so, the security of data was a major concern.

To encourage adoption, BPA enforced three key laws that already existed. These include:

I. The "Promotion of the Provision and Use of Public Data Act", which began to be enforced in 2013. The purpose of this act is to prescribe matters for promoting the provision and use of data held and managed by public institutions to guarantee citizens' rights to access public data. In accordance with the regulations of the Ministry of Interior and Safety, the BPA is required to undertake annual assessments of data quality assurance.

II. "Cybersecurity Basic Law", which was enacted in 2011 by Korea's National Intelligence Service (NIS) for the public sector and by the Ministry of Science and ICT (MSIT) for the private sector.

III. "The Personal Information Protection Act," which was also enacted in 2011. The act aims to protect personal data from unnecessary collection, unauthorized use or disclosure, and abuse.

Financing and pricing model

The platform is publicly financed. BPA invested 2.5 billion Korean Won (approximately USD 1.9 million) on the platform development. The tender was published on Korea's E-Procurement System in 2019. Once the tendering process was finalised, the BPA awarded contracts to NGL and SmartM2M, a local IT company based in Busan. NGL and SmartM2M were also made responsible for operation and maintenance.

There are no fees and charges for the use of Chain Portal. Private entities can access the Chain Portal and its data. The data is publicly available to external partners and public users, who are approved by BPA, to generate business opportunities in Korea.

In addition to the initiation investment, BPA spends approximately three hundred million Korean Won (approximately USD 228,000) on operations and maintenance each year.

Functional and technical architecture

Functional architecture

Chain Portal consists of three major functional streams. The first is the trans-shipment shuttle system (TSS). This is a blockchain-based system optimized for Inter-Terminal Transport (ITT) cargo that creates the group order. The second is a Vehicle Booking System (VBS). The advance booking system enables terminal operators to schedule the arrival and movement of vehicles within the terminal, allowing truck drivers to reduce truck waiting time. The third is a real-time terminal monitoring system (RTMS). This is a single-window concept of integrated terminal monitoring systems in BPA. Each is described in more detail below.

Trans-shipment Shuttle System (TSS). The TSS enables transport companies to send several transport orders simultaneously. The system automatically maps the cargo to the truck in a manner that facilitates movement. Consequently, the terminal reduces container re-handling time by minimizing the reconfiguration of cargo operations.

In addition, the TSS allows users to visualise planned events and alerts. The information about backloading cargo can be received in advance, which enables trucking companies and drivers to plan for additional trips on the backhaul.

The VBS is designed to reduce the effect of the 'peaks and troughs' of truck drivers arriving at the port during certain hours of the day. Requests for advanced bookings can be made through VBS. The truck driver obtains container location information utilizing VBS before entering the terminal.

Finally, the RTMS involves real-time terminal information for all nine terminals in Busan. Information includes the berth, yard, container location, empty container count, and loading/unloading status, along with many other terminal operational data. Before the implementation of this solution, the transport company would need to access each terminal to obtain information related to containers prior to processing the orders and assigning trucks. Through RTMS transport companies and truck drivers have instantaneous access to container-related information from nine different ports.

Blockchain

One of the key highlights of this case study is the use of Blockchain technology, which is only at its nascent stage in PCS developments. The Chain Portal platform allows for real-time data exchanges based on Blockchain technology. All of the container-related data that is used in TSS and VBS, such as truck allocation and transportation, truck driver's location, gate in/out status, and loading/unloading status, is connected in real-time through this technology.

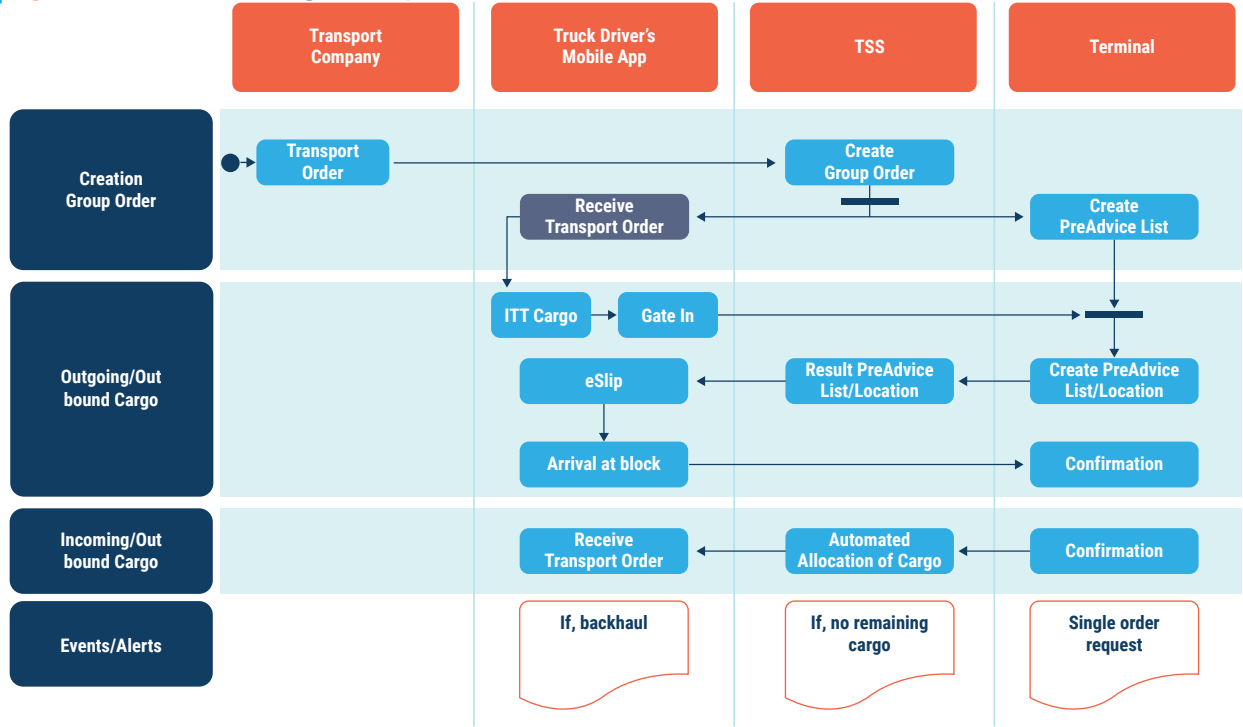**Figure 1.** The schematic diagram of operation and information flow on TSS

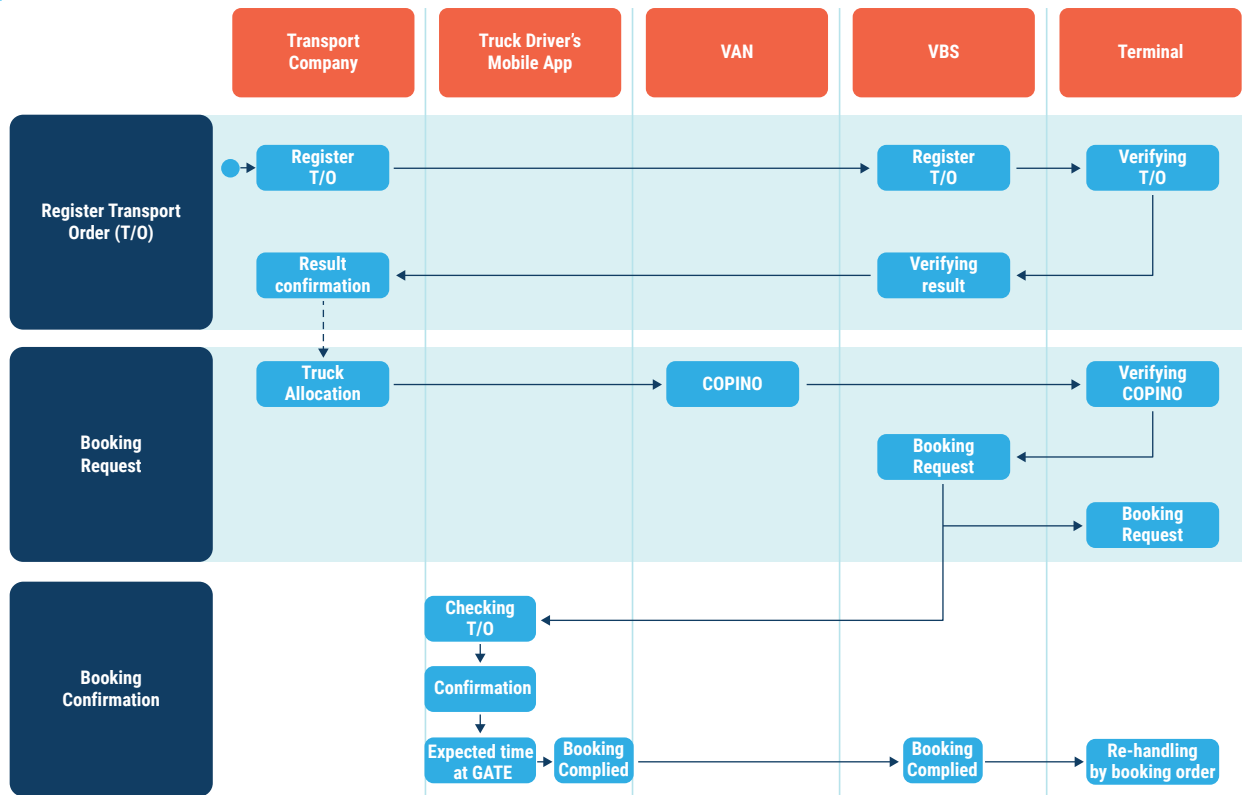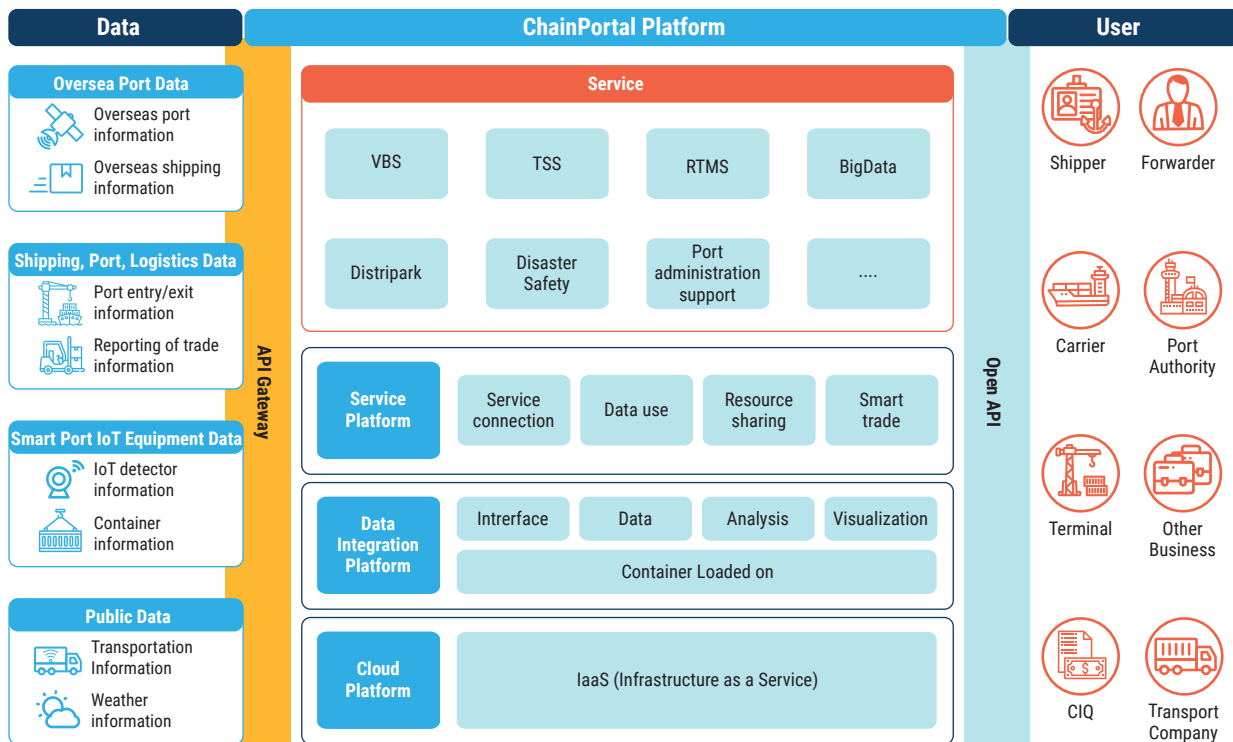**Figure 2.** Operation and information flow on VBS

Figure 3. Describes the service architecture of Chain Portal platform

The Blockchain technology is a distributed ledger-based method of sharing data, in contrast to the previously used method of delivering data through a central server. The decentralized structure of the ledger makes it impossible to manipulate or change the data. Furthermore, it has the advantage of preventing any single institution from monopolizing data, which in turn is helpful to appease data security concerns. To do this, the BPA uses an open source blockchain called Hyperledger Fabric. BPA allocates a node to stakeholders and data can be uploaded by assigned nodes. Each node is stored in one of three locations, depending on data ownership: the server of the stakeholder, the BPA server, or the cloud server.

Besides Blockchain, the other way information is exchanged is API. BPA uses open API to transfer data to stakeholders, logistics companies and public users who want to use the data. This can be accessed using a specific protocol.

In 2021, a total of approximately 12 million data transactions were processed by Chain Portal platform through these means. BPA also offers cloud servers to small and medium-sized businesses that lack the necessary resources to operate the system. This also ensures data transparency.

Links with MSW and hinterland ICT systems

Chain Portal does not connect to other systems serving MSW functionalities, PORT-MIS (NSW service in Korea), or the Customs Single Window system in Korea UNI-PASS[48]. Port-MIS specifically was developed as an electronic system for exchanging data on vessel entry and departure, as well as other reporting and permission processes to use port facilities. The system is owned by the MOF and cooperates with four different regional port authorities, including BPA.[49] At present, only a limited amount of data from Port-MIS is used in Chain Portal's Data service. BPA will consider interfacing Port-MIS with Chain Port in the future based on the demands of stakeholders.

Road transport systems, including hinterland and inland depots, will reportedly be integrated with Chain Portal to provide real-time visibility into freight movements in the future. Around 70 hinterland companies have registered to use Busan Port District Park system on Chain Portal. For now, however, the system is primarily used for administrative and information purposes.

---

48 Korea also has a Trade Single Window called uTradeHub, which automates trade procedure via an online portal including Customs, Logistics, Banking & Trade Finance, B2B commerce and Licensing & Certification.
49 These include: Busan Port Authority, Incheon Port Authority, UlsanPort Authority, and Yeosu Gwangyang Port Authority.

Benefits and impact

The PCS has reportedly been positive for stakeholders. Terminal operators report increased productivity by minimizing container relocation and re-handling time. This in turn has increased container yard throughput capacity, improved performance by allowing the right allocating of personnel, and by improving service reliability. This also had a positive impact on shipping lines, which have also been able to monitor the loading and unloading status of containers in real time. Eventually, this leads to lower vessel turnaround times.

Transport companies have benefitted from being able to schedule inbound and outbound visits. That has allowed them to balance peaks, improve capacity utilization, and reduce vehicle turnaround times. It has also saved fuel while idling in line in front of the terminal gate.

Truck drivers are able to receive container information upon arrival, or even before arriving, via the TSS mobile application. They can also receive real-time alerts on backhaul transportation. The solution reduces time spent at the gate and container yard. Moreover, the truck driver can reduce deadheading, allowing both the initial and return trips to be fully utilized.

In terms of adoption rates, approximately 3,300 users have registered, primarily from the trucking and transportation industry. Transport and trucking companies are predominantly small and medium-sized business (SMEs) with no operational systems. More recently, in August of 2022, BPA signed a Memorandum of Understanding (MOU) with the Korea Integrated Logistics Association and the Korea Public Service and Transport Workers Union. As a result, BPA anticipates that stakeholders will be encouraged to use the system actively.

Key takeaways

The PCS set-up in the Korean case study, Chain Portal, operates in a high volume and congested port environment. The driver for implementing a PCS solution was partly in response to the need to increase capacity at the port without costly investments in infrastructure.

In view of the above, the solution in Korea has been very much focused on traceability of trans-shipment cargo and trucking logistics, as well as real time monitoring of port related cargo handling activities. Trans-shipment represented 54% of throughput in Busan port in 2021. This increases opportunities to streamline and render port operations more effective and thereby enable increased throughput capacity in the port.

One of the key highlights includes the use of Blockchain technology, something that is still relatively new to the world of PCS systems. This has supported the success of the project by increasing trust around data security. Obtaining consent for receiving information was reported to be a challenge in this case study and Blockchain technology supported the initiative by increasing trust around this part of the project.

MOROCCO

PORTNET

Introduction

In brief

The Port Community System (PCS) and National Single Window (NSW) project in Morocco was initiated in the early 2000's as part of a series of sectoral reforms and upgrading programs of key Ministries in the country. The reforms aimed to improve the performance of the entire logistics chain in Morocco through, on the one hand, the strengthening of the hard infrastructure at the respective ports and terminals, and on the other hand, trade facilitation.

In the context of these reforms, the National Single Window "PORTNET" was developed in 2012. In addition to being intended as an NSW, PORTNET also plays the role of PCS for all Moroccan ports except for TangerMed, which has its own PCS. The case study specifically focuses on the use of PORTNET at the Port de Casablanca in Morocco.

Why this case is significant

The first key highlight of the case study is how stakeholders came together. Stakeholders were able to align on the project in view of the need for a one-stop shop in the context of ports in Morocco. Traders were keen to benefit from faster exit and clearance of goods, which would allow them to speed up the supply chain.

In addition, improved transparency and increased predictability reduced opportunities for fraud, both in the public and private sectors. Linked to this, a success factor that is highlighted is the role played by the port authority, the Office for Port Management (ANP), which took charge of project management and was able to convince partners in the port community of the effectiveness of moving towards a PCS.

The collaboration of Customs was also very important. Linked to this, the degree of maturity of the information system that Customs was using at the time of the PCS implementation allowed interoperability with the Single Window in both its two dimensions, namely, PCS and Single Window for administrative formalities.

Project background and development

The formal creation of PORTNET in Morocco in 2012 was the result of an overarching agreement by the port community and international trade actors led by the Office for Port Management (ANP) and the National Council for Foreign Trade (CNCE). These organizations were at the time looking for solutions to simplify

and facilitate procedures associated with foreign trade operations and achieved this by creating PORTNET.

Before this was achieved, several events took place, which prepared the ground for the project. In 2004, the Ministry of Transport and Equipment of Morocco requested the assistance of the World Bank to carry out a study on improving the performance of the entire supply chain. An inter-ministerial steering group for the "Single Window" project was set up for this purpose with the participation of the CNCE, which brings together the main Moroccan public and private players in the international trade supply chain.

In 2006 the Moroccan government also undertook a major reform of the port sector to improve productivity and competitiveness. Studies were carried out on congestion in the port of Casablanca. At that time, it was decided to separate the regulatory mission and the operational activities of the port. This involved a privatisation program and the withdrawal of the state from certain activities, thereby increasing the role of the private sector in the port. These studies helped to finalize the choice of the Single Window model and confirmed the services to be covered by the Single Window.

Subsequently, the port authority ANP[50] took over the leadership and implemented the solution according to a deployment plan developed with all the stakeholders. The services selected for the launch phase mainly concerned the management of the stopover (vessel announcement, manifest, dangerous goods, request for post assignment, etc.). As part of the reform initiative, the PCS project was thereby brought forward.

One of the factors driving the enabling environment was PORTNET's ability to listen to users and its proactive communication policy which is based on quick wins actions in terms of services which reinforced PORTNET's credibility as a facilitator. As a result, PORTNET is currently associated with national development strategies led by various government entities, which now put the national economic operator at the heart of their strategies.

The development took place over three key stages. The first was the pilot phase. The launch took place in 2008. The ANP played the role of "incubator. "The Portel/Indra consortium was selected in 2009 for the IT development of the solution. In March 2011, the ANP started the first pilot project for the digitalisation of ship calls at the Port of Casablanca by connecting stakeholders to the Single Window for the exchange of relevant documents. In the same year the ANP launched a pilot at the port of Casablanca for the coordinated management of the control and removal of containers.

Following this phase, in 2012 PORTNET.SA was created following the government decree authorizing the ANP to create a subsidiary with a capital of 6 million Dirhams, PORTNET SA. This entity was created in partnership with port actors and was mandated to take charge of EDI exchanges within the port community and between

---

50   https://www.anp.org.ma/fr/

foreign trade operators. In addition, because of the active collaboration with Customs and the ANP, PORTNET was able to develop additional services which encouraged users to join PORTNET to better track their goods and the process of their removal.

In 2014 PORTNET extended its activities beyond the port and became the NSW with the launch of the pilot project relating to foreign trade formalities (subscription of foreign trade documents). In September 2014 PORTNET began the gradual digitalisation of import documents to integrate international trade transactions transiting through all port, airports, and road (SW) cross-border points. This process was finalized in 2015.

Over time, new functionalities were added. In 2016, PORTNET operated the digitalization of export licenses (SW). It also connected the technical and health control services to electronically exchange the results of goods control with the Customs and Indirect Tax Administration (ADII). ANP had at this time implemented the paperless strategy in all ports through the electronic filing signed through PORTNET of all stopover documents. Later between 2017 and 2020, a series of new functions were added, including the launch of the electronic announcement via PORTNET of notices of arrival at the port of containers intended for export, a multi-channel payment service, and other new services. These included:

I. The scrapping of the physical filing of the detailed declaration and its attached documents.

II. The end of the transitional period of physical presentation of the notice of arrival and the verified gross mass.

III. The effective entry of the electronic truck appointment system.

IV. The digitalization of the docking request.

V. The online processing of equipment requests.

In 2020 the delivery order for maritime and air was digitalized. The same year, Customs put into service an electronic voucher for a delivery exchange circuit and proceeded to its gradual implementation for import operations carried out at clearance hubs and warehouses and ports. In addition, in 2021, PORTNET completed the digitalization of the multi-channel payment to the foreign trade community (laboratories, control offices, shipping companies, public administrations, forwarding agents, handling operators, etc.). During the same year, PORTNET launched its Business Intelligence platform "PORTNET'S KPI".

Legal framework and governance

Users are mandated to use PORTNET by government decree. Under this decree (2-10-146, of April 26, 2010), PORTNET SA is mandated to manage EDI exchanges within the port community and between foreign trade operators. Another decree (Order No. 1675-15 of May 19, 2015) issued by the Ministry of Foreign Trade that makes it compulsory to use PORTNET for the electronic submission of import and export formalities. Agreements were also concluded with regulatory agencies to use PORTNET to simplify procedures relating to imports.

From the outset, the system adopted the international standards of UN/CEFACT in terms of data and message formats. Its membership and active role within the African Ecommerce Alliance and within the technical commissions of CEFACT encouraged adherence to these standards and to the recommendations on the facilitation of CEFACT.

The ownership model changed over time. In the early years, the ANP was the owner of the PCS. In 2017, ownership was transferred to PORTNET. Today, PORTNET is a form of Public-Private partnership, with the ANP owning 78.8% shares and the remainder of shares owned by private operators, namely Marsa Maroc: 5.3% and other private operators with 15.8%.

From a governance perspective, PORTNET operates under the framework of its internal standard operating procedures, which have been validated by the Board of Directors. These procedures cover procurement, investments, and recruitment of technical and administrative staff. Different stakeholders are represented on the board of directors including the ANP, shipping agents, freight forwarders, Customs, stevedores, the National Council for Foreign Trade (CNCE), the Casablanca Chamber of Commerce, and rail carriers.

The choice of an autonomous operational structure governed by private company law provided a more agile set-up in the management of both human resources and investments. The private shareholders participate in the management and play a role in overseeing the achievement of performance objectives set out each year.

Financing and pricing model

Investments were made over time during the three phases mentioned above, namely, the pilot phase (2004-2008), the development of the platform within ODEP (2008-2012), and the go-live phase (from 2012). The funding for the development was provided by ODEP/ANP. The financing of the operation on the other hand was first ensured by the ANP and later by PORTNET SA after its creation in 2012. From 2012 to 2017, before the transfer of the platform to PORTNET, maintenance was ensured by the ANP and each year the cost of this maintenance was invoiced to PORTNET which operated the platform. The overall cost of the initial investment for the Single Window is estimated to be USD 4 million. Operational and maintenance costs are covered by the budget of PORTNET S.A. These are also estimated at 4 million USD per year.
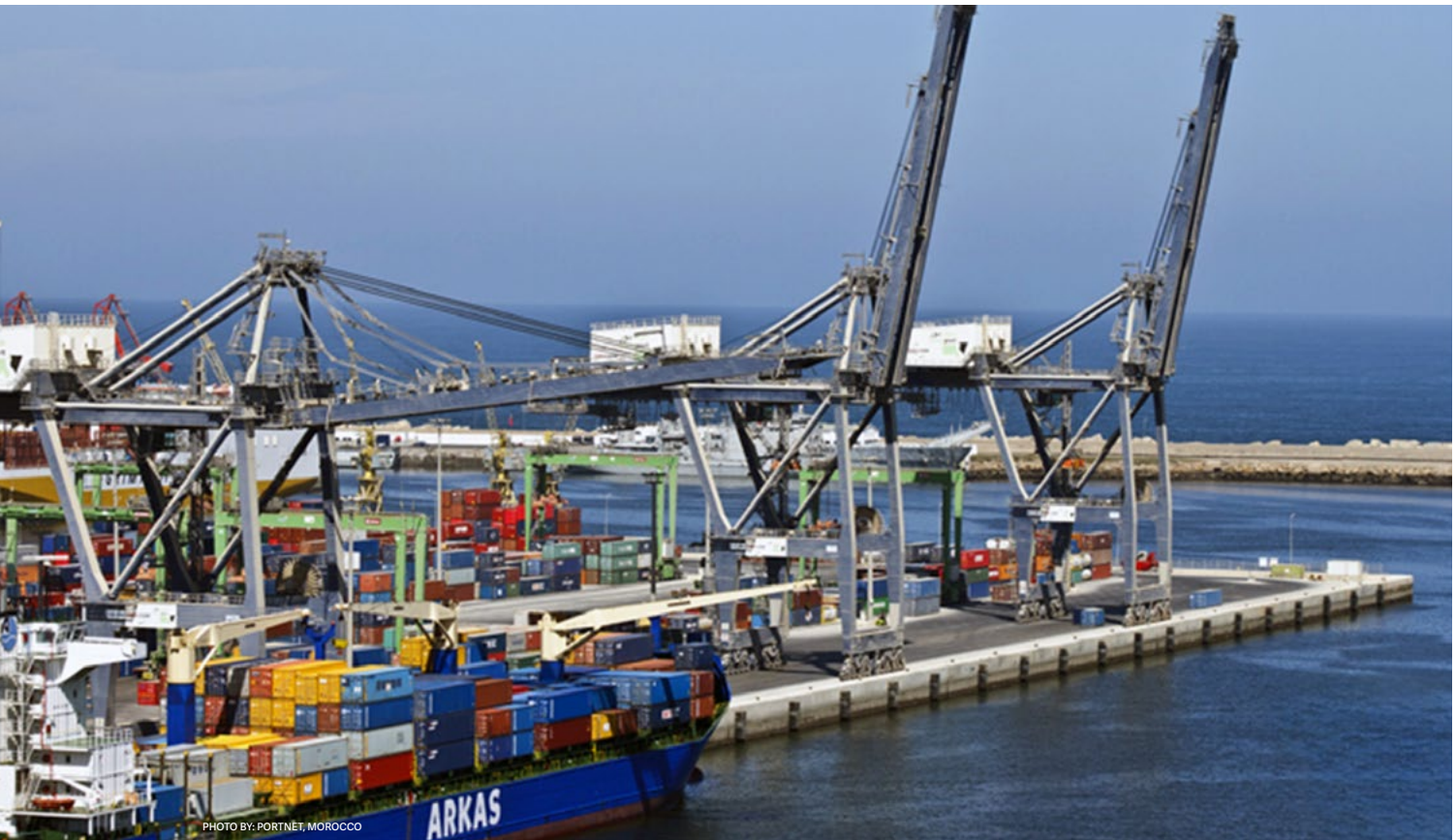
PHOTO BY: PORTNET, MOROCCO

PORTNET operates on a not-for-profit basis. However, PORTNET charges for its services to cover costs. Charges are levied by an annual subscription. Rates are set by user category. These prices are published on the PORTNET website. Rates were initially set as fixed annual fees of 3600 DH (350 US$). In 2022, the pricing of services was modified, and billing linked to the volume of transactions carried out by the user was introduced.

The rates charged by PORTNET are decided by the Board of Directors on the basis of consultation with users. It is understood that revenues must be sufficient to ensure the sustainability of the operation and to allow the maintenance of high service levels of the platform that guarantees interoperability with the systems of public and private users and with international networks.

Technical architecture

The organizations participating in the Single Window operate their IT systems independently of PORTNET and are interconnected and interoperable in EDI mode. It is possible to access the system via the internet to submit and monitor declarations.

In this configuration, PORTNET is a multi-channel exchange platform (Web/EDI) that offers tools for exchanging data and information. Economic operators who connect to it via the internet

can enter or upload files for submission and exchange them with stakeholders. After validation by PORTNET, data is then shared with partners and distributed to end users.

The implemented infrastructure model is divided into three layers depending on the service and application loads performed by the functional component. These include:

I. Production of the environment.

II. Disaster recovery environment.

III. Development, testing and training environment.

The selected IT architecture offers:

- Backup Center.
- Server cluster.
- Redundancy (power source, disks, etc…).

The architecture also offers the possibility of extensibility:

- Horizontal scalability: possibility of adding servers of a given type (web, application, etc.).
- Vertical scalability: possibility to upgrade a server.

In terms of interoperability, connected systems include:

I. The port community of Casablanca: This community was connected to the pilot project which offered a messaging system, managed by the GNS company. This project allowed agents and shipping companies to communicate ship information to ODEP/ANP.
II. The ANP/ODEP IS: SIPOR (Port Management information System).
III. Customs.
IV. RAM submitted its air manifests by EDI through the pilot system (15,000/year).
V. The major banks had their internal systems to enter information.

In terms of confidentiality of data, this is ensured by a computer security plan. Access to the service requires client authentication, which is based on user credentials (username and password). An additional layer of security is provided with the use of the digital signature, particularly for exchanges in EDI mode. The legal framework for electronic signature is in place. The law (Law 53-05 of November 30, 2007) allows the electronic exchange of legal information and the use of the digital signature.

PORTNET partially covers the services of an MSW, namely some of the IMO FAL forms that are required for ship arrivals and departures. Stores and bonded warehouses installed outside the port precincts are connected to PORTNET and use all its features. There are, however, currently no connections with hinterland logistics areas.

Benefits and impact

Benefits and advantages of the system have been different for different users. To monitor this, PORTNET, in collaboration with its partners, in particular the Customs and the ANP, produce detailed dashboards which help to measure the performance of the system.

Monthly dashboards are published by PORTNET. The system is accessible at any point during the day and the year. Benefits for private sector stakeholders, particularly shippers and consignees, include increased transparency and reduced opportunities for unequal or preferential treatment in the processing of documentation for imports and exports. This is a particularly important theme in discussions concerning the benefits of the system in Morocco. Other benefits include:

I. Increasing the efficiency of the logistics chains of economic operators and public and private service providers.
II. Acceleration of the cross-border passage of goods for import and export.
III. The establishment of an environment conducive to the competitiveness of economic operators with the possibility of working in tight flows.
IV. Reducing uncertainty about lead times and logistical costs.

V. Improving the business climate, good governance and increasing transparency in business-administration relations.
VI. Simplification and acceleration of procedures and formalities.
VII. Improving the traceability of operations, as well as anticipation and planning capabilities thanks to the quality and good circulation of information flows.
VIII. Elimination of unjustified privileges and preferential treatment.
IX. Elimination of steps or additional documents related to the process.
X. Reduced user response time.

For public sector entities, such as regulatory departments involved in the trade process, reported benefits of implementing PORTNET in Morocco included:

I. Improvement of the business climate, good governance, and transparency within the framework of the CNEA (National Business Climate Committee).
II. Improved national logistics competitiveness and reduced border crossing costs.
III. Compliance with the National trade development plan (international agreements signed by Morocco), and the implementation of the national plan to simplify procedures.
IV. Simplification, securing and facilitation of Customs' procedures as part of the constant commitment to businesses.
V. Transparency in the rules, efficiency of control, enrichment of information on exchanges, exteriors, adoption of good international practices.
VI. Generalization of electronic administration and innovation in public services.

Key takeaways

The system implemented in Morocco includes both an NSW and a PCS. The project was initiated in a top-down manner as part of an overall planning and implementation of reform initiatives all focused on improved transport efficiency and trade facilitation.

Such a top-down approach enabled a comprehensive approach to the implementation of the project, which is why PORTNET included both the functionalities of an NSW and a PCS. The scope and functionalities of the platform have increased and changed periodically since the inception of the system.

The ownership model also changed over time to become a PPP. Day to day governance and operations are governed by internal standard operating procedures, all overseen and determined by a Board of Directors.

Its independent operational structure governed by private company law has enabled the system to be adaptable and responsive to user needs and requirements and enabled continuous improvement of the system.

NEW CALEDONIA
GIPANC

Introduction

In brief

The Port Community System (PCS) project in New Caledonia began in 2010 with the intent to digitalise the port community of Noumea under the leadership of UMEP (Port and Maritime Union). The project is a private sector led initiative and was developed and implemented in a phased manner and using an off-the shelf solution.

To achieve successful uptake and implementation, the processes and procedures followed by stakeholders operating in and around the port were assessed before implementation. As-is and to-be mapping was performed. In addition, the Customs code applicable in New Caledonia was amended to enable for a smooth transition.

Why this case study is significant

The New Caledonia case study covers the first PCSO to be created by a SIDS in the Pacific. It is a useful reference in the Pacific Community for the amendment of custom legal frameworks related to the PCS.

The case study is an example of a private sector driven PCS and is entirely financed by the private sector. This is rather important since in other cases the PCS projects began with PPP concepts or pure public sector driven initiatives.

While entirely private sector financed, the project sought to reflect the needs of the port's public administrations as well. The involvement of Customs and the Port Authority was therefore important and progressively increased as the project developed. The economic model of the solution nevertheless allows it to be free from government administrative powers in its operations and billing methods.

Key highlights from this case study includes how the project was managed and how public sector entities engaged with the project. The Autonomous Port of New Caledonia (PANC) played a fairly passive role in the deployment of the PCS. The board's position was to let the private sector manage its costs and revenues without intervention from the public sphere. Private sector stakeholders are directly linked to its ownership structure and governance. The joint stock company GIPANC was founded by UMEP Port Community Association, to implement the project within time and budget.

The public sector was not involved in the deployment of the first generation of PCS but became engaged in the second generation implemented throughout the customs administration and the port authority.

One key area of interest is how this model may work in the longer term given the potential challenges associated with competition and sensitivities around information sharing.

Project preparation and development

Like many other PCS projects, the one in New Caledonia began with a renewed drive to modernize the port's business model and benefit from the logistical traceability provided by PCS to improve the port's security (implementation of the ISPS framework) and its performance. Unlike most PCS projects however, the private sector played a core role.

To achieve the objectives set out by the community, UMEP NC port community association was founded in 2010. UMEP, in turn, later created the PCS operator GIPANC, with the aim of entrusting this entity to implement and operate the PCS to automate all business processes related to the passage of goods at seaports and airports in New Caledonia.

The implementation was carried out in two phases, the first running from 2011 to 2018 and the second one from 2019 to 2022.

A call for tender in 2011 was issued by the UMEP for the design and implementation of the PCS. The call for tenders had several requirements including:

I. The possibility of the PCS to be interoperate with each of the systems already in place within the members of the port community without any major modification.

II. Local data hosting.

The selected system integrator was MGI, a PCS independent software vendor from Marseille, providing customisation to the specific needs of the port community of Noumea.

In the first phase of the contract, only imports were covered in scope. This was done to limit the costs of deploying the AP+ PCS while remaining consistent with the reality of port traffic flows in New Caledonia and to facilitate the acceptability of the PCS by all users.

The functional study of the import processing was the central preparatory element for the deployment of the PCS. It consisted of as-is and to-be analysis. The project team confirmed whether the processes could be optimized before customizing the PCS.

The implementation of PCS included the following steps:

I. Project management and change management. This included a review of documents delivered as part of the project. Ensuring that the system is developed in

PHOTO BY: © PCS OPERATOR | GIPANC, NEW CALEDONIA

accordance with the users' needs. Controls related to project planning: weekly reviews of the project's progress.

II. Phase 1. This included a study of the adequacy of the PCS with the needs of all users. It also included the launch of the project and validation of the scope.

III. Phase 2. Technical implementation.

IV. Phase 3: Support for the implementation of AP+

V. Phase 4: Implementation and follow-up.

At the time when it was decided to expand the scope to include exports, additional mapping exercises were performed for this purpose.

In 2018 GIPANC decide to migrate CI5 the new generation to the PCS developed by MGI and based on Amazon cloud solutions. The implementation took place in 2021 and 2022.

Legal framework

No specific legal framework was established for the use of the PCS during the first-generation development. During the second-generation development on the other hand a regulatory framework covering the PCS introduced regulatory provisions in the Customs code that makes the use of the PCS mandatory. The new regulation was adopted by the government in January 2022 and defined the obligations of the users of this import system during the different stages of the pre-clearance process.

The first amendment of the Customs Code adopted in January 2022[51] provides critical provisions on port digitalization, implementing the mandatory use of a PCS to comply with customs requirements: "art. Lp 61: *persons required to carry out the formalities provided for in this title shall use the port or airport logistics information system deployed at the customs office responsible for the customs operation, in accordance with the terms of the government of New Caledonia*". The insertion of specific provisions in the new code will ensure that the customs authority plays a leading role in the port digitalization process.

The Customs Code amendment redefines the pre-clearance customs process for imports, including the notification of logistics information in the PCS. The information that needs to be

---

51   Law of the country of January 21, 2022 amending the New Caledonia Customs Code.

submitted includes: (a) the announcement of the vessels and the provisional announcement of the goods to be unloaded by the shipping agents. (b) real-time report of unloading information by the handlers. (c) lodging of the final manifest by the shipping agents, with communication of any overages or shortages noted during unloading. (d) traceability of goods enabled until the clearance process is completed.

From a legal point of view, the change to the Customs code was generally accepted in view of the usefulness of the solution, which made interoperability possible between the three digital systems of CI5 PCS, Vigie Maritime Single Window and Asycuda World Customs Management System.[52]

Governance and business model

While all relevant actors are members of UMEP, the development of solutions was defined and validated by GIPANC in coordination with MGI. GIPANC is described in the AP+ quality guide as the "guarantor that the methodology used is in compliance with the regulations". The entity listens, advises, and provides technical support to users, facilitates interactions between them and optimizes business processes.

From an ownership standpoint, UMEP Port Community Association created GIPANC, a simplified joint stock company created with 29 shareholders. All the members of UMEP are shareholders. Each of the 29 shareholders are also its customers representing each core business, such as freight forwarders, maritime agencies, maritime companies, pilots, handling companies or declaring companies represented at the port.

From a governance and development standpoint, the organisational set-up has been developed in stages using committees with representatives from different strands of the industry. The aim of these committees is to give visibility to the different actors on their projects related to the port. They enable concrete lines of action to be defined (e.g., reform of port taxation, setting up joint customs and health authorities container control area, evolution of the port's boundaries with the implementation of the ISPS zone), while accounting for the needs or developments within the PCS. They provide a first response to the need for governance of the PCS by coordinating its development around concerted projects. These Committees have no regulatory functions and can only make recommendations.

The Governance framework is based on three levels:

I. A steering committee, that meets on yearly. Participants include GIPANC, MGI, Customs administration, port authority, forwarding agents, handlers, maritime agents.

II. A convergence committee was established in 2018 at the request of Customs and GIPANC. This involved the UMEP, GIPANC, the Customs and Health authorities and later SPADET, and the freight forwarders association.

III. User committees were set up early on in 2013 to include the views from stevedores. With regular monitoring of the tool's progress, these stakeholders became aware of the interactions between the different systems.

Customs do not have an official role on the governing boards. However, representatives do participate. The engagement has increased over time, driven by the goal to modernize the customs clearance tool, with the support of UNCTAD and enhance interoperability between CI5 PCS and ASYCUDA World, for the management of the manifest and for the clearance of goods.

Financing and revenue model

Revenue streams for GIPANC originate from user fees. GIPANC invoices forwarders according to use, namely number of customs declarations submitted. For each customs declaration validated in ASYCUDA World and followed in the PCS, GIPANC charges on average 8 USD.

In addition to user fees, revenues are generated from annual subscriptions. These are paid by all private users and are equal to 2,000 USD per year. The developer of the PCS, namely MGI, bills GIPANC for 50% of these revenues.

GIPANC's overall turnover is approximately 720,000 USD per year.

From a cost basis perspective, the initial audit conducted in 2013 was the main cost element paid by the government of New- Caledonia (USD 45,000). An additional functional study was produced in 2018 for the deployment of the export component.

AP+ or CI5 are off-the-shelf PCS systems. This was chosen to limit costs.

In order to limit the costs induced by specific developments, the amendment to the customs code was done before deployment to avoid pursuing customisations. At a project level, there is no financial participation in the maintenance of the system by either customs or other public sector entities.

Functional and technical architecture

To limit costs of deployment and boost uptake, the scope of the PCS in the first phase was limited. The scope was later expanded to include export processes.

---

52   As of the writing of this report VIGIE is not yet recognized in the Custom code or officially endorsed by the Government of New Caledonia.

A data center was implemented in Noumea to host the PCS. In 2021, the implementation of CI5 enabled migration to the cloud with AWS.

In addition, a new port of call management system (VIGIE) was implemented in 2020. With the implementation of VIGIE, PANC became more engaged with the PCS as VIGIE included the ship identifier into the PCS and validates the port of call. It also links the billing of the new berthing fee on information from the PCS, therefore becoming a fundamental piece of the collection of revenue for the Port Authority.

I. The AP+ first generation of PCS includes the following architecture:

II. The AP+ software package developed in Java is based on a Java Enterprise Edition (JEE) environment and operates through the Oracle Weblogic Application Server. The transition was made between Weblogic 8.1 and Weblogic 10.3 which required an adaptation of the AP+ code to the new JDK (Java Development Kit) 1.6.

III. The Oracle database was also migrated to the latest Oracle 11G version which provides optimized data access mechanisms and very high levels of data replication and security.

IV. The process used to connect CI5 with both public system (ASYCUDA called SYDONIA WORLD/ CUSTOM system + the Gate Control system /Port Authority System) is an API (Application programming Interface). The EDI process is used to connect with the private systems.

V. Web server is Apache. The web application is available on the web without implementation of VPN. Having a good quality internet connection is essential. Https ensures data confidentiality.

The second generation of PCS is a web application built on a modern architecture and open-source technologies. It is service-oriented and ensures strong interoperability between systems. It includes big data, the Internet of Things (IoT), fifth-generation technology (5G) and blockchain solutions. The interface has been modernized, being more ergonomic and intuitive.

Ci5 PCS data is stored in the PostgreSQL database hosted by the French national cloud AWS from Amazon. The cloud environment includes DevOps, Docker, and Container. Ci5 has secured its data exchange processes. The EDI message format complies with UN/CEFACT international standards (XML, EDIFACT, JSON, CSV, TEXT, CAR).

As already noted, Ci5 is based on-open sources technologies. It can connect to any system and capture information from any source to track goods in real time and optimize the supply chain management. Ci5 also provides API's (Application Programming Interface) to partners. The access is secured through ID's and OAuth2 protocol of authorization.

The functional services covered by Ci5 are divided into five categories, based on services in support of: (a) Maritime operations – related to port call, advance vessel information: harmonized cargo manifests are received well ahead of vessel arrival. (b) Port operations – loading and unloading of cargo at terminals, cargo delivery, temporary storage. (c) Hinterland operations – inward and outward movement of cargo, bonded warehouses. (d) On shore regulatory services – other regulatory services based on shore covering vessel security, dangerous goods, veterinary and sanitary inspections. (e) Transverse services – supply chain key performance indicators (KPI), port information portals providing operational and practical information to all port users, such as service hours, vessel arrival schedules or port tariffs.

Benefits and Impact

One of the key benefits of the introduction of the PCS has been enabling port community users to access data and information valuable for tracking and improvements in service. Users can ask GIPANC for data related to their own transactions. This does not include confidential data of other users.

In addition, GIPANC collects and aggregates data from users and uses these to publish and distribute data on port performance.

Key takeaways

The initial high acceptance rate of the New Caledonia PCS project was partly due to the fact that the process of implementing the PCS came from the private sector. It can be said that with the implementation of CI5 and its interoperability with Vigie Maritime Single Window and ASYCUSA World Customs management system that the public sector has regained leadership in the development and implementation of the PCS. The mandatory nature of the system has also been accepted and the manifest is now lodged in the PCS, signalling uptake.

The New Caledonia case study is significant because it is related to one of the first PCSO among SIDS in the Pacific. It is a useful reference in the Pacific Community for the amendment of custom legal frameworks related to the PCS.

The invoicing model has also supported high adoption rates, since each actor in the logistics chain is free to invoice its customers for transactions integrated into the PCS on its behalf. Freight forwarders in particular largely re-invoice their customers for the unit fee collected by GIPANC.

NETHERLANDS

PORTBASE

Introduction

In Brief

This case study concerns the PCS for Ports in the Netherlands, namely Portbase. Portbase is a publicly owned entity run and operated as an independent private company. It is an affiliate of both Havenbedrijf Rotterdam N.V. (Port of Rotterdam Authority) and Havenbedrijf Amsterdam N.V. (Port of Amsterdam Authority). Both entities are publicly owned and are shareholders of the company Portbase.

Portbase was established in 2009 following the integration of two PCSOs: Port infolink operating at the port of Rotterdam and PortNET operating at the port of Amsterdam. The impetus for uniting the ports was efficiency and coordination. The aim was to end digital fragmentation and better coordination nationwide.

The initiative is voluntary and is the result of both a formal top-down approach from its shareholders and an informal bottom-up approach. The initiative gained traction when the Harbour Masters' designated the PCS as their formal notification stations and the Customs Authority decided to go paperless with the electronic manifest system. On the level of B2B services, port operators are free to use it or not. As the acceptance and commitment of the port community is substantive, that uptake is high.

Why this case is significant

Key features of this case study include the greenfield nature of the project and the importance of building trust between stakeholders. Government support was critical for the development of the PCS for both port communities and the creation of a nationwide port system.

Secondly, the case study highlights the role played by the alliance between Portbase, the Harbour Masters, the Customs Authority, and the port community, represented by Deltalinqs, the promotor of the common interests of the entrepreneurs in the main port of Rotterdam. The Harbour Master created solid foundations for the PCS by appointing the PCS as its formal notification station. That provided a springboard for B2B services. These are voluntary. There is no legal compulsion to have a PCS.

In addition, the project regards the PCS as operating for the common good and as an integral part of port infrastructure. This is common to other projects but not all. It shows that treating a PCS as a public good can support cooperation and engagement among stakeholders.

Portbase PCSO is the largest in Europe in terms of annual revenue, customers, users, and transactions and is in the top league worldwide. Portbase is also a founding member of the International Port Community System Association.

Project preparation and development

The Portbase PCS is rooted in earlier systems including Port infolink, which was established in June 2002 by the Port of Rotterdam Authority. Sponsors and supporters of Port infolink included the Association of Rotterdam Ship Brokers and Agents (Vereniging van Rotterdamse Cargodoors (VRC)), Deltalinqs, and the Dutch Customs Authority.

The pilot phase for Port infolink lasted two years and had the goal of optimizing processes along the transport chain at the port of Rotterdam. Emphasis lay on the type of the platform, identifying functionalities, and engaging with stakeholders on matters such as ownership and responsibility for the operations. The first PCS platform was built by in-house system developer and was technically managed by systems integrator Pink Roccade.

The approach concerning who should operate the PCS was rooted in the idea of the public good. The start-up of the system was organized by the Port of Rotterdam Authority, which was regarded as impartial and without immediate commercial interests. In addition, the digital infrastructure of the port was seen as part of the general infrastructure of the port rather than a separate set-up. The Port of Rotterdam Authority therefore financed the project and became the sole shareholder of the separate entity Port infolink, which operated the PCS.

The PCSO of the Port of Amsterdam, PortNet, on the other hand was established in 2000 and mainly focused on information flows concerning border control, customs declarations, and Harbour Master notifications. Through the involvement of National Public Works there was not only a focus on the seaport of Amsterdam, but also on inland navigation. That said, Port infolink was the more advanced system.

Both systems were initially meant to make their respective ports more competitive by offering PCS functionalities. The driver to join forces was the ambition to serve customers active in both ports by enabling them to use the same system. Government agencies in both ports encouraged moves towards one system for both port communities and with a view to create a nationwide system.

The merger took place by an amendment to the Port infolink Articles of Association and the accession of Port of Amsterdam Authority with a 25% shareholding. Through this merger, the scope of Portbase gradually expanded from a local focus on Rotterdam and Amsterdam, to the Netherlands as a whole.

Governance and business model

Portbase has a strong governance framework. The company is a private limited company and is managed by a Board of Directors under the supervision of a Supervisory Board. Because a PCS is not enshrined in legislation in the Netherlands, contracting out

Figure 4. Portbase development 2002-2022
**The portbase story**
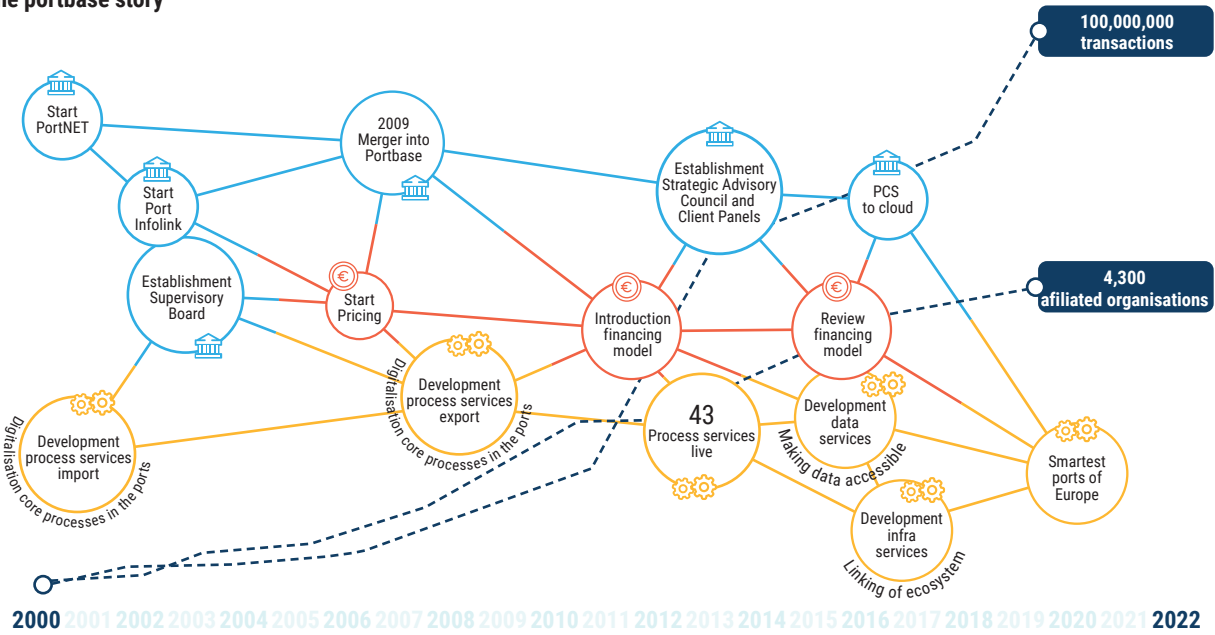
the operation of a PCS through a concession does not apply. The operation of Portbase is therefore possible through the internal procurement of the respective ports.

A Strategic Advisory Council examines the services offered. The Council, which includes port community representatives, determines whether services are adequate and whether new services should be offered. Strategic portfolio objectives are defined from which a community roadmap emerges.

The composition of the group reflects the strategic landscape of the Dutch port community. The roadmap is a method to keep the broader port community committed to Portbase and the other way around, to keep Portbase aligned with the different domains in the port community.

Client Panels help to set new objectives and priorities. These panels consist of representatives of clients and sector organizations. There are four Client Panels: 1) Hinterland. 2) Freight forwarders and shippers. 3) Ship operators and shipping agents. 4) Terminals and depots. Based on the strategic objectives agreed upon in the Strategic Advisory Council and the established selection criteria, the Client Panels set priorities for their specific domain. These together form the (concept) domain roadmap.

Figure 5. A national PCS
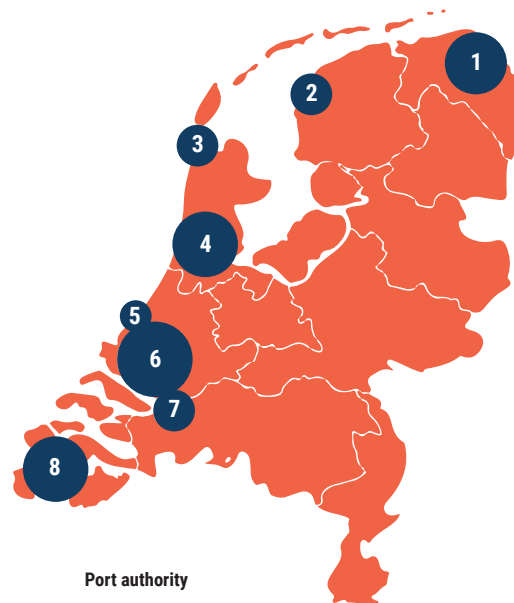
Port authority

1 Groningen Seasports (Delfzij / Eemshaven)

2 Harlingen Seasports

3 Port of Den Helder

4 Port of amsterdam

5 The Hague / Scheveningen

6 Port of Rotterdam

7 Port of Moerdijk

8 North Sea Port (Flushing / Terneuzen)
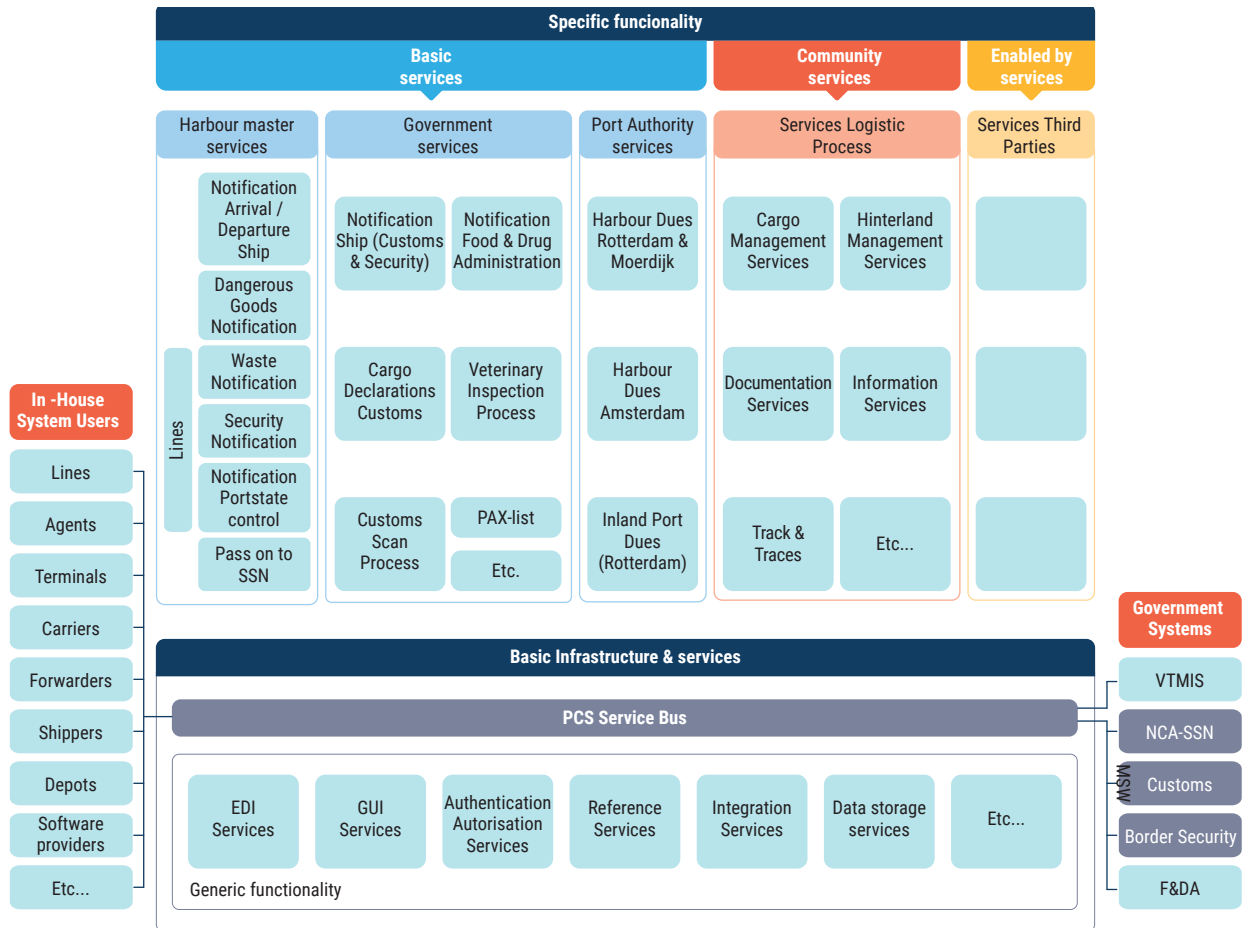
Financing and pricing model

Portbase runs on a not-for profit basis. Revenues are used to cover the costs of operating the platform and improving the system. The overall CAPEX invested by shareholders since the start of the PCS is reported to be over 120 million euros.

The investments and costs are partly funded by the Port of Rotterdam Authority and the Port of Amsterdam Authority as shareholders, and partly by the income of the specific services delivered by Portbase. The income covers CAPEX and OPEX such as staff, which amounts to approximately 115 full-time employees, including a CEO, COO, and leadership team of 10 persons.

In addition to the above, other cost streams that are covered by stakeholders through their allocated budget include:

I. Notifications to the Harbour Masters: the costs related to the development and operating of the notification services are financed by the respective Harbour Masters.

II. Community services to Port Operators: the costs related to the development of these services are pre-financed by Portbase and paid back by clients of the services, using a monthly subscription fee.

III. Strategic services: the development costs and the operating costs of these elements are paid for by the Port Authority for whom the strategic services apply to.

IV. Services to connect public sector users: the development costs and the operating costs for these are paid for by the specific (public) user.

From a transaction fee perspective, services fees were introduced in 2008 and the price of any specific service provided by Portbase consists of two components: a fixed fee for the subscription to a service, and a variable fee for every time a port user engages in a transaction using a service. In addition to traffic-based fees, connection fees also apply. These include an initial, one-off charge for setting up the system-interfaces.

Portbase applies fees when it provides Community Services to port operators. As highlighted above, the related costs for the development of the services are then pre-financed by Portbase and the price of a specific service is made up of two components: a fixed fee for the subscription to a service and a variable fee for every time a port operator engages in a transaction using he service.

Functional and technical architecture

Portbase has responsibility for designing building, management, maintenance and innovation in ICT-infrastructure. Portbase has migrated the entire Dutch PCS to the public cloud hosted by Amazon Web Services (AWS) in 2018. It provides a minimum 99.5% uptime environment with 145 million transactions per year. The uptime in 2021 was 99.98%. Portbase is also ISO 27001 certified.

Portbase serves four different groups:

I. Principal clients of Portbase include: Harbor Masters and the Port Authorities of both Rotterdam and Amsterdam, covering the port notification segment of the ICT-infrastructure, and the data collaboration segment of the ICT-infrastructure.

II. Notifications to Harbor Masters (and onwards to the Dutch Single Window Maritime & Air, and in context of local nautical regulations). Principal clients of Portbase in this context are the Harbour Masters assigning the development and operation of the notification tools on the platform and different port operators using the available notifications tools.

III. Community Services to Port Operators; the applications and services available for the stakeholders in the port representing 5,000 companies and 16,000 users.

IV. Strategic Services. The Port Authorities via Portbase perform these tasks to improve port processes.

All ports in the Netherlands are connected to the Harbour Master Notifications system of Portbase except for North Sea Ports (Flushing, Terneuzen). All the major ports are connected to Portbase for MSW-notifications. These include Groningen Seaports, Harlingen, Amsterdam, Scheveningen, Rotterdam and Den Helder. These ports act as a funnel for the notifications to other (river)ports. Finally, almost all maritime terminals for all types of cargo in the Netherlands are connected to the PCS. The main ones include Rotterdam: ECT (3 terminals), APM Terminals, Rotterdam World Gateway, Rotterdam Short Sea Terminals.

Key Takeaways

Portbase is an example of a greenfield PCS project that was enabled by the merger of PCSOs in the Port of Rotterdam and the Port of Amsterdam. As a result of the merger these entities became a national PCS. The fact that there were PCS operators in place before the merger of Portbase enabled a swift transition. The applicable governance framework was basically transferred to the new operation and amended as needed.

Port authorities and stakeholders worked together to ensure uptake and interoperability. **This was a recipe for success.** This allows for service levels to be maintained and effective developments and improvements to be applied. Trust was an engine that drove the start-up phase of the Dutch PCS's.

The coming into existence of Portinfolink and PortNET was more about momentum and grasping opportunities, and less about a carefully planned process. It was the result of an informal bottom-up approach by port stakeholders, but with strength and guidance from the top, its shareholders. This resulted in a great level of acceptance and commitment in the port community.

Having the Customs Authority involved was a crucial element. The Customs Authority aspired to serve the transport community with a paperless process. Portinfolink functioned as a voluntary tool and gained traction in this way.

Further relevance was gained by Portinfolink becoming the electronic station for public notifications to the Rotterdam Harbour Master. A next step was the development of services and applications for B2B port community processes.

A Port Community System resulting from an informal bottom-up process, has challenges. Appreciation of the benefits of creating a PCS helped to embed use of the Maritime Single Window.

Portbase is a founding member of the International Port Community System Association and has been able to generate annual revenues in 2021 of USD 21.98 million.

SINGAPORE
PORTNET

Introduction

In brief

The Port Community System (PCS) of Singapore started in 1984, when the Port of Singapore Authority (PSA) (now Maritime and Port Authority of Singapore, MPA) introduced its business to business (B2B) port logistics portal services (PORTNET). Since then, PORTNET, has become an extended PCS solution, enabling a Single Window environment and efficiency of port logistics and container handling services.

This case study focuses on how PORTNET was implemented in Singapore where high transhipment cargo volumes converge, and many different players operate. Singapore is one of the world's busiest hub ports and waterways. In 2022 more than 140,000 ships called on the port and 577.7 million tons of cargo and 37.3 million twenty-foot equivalent container units (TEUs) of containers passed through Singapore. Each hour 9 ships arrive and depart from 67 berths.

This case study focuses on how the three main objectives set out for the platform were achieved. The first included developing a collaborative electronic platform that facilitates end-to-end information flow and creates value for port users, trade and logistics businesses and government agencies. The second was to achieve operational efficiency and service excellence for the port and logistics community. Thirdly, another objective was providing an integrated database to capture all vessel and container and cargo information and used as a single window for each of the port's Terminal Operations System (TOS) to receive and disseminate such information in real-time.

Why this case is significant

This case study is significant partly because of the scale of the operation that the platform needs to cover. PORTNET has over 10,000 integrated users and more than 300 million transactions are processed every year. MPA/PSA encourages the port community to use PORTNET through a combination of strategies, including education, incentives, communicating early adopters' successes, and close stakeholder engagement. Over the last three decades, PORTNET has endeavoured to remain at the cutting edge, evolving into an ever more integrated facility.

The creation of an enabling environment for the project and the mandatory nature of its use are also key highlights of this case study. Core to this has been the leadership of some key institutions and support systems to facilitate the participation and engagement of stakeholders, as well as a strong legislative framework rendering the use of the system mandatory for stakeholders. These and other factors have resulted in a successful project highlighted by user uptake and other measures.

Finally, an aspect that is significant for this case study is the roll-out of the system to other countries, such as China and Thailand. While there are other examples of such developments, including the PCS operated by Dubai Ports World (DPW), it also demonstrates the vision of the entities driving the PCS in Singapore to commercialise the solution and expand.

Planning and system development

The leadership role in the conceptualization and implementation of the PORTNET PCS was the former Port of Singapore Authority (PSA) and PSA International, an arm of PSA Global. The Maritime and Port Authority of Singapore (MPA) later took over the role of PSA. PSA International is a fully-owned subsidiary of Temasek Holdings, and is a leading global port operator, owning and operating ports and terminals worldwide.

As of today, PORTNET Singapore is operated by PSA International. The system is a centralized platform that utilizes a web-based architecture, allowing for the exchange of information and data between the different stakeholders involved in transhipment operations through the use of web services and API's.

The vision for a PCS at the port of Singapore grew over time and was driven by the need to increase capacity at the port. IT developments were seen as a means to support this. The innovation cycle has continued over time and services expanded. Government agencies include all relevant authorities. On average about 17 governmental agencies are involved.

PORTNET has remained on a path towards integration with other systems, beginning with Singapore Computer Integrated Terminal Operations System (CITOS) and TradeNet. PSA's PORTNET+/ CALISTA® stands for Cargo Logistics, Inventory Streamlining & Trade aggregation, a platform connecting the logistic stakeholders. A mobile app called PORTNET® Mobile allows real-time information gathering on statuses. It offers alert report functions to the mobile user. PORTNET is integrating with MPA's next generation Vessel Traffic Management System to provide accurate, real-time situational awareness of the shipping traffic, and the digitalPORT@SGTM.

Business Value Proposition

PORTNET has a fully digital business model focused on several key activities, namely offering a value proposition, reach markets, maintain customer relationships, and earn revenues. The planning and development stages of the system were rather typical in scope and schedule and included the following steps. Private and public stakeholders were involved in all stages.

I. **Conceptualization:** This involved identifying the need for a centralized platform for the exchange of information and data between the different stakeholders involved in

Table 5. Key Feature of PORTNET

Online Ordering of Port Services	Customers' Work Process Modules
Facilitates vessel berthing and container handling • Service and Vessels Declaration • Berth application • Stevedoring services • Yard crane handling services • Pilots, tugs, and water boat services • Reefer monitoring services • Labeling / Monitoring / Fumigation services for Dangerous Goods (DG) cargos • On-dock depot facilities	Supports seamless flow of information for container shipment and facilitates interaction and synchronization of activities / information across multiple parties • Hauliers' job lists and subcontract functions • Government permits applications • Electronic Delivery Order (EDO) and delivery processing • Container store & release order • Support system to system integration
Fulfillment Facilitation	**Track and Trace**
Provides real time and updated information on fulfilment of services for end to end control of the whole supply chain. Empowers sharing and exchanging of information among partners • Facilitates efficient and effective discharging/loading of containers upon berthing • Guides clearance of trucks at PSA's "Flow-Through Gates" • Prevents over-stowage during planning • Proactive Exception Management Tool	Real time tracking and consolidated information on-demand for query and analysis purposes • Container status, including arrival and discharge timings • Vessel status, including current location, and changes in berthing details • Detailed schedules: shipping, berthing, yard crane • Ship planning data • Reefer containers' temperature • Dangerous Goods (DG) services enquiry
Financial Functions	
Online billing functions which integrate with customers' in-house systems • Financial Electronic Data Interchange (FEDI) of bills • Facilitate re-billing processes by shipping lines • Online viewing of PORTNET charges	

transhipment operations and defining the scope and objectives of the project through a value chain analysis.

II. **Feasibility study:** This involved conducting a feasibility study to determine the technical, operational, and financial viability of the project.

III. **Planning:** This involved developing a detailed project plan, including timelines, budgets, and resource requirements, as well as identifying the necessary stakeholders and their roles and responsibilities.

IV. **Design:** This involved creating the technical and functional design of the platform, including the user interface, data model, and integration with existing systems.

V. **Development:** This involved developing and testing the platform, including the implementation of security measures to ensure data security and confidentiality.

VI. **Deployment:** This involved deploying the platform in a live environment, including the training of stakeholders and the implementation of support and maintenance processes. Examples of such developments are the FastConnect system (direct input from shipping lines) and CIMOS

(Computer Integrated Marine Operations Systems, 1995) concerning the real time tracking of ships. After platform development there was platform functional testing (unit testing, integration testing, system testing, acceptance testing, user acceptance testing, testing of integration of the platform with other systems, such as customs and logistics systems), as well as non-functional testing (scalability and implementation of security measures to ensure data security and confidentiality (non-functional testing).

VII. **Evaluation:** This involved assessing the performance of the platform and making any necessary adjustments and improvements.

The testing phase was an essential step in the development process because it helped to identify and resolve issues in the system before it was deployed in a live environment. It also ensured that the system was ready for deployment and that it met the expectations of the stakeholders in terms of functionality, performance and security.

The IT approach was based on four key management success factors. These included only business driven-IT investments, aligning IT-plans with business plans, maintaining a flexible and extensible IT-infrastructure, and encouraging IT- innovation and creativity.

As is typical, the testing phase was included within the development stage, where the platform was tested to ensure that it met the functional and technical requirements defined in the design stage. This included functional testing, where the system was tested to ensure that it met the specified requirements, and non-functional testing, where the system was tested for performance, security, scalability, and other non-functional requirements. This phase also included the testing of the integration of the platform with other systems, such as customs and logistics systems.

Enabling environment

To ensure uptake by the Port Community and a successful project, the MPA launched an information campaign to engage with the community and encourage use of the system. The campaign was focused on highlighting the benefits of adoption and engaging to address possible concerns or obstacles to adoption.

There were challenges to adoption. Firstly, some stakeholders did not fully understand the benefits of the platform or how to use it. Secondly, some stakeholders hesitated to invest in the implementation and integration of a new platform due to what they perceived to be high extra costs associated with the change. Thirdly, some stakeholders had difficulty integrating the platform with their existing systems and technologies, which lead to resistance to adoption. Fourthly, some stakeholders highlighted data security and privacy concerns. This is rather common across case studies and involves reluctance by stakeholders to share sensitive data through a new platform.

In addition to the above, two further challenges emerged. The first, which includes some aspects of the earlier points, was the general resistance to change that many IT projects experience. Finally, some stakeholders at first did not see a direct benefit from using the platform and were not immediately motivated to adopt it. The case to adopt the system may therefore face challenges when the benefits are not necessarily immediate but apply in the medium to longer term.

To overcome resistance, PSA communicated the benefits of the platform and addressed concerns regarding adoption by means of developing activities and policies around education, incentives, and support. Additionally, key stakeholders were involved in the implementation process and training and technical assistance were provided to help them with the transition to the new platform.

Regulatory framework and business model

The use of PORTNET Singapore is mandatory for all shipping lines and logistics companies operating in the port. PSA enforces it through regulations and penalties for non-compliance. In addition, some entities have supported its adoption by setting guidelines.

Guidelines have been issued by the Infocomm Media Development Authority (IMDA) of Singapore, which regulates the use of digital information in logistics and supply chain operations. This entity has issued guidelines for the use of digital technologies in logistics, such as the adoption of electronic Data Interchange (EDI) systems and the use of radio-frequency identification (RFID) technology.

Additionally, the Ministry of Trade and Industry (MTI) has also issued guidelines on the use of digital technologies in logistics, including the use of blockchain technology in supply chain management. These guidelines are intended to encourage the adoption of digital technologies in logistics, to improve efficiency and reduce costs.

Other ways in which Singapore government agencies have encouraged and enforced adoption include:

I. Government funding and grants: The government of Singapore has provided funding and grants to companies that adopt digital technologies in logistics.

II. Incubation and accelerator programmes: Singapore's incubation and accelerator programmes provide mentorship, funding and resources to start-ups and small and medium-sized enterprises (SMEs) in the logistics and supply chain sector.

III. Singapore has invested in research and development to develop new technologies and solutions for logistics, such as blockchain and artificial intelligence.

IV. Industry collaboration: Singapore has established partnerships between government agencies, research institutions, and the private sector to promote the adoption of digital technologies in logistics.

V. Education and training: Singapore provided education and training opportunities for logistics professionals to acquire the necessary skills to work with digital technologies.

Concerning the business model adopted, a distinction is made between the governance of the system within Singapore and the development of the system in third party countries. Contractually the full development of the PCS in Singapore is controlled by PSA and sponsored by the MPA. PSA Group is responsible for commercializing PORTNET services internationally in ports that are considered not to be competitors. This is done by the creation of Joint Ventures with local authorities.

Pricing model

A transaction-based pricing scheme was adopted despite it being mandatory to use PORTNET. Singapore therefore generates revenue from the fees it charges for the use of its port

facilities and the services it provides, including but not limited to, PCS related services.

As a port management company, PORTNET Singapore is responsible for the operations and management of the ports at Pasir Panjang, Keppel, Tanjong Pagar, and Jurong Island, as well as aother maritime-related facilities. These facilities handle a wide range of cargo, including containerized cargo, bulk cargo, and roll-on/roll-off (RoRo) cargo.

PSA is also able to generate revenue by means of being allowed by the MPA to commercialize PORTNET in other ports, such as the port of Beibuwan in China, thereby capitalizing on the advantage of proven success (trust, privacy and cybersecurity issues).

Functional and technical architecture

PORTNET offers typical PCS functionalities including:

I. Submissions of regulatory documents, including cargo manifest, hazardous cargo declaration, vessel registration and static information, vessel arrival and departure declarations.

II. Submission of operations documents: Container Vessel Bay Plan, Stowage Instructions, Export Shipping Note, Delivery Order, Gate Appointment, Pre-gate information.

III. Request for services, namely, berth application, pilot, tugs, water, bunkers, stuffing/unstuffing service, reefers.

IV. Information services, including vessel schedule, berthing schedule, container and cargo tracking, gate schedule, performance reports, dwell time report, reefer monitoring reporting.

In addition, a mobile app is available called PORTNET® Mobile. The app allows for real-time information gathering on status and has alert report functions available to mobile users.

PORTNET is also expanding its services and is currently working on PN+/CALISTA as a next-generation B2B2G global open port portal to integrate PSA with other global trade and logistics solutions and new technologies. The intention is to also make use of new technologies such as APIs, blockchain, 4IR/Port4.0 IoT and 5G.

From an IT architecture perspective, this was led in-house except for some coding activities that were performed by external partners. The system is built using a combination of different technologies and components. Some of the main components include:

I. **Data collection and processing:** PORTNET Singapore uses a variety of technologies to collect and process data from different sources, such as Electronic Data Interchange (EDI)

Figure 6. Various functional features of PORTNET

Productized for Global Use

Best Practices. Over 66 proven and effective core Port Community processes

Cloud Ready. Faster deployment, Higher Scalability

Info Analytics. Hyper-awareness of Port situations

Robust Foundations

Open source Support

EDIs and APIs

Notifications
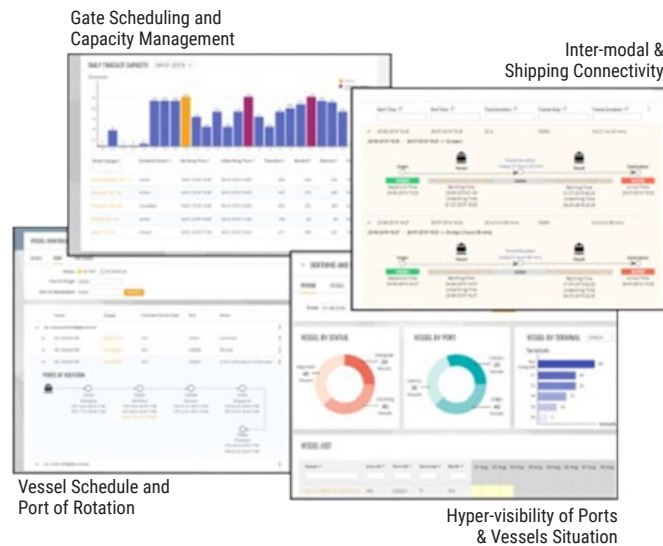
Security, 2FA

Accounts, Roles & Permissions

Multi-Lingual, Modern UI

TOS & Authorities Integration

Website Content Management

Gate Scheduling and Capacity Management

Inter-modal & Shipping Connectivity

Vessel Schedule and Port of Rotation

Hyper-visibility of Ports & Vessels Situation

systems, Radio-Frequency Identification (RFID) systems, and Automatic Identification System (AIS) systems.

II. **Database management:** The system uses a centralized database management system to store and manage the collected data. This allows for real-time access to information and enables data to be shared among different stakeholders.

III. **Web-based portal:** PORTNET Singapore provides a web-based portal for users to access the system and view the data. The portal is designed to be user-friendly and easy to navigate, providing real-time access to information.

IV. **Integration:** The platform integrates with other systems and technologies such as Electronic Data Interchange (EDI), Radio-Frequency Identification (RFID) and Automatic Identification System (AIS) to enable the sharing of real-time information, such as vessel tracking, cargo information, and shipping schedules.

V. **Security:** The system is built to comply with international standards and regulations for data security and privacy, such as the Payment Card Industry Data Security Standards (PCI DSS) and the General Data Protection Regulation (GDPR).

VI. **Scalability:** The system architecture is designed to be scalable and adaptable to accommodate the increasing volume and complexity of data.

VII. **Communication protocols:** PORTNET Singapore uses a variety of communication protocols, such as EDIFACT, XML and API, to facilitate the exchange of data between different systems and stakeholders.

Concerning data protection, the Personal Data Protection Act (PDPA) in Singapore regulates the collection, use and disclosure of personal data by organizations. This ensures that the personal data is protected against unauthorized or accidental access, collection, use, disclosure, copying, modification, disposal or similar risks. This regulation applies to PORTNET and compliance is therefore necessary. To comply, PORTNET like other entities, needs to appoint a Data Protection Officer (DPO) and implement appropriate technical and organizational measures to protect personal data.

In terms of interoperability, PORTNET connects with a variety of different systems and stakeholders including:

I. **Customs:** PORTNET Singapore connects to the Singapore Customs system to facilitate the electronic submission and processing of customs declarations and other documentation.

II. **Shipping lines and logistics companies:** Shipping lines and logistics companies use PORTNET Singapore to submit and access shipping and logistics information, such as vessel schedules, cargo information, and bills of lading.

III. Terminal operators: Terminal operators use PORTNET Singapore to submit and access information related to vessel operations and cargo handling, such as vessel berthing schedules and cargo manifests.

IV. Government agencies: Government agencies, such as the Maritime and Port Authority of Singapore (MPA), the Infocomm Media Development Authority (IMDA), and the Ministry of Trade and Industry (MTI) use PORTNET Singapore to access and exchange regulatory information with other stakeholders.

Impact and benefits

PORTNET has had a positive impact on various port stakeholders. The key success factor is the increased speed of data exchange and integration. For example, the truck at the gate-in needs 20 seconds to check in provided the paperwork is complete.

Some of the other key benefits mentioned by stakeholders include:

Shipping lines: PORTNET PCS helped shipping lines to streamline and automate their transhipment operations, improve data accuracy, and increase the speed of customs clearance.

Terminal operators: PORTNET PCS made terminal operators improve their coordination and planning of transhipment operations, reduce the potential for errors, and increase the speed of customs clearance.

Freight forwarders: PORTNET PCS assisted freight forwarders to improve data accuracy, increase the speed of customs clearance, and reduce the potential for errors.

Customs authorities: PORTNET PCS also made customs authorities improve data accuracy, increase the speed of customs clearance, and reduce the potential for errors or fraud.

Port community: PORTNET PCS helped to improve the overall efficiency and coordination of transhipment operations within the port community, leading to reduced lead times, lower costs and improved service levels. As such it further enhanced the reputation of Singapore as a global transhipment hub.

An effect that is not directly calculated but nevertheless very important is the increase in the efficiency of operations at the port. This in turn reduced the immediate need for new berth quays. By streamlining and automating various transhipment processes, such as data accuracy, real-time tracking and monitoring, automated gate-in and gate-out process, automated yard management and automated billing and invoicing, PORTNET PCS increased the capacity and utilization of existing quays.

However, it is important to note that other factors such as the growth of trade and demand for ports services, new regulations, the size and type of vessels, and the need for specialized facilities, did also influence the need for new berth quays.