

IPCSA
International Port Community Systems Association

IPCSA Foresight Report

2026

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01

Chairman's Foreword

When IPCSA decided to embark on its own Foresight exercise, some may have wondered why an association of system operators would spend time imagining the world of 2040, when the pressures of today already keep all of us more than busy. I would like to use these few lines to explain why I believe it was not only worthwhile, but necessary.

Our members sit at a unique point in global trade. Port, Airport and Cargo Community Systems and Trade Single Windows are where public authorities and private operators meet and where information is shared that would otherwise never be shared. This position rests on something that cannot be bought or quickly built: trust and neutrality. Yet the environment around us is changing faster than ever. Geopolitical tensions are redrawing trade routes and alliances. Artificial intelligence and new data platforms are changing what is technically possible. Cyber threats grow every day, and regulation is shifting in directions that are far from certain. In such a world, reacting well is no longer enough. We need to see change coming and, wherever possible, help shape it.

Others have studied the future of ports and logistics, and their work is valuable. But no one else will look at that future through the eyes of our community, with our concerns, our responsibilities and our knowledge of how data really flows across borders. That is why we chose to build our own Foresight, with our own members and partners, rather than borrow someone else's.

I had the privilege of taking part in the workshops myself, and what struck me most was not any single scenario but the quality of the conversation. Colleagues from very different regions, ownership models and levels of maturity debated fragmentation, data ownership, new financial orders and the future of trade routes with great openness. Their perspectives were different, but they kept arriving at the same conclusions. Trust and neutrality remain our greatest strengths in every plausible future. And our greatest risk is simple: not being at the table when the decisions that shape our sector are taken.

This report does not claim to predict the future. It offers a set of plausible futures, a shared vocabulary for discussing them and a number of concrete recommendations. These include influencing decision-making at every level, taking a global lead on the responsible use of data and future-proofing our platforms. Just as importantly, it gives our members the tools to carry out their own Foresight work, so that this becomes a continuing habit rather than a one-off exercise.

I would like to warmly thank all the participants, the facilitators and the IPCSA Secretariat for their time, their candour and their commitment. I invite every reader to use this report not as a conclusion, but as the start of a conversation within your own organisations and communities, and with us.

Javier Gallardo
Chairman, International Port Community Systems Association (IPCSA)

02

Background

Global trade depends on the fast, accurate and secure exchange of information between the many parties involved in moving goods across borders. Ports and airports sit at the heart of this exchange: they are the physical nodes where cargo, carriers, customs and other partner competent authorities, terminal operators and countless other stakeholders intersect.

As international supply chains have grown more complex, the need for digital infrastructure capable of coordinating this information flow — securely, efficiently and at scale — has become a strategic priority for governments, ports and the logistics sector alike.

Port Community Systems (PCS), Airport Community Systems (ACS), Trade Single Window (SW) platforms, and the digital services provided by these solutions have emerged as the backbone of this infrastructure. They connect public authorities and private operators on a single platform, enabling the electronic submission, processing and exchange of data required to move cargo, vessels and aircraft efficiently through ports and across borders. Their role is increasingly recognised as foundational to trade facilitation, supply chain visibility, and the broader digitalisation of global logistics.

The pace of change facing this infrastructure is accelerating. Geopolitical shifts, climate-driven disruption, the rise of automation and artificial intelligence, evolving cybersecurity threats, and new regulatory regimes are all reshaping the environment in which ports and trade logistics systems operate. Waiting for these changes to arrive before responding is no longer sufficient — the organizations that will thrive are those able to anticipate emerging trends, test alternative futures, and shape policy and standards ahead of disruption rather than in reaction to it. This is the discipline of strategic foresight: systematically exploring plausible futures in order to make better decisions today, and — where possible — to actively shape the future rather than simply adapt to it.

The International Port Community Systems Association (IPCSA) was established to represent and advance the collective interests of the organizations that build, operate and rely on these systems, and increasingly to help that community look further ahead in doing so.



About IPCSA

IPCSA is the international association representing Port Community System Operators (PCSOs), Airport Community Systems Operators (ACSOs), Cargo Community Systems Operators (CCSOs), Trade Single Window Operators (SWOs), and Sea and Air Port Authorities engaged in the electronic exchange of trade and logistics data and information. Its members operate at the intersection of public policy, technology and international trade, and share a common interest in ensuring that the systems they run are effective, interoperable, neutral and recognised as essential infrastructure for global commerce.

IPCSA provides a platform through which its members can act collectively — combining their expertise and influence to engage with policymakers, standards bodies and the wider logistics community on matters that affect the electronic exchange of information across supply chain.

IPCSA Mission

"To act in the common interest of IPCSA members to influence public policy at the international level, in order to promote the electronic exchange of information to enable seamless and efficient trade logistics processes. This will be achieved through lobbying, practical initiatives and projects, as well as engagement with the global, regional and national logistics communities and relevant public bodies."

This mission reflects three complementary pillars of activity:

Influence

Engaging with public policy at the international level to ensure the interests of the sector are understood and represented.

Action

Delivering practical initiatives and projects that advance electronic data exchange in real terms, not just in policy.

Engagement

Building relationships with logistics communities and public bodies at global, regional and national levels.

The three pillars

Each of these pillars carries a forward-looking dimension. Influencing policy at the international level is most effective when it is grounded in a clear view of where trade, technology and regulation are heading, not only where they stand today. Practical initiatives and projects are strongest when they are designed with future conditions in mind — anticipating how data standards, port operations and cross-border processes will need to evolve. And engagement with the wider logistics community is an essential channel for collective foresight: pooling the perspectives of members, public bodies and partner organizations to build a shared, evidence-based picture of what lies ahead.

Together, these pillars position IPCSA as both an advocate and an active contributor to the development of seamless, efficient trade logistics processes worldwide — and as a body positioned to help its members move from reacting to change, toward anticipating and actively shaping it.

IPCSA Objectives

To achieve its mission, IPCSA has agreed five core objectives. Read through a foresight lens, each objective is not only a statement of present-day intent, but a mechanism for ensuring the sector is prepared for — and able to influence — what comes next:

1.Recognition and consultation
To ensure that the importance of Port Community System Operators, Airport Community Systems Operators, Cargo Community Systems Operators, and Trade Single Window Operators is recognised internationally in relation to the electronic exchange of data and information, and that the sector is substantively consulted on any measure likely to affect it. Early, substantive consultation is itself a foresight mechanism: it gives the sector visibility of emerging policy before it is finalised, and the opportunity to shape it while it is still malleable.

2. Standards adoption
To promote the highest possible use of standards within PCSOs, ACSOs, CCSOs and SWOs, with particular emphasis on the use of international standards. Common standards are a hedge against an uncertain future — they preserve interoperability whichever technological or regulatory path the sector ultimately takes.

3. Proactive development
To encourage all IPCSA members to be proactive in the development of Port / Airport Community Systems, Trade Single Windows, and sea port and airport systems, specifically in relation to the electronic exchange of data. This objective speaks directly to future shaping: members are encouraged to lead system development ahead of demand, rather than retrofit systems once change has already arrived.

4. Trade facilitation
To support and promote international, regional and national trade facilitation measures, and to encourage the integration of PCS, ACS, CCS, Trade SW into such measures. Embedding PCS and Trade SW capability into trade facilitation frameworks as they are being designed ensures the sector's infrastructure is built into the future of trade policy, not bolted on afterwards.

5. Cross-border collaboration
To promote international collaboration for more effective cross-border and port-to-port exchange of data, processes and supply chain visibility. Greater visibility across the supply chain is, in effect, an early-warning system — improving the sector's collective ability to anticipate disruption and respond before it escalates.

These objectives form the practical framework through which IPCSA's mission is delivered, guiding the association's advocacy, projects and partnerships — and, taken together, they form the basis of a sector that does not merely track change, but helps to define its direction.

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Foresight and Future Shaping

IPCSA's mission and objectives are, at their core, forward-looking. They commit the association not simply to responding to change as it happens, but to helping determine what electronic trade logistics processes will look like in the years ahead — through the standards adopted, the policies influenced, and the collaborative infrastructure built today.

This positions foresight as a natural extension of IPCSA's existing work, rather than a separate activity. Three ideas are useful in framing that extension:

Anticipation
Systematically scanning for the trends, technologies and policy shifts likely to affect Port Community Systems, Airport Community Systems, Cargo Community Systems, and Trade Single Window solutions
so that members are not taken by surprise.

Preparedness
Using that anticipation to test how current systems, standards and processes would hold up under different future conditions and adjusting course while there is still time to do so.

Future shaping
Going beyond preparedness to actively influence the direction of policy, standards and technology, so that the future of trade logistics reflects the interests and expertise of the PCS, ACS, CCS, and Trade SW, rather than being defined without it.

Read in this light, IPCSA's mission statement can be understood as a foresight mandate: to act collectively, today, in order to influence the trade logistics environment of tomorrow.



03

Executive Summary

International trade relies on the fast, accurate and secure exchange of information between the many parties involved in moving goods across borders. Port Community Systems (PCS), Airport Community Systems (ACS), Cargo Community Systems (CCS) and Trade Single Window (SW) platforms sit at the centre of this exchange.

By linking customs and other authorities with carriers, terminal operators and logistics providers, they have become foundational infrastructure for trade facilitation and supply chain visibility. However, the conditions in which these systems operate are shifting rapidly. Geopolitical tensions, climate-related disruption, artificial intelligence, rising cyber threats and new regulatory frameworks are all reshaping global logistics, and responding only once change has arrived is no longer enough.

It was against this background that IPCSA launched its strategic foresight initiative. The initiative had two goals: to give members strategic insight that supports long-term thinking, and to provide them with the methods needed to conduct their own foresight work in future. Foresight was chosen because it looks beyond what can be predicted with certainty and instead explores a range of plausible futures and their consequences. Evidence suggests that organizations which invest consistently in foresight are more profitable and grow faster than those that do not, yet ports and PCS operators have had little access to this kind of insight. The initiative therefore also strengthens the value of IPCSA membership and fosters closer collaboration and a shared vision across the community.

The study was framed around a central question: what are the plausible futures of global trade up to 2040, and how can the PCS community prepare for them? Drawing on a process adapted from the Copenhagen Institute for Futures Studies, experts from across the IPCSA network took part in three workshops. The first focused on the dynamics of change and the identification of critical issues, the second on building plausible futures and understanding their implications, and the third on developing strategic options and recommendations. Once drafted, the report was circulated to workshop participants and selected external supporters for review and comment.

Critical issues shaping the future. Using the Futures Triangle, participants examined the historical forces resisting change, the present-day trends pushing it forward and the emerging signals pulling the industry towards new directions. These insights were organised through a PESTEL framework and assessed for impact and uncertainty.
Nine critical issues emerged: access to and ownership of data, means of transport, the content being transported, the pace of technological change, data governance, a new financial settlement order, energy and resources, trade routes, and policy and regulation. Across the discussions, trust, fragmentation and the tension between open and restricted data sharing stood out as recurring themes.

Scenarios and their Implications

By combining pairs of critical issues in scenario matrices, participants developed contrasting visions of the future, ranging from globally regulated and highly integrated trade to fragmented, regional and data-restricted worlds. A SWOT analysis showed that trust and neutrality are the defining strengths of PCS operators in every scenario, reinforced by strong governance, detailed process and technology knowledge, and a capacity for change. Weaknesses include limited control over the quality of data supplied by others, constrained financial resources and the difficulty of planning in volatile conditions. Opportunities were identified in cybersecurity services, AI-driven innovation, cloud and data services, and the growing trend towards data protectionism. Threats include cyber attacks, governments assuming services traditionally provided by PCS operators, shifting trade routes and shortages of skilled labour. A subsequent TOWS analysis translated these findings into strategic responses, such as acting as a neutral advisor to government, investing continuously in skills and innovation, and promoting PCS operators as critical infrastructure and attractive partners for public-private cooperation.

Preparing for Plausible Futures

In the final workshop, three scenarios were examined in depth: Fractured World Trade, Smart Regions and a Hyperconnected World. Through pre-mortem exercises, participants imagined their organizations failing in each future and worked backwards to identify the causes. The risks ranged from reduced transactions and weaker supply chain transparency, to data exchange bypassing PCS platforms altogether, to breakdowns in digital identity and trust. One common pattern emerged: PCS operators are most vulnerable when they are absent from the moment key decisions are made.

Recommendations

Participants agreed that PCS operators are widely regarded as trusted advisors and providers of reliable data. To build on this position and strengthen resilience as new players enter the data services market, the study recommends that PCS operators and IPCSA:

Influence Decision Making at National, Regional & Global Levels

PCSs need to create a map of the stakeholders that influence decisions on data exchange and trade. They can then approach them with some of the futures that emerged through the Foresight process and show how they could work with the stakeholders to create solutions.

Take a Global Lead on Data Use

PCSs and IPCSA should bring together a collaboration of stakeholders to create a manifesto on data. This would set out the right technological architecture and data governance in the interest of public and private entities, and create a shared vision of what good data sharing looks like.

Create New Service Lines through Collaboration with Other Data Holders

PCSs should work with other providers and sources of data, such as large warehousing organizations, to offer joint solutions to new and existing customers. Where appropriate, they can also deepen cooperation with public bodies such as Customs, Police and Municipalities, acting as a trusted and neutral party for data consolidation and exchange.

Develop Professional Consultancy & Advisory Services

PCSs can use their growing expertise in cyber and data security to offer these as services to maritime, logistics and supply chain operators. They can also extend their consultancy beyond the port community to cover processes, data flows and automation in hinterland connections and dry ports.

Future-Proof PCS Platforms against Technological Stagnation

PCS platforms designed for EDI-era batch exchange risk slowly losing relevance to real-time, API-first platforms from cloud-native, big tech and blockchain providers. To stay ahead, PCSs should modernise their services, invest in skills and innovation, and use foresight to monitor new technologies and competitors, while building on their core strengths of trust and neutrality.

Taken together, these recommendations provide a clear direction for the PCS community to move beyond simply reacting to change and to play an active role in shaping the future of global trade logistics.

They build on the strengths that PCS / ACS / Trade SW operators already bring, such as trust, neutrality, strong governance and deep knowledge of their communities, and point towards the new roles and services that will keep them relevant in a rapidly changing environment. At the same time, they highlight the importance of being present when key decisions are made, of working closely with public and private partners, and of continuously investing in technology, skills and innovation. By acting on these recommendations, PCS / ACS / Trade SW operators and IPCSA can strengthen their resilience and position themselves as indispensable partners in the digital trade ecosystem. Specific and detailed recommendations were developed from the discussions held throughout the workshops and are described extensively in the further course of the report.

04
Foresight Concept

“War, geopolitics, new trade agreements, etc., have a real impact on our business and we should take care to have that in our strategic thinking. The Foresight workshop was a wonderful opportunity for exchanging really critical and smart thinking.”

Uwe Liebschner

The purpose of the Foresight initiative

IPCSA decided to carry out the Foresight study for 2 reasons:

01. To provide its members with strategic information that can help with future thinking.

02. To provide members with the tools to carry out their own Foresight initiatives in the future.

Why Foresight rather than any other strategic tool:

Foresight is a process of looking beyond the immediate issues that businesses can see or predict with some certainty. It is about looking at possible future worlds and scenarios and then reflecting how these affect the industry and businesses represented within the study, in this case PCS operators.

Research suggests that strategic foresight can help to improve business competitiveness (European Business Review 02/22). When viewed in the long term, firms that systematically invest in foresight are more profitable and grow their value more than others. Yet it is hard for businesses to carry out their own foresight, they require the support of industry bodies to help facilitate it.

Foresight can significantly improve IPCSA member’s strategic confidence, growth opportunities and innovation. In particular:

Strategic confidence
Systematic foresight allows firms to gain a deeper and wider understanding of the changes in their operating environment. It helps firms prepare for alternative futures and associated risks. Most importantly, however, foresight is used not only to identify and control risks but also and specifically to facilitate controlled risk-taking.

Growth opportunities
Strategic foresight can help port communities to understand the impact of emerging markets, and changes in industries and value networks. It enables operators to understand the likely behavioural changes of their communities and develop their product portfolios.

Adaptation and innovation
Foresight provides a better understanding of emerging consumer habits, new markets and future scenario planning. This opens up new strategic opportunities for innovation. Foresight also helps to prepare for disruptions and risks, enabling leadership to manage vulnerability, sustainability, and resiliency for the organization.

Strategic foresight can provide both tangible and intangible results for IPCSA, its members and the broader community:

Direct Insight
Vigilant firms have a 33% higher profitability and a 200% higher market capitalization growth when compared with the sample average. The firms with future preparedness deficiencies had to accept a profitability discount (when compared to vigilant firms) of 37% to 44%. The discount effect for the firms with deficiencies was even greater on market capitalization and ranged from – 49% to – 108%. (Technological Forecasting & Social Change 129 (2018) 105–116). Despite these obvious benefits there is a dearth of information available to ports and PCS operators. By providing members with a continuous look at the future we will be providing them with a significant benefit of membership.

Better collaboration and understanding in the industry
The Foresight process is a way of increasing engagement and knowledge sharing among members and the communities they serve. It allows a diverse range of views on the opportunities and challenges the future may hold and creates a shared vision, and a shared response

Adaptation and innovation
Foresight practices allow IPCSA to understand the needs of members from different regions across the globe, ensuring its appeal to a wider selection of ports, operators and nation states. IPCSA will be seen as the worldwide fount of knowledge on everything to do with current and future PCS operations.

05
Methodology

The Scope

The initial question that the Foresight study sought to answer was: **‘What are the plausible futures of Global Trade, up to the year 2040?’**

The follow-up question to this was:
‘What can the PCS community do to prepare for potential futures?’

The Process

The process used in this study was adapted from The Copenhagen Institute for Futures Studies (CIFS). See Fig. 1

Three workshops were designed to assist experts (see ‘Attendees’ below) in sharing their knowledge and capturing key themes.

Workshop 1

Explore dynamics of change to discover critical issues.

Workshop 2

Use these issues to build plausible futures and understand implications.

Workshop 3

Develop strategic options and recommendations.

The next section provides information on the structure of each workshop, and the exercises used, as well as the key findings.

The Copenhagen Method™

Progression through the strategic foresight process

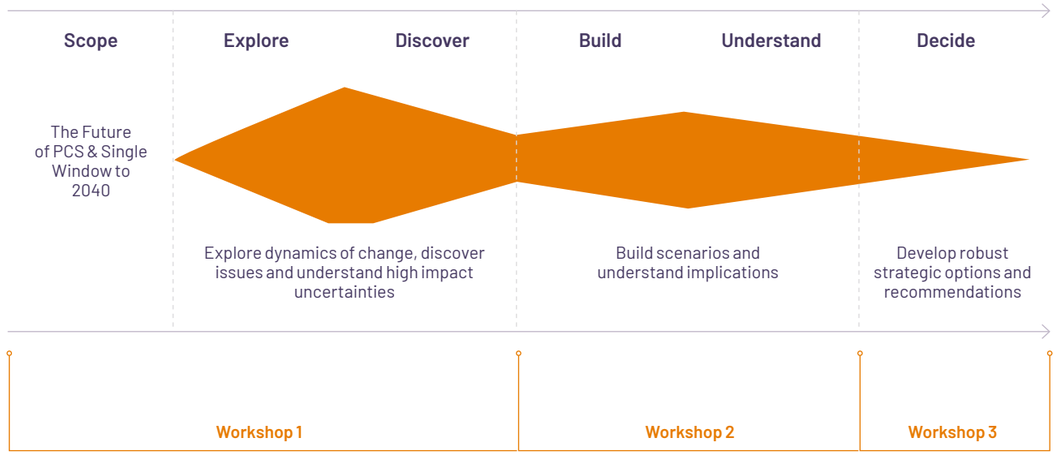


Figure 1: The Process used for this Foresight Study

06
Participants

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Mees van der Wiel
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07
Findings

Work shop 1
Explore dynamics of change and discover critical issues

Workshop 2
Build Plausible Futures and Understand Implications

Workshop 3
Develop strategic options and recommendations

Workshop 1

Explore dynamics of change and discover critical issues

Workshop 1 was designed to explore past, present and future drivers of change to global trade. This was achieved through a 3 stage approach of the Futures Triangle:

01.
Using the Futures Triangle to surface past, present and future drivers of change

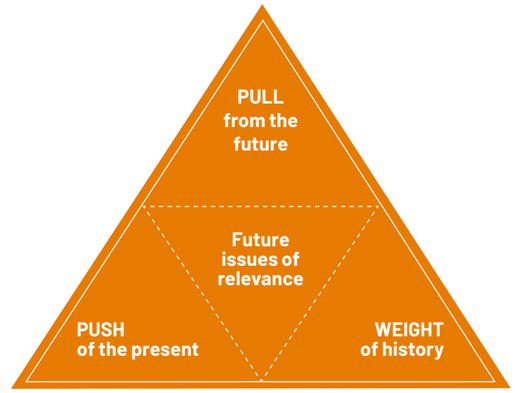
02.
Presenting the findings within a PESTEL framework

03.
Identifying critical issues (high impact and high uncertainty)

04.
For each critical issue identified, consider the potential directions it might take

The Futures Triangle

Participants were asked to explore the key factors driving change in global trade. In particular:



The PUSH of the present (Environmental Scanning):

- What trends are currently impacting the industry?
- What is pushing change forward?
- What is the nature and pace of change?

The PULL of the future (horizon scanning):

- What novel developments and signals of change are we seeing
- What seems to be slowing down or stopping, as well as starting or increasing?
- What do we know about the visions and aspirations of powerful actors
- What matters at the margin of current thinking shouldn't we miss?

The WEIGHT of history:

- What is holding us back from changing?
- Are there any deep structures resisting change (e.g. prevailing cultural norms and values)?
- What matters at the margin of current thinking shouldn't we miss?

Group findings using PESTEL

Thoughts and ideas were captured on sticky notes and then moved into a PESTEL framework - Political, Economic, Social, Technological, Environmental and Legal.

The findings are shown below:

WEIGHT of history

Political	Economic	Societal	Technological	Environmental	Legal
Zero trust Fragmentation	Equitable access to technology, PCS, SW, processes	Work force + Technology standards	Legacy Systems	Ignorance of environment affect the future	International Standards take longer to adapt.
The current establishment Financial institutions, Lobby	Capacity - Financial skills	We think only to have ideas Comfort zone: humans don't like change	Availability of tech	Capacity (e.g. lack of energy resources)	ISO, IMO for example.
Oil etc	Old economic model	Equitable access to technology, PCS, SW	Work force versus technology solutions	People and economy going before environment /nature slows down	Antique laws
World Order Institutional					
Pride of countries, leaders					



PUSH of the Present

Political

De globalization trends e.g:
- Protectionism
- De complying

Concentrations of wealth

Political shifts and disruptions e.g:
- Nationalism v globalization v isolationism

Government models:
- Short-term mandated
- Long-term sustainable strategy

Risky world: Several world crises have lead to uncertainty

Economic

Regional/Local/new trade flows
Ways of producing and consuming goods/ services
Freelance labour market
Imbalanced situation - bigger ships versus smaller shipments
Global is no more Global
Impact on flows
Resources: water / Energy / Raw materials / People

Capacity
New businesses and new business models
Change is the only constant
Networked economy

Resilience vs disruption, → major changes caused by war, nature etc.) Future of Europe?
→ Tension between big countries
→ Trading powers + weak contries
→ Need for more united EU
→ Focus on innovation/technology

Draghi report
→ Energy power union?
→ Cooperate within/ share knowledge innovation/technology
→ Hyperloop trains
→ Aerospace sector
→ Cyber security
Lack of data interoperability

Societal

Immediacy / urgency
Demographic situation and skills
Consumers behavior and expectations
Influencing trade flows
Platform business model
E-commerce

Business culture
Leadership
Human psychology (resistance)
Inequalities
Capacity - financial skills and technical skills / human resources

Dependency on certain countries for trade of critical essentials
Global imbalance
Demand and Supply
Digital transformation

Technological

High speed of technological advancements versus learning and adapting
Skills and resourcing gap
Data is the new "oil/gold"
Legacy systems and conventional processes/OLD
Cyber security challenges

Social media
AI
SME empowerment with technology
All business is in a way a tech business
Tech business model is evolving
Paper based transactions down, digital transactions increasing
Cyber threats

Digital transformation
Smart + data Logistics needs → digitalization
AI + ML +AI assistants → decision makers
Cyber resilience
Need for security - secure data sharing → trust
Fast pace of AT will slow down? → sustainability → clean energy / Present + Future (Technology +Environment)

Environmental

Green energy, EV, non - fossil energies

Climate change
Natural disasters
Sustainability

Climate change
Green IT versus challenge green IT + for green Sustainability rules and regulations → emission reduction
Emission free ports
Sustainability → energy transition (change of technology/cargo flows, push needed)

Legal

Overregulation

Regulations

Legislative reform
Lack of data governance

PULL of the Future

Political

How to rebuild trust?
Increased awareness of global trade

Trade blocs (e.g: groups of trading countries) are reshaping or being reshaped

Increased awareness of global trade

Happy 2040 - 2050
Emission free ports → emission free transport → clean ships

Change in economic thinking / What is the hidden impact?
Data/ information systems
Rules/regulations Banking/Finance
Increasing Cyberattacks
AI Ethics
P+L+S

Economic

Ownership is not important Use/non use of the service
Green economy
- Circular
- Sustainable
- New

Consolidation of large companies
Distrust in governments
Restructuring of supply chains
Us: inwards looking / China:
Belt initiative / India: NLP
Post lead development /
Germany: Compliance led /
UK: Lost?
New trade routes
Paradigm shift - global North vs Global South

Growth → Sustainable growth Circularity → changing trade flows

Societal

AI
Counting COPILOT

Inequalities
Distrust in data

Network economy
Greater interconnectedness
Need for working together → cooperating
Work force& social sustainability

Technological

Will teleporting be achieved by 2040?
Hyper loop is ready for use Ethical use of technology/AI

Do we need the ports and airports as they exist today?
Drones / air taxis / metaverse
Nuclear fusion
Deep tech is on the move:
AI / ML / Digital Twin

Major technology trends
- Device … what will be the next device? neural link
- Hyperloop …..
- New modes of transport
- Quantum computing/internet

Environmental

Future of human health (pandemic, mental health etc) .

Increased focus on 'resilience' (instead of "sustainability')

Climate change impacts
- floods, storms, heats etc.
→ unstable trade/impact on ports

Legal

Future legislations
Global regulations that are acceptable for business

Increase in global regulations?

Need for cross boarder international legislation

Discover: Impact Uncertainty Matrix

The next step was to identify the issues presented above that are ‘critical Uncertainties’. These are issues that are critical (i.e. they are likely to have a significant effect on global trade) but it is difficult to predict what might happen with this issue in the future.



Impact

High impact issues will fundamentally alter the organization, market or business environment. Low impact issues, will not.

Uncertainty

Low uncertainty issues are those which you are reasonably clear about the direction they will take. They are on a path and their trajectory on that path is fairly consistent and you can’t see anything disrupting either the path or the trajectory.

High uncertainty issues are the opposite. You are very uncertain about the future direction of the issue and their path or trajectory could be disrupted. For example, after the closing of the Suez Canal due to an accident and the closing of the Strait of Hormuz due to Geopolitical tensions highlight that the continuous opening of Straits never has been ‘certain’, even if we have become used to them being so.

Critical Issues (High Impact – High Uncertainty)

Participants were asked to select ‘high impact, high uncertainty’ issues from the Weight of History, the Push of the Present and The Pull of the Future.

Comprehensive discussion on critical uncertainties and issues were discussed in groups (A,B and C). The highlights of their discussions are shown below. Some of the more granular details of these discussions and presented in Appendix 1.

Critical Issues (High Impact – High Uncertainty)

Participants were asked to select ‘high impact, high uncertainty’ issues from the Weight of History, the Push of the Present and The Pull of the Future.

Comprehensive discussions on critical uncertainties and issues were held in groups (A,B and C). The highlights of their discussions are shown below. Some of the more granular details of these discussions and presented in Appendix 1.

1. Access to Information/Ownership of Data

This issue explores the tension between restricted data sharing (due to privacy, security, and potential monetization) and open data sharing necessary for efficiency and innovation. There is also the possibility of hybrid models where essential operational data remains freely accessible, while specific datasets can be controlled and monetized by the owners.

2. Means of Transport

This issue explores whether traditional transport will still dominate (maritime, air, rail, road) with ports acting as facilitators, to the emergence of newer means (drones, hyperloops) where ports evolve into orchestrators. Port ownership was another part of this discussion. Significant concern was raised regarding the potential for monopoly behaviour and loss of neutrality resulting from major carriers acquiring ports and terminals.

3. Content being transported

The discussion centred on 3D printing, highlighting a potential where raw materials (‘dust’) being transported for local assembly. Whilst currently, mass manufacturing using 3D printing remains unfeasible due to cost, this could change in the long run. On the other hand, the potential lifting of the WTO duty moratorium on e-commerce, which would impose tariffs on the electronic transfer of 3D printing designs and constrain global development.

4. Pace of Technological Change

This issue considered the accelerating pace of change driven by AI, Digital Twins, and the “revolution” of quantum computing. The key issue was whether technology can continue to be harnessed by PCS operators or whether the pace of change and security (or other) issues cause the PCS market to become disrupted by other players.

5. Data Governance and Ownership

This issue addresses balancing regulated transparency with unregulated use. Governments were defined as custodians of data, not owners. Practical examples, such as the Shein supply chain, illustrated how unregulated environments lead to severe data degradation, creating an “absolute nightmare” for customs clearance.

6. New Financial Settlement Order/Rules

The focus was the profound transformation of the financial system. Polarities described either the continuation of the traditional system anchored by Dollar hegemony or a fragmented, multicurrency system reliant on regional financial zone. Uncertainty exists regarding the management of volatile tariffs and the potential redefinition of an “asset” to include resources like water or critical minerals.

7. Energy & Resources

This issue could arguably encompass water, raw materials, and skilled labour, not just electricity costs. High costs drive production fragmentation. The immense and growing energy demands of AI were noted as a critical environmental and cost conundrum.

8. Trade Routes

Geopolitical tensions, water levels within the major straits, the opening of the Arctic all potentially affect trade routes. It is possible that the world could find itself divided into regions that are not based on geography but shared values and trust. Arctic crossings may be more viable for specialist, smaller ships. Therefore larger deep sea ports may lose their advantage as a point of destination.

9. Policy/Regulation

Policy and regulation are central to providing robust data governance. However, the future of regulation remains unclear. It is as likely that a Predictable Globally Regulated framework (stability, lower costs, efficiency) and an Uncertain Open Market (fragmented regulations, protectionism) could dominate by 2040. Geopolitical situations drive trends toward “reshoring” or “friendshoring”, necessitating policy flexibility to support digitalisation.

Consider the direction that critical issues might take (Polarities)

The next step was to ask participants to take the most critical issues that they had identified and consider the opposing direction these issues could take.

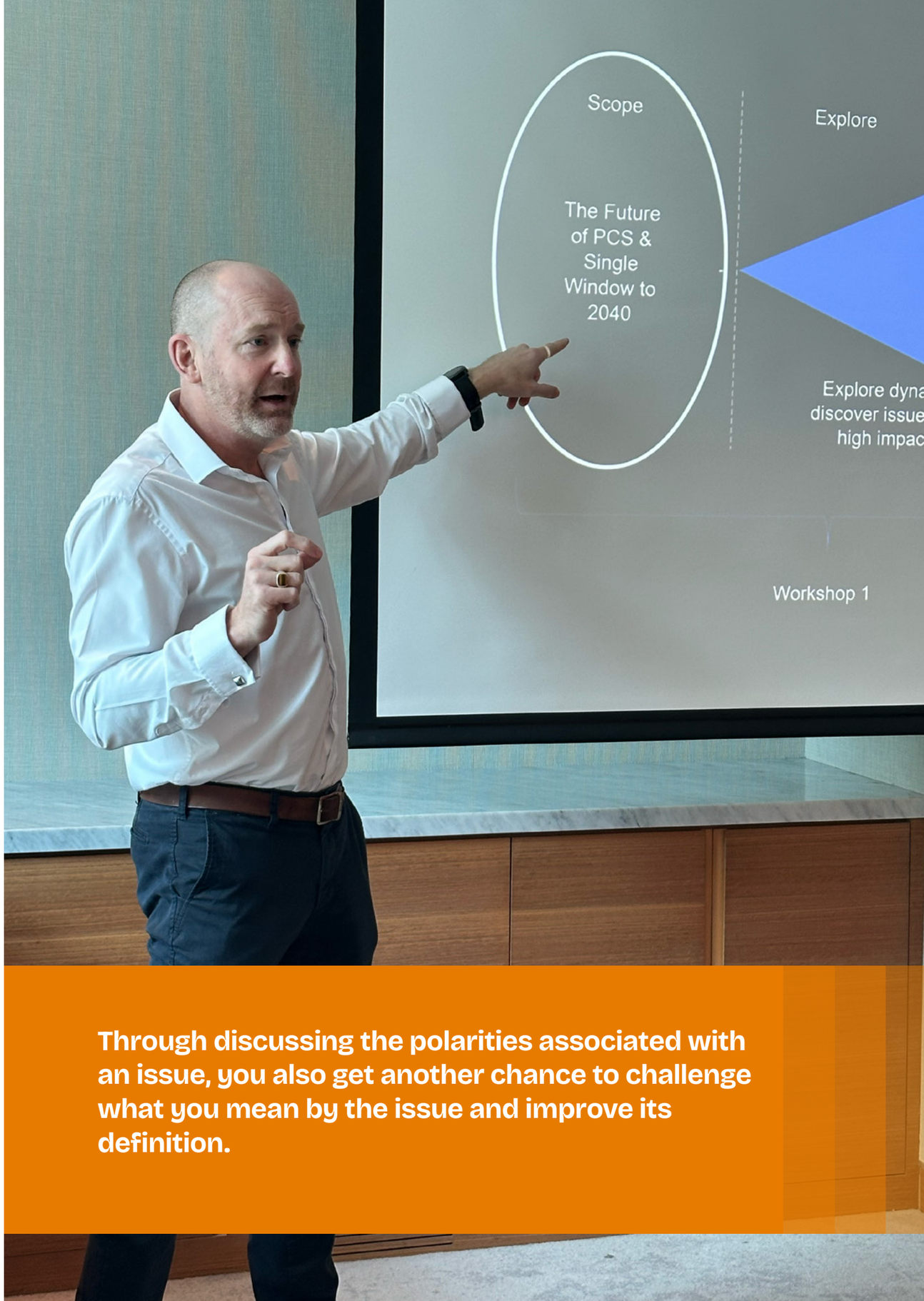
As an example, let's take one of the critical issues identified, 'Energy & Resources', there are two polar positions that this issue could take. It is as plausible that future will be dominated by 'high cost' as 'low cost' energy. It is also as plausible that the future to 2040 is dominated by high availability of green energy as low availability of green energy.

Through discussing the polarities associated with an issue, you also get another chance to challenge what you mean by the issue and improve its definition.

Participants were split into 3 groups. Each group was asked to choose 3 critical issues and discuss the possible polarities associated with it.

These are summarised and discussed below. Further details are then provided in Appendix 2

Polarity A	Critical Issue	Polarity B
Limited (not able or willing to share it)	1. Access to information / ownership of data	Open sharing (willing and able to share it)
Dominated by sea, air, rail and road freight passing through ports and multimodal exchanges	2. Means of transport	Newer means of transport play significant role: drones etc. Changes to use of ports and multimodal hubs
Digital designs (for 3D printing etc.)	3. Content being transported	Unable to cope / left behind from opportunities
Able to cope / build upon the technology	4. Pace of Technological Change	Unable to cope / left behind from opportunities
Regulated and transparent use of data	5. Data Governance and ownership	Unregulated
Digital currency New drivers of value Fragmented Not standardised / backed by different alliances	6. New financial settlement order / rules	Traditional currencies Traditional exchange methods Single global settlement system Transparent and standardised
High cost Low availability of green energy	7. Energy & Resources	Low cost High availability of green energy
Change to Trade routes / transport modes (new / alternative)	8.Trade Routes	No Change to Trade routes / transport modes
Predictable Globally regulated	9. Policy / regulation	Uncertain Open market



Through discussing the polarities associated with an issue, you also get another chance to challenge what you mean by the issue and improve its definition.

"The security analysis surrounding the circulation of goods in supranational regions highlights several challenges and impacts. One key issue is the increasing fragmentation as regions attempt to manage larger entities. This shift can potentially reduce the need for individual inspections and instead promote common inspection protocols. Additionally, data sharing emerges as a significant concern. The tension between maintaining localized control and adapting to broader, supranational frameworks is evident, as stakeholders navigate the complexities of integrating these varying scales of governance and operation."

Javier Gallardo

Robinson Cyrill: "Data sharing plays a crucial role in simplifying decision-making processes at both regional and international levels, particularly concerning emissions and process automation within countries or regions.

For instance, when a customs declaration is approved for cargo headed to the Netherlands, the ability to share this data, along with documentation and government-related documents such as x-ray test results, with foreign counterparts in advance can greatly facilitate their planning and pre-clearance procedures. This not only streamlines operations but also reduces the need for printing numerous documents and the associated transport required to submit them to local authorities. Consequently, it significantly impacts the efficiency of the enrolment process, reducing fragmentation in the workflow."

Warsama Guirreh: "The other polarity revolves around a highly liberal approach, emphasizing the comprehensive sharing of data with everyone. This policy-level initiative has brought various businesses together, aiming to share information for the regional benefit. A specific instance involves our collaboration with insurance companies. They have been utilizing data from PCs to assess the risk associated with certain insurance premiums. For example, they analyze the return of containers to ensure that deposits are secure and properly accounted for. As PCs, we possess a wealth of information that interests numerous parties, all striving to enhance logistics overall."

Javier Gallardo: "In our debate, we are examining two primary scenarios: one involves larger supranational regions, while the other focuses on smaller, more local regions with increased rationality. The discussion centres on how these different regional structures impact the transportation of goods and data sharing.

For instance, in larger regions, we might see streamlined processes and potentially fewer barriers to movement, whereas smaller regions could foster more tailored and efficient local networks.

Additionally, the choice between having multiple currencies or a single dominant currency in these regions is crucial. A single currency could simplify transactions and economic interactions within larger regions, while multiple currencies might offer more flexibility and control for smaller regions."

Vineet Malhotra: ""There seems to be a shift in the global economy, particularly in top economies and regions, though the exact nature and certainty of this shift are still uncertain. Within this context, governance and data ownership are likely to become significant topics of debate. Who owns the data, especially when it pertains to economies or resources like oil, is a question that will need addressing."

Magdalena Rzeczkowska :"The polarity lies in the ability to adapt and leverage technological advancements for business growth and success. Those who can identify and seize opportunities will thrive, while those who fail to adjust may fall behind, excluded from potential growth.

Data governance and ownership form another critical aspect. Whether data usage will be regulated and transparent, providing security, or if it will operate in an unregulated, free-market scenario, posing risks. The importance of establishing clear guidelines for data usage is emphasized to ensure a secure environment.

A new financial settlement order is anticipated, driven by digital currencies. The question arises whether a universal settlement system will emerge or if a fragmented financial landscape will prevail. The valuation of assets in this digital world can defy traditional economic standards, challenging conventional notions of supply and demand. The polarity in this scenario is between a globally standardised, transparent financial system and a fragmented one influenced by geopolitical factors.

The expectation is for a financial system that is just and stable, though perceptions of value can be subjective. The unpredictability of value in this new world mirrors the uncertainty of economic structures in flux. Is there a need for a standardised, transparent, and trustworthy trade system, reminiscent of past agreements like the Bretton Woods order? The direction remains uncertain, but the goal is clear: to achieve a more optimal, equitable trading environment."

Alexandre Sanchez: "I would like to highlight three main themes: energy resources, climate change resiliency, and policy regulation.

Firstly, energy resources are categorized by cost, with a distinction between low-cost and high-cost energy. This cost variability impacts accessibility and availability, influencing numerous aspects of society and the economy.

The discourse on regulation contrasts concentrated and predictable policies with those fraught with uncertainty. At the heart of this debate lies the spectrum between decreased and increased regulation, raising critical questions about the efficacy of adopting a global regulatory approach versus a localized, open-market system. This discussion underscores the need to strike a balance between regulation and market freedom, particularly in the face of evolving global challenges. As the world grapples with these issues, the search for an optimal regulatory framework remains a central focus, emphasising the importance of adaptability and foresight in policy-making.

"The polarity lies in the ability to adapt and leverage technological advancements for business growth and success."





> We were very happy to host this important Foresight workshop. This followed the first Foresight workshop held in Dubai, which explored the dynamics and drivers of change, discovering issues and understanding high-impact uncertainties. In this second workshop, we had a very intensive investigation of various scenarios, with excellent insights which helped us to consider how businesses can stay relevant and develop services for customers.

Youssef Ahouzi, CEO of Portnet

Workshop 2

Build Plausible Futures and Understand Implications

The objectives of Workshop 2 were to:

01.
Create future scenarios by plotting issues alongside each other

02.
Understand PCS Operators' strengths, weaknesses, opportunities and threats against each scenario (SWOT)

03.
Start to generate strategic responses to the issues and scenarios discussed

The Copenhagen Method™

Progression through the strategic foresight process

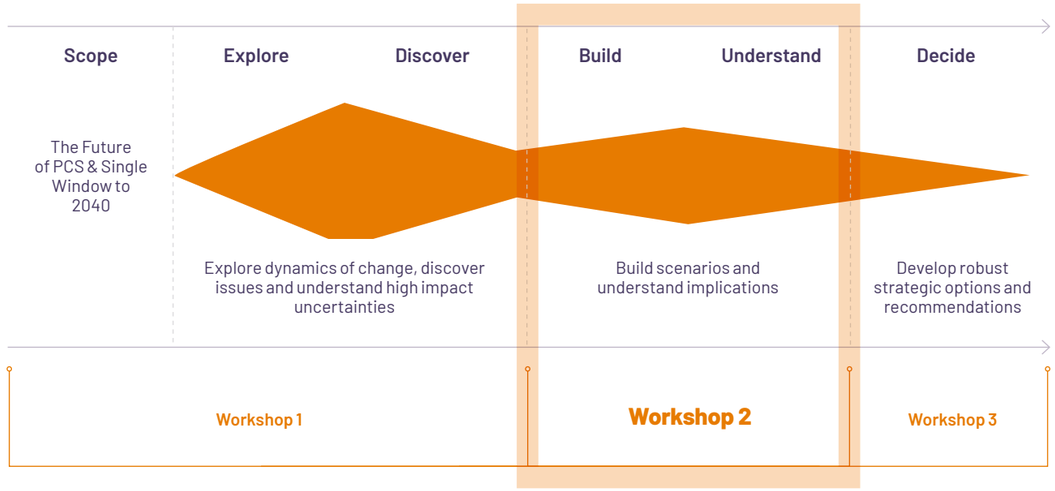
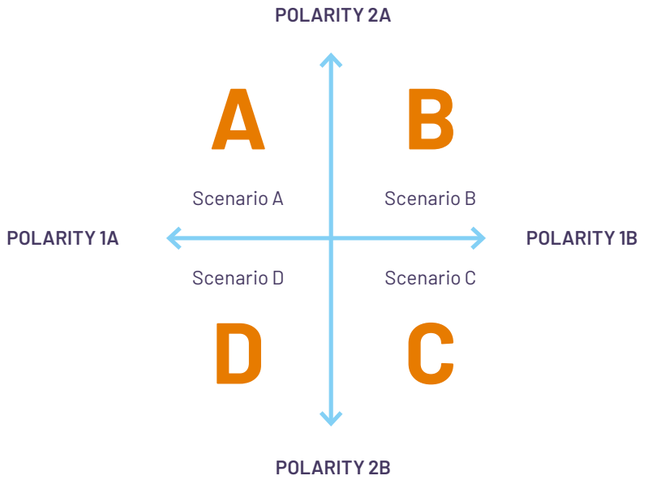


Figure 1: The Process used for this Foresight Study

Create future scenarios by plotting issues alongside

Through placing critical issues alongside each other we can explore scenarios. One way of doing this through a Scenario Matrix.



Through crossing two critical issues we are able to generate 4 potential futures.

The idea is not to view any of the scenarios as good or bad but to understand the potential opportunities and threats that they might provide.

Generating scenarios helps represent plausible changes in the environment that might affect the world of PCSs. Often they represent the continuation of something, the decline of something, the constraint or restriction of something, or the transformation of something.

Participants were asked to work in groups to:

- Map 2 critical issues alongside each other in a Scenario Matrix
- Ensure that the issues they select are very separate issues and don't overlap each other
- Explore the 4 scenarios that are presented

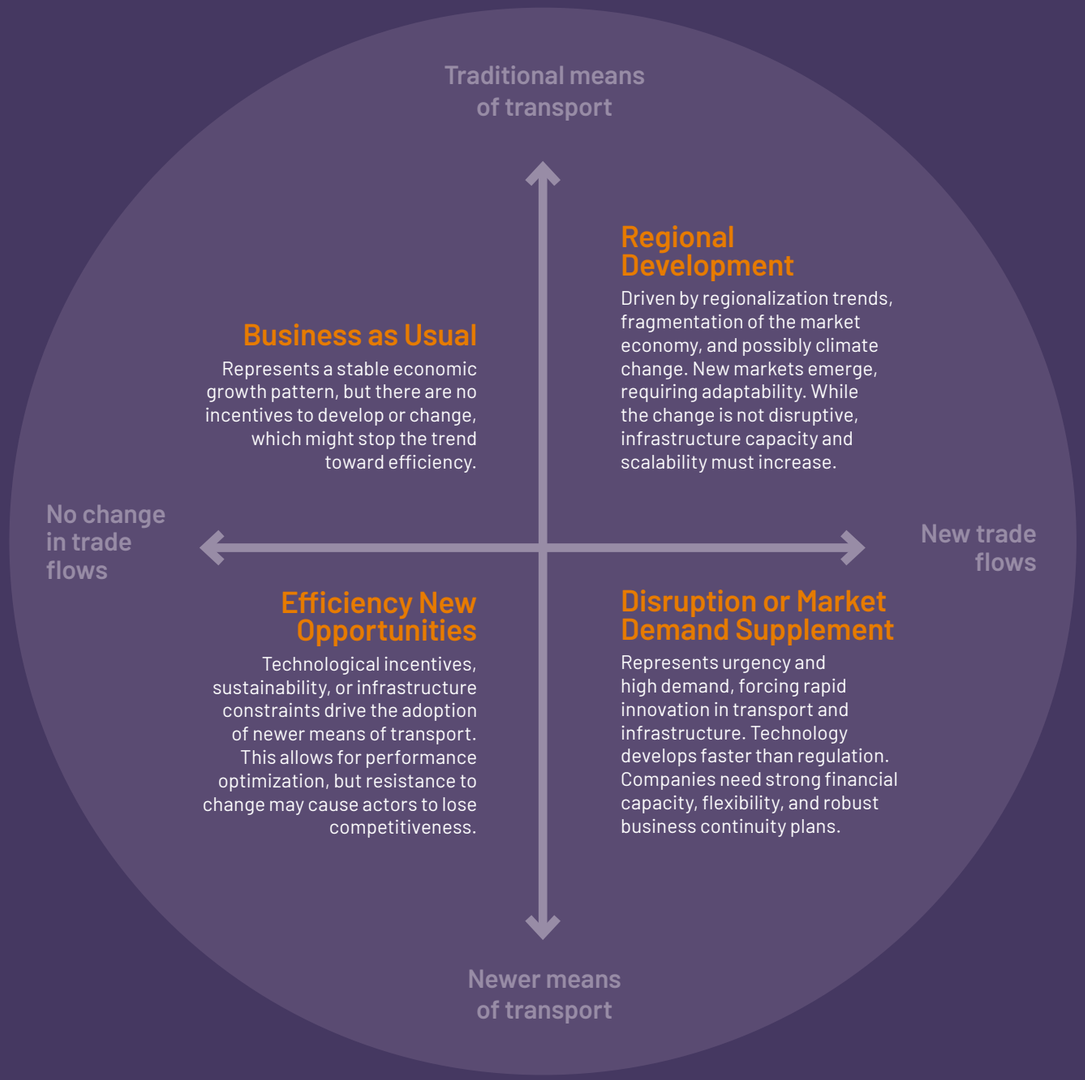
Group 1

Group 1 worked on the issues of **Policy and Regulation** (Globally Regulated vs. Uncertain Open Market) and **Trade Flows** (No Change to Routes/Modes of Transport vs. Changes to Routes/Modes of Transport). They created 4 scenarios and used famous film titles as titles.



Group 2

Group 2 focused on **Means of Transport** (Traditional vs. Newer Means) and **Trade Flows** (New trade flows vs. traditional trade flows). The group noted that 'necessity', such as the COVID-19 pandemic, often forces people to embrace digitalization when they might otherwise hesitate to do so.



Group 3

Group 3 worked on **Access to Information/Data** (Limited Access vs. Open Data Sharing) and **Trade Flows** (Increased Regional Trade/Changing Routes vs. Highly Globally Integrated Trade).



PCS Strengths, Weaknesses, Opportunities, and Threats (SWOT)

Following the scenario review, participants assessed the strengths, weaknesses, opportunities and threats (SWOT) that these scenarios posed for Port Community Systems and Single Window operators.





Strengths

Trusted and Neutral
This was identified as a common, defining strength across all scenarios, fostering resilience and a good reputation.

Strong governance
Extensive experience in managing stakeholder engagement and agreeing on data rules is a core strength.

Technology/Process Knowledge
Capability in technology, legal/regulatory compliance (data protection, ICS), and a full understanding of the overall logistics process flow.

Flexibility
Strong abilities in flexibility and change management.

Weaknesses

Data Quality
The issue of 'rubbish in - rubbish out" was raised, prompting debate over whether PCS can truly impact the data quality provided by other actors.

Financial Resources
Availability of financial resources is a weakness, particularly concerning different ownership structures (private, shared, public).

Planning Difficulty
In uncertain environments (like Brexit), it is difficult to plan roadmaps and innovate, forcing reactivity.

Opportunities

Data Protectionism
The global trend toward data protectionism can be leveraged by the network of trusted networks to provide global data access when competitors are restricted.

Cybersecurity as a Service
PCS expertise in securing IT infrastructure can be monetized as a service provider.

New Services/Revenue
Developing innovation (AI/ML) and offering data centres/ cloud services to the community.

Policy Aggregation
Policy changes can create opportunities to provide national services and aggregate more data.

Threats

Security
Broad security threats, including high volumes of cybersecurity attacks (e.g., DBH experiences 30,000 attacks per day) and physical security.

E-Government/Regulation
Governments might take over services traditionally provided
by PCS operators.

Trade Route Changes
Changes in routes (like the Red Sea or Panama) can reduce local port volume and cause customers to be lost.

Labor
Unavailability of skilled labour is a threat.

Data Protectionism
If data is too restrictive or requires extensive effort to extract, it threatens business.

> "Being able to brainstorm and pull together thoughts from across the IPCSA community was crucial. Foresight is about identifying ways to deal with unpredictability in a predictable fashion."
>
> **John Bescec**

Strategic Response using the TOWS Matrix

The final exercise of Day 2 applied the TOWS matrix, aiming to leverage strengths to maximize opportunities (S-O), use strengths to minimize threats (S-T), address weaknesses to capitalize on opportunities (W-O), and address weaknesses to reduce threats (W-T). Group 1 TOWS Analysis (Focusing on S-O, W-T, W-O, S-T).

The key findings were:

React Quickly and Leverage Trust
PCs should react quickly to disruption, leveraging trust and neutrality to provide accurate ETA and data provenance.

Guide Government Agencies
Leverage the neutral position, knowledge, and experience to guide government agencies based on data insights (e.g., providing advisory services related to complex regulation like Brexit).

Invest to Avoid Stagnation
To avoid the weakness of stagnation and the threat of disruption from competitors, PCs must invest in training staff, innovation, capacity, and technology, utilizing foresight (analogous to the Blockbuster/Netflix scenario).

Neutral Advisor in Regulation
Utilize key knowledge and diversity of stakeholders as a neutral advisor in shaping regulation. Work with the community to apply influence on external controls (e.g., challenging governmental double taxation on imported containers).

Professional Consultancy/Advisory
Extend consultancy services beyond the local maritime port community to include processes, data flows, and automation for logistics in hinterland connections and dry ports. This requires promoting the PCS's expertise and moving away from the perception of being merely a port service provider.

Facilitator of Innovation
Create new business lines by stepping out of the narrow environment, such as acting as a Security Service Provider for the entire port's IT side, leveraging existing skills.

Security, Safety, and Sustainability Line
Use data expertise to provide services ensuring security, safety, and sustainability for port companies, such as surveillance and measuring carbon footprint. Use managed services to leverage innovation (like machine learning) for small and medium companies that cannot afford it otherwise.

Public-Private Partnership (PPP) Promotion
Actively promote PCs as attractive partners to governmental entities, especially by emphasizing their role as critical infrastructure. Being recognized as critical infrastructure could lead to government funding and support for cybersecurity and infrastructure.

Public-to-Public (P2P) Partnerships
In regions where the port authority and operator are government-backed, foster P2P cooperation with departments like Customs, Police, and Municipalities. PCS can serve as a trusted, neutral party to consolidate data and offer data exchange services sought by government agencies.



> Foresight has been very valuable, both for networking and for gaining a clear understanding of the current position of Port Community Systems, as well as future strategic scenarios. Port Community Systems need to operate globally and prepare to facilitate data collaboration between ports and their respective PCS environments. The conversations have been highly valuable – and this is not a one-off exercise, but a continuous process, given the evolving geopolitical landscape and the need to stay adaptable to events and trends while maintaining a clear strategy.

Jan-Willem Den Ouden

Workshop 3

Develop strategic options and recommendations

The aim of Module 3 was to develop strategic options and recommendations for PCS operators as they considered the possible futures they may face.

In particular, participants were asked to consider:

01.

Which of the future scenarios (identified in Module 2) are we most prepared for and least prepared for?

02.

How can we make the most of the opportunities that these future scenarios present us with?

03.

How can we reverse any areas of threat?

The Copenhagen Method™

Progression through the strategic foresight process

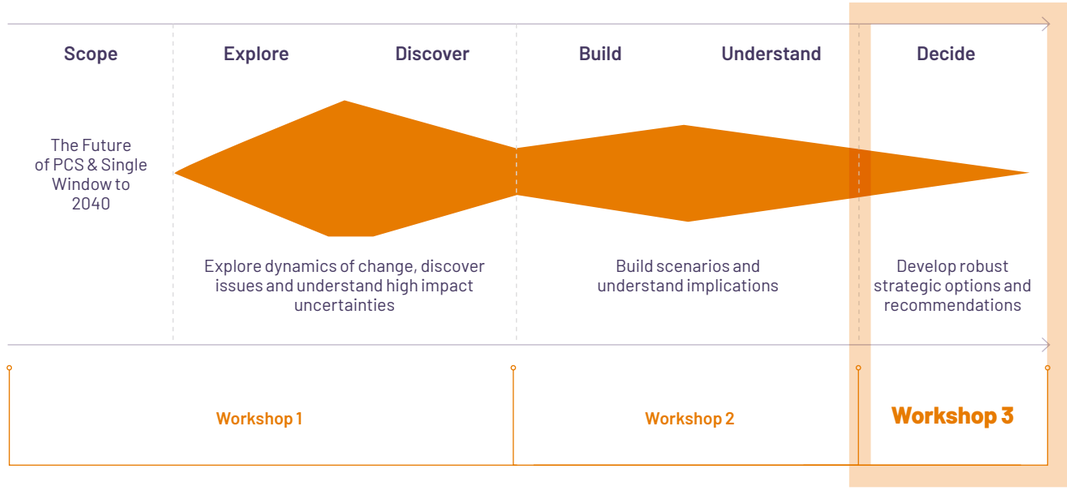


Figure 1: The Process used for this Foresight Study

Which of the future scenarios (identified in Module 2) are we most prepared for and least prepared for?

Participants selected scenarios they felt they were most prepared for and least prepared for. They were then asked to select the scenarios they felt warranted most discussion.

Participants chose 3 scenarios were chosen for further discussion. All 3 scenarios were related to Trade Flows (with the polarities of Global or Regional) and Access to Data (with the polarities of Restricted or Open). These were:

01.
Fractured World Trade
Regional trade
Limited access to data

02.
Smart Regions
Regional trade:
Open data sharing

03.
Hyperconnected World
Globally integrated trade:
Open data sharing

How can we make the most of the opportunities that these future scenarios present us with?

The participants were introduced to an innovation technique called Pre-Mortem. Participants are asked to imagine that a particular scenario came true and then imagine that their organizations had 'failed' to succeed in this environment. They are asked to consider 'what' failed, 'why' it failed and 'how' it failed. They are then asked to consider what they should be doing now in order to prepare for this potential future. Below are their thoughts:

01. Fractured World Trade
Regional trade: limited access to data

Key concerns in this scenario include restricted trade flows leading to a lack of transparency in the supply chain and less availability of data resulting in fewer transactions through PCSs. On a broader level, this could lead to a lack of availability of goods, less competition, less choice, quality of goods declining, less tax revenue and a decrease in wellbeing and positivity

It was believed PCS operators should respond through using their reputation as trusted partners to help businesses become more mature in the way they share knowledge and data and move towards more advanced digitalisation.

02. Smart Regions
Regional trade: open data sharing

In this scenario, the key concern is that data sharing becomes bilateral between parties and therefore less need to cooperate via PCS because less border movements, circularity, etc.

In this case, customers started moving away from PCSs because complexity of customs processes is not enough to keep working with PCS. As inland activities become more dominant than large cross regional movements, data can be found elsewhere and the role of the PCS will be taken by others with a greater sources of information - big Warehouse operations for example.

It was believed PCS operators should respond through diversifying their stakeholder base and finding out if there are any inland hubs that can be cooperated with. Together, it may be possible to combine data and provide new and innovative insights to public and private entities.



03. Hyperconnected World
Globally integrated trade: open data sharing

In this scenario, the key concern was the failure of digital identity. With a plethora of data moving around there are likely to be breakdowns in the digital chain of trust, especially if you cannot be sure who you are dealing with. The ever expanding global movement of goods could lead to a lack of established governance with no shared vision of what good data management looks like. This in turn could lead to a failure to establish transparency and cybersecurity becomes an afterthought. Smaller players get left behind due to limited access to funding or technical capacity and a lack of national legislation, or national legislation that conflicts with international legislation.

It was believed PCS operators should respond through:

1. providing businesses with dedicated cybersecurity resources, and supporting them with change management

2. identifying global stakeholders who could work together to resolve issues at a global level and making sure PCS operators are at that table. It was believed that this group should be focused on understanding and responding to the needs of business, ensuring they can achieve their aims through using data wisely and securely.



08
Recommendations

Remark

The recommendations resulting from this review are set out in summary form under Item 7 of this report. Given the number and scope of the recommendations, and in order to preserve the clarity and readability of the main report, it was considered appropriate to present them there in condensed form only.

A comprehensive and detailed account of each recommendation is provided in a separate document which accompanies this report and forms an integral part of it. That document sets out, for each recommendation, the findings on which it is based, its underlying rationale and its anticipated benefits, and provides such further context as is necessary for a full appreciation of its purpose and significance. The summary under Item 7 and the accompanying document should therefore be read in conjunction with one another, and reference should be made to the latter wherever a more thorough understanding of a particular recommendation is required.

"You shouldn't try to predict the future, but make it possible."

Antoine de Saint-Exupéry, French Writer

Recommendations

Before providing specific recommendations, it is worth considering the consensus of opinion that emerged amongst the Foresight participants throughout the process. Participants shared a similar view that PCS Operators are seen by their current stakeholders as trusted advisors and providers of high provenance data. On top of this, they are capable of leveraging this asset to provide solutions during times of stability and instability.

However, in each of the scenarios discussed in Module 3, it was felt that a potential source of failure for PCS operators was that they are not involved when key decisions are taking place. This is particularly the case when:

- When governments and global regulators are deciding legislation
- When newer sources of data are being sourced and shared
- When 'regions' (formed either geographically or through alliances) are deciding who to choose as their trusted data facilitators

To maintain their relevance, it is crucial that PCS operators are seen as trusted partners at, and before, the point of decision making, rather than merely a data provider to consult after the fact.

With new players entering the data services field all the time, it will also be necessary for PCS operators to increase their resilience. To do this they can utilise the knowledge they hold to provide new services and collaborations. Specific recommendations are therefore as follows:

01.
Influence decision making at national, regional and global levels

PCSs need to create a map of the stakeholders that have the greatest reach and impact on the way trade data is exchanged and present PCS operators as necessary partners to work with when shaping if ideas and making decisions. PCS operators, and IPCSA, could even approach decision makers with some of the 'potential futures' that emerged through the Foresight process and demonstrate their value in developing solutions.

02.
Take a global lead on data use

Lead a collaboration of stakeholders in the creation of a manifesto on Data (much like the Agile Manifesto). This could include, but not be limited to, creating the right technological architecture and data governance that is in the best interests of public and private entities.

This would help create a vision of what 'good' data sharing looks like and help generate a collective intent to continually improve in line with the values currently held by IPCSA and its members.

03.
Create new service lines through collaborating with other holders of data

Work with other providers or sources of data (large warehousing organizations for example) to provide collective solutions to new and existing and customers.

This could help PCS operators be seen as more than just a port service provider. Where the port authority and operator are either government-backed or an essential part of government optimisation, foster P2P cooperation with departments like Customs, Police, and Municipalities. PCS can serve as a trusted, neutral party to consolidate data and offer data exchange services sought by government agencies.

04.
Develop professional consultancy & advisory services

PCSs could utilise their ever-growing knowledge and expertise in cyber and data security to offer this as a service to maritime, logistics and supply chain operators. They could also extend their consultancy services beyond the local maritime port community to include processes, data flows, and automation for logistics in hinterland connections and dry ports.

05.
Future-Proof PCS Platforms against Technological Stagnation

PCS platforms designed for EDI-era batch exchange risk slowly losing relevance to real-time, API-first platforms from cloud-native, big tech and blockchain providers.

To stay ahead, PCSs should modernise their services, invest in skills and innovation, and use foresight to monitor new technologies and competitors, while building on their core strengths of trust and neutrality.

Core idea

PCS operators should identify key data/trade stakeholders and use Foresight scenarios to engage them, showing how collaboration can drive practical solutions.

How to make it real:

- **Map stakeholders:** go beyond a basic list - use a power/interest grid to classify stakeholders as decision-makers, influencers, or implementers.
- **Adapt engagement to each audience:** policymakers respond best to evidence-based position papers and pilot data, while commercial actors are more persuaded by live demos or sandbox environments based on Foresight scenarios.
- **Reinforce existing engagement channels:** build lasting influence and ensure Foresight scenarios keep pace with regulatory change.

Recommendation 1

Influence Decision Making at National Regional & Global levels

PCSs need to create a map of the stakeholders that influence decisions on data exchange and trade. They can then approach them with some of the futures that emerged through the Foresight process and show how they could work with the stakeholders to create solutions.

In what ways can members achieve this?

- Stakeholder mapping should go beyond a static list — it should classify actors by their level of influence and level of interest (a classic power/interest grid), distinguishing between decision-makers (ministries of transport, customs authorities, EU/UN bodies), influencers (trade associations, standard-setting bodies like UN/CEFACT or DSI), and implementers (terminal operators, carriers, freight forwarders).
- Once mapped, PCSs should tailor engagement: policymakers may respond best to evidence-based position papers and pilot data, while commercial stakeholders may respond better to live demonstrations or sandbox environments built on the Foresight scenarios.
- More focus and further development on the historically well-established engagement mechanism (e.g. a quarterly briefing, an advisory panel, or a seat at existing trade facilitation forums) would help PCSs to strengthens their sustained influence, ensuring the Foresight scenarios stay current as regulation evolves (e.g. EU eFTI, WTO Trade Facilitation Agreement implementation).



Recommended action list

1. Stakeholder mapping

- Build the stakeholder register with contacts, sector and role (Stakeholder Engagement Lead).
- Define the influence/interest scoring rubric on a 1–5 scale (Policy Analyst).
- Score each actor and tag its role as decision-maker, influencer or implementer, then place it on the grid (Policy Analyst).
- Validate the grid in an internal workshop and assign relationship owners for high-priority actors (Head of PCS).
- Re-score the grid every six months (Policy Analyst).

2. Tailored engagement

- Draft two or three position papers showing how the Foresight scenarios support local digital trade and single window policy (Policy Analyst).
- Compile pilot results into a short fact sheet (Data Analyst).

Pilot results are measurable outcomes from a trial of the Foresight scenarios, such as a digital data exchange between port actors and authorities. The pilot could be arranged based on these steps:

- Define the scope: one scenario, one problem, one trade flow.
- Select partners: three to five actors, including at least one authority.
- Set KPIs and a baseline: measure three to five indicators before starting.
- Agree on rules: a short pilot agreement covering data, roles and duration.
- Run for three to six months with regular partner check-ins.
- Evaluate against the baseline and gather user feedback.
- Communicate the results and decide whether to scale, adjust or stop.

- Hold bilateral meetings with priority ministries and customs (relationship owners).
- Build a sandbox based on one or two Foresight scenarios (IT/Product Lead).

This could include the following steps:

- Choose one or two use cases, such as a Maritime Single Window submission or an eBL exchange.
- Build a test environment with sample data, APIs and simulated authority systems.
- Share guidance in the form of documentation and test cases.
- Onboard participants, such as shipping lines, forwarders and terminals.
- Run test rounds of two to four weeks with regular feedback sessions.
- Capture findings, both technical issues and user input.
- Refine the solution and choose partners for a live pilot.

- Run demo sessions with terminal operators, carriers and forwarders, and collect feedback (Business Development Manager).

3. Sustained engagement

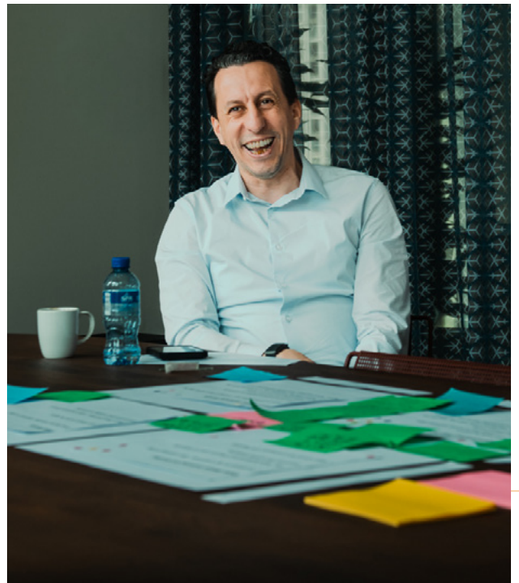
- Identify the relevant forums (NTFC, DTLF, UN/CEFACT, RPSCG, regional associations, engagement within IPCSA domains) and apply for a seat (Head of PCS).
- Launch a quarterly stakeholder briefing (PR / Communications Officer).
- Set up an advisory panel that meets twice a year (Head of PCS).
- Track regulatory changes monthly, including MSW, Customs law and the WTO TFA (Policy/Legal Officer).
- Update the Foresight scenarios once a year and report engagement KPIs quarterly (Strategy / Foresight Lead and Stakeholder Engagement Lead).



In what ways can IPCSA help?

- Use more intensively the capability IPCSA provides to its members with a shared "legislative intelligence" function.
- IPCSA could improve its regulatory watch function that tracks emerging data and trade legislation across jurisdictions (EU eFTI, US CBP initiatives, IMO digitalisation guidelines, national single-window mandates) and translates it into plain-language briefings for members, flagging where fragmentation is emerging so members aren't caught off guard by diverging national implementations of ostensibly harmonised rules.
- A more enhanced federated advocacy model would let IPCSA aggregate the collective voice of its members into formal consultation responses, position papers, and testimony to regulators.
- IPCSA could also convene a "regulatory sandbox" dialogue with regulators, using real member experience of fragmentation (e.g. conflicting data formats or liability rules across borders) as concrete evidence to push for harmonisation, rather than abstract advocacy.
- PCSA should actively publish policy briefings as well as technical and academic articles on topics within its field.

Doing so would reinforce its expertise, create new opportunities for cooperation with international institutions, and strengthen its ability to shape future standards and legislation through expert advice.



Recommended action list for IPCSA

Legislative intelligence and regulatory watch

- Set up a regulatory watch tracking EU eFTI, US CBP, IMO digitalisation guidelines and national single window mandates – MSW, WCO (IPCSA Secretariat in collaboration with the domain leads).
- Build a member network of country correspondents who report national developments (Secretariat, with member PCSs).
- Publish a monthly plain-language briefing that flags emerging fragmentation (Secretariat).
- Maintain a "fragmentation tracker" comparing national implementations of harmonised rules (Secretariat, ongoing).

2. Federated advocacy

- Monitor open consultations and alert members early (Secretariat, ongoing).
- Set up a fast-track process for gathering member input and agreeing common positions (Secretariat).
- Draft joint consultation responses and position papers on behalf of members (Secretariat in collaboration with Working Group, as needed).
- Nominate spokespersons for hearings and regulator meetings (IPCSA Board in collaboration with domain leads).

3. Regulatory sandbox dialogue

- Collect real member cases of fragmentation, such as conflicting data formats or liability rules (Secretariat, via member survey and central forum mechanism on the community web-environment).
- Turn the cases into short evidence briefs (Secretariat in collaboration with domain leads and working groups).
- Hold a yearly dialogue bringing together regulators, IPCSA and members to discuss harmonisation (IPCSA Board and Secretariat).
- Follow up on the agreed actions and report progress to members (Secretariat, ongoing).
- Longer term: a shared IPCSA position on data and process governance gives members a common reference point when engaging their own national regulators, so members aren't each reinventing arguments from scratch — fragmentation is countered not just by lobbying but by exporting a shared vocabulary and set of principles into national conversations.

Recommendation 2

Take a GLOBAL lead on data use and data exchange

Lead a collaboration of stakeholders to develop a shared framework on data that could include, among other things, establishing the right technological architecture and data governance in the best interests of both public and private entities. This would help define a vision for what "good" data sharing looks like and build collective momentum to continually improve in line with the values already held by IPCSA and its members.

Core idea

IPCSA should lead activities on a global framework of data for ports and logistics hubs — short, principle-based, and aspirational (like the Agile Manifesto), not a rulebook. Key principles: data sovereignty, interoperability, neutrality/trust/transparency, fairness for smaller ports, reciprocity, and seamless cross-border data exchange.

How to make it real:

- Co-author the framework (with competitors, regulators, vendors) for credibility
- Add a maturity model/self-assessment so PCSs can benchmark progress over time
- Go beyond Single Window toward "ask once, use many times" services
- Create a dedicated government relationship function to handle agency-specific trust and data agreements
- Leverage PCS neutrality to broker cross-agency collaboration and commercial data services, with clear governance

As supply chains span multiple jurisdictions, the ability to exchange data seamlessly across borders becomes as important as exchanging it within a single port community. PCSs are well placed to extend their trusted, neutral role beyond national boundaries by supporting interoperable, standards-based data exchange with PCSs and government systems in other countries — reducing the need for shippers and carriers to resubmit the same data multiple times as cargo crosses jurisdictions. This requires aligning on common data formats and semantics (building on standards such as UN/CEFACT, IMO, or DSI), agreeing on cross-border governance principles that respect differing national data sovereignty and privacy rules, and establishing bilateral or multilateral trust frameworks between PCS operators and customs authorities across countries. Done well, this positions PCSs not just as local hubs but as nodes in a wider international trade data network — directly reinforcing the broader data framework and legislative influence work discussed earlier, since consistent cross-border practice is far easier to achieve when built on shared principles agreed collectively rather than negotiated country by country.

Core themes worth considering:

- Data sovereignty (who owns and controls data),
- Interoperability (common standards over proprietary lock-in),
- Neutrality, trust and transparency (auditable, explainable data flows),
- Fairness (a level playing field for smaller ports and operators, not just the largest),
- And reciprocity (value flows back to those who contribute data, not just those who consume it).
- Cross-border data exchange

• **A shared framework** works best when it's short, principle-based, and aspirational rather than prescriptive — much like the Agile Manifesto's four values and twelve principles, it should be memorable enough to be quoted and referenced by people who weren't in the room when it was written.

• Legitimacy will depend on the breadth of **co-authorship** — involving competitors, regulators, and technology vendors alongside PCS members strengthens its credibility as an industry-wide reference point rather than an IPCSA-only position.

• Beyond publication, the framework could be operationalised through a **maturity model or self-assessment tool,** letting individual PCSs and ports benchmark themselves against the stated principles and show tangible progress year on year — turning a values statement into a living governance instrument rather than a one-off PR exercise.

• **Single Window as the reference model,** not the ceiling: many PCSs already contribute to or operate national Single Window systems, but there's room to go further — proactively designing government-facing services around "ask once, use many times" principles, so agencies increasingly turn to the PCS as their first port of call for trade data rather than building bespoke bilateral integrations with individual carriers or shippers.

• **Building agency-specific trust**, not just technical connections: different agencies have different risk appetites and legal constraints (e.g., Customs data is often subject to strict confidentiality regimes, while port health data may need faster, less formal sharing). A dedicated government relationship function within the PCS — distinct from commercial account management — would allow tailored governance agreements, data-sharing MOUs, and service levels for each agency, rather than a one-size-fits-all approach that risks being too rigid for public health use cases or too loose for Customs' legal requirements.

• **A platform for cross-agency collaboration:** once several agencies trust the PCS individually, it's well positioned to broker cross-agency coordination that would otherwise be difficult — for example, joint risk-based inspection scheduling between Customs and port health, or shared incident data between police and municipal authorities — turning the PCS into genuine government digital infrastructure rather than a single-agency data feed.

• **Commercial value without sacrificing neutrality:** government trust built through Customs and other partner-agency relationships becomes a credential PCSs can point to when pitching neutral data brokering or advisory services to commercial partners, provided the boundary between government and commercial data handling stays clearly governed and auditable.

• Government agencies are often wary of relying on data infrastructure controlled by a single commercial party (a carrier alliance or terminal operator, for example) for fear of competitive bias or conflicts of interest. A **PCS's neutral**, often government-affiliated or not-for-profit status is precisely what makes it credible as a shared data layer — this neutrality should be actively marketed as a feature, backed by clear governance commitments (data segregation, transparent access rules, independent oversight) that make the claim of neutrality verifiable rather than just asserted.

• There's a **reputational upside** too: being recognised as the originator of this "Data Framework for Ports" positions IPCSA as the reference body on data ethics and architecture in the sector, ahead of competing standards bodies or individual vendors trying to set the agenda.

In what ways can members achieve this?

Recommended action list

1. Engage in the IPCSA collaboration

- Nominate a representative for the IPCSA Data Framework Working Group, and volunteer for at least one theme (PCS Managing Director).
- Complete an IPCSA member survey on current data practices and challenges (Strategy/Policy Lead).
- Contribute feedback on the draft framework principles (Strategy/Policy Lead).

2. Assess your own position

- Map your current data flows, covering who provides, uses and owns each data set (Data/IT Architect; Business Analysts).
- Run a gap analysis against the six core themes: sovereignty, interoperability, trust and transparency, fairness, reciprocity, and cross-border exchange (Strategy/Policy Lead).
- Complete the IPCSA maturity self-assessment once it is available (Strategy/Policy Lead).

3. Align architecture and governance

- Check how far your systems comply with standards (UN/CEFACT, IMO Compendium, WCO, DSI) and plan the upgrades needed (IT Lead).
- Prioritise open APIs in the product roadmap (Product Manager, ongoing).
- Update your data governance policy and user agreements to cover ownership, access rights, audit trails and fair value sharing (Legal/Compliance Officer).

4. Prepare for cross-border exchange

- Identify one or two partner PCSs in other countries on your main trade lanes (Business Development Manager).
- Review national data protection and sovereignty rules that affect cross-border sharing (Legal/Compliance Officer).
- Engage your national customs authority on joining a cross-border trust framework (Managing Director).
- Volunteer for an IPCSA bilateral pilot (Managing Director).

5. Involve your community

- Brief local stakeholders such as terminals, forwarders, carriers and customs on the updates of the framework and what it means for them (Stakeholder Engagement Lead, ongoing).
- Collect local cases of duplicate data submission as evidence for IPCSA (Operations Lead, ongoing).
- Report progress internally in detail and to IPCSA in more general fashion once a year (Strategy/Policy Lead, yearly).



In what ways can IPCSA help?

Recommended action list for IPCSA



1. Launch the collaboration

- Create for regular exchange and cooperation a broader working group of member PCSs, customs, shipping lines, terminals and standards bodies (UN/CEFACT, IMO, DSI) (IPCSA Board).
- Set out the group's mandate, covering its goals, responsibilities, timeline and how decisions are taken (IPCSA Secretariat).
- Name a responsible person for each core theme: data sovereignty, interoperability, trust and transparency, fairness, reciprocity, and cross-border exchange.

2. Shape a common vision

- Gather members input on current practices, challenges and needs through a survey´s and other streams, such as the community web-presence of IPCSA (Secretariat).
- Write draft principles for each theme, grounded in IPCSA's existing values (Secretariat in collaboration with domain leads).
- Test the draft with stakeholders and adjust it based on their feedback (Working Group).
- Release the IPCSA Data Sharing Framework, including the vision, principles and a maturity model (IPCSA Board).

3. Technology and governance

- Review how member PCSs are built today and identify shared components.
- Design a reference architecture based on open standards and APIs to avoid vendor lock-in (Working Group).
- Set governance rules on who owns and accesses data, how data flows are audited, and how costs and benefits are shared fairly (Working Group).

4. Enable cross-border exchange

- Continue to work on harmonisation of data formats and definitions based on UN/CEFACT, the IMO Compendium, WCO Data Model, EU Customs Data Model and DSI (Secretariat in collaboration with the domain leads).
- Agree on principles for cross-border data flows that respect national sovereignty and privacy laws.
- Create a template trust agreement for use between PCSs and customs authorities in different countries (Working Group.
- Test the approach in one or two bilateral pilots between member PCSs to cut repeated data submissions (volunteer member PCSs).

5. Set the framework and sustain progress

- Connect the framework to IPCSA's regulatory watch and advocacy activities (Secretariat, ongoing).
- Review the framework every year and invite members to assess their own maturity (Working Group, yearly).
- Showcase pilot results at IPCSA events and in member communications (Secretariat in collaboration with domain leads, ongoing)
- Draft a short, principle-based framework, the "Data Framework for Ports", that is easy to quote and remember (Secretariat together with domain leads and with the support of volunteer members).
- Involve a broad group of co-authors: members, competitors, regulators, customs, standards bodies and technology vendors (IPCSA Board).
- Run an open consultation and collect endorsements before launch (Secretariat).
- Create the necessary survey templates and circulate them; carry our the result evaluation
- Develop a maturity model and self-assessment tool so PCSs can benchmark their progress each year (Working Group).
- Provide model MOUs and service level templates for different government agencies (Secretariat).
- Define verifiable neutrality commitments covering data segregation, transparent access rules and independent oversight (Secretariat + Working Group).
- Launch the framework and promote it at IMO, WCO, UN/CEFACT and EU forums to position IPCSA as the reference body (IPCSA Board).

Core idea

Shift from “port data platform” to “trusted data intermediary” — partnering with logistics providers and deepening B2G/G2G ties with Customs, police, and municipalities.

How to make it real:

- New products by combining port + logistics data (congestion prediction, end-to-end visibility, emissions tracking)
- Host shared government data spaces (“ask once, use many times”)
- Offer secure data centre hosting and cybersecurity-as-a-service
- Key requirement: Strong governance (access rules, data separation) to preserve neutrality.
- Approach: Test with small pilots (one logistics partner, one municipality) before scaling.

Recommendation 3

Create new service lines through collaborating with other holders of data

Work with other providers or sources of data (large warehousing organizations or ERP developers for example) to provide collective solutions to new and existing customers. This could help PCS operators be seen as more than just a port service provider. Where the port authority and operator are either government-backed or an essential part of government optimisation, foster B2G and G2G cooperation with departments like Customs, Police, and Municipalities.

In what ways can members achieve this?

PCS can serve as a trusted, neutral party to consolidate data and offer data exchange services sought by government agencies.

- The strategic shift here is **from “port data platform” to “trusted data intermediary”** — a broader positioning that opens revenue streams well beyond the traditional PCS remit, similar to how some airport operators have expanded into broader logistics and city-data roles.
- **Warehousing, rail, inland terminals, and last-mile logistics providers** all hold data that, combined with port data, could enable genuinely new products — predictive congestion management, end-to-end shipment visibility, or emissions tracking across the full supply chain rather than just the port leg.
- **The government-to-government (G2G) angle** is particularly promising because PCSs often already sit in a neutral, semi-public role — this makes them a natural candidate to host shared data spaces for Customs, police, immigration, and municipal authorities, reducing duplication of data requests to carriers and shippers (a “ask once, use many times” model, similar in spirit to the EU Single Window concept - single point of submission).
- **High-Secured Data Centre Solutions and Cybersecurity as a service:** As trust in data increasingly rests on where and how it is physically and digitally secured, PCSs are well placed to extend beyond software-layer services into infrastructure-layer trust — offering high-secured data centre solutions as a natural complement to their neutral, semi-public positioning. Many PCSs already operate mission-critical, highly available infrastructure to support port operations, and this same resilience and security discipline (redundant power, physical access control, disaster recovery, compliance with standards such as ISO 27001) could be packaged as a hosting or colocation service for maritime, logistics, and government partners who need a trusted, sovereign, or geographically-local alternative to hyperscale cloud providers. Layered on top of this, an expanded cybersecurity offering — covering managed security operations, threat monitoring, incident response, and compliance support against frameworks like NIS2 and the IMO’s cyber risk management guidelines — would let PCSs monetise the operational security expertise they already apply to their own platforms, extending it as a service to smaller ports, terminal operators, and hinterland logistics partners who lack the scale to build this capability in-house. Together, these offerings would reinforce the PCS’s role as critical digital infrastructure for the sector, deepening the trusted-intermediary positioning central to the data collaboration and consultancy recommendations above, while creating a defensible, recurring revenue stream that is less exposed to commoditisation than basic data exchange services alone.
- **Integrating maritime operational data into PCS offerings:** Traditionally, PCSs have focused on commercial, logistics and regulatory data. The next step is to integrate maritime operational data as well: ETA predictions, vessel traffic information, berth planning, and nautical services such as pilotage, towage and mooring. This lets PCSs support the full port call, from voyage planning through berthing to departure, and not only the cargo and document flows.

Here the interoperability challenge becomes very concrete, because operational terms are not used consistently worldwide. An ETA can refer to arrival at the pilot boarding place, the anchorage, the port limits or the berth, depending on the port and the party involved. Under Keel Clearance (UKC) is similarly calculated with different methods, safety margins and national rules, ranging from static calculations to dynamic models that consider squat, waves and tide. Without common definitions, shared data can easily be misunderstood. PCSs should therefore promote harmonised time stamps and definitions, building on the IMO Just-In-Time Arrival Guide, industry port call data standards such as those from DCSA, and the IMO Compendium.

- **Expand the data scope:** Integrate operational data such as ETA predictions, vessel traffic information, berth planning, and nautical services (pilotage, towage, mooring) alongside commercial, logistics, and regulatory data.
- **Support the full port call:** Cover the entire process from voyage planning through berthing to departure, not just cargo and document flows.
- **Harmonise time stamps:** Clearly define which reference point each time stamp refers to (pilot boarding place, anchorage, port limits, or berth) to avoid misinterpretation.
- **Clarify calculation methods:** Make transparent how operational values such as "Under Keel Clearance" are calculated, including methods, safety margins, and applicable national rules.
- **Build on existing standards:** Align with the IMO Just-In-Time Arrival Guide, DCSA port call data standards, and the IMO Compendium rather than creating new definitions.
- **Promote common definitions:** Encourage port community stakeholders to adopt shared terminology so exchanged data is understood consistently.
- **Data quality and trustworthiness as complements to cybersecurity:** Cybersecurity protects data from unauthorised access and manipulation, but it does not guarantee that the data is correct. For operational users such as pilots, terminal planners and masters, the key question is often whether the data is reliable enough to base a decision on. An inaccurate ETA or an outdated berth plan can lead to wasted fuel, idle resources or safety risks, even if the data has been transmitted perfectly securely.

  PCSs should therefore treat data quality as a core part of trust, alongside cybersecurity. This means clear indicators for data source, timeliness and accuracy, validation rules at the point of entry, and transparency about how reliable each data element is. Making data quality visible allows users to judge how much weight to give each piece of information in their decisions.
- **Treat data quality as core to trust:** Give data quality equal importance to cybersecurity, recognising that secure data is not necessarily correct data.
- **Show data provenance:** Clearly indicate the source of each data element so users know where it comes from.
- **Flag timeliness:** Display when data was last updated to prevent decisions based on outdated information such as old berth plans.
- **Indicate accuracy:** Provide accuracy or confidence levels, especially for predictive data like ETAs.
- **Validate at entry:** Apply validation rules when data is submitted to catch errors before they spread.
- **Be transparent about reliability:** Make data quality visible so pilots, planners, and masters can judge how much weight each piece of information gives.

Maritime interoperability standards and S-100

The IHO S-standards are technical standards from the **International Hydrographic Organization (IHO)**, which coordinates nautical charting worldwide.

The older **S-57** standard defines today's electronic navigational charts but covers mainly static chart data. Its successor, **S-100**, is a framework for building many product specifications that combine static and dynamic data, such as bathymetry (S-102), water levels (S-104), currents (S-111), navigational warnings (S-124), under keel clearance (S-129) and port call messages (S-211).

S-100-based ECDIS is being phased in from 2026, so ports and PCSs that provide data in these formats will be able to exchange information directly with ships and traffic services.

The IHO S-100 framework is emerging as the foundation for the next generation of digital maritime information services. Product specifications such as S-102 (bathymetric surfaces), S-104 (water levels), S-111 (surface currents), S-124 (navigational warnings), S-129 (under keel clearance management) and S-211 (port call messages) will shape how vessels, ports and traffic services exchange information. With S-100-based ECDIS being phased in during the coming years, these standards are likely to play an increasing role in traffic management and port operations.

PCSs should follow this development closely and consider how their platforms can connect to S-100-based services, for example by providing port call data in S-211 format or by linking dynamic UKC information to berth and arrival planning. Early alignment avoids costly retrofitting and strengthens the PCS's role as the bridge between the nautical and logistics sides of the port.

- **Monitor S-100 developments:** Closely follow the rollout of the IHO S-100 framework and the phase-in of S-100-based ECDIS.
- **Focus on relevant specifications:** Prioritise standards with direct port relevance, including S-102 (bathymetric surfaces), S-104 (water levels), S-111 (surface currents), S-124 (navigational warnings), S-129 (UKC management) and S-211 (port call messages).
- **Adopt S-211 for port call data:** Explore providing port call information in S-211 format to enable seamless exchange with vessels and traffic services.
- **Link dynamic UKC to planning:** Connect S-129-based UKC information with berth and arrival planning.
- **Align early:** Build S-100 compatibility into platform roadmaps now to avoid costly retrofitting later.
- **Bridge nautical and logistics domains:** Position the PCS as the connector between nautical information services and logistics processes in the port.
- **Governance will be critical:** acting as a neutral data broker for both commercial and government data requires clear rules on access, purpose limitation, and data separation, otherwise the PCS risks being seen as compromised by either side (e.g. commercial operators fearing government surveillance via the PCS, or agencies fearing commercial misuse of regulatory data).
- **Pilots with a single willing partner** (one large warehousing group, one municipality) would let PCSs test commercial and governance models on a small scale before rolling this out as a formal service line.



Recommended action list

1. Strategic positioning

- Define the positioning as a "trusted data intermediary" and update the strategy and value proposition to match (Managing Director).
- Get approval for the new direction from the board and shareholders (Managing Director).
- Study comparable models, such as airport operators that expanded into logistics and city data (Strategy Lead).

2. Supply chain data products

- Identify potential data partners in warehousing, rail, inland terminals and last-mile logistics (Business Development Manager).
- Define two or three product concepts, such as predictive congestion management, end-to-end shipment visibility and supply chain emissions tracking (Product Manager).

3. G2G data space

- Map the data requests that customs, police, immigration and municipal authorities make to carriers and shippers, and flag the duplicates (Government Relations Lead).
- Propose a shared "ask once, use many times" data space to the relevant authorities (Managing Director).

4. Secure data centre and cybersecurity services

- Assess your current infrastructure (redundancy, access control, disaster recovery, ISO 27001) for use as a hosting and colocation service (IT/Infrastructure Lead).
- Design a cybersecurity service package covering managed security operations, threat monitoring, incident response, and NIS2 and IMO compliance support (CISO (Chief Information Security Officer)).
- Validate demand with smaller ports, terminals and hinterland partners (Business Development Manager).
- Build the business case and pricing model (Finance Lead).

5. Governance

- Set clear rules on access, purpose limitation and data separation between commercial and government data (Legal/Compliance Officer).
- Introduce independent oversight and audit trails to make neutrality verifiable (Managing Director).
- Communicate the safeguards openly to both commercial and government users (Communications Officer).

6. Pilots

- Launch a commercial pilot with one willing partner, such as a large warehousing group (Product Manager).
- Launch a G2G pilot with one authority or municipality (Government Relations Lead).
- Evaluate the results and decide whether to roll out formal service lines (Management Team).



In what ways can IPCSA help?

Data quality is often the unglamorous but decisive factor in whether data-sharing initiatives succeed — poor quality data (incomplete, inconsistent, late, duplicated, consolidated) undermines trust faster than almost anything else, and erodes the credibility of any "trusted intermediary" positioning.

IPCSA could develop shared data quality standards and metrics (completeness, timeliness, accuracy, consistency across formats) that members can adopt as a common benchmark, similar in spirit to the manifesto but more operational and technical — a practical companion document rather than a competing initiative.

A data quality certification or scorecard, potentially tied into the maturity model, would let members assess their own data quality and demonstrate improvement over time, and would give commercial partners confidence in the data they're receiving through PCS platforms.

IPCSA could also play a coordinating role in root-cause diagnosis — data quality problems often originate upstream (e.g. inconsistent data entry by shippers or carriers) rather than within the PCS itself, so member PCSs pooling anonymised data quality issues could reveal common patterns and shared fixes (better validation rules, standardised reference data, automated reconciliation tools) that would be inefficient for each PCS to solve independently.

This is also a natural extension of the consultancy/advisory service line (Recommendation 4): PCSs with mature data quality practices could package this expertise as an advisory offering for less mature ports or hinterland logistics partners, turning an internal capability into a revenue stream.



Recommended action list for IPCSA

1. Data quality standards

- Form a Data Quality Working Group of technical experts from member PCSs (Secretariat).
- Define common metrics for completeness, timeliness, accuracy and consistency, and publish them as a companion to the Data Framework (Working Group).

2. Scorecard and certification

- Develop a data quality scorecard linked to the maturity model (Working Group).
- Pilot it with selected members, then decide on a certification scheme (Secretariat + Working Group).

3. Root-cause diagnosis

- Collect anonymised data quality issues from members (Secretariat).
- Analyse common upstream causes and develop shared fixes such as validation rules, reference data and reconciliation tools (Working Group).
- Engage carrier and shipper associations to fix problems at the source (IPCSA Board, ongoing).

4. Advisory services

- Package the expertise of mature members into an advisory offering for less mature ports and hinterland partners or even institutions like IMO, etc. (Working Group).
- Promote it as part of IPCSA's consultancy service line (IPCSA Board).

Recommendation 4

Professional Consultancy & Advisory services

PCS operators could utilise their ever-growing knowledge and expertise in cyber and data security to offer this as a service to maritime, logistics and supply chain operators. They could also extend their consultancy services beyond the local maritime port community to include processes, data flows, and automation for logistics in hinterland connections and dry ports.

This represents a shift from being purely an infrastructure/platform provider to becoming a knowledge business — monetising the tacit expertise built up over years of running complex, high-stakes data exchanges, which is a scarce skill set in the wider logistics sector.

Core idea

PCSs can monetise their data/cyber expertise by offering consultancy services — shifting from infrastructure provider to knowledge business.

How to make it real:

- Cybersecurity advisory service: leveraging regulatory pressure (NIS2, IMO guidelines) that smaller ports/operators struggle to meet in-house
- Extend consultancy: move from 'port only advice' towards working with hinterland/dry ports, applying proven port data governance models inland (rail hubs, logistics parks)
- Tiered offering: light advisory for smaller players, deep technical consulting for larger ones, potentially a certification scheme for recurring revenue

In what ways can members achieve this?

- **Cybersecurity** is a natural entry point given rising regulatory pressure (e.g. NIS2 in the EU, IMO cyber risk management guidelines) — many smaller ports, terminal operators, and hinterland logistics players lack in-house expertise and would value a trusted, sector-specific advisor rather than a generic IT consultancy.
- **Extending into hinterland** and dry port operations is a logical adjacency: as more cargo visibility and customs processes shift inland, the same data governance and interoperability challenges PCSs have already solved at the port become relevant to inland terminals, rail hubs, and logistics parks — effectively exporting the PCS's operating model beyond the port gate.
- **Transition services:** as ports and their partners shift toward more interoperable, standards-based data exchange, PCSs are well placed to offer dedicated transition support — helping smaller operators, agencies, and legacy system owners migrate without disrupting daily operations. This could include phased onboarding, sandbox testing environments, legacy data mapping support, and interim dual-running arrangements. Framing this as a core ongoing service, rather than a one-off cost, reinforces the PCS's role as a long-term enabler of change and ensures smaller or less digitally mature stakeholders aren't left behind.
- **This service line could be structured in tiers:** light-touch advisory/benchmarking for smaller operators, deeper technical consulting (system design, standards adoption, cyber audits) for larger ones, and possibly a certification or accreditation scheme that becomes a mark of trust in the market — creating recurring revenue rather than one-off engagements.
- **A risk to manage is channel conflict** — if a PCS starts consulting for organizations that could later become platform customers or competitors, it needs clear boundaries (e.g. a separate consulting entity or codes of conduct) to preserve its neutral, trusted-intermediary reputation.



Recommended action list for IPCSA

1. Cybersecurity advisory

- Assess your in-house cyber expertise against NIS2 and IMO requirements (CISO).
- Identify target clients among smaller ports, terminals and hinterland operators, and validate their needs (Business Development Manager).
- Develop a sector-specific cyber offering: risk assessments, compliance support and audits (CISO).

2. Hinterland and dry port expansion

- Map potential inland partners: inland terminals, rail hubs and logistics parks (Business Development Manager).
- Adapt the PCS model of data governance and interoperability for inland use (Product Manager).
- Launch a pilot with one inland terminal or dry port (Product Manager).

3. Transition services

- Define a transition service package covering phased onboarding, sandbox testing, legacy data mapping and dual-running support (Product Manager).
- Offer it as an ongoing service with a clear pricing model (Finance Lead).

4. Tiered service structure

- Design three tiers: light advisory and benchmarking, in-depth technical consulting, and certification or accreditation (Strategy Lead).
- Build recurring revenue models, such as subscriptions or annual audits (Finance Lead).

5. Managing channel conflict

- Decide on the setup: a separate consulting entity or an internal unit with clear boundaries (Managing Director and Board).
- Adopt a code of conduct covering confidentiality, conflicts of interest and data separation (Legal/ Compliance Officer).
- Communicate the safeguards openly to customers and partners (PR / Communications Officer).

Core idea

PCS platforms, built for EDI-era batch data exchange, risk becoming legacy infrastructure as cloud-native, big tech, and blockchain-based alternatives offer real-time, API-first flexibility. The threat isn't sudden disruption — it's slow irrelevance.

How to make it real:

- **Shared roadmap:** A member-developed roadmap helps smaller PCSs avoid legacy lock-in and gives larger PCSs a space to pilot new approaches.
- **Beyond tech:** Future-proofing also means diversifying into data/trust services and sustainability/energy offerings, not just EDI messaging.
- **Future generations:** Staying relevant means building technology around digital-native expectations and involving younger professionals / academia in shaping direction.
- **Annual tech review:** Benchmark platforms against emerging standards and flag early risks like EDI reliance or missing AI/automation roadmaps.

Recommendation 5

Future-Proofing: What actions are needed to prevent technology stagnation from making traditional port community hubs outdated?

The core risk is that PCS platforms, built for EDI-era batch data exchange, become legacy infrastructure as newer entrants (cloud-native supply chain platforms, big tech logistics offerings, blockchain-based trade platforms) offer more flexible, real-time, API-first alternatives — the danger isn't sudden disruption but slow irrelevance.

A shared technology roadmap or reference architecture would help smaller PCSs — who often lack R&D budgets — avoid being locked into ageing technology stacks, while giving larger PCSs a forum to pilot and share emerging approaches before wider rollout.

Future-proofing isn't purely technical — it's also about business model relevance: as the earlier recommendations on new service lines, consultancy, and data brokering suggest, a PCS that only exchanges EDI messages for the port community is more exposed to substitution than one that has diversified into a broader data and trust ecosystem. Continuous relevance may depend as much on scope expansion as on any single technology upgrade.

Sustainability & energy management: PCSs can support the sector's environmental goals by treating emissions, energy, and fuel data with the same rigor as trade data. Recommendations include common carbon and energy-reporting standards (aligned with IMO/GLEC (Global Logistics Emissions Council)) for comparability; using the PCS's neutral position to benchmark performance without exposing sensitive data; enabling shore power and just-in-time arrivals to cut idling and energy waste; sharing data on energy demand and alternative fuel infrastructure between operators and providers; and giving smaller ports access to shared reporting tools so compliance stays affordable for all. (to be considered: results of the IPCSA "sustainability group" work)

Focus on new generations: As digital natives enter the trade workforce, PCSs should shape their technology around expectations this generation already holds — real-time visibility, intuitive interfaces, and seamless system integration, rather than legacy batch-based processes. This means embracing APIs, automation, and AI-driven insights as standard, not optional, and delivering a user experience closer to consumer-grade digital services. To keep future generations genuinely engaged, PCSs should also create direct channels for younger professionals to shape the technology roadmap — through advisory panels, hackathons, or graduate



innovation programmes (more cooperation with academia) — ensuring the systems built today evolve with the people who will rely on them tomorrow. Staying ahead of this shift keeps trade infrastructure relevant to the shippers, regulators, and operators who will define its future.

A concrete near-term action would be an annual "state of PCS technology" review — assessing where member platforms sit relative to emerging standards and flagging early warning signs of stagnation (e.g. reliance on point-to-point EDI where the wider market has moved to APIs, or lack of any AI/automation roadmap) before they become a competitive liability.

PCSs should take an active role in driving acceptance of the electronic bill of lading (eBL) based on the UNCITRAL Model Law on Electronic Transferable Records (MLETR). As neutral, trusted hubs connecting carriers, forwarders, terminals, customs, and banks, PCSs are well placed to integrate eBL workflows into port processes, ensure interoperability with DCSA and DSI standards, and link eBLs to cargo release and customs clearance. IPCSA should support this by encouraging members to advocate for MLETR adoption with national governments, sharing implementation experience across the network, and positioning PCSs as key enablers of paperless trade.

AI-enabled decision support: Combining historical and real-time event data opens the way for AI-enabled decision support. Examples include congestion forecasting to anticipate peaks at berths, locks or gates; more accurate ETA prediction based on vessel behaviour, weather and port conditions; anomaly detection that flags unusual vessel movements or inconsistent data; and risk-based planning of nautical services and inspections. These tools can significantly extend the planning horizon for all port actors.

The value of AI depends directly on the quality of the underlying data. PCSs should also make sure that AI-based outputs are explainable and clearly labelled as predictions, so that operational users understand their limitations and remain responsible for final decisions.

- **Combine historical and real-time data:** Use both as the foundation for AI tools that extend the planning horizon for all port actors.
- **Prioritise high-value use cases:** Focus on congestion forecasting at berths, locks and gates; improved ETA prediction using vessel behaviour, weather and port conditions; anomaly detection for unusual movements or inconsistent data; and risk-based planning of nautical services and inspections.
- **Secure data quality first:** Ensure reliable input data before deploying AI, as output quality depends directly on it.
- **Make AI explainable:** Show users how predictions are generated so they can understand and assess them.
- **Label predictions clearly:** Distinguish AI-generated forecasts from confirmed data and communicate their limitations.
- **Keep humans in charge:** Ensure operational users remain responsible for final decisions, with AI serving as support.
- **Operational resilience:** As port operations rely more heavily on digital data, the impact of failures grows. GNSS jamming and spoofing, AIS outages, cyber incidents and system failures can all disrupt ETA predictions, traffic management and berth planning. Recent GNSS interference in several sea areas shows that these risks are real and increasing.

PCSs should therefore plan for operational resilience: fallback procedures for manual or degraded operation, alternative data sources such as radar and shore-based positioning, redundant systems and communication channels, and regular contingency exercises with port partners. Clear agreements on roles and responsibilities during disruptions are just as important as the technical measures. Resilience should be designed in from the start, reflecting the PCS's role as part of the critical digital infrastructure of the port and the wider supply chain.

- **Assess risks:** Plan for GNSS interference, AIS outages, cyber incidents and system failures.
- **Prepare fallbacks:** Define procedures for manual or degraded operation.
- **Use backup data:** Draw on radar and shore-based positioning when GNSS or AIS fail.
- **Build redundancy:** Duplicate critical systems and communication channels.
- **Exercise regularly:** Test contingency plans with port partners.
- **Agree on roles:** Set clear responsibilities during disruptions.
- **Design for resilience:** Treat the PCS as critical infrastructure from the start.

In what ways can members achieve this?

1.Align with the shared roadmap: Map your platform against the common reference architecture and plan upgrades accordingly. Smaller PCSs should use it to avoid lock-in; larger PCSs should volunteer as pilot sites and share results.

2. Self-assess annually: Take part in the "State of PCS Technology" review and act on its findings, especially any reliance on point-to-point EDI or a missing AI/automation roadmap.

3. Diversify your business model: Look beyond EDI message exchange to new service lines such as consultancy, data brokering, and trust services.

4.Treat emissions data like trade data: Adopt IMO/GLEC-aligned carbon and energy reporting, and use your neutral position to benchmark community performance without exposing sensitive data.

5. Enable energy savings in your port: Support shore power, just-in-time arrivals, and data sharing on energy demand and alternative fuels between operators and providers.

6. Use shared tools where sensible: Smaller PCSs should adopt shared reporting tools to keep compliance affordable, drawing on the IPCSA Sustainability Group's work.

7. Modernise the user experience: Make APIs, real-time visibility, automation, and AI-driven insights standard, and move away from batch-based processes.

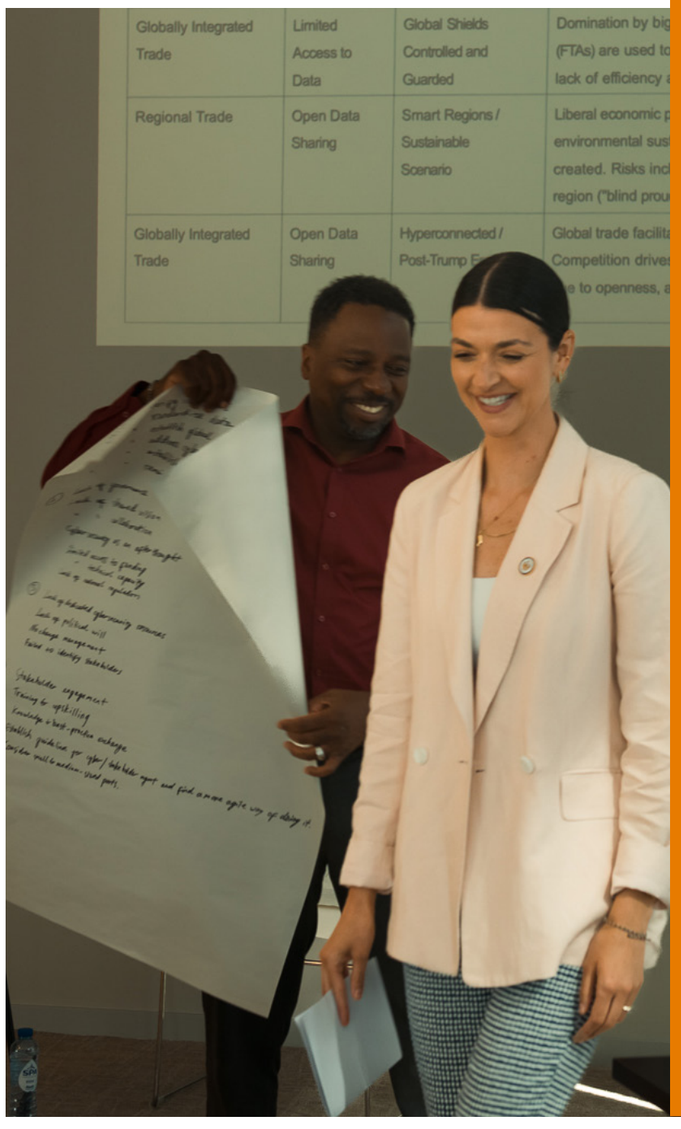
8. Involve young professionals: Set up advisory panels, hackathons, or graduate programmes with local universities to give them a voice in your roadmap.

9. Present the PCS / ACS / Trade SW to ministries as critical infrastructure and ask for formal recognition and support under NIS2 or national frameworks.

10.Continuously review and adjust the business continuity plan in line with the PCS / ACS / Trade SW, covering port, airport and hinterland operations, so that changes to processes, systems, interfaces or responsibilities are reflected promptly. Integrate strategic foresight to anticipate emerging risks and future scenarios, ensuring resilience and business continuity measures are not only current but prepared for tomorrow's disruptions across the entire logistics chain.

How can IPCSA actively support members?

IPCSA could establish a technology horizon-scanning function (building on the Foresight process) that tracks emerging architectures — API-first and event-driven data exchange, decentralised identity and verifiable credentials, AI-driven anomaly detection and predictive logistics, and interoperability standards like DSI's or DCSA's — and translates these into practical guidance and reference architectures members can adopt incrementally rather than through disruptive, all-at-once overhauls.



Recommended action list for IPCSA

1. Shared roadmap: Co-develop a technology roadmap and reference architecture with members.

2. Annual tech review: Publish a yearly "State of PCS Technology" report.

3. Set up the function: Establish a horizon-scanning team as part of the Foresight process.

4. Track key trends: Monitor API-first and event-driven data exchange, decentralised identity and verifiable credentials, AI-driven anomaly detection and predictive logistics, and DSI/DCSA interoperability standards.

5. Assess relevance: Rate each technology by maturity and impact on PCSs.

6. Translate into guidance: Publish practical guidance and reference architectures for members.

7. Enable step-by-step adoption: Define incremental migration paths that avoid all-at-once overhauls.

8. Update regularly: Refresh findings annually and link them to the "State of PCS Technology" review.

9. eBL

- Advocate for MLETR: Encourage members to promote MLETR-aligned legislation with their national governments.
- Track progress: Map MLETR adoption and eBL readiness across member countries.
- Set integration guidelines: Define how PCSs link eBLs to cargo release, customs clearance, and terminal processes.
- Ensure interoperability: Align with DCSA and DSI eBL standards and engage with eBL platform providers.
- Run pilots: Support member pilots of end-to-end eBL workflows and share the results.

10. Share knowledge: Publish case studies and offer training for members and their port communities.

> What stood out is how the Foresight approach and techniques allow us to go beyond the way we usually look at trends. At Portbase, we already spend time understanding trends and market developments, but these workshops helped me to look at them differently, more structurally and more in depth. Instead of just asking what is changing, we explored what those changes could actually mean in different futures. For me, the journey together and that shift from observing trends to really exploring their potential impact has been one of the most valuable aspects of the whole process.

Stephanie Van Den Berg

General observations

General observations and opinions of “Wise Persons” and member’s

Following the workshops, the draft report was sent out for a review cycle to all workshop participants and to a selected group of external supporters who had accompanied the process.

They were asked for their overall opinion of the draft and invited to share any additional thoughts, suggestions or corrections they considered important. The purpose of this step was to ensure that the report accurately reflects the discussions, ideas and results developed jointly during the workshops, and to give all those involved the opportunity to point out anything that was missing, unclear or not entirely accurate. Involving external supporters also provided a fresh outside perspective on the content and helped to test whether the findings are understandable and convincing to readers who had not taken part in every session. The response was very encouraging, with many reviewers reading the draft closely and providing thoughtful, constructive comments. All feedback was carefully reviewed, and a number of comments were incorporated directly into the individual sections of the report as well as into the recommendations, which considerably strengthened the quality and credibility of the final version. Beyond the comments that found their way into the report, reviewers also shared a range of additional thoughts and reflections, some of which are reflected in the following lines taken from the feedback received:

Global supply chains are entering a new phase. Growing volatility from geopolitical tensions, climate-related disruptions, pandemics and shifting trade patterns has shown how vulnerable tightly optimised, linear supply chains can be. At the same time, rising expectations for transparency, sustainability and speed are pushing shippers, carriers, ports and authorities to rethink how goods and information move. The supply chain of the future will be more connected, more predictive and more resilient, and data will be its backbone.

A key part of this shift is the move from document-based and batch-driven processes to event-driven solutions. Instead of exchanging static documents at fixed points in time, supply chain actors increasingly share real-time events: a vessel departing, a container being discharged, a customs release, or a truck arriving at the gate. Event-driven architectures allow every stakeholder to react immediately to changes, plan more accurately and coordinate more closely.

In parallel, the industry is moving towards platform solutions. Rather than building countless point-to-point connections, organizations connect once to shared



platforms that bring together data, services and partners. Port Community Systems (PCSs) have long played this role at the port level and are well placed to evolve into broader, trusted data intermediaries that link maritime, logistics, hinterland and government actors. As carriers, technology vendors and global initiatives compete to set the agenda, neutrality, openness and governance are becoming increasingly important differentiators.

Despite this progress, fundamental challenges remain. Data quality is still one of the most persistent barriers: incomplete, late, inconsistent or inaccurate data undermines trust and limits the value of even the most advanced digital solutions. Equally challenging is the interoperability and integration of data systems at a global level. Supply chains cross many jurisdictions, each with its own regulations, standards and legacy systems. Even where common standards exist, such as those from UN/CEFACT, the IMO, DCSA or the emerging IHO S-100 framework, their implementation often differs from country to country. The result is fragmentation, duplicate data submissions and costly integrations. Seamless data exchange across borders requires not only technical alignment, but also shared governance principles, mutual trust between public and private actors, and sustained international collaboration.

Shifting Dynamics: Supply Chain Stress, Market Structure, Cybersecurity and Single Windows

The foresight scenarios highlight several developments that will reshape the environment in which ports and Port Community Systems operate. While many trends are relevant, four stand out because they affect the very core of the PCS role and will require strategic attention in the coming years.

First, ports and supply chain disruptions influence each other in both directions. Ports are exposed to wider supply chain stress, such as geopolitical tensions, extreme weather or sudden shifts in demand, yet they can also amplify or absorb that stress depending on their preparedness.

Second, logistics networks are becoming increasingly vertically integrated, with large carriers and logistics groups extending control across multiple links of the chain. This shifts power dynamics and challenges the neutral position of PCSs.

Third, cybersecurity is gaining importance as digital connectivity deepens and threats grow more sophisticated. As trusted data hubs, PCSs are both critical assets and potential targets.

Fourth, the relationship between Maritime Single Windows, Trade Single Windows and PCSs continues to evolve, raising questions about roles, interfaces and complementarity. Clear coordination will be essential to avoid duplication and ensure seamless data flows.

Together, these trends call for a proactive and forward-looking response to safeguard the relevance and resilience of PCSs:



1. Ports and PCSs: both affected by supply chain stress and contributors to it

Geopolitical events, climate change, congestion, trade route disruptions and schedule unreliability are all putting pressure on global supply chains. Ports and their PCSs are often seen as affected by these shocks, but the relationship works both ways. As highlighted in the World Bank's Container Port Performance Index (CPPI), ports are both victims and transmitters of supply chain stress.

Supply chain stress weakens port performance through vessel bunching, unreliable schedules and congestion. At the same time, poor port performance feeds back into the wider supply chain. It increases delays, reduces effective shipping capacity and spreads disruption across maritime networks. Efficient ports dampen shocks, while inefficient ports amplify them.

The same logic applies to PCSs. A well-functioning PCS that provides timely, accurate and shared information helps port communities absorb disruptions, re-plan quickly and coordinate resources. A PCS with poor data quality, limited integration or low resilience can instead add to delays and uncertainty. This makes the performance of PCSs not just a local efficiency issue, but a factor in the stability of global supply chains. PCSs should therefore see shock absorption as an explicit part of their mission, supported by real-time data, predictive tools and close coordination with nautical and hinterland partners.

Recommended action list

- **Make shock absorption an explicit part of the PCS mission**, recognising ports as both victims and transmitters of supply chain stress.
- **Ensure timely, accurate and shared information** to help port communities absorb disruptions and re-plan quickly.
- **Improve data quality and system integration** to avoid adding delays and uncertainty.
- **Strengthen PCS resilience**, treating performance as a factor in global supply chain stability, not just local efficiency.
- **Invest in real-time data and predictive tools** to anticipate congestion, vessel bunching and schedule disruptions.
- **Coordinate closely with nautical and hinterland partners** to align resources during disruptions.

2. Vertical integration and the changing structure of logistics networks

The maritime and logistics sectors are increasingly shaped by vertical integration. Carriers are acquiring terminals, ports, logistics providers and digital platforms, building integrated end-to-end ecosystems. At the same time, as World Bank analysis of twenty years of change in the global liner shipping network shows, networks are becoming more concentrated around hub-and-spoke structures and a smaller number of dominant players.

This raises fundamental questions for data sharing and for the role of PCSs:

- Who will control critical logistics data?
- Will data sharing remain neutral and collaborative?
- What role will independent PCS operators play if major logistics actors increasingly control multiple stages of the transport chain?
- How can PCS operators preserve their role as trusted, neutral intermediaries?

These questions are closely linked to themes already identified in the foresight exercise, including data governance, ownership, trust and changing trade routes. As integrated players build their own platforms, the value of a neutral PCS lies more and more in its ability to offer a level playing field. It gives smaller operators, authorities and competing actors equal access to shared data under transparent rules. Strong governance, verifiable neutrality and close cooperation with public authorities will be essential for PCSs to keep this role in increasingly concentrated markets.

- **Monitor vertical integration and market concentration** and assess their impact on data sharing and the PCS role.
- **Safeguard neutral, collaborative data sharing** as integrated players build their own platforms.
- **Clarify data governance and ownership**, defining who controls critical logistics data and under which rules.
- **Position PCSs as trusted, neutral intermediaries** offering a level playing field for all actors.
- **Ensure equal access to shared data** for smaller operators, authorities and competitors under transparent rules.
- **Demonstrate verifiable neutrality** through strong governance and transparency.
- **Strengthen cooperation with public authorities** to secure the PCS role in concentrated markets.

3. Cybersecurity as a central strategic theme

Cybersecurity already appears throughout this report, but it should be elevated from an important issue to a central strategic theme. As the World Bank's recent work on cybersecurity in ports underlines, the growing digital integration of ports, logistics chains and PCSs makes cyber resilience an absolute prerequisite. The rapid spread of AI adds new opportunities, but also new and more sophisticated threats.

Several factors make this urgent. Cyber incidents can disrupt physical cargo flows and port operations, not only IT systems. Increasing digitalisation creates new vulnerabilities across interconnected actors, where the weakest link can compromise the whole chain. Smaller ports and logistics stakeholders often lack adequate cyber capabilities. Above all, trust in digital trade increasingly depends on confidence in cyber resilience.

This strengthens the case for the recommendations on cybersecurity services, advisory functions and trusted digital infrastructure. It also suggests going a step further: cybersecurity should be positioned as one of the fundamental foundations of future trade ecosystems, alongside interoperability, governance and standards. For PCSs, this means building security into every service by design, sharing threat intelligence within the community and with IPCSA, and supporting less mature stakeholders in raising their level of protection.

Recommended action list

- **Make cybersecurity a central strategic theme,** alongside interoperability, governance and standards.
- **Build security into every PCS service by design.**
- **Include cyber incidents in continuity planning,** as they can disrupt physical operations, not just IT.
- **Share threat intelligence** within the community and with IPCSA.
- **Support smaller and less mature stakeholders** in raising their protection level.
- **Develop cybersecurity services, advisory functions and trusted digital infrastructure.**
- **Prepare for AI-driven threats** while using AI to strengthen defences.

4. Maritime Single Window, Trade Single Window and PCS

National Maritime Single Windows (MSWs) are becoming increasingly important. Under the FAL Convention, the IMO now requires ship-related information to be exchanged electronically through a single window, and in Europe the European Maritime Single Window environment (EMSWe) is changing the way ship reporting is carried out. Alongside this, many countries run Trade Single Windows (TSWs) to handle cargo-related regulatory procedures, while PCSs enable business-to-business and business-to-government data exchange within port communities.

As the World Bank SSATP report on Maritime Single Windows illustrates, these three systems differ in scope, but overlap considerably. MSWs focus mainly on vessel-related formalities, TSWs on trade and cargo-related regulatory requirements, and PCSs on operational and commercial coordination between port community actors, often including regulatory submissions. The overlaps can create duplication, unclear responsibilities and competing investments. They can also create opportunities for close cooperation.

PCSs should therefore define their position clearly in relation to MSWs and TSWs in their national context. In many cases, the PCS can act as a data provider, an access point or a technical operator for single window functions, building on its existing connections to the port community. Clear agreements on roles, data flows and governance with the responsible authorities will help avoid duplication and support the "ask once, use many times" principle. At the international level, IPCSA can support its members by promoting common understanding of these models and sharing good practice.

Recommended action list

- **Map the national single window landscape** (MSW, TSW and PCS) and identify overlaps and gaps
- **Agree on clear roles and data flows with the responsible authorities,** for example the PCS acting as a data provider, access point or technical operator
- **Define end-to-end governance and trigger events for the entire flow,** including how government releases (customs, port health) and commercial releases (carrier, terminal) interact, and set the target level of automation for each step (.
- **Align PCS interfaces with MSW and EMSWe requirements** to avoid double reporting
- **Share good practice between members** on MSW, TSW and PCS cooperation models



References

World Bank, The Container Port Performance Index (CPPI):
www.worldbank.org/en/topic/transport/publication/cppi

World Bank Blogs, Mapping 20 years of change in the global liner shipping network:
blogs.worldbank.org/en/opendata/mapping-20-years-of-change-in-the-global-liner-shipping-network

World Bank, Cybersecurity in Ports:
www.worldbank.org/en/topic/transport/publication/cybersecurity-in-ports

World Bank SSATP, Maritime Single Window report (see figures 3–5 on MSW, TSW and PCS):
www.ssatp.org/sites/default/files/publication/REPORT_SSATP_MSW_21032025_PAGES.pdf

Conclusion

The shift towards event-driven, platform-based supply chains opens a significant opportunity for Port Community Systems. Experience with Port Call Optimisation and Just-In-Time Arrival demonstrates that value is not created by data exchange alone, but by data that can be trusted. Such data must be harmonised, of high quality, secure, interoperable across borders and resilient to disruption.

Meeting these requirements, however, demands substantial resources. Many PCS operators face limited funding, skills shortages and competing priorities, making it difficult to invest in advanced technologies, cybersecurity and continuous improvement. Pooling expertise, sharing solutions and securing sustainable financing will therefore be essential.

This also has implications for IPCSA itself. To support the industry effectively in the years ahead, a substantial change within the association may be required. Its structures, capabilities and services must evolve to match the growing complexity of the challenges and tasks its members face, from cyber resilience and data governance to foresight and international cooperation.

IPCSA's future role will depend on a clearly defined mission and scope, guided by a strategic roadmap and an active foresight capability. Expanding its expertise, strengthening its secretariat and opening membership more widely would enhance its capacity to act, while shared services and capacity building would directly benefit members. Its influence would grow through regular publications, closer ties with international institutions and a stronger voice in standard-setting, all made possible by diversified funding and joint resources.

Strategy & focus

- Communicate the clear mission and playing field of IPCSA, agreed with members, covering PCS, ACS and Trade Single Windows.
- Set a multi-year strategic roadmap with priority themes such as cybersecurity, data governance, interoperability and resilience.
- Establish a foresight function to monitor trends and translate them into guidance for members.

Structure & governance

- Create thematic working groups or centres of expertise (e.g. cyber, data sharing, AI, standards, sustainability).
- Strengthen the secretariat with dedicated experts rather than relying mainly on volunteer contributions.
- Broaden membership to include airports, hinterland operators, authorities and technology partners where relevant.

Services to members

- Offer shared services, such as cyber threat intelligence, maturity assessments and reference architectures.
- Develop a capacity-building programme with training, mentoring and twinning between mature and emerging PCSs.
- Build a knowledge platform with best practices, case studies and reusable solutions.

Influence & visibility

- Publish regular policy briefings and technical articles to strengthen IPCSA's authority.
- Enhance and communicate partnerships with the World Bank, IMO, WCO, UNECE, the EU and other institutions.
- Intensify the existing role in standards development and regulatory consultations.

Resources & funding

- Diversify funding through project grants, sponsored research, paid services and partnerships.
- Pool resources for joint projects, such as pilots on Just-In-Time Arrival or data spaces.

At the same time, the PCS, Airport Community System and Trade Single Window industry needs to take a clear strategic decision on its priorities. It must clearly define what matters most and establish the playing field in which IPCSA acts as the central body, representing the community, setting direction and speaking with one voice towards international institutions and policymakers.

By addressing these challenges together, PCSs and IPCSA can act as neutral, reliable hubs and help shape supply chains that are more efficient, sustainable and prepared for the future, while reinforcing trust among all public and private stakeholders.

09
Appendices

Appendix 1
Critical Issues (High Impact – High Uncertainty)

Appendix 2
Consider the direction that critical issues might take (Polarities)

Appendix 1
Critical Issues (High Impact – High Uncertainty)

Group A discussed the multifaceted concept of fragmentation across various dimensions, including the global order, institutional structures, and cultural landscapes. Although fragmentation is frequently perceived negatively due to its potential to disrupt established systems, it can also unveil opportunities for innovation and improvement. For instance, the decentralization and dissemination of information, if harnessed effectively, can significantly enhance the efficiency and resilience of supply chains.

Organizations that can adeptly integrate fragmented data from multiple sources may find themselves at a strategic advantage, leading to more agile and responsive operations.

Another pivotal theme the group explored was that of trust, which plays a crucial role in shaping our industry. Trust in data integrity, regulatory bodies, institutional frameworks, technological advancements, policy-making, and governance structures remains a variable and uncertain factor.

The trajectory of global trust is ambiguous, with possibilities ranging from a gradual increase in trust levels across the globe to the potential dominance of a zero-trust paradigm, where skepticism and verification become the norm and regionalisation and protectionism take over.

The interests of various institutional stakeholders, including lobbyists, technology firms, and governmental entities, also emerged as a significant force. The negotiation, alignment, and sometimes clash of these interests can lead to profound impacts on industry dynamics. The intricate interplay between trust and stakeholder interests results in a complex landscape with diverse outcomes varying across different geographical regions.

In exploration of critical uncertainties and issues, the group identified a significant trend: the growing distrust of global governments and institutions by citizens worldwide. This phenomenon isn't confined to non-developed countries but is increasingly evident even in developed regions. Trust, or the lack thereof, is emerging as a crucial trend that warrants our focus.

Regulation and policy were identified as interconnected yet distinct influences. While regulatory measures may not always exert a deep impact on global trade dynamics, policies such as import tariffs can wield substantial influence. Despite the challenges posed by fragmentation, there exists the potential for regional or even international regulatory frameworks, exemplified by initiatives like the African Continental Free Trade Area, which seeks to harmonize trade regulations across the continent.

Climate change resilience is another critical issue affecting trade routes and actor positioning, with noticeable impacts in both the global south and north. Cyber threats are recognized as a certainty, with ongoing efforts to establish guidelines to mitigate risks. Technological innovation sparked lively debates regarding its future impact on global trade, with some considering its current influence as manageable.

The discussion also touched on whether technological advancements over the next decade will significantly alter the global trade landscape compared to today. The overarching themes identified include fragmentation, trust, regulation, policy, resources, resilience, cyber threats, technological innovation, and institutional interests.

Overall, group discussion underscored that while certain trends within the industry are predictable, others remain shrouded in uncertainty yet hold the potential for significant impact. Addressing these uncertainties necessitates a strategic focus and proactive engagement, given their capacity to shape the future trajectory of our industry

While regulations continue to evolve, governments and legal systems play a crucial stabilizing role. Short-term challenges are seen as necessary facilitators for long-term trade stability and conflict prevention. Although regulatory impacts on climate change and ESG remain inconsistent globally, they are vital for future progress. Demographic changes also play a pivotal role in influencing productivity.

As digital integration increases, cybersecurity becomes ever more critical due to the rise in threats. The unpredictability of past events, such as COVID-19, underscores the need for vigilance, while climate change, though still a subject of debate, is expected to reach a consensus by 2040. The broader impacts of climate c hange on trade routes and resources are evident, as exemplified by droughts affecting the Panama Canal.

The discussion also highlighted the potential of melting ice caps to open new trade routes, which could significantly impact global trade, although uncertainties remain. Short-term factors such as the Panama Canal's condition and rising sea levels, including hurricane damage, demand preparedness. The group emphasised the rapid increase in hurricane frequency and their associated economic challenges.

Global trade complexities were discussed, particularly the stable nature of conflicts yet significant political-economic-trade interactions. The emergence of digital currencies adds another layer of complexity, with potential reserves projected at 1% to meet economic demands. A shift in the global economy is noted, with governance and data ownership as key areas of debate. Rapid technological advancements present both challenges and opportunities, influencing economic landscapes.

Cybersecurity threats are already prevalent, affecting organizations and countries alike, and pose uncertainties regarding their timing and origins, as well as their impact on trade flows. This aspect, closely tied to data, is critical.

Technological uncertainties, particularly how cyber-attacks employ technology, are significant. There's speculation that quantum technology might offer solutions, yet its future path and certainty are unclear.

Major technological trends and innovations like new devices, 3D printing, and drones, which have already transformed the world over the past decades. However, their future impacts and regulatory responses remain undefined and uncertain.

international rules, regulations, and legislation will significantly impact global dynamics, although their future trajectory remains uncertain.

The topic of warfare was revisited, acknowledging its historical recurrence but with uncertainties about specifics like timing and locations. Natural disasters and climate change are inevitable, yet their specific occurrences and impacts are uncertain. Geopolitical instability, tied to international regulations and trade imbalances, presents another layer of uncertainty, exemplified by how elections can alter trade flows.

The discussion also highlighted the importance of social sustainability and ethics, with uncertainties about their future direction. Biotechnology, often overlooked, was noted for its potential to alter food production and create new competitive markets. Data governance is expected to advance, influencing trade imbalances and dependencies. Technological regulation, especially concerning unregulated black boxes like chatbots, poses challenges that need addressing.

Technological failures, distinct from cyber-attacks, can result from internal issues like quality management lapses. The COVID-19 pandemic was cited as an example of how health crises, akin to natural disasters, can disrupt global trade and industry. The concept of resilience was mentioned as a broad term encompassing various aspects of these uncertainties, with an emphasis on understanding the specifics under broad headlines like technology and biotech.

In all, 9 potential critical issues were agreed upon. These were:

- Access to information / ownership of data
- Means of transport
- Content being transported
- Pace of technology
- Data governance and regulation
- Financial settlement rules
- Energy and resources
- Trade routes
- Trade regulations

Appendix 2

Consider the direction that critical issues might take (Polarities)

Polarity A	Critical Issue	Polarity B
Limited (not able or willing to share it)	**1. Access to information / ownership of data**	Open sharing (willing and able to share it)
Sea, air, rail and road freight passing through ports and multimodal exchanges still dominate	**2. Means of transport**	Newer means of transport play significant role: drones etc Changes to use of ports and multimodal hubs
Digital designs (for 3D printing etc.)	**3. Content being transported**	Transport of end product
Able to cope / build upon the technology	**4. Pace of Technological Change**	Unable to cope / left behind from opportunities
Regulated and transparent use of data	**5. Data Governance and ownership**	Unregulated
Digital currency New drivers of value Fragmented Not standardised / backed by different alliances	**6. New financial settlement order / rules**	Traditional currencies Traditional exchange methods Single global settlement system Transparent and standardised
High cost Low availability of green energy	**7. Energy & Resources**	Low cost High availability of green energy
Change to Trade routes / transport modes (new / alternative)	**8. Trade Flows**	No Change to Trade routes / transport modes
Predictable Globally regulated	**9. Policy / regulation**	Uncertain Open market

Appendix 2

1. Access to information / ownership of data

Polarity A	Critical Issue Access to Information & Ownership of Data	Polarity B
Limited Access to Data / Information Privacy Concerns Security Risks Competitive Advantage Regulatory Compliance Intellectual Property Protection	Access to information and ownership of data are influencing global trade, efficiency, innovation, and competitiveness. The criticality of this issue comes from the need to balance two opposing polarities: limited access to data and open data sharing. Limited access to data arises from concerns over privacy, security, competitive advantage, regulatory compliance, and intellectual property protection. Organizations may restrict data sharing to safeguard sensitive information, comply with legal requirements, and maintain a competitiveness. However, this can hinder collaboration, reduce transparency, and slow down innovation, creating barriers for smaller players who lack the resources to generate their own data. On the other hand, open data sharing promotes transparency, fosters innovation, and enhances collaboration across borders. It can lead to more efficient supply chains, better decision-making, and economic growth. However, it also presents challenges such as ensuring data security, protecting privacy, and managing the quality and reliability of shared data. There is also the risk of misuse or exploitation of freely available data. Balancing these polarities is crucial for leveraging data to drive global trade forward. Creating frameworks that protect sensitive information while promoting the benefits of data sharing is essential for a sustainable and competitive global trade environment.	Open Data Sharing and Free Unlimited Access to Information Transparency Innovation Collaboration Economic Growth Public good

Appendix 2
2. Means of transport

Polarity A Non maritime and alternative modes of transport increases as port infrastructure	**Critical Issue** Means of Transport	**Polarity B** Shipping increases along with current port infrastructure
Drop off zones and smaller high-tech hubs start replacing traditional ports Drones start carrying out more short-haul transfers, replacing the need for large port infrastructure Example: Panama feeding Caribbean islands. For example, as of February 2025 St. Maarten has been actively exploring the idea of Panama becoming a regional trade hub for fresh produce	Ports currently handle 80% of global goods, and the amount of goods being shipped is set to increase. However, as of March 2025, around 8.4% of the global container fleet—about 2.65 million TEUs—were delayed due to ongoing port congestion. This was before current trade wars and restrictions imposed on China by the US. China currently provides incredible value for money when it comes to developing port infrastructure, currently winning 2/3rds of contacts. There is an ambition to reduce dependencies in this area but this could increase costs and slow infrastructure development. When it comes to ship building, China produces more than all OECD countries and building ships. Again, any policy that reduces demands for ships from China will have a knock-on effect in terms of ship supply and therefore costs of transport. This uncertainty and increased costs are causing delays and re-evaluations of many projects. For instance, the unpredictability of vessel charges is directly affecting how risk is priced for port projects. Financial institutions now have to factor in scenarios where a port could lose a chunk of business simply because a significant portion of ships might avoid it due to regulatory costs. If these issues cause a demand and supply squeeze, we could see the rapid increase in new modes of transport. This will particularly be the case if new technologies make alternative modes of transport more appealing. The locations of current transshipment markets are largely determined by geography and major shipping routes. However, if these were to change, a new and more optimal hub location could emerge, potentially drawing traffic away from existing hubs.	Current ports continue to grow in infrastructure and demand Increased trade through current logistics hubs Ship – truck / train dominates

Appendix 2
3. Content Being Transported

Polarity A Digital Designs (for 3D printing etc)	**Critical Issue** Content being transported	**Polarity B** Transport of End Product
Quality of products may differ between locations Faster time to market, potentially quick to deploy in a crisis Potential to customise for local markets (IP Permitting) Requirement for local facilities in many locations for fabrication or assembly IP risk is increased and market exposure Carbon footprint maybe better from Supply Chain perspective (possible offset for local printing) Unknown if customs/tariffs will exist for this type of model in future	Traditional supply chains move parts or finished products around the world, this is a tried and tested model that is proven but also subject to uncertainty and risk. Digital designs (B2C or B2B) are not yet widely used, but are lightweight ways to transfer production of components to a localised market without risk, only reliant upon production or assembly at the end location. Alongside the polarities shown, there is potentially a hybrid model that could exist where components can be printed and more specialist or bulky parts that are not suitable for printing are imported to complete the end product. Not uncommon in automotive for example in prototype design/testing.	Quality of product is controlled at source Vulnerable to geopolitical risk, tariffs, and supply chain disruptions Mass production reduces options for customisation but controls product quality and cost. Economies of scale can be achieved Better control/protection of IP Carbon footprint more consistent but likely higher Customs and Tariffs applicable for end product (unpredictable)

Appendix 2
4. Pace of Technological Change

Polarity A Technology supports the growth of PCS	Critical Issue Pace of Technological Change	Polarity B Technology outgrows PCS
Emerging technologies like AI, cloud computing, and blockchain can enhance PCS by providing real-time data analysis, predictive modeling, and secure information sharing, according to PierNext and the World Bank. **PCS are crucial for competitiveness:** Ports with strong PCS implementations often score higher on the World Bank's Logistics Performance Index, indicating increased competitiveness. **Evolving PCS:** Next-generation PCS are expected to offer more comprehensive services, including real-time information, streamlined processes, and improved communication among stakeholders. **Increased reliance on digital solutions:** The shift towards digital transformation in the port sector will likely lead to a greater need for digital solutions like PCS. **Cybersecurity and data protection:** As ports become more reliant on technology, cybersecurity and data protection will become increasingly important, highlighting the need for robust PCS.	Port Community Systems are evolving from basic communication tools to sophisticated digital platforms, incorporating technologies like AI, IoT, and cloud computing. This evolution aims to improve real-time information sharing, logistics integration, and supply chain visibility. Key technological changes include cloud-based systems, containerization of applications, and the adoption of new concepts like blockchain and Industry 5.0. Specific technological advancements include: **Cloud Computing:** Moving to cloud-based systems enhances flexibility, scalability, and accessibility for various devices and stakeholders. **Containerization:** This allows for easier deployment, management, and scaling of applications within PCS. Artificial Intelligence (AI): AI is used for prediction, decision-making, and automation of repetitive tasks in maritime and land transport operations. **Internet of Things (IoT):** IoT devices, sensors, and autonomous vehicles provide real-time data and enable automation in various port operations. **Blockchain:** Blockchain technology is being adopted to improve security and transparency in data exchange and transactions. **Virtual Reality (VR):** VR is used to simulate port operations, analyze flows, and identify areas for improvement. **Digital Twins:** Digital twins, virtual representations of physical assets, can be used to optimize port design, operations, and maintenance. **Automation:** Automation, particularly through robotics and AI, is streamlining various port operations, including cargo handling and transportation. **Intermodal Services:** Integration of intermodal transport solutions optimizes time and cost, offering a new value-added service. However, while PCSs have played a crucial role in modernizing port operations to date, could the continued advancements in technology lead to a future where these systems are gradually phased out as more efficient and decentralized solutions emerge?	Technology, particularly advancements in AI, machine learning, and blockchain, could render port community systems (PCS) obsolete by automating processes, providing real-time data, and enabling seamless communication between stakeholders without needing a centralized platform. This could lead to more efficient, transparent, and secure port operations, potentially making PCS redundant. Here's a more detailed look at how: **Autonomous operations:** AI and machine learning can automate tasks like container loading/unloading, vessel scheduling, and even some customs clearance processes, reducing reliance on human intervention and the need for a central platform to manage these activities. **Predictive analytics:** AI can analyze vast amounts of data to predict potential delays, optimize resource allocation, and proactively address issues, minimizing disruptions and the need for a PCS to manage these events. **Real-time tracking and monitoring:** IoT sensors and blockchain can provide real-time visibility into cargo movements and conditions, eliminating the need for a PCS to collect and disseminate this information. **Secure and transparent data sharing:** Blockchain can facilitate secure and transparent data sharing between stakeholders, eliminating the need for a centralized PCS to manage data integrity and access. **Streamlined workflows:** Blockchain can automate tasks like document exchange, payment processing, and customs clearance, reducing paperwork and delays associated with current PCS workflows.

Appendix 2
4. Pace of Technological Change (continued)

Polarity A Technology supports the growth of PCS	Critical Issue Pace of Technological Change	Polarity B Technology outgrows PCS
		Increased trust and collaboration: Blockchain's providence and transparency can foster trust and collaboration among port stakeholders, reducing the need for a central authority to enforce agreements and standards. **Decentralized communication**: Advanced communication technologies can enable direct, secure, and real-time communication between port stakeholders, reducing the need for a centralized platform to manage communication channels. **AI-powered chatbots and virtual assistants:** AI can handle routine inquiries and provide information to users, reducing the need for human intervention and the need for a central PCS to manage these interactions. **Open data platforms:** Ports can create open data platforms that allow stakeholders to access and analyse real-time data, enabling more informed decision-making and reducing the need for a central PCS to manage data access. **From Isolated to Open Supply Chains:** As technology evolves, the focus could shift from isolated supply chains managed by a PCS to open and collaborative networks where information flows freely and seamlessly. **Physical Internet:** The concept of a "Physical Internet" envisions a future where goods move through a network of interconnected ports and supply chains without the need for traditional, centralized systems.

Appendix 2
5. Data Governance & Ownership

Polarity A
Regulated and transparent use of data

Trust and Compliance: Builds trust among trading partners by ensuring adherence to international trade laws and regulations, reducing the risk of illegal activities and fostering a reliable trading environment.

Market Efficiency: Reduces information gaps, allowing for more efficient market operations and fair competition. Businesses and policymakers can make better decisions based on transparent and accurate data.

Counterfeit Protection: Ensures the authenticity of goods, protecting consumers and brand owners from counterfeit products. This helps maintain brand integrity and consumer trust.

Accurate Data: Provides reliable statistical information, enabling governments to make informed policy decisions and businesses t o base their strategies on dependable data. This leads to more effective and targeted actions.

Sustainability: Promotes ethical and sustainable practices by identifying and mitigating environmental and human rights abuses in global supply chains. Transparency helps ensure that trade activities align with sustainability goals.

Potential Disadvantages: It can lead to increased complexity and cumbersome compliance requirements, making effective data management challenging. The higher costs associated with extensive regulations can strain financial and time resources. Moreover, excessive regulation can stifle innovation by imposing strict limitations on data usage and sharing. Operational inefficiencies may also arise, as organizations implement extensive processes and controls to ensure compliance.

Critical Issue
Data Governance and Ownership

Data governance and ownership are critical issues in today's global trading environment, primarily due to the complexities of privacy, data protection, and security. Different countries have varying regulations, such as GDPR in Europe, which complicate international data flows. Ensuring data security against breaches and cyber-attacks is essential, but challenging, especially as data moves across borders. Companies must navigate a complex web of international, regional, and national regulations, which can be conflicting and frequently changing. Additionally, data localization requirements in some countries can impact global operations and increase costs.

Including business confidential information in data governance discussions adds another layer of complexity. Protecting sensitive business data from unauthorized access and breaches is paramount. Companies must implement stringent security measures and protocols to safeguard proprietary information.

Ownership and control of data, including business confidential data, are contentious, with businesses, governments, and individuals all having stakes, leading to conflicts and legal challenges. Interoperability of data systems across different jurisdictions and platforms is vital for smooth global trade but often hindered.

Ethical considerations around data usage, such as consent and transparency, are increasingly important, requiring companies to use data responsibly and ethically. Coordinated efforts from governments, businesses, and international organizations are essential to create frameworks that balance trade facilitation with data protection and security.

Polarity B
Unregulated

Loss of Trust: Lack of transparency can erode trust among trading partners, leading to reduced cooperation and increased disputes.

Data Breaches: Unregulated data use increases the risk of data breaches, compromising sensitive information and causing financial and reputational damage.

Market Inefficiency: Non-transparent data practices can lead to information asymmetry, resulting in unfair competition and inefficient market operations.

Legal Risks: Failure to comply with international data regulations can result in legal penalties and trade restrictions, disrupting business operations.

Ethical Concerns: Unregulated data use can lead to unethical practices, such as exploitation and privacy violations, harming companies and individuals.

Potential advantages: It can foster increased innovation by allowing organizations to experiment more freely with new technologies and data practices. Additionally, it reduces compliance costs, enabling organizations to allocate resources more efficiently. The flexibility afforded by less regulation allows organizations to adapt their data governance strategies to their specific needs and market conditions.

Appendix 2
6. New financial settlement order / rules

Polarity A
Diversified international financial system (multipolar)

Disintegration of the financial system - fragmented financial system - not standardised/ backed by different alliances. A decrease in the importance of international financial institutions.

The progressive regionalization of world finance, the international financial system will be formed by zones or currency areas based on a regional currency (several zones) - Independent monetary systems without a single key currency or international currency. Based on different regulatory systems – lack of single regulatory system Limited free and global flow of capital (and goods) Strengthening the role of real economic processes (equalizing the position in relation to financial economics)

New drivers of value:
- ESG Integration
- Customer centricity
- Digital transformation and AI integration
- Operational efficiency and margin
- Innovation in product development
- Strategic acquisitions
- Economy without money or with new currencies (digital)
- New exchange methods and diverse/regionalized settlement systems

Critical Issue
Financial Systems

A financial system is a set of global, regional, or firm-specific institutions and practices used to facilitate the exchange of funds.

A financial system refers to all the institutions that facilitate the exchange of funds throughout an economy. This includes lenders like banks and credit unions, marketplaces like the stock exchange, government agencies like the Federal Reserve/Central Banks, and even international institutions like the IMF or World Bank. It is within the financial system that all interactions—borrowing, lending, investing, financing—can be conducted.

From the point of view of our foresight exercise it seems important to talk about financial system and monetary system / framework used by a country or region to manage its money supply, control exchange rates, and implement monetary policy. It encompasses the rules, regulations and institutions that govern how money is created, distributed and regulated within the economy. The primary goals of a monetary system is to ensure price stability, facilitate exchange of goods and services and promote economic growth, control the value of money in a currency, determine how to exchange currencies among countries.

We observe attempts to reformat the financial and trading order.

Polarity B
Traditional' global (single) international financial system

Strong links and dependencies between domestic financial markets and the global market, resulting in financial integration on an international scale.

Diversification of the applied exchange rate regimes, while stabilizing the proportion between fixed and floating exchange rates.

Development of financial engineering - financialization of the economy - (superior role of financial system, influencing the functioning of the real economy). Financial phenomena can determine the course of real economic processes.

Promoting conditions for the uninterrupted convertibility of national currencies into international money and an efficient payment system between countries.

Dollar 'hegemony' - a key currency with a global reach (reserve currency, extraterritorial status, stable rate).

Free capital and goods flows.

Traditional drivers of value – (product innovation, customer service, brand reputation, operational efficiency, revenue-generating activities).

Traditional currencies

Traditional exchange methods

Single global settlement system

Transparent and standardised rules/ regulations

Appendix 2
7. Energy & Resources

Polarity A
High cost - Low availability of green energy and other resources

Trust Higher level of outsourcing / shift to low cost areas .

Productivity issues in general.

Growth and thus prosperity at risk.

More fragmentation in production processes.

New level of globalisation - regarding energy costs / protectionism related to the availability of other resources.

Stronger focus on circular economy and sustainability necessary.

Where is the natural limit (availability of fossil energy supply)?

High costs of energy, raw materials, human resources, water brings economic life and thus societies to a standstill".

Growing protectionism vs. aggressive policy.

Innovation: More focus on innovative power solutions that can solve energy & resource issues

Critical Issue
Energy & Resources

The economically viable availability of energy and other resources in general will be a decisive factor in securing future prosperity and stability.

Shaping the future is therefore indisputably linked to addressing issues related to energy and resources.
Two important factors are dominating the discussion:

1. Saving the planet = sustainability!

2. Who has what resources available at what level of effort?

The challenges and tasks are more than obvious -

- Transformation to green energy
- Comprehensive circular economy contributes to an effective and efficient use of raw materials
- Sensitive and respectful use of water
- Besides next-level technologies based on AI and robotics, there will be a strong demand for skilled labour (shift to new content)
- AI currently requires the same amount of energy as the whole of Japan and is only just getting started.

Polarity B
Low cost - High availability of green energy and other resources

Easier digital operations (no capacity issues due to energy limitation).

Strong contribution to growing prosperity, safety, and happiness.

Dynamic innovation culture with focus on new products, services.

Easier digital operations (no capacity issues due to energy limitation).

Strong contribution to growing prosperity, safety, and happiness.

Dynamic innovation culture with focus on new products, services.

Appendix 2
8. Trade Routes

Polarity A
Increased Regional Trade

Rise of protectionism and fragmentation: In a more divided world, countries may prioritize national security and strategic interests over economic benefits, leading to protectionist measures and fragmentation of trade alliances – "strategic decoupling".

Although total global trade may be stable, regionalization would shift its flows, and supply shocks would multiply. These disruptions would strain commodity markets, while sanctions complicate capital flows. Global talent flows would also be obstructed.

Average trade-weighted distance falls.

Shorter supply chains.

Increased trade concentration within regions.

Businesses source and produce materials closer to their primary markets. A keener focus on "reshoring," "nearshoring," and "friendshoring".

The creation of transhipment loops to relay cargo using neutral drop-off points.

Critical Issue
Trade Flows

Some well-established and prominent logistics and transport routes worldwide, like the Panama Canal, Red Sea, and Silk Route, are majorly affected by geopolitical tensions and trade policy.

Geopolitical tensions such as the war in Ukraine has disrupted global supply chains and energy markets, forcing countries to seek alternative sources and routes.

Attacks on commercial vessels in the Red Sea have led to a significant drop in shipping transit through the Red Sea, impacting trade between Europe and Asia.

The prospect of steep U.S. port fees on Chinese-operated or Chinese-built ships is causing shipping lines to reconfigure routes and fleets. Operators are exploring swapping in non-Chinese-built ships on U.S. routes to avoid fees, and some carriers are considering creating transshipment loops to relay cargo on fee-exempt vessels.

Melting sea ice is opening up the Arctic, potentially shortening transit times between the Pacific and Atlantic.

Droughts are impacting inland waterways, such as the Panama Canal, forcing alternative routes and potentially limiting cargo capacity.

Emerging economies are increasing their domestic consumption, impacting global trade patterns and leading to more trade between emerging economies themselves.

Southeast Asia may benefit from diversification of supply chains from China and close links to Japan.

The U.S.-Mexico-Canada Agreement (USMCA) could strengthen, creating "nearshoring".

BRICS is expanding: The 10 BRICS+ nations currently account for half the world's population, two-fifths of global trade, and around 40% of both crude oil production and exports—and 12 more nations have applied for membership: "friendshoring".

Polarity B
Highly globally integrated trade

Trade happens over longer distances.

Broader supply chains.

Import concentrations rise
Trade (particularly of concentrated products) between geopolitically distant economies increases / expands.

Increased / expanded reciprocal trade agreement between regions.

Appendix 2
9. Policy / Regulation

Polarity A
High cost - Low availability of green energy and other resources

Promotes stability: Predictable regulations reduce uncertainty, allowing for better planning and investment in shipping and infrastructure.

Boosts efficiency: Standardised procedures streamline operations.

Lowers costs: Harmonized rules reduce delays caused by regulatory differences.

Encourages fair competition: A global framework ensures stakeholders follow the same rules.

Enhances trust in supply chains (predictability).

Supports long-term innovation: Clear and stable policies encourage investment in new technologies

Critical Issue
Policy / regulation

Policy and legislation play a crucial role in shaping the framework within which maritime trade operates. Effective and consistent maritime laws are essential for ensuring the safety, security, efficiency, and environmental sustainability of shipping activities.

Disparities in regulations between countries, and complex customs procedures can pose significant challenges for global trade. Additionally, geopolitical tensions and changes in national policies, such as sanctions, port access restrictions, or shifts in trade agreements, can directly impact shipping routes, costs, and efficiency.

As the maritime industry moves toward greater digitalization and sustainability, policy and legal frameworks must evolve accordingly to support innovation while maintaining fair and secure trade practices.

Polarity B
Uncertain. Open market

Fragmented regulations: Market uncertainty can cause countries to adopt divergent rules, complicating global compliance.

Protectionism risks: Nations may impose sudden restrictions or tariffs, affecting trade routes and access to markets.

Operational inefficiency: Inconsistent and reactive policies disrupt supply chains and slow down maritime operations.

Strategic uncertainty: Shipping companies face challenges in long-term planning, route optimization, and risk management.

Reduced investment: Businesses may delay or reduce investments due to unpredictable returns.

Abbreviations

Acronym	Meaning	Explanation
i.e.	id est	"That is".
IHO	International Hydrographic Organization	Coordinates nautical charting worldwide and publishes the S-100 standards.
IMO	International Maritime Organization	The UN agency that sets global rules for shipping.
IPCSA	International Port Community Systems Association	The association of port and cargo community system operators, and the author of both documents.
ISO	International Organization for Standardization	Publishes international standards.
IT	Information Technology	Computers, software and networks.
KPIs	Key Performance Indicators	Measurable targets used to track progress.
ML	Machine Learning	A branch of AI in which systems learn from data.
MLETR	Model Law on Electronic Transferable Records	The UNCITRAL model law that gives electronic trade documents legal recognition.
MOUs	Memoranda of Understanding	Formal but usually non-binding agreements between parties.
MSW / MSWs	Maritime Single Window(s)	A single point for submitting all reports required for a port call.
NIS2	Network and Information Security Directive 2	The EU cybersecurity directive covering critical infrastructure.
NTFC	National Trade Facilitation Committee	A national body coordinating trade facilitation between government and business.
P2P	Public-to-Public (Partnership)	Cooperation between public bodies. In these documents it does not mean "peer-to-peer".
PCS / PCSs	Port Community System(s)	Neutral digital platforms connecting all parties in a port.
PCSOs	Port Community System Operators	The organisations that run PCS platforms.
PESTEL	Political, Economic, Social, Technological, Environmental, Legal	A framework for grouping external drivers of change.
PPP	Public-Private Partnership	Cooperation between government bodies and private companies.
PR	Public Relations	Communications with the public and stakeholders.
PUSH / PULL / WEIGHT	Push of the present, Pull of the future, Weight of history	The CIFS futures triangle used in the workshops. These are headings written in capitals, not acronyms.
R&D	Research and Development	
RPSCG	Regional Port State Control Group	(My interpretation, as the document doesn't define it)
S-57	IHO standard for electronic navigational charts	The previous chart standard, which S-100 is replacing.
S-100	IHO Universal Hydrographic Data Model	The framework for the new generation of maritime data standards.
S-102	Bathymetric Surface	Water depth data.
S-104	Water Level Information	Tide and water level data.
S-111	Surface Currents	Current data.
S-124	Navigational Warnings	Digital navigational warnings.
S-129	Under Keel Clearance Management	Planning data for under keel clearance.
S-211	Port Call Message Format	The standard for exchanging port call data.
S-O	Strengths–Opportunities	TOWS strategy: use strengths to make the most of opportunities.
S-T	Strengths–Threats	TOWS strategy: use strengths to reduce threats.
SSATP	Africa Transport Policy Program	A World Bank programme (originally the Sub-Saharan Africa Transport Policy Program).
SW	Single Window	A single entry point for submitting all regulatory documents.
SWOs	Single Window Operators	The organisations that run Single Window platforms.
SWOT	Strengths, Weaknesses, Opportunities, Threats	An assessment of the internal and external position of an organisation.
TFA	Trade Facilitation Agreement	The WTO agreement on simplifying customs and border procedures.
TOWS	Threats, Opportunities, Weaknesses, Strengths	Builds on SWOT by combining its elements into strategies.
TSW / TSWs	Trade Single Window(s)	A single point for submitting trade and customs documents.
UKC	Under Keel Clearance	The space between a ship's keel and the seabed.
UN/CEFACT	UN Centre for Trade Facilitation and Electronic Business	Develops global standards for electronic trade documents.
UNCITRAL	UN Commission on International Trade Law	Drafts model laws for international trade, including MLETR.
UNECE	UN Economic Commission for Europe	The UN body that hosts UN/CEFACT.
vs.	versus	"Against" or "compared with".
W-O	Weaknesses–Opportunities	TOWS strategy: address weaknesses by taking advantage of opportunities.
W-T	Weaknesses–Threats	TOWS strategy: minimise weaknesses so that threats cause less damage.
WCO	World Customs Organization	The international body that coordinates customs administrations.
WTO	World Trade Organization	The international body that governs global trade rules.

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